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		* Registered Trade Mark for television camera tubes.	

New Products

The new products listed here appear in the Quick Reference Guide for the first time. The scale and scope of these new introductions reflect the dynamic nature of our business, and the fast developing demands of the electronics industry.

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Combined Index and Status Codes

This is a complete list of all products mentioned in the Guide, tabulated in alphanumeric order, and identified by a status code.

Status codes

D Design type. Recommended for new equipment designs.

C Current type. Recommended for use in existing equipment. Immediate availability for equipment in production.

M Maintenance type.

Recommended only to fulfill maintenance requirements on existing equipment.

O Obsolete type. No longer generally available though limited stocks may still exist.

S Special type Consult Mullard Limited for further information.

Suggested alternatives

* Near equivalent only.

● New product included in the Guide for the first time.

■ Surface mounted type.

Type No.	Status Code	Page No. or Suggested Alternatives	Type No.	Status Code	Page No. or Suggested Alternatives	Type No.	Status Code	Page No. or Suggested Alternatives
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7237		TY7-6000A	8597QB		PM2254B	40743	S	
7262A		XQ1032	8644		XP1117	40744	S	
7378		QV08-100	8666		YD1170	40745	S	
7400	C	65	8667		YD1171	40746	S	
7402	C	65	8668		YD1172	40747	S	
			8680		YD1212			
7403	C	65				40748	S	
7404	C	65	8728		YD1150	40755	S	
7405	C	65	8730		YD1152	40756	S	
7406	C	65	8731		YD1160	40757	S	
7407	C	65	8732		YD1161	40758	S	
7408	C	65	8733		YD1162	40759	S	
7410	C	65	8734		YD1173	40760	S	
7411	C	65	8735		YD1182	40768	S	
7413	C	67	8736		YD1192	40775	S	
7414	C	67	8752		YD1202	55029	O	
			8881	C	72			
7416	C	65				55030	O	
7417	C	65	8890	C	72	55031	O	
7420	C	65	8891	C	72	55032	O	
7421	C	65	9309	C	72	55340	O	
7425	C	65	9310	C	72	55534	S	
7426	C	65	9316	C	72	55535	S	
7427	C	65	9322	C	72	55547	S	
7428	C	65	9324	C	72	55561	S	
7430	C	65	9334	C	72	55563A	S	
7432	C	65	9386	C	72	55566	S	
			9401	D	120			
7433	C	65				55569	S	
7437	C	65	9403	D	102	55580	S	
7438	C	65	9514B		XP2230	55580A	S	
7439	C	65	9514S		XP2230	55581	S	
7440	C	65	9524B		XP2008	55581A	S	
7442	C	70	9594B		XP2022	55587	S	
7445	C	69	9595B		PM2102	55589	S	
7450	C	65	9596B		XP2203B	55590	S	
7451	C	65	9597B		XP2233B	55591	S	
7473	C	67	9602	C	72	55592	S	
			9635B		XP2230			
7474	C	67				55593	S	
7475	C	69	9635QB		XP2020Q	55594	S	
7476	C	67	9656KB		PM2102	55595	S	
7483	C	71	9698B		XP1117	55596	S	
7485	C	71	9708B		PM2312	55597	S	
7486	C	65	9710/M8	S		55598	S	
7490	C	68	9734B		XP2008	55599	S	
7492	C	68	9758B		PM2312	56032	O	
7493	C	68	9813B		PM2412	68000-6/BXC	D	118
7494	C	67	9814B		PM2412	68000-8/BXC	D	118
			9815B		PM2412			
7495	C	67				68154/BQA	D	118
7496	C	67	10002	S		68155/BQA	D	118
7527		QY4-400	10007	S		68172/BJA	D	118
7537	O		10149	D	80	74107	C	67
7650		YL1110	10155	D	80	74109	C	67
7693		PM2102	10415	S		74116	C	69

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■ 74123	C	67	100415	S		4312 020 37060	D	410
74125	C	66	100415A	S		4312 020 37070	D	410
74126	C	66	100415B	S		4312 020 37080	D	410
74128	C	66	100422A	S		4312 020 37090	D	410
74132	C	67	100422B	D	80	4312 020 37100	D	410
■ 74145	C	69	100422C	D	80	4312 020 37110	D	410
74147	C	70	100470	D	80	4312 020 37120	D	410
■ 74148	C	70	100470A	D	80	4312 020 37130	D	410
74150	C	70	100474A	D	80	4312 020 37140	D	410
74151	C	70	2322 522 Series	O		4312 020 37150	D	410
74153	C	70	2322 592 Series	D	396	4312 020 37160	D	410
74154	C	70	2322 593 Series	D	396	4312 020 37170	D	410
74155	C	70	2322 594 Series	D	396	4312 020 37180	D	410
74156	C	70	2322 595 Series	D	396	4312 020 37190	D	410
74157	C	70	2322 600 95001	C		4312 021 29240	DT2491	
74158	C	70	2322 610 Series	C	388	4312 021 29250	DT2492	
74160	C	68	2322 626 Series	D	392	4313 059 66000	D	429
74161	C	68	2322 627 Series	S		4313 059 66010	D	429
74163	C	68	2322 633 Series	D	392	4313 059 66020	D	429
74164	C	67	2322 635 Series	O		● 4313 059 66030	D	429
■ 74165	C	67	2322 640 Series	D	389	4313 059 66040	D	429
■ 74166	C	67	2322 642 Series	D	389	4313 059 66070	D	429
74170	C	67	2322 644 90008	O		4313 059 66100	D	429
74173	C	67	2322 644 Series	D	388	● 4313 059 66190	D	429
74174	C	67	2322 660 Series	D	395	● 4313 059 66200	D	429
74175	C	67	2322 661 Series	D	395	● 4313 059 67030	D	429
74180	C	71	2322 662 Series	D	394, 395	● 4313 059 67050	D	429
74181	C	71	2322 663 Series	D	395	● 4313 059 67060	D	429
74190	C	68	2322 664 Series	D	395	4313 059 68080	D	428
74191	C	68	2322 672 Series	S		● 4313 059 68140	D	428
74192	C	69	2322 678 93001	S		4313 059 68200	S	
74193	C	69	2322 680 Series	S		4313 059 68220	S	
74194	C	67	2322 691 Series	D	387	4313 059 68260	S	
74195	C	68	4322 043 Series	D	361	4313 059 68270	D	428
74199	C	68	143 04040	D	444	4313 059 68290	S	
■ 74221	C	67	143 04050	D	444	4313 059 68300	D	428
■ 74279	C	69	143 04090	D	444	4313 059 68330	D	428
74298	C	70	143 04100	D	444	4313 059 68350	D	428
74365A	C	66	143 04890	D	444	4313 059 68370	D	428
74366A	C	66	2422 136 7....	S		● 4313 059 68380	D	428
74367A	C	66	2422 136 802...	S		● 4313 059 68400	D	428
74368A	C	66	3122 104 90490	D	416	● 4313 059 68440	D	428
100101	D	76	3122 104 91110	D	416	● 4313 059 68500	D	428
100102	D	76	3122 104 91150	D	416	4322 020 05590	C	431
100107	D	76	3122 104 93760	D	416	4322 020 06040	C	431
100112	D	76	3122 134 90110	D	416	4322 020 08820	O	
100113	D	76	3122 138 50290	S		4322 020 08840	O	
100114	D	76	3122 138 50560	S		4322 020 08850	O	
100117	D	76	3122 138 51850	S		4322 020 08860	O	
100118	D	76	3122 138 51860	S		4322 020 08870	O	
100122	D	76	3122 138 55220	S		4322 020 08880	O	
100123	D	76	3122 138 55260	S		4322 020 08890	O	
100126	D	76	3122 138 55920	S		4322 020 08930	O	
100131	D	76	3122 138 56070	D		4322 020 34400	D	416
100131A	D	76	3122 138 56170	S		4322 020 34420	D	416
100136	D	76	3122 138 75581	S		4322 020 36750	D	416
100141	D	76	3122 138 75941	S		4322 020 55010	D	411
100142	S		3122 138 94350	S		4322 021 33850	D	410
100145	S		3122 138 94380	S		4322 021 33860	D	410
100149	D	80	3122 138 94440	S		4322 021 33870	D	410
100150	D	76	3332 142 11401	S		4322 021 33880	D	410
100151	D	76	4022 102 21590	S		4322 021 33890	D	410
100155	D	76	4203 031 60100	D	429	4322 021 33900	D	410
100158	D	76	● 431202034110	C	409	4322 021 33910	D	410
100160	D	76	4312 020 36630	D	417	4322 021 33920	D	410
100163	D	76	4312 020 36640	D	417	4322 021 34040	D	411
100164	D	76	4312 020 36650	D	417	4322 021 34050	D	411
100165	D	76	4312 020 36690	D	417	4322 021 34060	D	411
100166	D	76	4312 020 36700	D	417	4322 021 34070	D	411
100170	D	76	4312 020 36710	D	417	● 4322 021 34110	D	411
100171	D	76	4312 020 37000	D	410	● 4322 021 34170	D	411
100175	D	76	4312 020 37010	D	410	4322 021 38600	D	422
100179	D	76	4312 020 37020	D	410	4322 021 38610	D	422
100180	D	76	4312 020 37030	D	410	4322 021 38670	D	422
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4322 025 06070	D	411
4322 025 06080	D	411
4330 030 30080	D	416
4330 030 30110	D	416

Mullard approved components

Quality improvement is a major Mullard philosophy in every aspect of our business. The unrivalled range of internationally recognised approvals for our products demonstrates our commitment to this philosophy.

Many of the components listed meet BS9000, CECC, and D5007 specifications, although certain purchasing conditions may apply.

Further information on our quality capability is available.

BS9000

DIODES

Type No.	BS Spec. No.	
BYX22 Series	BS9331-F131	
BYX25 Series	BS9333-F003	see CECC
BYX30 Series	BS9333-F002	
BYX38 Series	BS9331-F127	see CECC
BYX42 Series	BS9331-F128	see CECC
BYX45 Series	BS9333-F004	
BYX52 Series	BS9331-F026	see CECC
BYX96 Series	BS9331-F129	
BYX97 Series	BS9331-F130	
BYX98 Series	BS9331-F114	see CECC
BYX99 Series	BS9331-F047	see CECC
BZY91 Series	BS9305-F052	
BZY93 Series	BS9305-F051	
BZY95 Series	BS9305-F050	

THYRISTORS

Type No.	BS Spec. No.
BTW40 Series	BS9341-F083

ELECTRONIC TUBES

Type No.	BS Spec. No.
QQV06-40A	BS9011-F006
CV2797	BS9011-F006

CECC

INTEGRATED CIRCUITS

HEF4000B	HEF4041B	HEF4502B	HEF4724B
HEF4001B	HEF4042B	HEF4505B	HEF40097B
HEF4001UB	HEF4043B	HEF4508B	HEF40098B
HEF4002B	HEF4044B	HEF4510B	HEF40106B
HEF4006B	HEF4046B	HEF4511B	HEF40160B
HEF4007UB	HEF4047B	HEF4512B	HEF40161B
HEF4008B	HEF4049B	HEF4514B	HEF40162B
HEF4011B	HEF4050B	HEF4515B	HEF40163B
HEF4011UB	HEF4051B	HEF4516B	HEF40174B
HEF4012B	HEF4052B	HEF4517B	HEF40175B
HEF4013B	HEF4053B	HEF4518B	HEF40192B
HEF4014B	HEF4066B	HEF4519B	HEF40193B
HEF4015B	HEF4067B	HEF4520B	HEF40194B
HEF4016B	HEF4068B	HEF4521B	HEF40195B
HEF4017B	HEF4069UB	HEF4522B	
HEF4018B	HEF4070B	HEF4526B	
HEF4019B	HEF4071B	HEF4528B	
HEF4020B	HEF4072B	HEF4531B	
HEF4021B	HEF4073B	HEF4532B	
HEF4022B	HEF4075B	HEF4534B	
HEF4023B	HEF4076B	HEF4538B	
HEF4024B	HEF4077B	HEF4539B	
HEF4025B	HEF4078B	HEF4541B	
HEF4027B	HEF4081B	HEF4543B	
HEF4028B	HEF4082B	HEF4555B	
HEF4029B	HEF4085B	HEF4556B	
HEF4030B	HEF4086B	HEF4557B	
HEF4031B	HEF4093B	HEF4585B	
HEF4035B	HEF4094B	HEF4720B	
HEF4040B	HEF4104B	HEF4720V	

Mullard approved components (cont.)

CECC (cont.)

DISCRETE SEMICONDUCTORS

Type No.	Spec. No.	Type No.	Spec. No.
BA314	CECC 50 001-026	CV7367, 8	CECC 50 001-021
BAT85	CECC 50 001-059	CV7379 to 7382	CECC 50 009-020
BAV18 to 21	CECC 50 001-022	CVA7476	CECC 50 008-015
BAW62	CECC 50 001-021	CV7667, 8	CECC 50 009-022
BAX16, 17	CECC 50 001-022	CV7672	CECC 50 002-132
BC107	CECC 50 002-076	CV7675, 6	CECC 50 002-133
BC108	CECC 50 002-077	CV7725 to 7727	CECC 50 004-096
BC109	CECC 50 002-078	CV7756, 7	CECC 50 001-021
BCY70, 71, 72	CECC 50 002-079/080/081	CV7768 to 7770	CECC 50 004-094
BF967	CECC 50 002-127	CV7875	CECC 50 001-038
BFR90A	CECC 50 002-086	CV8308	CECC 50 001-020
BFR91A	CECC 50 002-125	CV8617	CECC 50 001-021
BFR96A	CECC 50 002-126	CV8790	CECC 50 001-022
BFX29	CECC 50 002-071	CV8805	CECC 50 001-020
BFX30	CECC 50 004-083	CV9507	CECC 50 004-050
BFX37	CECC 50 002-185	CV9637	CECC 50 001-021
BFX84, 85, 86	CECC 50 004-100	CV9638	CECC 50 001-037
BFX87, 88	CECC 50 002-071	CV9790	CECC 50 002-168
BFY50, 51, 52	CECC 50 002-089	CV10253	CECC 50 004-095
BSS50 to 52	CECC 50 004-073	CV10254	CECC 50 002-176
BSV15, 16, 17	CECC 50 002-131	CV10440	CECC 50 004-087
BSV78 to 80	CECC 50 012-011	CV10806	CECC 50 002-165
BSX45, 46, 47	CECC 50 002-174	CV10807	CECC 50 004-085
BT151 Series	CECC 50 011-003	CV10814	CECC 50 002-141
BT152 Series	CECC 50 011-011	CV12253	CECC 50 004-095
BTW38 Series	CECC 50 011-006	PO33	CECC 50 001-026
BTW42 Series	CECC 50 011-006	1N914, 6	CECC 50 001-021
BTW45 Series	CECC 50 011-002	1N4148, 9	CECC 50 001-021
BTY79 Series	CECC 50 011-006	1N4446 to 9	CECC 50 001-021
BUS11, 11A	CECC 50 004-124	2N2904A	CECC 50 002-102
BUS12, 12A	CECC 50 004-106	2N2905A	CECC 50 002-102
BUS13, 13A	CECC 50 004-125	2N2906A	CECC 50 002-103
BY229 Series	CECC 50 009-021	2N2907A	CECC 50 002-103
BYV20 Series	CECC 50 009-033	2N2218, 8A	CECC 50 004-029
BYV21 Series	CECC 50 009-018	2N2219, 9A	CECC 50 004-029
BYV22 Series	CECC 50 009-034	2N2221, 1A	CECC 50 004-030
BYV23 Series	CECC 50 009-036	2N2222, 2A	CECC 50 004-030
BYV32 Series	CECC 50 009-026	2N3019, 20	CECC 50 002-175
BYW29 Series	CECC 50 009-014		
BYW30 Series	CECC 50 009-001		
BYW31 Series	CECC 50 009-002		
BYW54, 55, 56	CECC 50 008-015		
BYW92 Series	CECC 50 009-003		
BYW93 Series	CECC 50 009-028		
BYX25 Series	CECC 50 009-022		
BYX38 Series	CECC 50 009-019		
BYX42 Series	CECC 50 009-020		
BYX52 Series	CECC 50 009-024		
BYX56 Series	CECC 50 009-023		
BYX98 Series	CECC 50 009-004		
BYX99 Series	CECC 50 009-005		
BZT03 Series	CECC 50 005-017		
BZV85 Series	CECC 50 005-010		
BZW03 Series	CECC 50 005-019		
BZW70 Series	CECC 50 005-015		
BZX70 Series	CECC 50 005-015		
BZX79 Series	CECC 50 005-005		
CV7099 to 7106	CECC 50 005-005		
CV7138 to 7146	CECC 50 005-005		
CV7311 to 7320	CECC 50 009-019		
		ELECTRONIC TUBES	
		Type No.	Spec. No.
		CV2131	CECC 45 003-007
		QY4-250	CECC 45 003-007
		QY4-400	CECC 45 003-006
		CV1905	CECC 45 003-009
		CV2130	CECC 45 003-008
		CV2797	CECC 45 003-005
		CV5959	CECC 45 003-006
		QQV06-40A	CECC 45 003-005
		QY3-65	CECC 45 003-009
		QY3-125	CECC 45 003-008
		CAPACITORS	
		Type No.	Spec. No.
		050, 052 series	CECC 30 301-033
		108 series	CECC 30 301-027
		122 series	CECC 30 302-002
		123 series	CECC 30 302-003
		344 series	CECC 30 401-023,
			CECC 30 401-039

Mullard approved components (cont.)

CECC (cont.)

RESISTORS

Type No.

MRS16T series 1%

MRS25 series 1%

ES-SFR25 series 5%

Spec. No.

CECC 40 101-042 style AY

CECC 40 101-019 style FZ

CECC 40 101-019 style FX

D3007 (British Telecom approval)

BC327	BCV71	BD938	BSS68	TIP30,A,B,C
BC328	BCV72	BD940	BST15	TIP32,A,B,C
BC337	BCW29	BD942	BST16	TIP47
BC338	BCW30	BDT61,A,B,C	BU407	TIP48
BC368	BCW31	BDT62,A,B,C	BUV27A	TIP49
BC369	BCW32	BDT91	BUX84	TIP50
BC375	BCW33	BDT93	BUX85	TIP105
BC376	BCW60	BDT95	MPSA42	TIP106
BC546	BCW61	BDX45	MPSA43	TIP107
BC547	BCW69	BDX46	MPSA92	TIP110
BC548	BCW70	BDX47	MPSA93	TIP111
BC549	BCW71	BF420	ON898	TIP112
BC550	BCW81	BF421	ON4011	TIP135
BC556	BCW89	BF422	ON4012	TIP136
BC557	BCX17	BF423	PH2222	TIP137
BC558	BCX18	BF620	PH2222A	
BC559	BCX19	BF621	PH2369	
BC560	BCX20	BF622	PH2369A	
BC635	BCX51	BF623	PH2907	
BC636	BCX52	BF820	PH2907A	
BC637	BCX53	BF821	PH5415	
BC638	BCX54	BF822	PH5416	
BC639	BCX55	BF823	PH8616	
BC640	BCX56	BSR13	PH9507	
BCF29	BCX70	BSR14	PH9543	
BCF30	BCX71	BSR15	PH9790	
BCF32	BD240,A,B,C	BSR16	PH10253	
BCF33	BD242,A,B,C	BSS38	PH10254	
BCF70	BD934	BSS63	PH10440	
BCF81	BD936	BSS64	PH10806	

Mullard approved components (cont.)

CV cross reference list

SEMICONDUCTORS

Qualification Approval has been obtained for all CV7000 series devices eligible for conversion to BS9300 Appendix C and these are indicated in the list by means of a dagger, e.g. CV7166† to BS9300-C166. Qualification Approvals to the BS9000 scheme (including CV) are regularly listed in BS9002. For information on new or replacement types, please contact Mullard Ltd. The list indicates the nearest commercial equivalent to devices for which Mullard Ltd. has held CV approval. It does not imply that all types shown here are still available.

Obsolete/obsolescent types are indicated by an asterisk(*).

CV No.	Comparable Type	CV No.	Comparable Type	CV No.	Comparable Type
CV5712	CV7005*	CV7224†	BZY93-C75R*	CV7421†	BZY95-C15*
CV7026	BYX22-200, BYW54	CV7242	BZY93-C7V5*	CV7422†	BZY95-C16*
CV7027	BYX22-200, BYW54	CV7243†	BZY93-C8V2*	CV7423†	BZY95-C18*
CV7028	BYX22-400, BYW54	CV7244†	BZY93-C9V1*	CV7424†	BZY95-C20*
CV7029	BYX22-600, BYW54	CV7245†	BZY93-C10*	CV7425†	BZY95-C22*
CV7030	BYX22-800, BYW55	CV7246†	BZY93-C11*	CV7426†	BZY95-C24*
CV7099	BZX79-C4V7	CV7247†	BZY93-C12*	CV7427†	BZY95-C27*
CV7100	BZX79-C5V1	CV7248†	BZY93-C13*	CV7428†	BZY95-C30*
CV7101	BZX79-C5V6	CV7249†	BZY93-C15*	CV7429†	BZY95-C33*
CV7102	BZX79-C6V2	CV7250†	BZY93-C16*	CV7476†	BYX45/BYW56
CV7103	BZX79-C6V8	CV7251†	BZY93-C18*	CV7648	BSY95A
CV7104	BZX79-C7V5	CV7252†	BZY93-C20*	CV7667†	BYX25-1000R
CV7105	BZX79-C8V2	CV7253†	BZY93-C22*	CV7668†	BYX25-1000
CV7138	BZX79-C3V3	CV7254†	BZY93-C24*	CV7669†	2N2904
CV7139	BZX79-C3V6	CV7255†	BZY93-C27*	CV7670†	2N2905
CV7140	BZX79-C3V9	CV7256†	BZY93-C30*	CV7671†	2N2904A
CV7141	BZX79-C4V3	CV7257†	BZY93-C33*	CV7672†	2N2905A
CV7142	BZX79-C9V1	CV7258†	BZY93-C36*	CV7675†	2N2906A
CV7143	BZX79-C10	CV7259†	BZY93-C39*	CV7676†	2N2907A
CV7144	BZX79-C11	CV7260†	BZY93-C43*	CV7678†	BZY91-C10*
CV7145	BZX79-C12	CV7261†	BZY93-C47*	CV7679†	BZY91-C11*
CV7146	BZX79-C13	CV7262†	BZY93-C51*	CV7680†	BZY91-C12*
CV7166†	BZY95-C10*	CV7263†	BZY93-C56*	CV7681†	BZY91-C13*
CV7167†	BZY95-C11*	CV7264†	BZY93-C62*	CV7682†	BZY91-C15*
CV7168†	BZY95-C12*	CV7265†	BZY93-C68*	CV7683†	BZY91-C16*
CV7218†	BYZ93-C43R*	CV7266†	BZY93-C75*	CV7684†	BZY91-C18*
CV7200†	BZY93-C7V5R*	CV7311	BYX38-200	CV7685†	BZY91-C20*
CV7201†	BZY93-C8V2R*	CV7312	BYX38-300	CV7686†	BZY91-C22*
CV7202†	BZY93-C9V1R*	CV7313	BYX38-600	CV7687†	BZY91-C24*
CV7203†	BZY93-C10R*	CV7314	BYX38-900	CV7688†	BZY91-C27*
CV7204†	BZY93-C11R*	CV7315	BYX38-900	CV7689†	BZY91-C30*
CV7205†	BZY93-C12R*	CV7316	BYX38-300R	CV7690†	BZY91-C33*
CV7206†	BZY93-C13R*	CV7317	BYX38-300R	CV7691†	BZY91-C36*
CV7207†	BZY93-C15R*	CV7318	BYX38-600R	CV7692†	BZY91-C39*
CV7208†	BZY93-C16R*	CV7319	BYX38-900R	CV7693†	BZY91-C43*
CV7209†	BZY93-C18R*	CV7320	BYX38-900R	CV7694†	BZY91-C47*
CV7210†	BZY93-C20R*	CV7367	BAW62	CV7695†	BZY91-C51*
CV7211†	BZY93-C22R*	CV7368	BAW62	CV7696†	BZY91-C56*
CV7212†	BZY93-C24R*	CV7379†	BYX42-300R	CV7697†	BZY91-C62*
CV7213†	BZY93-C27R*	CV7380†	BYX42-600R	CV7698†	BZY91-C68*
CV7214†	BZY93-C30R*	CV7381†	BYX42-900R	CV7699†	BZY91-C75*
CV7215†	BZY93-C33R*	CV7382†	BYX42-1200R	CV7700†	BZY91-C10R*
CV7216†	BZY93-C36R*	CV7384†	BYX42-300	CV7701†	BZY91-C11R*
CV7217†	BZY93-C39R*	CV7385†	BYX42-600	CV7702†	BZY91-C12R*
CV7218†	BZY93-C43R*	CV7386†	BYX42-900	CV7703†	BZY91-C13R*
CV7219†	BZY93-C47R*	CV7387†	BYX42-1200	CV7704†	BZY91-C15R*
CV7220†	BZY93-C51R*	CV7417†	BZY95-C10*	CV7705†	BZY91-C16R*
CV7221†	BZY93-C56R*	CV7418†	BZY95-C11*	CV7706†	BZY91-C18R*
CV7222†	BZY93-C62R*	CV7419†	BZY95-C12*	CV7707†	BZY91-C20R*
CV7223†	BZY93-C68R*	CV7420†	BZY95-C13*	CV7708†	BZY91-C22R*

Mullard approved components (cont.)

CV cross reference list (cont.)

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CV7709†	BZY91-C24R*	CV7801†	BZY93-C51R*	CV7874	BSX59
CV7710†	BZY91-C27R*	CV7802†	BZY93-C56R*	CV7875	BAS11
CV7711†	BZY91-C30R*	CV7803†	BZY93-C62R*	CV8308	**
CV7712†	BZY91-C33R*	CV7804†	BZY93-C68R*	CV8615	**
CV7713†	BZY91-C36R*	CV7805†	BZY93-C75R*	CV8616	**
CV7714†	BZY91-C39R*	CV7806†	BZY93-C6V8*	CV8617	BAW62
CV7715†	BZY91-C43R*	CV7807†	BZY93-C7V5*	CV8790	BAX16
CV7716†	BZY91-C47R*	CV7808†	BZY93-C8V2*	CV8805	
CV7717†	BZY91-C51R*	CV7809†	BZY93-C9V1*	CV9297	BTX18-200
CV7718†	BZY91-C56R*	CV7810†	BZY93-C10*	CV9507	BFX30**
CV7719†	BZY91-C62R*	CV7811†	BZY93-C11*	CV9543	BCY72
CV7720†	BZY91-C68R*	CV7812†	BZY93-C12*	CV9637	BAW62
CV7721†	BZY91-C75R*	CV7813†	BZY93-C13*	CV9638	BAX12A
CV7756	BAW62	CV7814†	BZY93-C15*	CV9790	BFX29
CV7757	BAW62	CV7815†	BZY93-C16*	CV9919	BYX30-200
CV7762†	BAT39*	CV7816†	BZY93-C18*	CV9936	BUW87
CV7776†	BAT51	CV7817†	BZY93-C20*	CV10253	BFX85**
CV7777†	BAT51R	CV7818†	BZY93-C22*	CV10254	BFX85**
CV7778†	BAT51/51R pair	CV7819†	BZY93-C24*	CV10440	BC107**
CV7780†	BZY93-C6V8R*	CV7820†	BZY93-C27*	CV10806	BC109
CV7781†	BZY93-C7V5R*	CV7821†	BZY93-C30*	CV10807	BFX30
CV7782†	BZY93-C8V2R*	CV7822†	BZY93-C33*	CV10814	BCY71
CV7783†	BZY93-C9V1R*	CV7823†	BZY93-C36*	CV12253	CV10253
CV7784†	BZY93-C10R*	CV7824†	BZY93-C39*		
CV7785†	BZY93-C11R*	CV7825†	BZY93-C43*		
CV7786†	BZY93-C12R*	CV7826†	BZY93-C47*		
CV7787†	BZY93-C13R*	CV7827†	BZY93-C51*		
CV7788†	BZY93-C15R*	CV7828†	BZY93-C56*		
CV7789†	BZY93-C16R*	CV7829†	BZY93-C62*		
CV7790†	BZY93-C18R*	CV7830†	BZY93-C68*		
CV7791†	BZY93-C20R*	CV7831†	BZY93-C75*		
CV7792†	BZY93-C22R*	CV7841†	BZY95-C36*		
CV7793†	BZY93-C24R*	CV7842†	BZY95-C39*		
CV7794†	BZY93-C27R*	CV7843†	BZY95-C43*		
CV7795†	BZY93-C30R*	CV7844†	BZY95-C47*		
CV7796†	BZY93-C33R*	CV7845†	BZY95-C51*		
CV7797†	BZY93-C36R*	CV7846†	BZY95-C56*		
CV7798†	BZY93-C39R*	CV7847†	BZY95-C62*		
CV7799†	BZY93-C43R*	CV7848†	BZY95-C68*		
CV7800†	BZY93-C47R*	CV7849†	BZY95-C75*		

** Approved to BS9000 'N' specs. (Post Office)

ELECTRONIC TUBES

CV No.	Comparable Type	CV No.	Comparable Type	CV No.	Comparable Type
CV424	QQV06-40A*	CV3522	QY5-500	CV6122	QY3-65
CV635	TY4-350	CV3523	QV06-20*	CV6223	LB3-250B*
CV1351	TY4-500	CV3926	TY6-5000A	CV8479	TY4-400
CV1905	QY3-65	CV5219	QY5-3000A	CV9640	Q13-110BA*
CV1924	TY2-125	CV5239	TY7-6000A	CV10112	QQV06-40A(BS)*
CV2130	QY3-125	CV5397	EC157		
CV2131	QY4-250	CV5473	QQV02-6		
CV2466	QQV02-6	CV5847	QQV07-50*		
CV2797	QQV06-40A*	CV5937	QQV06-40A*		
CV2798	QQV03-10	CV5959	QY4-400		

Obsolete/obsolescent types are indicated by an asterisk(*)

Integrated circuits

- Products included for the first time in this guide are indicated in both the index pages and data pages by a black dot alongside the type number.
- Devices for surface mounting are indicated in both the index pages and the data pages by a black square alongside the type number.
- € Devices approved and available to CECC specifications.

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The first column shows the IC type numbers in alpha-numerical sequence. The second column gives the pin position, the third the number of pins and the fourth the reference page number in this guide.

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74F646	DIL	24	66
74F647	DIL	24	66
74F648	DIL	24	66
74F649	DIL	24	66
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■ 74F656A	DIL/SO24	24	71
■ 74F657	DIL/SO24	24	71
74F673A	DIL	24	68
74F674	DIL	24	68
74F675A	DIL	24	68
74F676	DIL	24	68
● 74F711	DIL	20	70
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● 74F723	DIL	24	70
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■ 74F765	DIL/SO40	40	71
■ 74F779	DIL/SO16	16	69
74F784	DIL	20	71
● 74F804	DIL	20	66
● 74F805	DIL	20	66
● 74F808	DIL	20	66
74F821	DIL	24	68
74F822	DIL	24	68
74F823	DIL	24	68
74F824	DIL	24	68
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74F841	DIL	24	69
74F842	DIL	24	69
74F843	DIL	24	69
74F844	DIL	24	69
74F845	DIL	24	69
74F846	DIL	24	69
74F861	DIL	24	66
74F862	DIL	24	66
74F863	DIL	24	66
74F864	DIL	24	66
74F881	DIL	24	71
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74HC/HCT03P	DIL	14	60
■ 74HC/HCT03T	SO14	14	60
74HC/HCT04P	DIL	14	60
■ 74HC/HCT04T	SO14	14	60
74HCU04P	DIL	14	60
■ 74HCU04T	SO14	14	60
74HC/HCT08P	DIL	14	60
■ 74HC/HCT08T	SO14	14	60
74HC/HCT10P	DIL	14	60
■ 74HC/HCT10T	SO14	14	60
74HC/HCT11P	DIL	14	60
■ 74HC/HCT11T	SO14	14	60
74HC/HCT14P	DIL	14	63
■ 74HC/HCT14T	SO14	14	63
74HC/HCT20P	DIL	14	60
■ 74HC/HCT20T	SO14	14	60
74HC/HCT21P	DIL	14	60
■ 74HC/HCT21T	SO14	14	60
74HC/HCT27P	DIL	14	60
■ 74HC/HCT27T	SO14	14	60
74HC/HCT30P	DIL	14	60
■ 74HC/HCT30T	SO14	14	60
74HC/HCT32P	DIL	14	60
■ 74HC/HCT32T	SO14	14	60
74HC/HCT42P	DIL	16	63
■ 74HC/HCT42T	SO16	16	63
74HC58P	DIL	14	60
■ 74HC58T	SO14	14	60
74HC/HCT73P	DIL	14	61
■ 74HC/HCT73T	SO14	14	61
74HC/HCT74P	DIL	14	61
■ 74HC/HCT74T	SO14	14	61
74HC/HCT75P	DIL	16	61
■ 74HC/HCT75T	SO16	16	61
74HC/HCT85P	DIL	16	62
■ 74HC/HCT85T	SO16	16	62
74HC/HCT86P	DIL	14	60
■ 74HC/HCT86T	SO14	14	60
74HC/HCT93P	DIL	14	62
■ 74HC/HCT93T	SO14	14	62
74HC/HCT107P	DIL	14	61
■ 74HC/HCT107T	SO14	14	61
74HC/HCT109P	DIL	16	61
■ 74HC/HCT109T	SO16	16	61
74HC/HCT112P	DIL	16	61
■ 74HC/HCT112T	SO16	16	61
74HC/HCT123P	DIL	16	63
■ 74HC/HCT123T	SO16	16	63
74HC/HCT125P	DIL	14	60
■ 74HC/HCT125T	SO14	14	60
74HC/HCT126P	DIL	14	60
■ 74HC/HCT126T	SO14	14	60
74HC/HCT132P	DIL	14	63
■ 74HC/HCT132T	SO14	14	63
74HC/HCT137P	DIL	16	63
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■ 74HC/HCT151T	SO16	16	62
74HC/HCT153P	DIL	16	62
■ 74HC/HCT153T	SO16	16	62
74HC/HCT154P	DIL	24	63
■ 74HC/HCT154T	SO24	24	63
74HC/HCT157P	DIL	16	62
■ 74HC/HCT157T	SO16	16	62
74HC/HCT158P	DIL	16	62
■ 74HC/HCT158T	SO16	16	62
74HC/HCT160P	DIL	16	62
■ 74HC/HCT160T	SO16	16	62
74HC/HCT161P	DIL	16	62
■ 74HC/HCT161T	SO16	16	62
74HC/HCT162P	DIL	16	62
■ 74HC/HCT162T	SO16	16	62
74HC/HCT163P	DIL	16	62
■ 74HC/HCT163T	SO16	16	62
74HC/HCT164P	DIL	14	61
■ 74HC/HCT164T	SO14	14	61
74HC/HCT165P	DIL	16	61
■ 74HC/HCT165T	SO16	16	61
74HC/HCT166P	DIL	16	61
■ 74HC/HCT166T	SO16	16	61
74HC/HCT173P	DIL	16	61
■ 74HC/HCT173T	SO16	16	61
74HC/HCT174P	DIL	16	61
■ 74HC/HCT174T	SO16	16	61
74HC/HCT175P	DIL	16	61
■ 74HC/HCT175T	SO16	16	61
74HC/HCT181P	DIL	24	62
■ 74HC/HCT181T	SO24	24	62
74HC/HCT182P	DIL	16	62
■ 74HC/HCT182T	SO16	16	62
74HC/HCT190P	DIL	16	62
■ 74HC/HCT190T	SO16	16	62
74HC/HCT191P	DIL	16	62
■ 74HC/HCT191T	SO16	16	62
74HC/HCT192P	DIL	16	62
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74HC/HCT193P	DIL	16	62
■ 74HC/HCT193T	SO16	16	62
74HC/HCT194P	DIL	16	61
■ 74HC/HCT194T	SO16	16	61
74HC/HCT195P	DIL	16	61
■ 74HC/HCT195T	SO16	16	61
74HC/HCT221P	DIL	16	63
■ 74HC/HCT221T	SO16	16	63
74HC/HCT237P	DIL	16	63
■ 74HC/HCT237T	SO16	16	63
74HC/HCT238P	DIL	16	63
■ 74HC/HCT238T	SO16	16	63
74HC/HCT240P	DIL	20	60
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74HC/HCT241P	DIL	20	60
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74HC/HCT242P	DIL	14	63
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74HC/HCT251P	DIL	16	62
■ 74HC/HCT251T	SO16	16	62
74HC/HCT253P	DIL	16	62
■ 74HC/HCT253T	SO16	16	62
74HC/HCT257P	DIL	16	62
■ 74HC/HCT257T	SO16	16	62
74HC/HCT258P	DIL	16	62
■ 74HC/HCT258T	SO16	16	62
74HC/HCT259P	DIL	16	61
■ 74HC/HCT259T	SO16	16	61
74HC7266P	DIL	14	60
■ 74HC7266T	SO14	14	60
74HC/HCT273P	DIL	20	61
■ 74HC/HCT273T	SO20	20	61
74HC/HCT280P	DIL	14	62
■ 74HC/HCT280T	SO14	14	62
74HC/HCT283P	DIL	16	62
■ 74HC/HCT283T	SO16	16	62
74HC/HCT297P	DIL	16	63
■ 74HC/HCT297T	SO16	16	63
74HC/HCT299P	DIL	20	61
■ 74HC/HCT299T	SO20	20	61
74HC/HCT354P	DIL	20	62
■ 74HC/HCT354T	SO20	20	62
74HC/HCT356P	DIL	20	62
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74HC/HCT366P	DIL	16	60
■ 74HC/HCT366T	SO16	16	60
74HC/HCT367P	DIL	16	60
■ 74HC/HCT367T	SO16	16	60
74HC/HCT368P	DIL	16	60
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74HC/HCT373P	DIL	20	61
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74HC/HCT374P	DIL	20	61
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74HC/HCT377P	DIL	20	61
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74HC/HCT390P	DIL	16	62
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74HC/HCT393P	DIL	16	62
■ 74HC/HCT393T	SO16	16	62
74HC/HCT423P	DIL	16	63
■ 74HC/HCT423T	SO16	16	63
74HC/HCT533P	DIL	20	61
■ 74HC/HCT533T	SO20	20	61
74HC/HCT534P	DIL	20	61
■ 74HC/HCT534T	SO20	20	61
74HC/HCT540P	DIL	20	60
■ 74HC/HCT540T	SO20	20	60
74HC/HCT541P	DIL	20	60
■ 74HC/HCT541T	SO20	20	60
74HC/HCT563P	DIL	20	61
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■ 74HC/HCT583T	SO16	16	62
74HC/HCT597P	DIL	16	61
■ 74HC/HCT597T	SO16	16	61
74HC/HCT7597P	DIL	16	61
■ 74HC/HCT7597T	SO16	16	61
74HC/HCT640P	DIL	20	63
■ 74HC/HCT640T	SO20	20	63
74HC/HCT643P	DIL	20	63
■ 74HC/HCT643T	SO20	20	63
74HC/HCT646P	DIL	24	63
■ 74HC/HCT646T	SO24	24	63
74HC/HCT648P	DIL	24	63
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74HC/HCT670P	DIL	16	61
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74HC/HCT688P	DIL	20	62
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74HC/HCT4015P	DIL	16	61
■ 74HC/HCT4015T	SO16	16	61
74HC/HCT4016P	DIL	14	63
■ 74HC/HCT4016T	SO14	14	63
74HC/HCT4017P	DIL	16	62
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74HC/HCT4053P	DIL	16	63
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74HC/HCT4066P	DIL	14	63
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74HC/HCT4067P	DIL	24	63
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74HC/HCT4538P	DIL	14	63
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74HC/HCT40102P	DIL	16	62
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74HC/HCT40103P	DIL	16	62
■ 74HC/HCT40103T	SO16	16	62
74HC/HCT40104P	DIL	16	61
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74LS160A	DIL	16	68
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74LS242	DIL	14	66
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■ 74LS368A	DIL/SO16	16	66
■ 74LS373	DIL/SO20	20	69
■ 74LS374	DIL/SO20	20	67
■ 74LS375	DIL/SO16	16	69
■ 74LS377	DIL/SO20	20	67
74LS378	DIL	16	67
■ 74LS390	DIL/SO16	16	69
■ 74LS393	DIL/SO14	14	69
74LS395A	DIL	16	68
74LS445	DIL	16	69
74LS490	DIL	16	69
■ 74LS540	DIL/SO20	20	66
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74LS568A	DIL	20	69
74LS569A	DIL	20	69
74LS620	DIL	20	66
74LS621	DIL	20	66
74LS622	DIL	20	66
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7410	DIL	14	65
7411	DIL	14	65
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7420	DIL	14	65
7421	DIL	14	65
7425	DIL	14	65
7426	DIL	14	65
7427	DIL	14	65
7428	DIL	14	65
7430	DIL	14	65
7432	DIL	14	65
7433	DIL	14	65
7437	DIL	14	65
7438	DIL	14	65
7439	DIL	14	65
7440	DIL	14	65
7442	DIL	16	70
7445	DIL	16	69
7450	DIL	14	65
7451	DIL	14	65
7473	DIL	14	67
7474	DIL	14	67
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7483	DIL	16	71
7485	DIL	16	71
7486	DIL	14	65
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74125	DIL	14	66
74126	DIL	14	66
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74147	DIL	16	70
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74150	DIL	24	70
74151	DIL	16	70
74153	DIL	16	70
74154	DIL	24	70
74155	DIL	16	70
74156	DIL	16	70
74157	DIL	16	70
74158	DIL	16	70
74160	DIL	16	68
74161	DIL	16	68
74163	DIL	16	68
74164	DIL	14	67
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74193	DIL	16	69
74194	DIL	16	67
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74298	DIL	16	70
74365A	DIL	16	66
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100112F	DIL	24	76
100112Y	FP;4x6	24	76
100113F	DIL	24	76
100113Y	FP;4x6	24	76
100114F	DIL	24	76
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100117F	DIL	24	76
100117Y	FP;4x6	24	76
100118F	DIL	24	76
100118Y	FP;4x6	24	76
100122F	DIL	24	76
100122Y	FP;4x6	24	76
100123F	DIL	24	76
100123Y	FP;4x6	24	76
100126F	DIL	24	76
100126Y	FP;4x6	24	76
100131F;AF	DIL	24	76
100131Y;AY	FP;4x6	24	76
100136F	DIL	24	76
100136Y	FP;4x6	24	76
100141F	DIL	24	76
100141Y	FP;4x6	24	76
100149F	-	-	80
100149Y	-	-	80
100150F	DIL	24	76
100150Y	FP;4x6	24	76
100151F	DIL	24	76
100151Y	FP;4x6	24	76
100155F	DIL	24	76
100155Y	FP;4x6	24	76
100158F	DIL	24	76
100158Y	FP;4x6	24	76
100160F	DIL	24	76
100160Y	FP;4x6	24	76
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100181F	DIL	24	76
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68155/BQA	-	-	118
68172/BJA	-	-	118

logic: CMOS HE4000B

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CMOS HE4000B FAMILY SPECIFICATIONS

The LOCMOS HE4000B range is a fully buffered digital integrated circuit family which meets the Jedec-B specification. The members of this family are plug-in replacements for the well-known CMOS 4000 and 14500 ranges.

The HE family has the same advantages as conventional CMOS circuits, plus the additional LOCMOS advantages.

Advantages of the CMOS

- low power dissipation - typically 10 nW per gate (static)
- wide operating supply voltage range
- wide operating temperature ranges:
 - 40 to + 85°C for standard temperature range (HEF)
 - 55 to + 125°C for extended temperature range (HEC)
- high d.c. fan-out
- inputs and outputs are protected against electrostatic voltages

In addition to these, the **LOCMOS HE4000B** range has:

- buffered outputs on **all** circuits
- higher speed
- higher packing density - essential for MSI/LSI
- excellent noise immunity

Recommended supply voltage range 3 to 15 V.

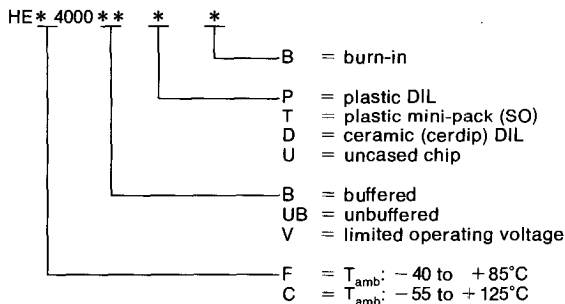
LOCMOS means Local Oxidation Complementary MOS

Inputs and outputs are protected against electrostatic effects in a wide variety of device-handling situations. However, to be totally safe, it is desirable to take handling precautions into account.

Type number designation

Type numbers have suffix which signifies the type of package and burn-in option.

HE* 4000*** complete type number which can be split up as follows:



Continued

CMOS HE4000B FAMILY SPECIFICATIONS (cont.)

The HE family is designed with standardized output drive characteristics which, combined with relative insensitivity to output capacitance loading, simplify system design.

Family ratings

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Supply voltage range	$V_{DD} - 0.5$ to $+18V$
Voltage on any input	$V_I - 0.5$ to $(V_{DD} + 0.5)V$
D.C. current into any input or output	± 1 max. 10 mA

D.C. family characteristics at $V_{SS} = 0$

parameter	symbol	$T_{amb} = -40^{\circ}C$		$T_{amb} = +25^{\circ}C$		$T_{amb} = +85^{\circ}C$		V_{DD} V	conditions
		min.	max.	min.	max.	min.	max.		
Quiescent device current for gates	$I_{DD}(\mu A)$	-	1.0	-	1.0	-	7.5	5	all valid input combinations; $V_I = V_{SS}$ or V_{DD}
		-	2.0	-	2.0	-	15.0	10	
		-	4.0	-	4.0	-	30.0	15	
Quiescent device current for buffers and flip-flops	$I_{DD}(\mu A)$	-	4.0	-	4.0	-	30	5	all valid input combinations; $V_I = V_{SS}$ or V_{DD}
		-	8.0	-	8.0	-	60	10	
		-	16.0	-	16.0	-	120	15	
Quiescent device current for MSI	$I_{DD}(\mu A)$	-	20	-	20	-	150	5	all valid input combinations; $V_I = V_{SS}$ or V_{DD}
		-	40	-	40	-	300	10	
		-	80	-	80	-	600	15	
Quiescent device current for LSI	$I_{DD}(\mu A)$	-	50	-	50	-	375	5	all valid input combinations; $V_I = V_{SS}$ or V_{DD}
		-	100	-	100	-	750	10	
		-	200	-	200	-	1500	15	
Output voltage LOW $ I_O < 1\mu A$	$V_{OL}(V)$	-	0.05	-	0.05	-	0.05	5	$V_I = V_{SS}$ or V_{DD} $V_D = 1.0$ or $9.0V$ $V_I = V_{SS}$ or V_{DD}
		-	0.05	-	0.05	-	0.05	10	
		-	0.05	-	0.05	-	0.05	15	
Output voltage HIGH $ I_O < 1\mu A$	$V_{OH}(V)$	4.95	-	4.95	-	4.95	-	5	$V_I = V_{SS}$ or V_{DD} $V_D = 1.0$ or $9.0V$ $V_I = V_{SS}$ or V_{DD}
		9.95	-	9.95	-	9.95	-	10	
		14.95	-	14.95	-	14.95	-	15	
Input voltage LOW $ I_O < 1\mu A$ (buffered stages only)	$V_{IL}(V)$	-	1.5	-	1.5	-	1.5	5	$V_O = 0.5$ or $4.5V$ $V_D = 1.0$ or $9.0V$ $V_O = 1.5$ or $13.5V$
		-	3.0	-	3.0	-	3.0	10	
		-	4.0	-	4.0	-	4.0	15	
Input voltage HIGH $ I_O < 1\mu A$ (buffered stages only)	$V_{IH}(V)$	3.5	-	3.5	-	3.5	-	5	$V_O = 0.5$ or $4.5V$ $V_D = 1.0$ or $9.0V$ $V_D = 1.5$ or $13.5V$
		7.0	-	7.0	-	7.0	-	10	
		11.0	-	11.0	-	11.0	-	15	

Continued

logic: CMOS HE4000B (cont.)

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Family ratings (cont.)

Power dissipation per package for plastic and ceramic (cerdip) DIL

for $T_{amb} = -40$ to $+60^{\circ}\text{C}$	P_{tot} max. 400 mW
for $T_{amb} = +40$ to $+85^{\circ}\text{C}$	derate linearly with 8 mW/K to 200 mW

Power dissipation per package for plastic SO mini-pack

for $T_{amb} = -40$ to $+70^{\circ}\text{C}$	P_{tot} max. 200 mW
for $T_{amb} = +70$ to $+85^{\circ}\text{C}$	derate linearly with 5 mW/K to 125 mW

Power dissipation per output P max. 100 mW

Operating ambient temperature range $T_{amb} -40$ to $+85^{\circ}\text{C}$

Storage temperature range $T_{stg} -65$ to $+150^{\circ}\text{C}$

D.C. family characteristics at $V_{SS} = 0$ (cont.)

parameter	symbol	$T_{amb} = -40^{\circ}\text{C}$		$T_{amb} = +25^{\circ}\text{C}$		$T_{amb} = +85^{\circ}\text{C}$		V_{DD} V	conditions
		min.	max.	min.	max.	min.	max.		
Input voltage LOW $ I_{O} < 1\mu\text{A}$ (unbuffered stages) only	$V_{IL}(V)$	-	1.0	-	1.0	-	1.0	5	$V_O = 0.5$ to $4.5V$
		-	2.0	-	2.0	-	2.0	10	$V_O = 1.0$ or $9.0V$
		-	2.5	-	2.5	-	2.5	15	$V_O = 1.5$ or $13.5V$
Input voltage HIGH $ I_{O} < 1\mu\text{A}$ (unbuffered stages) only	$V_{IH}(V)$	4.0	-	4.0	-	4.0	-	5	$V_O = 0.5$ or $4.5V$
		8.0	-	8.0	-	8.0	-	10	$V_O = 1.0$ or $9.0V$
		12.5	-	12.5	-	12.5	-	15	$V_O = 1.5$ or $13.5V$
Output (sink) current LOW	$I_{OL}(mA)$	0.52	-	0.44	-	0.36	-	5	$V_O = 0.4$; $V_I = 0/5V$
		1.3	-	1.1	-	0.9	-	10	$V_O = 0.5$; $V_I = 0/10V$
		3.6	-	3.0	-	2.4	-	15	$V_O = 1.5$; $V_I = 0/15V$
Output (source) current HIGH	$-I_{OH}(mA)$	0.52	-	0.44	-	0.36	-	5	$V_O = 4.6$; $V_I = 0/5V$
		1.3	-	1.1	-	0.9	-	10	$V_O = 9.5$; $V_I = 0/10V$
		3.6	-	3.0	-	2.4	-	15	$V_O = 13.5$; $V_I = 0/15V$
Output (source) current (HIGH)	$-I_{OH}(mA)$	1.7	-	1.1	-	1.1	-	5	$V_O = 2.5$; $V_I = 0/5V$
Input leakage current	$\pm I_{IN}(\mu A)$	-	0.3	-	0.3	-	1.0	15	$V_I = 0$ or $15V$
3 state output leakage current HIGH	$I_{OZH}(\mu A)$	-	1.6	-	1.6	-	12.0	15	output returned to V_{DD}
3-state output leakage current LOW	$I_{OZL}(\mu A)$	-	1.6	-	1.6	-	12.0	15	output returned to V_{SS}
Input capacitance per unit load	$C_I(pF)$	-	-	-	7.5	-	-	-	digital inputs

Standard functions

logic: CMOS HE4000B (cont.)

book 4 part 4

CMOS HE4000B FAMILY SURVEY

Type numbers have a suffix which signifies the type of package and burn-in option:

P = plastic DIL; D = ceramic (cerdip) DIL; T = plastic SO mini-pack;

U = uncased chip 2nd B = burn-in

NAND gates

■ € HEF4011B*	quadruple 2-input NAND gate
■ € HEF4011UB	quadruple 2-input NAND gate; unbuffered
■ € HEF4012B*	dual 4-input NAND gate
■ € HEF4023B*	triple 3-input NAND gate
■ € HEF4068B*	8-input NAND gate

AND gates

■ € HEF4073B*	triple 3-input AND gate
■ € HEF4081B*	quadruple 2-input AND gate
■ € HEF4082B	dual 4-input AND gate

NOR gates

■ € HEF4000B	dual 3-input NOR gate and inverter
■ € HEF4001B*	quadruple 2-input NOR gate
■ € HEF4001UB	quadruple 2-input NOR gate; unbuffered
■ € HEF4002B*	dual 4-input NOR gate
■ € HEF4025B*	triple 3-input NOR gate
■ € HEF4078B	8-input NOR gate

OR gates

■ € HEF4071B*	quadruple 2-input OR gate
■ € HEF4072B	dual 4-input OR gate
■ € HEF4075B	triple 3-input OR gate

Inverters and buffers

■ € HEF4007UB*	dual complementary pair and inverter
■ € HEF4041B	quadruple true/complement buffer
■ € HEF4049B*	hex inverting buffers
■ € HEF4050B*	hex non-inverting buffers
■ € HEF4069UB*	hex inverter
■ € HEF4502B	strobed hex inverter/buffer
■ € HEF40097B*	3-state hex non-inverting buffer
■ € HEF40098B*	3-state hex inverting buffer

Complex gates

■ € HEF4030B*	quadruple EXCLUSIVE-OR gate
■ € HEF4070B*	quadruple EXCLUSIVE-OR gate
■ € HEF4077B	quadruple EXCLUSIVE-NOR gate
■ € HEF4085B	dual 2-wide 2-input AND-OR-invert gate
■ € HEF4086B	4-wide 2-input AND-OR-invert gate

*HEC type with burn-in option available in cerdip package

Continued

logic: CMOS HE4000B (cont.)

book 4 part 4

Flip-flops

- € HEF4013B* dual D-type flip-flop
- € HEF4027B* dual JK flip-flop
- € HEF4076B quadruple D-type register with 3-state outputs
- € HEF40174B* hex D-type flip-flop
- € HEF40175B* quadruple D-type flip-flop

Counters

- € HEF4017B* 5-stage Johnson counter
- € HEF4018B pre-settable divide-by-n counter
- € HEF4020B* 14-stage binary counter
- € HEF4022B 4-stage divide-by-8 Johnson counter
- € HEF4024B* 7-stage binary counter
- € HEF4029B synchronous up/down counter, binary/decade counter
- € HEF4040B* 12-stage binary counter
- HEF4059B programmable divide-by-n counter
- HEF4060B 14-stage ripple-carry counter/divider and oscillator
- € HEF4510B* BCD up/down counter
- € HEF4516B binary up/down counter
- € HEF4518B dual BCD counter
- € HEF4520B* dual binary counter
- € HEF4521B 24-stage frequency divider
- € HEF4522B programmable 4-bit BCD down counter
- € HEF4526B programmable 4-bit binary down counter
- € HEF4534B real time 5-decade counter
- HEF4737B;V quadruple static decade counters
- HEF4751V* universal divider
- € HEF40160B 4-bit synchronous decade counter; asynchronous reset
- € HEF40161B 4-bit synchronous binary counter; asynchronous reset
- € HEF40162B 4-bit synchronous decade counter; synchronous reset
- € HEF40163B 4-bit synchronous binary counter; synchronous reset
- € HEF40192B 4-bit up/down decade counter
- € HEF40193B 4-bit up/down binary counter

Registers

- € HEF4006B 18-stage static shift register
- € HEF4014B* 8-bit static shift register
- € HEF4015B* dual 4-bit static shift register
- € HEF4021B 8-bit static shift register
- € HEF4031B 64-stage static shift register
- € HEF4035B* 4-bit universal shift register
- € HEF4076B quadruple D-type register with 3-state outputs
- € HEF4094B* 8-stage shift-and-store bus register
- € HEF4517B dual 64-bit static shift register
- € HEF4557B* 1-to-64 bit variable length shift register
- HEF4731B;V quadruple 64-bit static shift register
- € HEF40194B* 4-bit bidirectional universal shift register
- € HEF40195B* 4-bit universal shift register

*HEC type with burn-in option available in cerdip package

Continued

Decoders and demultiplexers

- € HEF4028B 1-of-10 decoder
 - € HEF4511B* BCD to 7-segment latch/decoder/driver
 - € HEF4514B 1-of-16 decoder/demultiplexer with input latches
 - € HEF4515B 1-of-16 decoder/demultiplexer with input latches
 - € HEF4543B BCD to 7-segment latch/decoder/driver
 - € HEF4555B dual 1-of-4 decoder/demultiplexer
 - € HEF4556B* dual 1-of-4 decoder/demultiplexer
-
- € HEF4019B* quadruple 2-input multiplexer
 - € HEF4512B* 8-input multiplexer with 3-state output
 - € HEF4519B* quadruple 2-input multiplexer
 - € HEF4539B* dual 4-input multiplexer

Analogue switches and multiplexers/demultiplexers

- € HEF4016B* quadruple bilateral switches
- € HEF4051B* 8-channel analogue multiplexer/demultiplexer
- € HEF4052B dual 4-channel analogue multiplexer/demultiplexer
- € HEF4053B triple 2-channel analogue multiplexer/demultiplexer
- € HEF4066B* quadruple bilateral switches
- € HEF4067B 16-channel analogue multiplexer/demultiplexer

Latches

- € HEF4042B* quadruple D-latch
- € HEF4043B quadruple R/S latch with 3-state outputs
- € HEF4044B quadruple R/S latch with 3-state outputs
- € HEF4508B dual 4-bit latch
- € HEF4724B 8-bit addressable latch

Multivibrators and timers

- € HEF4047B monostable/astable multivibrator
- € HEF4528B* dual monostable multivibrator
- € HEF4538B dual precision monostable multivibrator
- € HEF4541B* programmable timer
- HEF4753B universal timer module

Arithmetic circuits

- € HEF4008B 4-bit binary full adder
- € HEF4531B 13-input parity checker/generator
- € HEF4532B 8-input priority encoder
- € HEF4585B* 4-bit magnitude comparator

*HEC type with burn-in option available in cerdip package

Continued

logic: CMOS HE4000B (cont.)

book 4 part 4

Schmitt triggers

- € HEF4093B* quadruple 2-input NAND Schmitt trigger
- € HEF40106B hex inverting Schmitt trigger

Memories

- € HEF4505B* 64-bit static read/write RAM
- € HEF4720B;V 256-bit, 1-bit per word RAM

Octal circuits

- HEF40240B octal buffers with 3-state outputs
- HEF40244B octal buffers with 3-state outputs
- HEF40245B octal bus transceiver with 3-state outputs
- HEF40373B octal transparent latch with 3-state outputs
- HEF40374B octal D-type flip-flop with 3-state outputs

Special functions

- € HEF4046B phase-locked loop
- € HEF4104B quadruple low-to-high voltage translator with 3-state outputs
- HEF4527B BCD rate multiplier
- HEF4738V IEC/IEEE bus interface
- HEF4750V* frequency synthesizer
- € HEF4752V a.c. motor control circuit
- € HEF4754V 18-element bar graph LCD driver
- € HEF4755V transceiver for serial data communication

*HEC type with burn-in option available in cerdip package

HCMOS PC74 FAMILY SPECIFICATIONS

General

These family specifications cover the common electrical ratings and characteristics of the entire HCMOS PC74 family, unless otherwise specified in the individual device data sheet.

Introduction

The PC74 high-speed Si-gate CMOS logic family combine the low power advantages of the HE4000B family with the high speed and drive capability of the low power Schottky TTL (LSTTL). The family will have the same pin-out as the 74 series and provide the same circuit functions. In these families are included several HE4000B family circuits which do not have TTL counter parts and some special circuits.

The basic family of buffered devices, designated as PC74HCXXXX, will operate at CMOS input logic levels for high noise immunity, negligible typical quiescent supply current and the input current is operated from a power supply of 2 to 6 V.

A subset of the family, designated as PC74HCT, with the same features and functions as the "HC-types", will operate as standard TTL power supply voltage ($5\text{ V} \pm 10\%$) and logic levels (0,8 to 2,0 V) for use as pin-to-pin compatible CMOS replacements to reduce power consumption without loss of speed.

These types are also suitable for converted switching from TTL to CMOS.

Another subset, the PC74HCU, are single-stage unbuffered CMOS compatible devices for application in RC or crystal controlled oscillators and other types of feed-back circuits which operate in the linear mode.

Handling MOS devices

Inputs and outputs are protected against electrostatic effects in a wide variety of device-handling situations. However, to be totally safe, it is desirable to take handling precautions into account.

Features

- Functions and pinning identical to the LSTTL and HE4000B family CMOS circuits
- Standard CMOS input switching levels for high-noise immunity (PC74HC)
- TTL input switching levels for PC74HCT devices
- Fan-out equal to 10 LSTTL loads (4 mA) for devices with standard outputs and 15 LSTTL loads (6 mA) for devices with bus driver outputs
- Balanced output characteristics for optimum speed and performance
- Typical quiescent power supply current: 10 nA (gates), 20 nA (flip-flops), 40 nA (MS)
- Operating frequency (50 MHz) compatible with LSTTL
- Wide operating supply voltage:
2 to 6 V for PC74HC/HCU devices
 $5\text{ V} \pm 10\%$ for PC74HCT devices
- Wide operating temperature ranges:
standard: -40 to $+85^\circ\text{C}$ and -40 to 125°C , the different characteristics are given in the data
- Available package:
plastic DIL and mini-pack (SO)
- Built-in protection against latch-up
- Highly immune to electrostatic discharge
- Alternate source is RCA

Continued

logic: HCMOS PC74 (cont.)

book 4 part 5

Type number designation

PC74*** ***** *

package code:

= plastic DIL;

= plastic mini-pack (SO)

P

T

device number (up to 5 digits)

HC

= CMOS input switching levels;
supply voltage range 2 to 6 V;
fully buffered

HCT

= TTL input switching levels;
supply voltage range 2 to 6 V;
fully buffered

HCU

= CMOS input switching levels;
supply voltage range 2 to 6V;
unbuffered (single-stage devices)

74

= temperature range;

-40 to +85°C or -40°C to +125°C

Continued

Family ratings

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages are referenced to GND (ground = 0V)

parameter	conditions	symbol	min	typ	max	unit
D.C. supply voltage		V_{CC}	-0.5	-	+7	V
D.C. input diode current	for $V_i < -0.5V$ or $V_i > V_{CC} + 0.5V$	$\pm I_{IK}$	-	-	20	mA
D.C. output diode current	for $V_o < -0.5V$ or $V_o > V_{CC} + 0.5V$	$\pm I_{OK}$	-	-	20	mA
D.C. output source or sink current	for $-0.5V < V_o < V_{CC} + 0.5V$					
	standard outputs	$\pm I_o$	-	-	25	mA
	bus driver outputs	$\pm I_o$	-	-	35	mA
D.C. V_{CC} or GND current	standard outputs	$\pm I_{CC};$ $\pm I_{GND}$	-	-	50	mA
	bus driver outputs	$\pm I_{CC};$ $\pm I_{GND}$	-	-	70	mA
Storage temperature range		T_{stg}	-65	-	+150	°C
Power dissipation per package	for temperature range; -40 to +85°C PC74HC/HCT/HCU					
	plastic DIL	P_{tot}	-	-	500	mW
	above +60°C	P_{tot}^*	-	-	-	mW
	plastic minipack (SO)	P_{tot}	-	-	400	mW
	above +60°C	P_{tot}^{**}	-	-	-	mW
Power dissipation per package	for temperature range; -40 to +125°C; PC74HC/HCT/HCU					
	plastic DIL	P_{tot}	-	-	500	mW
	above +70°C	P_{tot}^*	-	-	-	mW
	plastic minipack (SO)	P_{tot}	-	-	400	mW
	above +70°C	P_{tot}^{**}	-	-	-	mW

* Derate linearly with 8 mW/K.

** Derate linearly with 6 mW/K.

Continued

logic: HCMOS PC74 (cont.)

book 4 part 5

Recommended operating conditions

Voltages are referenced to GND (ground = 0V)

parameter	symbol	min.	typ.	max.	unit	conditions
D.C. supply voltage range						
PC74HC/HCU	V_{CC}	2.0	5.0	6.0	V	
PC74HCT	V_{CC}	4.5	5.0	5.5	V	
D.C. input voltage range	V_i	0	–	V_{CC}	V	
D.C. output voltage range	V_o	0	–	V_{CC}	V	
Operating ambient temperature range						
PC74HC/HCT/NCU	T_{amb}	–40	–	+85	°C	standard
PC74HC/HCT/HCU	T_{amb}	–40	–	+125	°C	extended
Input rise and fall times except for Schmitt trigger inputs	$t_r; t_f$	–	–	1000	ns	$V_{CC} = 2.0\text{ V}$
		–	6.0	500	ns	$V_{CC} = 4.5\text{ V}$
		–	–	400	ns	$V_{CC} = 6.0\text{ V}$

Continued

D.C. family characteristics, PC74HC

Voltages are referenced to GND (ground = 0 V)

parameter	V _{CC} (V)	symbol	T _{amb} (°C)						conditions			
			+25			-40 to +85		-40 to +125		V _I	other	
			min.	typ.	max.	min.	max.	min.	max.			unit
HIGH level input voltage	2.0	V _{IH}	1.5	1.3	-	1.5	-	1.5	-	-		
	4.5		3.15	2.4	-	3.15	-	3.15	-	V		
	6.0		4.2	3.1	-	4.2	-	4.2	-	V		
LOW level input voltage	2.0	V _{IL}	-	0.7	0.5	-	0.5	-	0.5	V		
	4.5		-	1.8	1.35	-	1.35	-	1.35	V		
	6.0		-	2.3	1.80	-	1.80	-	1.80	V		
HIGH level output voltage all outputs	2.0	V _{OH}	1.9	2.0	-	1.9	-	1.9	-	V	V _{IH}	-I _O = 20 μA
	4.5		4.4	4.5	-	4.4	-	4.4	-	V	or	-I _O = 20 μA
	6.0		5.9	6.0	-	5.9	-	5.9	-	V	V _{IL}	-I _O = 20 μA
HIGH level output voltage standard	4.5	V _{OH}	3.98	-	-	3.84	-	3.7	-	V	V _{IH}	-I _O = 4.0 mA
	6.0		5.48	-	-	5.34	-	5.2	-	V	or	-I _O = 5.2 mA
HIGH level output voltage bus driver	4.5	V _{OH}	3.98	-	-	3.84	-	3.7	-	V	V _{IH}	-I _O = 6.0 mA
	6.0		5.48	-	-	5.34	-	5.2	-	V	or	-I _O = 7.8 mA
LOW level output voltage all outputs	2.0	V _{OL}	-	0	0.1	-	0.1	-	0.1	V	V _{IH}	I _O = 20 μA
	4.5		-	0	0.1	-	0.1	-	0.1	V	or	I _O = 20 μA
	6.0		-	0	0.1	-	0.1	-	0.1	V	V _{IL}	I _O = 20 μA
LOW level output voltage standard	4.5	V _{OL}	-	-	0.26	-	0.33	-	0.4	V	V _{IH}	I _O = 4.0 mA
	6.0		-	-	0.26	-	0.33	-	0.4	V	or	I _O = 5.2 mA
LOW level output voltage bus driver	4.5	V _{OL}	-	-	0.26	-	0.33	-	0.4	V	V _{IH}	I _O = 6.0 mA
	6.0		-	-	0.26	-	0.33	-	0.4	V	or	I _O = 7.8 mA
Input leakage current	6.0	±I _I	-	-	0.1	-	1.0	-	1.0	μA	V _{CC} or GND	
3-state OFF-state current	6.0	±I _{OZ}	-	-	0.5	-	5.0	-	10.0	μA	V _{IH} or V _{IL}	V _O = V _{CC} or GND
Quiescent supply current												
SSI flip-flops	6.0	I _{CC}	-	-	2.0	-	20.0	-	40.0	μA	V _{CC}	I _O = 0
	6.0	I _{CC}	-	-	4.0	-	40.0	-	80.0	μA	or	I _O = 0
MSI	6.0	I _{CC}	-	-	8.0	-	80.0	-	160.0	μA	GND	I _O = 0

Continued

logic: HCMOS PC74 (cont.)

book 4 part 5

D.C. family characteristics, PC74HC

Voltages are referenced to GND (ground = 0V)

parameter	V_{CC} (V)	symbol	T_{amb} (°C)						unit	conditions		
			+ 25			- 40 to + 85		- 40 to + 125		V_I	other	
			min.	typ.	max.	min.	max.	min.				max.
HIGH level input voltage	2.0	V_{IH}	1.7	-	-	1.7	-	1.7	-	V		
	4.5		3.6	-	-	3.6	-	3.6	-	V		
	6.0		4.8	-	-	4.8	-	4.8	-	V		
LOW level input voltage	2.0	V_{IL}	-	-	0.3	-	0.3	-	0.3	V		
	4.5		-	-	0.9	-	0.9	-	0.9	V		
	6.0		-	-	1.2	-	1.2	-	1.2	V		
HIGH level output voltage	2.0	V_{OH}	1.8	-	-	1.8	-	1.8	-	V	V_{IH}	$-I_o = 20 \mu A$
	4.5		4.0	-	-	4.0	-	4.0	-	V	or	$-I_o = 20 \mu A$
	6.0		5.5	-	-	5.5	-	5.5	-	V	V_{IL}	$-I_o = 20 \mu A$
HIGH level output voltage	4.5	V_{OH}	3.98	-	-	3.84	-	3.7	-	V	V_{CC}	$-I_o = 4.0 \text{ mA}$
	6.0		5.48	-	-	5.34	-	5.2	-	V	or GND	$-I_o = 5.2 \text{ mA}$
LOW level output voltage	2.0	V_{OL}	-	-	0.2	-	0.2	-	0.2	V	V_{IH}	$I_o = 20 \mu A$
	4.5		-	-	0.5	-	0.5	-	0.5	V	or	$I_o = 20 \mu A$
	6.0		-	-	0.5	-	0.5	-	0.5	V	V_{IL}	$I_o = 20 \mu A$
LOW level output voltage	4.5	V_{OL}	-	-	0.26	-	0.33	-	0.4	V	V_{CC}	$I_o = 4.0 \text{ mA}$
	6.0		-	-	0.26	-	0.33	-	0.4	V	or GND	$I_o = 5.2 \text{ mA}$
Input leakage current	6.0	$\pm I_I$	-	-	0.1	-	1.0	-	1.0	μA	V_{CC} or GND	
Quiescent supply current SSI	6.0	I_{CC}	-	-	2.0	-	20.0	-	40.0	μA	V_{CC} or GND	$I_o = 0$

Continued

D.C. family characteristics, PC74HCT

Voltages are referenced to GND (ground = 0V)

parameter	V _{CC} (V)	symbol	T _{amb} (°C)						unit	conditions		
			+25			-40 to +85		-40 to +125		V _I	other	
			min.	typ.	max.	min.	max.	min.				max.
HIGH level input voltage	4.5 - 5.5	V _{IH}	2.0	-	-	2.0	-	2.0	-	V		
LOW level input voltage	4.5 - 5.5	V _{IL}	-	-	0.8	-	0.8	-	0.8	V		
HIGH level output voltage all outputs	4.5	V _{OH}	4.4	4.5	-	4.4	-	4.4	-	V	V _{IH} or V _{IL}	-I _O = 20µA
HIGH level output voltage standard	4.5	V _{OH}	3.98	-	-	3.84	-	3.7	-	V	V _{IH} or V _{IL}	-I _O = 4.0mA
HIGH level output voltage bus driver	4.5	V _{OH}	3.98	-	-	3.84	-	3.7	-	V	V _{IH} or V _{IL}	-I _O = 6.0mA
LOW level output voltage all outputs	4.5	V _{OL}	-	0	0.1	-	0.1	-	0.1	V	V _{IH} or V _{IL}	I _O = 20µA
LOW level output voltage standard	4.5	V _{OL}	-	-	0.26	-	0.33	-	0.4	V	V _{IH} or V _{IL}	I _O = 4.0mA
LOW level output voltage bus driver	4.5	V _{OL}	-	-	0.26	-	0.33	-	0.4	V	V _{IH} or V _{IL}	I _O = 6.0mA
Input leakage current	5.5	±I _I	-	-	0.1	-	1.0	-	1.0	µA	V _{CC} or GND	
3-state OFF-state current	5.5	±I _{OZ}	-	-	0.5	-	5.0	-	10.0	µA	V _{IH} or V _{IL}	V _O = V _{CC} or GND per input pin; other inputs at V _{CC} or GND; I _O = 0
Quiescent supply current												
SSI	5.5	I _{CC}	-	-	2.0	-	20.0	-	40.0	µA	V _{CC} or GND	I _O = 0
flip-flops	5.5	I _{CC}	-	-	4.0	-	40.0	-	80.0	µA	GND	I _O = 0
MSI	5.5	I _{CC}	-	-	8.0	-	80.0	-	160.0	µA	GND	I _O = 0
A.Q.S.C. (see note)	4.5 - 5.5	I _{CC}	-	100	360	-	450	-	490	µA	V _{CC} or GND	other inputs at -2.1 V

Note: Additional quiescent supply current (A.Q.S.C.) per input pin for unit load coefficient is 1.*
 *The additional quiescent supply current per input is determined by the ΔI_{CC} unit load, which has to be multiplied by the unit load coefficient as given in the individual data sheets. For dual supply systems the theoretical worst-case (V_I = 2.4; V_{CC} = 5.5V) specification is: ΔI_{CC} = 0.65 mA (typical) and 1.8 mA (maximum) across temperature.

Continued

logic: HCMOS PC74 (cont.)

book 4 part 5

A.C. family characteristics

GND = 0V; $C_L = 50 \text{ pF}$; $t_r = t_f = 6 \text{ ns}$

PC74HC

parameter	V_{CC} (V)	symbol	T_{amb} (°C)						unit	
			+25			-40 to +85		-40 to +125		
			min.	typ.	max.	min.	max.	min.		max.
Output transition time standard outputs	2.0	$t_{THL}/$ t_{TLH}	-	-	75	-	95	-	110	ns
	4.5	t_{TLH}	-	-	15	-	19	-	22	ns
	6.0		-	-	13	-	16	-	19	ns
Output transition time bus driver outputs	2.0	t_{THL}	-	-	60	-	75	-	90	ns
	4.5	t_{TLH}	-	-	12	-	15	-	18	ns
	6.0		-	-	10	-	13	-	15	ns

PC74HCU

parameter	V_{CC} (V)	symbol	T_{amb} (°C)						unit	
			+25			-40 to +85		-40 to +125		
			min.	typ.	max.	min.	max.	min.		max.
Output transition time	2.0	t_{THL}	-	-	75	-	95	-	110	ns
	4.5	t_{TLH}	-	-	15	-	19	-	22	ns
	6.0		-	-	13	-	16	-	19	ns

PC74HCT

parameter	V_{CC} (V)	symbol	T_{amb} (°C)						unit	
			+25			-40 to +85		-40 to +125		
			min.	typ.	max.	min.	max.	min.		max.
Output transition time standard outputs	4.5	$t_{THL}/$ t_{TLH}	-	-	15	-	19	-	22	ns
Output transition time bus driver outputs	4.5	$t_{THL}/$ t_{TLH}	-	-	12	-	15	-	18	ns

HCMOS PC74 FAMILY SURVEY

Type numbers have a suffix which signifies the type of package:

P = plastic DIL; T = plastic SO mini-pack

NAND/NOR gates

- 74HC/HCT00 quad 2-input NAND gate
- 74HC/HCT02 quad 2-input NOR gate
- 74HC/HCT03 quad 2-input NAND gate; open drain
- 74HC/HCT10 triple 3-input NAND gate
- 74HC/HCT20 dual 4-input NAND gate
- 74HC/HCT27 triple 3-input NOR gate
- 74HC/HCT30 8-input NAND gate
- 74HC7266 quad 2-input EXCLUSIVE-NOR gate
- 74HC/HCT4002 dual 4-input NOR gate

AND/OR/EXCLUSIVE-OR gates

- 74HC/HCT08 quad 2-input AND gate
- 74HC/HCT11 triple 3-input AND gate
- 74HC/HCT21 dual 4-input AND gate
- 74HC/HCT32 quad 2-input OR gate
- 74HC58 dual AND-OR gate
- 74HC/HCT86 quad 2-input EXCLUSIVE-OR gate
- 74HC/HCT4075 triple 3-input OR gate

Inverters/buffers/line drivers/level shifters

- 74HC/HCT04 hex inverter
- 74HCU04 hex inverter (unbuffered)
- 74HC/HCT125* quad buffer/line driver; 3-state
- 74HC/HCT126* quad buffer/line driver; 3-state
- 74HC/HCT240* octal buffer/line driver; 3-state; inverting
- 74HC/HCT241* octal buffer/line driver; 3-state
- 74HC/HCT244* octal buffer/line driver; 3-state
- 74HC/HCT365* hex buffer/line driver with common enable; 3-state
- 74HC/HCT366* hex buffer/line driver with common enable; 3-state; inverting
- 74HC/HCT367* hex buffer/line driver; 3-state
- 74HC/HCT368* hex buffer/line driver; 3-state; inverting
- 74HC/HCT540* octal buffer/line driver; 3-state; inverting
- 74HC/HCT541* octal buffer/line driver; 3-state
- 74HC4049 hex inverting HIGH-to-LOW level shifter
- 74HC4050 hex HIGH-to-LOW level shifter

* Types with a bus driver output stage.

Continued

logic: HCMOS PC74 (cont.)

book 4 part 5

Flip-flops/latches/registers

■ 74HC/HCT73	dual JK flip-flop with reset; negative-edge trigger
■ 74HC/HCT74	dual D-type flip-flop with set and reset; positive edge-trigger
■ 74HC/HCT75	quad bistable transparent latch
■ 74HC/HCT107	dual JK flip-flop with reset; negative-edge trigger
■ 74HC/HCT109	dual JK flip-flop with set and reset; positive edge-trigger
■ 74HC/HCT112	dual JK flip-flop with set and reset; negative edge-trigger
■ 74HC/HCT173*	quad D-type flip-flop; positive-edge trigger; 3-state
■ 74HC/HCT174	hex D-type flip-flop with reset; positive-edge trigger
■ 74HC/HCT175	quad D-type flip-flop with reset; positive edge-trigger
■ 74HC/HCT259	8-bit addressable latch
■ 74HC/HCT273	octal D-type flip-flop with reset; positive edge-trigger
■ 74HC/HCT373*	octal D-type transparent latch; 3-state
■ 74HC/HCT374*	octal D-type flip-flop; positive-edge trigger; 3-state
■ 74HC/HCT377	octal D-type flip-flop with data enable; positive-edge trigger
■ 74HC/HCT533*	octal D-type transparent latch; 3-state; inverting
■ 74HC/HCT534*	octal D-type flip-flop; positive-edge trigger; 3-state; inverting
■ 74HC/HCT563*	octal D-type transparent latch; 3-state; inverting
■ 74HC/HCT564*	octal D-type flip-flop; positive-edge trigger; 3-state; inverting
■ 74HC/HCT573*	octal D-type transparent latch; 3-state
■ 74HC/HCT574*	octal D-type flip-flop; positive-edge trigger; 3-state

Shift registers

■ 74HC/HCT164	8-bit serial-in/parallel-out shift register
■ 74HC/HCT165	8-bit parallel-in/serial-out shift register
■ 74HC/HCT166	8-bit parallel-in/serial-out shift register
■ 74HC/HCT194	4-bit bidirectional universal shift register
■ 74HC/HCT195	4-bit parallel access shift register
■ 74HC/HCT299*	8-bit universal shift register; 3-state
■ 74HC/HCT597	8-bit shift register with input latches
■ 74HC/HCT7597	8-bit shift register with input latches
■ 74HC/HCT670*	4 × 4 register file; 3-state
■ 74HC/HCT4015	dual 4-bit serial-in/parallel-out shift register
■ 74HC/HCT4094	8-stage shift-and-store bus register
■ 74HC/HCT7030	9-bit × 64 word FIFO register; 3-state
■ 74HC/HCT40104*	4-bit bidirectional universal shift register; 3-state
■ 74HC/HCT40105	4-bit × 16 word FIFO register

* Types with a bus driver output stage.

Continued

Arithmetic circuits

- 74HC/HCT85 4-bit magnitude comparator
- 74HC/HCT181 4-bit arithmetic logic unit
- 74HC/HCT182 look-ahead carry generator
- 74HC/HCT280 9-bit odd/even parity generator/checker
- 74HC/HCT283 4-bit full adder with fast carry
- 74HC/HCT583 4-bit full adder with fast carry
- 74HC/HCT688 8-bit magnitude comparator

Counters

- 74HC/HCT93 4-bit binary ripple counter
- 74HC/HCT160 presettable synchronous BCD decade counter; asynchronous reset
- 74HC/HCT161 presettable synchronous 4-bit binary counter; asynchronous reset
- 74HC/HCT162 presettable synchronous BCD decade counter; synchronous reset
- 74HC/HCT163 presettable synchronous 4-bit binary counter; synchronous reset
- 74HC/HCT190 presettable synchronous BCD decade up/down counter
- 74HC/HCT191 presettable synchronous 4-bit binary up/down counter
- 74HC/HCT192 presettable synchronous BCD decade up/down counter
- 74HC/HCT193 presettable synchronous 4-bit binary up/down counter
- 74HC/HCT390 dual decade ripple counter
- 74HC/HCT393 dual 4-bit binary ripple counter
- 74HC/HCT4017 Johnson decade counter with 10 decoded outputs
- 74HC/HCT4020 14-stage binary ripple counter
- 74HC/HCT4024 7-stage binary ripple counter
- 74HC/HCT4040 12-stage binary ripple counter
- 74HC/HCT4059 programmable divide-by-n-counter
- 74HC/HCT4060 14-stage binary ripple counter with oscillator
- 74HC/HCT4510 BCD up/down counter
- 74HC/HCT4516 binary up/down counter
- 74HC/HCT4518 dual synchronous BCD counter
- 74HC/HCT4520 dual synchronous 4-bit binary counter
- 74HC/HCT40102 8-stage synchronous BCD down counter
- 74HC/HCT40103 8-bit synchronous binary down counter

Multiplexers

- 74HC/HCT151 8-input multiplexer
- 74HC/HCT153 dual 4-input multiplexer
- 74HC/HCT157 quad 2-input multiplexer
- 74HC/HCT158 quad 2-input multiplexer; inverting
- 74HC/HCT251 8-input multiplexer; 3-state
- 74HC/HCT253* dual 4-input multiplexer; 3-state
- 74HC/HCT257* quad 2-input multiplexer; 3-state
- 74HC/HCT258 quad 2-input multiplexer; 3-state
- 74HC/HCT354* 8-input multiplexer/register with transparent data latch; 3-state
- 74HC/HCT356* 8-input multiplexer/register; 3-state

* Types with a bus driver output stage.

Continued

logic: HCMOS PC74 (cont.)

book 4 part 5

Decoders/demultiplexers

- 74HC/HCT42 BCD to decimal decoder (1-of-10)
- 74HC/HCT137 3-to-8 line decoder/demultiplexer with address latches
- 74HC/HCT138 3-to-8 line decoder/demultiplexer; inverting
- 74HC/HCT139 dual 2-to-4 line decoder/demultiplexer
- 74HC/HCT147 10-to-4 line priority encoder
- 74HC/HCT154 4-to-16 line decoder/demultiplexer
- 74HC/HCT237 3-to-8 line decoder/demultiplexer with address latches
- 74HC/HCT238 3-to-8 line decoder/demultiplexer
- 74HC/HCT4511 BCD to 7-segment latch/decoder/driver
- 74HC/HCT4514 4-to-16 line decoder/demultiplexer with input latches
- 74HC/HCT4515 4-to-16 line decoder/demultiplexer with input latches
- 74HC/HCT4543 BCD-to-7 segment latch/decoder/driver for LCDs

Switches/multiplexers/demultiplexers

- 74HC/HCT4016 quad bilateral switches
- 74HC/HCT4051 8-channel analog multiplexer/demultiplexer
- 74HC/HCT4052 dual 4-channel analog multiplexer/demultiplexer
- 74HC/HCT4053 triple 2-channel analog multiplexer/demultiplexer
- 74HC/HCT4066 quad bilateral switches
- 74HC/HCT4067 16-channel analog multiplexer/demultiplexer
- 74HC/HCT4316 quad bilateral switches
- 74HC/HCT4351 8-channel analog multiplexer/demultiplexer with latch
- 74HC/HCT4352 dual 4-channel analog multiplexer/demultiplexer with latch
- 74HC/HCT4353 triple 2-channel analog multiplexer/demultiplexer with latch

Bus transceivers

- 74HC/HCT242* quad bus transceiver; 3-state; inverting
- 74HC/HCT243* quad bus transceiver; 3-state
- 74HC/HCT245* octal bus transceiver; 3-state
- 74HC/HCT640* octal bus transceiver; 3-state; inverting
- 74HC/HCT643* octal bus transceiver; 3-state; true/inverting
- 74HC/HCT646* octal bus transceiver/register; 3-state
- 74HC/HCT648* octal bus transceiver/register; 3-state; inverting

Schmitt triggers

- 74HC/HCT14 hex inverting Schmitt trigger
- 74HC/HCT132 quad 2-input NAND Schmitt trigger

One-shot multivibrators

- 74HC/HCT123 dual retriggerable monostable multivibrator with reset
- 74HC/HCT221 dual non-retriggerable monostable multivibrator with reset
- 74HC/HCT423 dual retriggerable monostable multivibrator with reset
- 74HC/HCT4538 dual retriggerable precision monostable multivibrator

Miscellaneous

- 74HC/HCT297 digital phase-locked-loop filter
- 74HC/HCT4046A phase-locked loop with VCO
- 74HC/HCT7046A PLL with lock detector

* Types with a bus driver output stage.

Standard functions

logic: TTL families

book 4 parts 8 & 8a

TTL FAMILY CHARACTERISTICS COMPARISON

	SSI gates propagation delay	flip-flops toggle rate	MSI ALU 4-bit add time
STANDARD TTL (STD)			
7400 Series SSI and MSI 8200 Series MSI 9300 and 9600 Series MSI Standard "gold doped" TTL is the industry's longest selling digital logic family still in high volume production. New system designs generally favour the Low Power Schottky TTL equivalent functions.	10 ns at 10 mW	25 MHz	27 ns
LOW POWER SCHOTTKY TTL (LS)			
74LS00 Series SSI and MSI Low power Schottky provides the same speed as standard TTL at 1/5 the power. The power savings and LSI potential are encouraging the use of 74LS in most new system designs.	10 ns at 2 mW	30 MHz	21 ns
SCHOTTKY TTL (S)			
74S00 Series SSI, MSI and 82S00 Series MSI Schottky TTL uses a diode clamp design to insure the highest speed possible at TTL logic levels.	3 ns at 30 mW	90 MHz	11 ns
FAST TTL (F)			
74F00 Series SSI and MSI New FAST Series offer higher speed than Schottky TTL.	3 ns at 4 mW	-	-

logic: TTL 74 series

book 4 parts 8 & 8a

TTL 74 SERIES

STD LS S F

Gates

■ 7400	quad 2-input NAND gate	
■ 7401	quad 2-input NAND gate (open collector)	
■ 7402	quad 2-input NOR gate	
■ 7403	quad 2-input NAND gate (open collector)	
■ 7408	quad 2-input AND gate	
■ 7409	quad 2-input AND gate (open collector)	
■ 7410	triple 3-input NAND gate	
■ 7411	triple 3-input AND gate	
■ 7420	dual 4-input NAND gate	
■ 7421	dual 4-input AND gate	
■ 7425	dual 4-input NOR gate with strobe	
■ 7426	quad 2-input NAND gate (open collector)	
■ 7427	triple 3-input NOR gate	
■ 7430	8-input NAND gate	
■ 7432	quad 2-input OR gate	
■ 7450	expandable dual 2-wide 2-input AND-OR-invert gate	
■ 7451	dual 2-wide 2-input AND-OR-invert gate	
■ 7454	4-wide 2 and 3-input AND-OR-invert gate	
■ 7464	4-2-3-2 input AND-OR-invert gate	
■ 7486	quad 2-input EXCLUSIVE-OR gate	
■ 74133	13-input NAND gate	
■ 74134	12-input NAND gate (3-state)	
■ 74135	quad EXCLUSIVE-OR/NOR gate	
■ 74136	quad EXCLUSIVE-OR gate (open collector)	
■ 74260	dual 5-input NOR gate	
■ 74266	quad 2-input EXCLUSIVE-NOR gate (open collector)	

Buffers, inverters

■ 7404	hex inverter	
■ 7405	hex inverter (open collector)	
■ 7406	hex inverter buffer/driver (open collector)	
■ 7407	hex buffer/driver (open collector)	
■ 7416	hex inverter buffer/driver (open collector)	
■ 7417	hex buffer/driver (open collector)	
■ 7428	quad 2-input NOR buffer	
■ 7433	quad 2-input NOR buffer (open collector)	
■ 7437	quad 2-input NAND buffer	
■ 7438	quad 2-input NAND buffer (open collector)	
■ 7439	quad 2-input NAND buffer (open collector)	
■ 7440	dual 4-input NAND buffer	
■ 74827	10-bit buffer, non-inverting	
■ 74828	10-bit buffer, inverting	
■ 741240	octal buffer (3-state); light load	
■ 741241	octal buffer (3-state); light load	
■ 741244	octal buffer (3-state)	
■ 741245	octal bus transceiver (3-state); light load	

Continued

Standard functions

logic: TTL 74 series (cont.)

book 4 parts 8 & 8a

TTL 74 SERIES

STD LS S F

Bus drivers, transceivers

■	74125	quad buffer (3-state)	●		●
■	74125A	quad buffer (3-state)		●	
■	74126	quad buffer (3-state)	●		●
■	74126A	quad buffer (3-state)		●	
	74128	quad 2-input NOR buffer	●		
■	74240	octal inverter buffer (3-state)		●	●
■	74241	octal buffer (3-state)		●	●
■	74242	quad bus inverting transceiver (3-state)		●	●
■	74243	quad transceiver (3-state)		●	●
■	74244	octal buffer (3-state)		●	●
■	74245	octal bus transceiver (3-state)		●	●
	74365	hex buffer/driver (3-state)			●
■	74365A	hex buffer/driver (3-state)	●	●	
	74366	hex inverter buffer (3-state)			●
	74366A	hex inverter buffer (3-state)	●	●	
	74367	hex buffer/driver (3-state)			●
■	74367A	hex buffer/driver (3-state)	●	●	
	74368	hex inverter buffer (3-state)			●
■	74368A	hex inverter buffer (3-state)	●	●	
	74540	octal buffer/line driver (3-state)		●	●
■	74541	octal non-inverting buffer/line driver (3-state)	●	●	●
■	74545	octal bus transceiver (3-state)		●	●
	74588	GPIO compatible octal transceiver			●
■	74620	octal bus transceiver (3-state)		●	●
■	74621	octal bus transceiver (O.C.)		●	●
■	74622	octal bus transceiver (O.C.)		●	●
	74623	octal bus transceiver (3-state)		●	●
■	74640	inverting octal bus transceiver (3-state)		●	●
■	74640-1	inverting octal bus transceiver (3-state)		●	●
■	74641	octal bus transceiver (open collector)			●
■	74641-1	octal bus transceiver (open collector)		●	
■	74642	inverting octal bus transceiver (open collector)		●	●
	74642-1	inverting octal bus transceiver (open collector)		●	●
■	74645	octal bus transceiver (3-state)		●	
■	74645-1	octal bus transceiver (3-state)		●	
	74646	octal bus transceiver and register (3-state)			●
	74647	octal bus transceiver and register (O.C.)			●
	74648	octal bus transceiver and register (3-state)			●
	74649	octal bus transceiver and register (O.C.)			●
●	74804	hex 2-input NAND driver			○
●	74805	hex 2-input NOR driver			○
●	74808	hex 2-input AND driver			○
	74861	10-bit transceiver, non-inverting			○
	74862	10-bit transceiver, inverting			○
	74863	9-bit transceiver, non-inverting (3-state)			○
	74864	9-bit transceiver, inverting (3-state)			○
■	741242	quad transceiver; inverting (3-state) light load			●
■	741243	quad transceiver (3-state); light load			●
	743037	quad 2-input NAND, 30 Ohm transmission line driver			●
	743038	quad 2-input NAND, 30 Ohm transmission line driver, (O.C.)			●

○ = planned.
Continued

logic: TTL 74 series (cont.) book 4 parts 8 & 8a

TTL 74 SERIES STD LS S F

Bus drivers, transceivers (cont.)

743040	dual 4-input NAND, 30 Ohm transmission line driver	
7430240	octal inverting 30 Ohm transmission line driver	
7430244	octal 30 Ohm transmission line driver	
7430245	octal transceiver, 30 Ohm transmission line driver, non inverting (O.C.)	
7430640	octal transceiver, 30 Ohm transmission line driver, inverting (O.C.)	

Flip-flops

■ 7413	dual 4-input NAND Schmitt trigger	
■ 7414	hex inverter Schmitt trigger	
■ 7473	dual JK master-slave flip-flop	
■ 7474	dual D-type edge-triggered flip-flop	
■ 7474A	dual D-type edge-triggered flip-flop	
■ 7476	dual JK master-slave flip-flop	
■ 74107	dual JK master-slave flip-flop	
■ 74109	dual JK positive-edge triggered flip-flop	
■ 74109A	dual JK positive-edge triggered flip-flop	
■ 74112	dual JK negative-edge triggered flip-flop	
■ 74113	dual JK positive-edge triggered flip-flop	
■ 74114	dual JK negative-edge triggered flip-flop	
■ 74121	monostable multivibrator	
■ 74123	dual retriggerable monostable multivibrator	
■ 74132	quad 2-input NAND Schmitt trigger	
■ 74173	quad D-type flip-flop (3-state)	
■ 74174	hex D-type flip-flop with reset	
■ 74175	quad D-type edge-triggered flip-flop with reset	
■ 74221	dual monostable multivibrator	
■ 74273	octal D-type flip-flop with reset	
■ 74364	octal D-type flip-flop (3-state)	
■ 74374	octal D-type flip-flop (3-state)	
■ 74377	octal D-type flip-flop with clock enable	
■ 74378	hex D-type flip-flop with clock enable	
■ 74379	quad D flip-flop with enable	
■ 74564	octal D flip-flop (3-state) broadside pinout	
■ 74574	octal D flip-flop (3-state) broadside pinout	

Shift registers

■ 7494	4-bit shift register	
■ 7495	4-bit shift register	
■ 7495B	4-bit left-right shift register	
■ 7496	5-bit shift register	
■ 74164	8-bit serial-in/parallel-out shift register	
■ 74165	8-bit parallel-in/serial-out shift register	
■ 74166	8-bit parallel-in/serial-out shift register	
■ 74170	4 x 4 register file (open collector)	
■ 74172	16-bit multiple port register file (3-state)	
■ 74194	4-bit bidirectional universal shift register	
■ 74194A	4-bit bidirectional universal shift register	

= planned.

Continued

Standard functions

logic: TTL 74 series (cont.)

book 4 parts 8 & 8a

TTL 74 SERIES

STD LS S F

Shift registers (cont.)

■ 74195	4-bit parallel access shift register	●		●	●
■ 74195A	4-bit parallel access shift register		●		
■ 74198	8-bit bidirectional universal shift register				○
■ 74199	8-bit parallel-access shift register	●			○
■ 74225	FIFO			●	
■ 74295B	4-bit shift register (3-state)		●		
■ 74299	octal shift/storage register (3-state)				●
■ 74322	octal shift/storage register (3-state)				○
■ 74323	octal shift/storage register (3-state)				○
■ 74395	4-bit cascadable shift register (3-state)				●
■ 74395A	4-bit cascadable shift register (3-state)		●		
■ 74398	quad 2-port register true				●
■ 74399	quad 2-port register true				●
■ 74595	8-bit shift register with output latch				○
■ 74597	8-bit shift register with input latch				○
■ 74598	8-bit shift register with input latch				○
■ 74670	4 × 4 register file (3-state)		●		
■ 74673A	16-bit serial-in, serial/parallel-out shift register (3-state)				○
■ 74674	16-bit serial/parallel-in, serial out shift register (3-state)				○
■ 74675A	16-bit serial-in, serial/parallel-out shift register (3-state)				○
■ 74676	16-bit serial/parallel-in, serial out shift register (3-state)				○

Other registers

■ 74821	10-bit register, non-inverting				●
■ 74822	10-bit register, inverting				●
■ 74823	9-bit register, non-inverting				●
■ 74824	9-bit register, inverting				●
■ 74825	9-bit register, non-inverting				●
■ 74826	9-bit register, inverting				●

Counters

■ 7490	4-bit decade ripple counter	●	●		
■ 7492	divide-by-twelve counter	●	●		
■ 7493	4-bit binary ripple counter	●	●		
■ 74160	synchronous BCD decade counter	●			
■ 74160A	synchronous BCD decade counter		●		●
■ 74161	synchronous 4-bit binary counter	●			
■ 74161A	synchronous 4-bit binary counter		●		●
■ 74162A	synchronous BCD decade counter		●	●	●
■ 74163	synchronous 4-bit binary counter	●			
■ 74163A	synchronous 4-bit binary counter		●		●
■ 74168	synchronous BCD decade up/down counter				○
■ 74168A	synchronous BCD decade up/down counter		●	●	
■ 74169	synchronous 4-bit binary up/down counter				○
■ 74169A	synchronous 4-bit binary up/down counter		●	●	
■ 74190	presettable BCD/decade up/down counter	●	●		○
■ 74191	presettable 4-bit binary up/down counter	●	●		○

○ = planned.

Continued

logic: TTL 74 series (cont.) book 4 parts 8 & 8a

TTL 74 SERIES

STD LS S F

Counters (cont.)

■ 74192	presetable BCD/decade up/down counter	●	●	○
■ 74193	presetable 4-bit binary up/down counter	●	●	○
■ 74197	presetable 4-bit binary ripple counter		●	
■ 74269	8-bit binary counter			●
■ 74290	4-bit decade ripple counter		●	
■ 74293	4-bit binary ripple counter		●	
■ 74390	dual decade ripple counter		●	
■ 74393	dual 4-bit binary ripple counter		●	
■ 74490	dual BCD decade ripple counter		●	
74568	BCD decade up/down synchronous counter (3-state)			○
74568A	BCD decade up/down synchronous counter (3-state)		●	
74569	4-bit binary up/down synchronous counter (3-state)			○
74569A	4-bit binary up/down synchronous counter (3-state)		●	
■ 74579	8-bit up/down counter, common I/O (3-state)			●
■ 74779	8-bit up/down counter, common I/O (3-state)			●

Latches

7475	quad bistable latch	●	●	
74116	dual 4-bit transparent latch with reset	●		
■ 74256	dual 4-bit addressable latch		●	●
■ 74259	8-bit addressable latch		●	●
■ 74279	quadruple S-R latch	●		
■ 74363	octal transparent latch (3-state)		●	
■ 74373	octal transparent latch (3-state)		●	●
■ 74375	quad transparent bistable latch		●	
74412	octal multimode buffered latch			●
74432	octal multimode buffered latch			●
■ 74533	inverting octal D-type latch (3-state)			●
■ 74534	octal D-type flip-flop (3-state)		●	
74543	octal transparent bidirectional latch			●
74544	octal transparent bidirectional latch			●
74563	octal D latch (3-state) broadside pinout			●
74573	octal D latch (3-state) broadside pinout			○
■ 74604	dual 8-bit latch (3-state)			●
■ 74605	dual 8-bit latch (O.C.)			●
74841	10-bit latch, non-inverting			○
74842	10-bit latch, inverting			○
74843	9-bit latch, non-inverting			○
74844	9-bit latch, inverting			○
74845	8-bit latch, non-inverting			○
74846	8-bit latch, inverting			○

Decoders/drivers

■ 7445	BCD-to-decimal decoder/driver (open collector)	●		
■ 74140	dual 4-input NAND line driver (50 Ohm)			●
■ 74145	BCD-to-decimal decoder/driver (open collector)	●		
74445	BCD-to-decimal decoder/driver (open collector)		●	

○ = planned.

Continued

Standard functions

logic: TTL 74 series (cont.)

book 4 parts 8 & 8a

TTL 74 SERIES		STD	LS	S	F
Decoders/(de)multiplexers					
■	7442		●		
■	74138		●		
■	74139		●	●	●
■	74147		●	●	●
■	74148		●		●
■	74150		●		
■	74151		●	●	●
■	74153		●	●	●
■	74154		●	●	
■	74155		●		
■	74156		●		
■	74157		●		
■	74157A		●	●	
■	74158				●
■	74158A		●	●	
■	74251				●
■	74253		●	●	●
■	74257			●	
■	74257A				●
	74258		●		●
■	74258A			●	
■	74298		●		●
■	74352		●		●
■	74353		●		●
	74384				○
	74537				●
	74538				○
	74539				○
	74547				○
	74548				○
●	74711				○
●	74712				○
●	74723				○
●	74725				○
●	74732				○
●	74733				○

○ = planned.

Continued

logic: TTL 74 series (cont.)

book 4 part 8 & 8a

TTL 74 SERIES

STD LS S F

Arithmetic circuits

■ 7483	4-bit binary full adder (ripple carry)	●			●
■ 7483A	4-bit binary full adder (fast carry)		●		
■ 7485	4-bit magnitude comparator	●	●	●	●
■ 74180	8-bit odd/even parity generator/checker	●			
■ 74181	4-bit arithmetic logic unit	●	●		●
■ 74182	look-ahead carry generator			●	●
■ 74280	9-bit odd/even parity generator/checker			●	
■ 74280A	9-bit odd/even parity generator/checker				●
■ 74280B	9-bit odd/even parity generator/checker				●
■ 74283	4-bit full adder with fast carry		●		●
■ 74350	4-bit shifter (3-state)			●	●
■ 74381	4-bit arithmetic logic unit				●
■ 74382	4-bit arithmetic logic unit				●
■ 74385	quad serial adder/subtractor				○
■ 74455	octal buffer with parity generator checker				●
■ 74456	octal buffer with parity generator checker				●
■ 74521	8-bit identify comparator				●
● 74524	8-bit register comparator (O.C.)				○
● 74582	4-bit BCD ALU				○
● 74583	4-bit DCD adder				○
■ 74655A	octal inverting buffer with parity generator checker				●
■ 74656A	octal buffer with parity generator checker (3-state)				●
■ 74657	octal bus transceiver with parity generator checker				●
74881	arithmetic logic unit/function generator				●
74882	32-bit look-ahead carry generator				●

Memories

74189	64-bit bipolar scratchpad memory (16 × 4)				○
74301	256-bit TTL RAM (256 × 1)		●	●	

Special functions

74630	memory error detector/corrector (3-state)				○
74631	memory error detector/corrector (O.C.)				○
■ 74764	dual port RAM controller		●		●
■ 74765	dual port RAM controller without latch		●		●
74784	8-bit serial multiplier and adder subtractor				○
741801	bit stream manager EN/DEC		●		
741802	bit stream manager SER/DES		●		

○ = planned.

Standard functions

logic: TTL 8200, 9300 & 9600 series

TTL 8200, 9300 AND 9600 SERIES

Arithmetic circuits

82S82	4-bit arithmetic unit
82S83	4-bit BCD adder

Counters

9310	4-bit decade counter
9316	4-bit binary counter

Decoders/display drivers

82S50	binary-to-octal decoder
82S52	BCD-to-decimal decoder

Flip-flops

9602	dual monostable multivibrator
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Multiplexers

8234	2-input, 4-bit digital multiplexer
8266	2-input, 4-bit digital multiplexer
9309	dual 4-input multiplexer
9322	data selector/multiplexer

Parity functions

82S41	quad EXCLUSIVE-OR gate
8242	quad EXCLUSIVE-NOR gate
8262	8-bit parity generator and checker
82S62	8-bit parity generator and checker
9324	5-bit comparator

Registers/latches

8271	4-bit shift register
8273	10-bit serial-in/parallel-out shift register
8274	10-bit parallel-in/serial-out shift register
8881	quad 2-input NAND O/C
8890	HEX invertor
8891	HEX invertor
9334	8-bit addressable latch
9386	quad exclusive - NOR

logic: TTL 8T00 series

book 4 part 8

TTL 8T00 SERIES

Timing circuits

- **8T20** bidirectional one shot

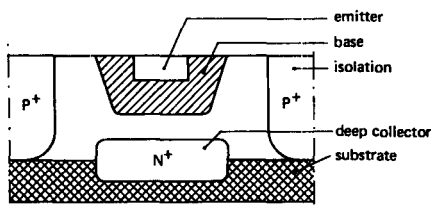
Line drivers/receivers/transceivers

- 8T09** quad 3-state bus driver
- 8T10** quad 3-state D-type bus latch
- **8T13** dual low impedance line driver
- 8T15** dual communications line driver
- 8T16** dual communications line receiver
- 8T23** dual IBM 360/370 line driver
- **8T24** triple IBM 360/370 line receiver
- **8T26A** quad inverting bus transceiver (3-state)
- 8T28** quad non-inverting bus transceiver (3-state)
- 8T34** quad bus transceiver (3-state)
- 8T37** hex bus receiver/Schmitt trigger
- 8T38** quad bus transceiver (open collector)
- **8T95/97** high-speed hex buffer (3-state)
- **8T96/98** high-speed hex inverter (3-state)
- 8T125** octal transceiver (inverting)
- 8T126** quad bus driver/receiver (inverting)
- 8T127** quad bus driver/receiver (inverting)
- 8T128** quad bus driver/receiver (non-inverting)
- 8T129** quad bus driver/receiver (non-inverting)
- 8T245** octal transceiver
- **8T380** quad bus receiver with hysteresis/Schmitt trigger

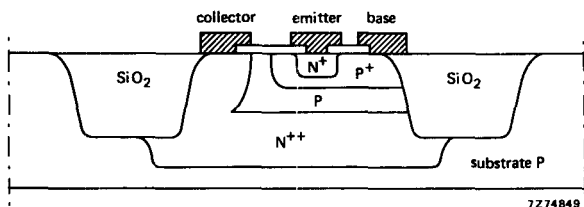
ECL 100 000 FAMILY SPECIFICATIONS

To satisfy the needs of new generations of computer and telecommunication systems in standard and LSI circuit design, a new technological process has been developed using oxide lateral isolation. The process is called SUBILO and permits the manufacture of integrated circuits with ultra-high speeds and high integration density.

Instead of conventional planar junction isolation technology, SUBILO uses a process that results in a considerable reduction in transistor area and an increase integration density. By using an increase in silicon oxide instead of isolation diffusion 'p', and removing the part between the emitter and isolation oxide, SUBILO technology results in a further reduction of transistor area. At the same time, the collector-base capacitance decreases, which is an important improvement in the dynamic performance of the transistor.



Junction-isolated PLANAR technique used for ECL 10 000.



The SUBILO process uses silicon oxide between devices instead of the p⁺ regions used in the planar process.

Planar process in comparison with SUBILO technology

	Planar	SUBILO	Unit
Transistor area	3000	500	μm ²
Transition frequency	1,5	4,5	GHz
Application	ECL 10 000	ECL 100 000	

Family ratings

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Supply voltage (d.c.):	V_{EE} max. - 7 V
Input voltage range:	$V_I = 0$ to V_{EE} if $V_{EE} > -6$ V; 0 to -6 V > $V_{EE} > -7$ V
Output current:	I_O max. 55 mA
Storage temperature range:	T_{stg} - 55 to + 150 °C

Continued

logic: ECL 100 000 family (cont.) book 4 part 10

D.C. family characteristics

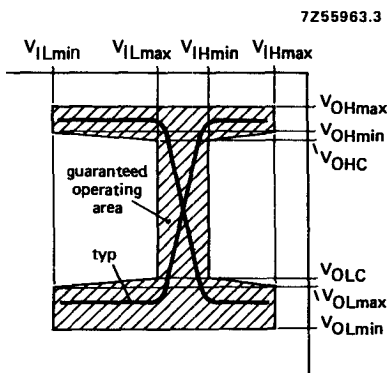
V_{CC} ground; $V_{EE} = -4,5 \text{ V}$; $T_{amb} = 0 \text{ to } +85 \text{ }^\circ\text{C}$; $R_L = 50 \text{ Ohm to } -2 \text{ V}$.

Each 100K circuit has been designed to meet the d.c. specifications shown in the test table, after thermal equilibrium has been established. The circuit is in a test socket or mounted on a printed-circuit and transverse air flow $> 2,5 \text{ m/s}$ is maintained.

Test values are given in the table and defined in the figure.

Test table

Parameter	Symbol	Value	Unit
Input voltage HIGH	V_{IHA}	-880	mV
	V_{IHB}	-1165	mV
Input voltage LOW	V_{ILA}	-1475	mV
	V_{ILB}	-1810	mV
Output voltage HIGH	V_{OHA}	-880	mV
	V_{OHB}	-1025	mV
Output voltage LOW	V_{OLA}	-1620	mV
	V_{OLB}	-1810	mV
Output threshold voltage HIGH	V_{OHC}	-1035	mV
	V_{OLC}	-1610	mV



Standard functions

logic: ECL 100 000 family (cont.) book 4 part 10

ECL 100 000 FAMILY SURVEY

Gates

100101	triple 5-input OR/NOR gate
100102	quintuple 2-input OR/NOR gate with common enable
100107	quintuple EXCLUSIVE OR/NOR gate with compare
100112	quadruple double fan-out OR/NOR gate
100113	quadruple fan-out OR/NOR gate
100117	triple 1-2-2 input OR/AND-OR/NAND gate
100118	2-4-4-4-5 input OR/AND-OR/NAND gate

Drivers

100123	hex bus driver
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Interfaces

100114	quintuple differential line receiver
100122	9-bit buffer gate
100126	9-bit buffer gate
100175	5-bit 100K to 10K interface with latch
100255	5-bit ECL/TTL interface

Flip-flops

100131	triple D master-slave flip-flop
100131A	high-speed triple D master-slave flip-flop
100150	hex D latch flip-flop
100151	hex D master-slave flip-flop

Matrix

100158	8-bit shift matrix
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Multiplexers

100155	quadruple 2-way multiplexer latch
100163	dual 8-bit multiplexer
100164	16-input multiplexer
100171	triple bit 4-way multiplexer

Counters and registers

100136	multipurpose counting register
100141	8-bit universal shift register

Complex functions

100160	dual 9-bit parity generator/8-bit comparator
100165	universal priority encoder
100166	9-bit comparator
100170	universal demultiplexer/decoder
100179	high speed carry look ahead generator
100180	fast 6-bit adder
100181	4-bit ALU binary/decimal

memories

book 4 part 7

BIPOLAR TTL RAM

Device	Organization	Output circuit ¹⁾	Output logic ²⁾	Access time (ns)	Temperature range ³⁾	Package	No. of pins	I _{CCmax} (mA)
3101A	16 × 4	OC	B	35	C	F,N	16	105
74S189	16 × 4	TS	B	35	C	F,N	16	110
82S16	256 × 1	TS	T	50	C	F,N	16	115
82S16				70	M	F		120
74S301	256 × 1	OC	B	50	C	F,N	16	115
82LS16	256 × 1	TS	T	40	C	F,N	16	70
74LS301	256 × 1	OC	B	40	C	F,N	16	70
82S09	64 × 9	OC	T	45	C	F,N	28	190
82S09A				35	C	F,N	28	190
82S19				35	C	F,N	28	190
82S212	256 × 9	TS	B	45	C	F,N	24	185
82S212				70	M	F		200
82S212A				35	C	F,N		185
8X350	256 × 8	TS	B	N/A	C	F,N	22	185
8X350				N/A	M	F		200

Notes

- 1) Output circuit : OC = Open collector
TS = 3-state
- 2) Output logic : T = Transparent - input data appears on output during Write
B = Blanked - output is blanked during Write
- 3) Temperature range : C = Commercial (0 °C to +75 °C)
M = Military (-55 °C to +125 °C)

memories (cont.)

book 4 part 7

BIPOLAR TTL PROM

Device	Organization	Output circuit ¹⁾	Access time (ns)	Temperature range ²⁾	Package	No. of pins	I _{CCmax} (mA)
82S23	32 × 8	OC	50	C	F,N	16	77
82S23A			25	C	F,N		100
			65	M	F		85
82S123	32 × 8	TS	50	C	F,N	16	77
82S123A			25	C	F,N		85
			65	M	F		77
82S126	256 × 4	OC	50	C	F,N	16	120
82S126A			30	C	F,N		120
			70	M	F		125
82S129	256 × 4	TS	50	C	F,N	16	120
82S129A			27	C	F,N		120
			70	M	F		125
82S130	512 × 4	OC	50	C	F,N	16	140
82S130A	512 × 4	OC	33	C	F,N		140
			70	M	F		140
82S131	512 × 4	TS	50	C	F,N	16	140
82S131A	512 × 4	TS	30	C	F,N		140
			70	M	F		140
82LS135	256 × 8	TS	100	C	F,N	20	100
82S135	256 × 8	TS	45	C	F,N	20	155
82S115	512 × 8	TS	60	C	F,N	24	175
			90	M	F		185
82S137	1024 × 4	TS	60	C	F,N	18	140
			70	M	F		150
82S137A	1024 × 4	TS	45	C	F,N	18	140
82S137B	1024 × 4	TS	35	C	F,N	18	140
82S147	512 × 8	TS	60	C	F,N	20	155
82S147A	512 × 8	TS	45	C	F,N	20	155
82LS181	1024 × 8	TS	150	C	F,N	24	80
82S181	1024 × 8	TS	70	C	F,N	24	175
			90	M	F,G		185
82S181A			50	C	F,N		24
			80	M	F,G		185
82S181C	1024 × 8	TS	30	C	F,N	24	175
82S183	1024 × 8	TS	60	C	F,N	24	175
82S185	2048 × 4	TS	100	C	I,N	18	120
			115	M	I		130
82S185A	2048 × 4	TS	50	C	F,N	18	155
			80	M	F,G		160
82S185C	2048 × 4	TS	30	C	F,N	18	155
82HS187	1024 × 8	TS	45	-	N	24	185
82HS189	1024 × 8	TS	45	-	N	24	185
82S191	2048 × 8	TS	80	C	F,N	24	175
			100	M	F,G		185
82S191A			55	C	F,N		24
			80		F,G		185

- 1) Output circuit : OC = Open collector; TS = 3-state
 2) Temperature range : C = Commercial (0 °C to +75 °C)
 M = Military (-55 °C to +125 °C)

Continued

memories (cont.)

book 4 part 7

BIPOLAR TTL PROM (cont.)

Device	Organization	Output circuit ¹⁾	Access time (ns)	Temperature range ²⁾	Package	No. of pins	I _{CCmax} (mA)
82S191C			35	C	F,N		175
82HS195	4096 × 4	TS	30	C	F,N		155
82HS195A	4096 × 4	TS	35	—	N	20	145
82HS195B	4096 × 4	TS	25	—	N	20	145
82HS321	4096 × 8	TS	35	C	F,N	24	175
82HS321A	4096 × 8	TS	35	—	N	24	175
82HS321B	4096 × 8	TS	30	—	N	24	175
82HS641	8192 × 8	TS	45	C	F,N	24	175
82HS641A	8192 × 8	TS	45	—	N	24	175
82HS641B	8192 × 8	TS	35	—	N	24	175

- 1) Output circuit : OC = Open collector; TS = 3-state
 2) Temperature range : C = Commercial (0 °C to +75 °C)
 M = Military (–55 °C to +125 °C)

BIPOLAR ECL RAM

10422B; C	256 × 4-bit RAM
10470; A	4096 × 1-bit RAM
10474A	1024 × 4-bit RAM

100422B; C	256 × 4-bit RAM
100470; A	4096 × 1-bit RAM
100474A	1024 × 4-bit RAM

Access time: A = 15 ns; B = 10 ns; C = 7 ns

BIPOLAR ECL PROM

10149/100149	1024-bit, 4-bits per word PROM
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BIPOLAR ECL CAM

10155	16-bit, 2-bits per word CAM
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CMOS EPROM

27C64	65 536-bit CMOS EPROM (8192 × 8)
27C256	262 144-bit CMOS EPROM (32K × 8)

CMOS EEPROM

PCB8582	256 × 8-bit electrically erasable PROM with I ² C bus interface
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All parts offer 200 ns, 250 ns and 300 ns access time.

CMOS RAM

■ PCF8570	256 × 8-bit static RAM with I ² C bus interface
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SBB6116L-10	2048 × 8-bit static RAM; max. access time 100 ns
SBB6116L-12	2048 × 8-bit static RAM; max. access time 120 ns
SBB6164	8k × 8-bit static RAM; access time 150 ns

PERIPHERAL INTERFACES

■ MC1488	quad line driver
■ MC1489/1489A	quad line receiver
■ NE587	LED decoder driver
■ NE589	LED decoder driver
NE590	addressable peripheral drivers
NE591	addressable peripheral drivers
NE/SA594	vacuum fluorescent display driver
NE5080	FSK modem transmitter
NE5081	FSK modem receiver
NE5090	addressable relay driver
● ● NE5170	octal line driver
● ● NE5180	octal line receiver with filter
● ● NE5181	octal line receiver without filter
■ NE5520	LVDT signal conditioner
■ SE/NE5521	LVDT signal conditioner

COMPARATORS

■ LM111/211/311 *	voltage comparator
■ LM119/219/319 *	dual voltage comparator
■ LM139/239/339 *	quad voltage comparator
■ LM193/293/393	dual voltage comparator
■ LM2901	quad voltage comparator
■ LM2903	low power dual voltage comparator
■ MC3302	quad voltage comparator
■ NE/SE521/522 *	high speed dual differential comparator
■ NE/SE527 *	high speed voltage comparator
■ NE/SE529 *	high speed voltage comparator
● NE5105	high speed precision comparator

D/A AND A/D CONVERTERS

ADC0801/2/3/4/5-1	8-bit CMOS A/D converter
● ADC0820	super fast CMOS A/D converter
AM6012	12-bit high speed multiplying D/A converter
DAC-08 series	8-bit D/A converter
■ MC3410/3510	10-bit high speed multiplying D/A converter
NE/SE5410	10-bit high speed multiplying D/A converter
■ MC1408-7	8-bit D/A converter, 1 LSB accuracy
■ MC1408-8	8-bit D/A converter, 1/2 LSB accuracy
■ MC1508-8 *	8-bit D/A converter, 1/2 LSB accuracy
■ NE/SE5018 *	8-bit D/A converter subsystem, 1/2 LSB accuracy, V_{out}
NE/SE5019 *	8-bit D/A converter subsystem, 1/4 LSB accuracy, V_{out}
NE/SE5118	8-bit D/A converter subsystem, 1/2 LSB accuracy, I_{out}
NE/SE5119	8-bit D/A converter subsystem, 1/4 LSB accuracy, I_{out}
NE5020	10-bit D/A converter subsystem, 1 LSB accuracy, I_{out}
● NE5030	10-bit high speed A/D
NE5034	8-bit general purpose A/D converter
■ NE5036	8-bit A/D converter (serial output)
■ NE5037	6-bit A/D converter (parallel outputs)
● NE5150	video DAC with memory
● NE5151	video DAC no memory
● NE5152	video DAC - TTL
PNA7507	7-bit, 20 MHz, $\pm 1/2$ LSB
PNA7509	7-bit, 22 MHz, $\pm 1/2$ LSB 3-state ADC (NMOS)
■ PNA7510	7-bit, 22 MHz, $\pm 1/2$ LSB 3-state + ref. voltage ADC (NMOS)
PNA7518	8-bit, 30 MHz, $\pm 1/2$ LBS D/A converter (NMOS)

D/A AND A/D CONVERTERS (cont.)

■ TDA1432P;T	8-bit D/A converter (CMOS)
TDA1534	monolithic 14-bit A/D converter
TDA1540P	14-bit D/A converter with 85 dB S/N ratio, 1/2 LSB accuracy
TDA1541	dual 16-bit DAC
TDA5702	8-bit D/A converter (bipolar)
TDA5703	8-bit A/D converter (bipolar)
TDB1710	CDAC

OPERATIONAL AMPLIFIERS

■ LM124/224/324*	general purpose single supply quad op amp
■ LM158/258/358*	dual lower power op amp
■ MC1458/1558*	general purpose dual op amp
■ MC3303/3403/3503	quad low power op amp
NE/SE530	high slew rate op amp
NE/SE531	high slew rate op amp
■ NE/SE532*	dual low power op amp
NE/SE538	single high slew rate op amp
■ ● NE1012	low noise op amp with pic-amp-I/P current
■ ● NE1037	low noise precision op amp high speed
■ NE/SE4558	dual general purpose op amp
■ ● NE5212	transimpedance amp
■ NE/SE5512	dual high performance op amp
■ NE/SE5514	quad high performance op amp
■ NE5517	dual transconductance amp
■ NE5517A	dual transconductance amp
■ NE/SE5532	internally compensated dual low noise op amp
NE/SE5532A	internally compensated dual low noise op amp
NE/5533	dual low noise op amp
NE/5533A	dual low noise op amp
■ NE/SE5534	single low noise op amp
■ NE/SE5534A	single low noise op amp
NE/SE5535	dual high slew rate op amp
■ NE5230	low voltage op amp
■ TCA520B;D	low-power/low-voltage op amp
■ NE5205	high frequency amplifier
■ μ A741/741C*	general purpose op amp
■ μ A747/747C*	dual op amp

VIDEO AMPLIFIERS

■ NE/SE5539	ultra high frequency op amp
■ NE/SE592	video amplifier
■ NE5592	video amplifier
μ A733/733C	differential video amplifier

SAMPLE AND HOLD CIRCUITS

● NE5060	precision high speed sample and hold amplifier
■ NE/SE5537	low leakage sample and hold amplifier
LF398	sample and hold circuit
TDA1535	sample and hold circuit

linear (cont.)

book 4 part 6

TIMERS

■	NE/SE555*	timer
■	NE/SE556*	dual timer
■	NE/SE556-1	dual timer
■	NE/SE558	quad timer

MOTOR CONTROL AND SENSOR CIRCUITS

■	NE5044	programmable 7 channel RC encoder
■	NE5045	seven channel RC decoder
	NE544	servo amplifier

PHASE LOCKED LOOPS

■	HE4046B	phase-locked loop
■	NE/SE564*	phase locked loop; 5 V supply; up to 50 MHz; TTL compatible in/out
■	NE/SE565	phase locked loop; ± 6 to ± 12 V supply; TTL/DTL compatible output
■	NE/SE566	function generator
■	NE/SE567*	tone/frequency decoder PLL
■	NE568	phase locked loop; up to 150 MHz

COMPANDORS

	NE570	compandor
■	NE/SA571	compandor
■	NE/SA572	programmable compandor

SMPS CONTROLLERS

	NE/SE5560	SMPS controller
	NE/SE5561	SMPS controller
■	NE/SE5562	SMPS controller
■	NE/SE5563	SMPS controller
■	NE5568	SMPS controller
	SG3524	SMPS controller
	SG/1526A/2526A/3526A	SMPS controller
■	μ A723/CC/SA723C	precision voltage regulator

COMMUNICATION CIRCUITS

	MC1496/1596	balanced modulator/demodulator
■	MC3361	low power FM. IF.
	NE542	dual low noise of amp
■	NE575	voltage compandor (expandor and compandor)
■	NE576	dual voltage compandor
■	NE/SA602	double balanced mixer & oscillator, meets cellular radio specification
■	NE612	double balanced mixer & oscillator
■	NE/SA604	low power narrow band FM. IF., meets cellular radio specification
■	NE614	low power narrow band FM. IF.
■	NE5050	power line modem
■	NE5240†	Dolby digital audio decoder
■	NE5900	call progress decoder
	μ A758	FM stereo multiplex decoder phase locked loop
■	ULN2003/4	high-voltage/high current Darlington transistor array

* Available with military processing

† Dolby is a registered trademark of Dolby Laboratories Licensing Corporation, San Francisco, California (U.S.A.)

Standard functions

digital

LCD DRIVERS; CMOS

- PCF1303T Bargraph LCD driver (18 segments); with analogue input
- PCF2100 LCD duplex driver; 40 segments
- PCF2110 LCD duplex driver; 60 segments and 2 LEDs
- PCF2111 LCD duplex driver; 64 segments

- PCF2112 LCD driver; 32 segments
- PCF8576 universal LCD driver for low multiplex rates (1:1 to 1:4); I²C bus interface

- PCF8577 LCD direct driver (32 segments) or duplex driver (64 segments) with I²C bus interface

DISPLAY DRIVERS; BIPOLAR

- NE587/589 LED decoder/driver
- NE/SE594 vacuum fluorescent display driver
- ● SAA1064 LED driver

CLOCK TIMERS; CMOS

- PCF8573 clock/calendar with serial I/O; I²C bus interface

A/D AND D/A CONVERTERS; NMOS

- PNA7507 7-bit, 20 MHz, $\pm 1/2$ LSB
- PNA7509 7-bit, 22 MHz, $\pm 1/2$ LSB 3-state output A/D converter
- PNA7510 7-bit, 22 MHz, $\pm 1/2$ LSB 3-state + ref. voltage A/D converter
- PNA7518 8-bit, 30 MHz, $\pm 1/2$ LBS D/A converter

MISCELLANEOUS; BIPOLAR ECL

- 23-101 16 lines to 8 lines high level connection matrix; 10K compatible
- 231-101 16 lines to 8 lines high level connection matrix; 100K compatible
- 241-141 high-speed FIFO RAM controller

- SAB1164 sensitive 1 GHz divider-by-64
- SAB1165 sensitive 1 GHz divider-by-64
- SAB1256 sensitive 1 GHz divider-by-256
- SAB6456 sensitive 1:3 GHz switchable divider-by-64/256
- SAB6456T sensitive 1:3 GHz switchable divider-by-64/256

AD/DA converter CMOS

- PCF8591 8-bit AD/DA converter with I²C bus interface

REMOTE I/O EXPANDER

- PCF8574 remote I/O expander/LED driver

MEMORIES

- PCF8570 256 \times 8-bit static Ram with I²C bus interface
- PCF8571 128 \times 8-bit static Ram with I²C bus interface

radio/audio

book 4 part 1

AM CHANNELS

TDA1072A AM receiver circuit for hi-fi and car radio
TEA5570 AM/FM radio receiver circuit

FM CHANNELS

TDA1574 integrated FM tuner for radio receivers
TDA1576 FM/IF amplifier and detector
TDA1596 FM/IF amplifier and detector
TDA7000 FM radio circuit (in plastic DIL-18)
■ **TDA7010T** FM radio circuit (in SO-16 plastic mini-pack)
■ **TDA7021;T** low voltage FM stereo radio circuit (for MTOS)

TEA5570 AM/FM radio receiver circuit
TEA6000 FM/IF system and microcomputer-based tuning interface

AM/FM COMBINED CHANNELS

TEA5570 AM/FM radio receiver circuit

STEREO DECODERS

TDA1578A time multiplex PLL stereo decoder for hi-fi and car radio
TDA1598 time multiplex PLL stereo decoder for hi-fi and car radio

TEA5580 PLL stereo decoder

INTERFERENCE SUPPRESSORS

■ **TDA1001B** interference and noise suppression circuit for FM receivers
■ **TDA1001BT** interference and noise suppression circuit for FM receivers

TUNING CIRCUITS

■ **HEF4750V** frequency synthesizer
■ **HEF4751V** universal divider

SAA1057 radio tuning PLL frequency synthesizer
SAA1300 tuner switching circuit

SAB3035 computer interface for tuning and control (CITAC); 8 DACs;
I²C bus compatible

SAB3036 computer interface for tuning and control (CITAC); without DACs;
I²C bus compatible

SAB3037 computer interface for tuning and control (CITAC); 4 DACs;
I²C bus compatible

■ **TDD1742T** low power synthesizer

Continued

BUS CONTROLLED AUDIO CIRCUITS

TDA8420	stereofone/volume control circuit with head phone channel, spatial and pseudo-stereo sound
TEA6300	car radio preamplifier with source selector, sound and fader control

D.C. CONTROLLED AUDIO CIRCUITS

TDA1029	signal-sources switch (4 × two channels)
TDA1074A	dual tandem electronic potentiometer circuit
TDA1524A	stereo-tone/volume control circuit
TDA3810	spatial, stereo and pseudo-stereo sound circuit

AUDIO POWER AMPLIFIERS

TDA1011	2 to 6 W audio power amplifier
TDA1013A	4 W audio power amplifier with d.c. volume control
TDA1015	1 to 4 W audio power amplifier
■ TDA1015T	0.5 W audio power amplifier
TDA1020	12 W car radio power amplifier
TDA1512	12 to 20 W hi-fi audio power amplifier
TDA1514	40 W hi-fi power amplifier for compact disc
TDA1515A	24 W BTL or 2 × 12 W stereo car radio power amplifier
TDA1520;A	20 W hi-fi audio power amplifier
TDA1521	2 × 12 W audio power amplifier
■ TDA2611A	5 W audio power amplifier
TDA7050T	low voltage mono/stereo power amplifier; stereo: 75 mW; BTL: 150 mW

RECORDER (CASSETTE) AMPLIFIERS/CONTROL CIRCUITS

TDA1016	recording/playback and 2 W audio power amplifier
TDA1522	stereo cassette head preamplifier and equalizer
TDA1600	oscillator switch and playback recorder amplifiers

MOTOR SPEED CONTROL CIRCUITS

■ HEF4752V	a.c. motor control circuit
TDA1533	PLL motor speed control circuit for hi-fi applications
TDA1559	motor speed regulator

Continued

radio/audio (cont.)

book 4 part 1

DISPLAY DRIVERS

PCF2100	LCD duplex driver; 40 segments
PCF2110	LCD duplex driver; 60 segments and 2 LEDs
PCF2111	LCD duplex driver; 64 segments
PCF2112	LCD driver; 32 segments
PCF8574	remote I/O expander/LED driver
PCF8576	universal LCD driver for low multiplex rates (1:1 to 1:4); I ² bus interface
PCF8577	LCD direct driver (32 segments) or duplex driver (64 segments) with I ² bus interface
SAA1060	LED display/interface circuit
SAA1061	LED display/interface circuit
SAA1062A	LCD display/interface circuit
SAA1062AT	LCD display/interface circuit
SAA1063	fluorescent display/interface circuit

PERSONAL RADIO/AUDIO

TDA7000	FM radio circuit (in plastic DIL-18)
TDA7010T	FM radio circuit (in SO-16 plastic mini-pack)
TDA7021;T	low voltage FM stereo radio circuit (MTOS)
TEA0670T	low voltage dolby B and C type noise reduction circuit

COMPACT DISC DIGITAL AUDIO SYSTEM CIRCUITS

SAA7210	CD2 decoder
SAA7220	CD2 digital filter
TDA1540P	14-bit DAC with 85 dB S/N ratio
TDA1541	dual 16-bit DAC
TDA1542	low pass filter IC
TDA5708;T	photo diode signal processor
TDA5709;T	radial error signal processor

SPEECH SYNTHESIZERS

MEA8000	voice synthesizer
PCF8200	voice synthesizer
OM8000	standard Euro-card demonstration for MEA8000
OM8001	speech demonstration box
OM8002	dutch diphone board
OM8010	stand-alone speech editing system
OM8200	Euro-card demonstration for PCF8200
OM8201	speech demonstration box for PCF8200
OM8209	update package for OM8010
OM8210	speech editing system for PCF8200

Continued

MISCELLANEOUS

MC1496/1596 balanced modulator/demodulator

- **NE5044** programmable 7-channel RC encoder
- **NE5045** 7-channel RC decoder

TDA1540P 14-bit DAC with 85 dB S/N ratio

DOLBY CIRCUITS

NE645/646 * Dolby noise reduction circuit
NE648/649 * low voltage Dolby noise reduction circuit
NE650 * Dolby B/C type noise reduction circuit

- TEA0651 *** Dolby C processor
- TEA0652 *** Dolby C processor
- **TEA0653T *** stereo Dolby B processor
- TEA0654 *** Dolby C switch
- **TEA0665;T *** Dolby B and C type noise reduction circuit
- **TEA0666;T** Dolby B and C type noise reduction circuit
- **TEA0670T** low voltage Dolby B and C type noise reduction circuit

*Dolby is a registered trademark of Dolby Laboratories Licensing Corporation, San Francisco, California (U.S.A.)

television/video

book 4 parts 2a & b

VISION I.F. CIRCUITS

Economical circuits

TDA2540	i.f. amplifier and demodulator; n-p-n tuners
TDA2541	i.f. amplifier and demodulator; p-n-p tuners
TDA2542	i.f. amplifier and demodulator; for E and L standards; p-n-p tuners
TDA2544	i.f. amplifier and demodulator; MOS tuners
TDA2548	i.f. amplifier and demodulator; p-n-p tuners
TDA2549	i.f. amplifier and demodulator for multistandard TV receivers

High-performance circuits

TDA2549	i.f. amplifier and demodulator for multistandard TV receivers
TDA3540	i.f. amplifier and demodulator; n-p-n tuners
TDA3541	i.f. amplifier and demodulator; p-n-p tuners

COLOUR DECODING CIRCUITS

TDA3505	video control combination with automatic cut-off control
TDA3561A	PAL decoder
TDA3562A	PAL/NTSC decoder
TDA3565	PAL decoder
TDA3590A	SECAM processor circuit (improved TDA3590)
TDA3592A	SECAM-PAL transcoder
TDA4510	PAL decoder
TDA4555	multi-standard decoder (colour difference output; negative going)
TDA4565	colour transient improvement circuit
TDA8442	bus interface for colour decoders

VERTICAL DEFLECTION CIRCUITS

TDA2653A	PIL-S4; 30AX; monitor; with +60 V and protection
TDA3651	vertical deflection circuit
TDA3651A	vertical deflection circuit
TDA3652	vertical deflection circuit
TDA3653; A	vertical deflection circuit with +60 V and protection
TDA3654	vertical deflection circuit with +60 V and protection

SYNC PROCESSORS; HORIZONTAL; VERTICAL

TDA2578A	synchronization circuit with vertical oscillator and driver stages
TDA2579	synchronization circuit (628 lines)
TDA2595	horizontal combination with transmitter identification and protection circuits

DIGITAL VIDEO PROCESSING

SAA9001	317 K CCD memory
SAA9010	picture enhancement processor
SAA9020	field memory controller
SAA9030	background memory controller
SAA9035	video time multiplexer VMX
SAA9040	computer-controlled teletext extension
SAA9045	video time demultiplexer VDX

Continued

Dedicated functions

television/video (cont.)

book 4 parts 2a & b

SOUND CIRCUITS

TBA120U	sound i.f. amplifier/demodulator for TV
TDA1013A	4 W audio power amplifier
TDA1029	signal sources switch (4 × two channels)
TDA1512	12 to 20 W hi-fi audio power amplifier
TDA1520A	20 W hi-fi audio power amplifier
TDA1524A	stereo-tone/volume control circuit
TDA2543	AM sound i.f. circuit for French standard
TDA2545A	quasi-split-sound circuit
TDA2546A	quasi-split-sound circuit with 5,5 MHz demodulation
TDA2555	dual FM demodulator with 8 stage limiter
TDA2556	quasi-split-sound circuit with dual sound modulators
TDA2557	dual FM demodulator with 5 stage limiter
TDA2611A	5 W audio power amplifier
TDA3800G; GS	stereo/dual sound processing circuit
TDA3803A	stereo/dual TV sound decoder circuit
TDA3810	spatial, stereo and pseudo-stereo sound circuit
TEA6300	car radio preamplifier with source selector, sound- and fader control

VIDEO RECORDER CIRCUITS

■ SAA5235	DATALINE slicer
■ SAD1009	UDAC universal digital to analog converter
● SAF1135	DATALINE decoder
TDA2501	PAL/NTSC encoder
■ TDA2504P;T	FM modem for 8 mm video
TDA3730	frequency demodulator and drop-out compensator
TDA3740	video processor/frequency modulator
TDA3755	PAL/NTSC synchronization processor for VHS system
TDA3760	PAL chrominance signal processor for VHS system
TDA3765	NTSC chrominance signal processor for VHS system
TDA3766	PAL/NTSC chrominance signal processor for VHS system
TDA5702	8-bit D/A converter (bipolar)
TDA5703	8-bit A/D converter (bipolar)

VIDEO CAMERA CIRCUITS

SAA1043	universal sync generator
SAA1044	subcarrier coupling circuit
■ TDA4301	vertical driver
■ TDA4302	pixel oscillator
■ TDA4303	white processor
■ TDA4304	d.c. controller
■ TDA4305	horizontal driver
■ TDA4306	master gain circuit

Continued

television/video (cont.)

book 4 parts 2a & b

VIDEO AMPLIFIERS

- **NE/SE592** differential video amp.
- **μA733/733C** differential video amp.

MISCELLANEOUS

- **TDA1082** east-west correction driver circuit
- **TDA2506;T** SECAM encoder
- **TDA2507;T** FM modulator controller
- **TDA4501** monolithic integrated small signal combination for television receivers
- **TDA4502** small signal combination IC for colour TV with video switch
- **TDA4503** small signal combination IC for monochrome TV
- **TDA4505** monostandard small signal combination IC for television receivers
- **TDA5030;A;AT** mixer/oscillator for VHF tuner
- ● **TDA6800;T** VHF/UHF modulator
- **TDA8440** PT COMMUTATOR switch
- **TDA8442** I²C bus interface
- **TDA8443** YUB RGB switch
- **TDA9045** start analog control

- **TEA1011** preamplifier and amplifier (for systems minitel and games)
- **TEA2000** NTSC/PAL colour encoder and video summer (64 different colours)

Dedicated functions

digital systems – radio/audio/television/video: remote control & video tuning systems

book 4 parts 2a & b

REMOTE CONTROL SYSTEMS

General purpose applications

SAA1082P	remote transmitter
SAF1032P	receiver/decoder for infrared operation
SAF1039P	remote transmitter for infrared operation

Radio and video systems

■ SAA3004	remote control transmitter for infrared operation
■ SAA3006	low voltage infrared remote control transmitter (RC-5)
■ SAA3007	low voltage infrared remote control transmitter (455 KHz)
■ SAA3008	low voltage infrared remote control transmitter (38 KHz)
■ SAA3027	infrared remote control transmitter (RC-5)
■ SAA3028	infrared remote control transcoder (RC-5); I ² C bus compatible

Infrared preamplifiers

■ TDA3047	infrared receiver, output active positive
■ TDA3048	infrared receiver, output active negative

VIDEO TUNING SYSTEM (VTS)

Control systems

See 3 pages later for microcontrollers used in this function

Tuning systems

SAB1164	sensitive 1 GHz divider-by-64
SAB1165	sensitive 1 GHz divider-by-64
SAB1256	sensitive 1 GHz divider-by-256
SAB3035	computer interface for tuning and control (CITAC); 8 DACs; I ² C bus compatible
SAB3036	computer interface for tuning and control (CITAC); without DACs; I ² C bus compatible
SAB3037	computer interface for tuning and control (CITAC); 4 DACs; I ² C bus compatible
SAB6456	1,3 GH divider switchable by 64/256
SAB6456T	1,3 GH divider switchable by 64/256

Display systems

■ SAA1060	LED display/interface circuit
■ SAA1061	LED display/interface circuit
● SAA1064	LED display/interface circuit

Additional optional circuits

■ PCF8573	clock/calendar with serial I/O; I ² C bus interface
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digital systems – radio/audio/television/video: text decoder systems book 4 parts 2a & b

TEXT DECODER SYSTEMS

Teletext decoder ICs

SAA5020	teletext timing chain circuit (625 lines)
SAA5030	teletext video processor
SAA5040B	teletext acquisition and control circuit
SAA5041;42	teletext acquisition and control circuit
SAA5050	teletext character generator (English)
SAA5051	teletext character generator (German)
SAA5052	teletext character generator (Swedish)
SAA5053	teletext character generator (Italian)
SAA5054	teletext character generator (Belgian)
SAA5056	teletext character generator (Hebrew)
SAA5057	teletext character generator (Cyrillic)
● SAA5058	teletext character generator (Afrikaans)
● SAA5231	teletext video processor II
SAA5240A	computer controlled teletext circuit (CCT); 625-line system (English, German, Swedish)
SAA5240B	computer controlled teletext circuit (CCT); 625-line system (Italian, German, French)
● SAA5250	CIDAC (Antiope decoder)

Videotex

See 2 pages later for microcontrollers used in this function

SAA5020	timing chain circuit (625 lines)
SAA5050	character generator (English)
SAA5051	character generator (German)
SAA5052	character generator (Swedish)
SAA5053	character generator (Italian)
SAA5054	character generator (Belgian)
SAA5056	character generator (Hebrew)
SAA5057	character generator (Cyrillic)
SAA5070	microcontroller/microprocessor peripheral IC for viewdata (LUCY)
SAA5240A	computer controlled teletext circuit (CCT); 625-line system (English, German, Swedish)
SAA5240B	computer controlled teletext circuit (CCT); 625-line system (Italian, German, French)
SAA5350	Eurom, CRT controller (CEPT standard)

Field memory system

SAA9001	CCD memory (320 K bits)
SAA9010	picture enhancement controller (PEP)
SAA9020	field memory controller (FMC)
SAA9030	background memory controller (BMC)
SAA9040	computer-controlled teletext extension (CCTE)

Continued

Dedicated functions

digital systems – radio/audio/television/video: text decoder (cont.)/radio tuning & frequency book 4 parts 2a & b

Digital TV

SAA9050	Digital Multi Standard Decoder (DMSD) NMOS for all standards, with I ² C capability
SAA9055	Digital Secam Color Decoder (DSD) CMOS with I ² C capability
SAA9057	Clock Generator Circuit (CGC) CMOS
SAA9058	Sample Rate Converter (SRC) NMOS
SAA90xx	A/D converter for digital TV NMOS like PNA7510

RADIO TUNING SYSTEM (RTS)

Tuning, display and control ICs

See next page for microcontrollers used in this function

■ PCF2100	LCD duplex driver; 40 segments
■ PCF2110	LCD duplex driver; 60 segments and 2 LEDs
■ PCF2111	LCD duplex driver; 64 segments
■ PCF2112	LCD driver; 32 segments
■ PCF8576	universal LCD driver for low multiplex rates (1:1 to 1:4); I ² C bus interface
■ PCF8577	LCD direct driver (32 segments) or duplex driver (64 segments) with I ² C bus interface
SAA1057	radio tuning PLL frequency synthesizer (SYMO II)
SAA1060	LED display/interface circuit
SAA1061	LED display/interface circuit
■ SAA1062A;AT	LCD display/interface circuit
■ ● SAA1064	LED display/interface circuit
SAA1097	analogue head switch
SAA1300	tuner switching unit
■ PCF8574	remote I/O expander/LED driver

FREQUENCY MEASUREMENT AND DISPLAY SYSTEM

SERIAL MEMORIES

■ PCF8570	256 × 8-bit static CMOS RAM with I ² C bus interface
■ PCF8571	128 × 8-bit static CMOS RAM with I ² C bus interface

AD/DA CONVERTER

■ PCF8591	8-bit AD/DA converter with I ² C bus interface
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digital systems – radio/audio/television/video: microcontrollers book 4 part 9

MICROCONTROLLERS MOS

NMOS single-chip 8-bit μ C

■	MAB8031AH	128 × 8 RAM; ROM-less version of MAB8051AH
■	MAB8032AH	256 × 8 RAM; ROM-less version of MAB8052AH
	MAB8035HL	64 × 8 RAM; ROM-less version of MAB8048H
	MAB8039HL	128 × 8 RAM; ROM-less version of MAB8049H
	MAB8040HL	256 × 8 RAM; ROM-less version of MAB8050H
	MAB8048H	1K × 8 ROM, 64 × 8 RAM
	MAB8049H	2K × 8 ROM, 128 × 8 RAM
	MAB8050H	4K × 8 ROM, 256 × 8 RAM
	MAB8051AH	4K × 8 ROM, 128 × 8 RAM
■	MAB8052AH	8K × 8 PROM, 256 × 8 bytes RAM
■	MAB8401WP	like MAB8400 but with 8-bit LED-driver
■	MAB8411	1K ROM/64 RAM bytes
■	MAB8421	2K ROM/64 RAM bytes plus 8-bit LED driver
	MAB8422	2K ROM/64 RAM bytes
■	MAB8441	4K ROM/128 RAM bytes plus 8-bit LED driver
	MAB8442	4K ROM/128 RAM bytes
	MAB8461	6K ROM/128 RAM bytes plus 8-bit LED driver
	MAF8031AH	128K RAM; ROM-less version of MAB8051AH; extended temperature
	MAF80A31AH	128K RAM; ROM-less version of MAB8051H; reduced frequency; extended temperature
	MAF8035HL	64K RAM; ROM-less version of MAB8048H; extended temperature
	MAF80A35HL	64K RAM; ROM-less version of MAB8048H; reduced frequency; extended temperature
	MAF8039HL	128K RAM; ROM-less version of MAB8049H; extended temperature
	MAF80A39HL	128K RAM; ROM-less version of MAB8049H; reduced frequency; extended temperature
	MAF8040HL	256K RAM; ROM-less version of MAB8050H; extended temperature
	MAF80A40HL	256K RAM; ROM-less version of MAB8050H; reduced frequency; extended temperature
	MAF8048H	1K × 8 ROM, 64 × 8 RAM; extended temperature
	MAF80A48H	1K × 8 ROM, 64 × 8 RAM; reduced frequency; extended temperature
	MAF8049H	2K × 8 ROM, 128 × 8 RAM; extended temperature
	MAF80A49H	2K × 8 ROM, 128 × 8 RAM; reduced frequency; extended temperature
	MAF8050H	4K × 8 ROM, 256 × 8 RAM; extended temperature
	MAF80A50H	4K × 8 ROM, 256 × 8 RAM; reduced frequency; extended temperature
	MAF8051H	4K × 8 ROM, 128 × 8 RAM; extended temperature
	MAF80A51H	4K × 8 ROM, 128 × 8 RAM; reduced frequency; extended temperature
	MAF8411	1K ROM/64 RAM bytes
■	MAF84A11	1K × 8 ROM, 64 × 8 RAM; reduced frequency; extended temperature
■	MAF8421	2K ROM/64 RAM bytes plus 8-bit LED driver
	MAF8422	2K ROM/64 RAM bytes; extended temperature
	MAF84A22	2K ROM/64 RAM bytes; reduced frequency; extended temperature
■	MAF8441	4K ROM/128 RAM bytes plus 8-bit LED driver
	MAF84A41	4K ROM/128 RAM bytes; reduced frequency; extended temperature
	MAF8442	4K ROM/128 RAM bytes; extended temperature
	MAF84A42	4K ROM/128 RAM bytes; reduced frequency; extended temperature
	MAF8461	6K ROM/128 RAM bytes plus 8-bit LED driver
	MAF84A61	6K ROM/128 RAM bytes; reduced frequency; extended temperature

Continued

Dedicated functions

digital systems – radio/audio/television/video: microcontrollers (cont.) & video games

book 4 part 9

CMOS single-chip 8-bit μ C

■ PCB80C31	128K RAM; ROM-less version of PCB80C51
■ PCB80C39	128K RAM; ROM-less version of PCB80C49
■ PCB80C49	2K \times 8 ROM, 128 \times 8 RAM
■ PCB80C51	4K \times 8 ROM, 128 \times 8 RAM
PCB85C51	128K RAM; ROM-less version of PCB80C51; 28-pin EPROM on top
PCF80C39	128K RAM; ROM-less version of PCB80C49; extended temperature
PCF80C49	2K ROM/128 RAM bytes; extended temperature

Derivates of PCB80C51 CMOS

PCB80C351	128K RAM; ROM-less version of PCB83C351
PCB80C451	128K RAM; ROM-less version of PCB83C451
PCB80C552	256K RAM; ROM-less version of PCB83C552
PCB80C652	256K RAM; ROM-less version of PCB83C652
PCB83C351	4K ROM/128 RAM bytes; 1 \times 16-bit capture timer/counter; I ² C (HW/SW) and D ² B 9-bit (HW) on chip
PCB83C451	4K ROM/128 RAM bytes; 2 \times 8-bit quasi bidirectional ports; 4 data-signals connected to port 6
PCB83C552	8K ROM/256 RAM bytes; 1 \times 16-bit capture/compare timer/counter; 1 watch-dog-timer and 2 pulse width modulated signals; 1 \times 8-bit input connected to A/D converter
PCB83C652	8K ROM/256 RAM bytes; serial I/O UART and I ² C-HW

VIDEO GAMES

ME8000	Voice Synthesizer
OM1099	demonstration board for SAA1099
PCF8200	Voice Synthesizer
SAA1099	microprocessor controlled stereo sound effects generator
SCN2650A	8-bit Microprocessor
■ TDA2506;T	SECAM encoder
■ TDA2507;T	FM modulator controller
■ ● TDA6800;T	VHF/UHF modulator
TEA1011	preamplifier and amplifier for systems minitel and games
TEA2000	NTSC/PAL colour encoder and video summer (64 different colours)

telephony: bipolar ICs

book 4 part 3

BIPOLAR INTEGRATED CIRCUITS FOR TELEPHONE SUBSCRIBER SETS

DTMF diallers with line interface

TEA1075P DTMF generator for telephone dialling

Speech/transmission circuits

TEA1042 telephone transmission circuit for handsfree loudspeaking
TEA1060 versatile telephone transmission circuit with dialler interface;
for dynamic and magnetic microphones
TEA1061 versatile telephone transmission circuit with dialler interface;
for piezoelectric and electret microphones
■ **TEA1066T** telephone transmission circuit
TEA1067 see 1060/1061 for low voltage
TEA1068 versatile telephone transmission circuit with dialler interface
and for high and low omic microphones
TEA1080 supply circuit for telephone set peripherals

DTMF/speech transmission combination

TEA1046P DTMF/speech transmission IC for telephone applications

CMOS INTEGRATED CIRCUITS FOR TELEPHONE SUBSCRIBER SETS

DTMF dialler with redial

- **PCD3310** DTMF/pulse dialler with redial

Pulse diallers with redial

- PCD3320** interrupted current-loop dialling circuit
- PCD3321** interrupted current-loop dialling circuit
- PCD3322** interrupted current-loop dialling circuit
- PCD3325A** interrupted current-loop dialling circuit
- PCD3326** interrupted current-loop dialling circuit
- PCD3327P** interrupted current-loop dialling circuit

Pulse repertory dialler/telephone-set controller

- **PCD3315** pulse repertory dialler
- **PCD3341** Pulse repertory dialler/telephone-set controller
- **PCD3343** microcontroller for telephone-sets

Microcontroller peripherals (DTMF/MODEM, RAM, LCD, clock)

- **PCD3311** DTMF generator/modem generator with I²C bus or parallel interface
- **PCD3312** DTMF generator/modem generator with I²C bus interface
- **PCF2111** LCD duplex driver; 64 segments
- **PCF8570** 256 × 8-bit static RAM with I²C bus interface
- **PCF8571** 128 × 8-bit static RAM with I²C bus interface
- **PCF8573** clock/calender with serial I/O; I²C bus interface
- **PCF8574** remote I/O expander/LED driver
- **PCF8576** universal LCD driver for low multiplex rates (1:1 to 1:4); I²C bus interface
- **PCF8577** LCD direct driver (32 segments) or duplex driver (64 segments) with I²C bus interface

Multi-tone ringer

- **PCD3360** programmable multi-tone ringer

clocks and watches: digital, analog & car

ANALOG WATCHES

PCA1260 32 kHz watch circuit with motor pulse control
PCA1400 (family) 32 kHz watch circuit; electrically trimmable

ANALOG CLOCKS

PCA1564 32 kHz a.c. alarm clock circuit; bipolar motor: $T = 2 \text{ s}; t_p = 46,8 \text{ ms}$
PCA1574 32 kHz a.c. alarm clock circuit; bipolar motor: $T = 2 \text{ s}; t_p = 46,8 \text{ ms}$
PCA1580 (family) 32 kHz alarm clock; electrical trimmable

CAR CLOCKS

■ **PCF1171** 4-digit LCD car clock circuit
■ **PCF1172** 3.5-digit LCD car clock circuit

Dedicated functions

general industrial

CONTROL CIRCUITS FOR SWITCHED-MODE POWER SUPPLIES (SMPS)

- **NE/SE5560** SMPS control circuit
- **NE/SE5561** SMPS control circuit

- **SG3524** SMPS control circuit

- TDA1060; A; B** control circuits for SMPS

- TEA1039** control circuit for SMPS

- **μA723/723C** precision voltage regulator

MOTOR DRIVE CIRCUITS

- SAA1027** stepping motor control circuit

- **SAK150BT** servo-motor control circuit

- TEA1012** stepping motor control circuit

TRANSISTOR ARRAYS

- **ULN2003/4** high-voltage/high-current Darlington transistor array

SPEECH SYNTHESIZERS

- MEA8000** voice synthesizer
- PCF8200** voice synthesizer

- OM8000** standard Euro-card demo for MEA8000
- OM8001** speech demonstration box
- OM8002** dutch diphone board
- OM8010** stand-alone speech editing system
- OM8200** Euro-card demo for PCF8200
- OM8201** speech demo box for PCF8200
- OM8209** update package for OM8010
- OM8210** speech editing system for PCF8200

MISCELLANEOUS

- MEB3000** PDV-bus interface circuit

- NE542** dual low-noise preamp
- NE544** servo amplifier
- **NE570/571/SA571** analog compandor
- **NE572** programmable analog compandor

- SAA1029** universal industrial logic and interface circuit

- TDA1432P;T** 8-bit D/A converter (CMOS)
- TDA1540P** 14-bit DAC with 85 dB S/N ratio
- TDA1721** 8-bit multiplying DAC
- TDA5702** 8-bit D/A converter (bipolar)
- TDA5703** 8-bit A/D converter (bipolar)

- TEA1017** 13-bit series-parallel converter and display driver

- μA758** FM stereo multiplex decoder; PLL

domestic appliances data communications, video display book 4 part 9

DOMESTIC APPLIANCES

SAB3045 motor speed controller (e.g. washing machines)

TDA1023 proportional-control triac triggering circuit

DATA COMMUNICATIONS

- **SCN2641** Asynchronous Communication Interface (ACI)
- **SCN2651** Programmable Communications Interface (PCI)
- **SCN2652** Multi-Protocol Communications Controller (MPCC)
- **SCN2653** Polynomial Generator Checker (PGC)
- **SCN2661** Enhanced Programmable Communications Interface (EPCI)
- **SCN2681** Dual Asynchronous Receiver/Transmitter (DUART)

VIDEO DISPLAY (CRT)

- SAA5350** EUROM, CRT controller (CEPT standard)
- **SCB2673** Video Attributes Controller (VAC)
- **SCB2675** Color/Monochrome Attributes Controller (CMAC)
- **SCB2677** Video Attributes Controller (VAC)

- **SCN2670** Display Character and Graphics Generator (DCGG)
- **SCN2671** Programmable Keyboard & Comm Controller (PKCC)
- **SCN2672** Programmable Video Timing Controller (PVTC)
- **SCN2674** Advanced Video Display Controller (AVDC)

8-BIT MICROPROCESSOR FAMILY

8T31*	Transparent I/O Port; 8-bit bidirectional
8T32*	Addressable I/O Port; 8-bit bidirectional, synchronous
8T36*	Addressable I/O Port; 8-bit bidirectional, asynchronous
8X305	Microcontroller; 200 ns cycle time
8X310	Interrupt controller
8X320	Bus Interface Array; 2-port RAM for 8/16-bit mailbox interface
8X330	Floppy Disk Formatter/Controller
8X350	Bipolar RAM; 256 × 8 high-speed memory with bus interface
8X353	Bipolar RAM; 32 × 8 high-speed memory with bus interface
8X355	LIFO RAM; 32 × 8 high-speed LIFO stack with bus interface
8X360	Memory Address Director
8X371	Transparent I/O Port; 8-bit bidirectional
8X372	Addressable I/O Port; 8-bit bidirectional, synchronous
8X374	Addressable I/O Port; 8-bit bidirectional, synchronous with parity
8X376	Addressable I/O Port; 8-bit bidirectional, asynchronous
8X382	Addressable I/O Port; 4-in/4-out
■ ● 8X401	Micro controller; 150 ns cycle time
● 8X450	High-speed Bipolar RAM; 32 × 8
● 8X470	Addressable I/O Port; 2 × 8-bit bidirectional, synch and asynch

Prototyping aids

8X300KT2SK	memory expansion for 8X305 prototyping kit
8X300KT1SK	8X305 prototyping and evaluation board
8X305ICEPACK	development system and emulator (available from SIGEN Corp. USA)
● 8X400KT1SK	8X400 development board

EX-PRO	8X300/8X305 development system (available from American Automation - USA)
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Software

8X300AS2SS	8X300/8X305 cross assembler for Intel Intellec system
8X300AS3SS	8X300/8X305 cross assembler; FORTRAN, ASCII, 1600 BPI
8X300AS4SS	8X300/8X305 cross assembler; FORTRAN, EBCDIC, 1600 BPI
● 8X400AS1SS	8X400 cross assembler for IBM-PC

Bipolar LSI support products

9401/8X01A	CRC generator/checker
● 8X02A	control store sequencer
● 8X41	auto directional buff transceiver
9403	64-bit FIFO buffer memory (16 × 4)
8X60	FIFO CAM controller (4K RAM)

MOS: 8- & 16-bit microprocessors book 4 part 9

8-BIT MICROPROCESSOR FAMILY

16-BIT MICROPROCESSOR FAMILY: SC68000 SERIES

Microprocessor unit (MPU)

- **SCN68000** 16/32-bit MPU; 16-bit external/32-bit internal MPU; 17 general purpose 32-bit registers; 16 MB linear address space
- **SCN68010** 16/32-bit MPU; 16-bit external/32-bit internal MPU; 17 general purpose 32-bit registers; 16 MB linear address space
- **SCC68070** 16-bit MPU, plus DMA, MMU and peripheral functions (CMOS)

Direct memory access

- **SCB68430** Direct Memory Access Interface (DMAI); single-channel DMA interface; cycle steal or burst data transfers; supports 32-bit transfers on VME bus

Data communication

- **SCN68562** Dual Universal Serial Communications Controller (DUSCC); dual channel, asynchronous; byte control protocols, BISYNC DDCMP X.21; bit-oriented protocol HDLC, ADCCP, SDLC, X.25; DMA interface, counter timer
- **SCN68652** Multi-Protocol Communications Controller (MPCC); synchronous communications controller; bit and byte protocols; CRC Polynomial Generator Checker (PGC); error correction, code generation/comparator circuit; comparator circuit; companion chip to MPCC or EPCI
- **SCN68661** Enhanced Programmable Communications Interface (EPCI); universal synchronous/asynchronous double buffered $R \times T$ internal baud rate generator; three versions with different baud rates
- **SCN68681** Dual Asynchronous Receiver/Transmitter (DUART); dual channel, quad buffered receiver; double buffered transmitter; independent baud rate selection; the SCN68681 is for non-multiplexed bus processors like SCN68000; the SCN2681 is for multiplexed bus processors like Intel/Zilog etc.

Disk control

- **SCB68459** Disk Phase Lock Loop (DPLL); companion device to SCN68454 (IMDC) used for interfacing to more than on IMDC
- **SCN68454** Intelligent Multiple Disk Controller (IMDC); simultaneously controls up to 4 hard or floppy drives in any combination SA1000 or ST506 interfaces

Memory access control

- **SCC68905** Basic Memory Access Controller (BMAC) for 68010
- **SCC68906** Basic Memory Access Controller (BMAC) for 68020

Interface

- **SCB68172** VME bus controller (BUSCON) interface circuit; master-slave configurations, processor or DMA interface
- **SCB68154** Interrupt generator
- **SCB68155** Interrupt handler
- **SCB68175** Master only bus controller

MICROCONTROLLERS MOS

NMOS single-chip 8-bit μ C

■	MAB8031AH	ROM-less version of MAB8051AH
	MAB8032AH	ROM-less version of MAB8052AH
	MAB8035HL	ROM-less version of MAB8048H
	MAB8039HL	ROM-less version of MAB8049H
	MAB8040HL	ROM-less version of MAB8050H
	MAB8048H	1K \times 8 ROM, 64 \times 8 RAM
	MAB8049H	2K \times 8 ROM, 128 \times 8 RAM
	MAB8050H	4K \times 8 ROM, 256 \times 8 RAM
	MAB8051AH	4K \times 8 ROM, 128 \times 8 RAM
	MAB8052AH	8K \times 8 PROM, 256 \times 8 bytes RAM
■	MAG8401WP	128 \times 8 RAM; external program memory plus 8-bit LED-driver
■	MAB8411	1K ROM/64 RAM bytes
■	MAB8421	2K ROM/64 RAM bytes plus 8-bit LED driver
	MAB8422	2K ROM/64 RAM bytes
■	MAB8441	4K ROM/128 RAM bytes plus 8-bit LED driver
	MAB8442	4K ROM/128 RAM bytes
	MAB8461	6K ROM/128 RAM bytes plus 8-bit LED driver
	MAF8031AH	ROM-less version of MAB8051AH; extended temperature
	MAF80A31AH	ROM-less version of MAB8051H; reduced frequency; extended temperature
	MAF8035HL	ROM-less version of MAB8048H; extended temperature
	MAF80A35HL	ROM-less version of MAB8048H; reduced frequency; extended temperature
	MAF8039HL	ROM-less version of MAB8049H; extended temperature
	MAF80A39HL	ROM-less version of MAB8049H; reduced frequency; extended temperature
	MAF8040HL	ROM-less version of MAB8050H; extended temperature
	MAF80A40HL	ROM-less version of MAB8050H; reduced frequency; extended temperature
	MAF8048H	1K \times 8 ROM, 64 \times 8 RAM; extended temperature
	MAF80A48H	1K \times 8 ROM, 64 \times 8 RAM; reduced frequency; extended temperature
	MAF8049H	2K \times 8 ROM, 128 \times 8 RAM; extended temperature
	MAF80A49H	2K \times 8 ROM, 128 \times 8 RAM; reduced frequency; extended temperature
	MAF8050H	4K \times 8 ROM, 256 \times 8 RAM; extended temperature
	MAF80A50H	4K \times 8 ROM, 256 \times 8 RAM; reduced frequency; extended temperature
	MAF8051H	4K \times 8 ROM, 128 \times 8 RAM; extended temperature
	MAF80A51H	4K \times 8 ROM, 128 \times 8 RAM; reduced frequency; extended temperature
■	MAF8411	1K ROM/64 RAM bytes
	MAF84A11	1K \times 8 ROM, 64 \times 8 RAM; reduced frequency; extended temperature
■	MAF8421	2K ROM/64 RAM bytes plus 8-bit LED driver
	MAF8422	2K ROM/64 RAM bytes; extended temperature
	MAF84A22	2K ROM/64 RAM bytes; reduced frequency; extended temperature
■	MAF8441	4K ROM/128 RAM bytes plus 8-bit LED driver
	MAF84A41	4K ROM/128 RAM bytes; reduced frequency; extended temperature
	MAF8442	4K ROM/128 RAM bytes; extended temperature
	MAF84A42	4K ROM/128 RAM bytes; reduced frequency; extended temperature
	MAF8461	6K ROM/128 RAM bytes plus 8-bit LED driver
	MAF84A61	6K ROM/128 RAM bytes; reduced frequency; extended temperature

Continued

MOS: 8-bit microcontrollers (cont.) & peripheral ICs

book 4 part 9

CMOS single-chip 8-bit μ C

■	PCB80C31	ROM-less version of PCB80C51
■	PCB80C39	ROM-less version of PCB80C49
■	PCB80C49	2K \times 8 ROM, 128 \times 8 RAM
■	PCB80C51	4K \times 8 ROM, 128 \times 8 RAM
	PCB85C51	ROM-less version of PCB80C51; 28-pin EPROM on top
	PCF80C39	ROM-less version of PCB80C49; extended temperature
	PCF80C49	2K ROM/128 RAM bytes; extended temperature
■	PCF84C00	256 RAM bytes; external program memory
■	PCF84C20	2K ROM/64 RAM bytes
■	PCF84C40	4K ROM/128 RAM bytes

Derivates of PCB80C51 CMOS

	PCB80C351	ROM-less version of PCB83C351
	PCB80C451	ROM-less version of PCB83C451
	PCB80C552	ROM-less version of PCB83C552
	PCB80C652	ROM-less version of PCB83C652
	PCB83C351	4K ROM/128 RAM bytes; 1 \times 16-bit capture timer/counter; I ² C (HW/SW) and D ² B 9-bit (HW) on chip
	PCB83C451	4K ROM/128 RAM bytes; 2 \times 8-bit quasi bidirectional ports; 4 data-signals connected to port 6
	PCB83C552	8K ROM/256 RAM bytes; 1 \times 16-bit capture/compare timer/counter; 1 watch-dog-timer and 2 pulse width modulated signals; 1 \times 8-bit input connected to A/D converter
	PCB83C652	8K ROM/256 RAM bytes; serial I/O UART and I ² C-HW

PERIPHERAL CIRCUITS

■	PCF2100	LCD duplex driver; 40 segments
■	PCF2110	LCD duplex driver; 60 segments and 2 LEDs
■	PCF2111	LCD duplex driver; 64 segments
■	PCF2112	LCD driver; 32 segments
■	PCF8570	256 \times 8-bit static CMOS RAM with I ² C bus interface
■	PCF8571	128 \times 8-bit static CMOS RAM with I ² C bus interface
■	PCF8573	clock/calendar with serial I/O; I ² C bus interface
■	PCF8574	remote 8-bit I/O for I ² C bus
■	PCF8576	universal LCD driver for low multiplex rates (1:1 to 1:4); I ² C bus interface
■	PCF8577	universal LCD driver for low multiplex rates (1:1 to 1:4) I ² C bus interface
■	PCF8591	8-bit AD/DA converter with I ² C bus interface

PLD SERIES 20

PLS151 (82S151)	Field Programmable Gate Array (FPGA) (18 × 15 × 12)
PLS153 (82S153)	Field Programmable Logic Array (FPLA) (18 × 42 × 10)
PLS153A (82S153A)	Field Programmable Logic Array (FPLA) (18 × 42 × 10)
PLS155 (82S155)	Field Programmable Logic Sequencer (FPLS) (16 × 45 × 12) 4-bit register
PLS157 (82S157)	Field Programmable Logic Sequencer (FPLS) (16 × 45 × 12) 6-bit register
PLS159 (82S159)	Field Programmable Logic Sequencer (FPLS) (16 × 45 × 12) 8-bit register

PLD SERIES 24

PLS161 (82S161)	Field Programmable Logic Array (FPLA) (12 × 48 × 8)
PLS162 (82S162)	Field Programmable Gate Array (FPGA) (16 × 5)
PLS163 (82S163)	Field Programmable Gate Array (FPGA) (12 × 9)
PLS167 (82S167)	Field Programmable Logic Sequencer (FPLS) (14 × 48 × 6)
PLS167A (82S167A)	Field Programmable Logic Sequencer (FPLS) (14 × 48 × 6)
PLS168 (82S168)	Field Programmable Logic Sequencer (FPLS) (12 × 48 × 8)
PLS168A (82S168A)	Field Programmable Logic Sequencer (FPLS) (12 × 48 × 8)
PLS173 (82S173)	Field Programmable Logic Array (FPLA) (22 × 42 × 10)
PLS179 (82S179)	Field Programmable Logic Sequencer (FLPS) (12 × 42 × 12)

PLD SERIES 28

PLS100 (82S100)	Field Programmable Logic Array (FPLA) (16 × 48 × 8)
PLS103 (82S103)	Field Programmable Gate Array (FPGA) (16 × 9 × 9)
PLS105 (82S105)	Field Programmable Logic Sequencer (FPLS) (16 × 48 × 8)
PLS105A (82S105A)	Field Programmable Logic Sequencer (FPLS) (16 × 48 × 8)

PLD software support

AMAZE

Boolean equation entry and simulator packages for VAX-VMS,
PDP-RSX11, IBMPC-MSDOS

SystemGate and SystemCell software support

SystemGate and SystemCell are supported on such popular engineering workstations as Mentor and Daisy. Mullard will supply SystemGate and SystemCell libraries and design manuals, so that you can do your designs in-house.

SystemGate and SystemCell are also supported on the Personal Design Station, with the following configurations:

hardware — IBM-PC (model XT or AT)

— Future Net Dash 4

software — LESIM, a Philips proprietary
simulation package

We can also offer you a full design flow on VAX computers, using proprietary software.

ACE software support

ACE arrays are supported on such popular engineering workstations as Mentor and Daisy.

Mullard will supply an ACE library, and a design manual, so that you can do your design in-house. We can also offer you a full design flow on VAX computers using proprietary software.

Semi-custom circuits

gate arrays: CMOS

CMOS

Standard Speed: 4 μ SLM

		■ PCF0330 ■ PCC0330	■ PCF0450 ■ PCC0450	■ PCF0700 ■ PCC0700	■ PCF1100 ■ PCC1100
Gate equivalents (2-input)		330	448	704	1116
Cell units		165	224	352	558
Rows of cell units		11	14	16	18
Cell units per row		15	16	22	31
Horizontal mask-programmable interconnection strips					
above top row of cell units	max.	5	5	5	6
between cell units	max.	10	9	10	13
below bottom row of cell units	max.	5	5	5	6
Bonding pads	max.	40	28	40	68
Input/output stages with choice of		38	26	38	66
3-state I/O	max.	34	26	38	66
drivers	max.	38	14	22	66
buffers	max.	38	12	16	66
Schmitt-triggers	max.	34	8	10	66
Pin pull-up/pull-down resistors	max.	34	26	34	66
Gate delays					
at $V_{DD} = 5\text{ V}$	max.	16 ns	16 ns	16 ns	16 ns
	typ.	8 ns	8 ns	8 ns	8 ns
at $V_{DD} = 10\text{ V}$	max.	6.4 ns	6.4 ns	6.4 ns	6.4 ns
	typ.	3.2 ns	3.2 ns	3.2 ns	3.2 ns
at $V_{DD} = 15\text{ V}$	max.	4 ns	4 ns	4 ns	4 ns
	typ.	2 ns	2 ns	2 ns	2 ns
Maximum toggle frequency					
at $V_{DD} = 5\text{ V}$	min.	6 MHz	6 MHz	6 MHz	6 MHz
at $V_{DD} = 10\text{ V}$	min.	12 MHz	12 MHz	12 MHz	12 MHz
at $V_{DD} = 15\text{ V}$	min.	15 MHz	15 MHz	15 MHz	15 MHz
Supply voltage					
	<i>rating</i>		<i>operating voltage</i>		
PCXXXXXB	-0.5 to 18		3 to 15.0V		
PCXXXXXV	-0.5 to 18		3 to 12.5V		

Refer to the next but one page for package availability.

Continued

gate arrays: CMOS (cont.)

CMOS (cont.)

High speed: 3 μ SLM

		■ PCF0336 ■ PCC0336	■ PCF0456 ■ PCC0456	■ PCF0706 ■ PCC0706	■ PCF1106 ■ PCC1106
Gate equivalent (2-input)		330	448	704	1116
Cell units		165	224	352	558
Rows of cell units		11	14	16	18
Cell units per row		15	16	22	31
Horizontal mask-programmable interconnection strips					
above top row of cell units	max.	5	5	5	6
between cell units	max.	10	9	10	13
below bottom row of cell units	max.	5	5	5	5
Bonding pads	max.	40	28	40	68
Input/output stages with choice of		38	26	38	66
3-state I/O drivers	max.	38	26	38	66
buffers	max.	38	26	38	66
Schmitt-triggers	max.	38	26	38	66
Pin pull-up/pull-down resistors	max.	38	26	38	66
Gate delays					
at $V_{CC} = 2.0$ V	typ.	8.5 ns	8.5 ns	8.5 ns	8.5 ns
at $V_{CC} = 5.0$ V		2.0 ns	2.0 ns	2.0 ns	2.0 ns
at $V_{CC} = 6.0$ V		1.8 ns	1.8 ns	1.8 ns	1.8 ns
Maximum toggle frequency					
at $V_{CC} = 2.0$ V	typ.	15 MHz	15 MHz	15 MHz	15 MHz
at $V_{CC} = 5.0$ V	typ.	50 MHz	50 MHz	50 MHz	50 MHz
at $V_{CC} = 6.0$ V	typ.	60 MHz	60 MHz	60 MHz	60 MHz

Refer to the next page for package availability.

Continued

Semi-custom circuits

gate arrays: CMOS (cont.)

CMOS (cont.)

Standard speed: 4 μ SLM and High speed: 3 μ SLM

PACKAGE AVAILABILITY

package type	no. of pins	PCF0330 PCC0330 PCF0336 PCC0336	PCF0450 PCC0450 PCF0456 PCC0456	PCF0700 PCC0700 PCF0706 PCC0706	PCF1100 PCC1100 PCF1106 PCC1106
Plastic DIL	8	*	*	*	—
	14	*	*	—	—
	16	*	*	—	—
	18	*	*	*	—
	20	*	*	*	—
	24	*	*	*	*
	28	*	*	*	*
40	*	—	*	*	
Plastic SO	16	*	*	*	—
	20	*	*	*	—
	24	*	*	*	—
	28	*	*	*	—
Plastic VSO	40	*	—	*	*
PLCC (Plastic leaded chip carrier)	44	—	—	*	*
	68	—	—	*	*
Ceramic (cerdip)	14	*	*	—	—
	16	*	*	—	—
	18	*	*	—	—
	20	*	*	*	—
	24	*	*	*	*
	28	*	*	*	*
	40	*	—	*	*

gate arrays: CMOS (cont.)

CMOS (cont.)

SystemGate: 2 μ DLM

SystemGate is executed in a 2 μ m drawn gate (1.6 μ m effective channel length) N-well CMOS process (C428). This gives typical gate delays of 1.5ns, and a maximum flip-flop toggle frequency of 60MHz. The double layer metal (DLM) interconnect minimises the wiring delays and allows implementation of designs with a typical clock frequency of up to 40MHz, dependent of course on the system design.

SystemGate Features

- complexity 800–6300 gates
- 2.0 μ m CMOS (drawn gate)
- double layer metal interconnect
- 1.5ns typical gate delay
- comprehensive library of functions
- supported on Mentor & Daisy engineering work stations
- supported on the Philips Personal Design Station
- wide packaging range
- operating voltage 2–6 Volt
- standard operating temperatures –40 to +85°C
- extended temperature range –55 to +125°C (PCC 0800–PCC 6300)
- output current 2, 4, and 8mA (source and sink)
- TTL and CMOS compatible inputs
- maximum flip-flop toggle frequency 60MHz
- systemclock frequency up to 40MHz
- suitable for synchronous and asynchronous designs
- latch-up free (epitaxial layers)
- ESD-protection exceeding 2kV
- fully SystemCell compatible

Type No.	No. of gates	No. of bond pads	max. I/O's	V _{DD} /V _{SS}
■ ● PCC0800 ■ ● PCF0800	832	52	44	4/4
■ ● PCC1500 ■ ● PCF1500	1513	68	60	4/4
■ ● PCC2400 ■ ● PCF2400	2380	88	80	4/4
■ ● PCC3300 ■ ● PCF3300	3312	104	96	4/4
■ ● PCC4500 ■ ● PCF4500	4525	128	120	4/4
■ ● PCC6300 ■ ● PCF6300	6272	156	148	4/4

Continued

Semi-custom circuits

gate arrays: CMOS (cont.)

CMOS (cont.)

SystemGate: 2 μ DLM

PACKAGE AVAILABILITY

package type	no. of pins	PCC0800 PCF0800	PCC1500 PCF1500	PCC2400 PCF2400	PCC3300 PCF3300	PCC4500 PCF4500	PCC6300 PCF6300
Plastic DIL	24	*	*				
	28	*	*	*	*		
	40	*	*	*	*	0†	
Plastic SO	24	*	*				
	28	*	*				
PLCC (Plastic leaded- chip carrier)	44	*	*	*	*	*	*
	68		*	*	*	*	*
	84			*	*	*	*
PGA (ceramic pin grid array)	84			0†	0†	*	*
	120				*	*	0†
	144				*	*	0†

† More lead frames will be introduced in the near future to allow these combinations.

cell array family: ECL (ACE)

ECL (ACE); 10K or 100K compatible

■ THE ACE CELL ARRAY FAMILY, AVAILABLE IN TURBO (T) AND LOW POWER (L) OPTIONS.

	● ACE2L00	ACE6L00	ACE9L00	ACE14L00	ACE1320	ACE22L00	
	● ACE2T00	ACE6T00	ACE9T00	ACE14T00		ACE22T00	● ACE30T00
Equivalent gates	200	600	900	1400	1000	2200	1000
Major cell sites	8	24	36	60	52	100	36
Minor cell sites	4	10	22	12	14	16	16
Input cell sites	16	30	30	—	—	—	—
I/O cell sites	20	28	28	96	112	128	128
Versions with RAM	—	—	—	5	—	8	—
On-chip RAM (bits)	—	—	—	—	320	—	1280
Typical power dissipation (W)							
L-versions	0.5	1	1.4	2.1	—	3	—
T-versions	0.9	1.8	2.3	3.5	—	5	—
Number of pins	24/28/44	64/68	64/68	84/144	144/148	144/148	144/148
Supply pins	6	6	6	16	16	16	16

PACKAGE CODING

PACKAGE LETTERS	PIN GRID ARRAY (PGA)		QUAD FLAT PACK (QFP)		
	64 PIN	144 PIN	68 PIN	84 PIN	148 PIN
	Soldered PC	Soldered PCK	YCR	YCM	YCT
ACE 200	—	—	—	—	—
ACE 600	*	—	*	—	—
ACE 900	*	—	*	—	—
ACE 1400	—	*	—	*	*
ACE 2200	—	*	—	*	*
ACE 1320	—	*	—	*	*
ACE 3000	—	*	—	—	*

	PLCC			CERDIP	FLATPACK
	28 PIN	44 PIN	66 PIN	24 PIN	24 PIN
ACE 200	*	*	—	*	*
ACE 600	*	*	*	—	—
ACE 900	—	—	*	—	—
ACE 1400	—	—	—	—	—
ACE 2200	—	—	—	—	—
ACE 1320	—	—	—	—	—
ACE 3000	—	—	—	—	—

The following heatsinks are available for PGA packages

DESCRIPTION	LETTER	64 PIN	144 PIN
Extruded	S	*	—
Vertical fins	H	*	*
Horizontal plates	P	*	*

Semi-custom circuits

cell libraries: CMOS

SystemCell

SystemCell features:

- CMOS N-cell silicon gate technology employing Double Layer Metal interconnects.
- 2 μ m drawn transistor channel length; 1.6 μ m effective gate length.
- comprehensive cell library already containing more than 250 different functions, which is being continually extended.
- allows design complexity of up to 10k equivalent 2-input gates per chip.
- typical 1ns internal gate delay.
- 60MHz maximum flip-flop toggle frequency.
- CMOS and TTL compatible I/O cells.
- 2V to 6V power supply range.
- operating temperature range: normal -40 to +85°C
extended -55 to +125°C
- ESD protected up to 2kV.
- latch up free (epitaxial layers) up to at least 100mA at 25°C.
- wide packaging range.
- fully alternate sourced by Texas Instruments.

Core cells

inverters
buffers
NAND/AND gates
OR/NOR gates
EXOR/EXNOR gates
multiplexers/decoders
positive triggered patches/
master modules
negative triggered latches/
slave modules
flip-flops
registers
complex logic functions

Macro functions

decoders
multiplexers
counters
ALUs
shift registers
octal drivers
latches and flip-flops
adders
comparators
odd/even parity generator/
checker

I/O functions

inverting/non inverting input
buffers (CMOS or TTL levels)
output buffers
(push-pull, open-drain or 3-state)
bi-directional buffers
(CMOS or TTL level inputs)

Subsequent general releases of the System Cell library will include RAMs, ROMs, PLAs, 290X blocks, analog functions and interface functions. We can already accept designs which incorporate these elements.

Packaging

Plastic DIL	Plastic SO	PLCC plastic leaded-chip carrier	PGA ceramic pin grid array
8, 16, 18, 20, 24, 28 and 40 pins	14, 16, 20, 24 and 28 pins	44, 68 and 84 pins	88 and 144 pins

More packages will be added to this list. For example, quad flatpacks (64 to 160 pins) and higher pin-count packages (up to 240 pins).

speech synthesizers

SPEECH SYNTHESIZERS

MEA8000	voice synthesizer
PCF8200	voice synthesizer
OM8000	standard Euro-card demo for MEA8000
OM8001	speech demonstration box
OM8002	dutch diphone board
OM8010	stand-alone speech editing system
OM8200	Euro-card demo for PCF8200
OM8201	speech demo box for PCF8200
OM8209	update package for OM8010
OM8210	speech editing system for PCF8200

Signetics military products

PROCESSING LEVELS

JAN Class B (order code prefix JB)

JAN-qualified product provides the optimum in quality and reliability. This level is offered as a result of the US Government's standardisation programmes and is monitored by the Defense Electronic Supply Center (DESC) by the use of industry-wide procedures and specifications. JAN-qualified devices are manufactured, processed and tested in a facility certified to MIL-M-38510 and appropriate device slash sheet specifications. Design documentation, lot sampling plans, electrical test data and qualification data for each specific part type have been approved by DESC and products appear on the DESC Qualified Products List (QPL-38510).

MIL-STD-883 Class B (order code prefix RB)

Product is processed to MIL-STD-883 Methods 5004 and 5005 and is the industry standard where military temperature range, screening and burn-in are required.

Wherever possible product is manufactured in full compliance with the requirements of Revision C of MIL-STD-883; non-compliant product may be identified by the addition of 'NC' to the device marking.

Package outlines for JAN and 883 products

Package outlines and physical dimensions conform with Appendix C of MIL-M-38510

Table 1 Military package designations

Class B Case outline Lead finish	Package description, dual-in-line (DIL) and ceramic leadless chip carrier (CLCC)			
	Pins	Width (ins)	DIL	CLCC
BCA	14	0.3	●	—
BEA	16	0.3	●	—
BJA	24	0.6	●	—
BLA	24	0.3	●	—
BPA	8	0.3	●	—
BQA	40	0.6	●	—
BQC	40	0.6	●	—
BRA	20	0.3	●	—
BVA	18	0.3	●	—
BWA	22	0.4	●	—
BXA	50	0.9	●	—
BXC	68	0.9	●	—
B2C	20	—	—	●
B3C	28	—	—	●

Lead finish. A = Hot solder dip

C = Gold electroplate

Signetics military products

Table 2 Bipolar memory and programmable logic

883 Type Marking	Organisation	Output structure	Speed (ns)	MIL-M-38510 Slash sheet
PROM				
82S126/BEA	256 × 4	open collector	70	20301BEA
82S126A/BEA	256 × 4	open collector	35	20303BEA†
82S129/BEA	256 × 4	3-state	70	20302BEA
82S129A/BEA	256 × 4	3-state	35	20304BEA†
82S130/BEA	514 × 4	open collector	70	20401BEA
82S130A/BEA	514 × 4	open collector	35	20403BEA†
82S131/BEA	514 × 4	3-state	70	20402BEA
82S131A/BEA	514 × 4	3-state	35	20404BEA†
82S137/BVA	1K × 4	3-state	80	20602BVA
82S137A/BVA	1K × 4	3-state	70	20602BVA
82S185/BVA	2K × 4	3-state	115	20902BVA
82S185A/BVA	2K × 4	3-state	80	20902BVA
82HS195/BRA†	4K × 4	3-state	40	21005BRA†
82S23/BEA	32 × 8	open collector	65	20701BEA
82S23A/BEA	32 × 8	open collector	35	20703BEA†
82S123/BEA	32 × 8	3-state	65	20702BEA
82S123A/BEA	32 × 8	3-state	35	20704BEA†
82S115/BJA *	512 × 8	3-state	90	20803BJA†
82S141/BJA	512 × 8	3-state	90	20802BJA
82S147/BRA	512 × 8	3-state	75	
82S181/BJA	1K × 8	3-state	90	20904BJA
82S181A/BJA	1K × 8	3-state	80	20904BJA†
82S181A/B3C NC	1K × 8	3-state	80	
82HS187/BJA *†	1K × 8	3-state		
82HS189/BJA *†	1K × 8	3-state		
82S191/BJA	2K × 8	3-state	100	21002BJA
82S191/B3C NC	2K × 8	3-state	100	
82S191A/BJA	2K × 8	3-state	60	21004BJA†
82S191A/BLA	2K × 8	3-state	60	21004BLA†
82S191A/B3C NC	2K × 8	3-state	60	
82S321/BJA	4K × 8	3-state	80	
82S321/B3C† NC	4K × 8	3-state	80	
82HS321/BJA†	4K × 8	3-state	45	
82HS321/B3C† NC	4K × 8	3-state	45	
82HS641/BJA†	8K × 8	3-state	60	
PLD				
82S100/BXA	Logic Array 16 × 48 × 8	3-state	80	
82S101/BXA	Logic Array 16 × 48 × 8	open collector	80	
82S105/BXA	Sequencer 16 × 48 × 8	3-state		
82S153/BRA NC	Logic Array 16 × 42 × 10	3-state	55	
82S153A/BRA	Logic Array 16 × 42 × 10	3-state	45	
82S161/BLA†	Logic Array 12 × 48 × 8	3-state		
82S167/BLA†	Sequencer 14 × 48 × 6	3-state		
82S168/BLA†	Sequencer 12 × 48 × 8	3-state		
82S173/BLA†	Logic Array 22 × 42 × 10	3-state		
82S179/BLA†	Sequencer 12 × 42 × 12	3-state		
RAM				
54S189/BEA	16 × 4	3-state	50	
82S09/BXA	64 × 9	open collector	80	
82S16/BEA	256 × 1	3-state	70	
82S212/BWA NC	256 × 9	3-state	70	
8X350/BWA NC	256 × 8	3-state	40	

Notes † = Planned for introduction

* = Registered outputs

NC = Not fully compliant with Revision C of MIL-STD-883, due to non availability of recent Group C or Group D results.

Signetics military products

Table 3 Bipolar and MOS LSI

833 type marking	Description
Bipolar LSI	
8X60/BXA NC	FIFO RAM controller
8X305/BXA NC	8-bit microcontroller
8X310/BQA NC	Interrupt controller
8X320/BQC NC	Dual port RAM
8X371/BXC NC	8-bit sync I/O port
8X372/BXC NC	Sync. addressable I/O port
8X376/BXC NC	Async. addressable I/O port
MOS LSI	
68000-6/BXC NC	Microprocessor 16-bit 6 MHz
68000-8/BXC NC	Microprocessor 16-bit 8 MHz
2661/BXA NC†	USART
2681/BQA NC†	Dual UART
68154/BQA NC†	VME Bus interrupt generator
68155/BQA NC†	VME bus interrupt handler
68172/BJA NC†	VME bus controller m/s

Notes † = Planned for introduction during 1986

NC = Not fully compliant with Revision C of MIL-STD-883, due to non-availability of recent Group C or Group D results.

Table 4 Bipolar logic

883 type marking	Description	MIL-M-38510 Slash Sheet
54F00/BCA	Quad 2-input NAND gate	33001BCA†
54F02/BCA	Quad 2-input NOR gate	33301BCA†
54F04/BCA	Hex inverter	33002BCA†
54F08/BCA	Quad 2-input AND gate	34001BCA†
54F10/BCA	Triple 3-input NAND gate	33003BCA†
54F11/BCA	Triple 3-input AND gate	34002BCA†
54F20/BCA	Dual 4-input NAND gate	33004BCA†
54F32/BCA	Quad 2-input OR gate	33501BCA†
54F38/BCA	Quad 2-input NAND buffer	
54F64/BCA	AND/OR inverter	33401BCA†
54F74/BCA	Dual D-type flip-flop	34101BCA†
54F86/BCA	Quad 2-input EX-OR gate	34501BCA†
54F109/BEA	Dual JK flip-flop	34102BEA†
54F138/BEA	1-of-8 decoder	33701BEA†
54F139/BEA	Dual 1-of-4 decoder	33702BEA†
54F151/BEA	8-input multiplexer	33901BEA†
54F153/BEA	Dual 4-input multiplexer	
54F157A/BEA	Quad 2-input multiplexer	33903BEA†
54F161A/BEA†	Synchronous 4-bit counter	
54F163A/BEA	Synchronous 4-bit counter	
54F175/BEA	Quad D-type flip-flop	34104BEA†
54F194/BEA	4-bit shift register	33601BEA†
54F240/BRA	Octal inverting buffer	33201BRA†
54F241/BRA†	Octal buffer	
54F244/BRA†	Octal buffer	
54F245/BRA	Octal transceiver	
54F251/BEA†	8-input multiplexer TSO/P	
54F253/BEA	Dual 4-input multiplexer	33908BEA†
54F257A/BEA	Quad 2-input multiplexer	33906BEA†
54F258A/BEA†	Quad 2-input mux-inverting	
54F280A/BEA†	9-bit parity generator	
54F283/BEA	4-bit adder	
54F373/BRA	Octal latch TS output	34601BRA†
54F374/BRA	Octal D-type TS output	34105BRA†
54F521/BRA	Octal comparator	

Note † = Planned for introduction

Signetics military products

Table 5 Bipolar linear

883 type marking	Description	MIL-M-38510 Slash Sheet
LH2101A/BEA	Dual op amp	10105BEA
LM124/BCA	Quad op amp	
LM139/BCA NC	Quad comparator	
LM139A/BCA NC	Quad comparator	
μA733/BCA	Video op amp	
521/BCA NC	Dual comparator	
527/BCA NC	High speed comparator	
529/BCA NC	High speed comparator	
555/BCA	Timer 14 pin	10901BCA
555/BPA	Timer 8 pin	10901BPA
556-1/BCA NC	Dual Timer	10902BCA
567/BCA	Tone decoder	
592/BCA	Video op amp	
5018/BWA	8-bit D/A converter	
5205/BPA†	20 dB video amplifier	
5512/BPA	Dual op amp	
5521/BVA†	LVDT controller	
5532A/BPA	Dual low noise op amp	
5534A/BPA	Low noise op amp	
5539/BCA	Video op amp	
5560/BCA NC	SMPS controller	

Notes † = Planned for introduction

NC = Not fully compliant with Revision C of MIL-STD-883, due to non availability of recent Group C or Group D text data.

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Mullard

Discrete Semiconductors

- Products included for the first time in this guide are indicated both in the index pages and data pages by a black dot alongside the type number.
- Devices for surface mounting are indicated in both the index pages and the data pages by a black square alongside the type number.
- € Devices approved and available to CECC specifications.

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Small-signal transistors

n-p-n silicon low power transistors book 1 part 1a

$I_{C(AV)}$ max.	Type No.	Ratings		Characteristics						Com- ments	Outline	Pinning
		V_{CE0} (V)	P_{tot} at 25°C (mW)	h_{FE} min.	h_{FE} max.	at I_C (mA)	f_T min. (MHz)	$V_{CE(sat)}$ max. (V)	at I_C/I_B (mA)			
(A)												1, 2, 3
GENERAL PURPOSE												
0.05	†BF420 †BF422	300† 250	830	50	–	25	60	–	–		TO-92	cbe
0.05	BF483 BF485 BF487	250 300 350	830	50	–	25	70	–	–	Class A video output	TO-92	cbe
0.1	€ BC107	45	300	110	450	2	300*	0.25	10/0.5		TO-18	ebc▲
	€ BC108	20		110	800					N < 4dB		
	€ BC109	20		200	800							
	€ BC107A,B	45		A 110	220							
	€ BC108A,B,C	20		B 200	450						N < 4dB	
€ BC109B,C	20		C 420	800								
0.1	†BC546	65	500	110	450	2	300*	0.25	10/0.05		TO-92	ebc
	†BC547	45		110	800							
	†BC548	30		110	800							
	†BC549	30		200	800					N < 4dB		
	†BC550	45		200	800					N < 3dB		
	†BC546A,B	65										
	†BC547A,B,C	45		A 110	220							
	†BC548A,B,C	30		B 200	450						N < 4dB	
	†BC549B,C	30		C 420	800						N < 3dB	
†BC550B,C	45											
0.5	†BC337	45	800	100	600	100	200*	0.7	500/50		TO-92	ebc
	†BC338	25		100	600							
	†BC337-16,25,40	45		16 100	250							
	†BC338-16,25,40	25		25 160	400							
				40 250	600							
0.5	● MPSA42	300	625	40	–	30	50	0.5	20/2		TO-92	cbe
	● MPSA43	200								(in line)		
0.6	2N5550	140	625	60	250	10	100	0.25	50/5		TO-92	cbe
	2N5551	160		80	250			0.20		(in line)		
0.8	€ 2N2222	30	500	75	–	10	250	0.4	150/5		TO-18	ebc▲
0.8	€ 2N2219	30	800	75	–	10	250	0.4	150/15		TO-39	ebc▲

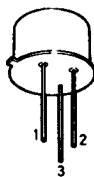
*Typical † V_{CER} € Also available to CECC 50 000
‡ Also available to D3007

▲ Collector connected to case

Continued



TO-18



TO-39



TO-92



TO-92 (in line)

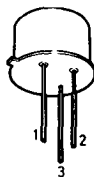
n-p-n silicon low power transistors E (cont.) book 1 part 1a

$I_{C(AV)}$ max.	Type No.	Ratings		Characteristics					Comments	Outline	Pinning
		V_{CE0} (V)	P_{tot} at 25°C (mW)	h_{FE} min.	h_{FE} max.	at I_C (mA)	f_T min. (MHz)	$V_{CE(sat)}$ max. (V)			
(A)											1, 2, 3

GENERAL PURPOSE (cont.)

1	E BFX84	60	800	30	—	150	50	0.35	150/15		TO-39	ebc▲
	E BFX85	60		70								
1	E BFY50	35	800	30	—	150	60	0.2	150/15		TO-39	ebc▲
	E BFY51	30		40			50	0.35				
	E BFY52	20		60			50	0.35				
1	E 2N3019	80	800	100	300	150	100	0.5	500/50	Gain linearity	TO-39	ebc▲
1	‡BC368	20	1W	85	375	500	60*	0.5	1A/100		TO-92	bce
1	‡BC635	45	1W	40	250	150	130*	0.5	500/50		TO-92	bce
	‡BC637	60										
	‡BC639	80										
1	E BSX47	80	6.2W ⁽¹⁾	40	160	100	50	0.9	500/25	$\left. \begin{array}{l} t_{on} = 200\text{ns} \\ t_{off} = 850\text{ns} \\ \text{at } I_C = 100\text{nA} \end{array} \right\}$	TO-39	ebc▲

*Typical ¹T_{case} = 25°C E Also available to CECC 50 000 ▲ Collector connected to case
‡ Also available to D3007



TO-39



TO-92

Small-signal transistors

p-n-p silicon low power transistors book 1 part 1a

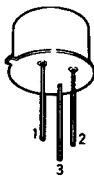
$I_{C(AV)}$ max.	Type No.	Ratings		Characteristics						Com- ments	OutlinePinning	
		V_{CE0} (V)	P_{tot} at 25°C (mW)	h_{FE} min.	h_{FE} max.	at I_C (mA)	f_T min. (MHz)	$V_{CE(sat)}$ max. (V)	at I_C/I_B (mA)			
(A)												1, 2, 3
GENERAL PURPOSE												
0.05	‡BF421 ‡BF423	-300† -250	830	50	-	25	60	-	-			TO-92 bce
	‡BC556 ‡BC557 ‡BC558 ‡BC559 ‡BC560	-65 -45 -30 -30 -45	500	75 75 75 125 125	900 900 900 900 900	2.0	200*	-0.3	10/0.5			TO-92 ebc N < 4dB N < 3dB
0.1	‡BC556A,B ‡BC557A,B,C ‡BC558A,B,C ‡BC559A,B,C ‡BC560A,B,C	-65 -45 -30 -30 -60		A 125 B 220 C 420	250 475 800							N < 4dB N < 3dB
0.2	€BCY70 €BCY71 €BCY72	-40 -45 -25	350	100 100 100	- 400 -	10	250	-0.25	10/1			TO-18 ebc▲
0.5	‡BC327 ‡BC328 ‡BC327-16,25,40 ‡BC328-16,25,40	-45 -25 -45 -25	625	100 100 16 25 40	600 600 100 160 250 600	100	100*	-0.7	500/50			TO-92 ebc
0.5	BFT44 BFT45	-300 -250	5W ¹⁾	50	150	10	70*	-5.0 -3.0	500/100			TO-39 ebc▲
0.5	●MPSA92 ●MPSA93	-300 -200	625	25	-	30	50	-0.5	20/2			TO-92 cbe (in line)
0.6	€BFX29 €BFX87 €BFX88	-60 -50 -40	600	50 40	- -	10	100	-0.4	150/15			TO-39 ebc▲
0.6	2N5400 2N5401	-120 -150	625	40 60	180 240	10	100	-0.5	50/5			TO-92 cbe (in line)

*Typical † V_{CER} ¹⁾ $T_{case} = 50^\circ C$ € Also available to CECC 50 000 ▲ Collector connected to case
‡ Also available to D3007

Continued



TO-18



TO-39



TO-92



TO-92
(in line)

p-n-p silicon low power transistors Ξ (cont.) book 1 part 1a

$I_{C(AV)}$ max.	Type No.	Ratings		Characteristics						Outline Pinning	
		V_{CE0} (V)	P_{tot} at 25°C (mW)	min.	h_{FE} max.	at I_C (mA)	f_T min. (MHz)	$V_{CE(sat)}$ max. (V)	at I_C/I_B (mA)	1, 2, 3	
(A)											
GENERAL PURPOSE (cont.)											
1	\ddagger BC369	-20	1W	85	375	500	60*	-0.5	1A/100	TO-92	bce
1	2N4032 2N4033	-60 -80	800	70	-	500	150	-0.5	500/50	TO-39	ebc▲
1	Ξ BSV17	-80	800	40	160	100	50	-1.0	500/25	TO-39	ebc▲
1	\ddagger BC636 \ddagger BC638 \ddagger BC640	-45 -60 -80	1W	40	250	150	50*	-0.5*	500/50	TO-92	bce
1	\ddagger PH5415 \ddagger PH5416	-200 -300	500	30 30	150 120	50	15	-2.5 -2.0	50/5	TO-92	ebc

*Typical Ξ Also available to CECC 50 000
 \ddagger Also available to D3007

▲ Collector connected to case



TO-39



TO-92

Small-signal transistors

low-voltage medium power transistors

book 1 part 1b

$I_{C(AV)}$ max.	Type No.		Maximum ratings				Characteristics					Outline	
			V_{CBO}	V_{CEO}	I_{CM}	$P_{T_{mb}}^{tot} = 25^{\circ}C$ (W)	h_{FE} min.	h_{FE} max.	at I_C	f_T min.	$V_{CE(sat)}$ max.		at I_C/I_B
(A)	N-P-N	P-N-P	(V)	(V)	(A)	(W)			(mA)	(MHz)	(V)	(A)	
1	BD135	BD136	45	45	1.5	8	40	250	150	250*a)	0.5	0.5/0.05	TO-126
	BD137	BD138	60	60									
	BD139	BD140	100	80									
1	BD825	BD826	45	45	1.5	2‡	40	250	150	250*a)	0.5	0.5/0.05	TO-202
	BD827	BD828	60	60									
	BD829	BD830	100	80									
1.5	BD226	BD227	45	45	3	12.5	40	250	150	125*b)	0.8	1/0.1	TO-126
	BD228	BD229	60	60									
	BD230	BD231	100	80									
1.5	BD839	BD840	45	45	3	2‡	40	250	150	125*b)	0.8	1/0.1	TO-202
	BD841	BD842	60	60									
	BD843	BD844	100	80									
3	BD131		70	45	6	15	40	-	500	60	0.3	0.5/0.05	TO-126
		BD132	45	45									

*Typical

f_T = a) 75MHz for p-n-p types,
b) 50MHz for p-n-p types

‡ In free air



TO-126



TO-202

n-p-n silicon low/medium power switching transistors

book 1 part 1a

$I_{C(AV)}$ max.	Type No.	Ratings		Characteristics							Outline Pinning	
		V_{CEO} (V)	P_{tot} at 25°C (mW)	min.	h_{FE} max.	at I_C (mA)	t_{on} max. (ns)	t_{off} max. (ns)	t_s max. (ns)	at I_C (mA)	1, 2, 3	
0.1	BSY95A	15	300	50	200	10	–	–	50	10	TO-18	ebc▲
0.1	‡ BSS38	100	500	20	–	4	–	1000	–	15	TO-92	ebc
0.2	2N3903 2N3904	40	350	50 100	150 300	10	70	225 250	175 200	10	TO-92	cbe (in line)
0.2	2N2369 2N2369A	15	360	40 40 –	120 – 120	10(1V) 10(0.35V) 10(1V)	12	18	13	10	TO-18	ebc▲
0.5pk	BSX19 BSX20	15	360	20 40	60 120	10 10	12	15 18	10 13	10	TO-18	ebc▲
0.5pk	PH2369 PH2369A	15	500	40 40 –	120 – 120	10 10(0.35V) 10(1V)	12	18	13	10	TO-92	ebc
0.8	€ 2N2222A	40	500	75	–	10	35	285	225	150	TO-18	ebc▲
0.8	‡ PH2222 ‡ PH2222A	30 40	625	75	–	10	35	285	225	150	TO-92	ebc
0.8	€ 2N2219A	40	800	75	–	10	35	285	225	150	TO-39	ebc▲
1	BSW66A BSW67A BSW68A	100 120 150	800	30	–	10	500	900	–	500	TO-39	ebc▲
1	BSX59 BSX60 BSX61	45 30 45	800	30	–	500	35 40 50	60 70 100	–	500	TO-39	ebc▲
2	BFX34	60	870	40	150	2A	600	1200	–	5A	TO-39	ebc▲
2	BSV64	60	870	40	–	2A	600	1200	–	5A	TO-39	ebc▲

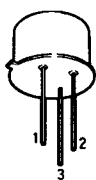
€ Also available to CECC 50 000

▲ Collector connected to case

‡ Also available to D3007



TO-18



TO-39



TO-92



TO-92
(in line)

Small-signal transistors

p-n-p silicon low/medium power switching transistors

book 1 part 1a

$I_{C(AV)}$ max.	Type No.	Ratings		Characteristics							Outline Pinning	
		V_{CE0} (V)	P_{tot} at 25°C (mW)	min.	h_{FE} max.	at I_C (mA)	t_{on} max. (ns)	t_{off} max. (ns)	t_s max. (ns)	at I_C (mA)	1, 2, 3	
0.1	€ BSS68	-100	500	30	-	25	-	-	-	-	TO-92	ebc
0.2	2N3905 2N3906	-40	350	50 100	150 300	10	70	260 295	200 225	10	TO-92	cbe (in line)
0.6	€ BFX30	-65	600	50	200	10	50	290	250	100	TO-39	ebc▲
0.6	€ 2N2906 € 2N2906A	-40 -60	400	40	120	150	45	100	80	150	TO-18	ebc▲
0.6	€ 2N2907 € 2N2907A	-40 -60	400	100	300	150	45	100	80	150	TO-18	ebc▲
0.6	€ 2N2904 € 2N2904A	-40 -60	600	40	120	150	45	100	80	150	TO-39	ebc▲
0.6	€ 2N2905 € 2N2905A	-40 -60	600	100	300	150	45	100	80	150	TO-39	ebc▲
0.6	‡PH2907 ‡PH2907A	-40 -60	625	100	300	150	45	100	80	150	TO-92	ebc

€ Also available to CECC 50 000

▲ Collector connected to case

‡ Also available to D3007



TO-18



TO-39



TO-92



TO-92
(in line)

n-p-n high-voltage medium power transistors

book 1 part 1e

$I_{C(AV)}$ max.	Type No.	Maximum ratings				Characteristics						Comments	Outline
		V_{CBO}	V_{CEO}	I_{CM}	P_{tot} $T_{mb} = 25^\circ C$	$t_{\dagger\dagger}$ max.	$V_{CE(sat)}$ max.	at I_C/I_B	h_{FE} min.	h_{FE} max.	at I_C		
(A)		(V)	(V)	(A)	(W)	(μs)	(V)	(A)			(mA)		
0.05	BF469	250	250	0.1	1.8	-	-	-	50	-	25	Class AB or Class B video output	TO-126
	BF471	300	300**										
0.05	BF583	300	250	0.1	5	-	-	-	50	-	25	Class A video output	TO-202
	BF585	350	300										
	BF587	400	350										
0.05	BF869	250	250	0.1	1.6	-	-	-	50	-	25	Class AB or B video output	TO-202
	BF871	300	300**										
0.1	BF419	300	250	0.3	6	-	11	0.2/0.02	45*	-	20	Line output drive for colour tv	TO-126
0.1	BF457	160	160	0.3	6	-	1.0	0.03/ 0.006	26	-	30	Class A video output	TO-126
	BF458	250	250										
	BF459	300	300										
0.1	BF819	300	250	0.3	2	-	11	0.2/0.02	45*	-	20	Line output drive for colour tv	TO-202
0.1	BF857	160	160	0.3	2	-	1.0	0.03/ 0.006	26	-	30	Class A video output	TO-202
	BF858	250	250										
	BF859	300	300										

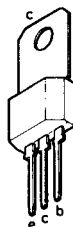
*Typical

** V_{CER} max., $R = 2.7k\Omega$

†† Under resistive conditions



TO-126



TO-202

Small-signal transistors

p-n-p high-voltage medium power transistors book 1 part 1e

$I_{C(AV)}$ max.	Type No.	Maximum ratings				Characteristics					Comments	Outline	
		V_{CBO}	V_{CEO}	I_{CM}	P_{tot} $T_{mb} = 25^\circ C$	$t_f^{\dagger\dagger}$ max.	$V_{CE(sat)}$ max.	at I_C/I_B	h_{FE} min.	h_{FE} max.			at I_C
(A)		(V)	(V)	(A)	(W)	(μs)	(V)	(A)			(mA)		
0.05	BF470	--250	-250	0.1	1.8	-	-	-	50	-	25	Class AB or B video output	TO-126
	BF472	--300	-300*										
0.05	BF870	--250	-250	0.1	1.6	-	-	-	50	-	25	Class AB or B video output	TO-202
	BF872	--300	-300*										

* V_{CER} max., $R = 2.7 k\Omega$

†† Under resistive conditions



TO-126

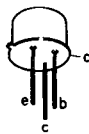


TO-202

low-voltage darlings book 1 parts 1a and 1b

$I_{C(AV)}$ max.	Type No.		Outline	Maximum ratings				Characteristics				Special features			
	N-P-N	P-N-P		V_{CBO} (V)	V_{CEO} V_{CER} (V)	I_{CM} (A)	P_{tot} max. (W)	h_{FE} min.	at I_C (mA)	$V_{CE(sat)}$ max. (V)	at I_C (A)	I_B (mA)	t_{on} typ. (μ s)	t_{off} typ. (μ s)	at I_C (A)
0.4A	● BC517	● BC516	TO-92	40	30	0.4	0.625	30000	20	1	0.1	0.1	—	—	—
1A	BSR50	BSR60	TO-92	60	45	2	0.8†	2000	500	1.3	0.5	0.5	BSR50,51,52: 0.4 < 1.5 0.5		
	BSR51			—60	—45	80	60	BSR60,61,62: <1 < 1.5 0.5							
	BSR52	BSR61		—80	—60	90	80								
		BSR62		—90	—80	90	80								
	1A	€ BSS50		€ BSS60	TO-39	60	45	2	0.8†	2000	500	1.6	1	4.0	0.4
€ BSS51		—60	—45			80	60								
€ BSS52		€ BSS61	—80	—60		90	80								
		€ BSS62	—90	—80		90	80								
1A		BDX42	BDX45	TO-126		60	45	2	5	2000	500	1.6	1	4.0	0.4
	BDX43	—60			—45	80	60								
	BDX44	BDX46	—80		—60	100	80								
		BDX47	—100		—80	100	80								

† $T_{amb} \leq 25^\circ\text{C}$ € Also available to CECC 50 000



TO-39



TO-92



TO-126

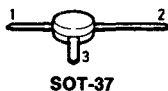
Small-signal transistors

silicon r.f. amplifier low-power transistors

book 1 part 1a

$I_{C(AV)}$ max. (mA)	Type No.	Ratings		Characteristics			Comments	Outline	Pinning	
		V_{CE0} (V)	P_{tot} at 25°C (mW)	min.	h_{FE} max.	at I_C (mA)				f_T min. (MHz)
									1, 2, 3	
N-P-N TYPES										
20	BF496	20	300	40*	—	2	550*	Typ. G_{UM} at 200 MHz = 27dB	TO-92	e b c
25	BF240 BF241	40	250	67 36	222 125	1	380* 350*	$C_{re} < 0.34\text{pF}$ at 1 MHz	TO-92	b e c
25	BF198 BF199	30 25	500	22 38	— —	4	400* 550*	$C_{re} = 0.2\text{pF}$ at 10.7MHz $C_{re} = 0.3\text{pF}$ at 10.7MHz	TO-92	b e c
30	BF494 BF495	20	300	115* 67*	— —	1	260* 200*	$C_{re} = 0.85\text{pF}$ at 0.45MHz	TO-92	b e c
100	BF370	15	500	40	—	10	500	Typ. $G_V = 24\text{dB}$ at 36MHz	TO-92	e b c
500pk	BFR54	15	500	40	—	10	500	Typ. $G_{UM} = 19\text{dB}$ at 200MHz	TO-92	e b c
P-N-P TYPES										
25	BF324	-30	250	25	—	4	450*	$N = 3\text{dB}$ typ. at $f = 100\text{MHz}$	TO-92	e b c
25	BF450 BF451	-40	250	60 30	— —	1	325* 1		TO-92	b e c
25	BF926	-20	250	30	—	1	400*	Typ. G_V at 200MHz = 17.5dB	TO-92	b e c
25	BF936	-20	250	25	—	1	350*	Typ. G_V at 200MHz = 17.5dB	TO-92	e b c
30pk	BF979	-20	140	20	—	10	1350	Typ. G_V at 800MHz = 16dB	SOT-37	e c b
30	BF970	-35	160	25	—	3	750	Typ. G_V at 200MHz = 14.5dB	SOT-37	e c b

*Typical



silicon planar n-p-n differential transistors

book 1 part 1a

$I_{C(AV)}$ max. (mA)	Type No.	Ratings		Characteristics					Comments	Outline	Pinning	
		V_{CEO} (V)	P_{tot} at 25°C (mA)	h_{FE} min.	h_{FE} max.	at I_C (mA)	f_T min. (MHz)	I_{C1}/I_{C2} ratio at equal V_{BE} min.				ratio at V_{BE} max.
	BCY87	40	150	100	450	0.05	50	0.9	1.11	Matched dual. For differential amplifiers	TO-71	e ₁ e ₂ c ₂ b ₂ b ₁ c ₁
30	BCY88			120	600	0.5	50	0.8	1.25			
	BCY89			100	600	10	50	0.67	1.5			



TO-71

Small-signal transistors

silicon planar p-n-p-n switches

book 1 parts 1a and 4b

I_{ARM} max. (A)	Type No.	Description	Ratings						Outline	Pinning				
			V_{GaK} (V)	V_{GaA} (V)	I_A (mA)	T_j (°C)	P_{tot} at 25°C (mW)	V_A (V)		at I_A (mA)	1, 2, 3,	4		
2	BR100/03	Bi-directional trigger device for use in triac and thyristor trigger circuits	-	28 to 36 ($V_{(BO)}$)	-	100	150	-	-	B				
2.5	BR101	p-n-p-n controlled switch for use as a saw tooth generator in t.v. field timebase applications	50	50	175	150	275	<1.4	50	TO-72	k	kg	ag▲	a
2.5	BRY39	Integrated p-n-p-n transistor pair. Applications include controlled switch, programmable unijunction transistor and thyristor tetrode	70	70	175	150	275	<1.4	100	TO-72	k	kg	ag▲	a
2.5	BRY56	Trigger device for switching applications such as motor controls, oscillators, relay replacements, timers, pulse shapers	70	70	175	150	300	<1.4	100	TO-92	ag	a	k	-

▲ ag connected to case



TO-72



TO-92



B

junction field-effect transistors (n-channel)

book 1 part 1c

Type No.	Ratings			Characteristics					Special features	Outline	Pinning	
	$\pm V_{DS}$ V_{DG} (V)	I_b (mA)	P_{tot} at 25°C (mW)	$-V_{(PI)SS}$ max. (V)	I_{GSS} max. (nA)	I_{DSS} min. (mA)	I_{DSS} max. (mA)	y_{fs} min. (f = 1kHz) (mA/V)			1, 2, 3,	4
AMPLIFIERS												
BC264A	30	10	300	>0.5	10	2	4.5	2.5	For audio frequency use	TO-92	d s g -	
BC264B		(I_G)				3.5	6.5	3				
BC264C						5	8	3.5				
BC264D						7	12	4				
BF245A	30	25	300	8	5	2	6.5	3	N = 1.5dB typ. at f = 100MHz, $R_G = 1k\Omega$	TO-92	d s g -	
BF245B						6	15					
BF245C						12	25					
BF247A	25	10	250	14.5	5	30	80	8	For amplifiers and general purpose switching	TO-92	d s g -	
BF247B		(I_G)				60	140					
BF247C						110	250					
BF256A	30	10	300	-	5	3	7	4.5	$G_p = 11dB$ typ. at f = 800MHz, $R_s = 47\Omega$	TO-92	d s g -	
BF256B		(I_G)				6	13					
BF256C						11	18					
BF410A	20	30	300	0.8*	10	0.7	3.0	2.5	N = 1.5dB typ. at f = 100MHz	TO-92	d s g -	
BF410B				1.5*		2.5	7.0	4.0				
BF410C				2.2*		6.0	12	6.0				
BF410D				3.0*		10	18	7.0				
BFW10	30	20	300	8	0.1	8	20	3.5	Noise voltage < 75nV/ \sqrt{Hz} at 10Hz	TO-72	s d g sh▲	
BFW11		20	300	6		4	10	3				
BFW12		10	150	2.5		1	5	2.0				

*Typical

▲ shield connected to case
Continued



TO-72



TO-92

Small-signal transistors

junction field-effect transistors (n-channel) E (cont.) book 1 part 1c

Type No.	Ratings			Characteristics				Special features	Outline	Pinning 1, 2, 3, 4
	$\pm V_{DS}$ V_{DG} (V)	I_D (mA)	P_{tot} at 25°C (mW)	$-V_{(PI)GS}$ max. (V)	I_{GSS} max. (nA)	I_{DSS} min. (mA)	I_{DSS} max. (mA)			
SWITCHING										
E BSV78	40	50	350	11	0.25	50	-	-	$R_{DS(on)} < 25\Omega$	TO-18 s d g▲ -
E BSV79		(I_G)		7		20	-		$< 40\Omega$	
E BSV80				5		10	-		$< 60\Omega$	
2N4091	40	-	1.8W	10	0.2	30	-	-	$R_{DS(on)} < 30\Omega$	TO-18 s d g▲ -
2N4092			(T_{case})	7	(I_{SGO})	15	-	-	$< \Omega$	
2N4093				5		8	-	-	$< 80\Omega$	
2N4391	40	50	1.8W	10	0.1	50	150	-	$R_{DS(on)} < 30\Omega$	TO-18 s d g▲ -
2N4392		(I_G)	(T_{case})	5		25	75		$< 60\Omega$	
2N4393				3		5	30		$< 100\Omega$	
2N4856	40	50	360	10	0.25	50	-	-	$R_{DS(on)} < 25\Omega$	TO-18 s d g▲ -
2N4857		(I_G)		6		20	100		$< 40\Omega$	
2N4858				4		8	80		$< 60\Omega$	

E Also available to CECC 50 000

▲ gate connected to case



TO-18

mos field-effect transistors



book 1 part 1c

SINGLE INSULATED-GATE FETs

Type No.	Ratings			Characteristics				Special features	Outline	Pinning	
	V_{DS} (V)	$\pm V_{GB}$ (V)	I_D (mA)	P_{tot} at 25°C (mW)	I_{GSS} max. (nA)	I_{DSS} typ. (nA)	I_{DSS} max. (nA)				$R_{DS(on)}$ typ. (Ω)
Depletion n-channel											
BFR29	-	10	20	200	0.01	>10 (mA)	40	-	For linear applications in the audio as well as the i.f. and v.h.f. frequency region	TO-72	d s g b▲
BSD10	10	15	50	275	10	1	-	15	For analogue and/or digital switching, converter and chopper applications	TO-72	s d g b▲
BSD12	20										
BSV81	-	10	50 (peak)	200	0.01	-	-	50	For switching and particularly for chopper applications	TO-72	d s g b▲
Enhancement n-channel											
BSD212	10	40	50	275	-	1	-	25	For analogue and/or digital switching, converter and chopper applications	TO-72	s d g b▲
BSD213	10	15									
BSD214	20	40									
BSD215	20	15									

▲ substrate connected to case
Continued



TO-72

Small-signal transistors

mos field-effect transistors (cont.)



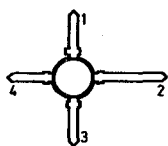
book 1 part 1c

DUAL INSULATED-GATE FETs

Type No.	Ratings			Characteristics				Special features	Outline	Pinning
	V_{DS} (V)	I_D (mA)	P_{tot} at 25°C (mW)	I_{GSS} (max.) (nA)	I_{DSS} min. (mA)	I_{DSS} max. (mA)	$-C_{rss}$ typ. (fF)			
Depletion n-channel										
† BF960	20	20	225	50	2	20	25	9.5	N = 2.8dB at f = 800MHz	SOT-103 s d g2 g1
● BF964S	20	30	225	50	4	20	25	18	N = 1.0dB at f = 200MHz	SOT-103 s d g2 g1
● BF966S	20	30	300	50	4	20	25	18	N = 1.8dB at f = 800MHz	SOT-103 s d g2 g1
BF980	18	30	225	25	—	—	25	17	N = 2.8dB at f = 800MHz	SOT-103 s d g2 g1
† BF981	20	20	225	50	4	25	20	10	N < 2dB at 200MHz	SOT-103 s d g2 g1
† BF982	20	40	225	25	—	—	30	20	N = 1.2dB at 200MHz	SOT-103 s d g2 g1
† BF984	20	50	300	10	20	55	30	12	N < 3dB at 200MHz	TO-72 d g2 g1 s(b)▲

† The gates are diode-protected

▲ source and substrate connected to case
Continued



SOT-103



TO-72

mos field-effect transistors (cont.)



book 1 part 1c

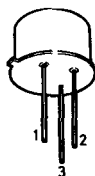
D-MOS FETs

Type No.	Ratings			Characteristics			Switching times			Outline	Pinning	
	V_{DS} (V)	I_D (A)	P_{tot} at 25°C (W)	I_{GSS} max. (nA)	I_{DSS} max. (μ A)	$R_{DS(on)}$ typ. (Ω)	t_{on} max. (ns)	t_{off} max. (ns)	at I_D (mA)		1, 2, 3	
Enhancement n-channel												
BS107	200	0.12	0.5	10	0.03	15	—	—	—	TO-92	s	g d
BS170	60	0.5	0.83	10	0.5	3.5	10	10	200	TO-92	s	g d
BST70A	80	0.5	1	100	10	2.0	10	15	500	TO-92	s	g d
BST72A	80	0.3	0.83	100	1.0	7	10	10	200	TO-92	s	g d
BST74A	200	0.25	1	100	10	6	10	25	250	TO-92	s	g d
BST76A	180	0.3	1	100	10	7	10	15	300	TO-92	s	g d
BST78	450	0.75	15	100	25	15	10	100	100	TO-126	s	d▲ g
BST90	80	0.5	2.5	100	10	2	10	15	500	TO-39	s	g d▲
BST97	180	0.3	1.5	100	10	6	10	15	300	TO-18	s	g d
2N6659	35	1.4	6.25	100	10	0.9	10	20	1000	TO-39	s	g d
2N6660	60	1.1				1.4						
2N6661	90	0.9				1.9						
Enhancement p-channel												
● BS250	-45	0.25	0.83	20	0.5	9	4	10	200	TO-92	s	g d
BST100	-60	0.3	1	100	10	4.5	4	20	200	TO-92	s	g d
BST110	-50	0.25	0.83	100	10	7.5	—	—	—	TO-92	s	g d

▲ drain connected to case/mounting base



TO-18



TO-39



TO-92



TO-126

Surface-mounted semiconductors

TAPE AND REEL SPECIFICATION FOR SURFACE-MOUNTED SEMICONDUCTORS

Semiconductors in SOT-23 and SOT-143 encapsulations can be delivered in reel packing for automatic placement on hybrid circuits and printed circuit boards. The devices are placed with the mounting side downwards in compartments.

A separate cross-section for SOD-80 encapsulation is given in Fig.3.

Taped and reeled products fulfil the requirement of IEC 286-3:

TAPE PACKAGING OF LEADLESS COMPONENTS ON CONTINUOUS TAPES.

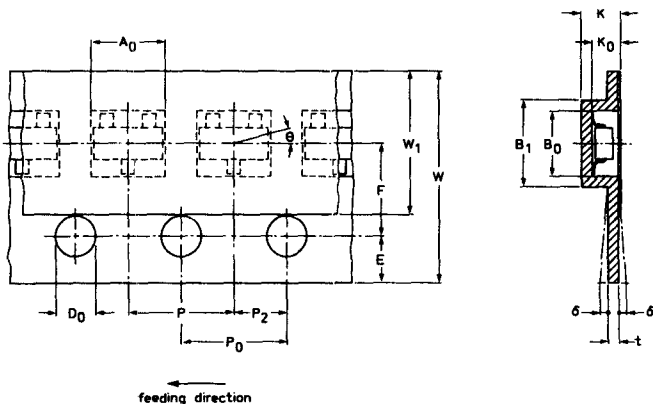


Fig. 1 Configuration of bandolier. Dimensions in mm.

Compartment

			tol.
length	A_0	component length	+0.2
width	B_0	component width	+0.2
depth	K_0	0.95	+0.2
width outside	B_1	3.3	max.
pitch	P	4.0	± 0.1
deviation	Θ	15°	max.

Sprocket hole

diameter	D_0	1.5	± 0.1
pitch	P_0	4.0	± 0.1
distance	E	1.75	± 0.1
cumulative (10)			
pitch error		± 0.1	

Centre line dimensions

			tol.
length direction	P_2	2.0	± 0.05
width direction	F	3.5	± 0.05

Fixing tape

width	W_1	5.5	± 0.25
thickness	-	0.1	max.

Carrier tape

width	W	8.0	± 0.2
bending	δ	0.3	max.
thickness	t	0.4	max.

Overall thickness

K	1.5	max.
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Continued

Surface-mounted semiconductors

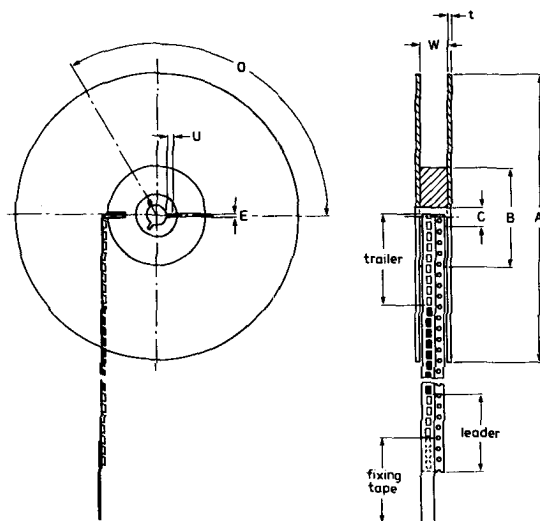


Fig. 2 Configuration of reel and flange (dimensions in mm).

Flange				Hub			
			tol.				tol.
diameter	A	180	+0 -2	diameter	B	62	± 1.5
thickness	t	1.5	+0.5 -0.1	spindle hole	C	12.75	+0.15 -0
space between flanges	W	9.5	± 0.5	key slit			
				width	E	2	± 0.5
				depth	U	4	± 0.5
				location	O	120	degrees

Amount of devices per reel

The bandolier of a 180 mm reel contains at least 3000 devices with no more than 15 empty compartments (0.5%). Three consecutive empty places might be found provided this gap is followed by 6 consecutive devices.

The carrier tape (leader) starts with at least 75 empty positions (equivalent to 300 mm); the covering foil is at least 300 mm. In order to fix the carrier tape a self-adhesive tape of 20 to 50 mm is applied.

At the end of the bandolier (trailer) at least 75 empty positions (equivalent to a length of 300 mm) and 300 mm foil. For fixing onto the reel a self-adhesive tape of 20 to 50 mm is applied.

Continued

Surface-mounted semiconductors

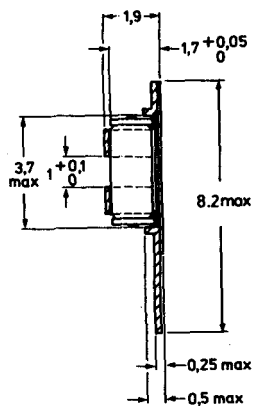


Fig. 3 Cross-sectional view of bandolier with SOD-80 devices.

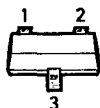
Note: Testing of SOD-80 devices is possible in this tape. Total number of devices per reel is 2500.

Surface-mounted semiconductors

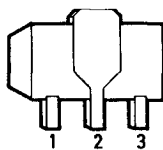
n-p-n general purpose transistors

I_C max. (mA)	Type No.	Ratings		Characteristics					Outline	Pinning			
		V_{CE0} (V)	P_{tot} (mW)	h_{FE} min./max.	V_{CEsat} max.	f_T typ. (MHz)	1, 2, 3, 4						
				at I_C/V_{CE} (mA/V)	at I_C/I_B (mA)								
100	BC846	65	200	200/800	2/5	0.25	10/0.5	300	SOT-23	e	b	c	-
	BC847	45		220/800									
	BC848	30		220/800									
	BC849	30		450/800									
	BC850	45		450/800									
100	BCV61	30	200	100/800	2/5	0.60	100/5	300	SOT-143	c2*c1	e1	e2	
100	BCV71	60	350	110/220	2/5	0.25	10/0.5	300	SOT-23	e	b	c	-
	BCV72			200/450									
100	BCW31	32	350	110/220	2/5	0.25	10/0.5	300	SOT-23	e	b	c	-
	BCW32			200/450									
	BCW33			420/800									
100	BCW71	45	350	110/220	2/5	0.25	10/0.5	300	SOT-23	e	b	c	-
	BCW72			220/450									
100	BCW81	45	350	420/800	2/5	0.25	10/0.5	300	SOT-23	e	b	c	-
200	BCW60A	32	150	120/220	2/5	0.35	10/0.25	250	SOT-23	e	b	c	-
	BCW60B			180/310									
	BCW60C			250/460									
	BCW60D			380/630									
200	BCX70G	45	150	120/220	2/5	0.35	10/0.25	250	SOT-23	e	b	c	-
	BCX70H			180/310									
	BCX70J			250/460									
	BCX70K			380/630									
500	BC817	45	310	100/600	100/1	0.70	500/50	200	SOT-23	e	b	c	-
	BC818	25											
500	BCX19	45	425	100/600	100/1	0.62	500/50	200	SOT-23	e	b	c	-
	BCX20	25											
1000	BC868	20	1000	85/375	500/1	0.50	1000/100	60	SOT-89	e	c	b	-
1000	BCX54	45	1000	45/250	150/2	0.50	500/50	130	SOT-89	e	c	b	-
	BCX55	60		40/250									
	BCX56	80		40/250									

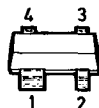
*b1 and b2 connected to pin 1.



SOT-23



SOT-89



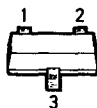
SOT-143

Surface-mounted semiconductors

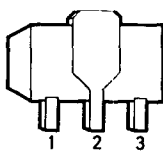
p-n-p general purpose transistors

I_C max.	Type No.	Ratings		Characteristics					Outline	Pinning			
		V_{CE0} (V)	P_{tot} (mW)	h_{FE} min./max. at I_C/V_{CE} (mA/V)		V_{CEsat} max. at I_C/I_B (V)	f_T typ. (MHz)	1,		2,	3,	4	
100	BC856	-65	200	75/475	2/5	0.30	10/0.5	150	SOT-23	e	b	c	-
	BC857	-45		75/800									
	BC858	-30		75/800									
	BC859	-30		125/800									
	BC860	-45		125/800									
100	BCV62	-30	200	100/800	2/5	0.65	100/5	150	SOT-143	c2*c1	e1	e2	
100	BCW29	-32	350	120/260	2/5	0.30	10/0.5	150	SOT-23	e	b	c	-
	BCW30			215/500									
100	BCW69	-45	350	120/260	2/5	0.30	10/0.5	150	SOT-23	e	b	c	-
	BCW70			215/500									
100	BCW89	-60	350	120/260	2/5	0.30	10/0.5	150	SOT-23	e	b	c	-
200	BCW61A	-32	150	120/220	2/5	0.25	10/0.25	180	SOT-23	e	b	c	-
	BCW61B			180/310									
	BCW61C			250/460									
	BCW61D			380/630									
200	BCX71G	-45	150	120/220	2/5	0.25	10/0.25	180	SOT-23	e	b	c	-
	BCX71H			180/310									
	BCX71J			250/460									
	BCX71K			380/630									
500	BC807	-45	310	100/600	100/1	0.70	500/50	100	SOT-23	e	b	c	-
	BC808	-25											
500	BCX17	-45	425	100/600	100/1	0.62	500/50	100	SOT-23	e	b	c	-
	BCX18	-25											
1000	BC869	-20	1000	85/375	500/1	0.50	1000/100	60	SOT-89	e	c	b	-
1000	BCX51	-45	1000	40/250	150/2	0.50	500/50	50	SOT-89	e	c	b	-
	BCX52	-60											
	BCX53	-80											

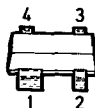
*b1 and b2 connected to pin 1



SOT-23



SOT-89

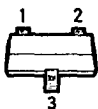


SOT-143

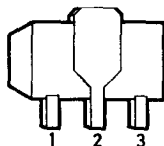
high-voltage transistors

I_C max. (mA)	Type No.	Ratings		Characteristics				Outline	Pinning 1, 2, 3	
		V_{CE0} (V)	P_{tot} (mW)	h_{FE} min./max. at I_C/V_{CE}	V_{CEsat} max. at I_C/I_B	f_T min. (MHz)				
N-P-N										
20	BF620 BF622	300* 250	1000	50/-	25/20	0.6	30/5	60	SOT-89	e c b
50	BF820 BF822	300* 250	310	50/-	25/20	0.6	30/5	60	SOT-23	e b c
200	PMBTA42 PMBTA43	300 200	310	40/-	30/10	0.5	20/2	50	SOT-23	e b c
1000	BST39 BST40	300 250	1000	40/-	20/10	0.5	50/4	15	SOT-89	e c b
P-N-P										
20	BF621 BF623	-300* -250	1000	50/-	25/20	0.8	30/5	60	SOT-89	e c b
50	BF821 BF823	-300* -250	310	50/-	25/20	0.8	30/5	60	SOT-23	e b c
500	PMBTA92 PMBTA93	-300 -200	350	40/-	10/10	0.5	20/2	50	SOT-23	e b c
1000	BST15 BST16	-200 -300	1000	30/150 30/120	50/10	2.5 2.0	50/5	15	SOT-89	e c b

* V_{CER}



SOT-23

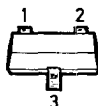


SOT-89

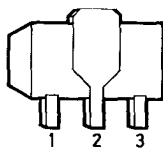
Surface-mounted semiconductors

switching transistors

I_C max. (mA)	Type No.	Ratings		Characteristics						Outline	Pinning
		V_{CE0} (V)	P_{tot} (mW)	h_{FE} min./max. at I_C/V_{CE} (mA/V)	V_{CEsat} max. at I_C/I_B (V)	t (max.) on/off at I_C/I_B (ns)					
N-P-N											
100	BSS64	80	350	20/—	10/1	0.2	50/15	—/1000	15/1	SOT-23	e b c
100	BSV52	12	250	40/120	10/1	0.4	50/5	12/18	10/3	SOT-23	e b c
200	BSR17 BSR17A	40	350	50/150 100/300	10/1	0.3	50/5	70/225 70/250	10/1	SOT-23	e b c
800	BSR13 BSR14	30 40	425	100/300	150/10	1.6 1.0	500/50	35/285	150/—	SOT-23	e b c
1000	BSR40 BSR41 BSR42 BSR43	60 60 80 80	1000	40/120 100/300 40/120 100/300	100/5	0.5	500/50	250/1000	100/5	SOT-89	e c b
P-N-P											
100	BSR12	-15	250	30/120	50/1	0.45	100/10	20/30	30/3	SOT-23	e b c
100	BSS63	-100	350	30/—	25/1	0.25	25/2.5	—	—	SOT-23	e b c
200	BSR18 BSR18A	-40	200	50/150 100/300	10/1	0.40	50/5	70/260 70/300	10/1	SOT-23	e b c
600	BSR15 BSR16	-40 -60	425	100/300	150/10	1.6	500/50	45/100	150/15	SOT-23	e b c
1000	BSR30 BSR31 BSR32 BSR33	-60 -60 -80 -80	1000	40/120 100/300 40/120 100/300	100/5	0.5	500/50	500/650	100/5	SOT-89	e c b



SOT-23



SOT-89

Surface-mounted semiconductors

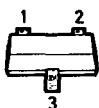
low-noise transistors

($F < 4\text{dB}$ at $f = 1\text{kHz}$; $B = 200\text{Hz}$)

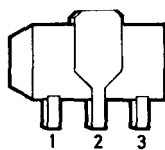
I_C max. (mA)	Type No.	Ratings		Characteristics					Outline	Pinning		
		V_{CE0} (V)	P_{tot} (mW)	h_{FE} min./max.	I_C/V_{CE} (mA/V)	V_{CEsat} max. at I_C/I_B (V)	f_T typ. (MHz)	1		2	3	
N-P-N												
100	BCF32	32	350	200/450	2/5	0.25	10/0.5	300	SOT-23	e	b	c
	BCF33	32		420/800								
	BCF81	45		420/800								
P-N-P												
100	BCF29	-32	350	120/260	2/5	0.3	10/0.5	150	SOT-23	e	b	c
	BCF30	-32		215/500								
	BCF70	-45		215/500								

low-voltage darlingtontons

I_C max. (mA)	Type No.	Ratings		Characteristics					Outline	Pinning			
		V_{CE0} (V)	P_{tot} (mW)	h_{FE} min./max.	I_C/V_{CE} (mA/V)	V_{CEsat} max. at I_C/I_B (V)	$t(\text{max.})$ on/off at I_C/I_B (ns)	1		2	3		
N-P-N													
300	BCV27	30	350	20000/—	100/5	1.0	100/0.1	—	—	SOT-23	e	b	c
	BST50 BST51 BST52	45 60 80	1000	1000/—	150/10	1.3	500/50	400/1500	500/0.5	SOT-89	e	c	b
P-N-P													
300	BCV26	-30	350	20000/—	100/5	1.0	100/0.1	—	—	SOT-23	e	b	c
	BST60 BST61 BST62	-45 -60 -80	1000	1000/—	150/10	1.3	500/0.5	400/1500	500/0.5	SOT-89	e	c	b



SOT-23

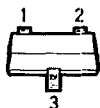


SOT-89

Surface-mounted semiconductors

high-frequency transistors

I_C max. (mA)	Type No.	Ratings		Characteristics					Outline	Pinning	
		V_{CE0} (V)	P_{tot} (mW)	h_{FE} min./max. at I_C/V_{CE} (mA/V)	F typ. at f (dB)	F at f (MHz)	f_T typ. (MHz)	C_{re} typ. (pF)			
N-P-N											
25	BFS20	20	250	40/-	7/10	-	-	450	0.35	SOT-23	e b c
30	BFS18 BFS19	20	250	35/125 65/225	1/10	4	100	200 260	0.85	SOT-23	e b c
P-N-P											
25	BF536	-30	200	25/-	1/10	5	200	350	-	SOT-23	e b c
25	BF550	-40	200	50/-	1/10	2	0.1	325	0.5	SOT-23	e b c
25	BF660	-30	200	30/-	3/10	-	-	650	0.65	SOT-23	e b c
25	BF579	-20	150	20/-	10/10	4,5	800	1350	0.46	SOT-23	e b c
25	BF824	-30	300	-	-	3	100	450	0.1	SOT-23	e b c
30	BF569	-35	200	25/-	3/10	4.5	800	900	0.33	SOT-23	e b c

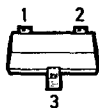


SOT-23

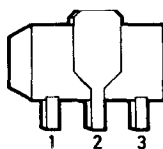
Surface-mounted semiconductors

broadband transistors

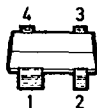
I_C max. (mA)	Type No.	Ratings		Characteristics						Outline	Pinning					
		V_{CE0} (V)	P_{tot} (mW)	h_{FE} min./max. at I_C/V_{CE}	d_{im} typ. at f (dB)	f_T typ. (GHz)	C_{re} typ. (pF)	1, 2, 3, 4								
N-P-N																
1st generation																
25	BFS17	15	250	20/150	2/1	45	217	1.3	0.65	SOT-23	e	b	c	-		
50	BFR53	10	250	25/-	50/5	60	217.0	2.0	0.9	SOT-23	e	b	c	-		
150	BFQ17	25	1000	25/-	150/5	-	-	1.2	1.9	SOT-89	e	c	b	-		
2nd generation																
6.5	BFT25	5	50	20/-	1/1	-	-	2.3	0.45	SOT-23	e	b	c	-		
25	BFR92 BFR92A	15	200	25/- 40/-	14/10	60	493.25 793.25	5.0	0.7 0.35	SOT-23	e	b	c	-		
25	● BFG92A	15	300	40/-	14/10	-	-	5.0	0.35	SOT-143	c	b	e	e		
35	BFR93 BFR93A	12	200	25/- 40/-	30/5	60	493.25 793.25	5.0	0.8 0.6	SOT-23	e	b	c	-		
35	● BFG93A	12	300	40/-	30/5	-	-	6.0	0.6	SOT-143	c	b	e	e		
75	BFQ19	15	500	25/-	75/10	-	-	5.0	1.3	SOT-89	e	c	b	-		
150	BFQ18A	15	1000	25/-	100/10	60	793.25	3.6	1.2	SOT-89	e	c	b	-		
3rd generation																
50	BFQ67	10	180	100typ.	15/5	-	-	7.5	0.5	SOT-23	e	b	c	-		
50	BFG67	10	300	60/-	15/5	-	-	7.5	0.5	SOT-143	c	b	e	e		
P-N-P																
2nd generation																
25	BFT92	-15	200	20/-	14/10	60	493.25	5	0.7	SOT-23	e	b	c	-		
35	BFT93	-12	200	20/-	30/5	60	493.25	5	1.0	SOT-23	e	b	c	-		



SOT-23



SOT-89



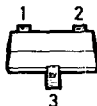
SOT-143

Surface-mounted semiconductors

junction field-effect transistors

book 1 part 1c

Type No.	Ratings			Characteristics				Outline	Pinning	
	$\pm V_{DS}$ (V)	I_D (mA)	P_{tot} (mW)	$-I_{GSS}$ max. (nA)	I_{DSS} min./max. (mA)	$-V_{(P)GS}$ max. (V)	y_{fs} min. (ms)			C_{rs} max. (pF)
AMPLIFIERS										
BF510	20	30	250	10	0.7/3.0	0.8	2.5	0.4	SOT-23	d g s -
BF511					2.5/7.0	1.5	4			
BF512					6/12	2.2	6			
BF513					10/18	3	7			
BFR30	25	10	250	0.2	4/10	5	1	1.5	SOT-23	s d g -
BFR31					1/5	2.5	1.5			
BFT46	25	10	250	0.2	0.2/1.5	1.2	0.5	1.5	SOT-23	s d g -
SWITCHING										
BSR56	40	50	250	1	50/-	10	25	25	SOT-23	s d g -
BSR57		(I_{GF})			20/100	6	50	40		
BSR58					8/80	4	100	60		



SOT-23

mos field-effect transistors



book 1 part 1c

INSULATED GATE

Type No.	Ratings			Characteristics						Outline	Pinning
	V_{DS} (V)	I_D (mA)	P_{tot} (mW)	I_{GSS} max. (nA)	I_{DSSoff} max. (nA)	$-V_{(P)GS}$ max. (V)	t_{on} typ. (ns)	t_{off} typ. (ns)	$R_{DS(on)}$ min. (Ω)		
Enhancement n-channel											
BSS83†	10	50	230	–	10	2.0	1	5	45	SOT-143	b s d g
Depletion n-channel											
BSD20†	10	50	230	10	1	2.0	1	5	30	SOT-143	b s d g
BSD22†	20				(typ.)						

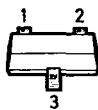
DUAL INSULATED GATE

Type No.	Ratings			Characteristics					Outline	Pinning	
	V_{DS} (V)	I_D (mA)	P_{tot} (mW)	I_{GSS} max. (nA)	I_{DSS} min./max. (mA)	$-V_{(P)GS}$ max. (V)	Y_{fs} min. (mA/V)	C_{rs} typ. (fF)			
Depletion n-channel											
BF989†	20	20	200	50	2/20	2.7	9.5	25	SOT-143	s, b d g2 g1	
BF990	18	30	200	25	–	1.3	17	25	SOT-143	s, b d g2 g1	
BF991†	20	20	200	50	4/25	2.5	10	20	SOT-143	s, b d g2 g1	
BF992†	20	40	200	25	–	1.3	20	30	SOT-143	s, b d g2 g1	
BF994	20	30	200	50	2/20	2.5	15	25	SOT-143	s, b d g2 g1	
BF996	20	30	200	50	2/20	2.5	15	25	SOT-143	s, b d g2 g1	

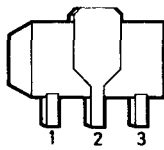
D-MOS

Type No.	Ratings			Characteristics						Outline	Pinning
	V_{DS} (V)	I_D (mA)	P_{tot} (W)	I_{GSS} max. (nA)	I_{DSS} max. (μ A)	Y_{fs} typ. (mA/V)	t_{on} max. (ns)	t_{off} max. (ns)	$R_{DS(on)}$ typ. (Ω)		
Enhancement n-channel											
BST80	80	500	1	100	10	300	10	15	2	SOT-89	s d g
BST82	80	175	0.3	100	1.0	150	10	10	7	SOT-23	s g d
BST84	200	250	1	100	10	250	10	25	6	SOT-89	s d g
BST86	180	300	1	100	10	250	10	15	7	SOT-89	s d g
Enhancement p-channel											
BST120	–60	300	1	100	10	200	4	20	4.5	SOT-89	s d g
BST122	–50	250	1	100	10	125	4	20	7.5	SOT-89	s d g

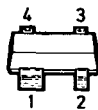
† The gates are diode protected



SOT-23



SOT-89

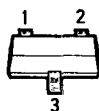


SOT-143

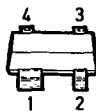
Surface-mounted semiconductors

p-n-p-n switches

Type No.	Description	Ratings			Characteristics			Outline	Pinning			
		V_{GA} (V)	I_A (mA)	P_{tot} (mW)	I_V (μ A)	$V_{A, max.}$ (V)	at I_A (mA)		1,	2,	3,	4
BRY61	Trigger device for switching applications such as motor control, oscillators, relay replacements, timers, pulse shapers	70	175	275	>30	1.4	100	SOT-23	k	a	ag	-
BRY62	Integrated p-n-p-n transistor pair. Applications include controlled switch, programmable uni-junction transistor and thyristor tetrode	70	175	275	-	1.4	50	SOT-143	ga	a	k	gk



SOT-23



SOT-143

diodes

book 1 part 3

Outline SOT-23

Type No.	Description	Ratings			Characteristics			Nearest conventional type	Pinning		
		V_{RRM} (V)	I_{FRM} (mA)	$I_{F(AV)}$ (mA)	V_F (V)	at I_F (mA)	t_{rr} max. (ns)		1,	2,	3
BAS16	Single diode	85	200	100	< 1.1	50	6*	1N4148	n.c.	a	k
BAS17	Low-voltage stabistor	-	250	-	< 0.96	100	-	BA314	n.c.	a	k
BAS19	Switching and general purpose diodes	120	625	200	< 1.0	100	50**	BAV19 BAV20 BAV21	n.c.	a	k
BAS20		200									
BAS21		250									
BAT18	Bandswitch diode	35(V_R)	-	100	< 1.2	100	-	BA482	n.c.	a	k
BAV70	Common cathode double diode	70	200	100	< 1.1	50	6*	2 × 1N4148	a1	a2	k
BAW56	Common anode double diode								k1	k2	a
BAV99	Two diodes in series								k1	a2	a1, k2

Outline SOD-80

BAS32	High-speed diode for fast logic applications	75	450	150	< 1.0	100	4*	1N4148
BAV100	General purpose diodes	60	625	250	< 1.0	100	50**	BAV18 BAV19 BAV20 BAV21
BAV101		120						
BAV102		200						
BAV103		250						

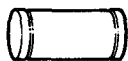
*From $I_F = 10\text{mA}$ to $I_R = 10\text{mA}$

**From $I_F = 30\text{mA}$ to $I_R = 30\text{mA}$

low-power rectifier diodes

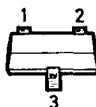
Outline SOD-87

Type No.	Description	Ratings			Characteristics		Nearest conventional type
		V_{RRM} (V)	I_{FRM} (A)	$I_{F(AV)}$ (A)	V_F (V)	at I_F (A)	
● BYD17D	General purpose	200	5.5	1.5	1.05	1	1N4003
● BYD17G	Rectifier diodes	400					1N4004
● BYD17J		600					1N4005
● BYD17K		800					1N4006
● BYD17M		1000					1N4007



Cathode is indicated by a coloured band.

SOD-80, 87



SOT-23

Surface-mounted semiconductors

variable capacitance diodes

book 1 part 3

Outline SOT-23

Type No.	Description	Ratings		Characteristics			Nearest conventional type	Pinning	
		V_R max.	I_R max.	C_d (pF)		at V_R			
		(V)	(nA)	min.	max.	(V)			Capacitance ratio typ.
BBY31	UHF varicap diode	28	100	1.8	2.8	25	5	BB405B	n.c. a k
BBY40	VHF varicap diode	28	50	4.3	6	25	5-6.5	BB809	n.c. a k

schottky diodes

book 1 part 3

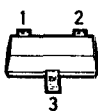
Outline SOT-23

Type No.	Ratings			Characteristics			Nearest conventional type	Pinning	
	V_R max. (V)	I_F max. (mA)	T_j max. (°C)	V_F ¹⁾ (V)	C_d (pF)	N ²⁾ (dB)			
BAT17	4	30	100	<0.6	<1	<8	BA481	n.c. a k -	
BAT54	30	200	125	<0.4	<10	-	BAT85	n.c. a k -	
Double diode							Outline SOT-143		
BAT74	30	200*	125	<0.4	<10	-	2 × BAT85	k1 k2 a2 a1	

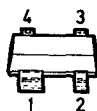
* Single diode operation (110mA double diode operation)

¹⁾ At $I_F = 10\text{mA}$

²⁾ At $f = 900\text{MHz}$



SOT-23



SOT-143

silicon planar voltage regulator diodes

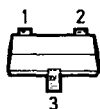
book 1 part 3

350mW ($T_{amb} = 25^{\circ}\text{C}$) $\pm 5\%$ voltage tolerance; I_{FRM} ; $I_{ZRM} = 250\text{mA}$

Outline SOT-23

Type No.	Nom. Zener voltage (V)	Measured at test min. voltage (V)	at test I_z max. voltage (V)	Max. slope resistance (Ω)	Typ. temp. coefficient (mV/ $^{\circ}\text{C}$)	Test I_z (mA)	Max. I_R at V_R (μA)	(V)
BZX84								
-C2V4	2.4	2.2	2.6	100	-1.6	5	50	1
-C2V7	2.7	2.5	2.9	100	-2.0	5	20	1
-C3V0	3.0	2.8	3.2	95	-2.1	5	10	1
-C3V3	3.3	3.1	3.5	95	-2.4	5	5.0	1
-C3V6	3.6	3.4	3.8	90	-2.4	5	5.0	1
-C3V9	3.9	3.7	4.1	90	-2.5	5	3.0	1
-C4V3	4.3	4.0	4.6	90	-2.5	5	3.0	1
-C4V7	4.7	4.4	5.0	80	-1.4	5	3.0	2
-C5V1	5.1	4.8	5.4	60	-0.8	5	2.0	2
-C5V6	5.6	5.2	6.0	40	+1.2	5	1.0	2
-C6V2	6.2	5.8	6.6	10	+2.3	5	3.0	4
-C6V8	6.8	6.4	7.2	15	+3.0	5	2.0	4
-C7V5	7.5	7.0	7.9	15	+4.0	5	1.0	5
-C8V2	8.2	7.7	8.7	15	+4.6	5	0.7	5
-C9V1	9.1	8.5	9.6	15	+5.5	5	0.5	6
-C10	10	9.4	10.6	20	+6.4	5	0.2	7
-C11	11	10.4	11.6	20	+7.4	5	0.1	8
-C12	12	11.4	12.7	25	+8.4	5	0.1	8
-C13	13	12.4	14.1	30	+9.4	5	0.1	8
-C15	15	13.8	15.6	30	+11.4	5	0.05	10.5
-C16	16	15.3	17.1	40	+12.4	5	0.05	11.2
-C18	18	16.8	19.1	45	+14.4	5	0.05	12.6
-C20	20	18.8	21.2	55	+16.4	5	0.05	14
-C22	22	20.8	23.3	55	+18.4	5	0.05	15.4
-C24	24	22.8	25.6	70	+20.4	5	0.05	16.8
-C27	27	25.1	28.9	80	+23.4	2	0.05	18.9
-C30	30	28	32	80	+26.6	2	0.05	21
-C33	33	31	35	80	+29.7	2	0.05	23.1
-C36	36	34	38	90	+33.0	2	0.05	25.2
-C39	39	37	41	130	+36.4	2	0.05	27.3
-C43	43	40	46	150	+41.2	2	0.05	30.1
-C47	47	44	50	170	+46.1	2	0.05	32.9
-C51	51	48	54	180	+51.0	2	0.05	35.7
-C56	56	52	60	200	+57.0	2	0.05	39.2
-C62	62	58	66	215	+64.4	2	0.05	43.4
-C68	68	64	72	240	+71.7	2	0.05	47.6
-C75	75	70	79	255	+80.2	2	0.05	52.5

Continued



Pinning

1 2 3
n.c. a k

SOT-23

Surface-mounted semiconductors

silicon planar voltage regulator diodes (cont.)

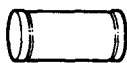
book 1 part 3

400mW ($T_{amb} = 50^{\circ}\text{C}$) \pm 5% voltage tolerance; $I_{FRM} = 250\text{mA}$

Outline SOD-80

Type No.	Norm. Zener voltage (V)	Measured min. voltage (V)	at test I_z max. voltage (V)	Max. slope resistance (Ω)	Typ. temp. coefficient (mV/ $^{\circ}\text{C}$)	Test I_z (mA)	Max. I_R at V_R (μA)	(V)
BZV55								
-C2V4	2.4	2.2	2.6	100	-1.6	5	50	1
-C2V7	2.7	2.5	2.9	100	-2.0	5	20	1
-C3V0	3.0	2.8	3.2	95	-2.1	5	10	1
-C3V3	3.3	3.1	3.5	95	-2.4	5	5.0	1
-C3V6	3.6	3.4	3.8	90	-2.4	5	5.0	1
-C3V9	3.9	3.7	4.1	90	-2.5	5	3.0	1
-C4V3	4.3	4.0	4.6	90	-2.5	5	3.0	1
-C4V7	4.7	4.4	5.0	80	-1.4	5	3.0	2
-C5V1	5.1	4.8	5.4	60	-0.8	5	2.0	2
-C5V6	5.6	5.2	6.0	40	+1.2	5	1.0	2
-C6V2	6.2	5.8	6.6	10	+2.3	5	3.0	4
-C6V8	6.8	6.4	7.2	15	+3.0	5	2.0	4
-C7V5	7.5	7.0	7.9	15	+4.0	5	1.0	5
-C8V2	8.2	7.7	8.7	15	+4.6	5	0.7	5
-C9V1	9.1	8.5	9.6	15	+5.5	5	0.5	6
-C10	10	9.4	10.6	20	+6.4	5	0.2	7
-C11	11	10.4	11.6	20	+7.4	5	0.1	8
-C12	12	11.4	12.7	25	+8.4	5	0.1	8
-C13	13	12.4	14.1	30	+9.4	5	0.1	8
-C15	15	13.8	15.6	30	+11.4	5	0.05	10.5
-C16	16	15.3	17.1	40	+12.4	5	0.05	11.2
-C18	18	16.8	19.1	45	+14.4	5	0.05	12.6
-C20	20	18.8	21.2	55	+16.4	5	0.05	14
-C22	22	20.8	23.3	55	+18.4	5	0.05	15.4
-C24	24	22.8	25.6	70	+20.4	5	0.05	16.8
-C27	27	25.1	28.9	80	+23.4	2	0.05	18.9
-C30	30	28	32	80	+26.6	2	0.05	21
-C33	33	31	35	80	+29.7	2	0.05	23.1
-C36	36	34	38	90	+33.0	2	0.05	25.2
-C39	39	37	41	130	+36.4	2	0.05	27.3
-C43	43	40	46	150	+41.2	2	0.05	30.1
-C47	47	44	50	170	+46.1	2	0.05	32.9
-C51	51	48	54	180	+51.0	2	0.05	35.7
-C56	56	52	60	200	+57.0	2	0.05	39.2
-C62	62	58	66	215	+64.4	2	0.05	43.4
-C68	68	64	72	240	+71.7	2	0.05	47.6
-C75	75	70	79	255	+80.2	2	0.05	52.5

Continued



Cathode is indicated by a coloured band.

SOD-80

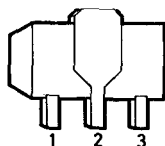
silicon planar voltage regulator diodes (cont.)

book 1 part 3

1W ($T_{amb} = 25^{\circ}\text{C}$) $\pm 5\%$ voltage tolerance; $I_{FRM} = 250\text{mA}$

Outline SOT-89

Type No.	Nom. Zener voltage (V)	Measured at test min. voltage (V)	Max. at test I_z max. voltage (V)	Max. slope resistance (Ω)	Typ. temp. coefficient (mV/ $^{\circ}\text{C}$)	Test I_z (mA)	Max. I_R at V_R (μA)	(V)
BZV49								
-C2V4	2.4	2.2	2.6	100	-1.6	5	50	1
-C2V7	2.7	2.5	2.9	100	-2.0	5	20	1
-C3V0	3.0	2.8	3.2	95	-2.1	5	10	1
-C3V3	3.3	3.1	3.5	95	-2.4	5	5.0	1
-C3V6	3.6	3.4	3.8	90	-2.4	5	5.0	1
-C3V9	3.9	3.7	4.1	90	-2.5	5	3.0	1
-C4V3	4.3	4.0	4.6	90	-2.5	5	3.0	1
-C4V7	4.7	4.4	5.0	80	-1.4	5	3.0	2
-C5V1	5.1	4.8	5.4	60	-0.8	5	2.0	2
-C5V6	5.6	5.2	6.0	40	+1.2	5	1.0	2
-C6V2	6.2	5.8	6.6	10	+2.3	5	3.0	4
-C6V8	6.8	6.4	7.2	15	+3.0	5	2.0	4
-C7V5	7.5	7.0	7.9	15	+4.0	5	1.0	5
-C8V2	8.2	7.7	8.7	15	+4.6	5	0.7	5
-C9V1	9.1	8.5	9.6	15	+5.5	5	0.5	6
-C10	10	9.4	10.6	20	+6.4	5	0.2	7
-C11	11	10.4	11.6	20	+7.4	5	0.1	8
-C12	12	11.4	12.7	25	+8.4	5	0.1	8
-C13	13	12.4	14.1	30	+9.4	5	0.1	8
-C15	15	13.8	15.6	30	+11.4	5	0.05	10.5
-C16	16	15.3	17.1	40	+12.4	5	0.05	11.2
-C18	18	16.8	19.1	45	+14.4	5	0.05	12.6
-C20	20	18.8	21.2	55	+16.4	5	0.05	14
-C22	22	20.8	23.3	55	+18.4	5	0.05	15.4
-C24	24	22.8	25.6	70	+20.4	5	0.05	16.8
-C27	27	25.1	28.9	80	+23.4	2	0.05	18.9
-C30	30	28	32	80	+26.6	2	0.05	21
-C33	33	31	35	80	+29.7	2	0.05	23.1
-C36	36	34	38	90	+33.0	2	0.05	25.2
-C39	39	37	41	130	+36.4	2	0.05	27.3
-C43	43	40	46	150	+41.2	2	0.05	30.1
-C47	47	44	50	170	+46.1	2	0.05	32.9
-C51	51	48	54	180	+51.0	2	0.05	35.7
-C56	56	52	60	200	+57.0	2	0.05	39.2
-C62	62	58	66	215	+64.4	2	0.05	43.4
-C68	68	64	72	240	+71.7	2	0.05	47.6
-C75	75	70	79	255	+80.2	2	0.05	52.5



SOT-89

Pinning

1 2 3
a k a

Diodes

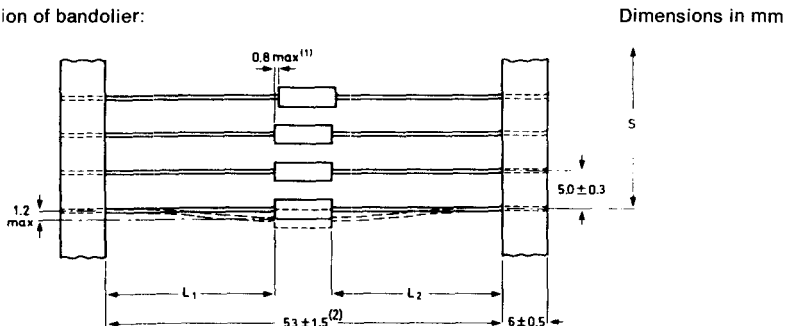
Mullard diodes are normally supplied bandoliered.

BANDOLIER AND REEL SPECIFICATIONS FOR AXIAL-TAPED DIODES

This specification concerns all axial-leaded diodes in this publication.

The taped and reeled products fulfil the requirements of IEC 286-1: Tape packaging of components with axial leads on continuous tapes.

Fig.1 Configuration of bandolier:



The red tape indicates the diode cathode side.

⁽¹⁾ Displacement between any two diodes; for DO-34 maximum 0.4.

⁽²⁾ For outline SCD-61 this dimension is 58 ± 2 and for 26mm tape this dimension is 26 ± 1.5 .

The cumulative space (S) measured over ten spacings = 50 ± 2 ; for 26mm: 20 spacings (= 100 ± 2).

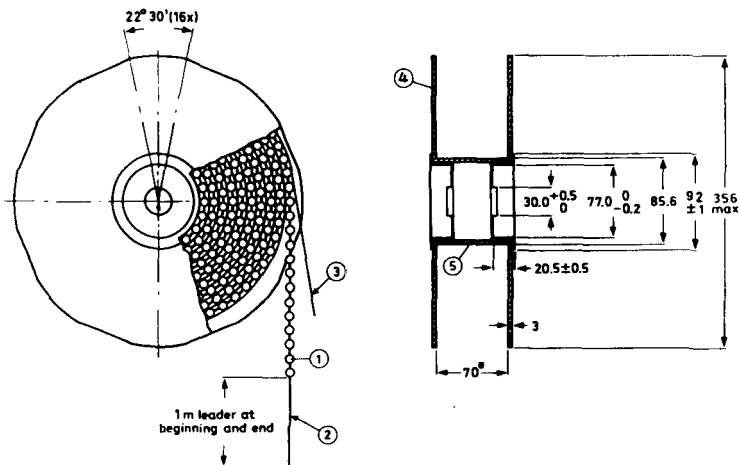
The diodes are centred so that $|L_1 - L_2| \leq 1.2\text{mm}$.

A black marker is printed on the white tape of the bandolier every 50 diodes.

The axial taping specification described above is compatible with automatic insertion equipment as manufactured by Universal, U.S.M. (Dynapert) and M.E.I. (Panaset).

Continued

Fig.2 Reel dimensions (mm) for axial-taped components.



- (1) Diode
- (2) Bandolier
- (3) Paper

- (4) Flange
- (5) Cylinder

* For outline SOD-61 this dimension is 75, and for 26mm tape this dimension is 40.

outline		quantity per reel, 52 mm tape
SOD-27	DO-35	10 000 (B-zeners: 5000); see also Fig. 3
SOD-57	—	5 000
SOD-61	—	7 000 (additional packing in aluminium bag)
SOD-64	—	4 000
SOD-66	DO-41	5 000
SOD-68	DO-34	10 000; see also Fig. 3
SOD-81	—	5 000

Continued

Diodes

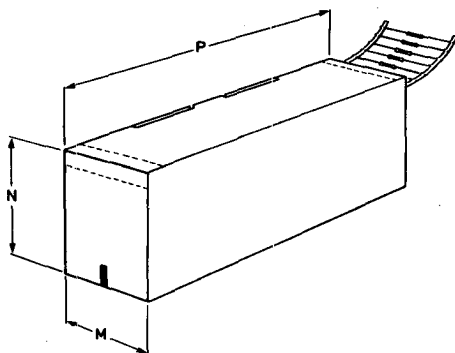


Fig. 3.

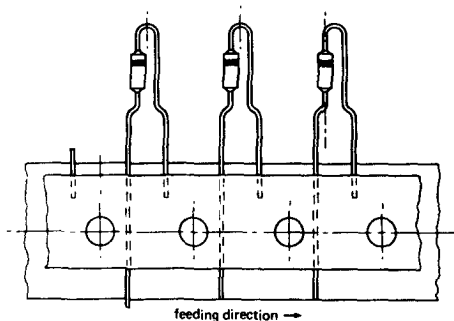
DO-34 and DO-35 axial-leaded components on 26 mm tape in ammo-boxes. Quantity: 5000 diodes per box. When ordering on 52 mm reel the last 3 digits of the catalogue number are 113; when ordering on 26 mm tape in ammo-pack the last 3 digits are 143.

	DO-34	DO-35
P	254	254 mm
N	63	77 mm
M	50	50 mm

BANDOLIER AND REEL SPECIFICATION FOR RADIAL-TAPED DIODES.

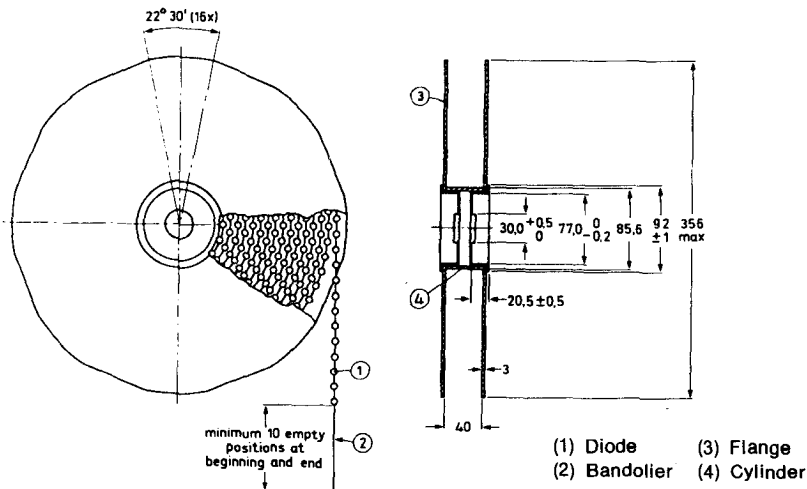
Fig.1 Configuration of bandolier:

Dimensions in mm



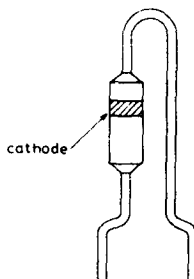
This specification concerns radial-taped diodes in DO-34 and DO-35 envelopes. The taped and reeled products fulfil the requirements of IEC 286-2: Tape packaging of components with unidirectional leads.

Fig.2 Reel dimensions (mm) for radial-taped diodes.



Quantity per reel for DO-34 and DO-35 encapsulations is 5000 diodes.

Fig.3 The diodes are delivered with cathode-leading configuration.



silicon whiskerless diodes

book 1 part 3

Type No.	Description	Outline	V_{RRM}	I_{FRM}	$I_{F(AV)}$	C_{dmax}	V_F	at	Max. reverse recovery time measured at:				
			max.	max.	max.	max.	max.	I_F	t_{rr}	I_F	V_R	R_L	I_R
			(V)	(mA)	(mA)	(pF)	(V)	(mA)	(ns)	(mA)	(V)	(Ω)	(mA)
€ BA314	Low voltage stabistor	DO-35	—	250	—	140	0.96	100	—	—	—	—	—
BA316 BA317 BA318	10V, 30V and 50V general purpose diodes	DO-35	10 30 50	225	100	3	1.1	100	4	10	6	100	1
BAS11	General purpose avalanche diode	DO-35	300 (V_{RW})	900	300	1.5	1.1 (typ)	300	1 μ s	400	50	—	$-di_F/dt = 400\text{mA}/\mu\text{s}$
BAV10	High speed diode for core gating applications in very fast memories	DO-35	60	600	300	2.5	1.0	200	6	400	—	100	40
€ BAV18 € BAV19 € BAV20 € BAV21	General purpose switching diodes	DO-35	60 120 200 250	625	250	5	1.25	200	50	30	—	100	3
€ BAW62	High speed diode for fast logic applications	DO-35	75	225	100	2	1.0	100	4	10	1	100	1
BAX12	Controlled avalanche diode. Avalanche 120-175V at 1mA	DO-35	90	800	400	35	1.0	200	50	30	—	100	3
BAX13	High speed diode intended for logic applications	DO-35	50	150	75	3	1.0	20	4	10	6	100	1
€ BAX16	Intended for general purpose industrial applications	DO-35	150	300	200	10	1.3	100	120	30	3	100	1
€ BAX17	Intended for general purpose industrial applications	DO-35	200	300	200	10	1.2	200	120	30	3	100	1
€ CV7367	For telephony applications	DO-35	100†	450	100	4	1.0	10	5	10	—	—	1
€ CV7368	For telephony applications	DO-35	100†	450	100	2	1.0	10	5	10	—	—	1
€ CV7756	For telephony applications	DO-35	75†	450	100	4	1.0	10	8	10	—	—	1
€ CV7757	For telephony applications	DO-35	75†	450	100	2	1.0	10	8	10	—	—	1
€ CV7875	General purpose avalanche diode	DO-35	150†	750	150	35	1.2	100	—	—	—	—	—
€ CV8617	For telephony applications	DO-35	100	450	75	6	1.5	50	$Q_S < 100\text{pC}$	at $I_F 1\text{mA}$, $t_p 1\mu\text{s}$	—	—	—
€ CV8790	General purpose diode	DO-35	150	625	150	10	1.2	100	—	—	—	—	—
€ CV9637	For telephony applications	DO-35	75†	450	100	2.8	0.87	10	5	10	—	—	1

€ Also available to CECC 50 000 † V_R

Continued

silicon whiskerless diodes

(cont.)

book 1 part 3

Type No.	Description	Outline	V_{RRM} max.	I_{FRM} max.	$I_{F(AV)}$ max.	C_{dmax} (pF)	V_F max.	at I_F	Max. reverse recovery time measured at:				
									t_{rr} (ns)	I_F (mA)	V_R (V)	R_L (Ω)	I_R (mA)
€ CV9638	For telephony applications	DO-35	65†	750	200	15	0.9	200	70	200	—	—	20
OA200 OA202	General purpose diodes	DO-35	50 150	250	80	25	1.15	30	3.5 μ s (typ)	30	35	2.5k	4
€ 1N914 € 1N916	High speed diodes for computer and other applications	DO-35	100	225	75	4	1.0	10	4	10	6	100	1
€ 1N4148	High speed diodes for computer and other applications	DO-35	75	225	75	4	1.0	10	4	10	6	100	1
€ 1N4446 € 1N4448	High speed diodes for fast logic applications	DO-35	75	450	150	4	1.0	20 1.0	4	10	—	100	1
1N4531	High-speed general purpose diode	DO-34	75	450	150	4	1.0	10	4	10	—	100	1

€ Also available to CECC 50 000 † V_R

Diodes

silicon Schottky-barrier diodes book 1 part 3

Type No.	Description	Outline	Ratings			Characteristics			
			V_R max. (V)	I_F max. (mA)	I_{FSM} max. (mA)	V_F max. at I_F (V)	C_d max. (pF)	t_{rr} † max. (ns)	
BA481	U.H.F. mixer diode	DO-34	4	30	—	0.55	10	1.1	—
BAT81 BAT82 BAT83	Switching diodes	DO-34	40 50 60	30	150	0.41	1.0	1.6	1
BAT85	Switching diode	DO-34	30	200	600	0.4	10	10	5
BYV10-20 -30 -40	Switching diodes	DO-41	20* 30* 40*	1A	—	0.39	100	220 (typ)	30

* V_{RRM} max. † Switched from $I_F = 10$ mA to $I_R = 10$ mA; $R_L = 100\Omega$

⊕ Also available to CECC 50 000

tuner diodes

book 1 part 3

Type No.	Description	Outline	Ratings			Characteristics				
			V_R max. (V)	I_F max. (mA)	I_R max. (μ A)	C_d (pF) min. max.	at V_R (V)	Capacitance ratio min. max.		
BA423	Band switching in a.m. radio receivers	DO-34	20	50	0.1	—	2.5	3	$r_D < 1.2\Omega$	
BA482	Band switching in v.h.f. tv tuners	DO-34	35	100	0.1	—	1.2	3	$r_D < 0.7\Omega$	
BB112	For tuning circuits in a.m. receivers	SOD-69	12	50	0.05	440	540	1	18	
BB119	Intended for automatic frequency control in radio and tv receivers	DO-35	15	200	2.0	20	25	4	1.3	
BB212	Double-turning diode (common cathode) for car and domestic receivers	TO-92**	12	100	0.05	500	620	0.5	23	36
BB405B	For u.h.f. tuning	DO-34	28	20	0.01	2.0	2.3	25	4.8	5.8
BB809	For v.h.f. tv tuners	DO-34	28	20	0.01	26	32	3	5	6.5
BB909A	For electronic tuning in v.h.f. tv tuners for C.A.T.V. applications	DO-34	32	20	0.01	2.6	3.0	28	12	15

**Pin 1 = a1, 2 = k, 3 = a2

silicon low-leakage diodes

book 1 part 3

Type No.	Description	Ratings				Characteristics				
		V_{RRM} max. (V)	I_{FRM} max. (mA)	I_F max. (mA)	I_R at V_R (pA)	I_R at V_R (V)	V_F at I_F (V)			
BAV45	Extremely low leakage and low capacitance diode. Outline TO-18, pin 1 = a, 3 = k	35	100	50	<5	5	<10	20	<1.0	10
BAS45	Switching diode with a very low reverse current. Outline DO-34	125 (V_R)	450	225	600	30	1000	125	<1.0	200

ultra-fast low-power rectifier diodes book 1 part 3

Type No.	Description	Outline	Ratings			Characteristics					
			V_{RRM} max.	I_{FSM} max.	$I_{F(AV)}$ max.	V_F max.	at I_F	Max. reverse recovery time when switched from			
			(V)	(A)	(A)	(V)	(A)	t_{rr} max. (ns)	I_F (A)	to	I_R (A)
BYD73A	Epitaxial avalanche diodes in 'implosion' envelopes for SMPS and other high-frequency circuits	SOD-81	50	25	1.75	0.95	1	25	0.5		1
BYD73B			100		1.75	0.95		25			
BYD73C			150		1.75	0.95		25			
BYD73D			200		1.75	0.95		25			
BYD73E			250		1.7	1.05		50			
BYD73F			300		1.7	1.05		50			
BYD73G			400		1.7	1.05		50			
BYV27-50	Glass passivated diodes for SMPS and other high-frequency circuits	SOD-57	50	50	2	1.25	5	25	0.5		1.0
-100			100								
-150			150								
-200			200								
BYV28-50	Glass passivated diodes for SMPS and other high-frequency circuits	SOD-64	50	80	3.5	1.1	5	30	0.5		1.0
-100			100								
-150			150								
-200			200								






fast soft-recovery low-power rectifier diodes book 1 part 3

Type No.	Description	Outline	Ratings			Characteristics						
			V_{RRM} max.	I_{FSM} max.	$I_{F(AV)}$ max.	V_F max.	at I_F	Max. reverse recovery time measured at				
			(V)	(A)	(A)	(V)	(A)	t_{rr} max. (ns)	I_F (A)	V_R (V)	$-di/dt$ (A/ μ s)	
BYD33D	Avalanche diodes in 'implosion' envelopes for SMPS, scan rectifiers, inverters and converters	SOD-81	200	20	1.3	1.3	1	250	1	≥ 30	20	
BYD33G			400					250				
BYD33J			600					250				
BYD33K			800					300				
BYD33M			1000					300				
BYV95A	Glass passivated diodes for SMPS, scan rectifiers, inverters and converters	SOD-57	200	35	1.5	1.6	3	250	1	≥ 30	20	
BYV95B			400									
BYV95C			600									
BYV96D	As BYV95	SOD-57	800	35	1.5	1.6	3	300	1	≥ 30	20	
BYV96E			1000									
BYW95A	Glass passivated diodes for SMPS, scan rectifiers, inverters and converters	SOD-64	200	70	3	1.5	5	250	1	≥ 30	20	
BYW95B			400									
BYW95C			600									
BYW96D	As BYW95	SOD-64	800	70	3	1.5	5	300	1	≥ 30	20	
BYW96E			1000									


Diodes

low-power silicon rectifier diodes

book 1 part 3

Type No.	Description	Outline	Ratings			Characteristics		
			V_{RRM} max. (V)	I_{FSM} max. (A)	$I_{F(AV)}$ max. (A)	V_F max. at I_F (V)	I_F (A)	I_R max. at V_{RRM} (μA)
BY228	Parallel efficiency diode	SOD-64	1500	50	$5(I_{FWM})$	1.5	5	200
BY448	Parallel efficiency diode	SOD-57	1500	30	$4(I_{FWM})$	1.6	3	200
BYD13D BYD13G BYD13J BYD13K BYD13M	Controlled avalanche diodes in 'implosion' envelopes for general purpose rectifier applications	SOD-81	200** 400** 600** 800** 1000**	20	1.4	1.05	1	1
 BYW54  BYW55  BYW56	Double diffused passivated rectifiers for telephony and general purpose application	SOD-57	600 800 1000	50	2	1.65	10*	1
 CV8308  CV8805	Controlled avalanche rectifier diodes	SOD-57 SOD-81	60 150	20	0.25	0.9	0.25	1
1N4001D to 1N4007D	General purpose diodes	SOD-81	50 to 1000	30	1	1.1	1	10
1N4001G to 1N4007G	General purpose diodes	SOD-57	50 to 1000	30	1	1.1	1	10

* Measured under pulse conditions

 Also available to CECC 50 000

** V_{RRM} max.

low-power high-voltage diodes

book 1 part 3

$I_{F(AV)}$ max. (mA)	Type No.	Outline	V_{RW} max. (kV)	V_{RRM} max. (kV)	Description
3	BY710	SOD-61	14	17	E.H.T. rectifier diodes featuring non-snap-off characteristics, for use in high-voltage supplies of tv receivers and monitors.
	BY711		16	19	
	BY712		18	22	
	BY713		20	24	
	BY714		24	30	
4	BY509	SOD-61	11.5	15	E.H.T. rectifier diode featuring non-snap-off characteristics, for use in triplers and diode-split transformers.
85	BY584	SOD-61	1.5	1.8	High-voltage rectifier diode featuring non-snap-off characteristics, for use as V_{G2} supply in colour tv receivers and as a general purpose rectifier.
550	BYX90G	SOD-83	6	7.5	E.H.T. avalanche fast soft-recovery diode for general purpose high-voltage rectification.

Other high-voltage diodes with V_R varying from 2-20 kV, $I_{F(AV)}$ up to 1.5A and t_{rr} varying from 30ns to 5 μ s are available. Please contact Mullard Ltd. for details.

silicon voltage reference diodes

book 1 part 3

Type No.	Outline	Zener voltage (at test I_z) (V)		Typical temperature coefficient (%/°C)	Ambient temperature range (°C)		Max. dynamic resistance (at test I_z) (Ω)	Test I_z (mA)	I_{ZM} max. (mA)	P_{tot} max. (mW)
		Min.	Max.		Min.	Max.				
BZV10	DO-34	6.2	6.8	± 0.01	0	+70	50	2	50	400
BZV11				± 0.005						
BZV12				± 0.002						
BZV13				± 0.001						
BZV14				± 0.0005						
BZX90	DO-34	6.2	6.8	± 0.01	-55	+100	15	7.5	50	400
BZX91				± 0.005						
BZX92				± 0.002						
BZX93				± 0.001						
BZX94				± 0.0005						
1N821	DO-34	5.9	6.5	± 0.01	-55	+100	15	7.5	50	400
1N823				± 0.005						
1N825				± 0.002						
1N827				± 0.001						
1N829				± 0.0005						

silicon voltage regulator diodes (stabistors)

book 1 part 3

Type No.	Outline	V_{RRM} max. (V)	I_{FRM} max. (mA)	V_F at $I_F=5$ mA (V)	r_{diff} max. at $I_F=5$ mA (Ω)	P_{tot} max. (mW)
BZV46-1V5	DO-35	4	120	1.35-1.55	20	250
BZV46-2V0			80	2.00-2.30	30	

silicon voltage regulator diodes, low power

book 1 part 3

350mW (BZX84 Series): see Surface mounted semiconductors

400mW (BZV55 Series): see Surface mounted semiconductors

400mW ($T_{amb} = 50^{\circ}\text{C}$) $\pm 5\%$ voltage tolerance

Outline DO-35

Type No.	Nom. Zener voltage (V)	Measured at test I_Z			Temp. coefficient		Test I_Z (mA)	Max. I_R at (μA)	V_R (V)
		min. voltage (V)	max. voltage (V)	max. slope resistance (Ω)	min. (mV/°C)	max. (mV/°C)			
⊕ BZX79-C2V4	2.4	2.2	2.6	100	-3.5	0	5	50	1
-C2V7	2.7	2.5	2.9	100	-3.5	0	5	20	1
-C3V0	3.0	2.8	3.2	95	-3.5	0	5	10	1
-C3V3	3.3	3.1	3.5	95	-3.5	0	5	5	1
-C3V6	3.6	3.4	3.8	90	-3.5	0	5	5	1
-C3V9	3.9	3.7	4.1	90	-3.5	0	5	3	1
-C4V3	4.3	4.0	4.6	90	-3.5	0	5	3	1
-C4V7	4.7	4.4	5.0	80	-3.5	0.2	5	3	2
-C5V1	5.1	4.8	5.4	60	-2.7	1.2	5	2	2
-C5V6	5.6	5.2	6.0	40	-2.0	2.5	5	1	2
-C6V2	6.2	5.8	6.6	10	0.4	3.7	5	3	4
-C6V8	6.8	6.4	7.2	15	1.2	4.5	5	2	4
-C7V5	7.5	7.0	7.9	15	2.5	5.3	5	1	5
-C8V2	8.2	7.7	8.7	15	3.2	6.2	5	0.7	5
-C9V1	9.1	8.5	9.6	15	3.8	7.0	5	0.5	6
-C10	10	9.4	10.6	20	4.5	8.0	5	0.2	7
-C11	11	10.4	11.6	20	5.4	9.0	5	0.1	8
-C12	12	11.4	12.7	25	6.0	10.0	5	0.1	8
-C13	13	12.4	14.1	30	7.0	11.0	5	0.1	8
-C15	15	13.8	15.6	30	9.2	13.0	5	0.05	10.5
-C16	16	15.3	17.1	40	10.4	14.0	5	0.05	11.2
-C18	18	16.8	19.1	45	12.4	16.0	5	0.05	12.6
-C20	20	18.8	21.2	55	14.4	18.0	5	0.05	14
-C22	22	20.8	23.3	55	16.4	20.0	5	0.05	15.4
-C24	24	22.8	25.6	70	18.4	22.0	5	0.05	16.8
-C27	27	25.1	28.9	80	21.4	25.3	2	0.05	18.9
-C30	30	28	32	80	24.4	29.4	2	0.05	21
-C33	33	31	35	80	27.4	33.4	2	0.05	23.1
-C36	36	34	38	90	30.4	37.4	2	0.05	25.2
-C39	39	37	41	130	33.4	41.2	2	0.05	27.4
-C43	43	40	46	150	37.6	46.6	2	0.05	30.1
-C47	47	44	50	170	42.0	51.8	2	0.05	33
-C51	51	48	54	180	46.6	57.2	2	0.05	35.7
-C56	56	52	60	200	52.2	63.8	2	0.05	39.3
-C62	62	58	66	215	58.8	71.6	2	0.05	43.5
-C68	68	64	72	240	65.6	79.8	2	0.05	47.7
-C75	75	70	79	255	73.4	88.6	2	0.05	52.5

⊕ Available to CECC 50 005-005

Continued

Diodes

silicon voltage regulator diodes, low power book 1 part 3

1W (BZV49 series): see Surface mounted semiconductors

1.3W ($T_{ip} = 55^{\circ}\text{C}$) $\pm 5\%$ voltage tolerance

Outline DO-41

Type No.	Nom. Zener voltage (V)	Measured at test I_Z			Temp. coefficient		Test I_Z (mA)	Max. I_R at (μA)	V_R (V)
		min. voltage (V)	max. voltage (V)	max. slope resistance (Ω)	min. (mV/°C)	max. (mV/°C)			
⊗ BZV85-C3V6	3.6	3.4	3.8	15	-3.5	-1.0	60	50	1
-C3V9	3.9	3.7	4.1	15	-3.5	-1.0	60	10	1
-C4V3	4.3	4.0	4.6	13	-2.7	0	50	5	1
-C4V7	4.7	4.4	5.0	13	-2.0	0.7	45	3	1
-C5V1	5.1	4.8	5.4	10	-0.5	2.2	45	3	2
-C5V6	5.6	5.2	6.0	7	0	2.7	45	2	2
-C6V2	6.2	5.8	6.6	4	0.6	3.6	35	2	3
-C6V8	6.8	6.4	7.2	3.5	1.3	4.3	35	2	4
-C7V5	7.5	7.0	7.9	3	2.5	5.5	35	1	4.5
-C8V2	8.2	7.7	8.7	5	3.1	6.1	25	0.7	5
-C9V1	9.1	8.5	9.6	5	3.8	7.2	25	0.7	6.5
-C10	10	9.4	10.6	8	4.7	8.5	25	0.2	7
-C11	11	10.4	11.6	10	5.3	9.3	20	0.2	7.7
-C12	12	11.4	12.7	10	6.3	10.8	20	0.2	8.4
-C13	13	12.4	14.1	10	7.4	12.0	20	0.2	9.1
-C15	15	13.8	15.6	15	8.9	13.6	15	0.05	10.5
-C16	16	15.3	17.1	15	10.7	15.4	15	0.05	11
-C18	18	16.8	19.1	20	11.8	17.1	15	0.05	12.5
-C20	20	18.8	21.2	24	13.6	19.1	10	0.05	14
-C22	22	20.8	23.3	25	16.6	22.1	10	0.05	15.5
-C24	24	22.8	25.6	30	18.3	24.3	10	0.05	17
-C27	27	25.1	28.9	40	20.1	27.5	8	0.05	19
-C30	30	28	32	45	22.4	32.0	8	0.05	21
-C33	33	31	35	45	24.8	35.0	8	0.05	23
-C36	36	34	38	50	27.2	39.9	8	0.05	25
-C39	39	37	41	60	29.6	43.0	6	0.05	27
-C43	43	40	46	75	34.0	48.3	6	0.05	30
-C47	47	44	50	100	37.4	52.5	4	0.05	33
-C51	51	48	54	125	40.8	56.5	4	0.05	36
-C56	56	52	60	150	46.8	63.0	4	0.05	39
-C62	62	58	66	175	52.2	72.5	4	0.05	43
-C68	68	64	72	200	60.5	81.0	4	0.05	48
-C75	75	70	79	225	66.5	88.0	4	0.05	53

⊗ Available to CECC 50 005-010

Continued

silicon voltage regulator diodes, low power

(cont.)

1.3W ($T_p = 25^\circ\text{C}$) $\pm 5\%$ voltage tolerance

Outline SOD-81

Type No.	Nom. Zener voltage (V)	Measured at test I_z			Temp. coefficient		Test I_z (mA)	Max. I_R at (μA)	V_R (V)
		min. voltage (V)	max. voltage (V)	max. slope resistance (Ω)	min. (%/°C)	max. (%/°C)			
● BZD23-C3V9	3.9	3.7	4.1	8	-0.14	-0.04	100	-	-
-C4V3	4.3	4.0	4.6	7	-0.12	-0.02	100	-	-
-C4V7	4.7	4.4	5.0	7	-0.10	0	100	-	-
-C5V1	5.1	4.8	5.4	6	-0.08	0.02	100	100	2
-C5V6	5.6	5.2	6.0	4	-0.04	0.04	100	50	2
-C6V2	6.2	5.8	6.6	3	-0.01	0.06	100	20	2
-C6V8	6.8	6.4	7.2	3	0	0.07	100	200	3
-C7V5	7.5	7.0	7.9	2	0	0.07	100	50	3
-C8V2	8.2	7.7	8.7	2	0.03	0.08	100	10	3
-C9V1	9.1	8.5	9.6	4	0.03	0.08	50	5	5
-C10	10.0	9.4	10.6	4	0.05	0.09	50	7	7.5
-C11	11.0	10.4	11.6	7	0.05	0.10	50	3	8.2
-C12	12.0	11.4	12.7	7	0.05	0.10	50	2	9.1
-C13	13.0	12.4	14.1	10	0.05	0.10	50	2	10
-C15	15.0	13.8	15.6	10	0.05	0.10	50	1	11
-C16	16.0	15.3	17.1	15	0.06	0.11	25	1	12
-C18	18.0	16.8	19.1	15	0.06	0.11	25	1	13
-C20	20.0	18.8	21.2	15	0.06	0.11	25	1	15
-C22	22.0	20.8	23.3	15	0.06	0.11	25	1	16
-C24	24.0	22.8	25.6	15	0.06	0.11	25	1	18
-C27	27.0	25.1	28.9	15	0.06	0.11	25	1	20
-C30	30	28	32	15	0.06	0.11	25	1	22
-C33	33	31	35	15	0.06	0.11	25	1	24
-C36	36	34	38	40	0.06	0.11	10	1	27
-C39	39	37	41	40	0.06	0.11	10	1	30
-C43	43	40	46	45	0.07	0.12	10	1	33
-C47	47	44	50	45	0.07	0.12	10	1	36
-C51	51	48	54	60	0.07	0.12	10	1	39
-C56	56	52	60	60	0.07	0.12	10	1	43
-C62	62	58	66	80	0.08	0.13	10	1	47
-C68	68	64	72	80	0.08	0.13	10	1	51
-C75	75	70	79	100	0.08	0.13	10	1	56
-C82	82	77	87	100	0.08	0.13	10	1	62
-C91	91	85	96	200	0.09	0.13	5	1	68
-C100	100	94	106	200	0.09	0.13	5	1	75
-C110	110	104	116	250	0.09	0.13	5	1	82
-C120	120	114	127	250	0.09	0.13	5	1	91
-C130	130	124	141	300	0.09	0.13	5	1	100
-C150	150	138	156	300	0.09	0.13	5	1	110
-C160	160	153	171	350	0.09	0.13	5	1	120
-C180	180	168	191	400	0.09	0.13	5	1	130
-C200	200	188	212	500	0.09	0.13	5	1	150
-C220	220	208	233	750	0.09	0.13	2	1	160
-C240	240	228	256	850	0.09	0.13	2	1	180
-C270	270	251	289	1000	0.09	0.13	2	1	200

Diodes in the voltage range 300 to 510V available on request.

Continued

Diodes

silicon voltage regulator diodes, low power book 1 part 3

3.25W ($T_{ip} = 25^{\circ}\text{C}$) $\pm 5\%$ voltage tolerance

Outline SOD-57

Type No.	Nom. Zener voltage (V)	Measured at test I_z		Temp. coefficient (%/ $^{\circ}\text{C}$)	Test I_z (mA)	Max. I_R at (μA)	V_R (V)		
		min. voltage (V)	max. voltage (V)					max. slope resistance (Ω)	
⊕ BZT03-C7V5	7.5	7.0	7.9	2	0	0.07	100	750	5.6
-C8V2	8.2	7.7	8.7	2	0.03	0.08	100	600	6.2
-C9V1	9.1	8.5	9.6	4	0.03	0.08	50	10	6.8
-C10	10	9.4	10.6	4	0.05	0.09	50	5	7.5
-C11	11	10.4	11.6	7	0.05	0.10	50	4	8.2
-C12	12	11.4	12.7	7	0.05	0.10	50	3	9.1
-C13	13	12.4	14.1	10	0.05	0.10	50	2	10
-C15	15	13.8	15.6	10	0.05	0.10	50	1	11
-C16	16	15.3	17.1	15	0.06	0.11	25	1	12
-C18	18	16.8	19.1	15	0.06	0.11	25	1	13
-C20	20	18.8	21.2	15	0.06	0.11	25	1	15
-C22	22	20.8	23.3	15	0.06	0.11	25	1	16
-C24	24	22.8	25.6	15	0.06	0.11	25	1	18
-C27	27	25.1	28.9	15	0.06	0.11	25	1	20
-C30	30	28	32	15	0.06	0.11	25	1	22
-C33	33	31	35	15	0.06	0.11	25	1	24
-C36	36	34	38	40	0.06	0.11	10	1	27
-C39	39	37	41	40	0.06	0.11	10	1	30
-C43	43	40	46	45	0.07	0.12	10	1	33
-C47	47	44	50	45	0.07	0.12	10	1	36
-C51	51	48	54	60	0.07	0.12	10	1	39
-C56	56	52	60	60	0.07	0.12	10	1	43
-C62	62	58	66	80	0.08	0.13	10	1	47
-C68	68	64	72	80	0.08	0.13	10	1	51
-C75	75	70	79	100	0.08	0.13	10	1	56
-C82	82	77	87	100	0.08	0.13	10	1	62
-C91	91	85	96	200	0.09	0.13	5	1	68
-C100	100	94	106	200	0.09	0.13	5	1	75
-C110	110	104	116	250	0.09	0.13	5	1	82
-C120	120	114	127	250	0.09	0.13	5	1	91
-C130	130	124	141	300	0.09	0.13	5	1	100
-C150	150	138	156	300	0.09	0.13	5	1	110
-C160	160	153	171	350	0.09	0.13	5	1	120
-C180	180	168	191	400	0.09	0.13	5	1	130
-C200	200	188	212	500	0.09	0.13	5	1	150
-C220	220	208	233	750	0.09	0.13	2	1	160
-C240	240	228	256	850	0.09	0.13	2	1	180
-C270	270	251	289	1000	0.09	0.13	2	1	200

⊕ Also available to CECC 50 005-017

Continued

silicon voltage regulator diodes, low power

(cont.) book 1 part 3

6W ($T_p = 25^\circ\text{C}$) $\pm 5\%$ voltage tolerance

Outline SOD-64

Type No.	Nom. Zener voltage (V)	Measured at test I_z			Temp. coefficient		Test I_z (mA)	Max. I_R at (μA)	V_R (V)
		min. voltage (V)	max. voltage (V)	max. slope resistance (Ω)	min. (%/°C)	max. (%/°C)			
€ BZW03-C7V5	7.5	7.0	7.9	1.5	0	0.07	175	1500	5.6
-C8V2	8.2	7.7	8.7	1.5	0.03	0.08	150	1200	6.2
-C9V1	9.1	8.5	9.6	2	0.03	0.08	150	40	6.8
-C10	10	9.4	10.6	2	0.05	0.09	125	20	7.5
-C11	11	10.4	11.6	2.5	0.05	0.10	125	15	8.2
-C12	12	11.4	12.7	2.5	0.05	0.10	100	10	9.1
-C13	13	12.4	14.1	2.5	0.05	0.10	100	4	10
-C15	15	13.8	15.6	2.5	0.05	0.10	75	2	11
-C16	16	15.3	17.1	2.5	0.06	0.11	75	2	12
-C18	18	16.8	19.1	2.5	0.06	0.11	65	2	13
-C20	20	18.8	21.2	3	0.06	0.11	65	2	15
-C22	22	20.8	23.3	3.5	0.06	0.11	50	2	16
-C24	24	22.8	25.6	3.5	0.06	0.11	50	2	18
-C27	27	25.1	28.9	5	0.06	0.11	50	2	20
-C30	30	28	32	8	0.06	0.11	40	2	22
-C33	33	31	35	10	0.06	0.11	40	2	24
-C36	36	34	38	11	0.06	0.11	30	2	27
-C39	39	37	41	14	0.06	0.11	30	2	30
-C43	43	40	46	20	0.07	0.12	30	2	33
-C47	47	44	50	25	0.07	0.12	25	2	36
-C51	51	48	54	27	0.07	0.12	25	2	39
-C56	56	52	60	35	0.07	0.12	20	2	43
-C62	62	58	66	42	0.08	0.13	20	2	47
-C68	68	64	72	44	0.08	0.13	20	2	51
-C75	75	70	79	45	0.08	0.13	20	2	56
-C82	82	77	87	65	0.08	0.13	15	2	62
-C91	91	85	96	75	0.09	0.13	15	2	68
-C100	100	94	106	90	0.09	0.13	12	2	75
-C110	110	104	116	125	0.09	0.13	12	2	82
-C120	120	114	127	170	0.09	0.13	10	2	91
-C130	130	124	141	190	0.09	0.13	10	2	100
-C150	150	138	156	260	0.09	0.13	8	2	110
-C160	160	153	171	350	0.09	0.13	8	2	120
-C180	180	168	191	430	0.09	0.13	5	2	130
-C200	200	188	212	500	0.09	0.13	5	2	150
-C220	220	208	233	700	0.09	0.13	5	2	160
-C240	240	228	256	900	0.09	0.13	5	2	180
-C270	270	251	289	1200	0.09	0.13	5	2	200

€ Also available to GECC 50 005-019

n-p-n transistors

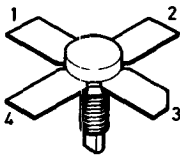
book 1 part 2a

$I_{C(AV)}$ max. (mA)	Type No.	Ratings		Characteristics			Comments	Outline	Pinning	
		V_{CEO} (V)	P_{tot} at 25°C (mW)	h_{FE} min.	max.	at I_C (mA)				f_T min. (GHz)
1st generation; f_T to 1.5 GHz										
25	BFW92A	15	200	20	150	2	2.8*	$V_O = 150mV$ at $d_{im} = -60dB$	SOT-37	b c e -
	BFY90	15	200	25	150	2	1	$N < 3.5dB$ at 200MHz	TO-72	e b c s†
	BFX89	15	200	20	150	2	1.2*	$N = 7dB$ at 800MHz	TO-72	e b c s†
	BF689K	15	360	35	70	20	1.8*	Typ. $G_p = 16dB$ at 200MHz	TO-92	e b c -
50	BFW30	10	250	25	-	50	1.6*	$N < 5.0dB$ at 500MHz	TO-72	e b c s†
150	BFR95	25	1.5W	30	-	150	3.5*	Typ. $G_p = 9dB$, 40-300MHz	TO-39	e b c ▲-
	BFW16A	25	1.5W	25	-	150	1.2*	Typ. $G_p = 6.5dB$ at 800MHz	TO-39	e b c ▲-
	BFW17A	25	1.5W	25	-	150	1.1*	Typ. $G_p = 16dB$ at 200MHz	TO-39	e b c ▲-
2nd generation; f_T to 5GHz										
2.5	BFT24	5	30	20	-	1	1.2	Typ. $G_{UM} = 17dB$ at 500MHz	SOT-37	b c e -
	BFQ53	15	150	25	-	14	5	BFR90 in TO-72	TO-72	e b c s†
25	BFR90	15	180	40	-	14	5*	$N = 2.4dB$ typ. at 500MHz	SOT-37	b c e -
	BFR90A							$N = 1.8dB$ typ. at 800MHz		
	BFQ90A	15	180	40	-	14	5*	Typ. $G_{UM} = 18dB$ at 800MHz	SOT-103	e c e b
30	BFP90A	15	250	40	-	14	5*	Typ. $G_{UM} = 19dB$ at 800MHz	SOT-173	c e b e
35	BFR91	12	180	25	-	30	5*	$N = 1.9dB$ typ. at 500MHz	SOT-37	b c e -
	BFR91A		300	40	-		6*	$N = 1.6dB$ typ. at 800MHz		
	BFQ22S	12	150	50	150	10	5*	BFR91 in TO-72	TO-72	e b c s†
	BFQ91A	12	300	40	-	30	6*	Typ. $G_{UM} = 17dB$ at 800MHz	SOT-103	e c e b
50	BFP91A	12	350	40	-	30	6*	Typ. $G_{UM} = 18dB$ at 800MHz	SOT-173	c e b e
75	BFR96	15	500	25	-	50	5*	$V_O = 0.5V$ at $d_{im} = -60dB$	SOT-37	b c e -
100	BFR96S		700		-	70	5*	$V_O = 0.7V$ at $d_{im} = -60dB$		
75	BFQ63	15	250	50	150	20	4.5*	Typ. $G_{UM} = 11.5dB$ at 500MHz	TO-72	e b c s†
150	BFG96	15	700	25	-	50	5*	Typ. $G_{UM} = 14dB$ at 800MHz	SOT-103	e c e b
100	BFP96	15	500	25	-	50	4.5*	Typ. $G_{UM} = 15dB$ at 800MHz	SOT-173	c e b e
150	BFQ34T	18	1W	25	-	100	3.7*	$V_O = 1V$ at $d_{im} = -60dB$	SOT-37	b c e -
	BFQ34	18	1W	25	-	100	3.7*	Typ. $G_{UM} = 14dB$ at 800MHz	SOT-103	e c e b
	BFQ34	18	2.2W	25	-	75	3.5	$V_O = 1.2V$ at $d_{im} = -60dB$	SOT-122	b e c e
300	BFQ68	18	4.5W	25	-	240	4*	$V_O = 1.6V$ at $d_{im} = -60dB$	SOT-122	b e c e
600	BFQ136	18	9W	25	-	500	4*	Typ. $G_{UM} = 12.5dB$ at 800MHz	SOT-122	b e c e

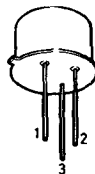
*Typical †Shield connected to case

▲Collector connected to case

Continued



SOT-122



TO-39



TO-72



TO-92

See also facing page

n-p-n transistors (cont.)

book 1 part 2a

$I_{C(AV)}$ max. (mA)	Type No.	Ratings		Characteristics				Comments	Outline	Pinning
		V_{CE0} (V)	P_{tot} at 25°C (mW)	h_{FE} min.	max.	at I_C (mA)	f_T min. (GHz)			
3rd generation; f_T to 7.5 GHz										
20	BFQ33C	7	140	50	—	14	12*	Typ. $G_{UM} = 13.3\text{dB}$ at 2GHz	SOT-173	c e b e
50	BFQ65	10	300	60	—	15	7.5*	Typ. $G_{UM} = 8\text{dB}$ at 2GHz	SOT-37	b c e —
	BFQ65	10	300	25	—	15	7.5*	Typ. $G_{UM} = 11.5\text{dB}$ at 2GHz	SOT-103	e c e b
	BFQ66	10	350	60	—	15	7.5*	Typ. $G_{UM} = 12.5\text{dB}$ at 2GHz	SOT-173	c e b e
100	● BFG195	10	500	40	—	50	7.5*	Typ. $G_{UM} = 12\text{dB}$ at 2GHz	SOT-103	e c e b

p-n-p transistors

book 1 part 2a

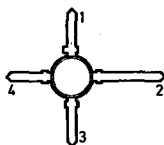
$I_{C(AV)}$ max. (mA)	Type No.	Ratings		Characteristics				Comments	Outline	Pinning
		V_{CE0} (V)	P_{tot} at 25°C (mW)	h_{FE} min.	max.	at I_C (mA)	f_T min. (MHz)			
2nd generation; f_T to 5 GHz										
25	● BFQ52	—15	150	20	—	14	5*	P-N-P complement of BFQ53	TO-72	e b c s†
25	BFQ51	—15	180	20	—	14	5*	P-N-P equivalent of BFR90	SOT-37	b c e —
	BFG51	—15	180	50	—	14	5*	Typ. $G_{UM} = 8\text{dB}$ at 2GHz	SOT-103	e c e b
	BFQ51C	—15	250	20	50	14	5*	Typ. $G_{UM} = 17\text{dB}$ at 800MHz	SOT-173	c e b e
35	● BFQ24	—12	150	20	—	30	5*	P-N-P complement of BFQ22S	TO-72	e b c s†
35	BFQ23	—12	180	20	—	30	5*	$N = 2.4\text{dB typ.}$ at 500MHz	SOT-37	b c e —
	BFG23	—12	180	20	—	30	5*	Typ. $G_{UM} = 6.5\text{dB}$ at 2GHz	SOT-103	e c e b
	BFQ23C	—12	350	20	—	30	5*	Typ. $G_{UM} = 15\text{dB}$ at 800MHz	SOT-173	c e b e
75	BFQ32	—15	500	20	—	50	3.6	$d_{jm} = -60\text{dB typ.}$ at $V_o = 0.5\text{V}, 500\text{MHz}$	SOT-37	b c e —
	BFG32	—15	700	20	—	50	4.5*	Typ. $G_{UM} = 6\text{dB}$ at 2GHz	SOT-103	e c e b
	BFQ32C	—15	500	20	—	50	4.5*	Typ. $G_{UM} = 13\text{dB}$ at 800MHz	SOT-173	c e b e

*Typical

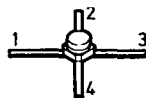
† Shield lead connected to case



SOT-37



SOT-103



SOT-173

R.F. wideband devices

catv modules

Outline: SOT-115**

Type No.	f (MHz)	G_p at f = 50MHz (dB)	V_o min. (dBmV)	Composite triple beat X_{mod} (dB) (dBmV)		N max. (dB)	Typ. d.c. current consumption † (mA)
BGY50	40-330	12.5	61	-	-	7	160
BGY51			63.5			8	200
BGY52	40-330	16.4	61	-	-	6	160
BGY53						7	200
BGY54	40-330	17	61	-	-	6	160
BGY55			63.5			6.5	200
BGY56	40-330	22	61.5	-	-	6	160
BGY57			64			7	200
BGY58	40-330	33	64	-	-	6	320
BGY58A		34					
BGY59	40-330	38.5	64	-	-	6	320
BGY60	40-330	33.3	64	-	-	6	320
BGY61	5-200	13	64	-	-	7*	200
BGY65	5-200	18.5	65	-	-	6*	200
BGY67	5-200	22.5	64	-	-	5*	200
BGY70	40-450	12.5	61	-	-	7.5	160
BGY71			63.5			8.5	200
BGY78	40-450	34	47	-	-	6	320
BGY84	40-450	17	60	-	-	6.5	180
BGY84A		18.4					
BGY85	40-450	17	62.5	-	-	7	220
BGY85A		18.4					
BGD102	40-450	18.5	-	-65	-67	7	< 435
BGD104		20		-64	-66		
BGD102E	40-450	18.5	65	-	-	7	< 435
BGD104E		20	64.5				

* Typical † At supply voltage = +24V ** BGY60: pin 4 = output pre-stage, pin 6 = input final stage

h.f. single sideband 1.6–30 MHz



book 1 part 2b

Class AB
Intermodulation distortion $d_3 < -40\text{dB}$

Type No.	Outline	P_L (W)	V_{DD} (V)	Power gain (dB)
● BLF242	SOT-123	1	28	25
● BLF244	SOT-123	4	28	25
● BLF145	SOT-123	8	28	24
● BLF175	SOT-123	8	50	24

Class AB
Intermodulation distortion $d_3 < -30\text{dB}$

Type No.	Outline	P_L (W)	V_{DD} (V)	Power gain (dB)
● BLF145	SOT-123	30	28	22
● BLF146	SOT-121	80	28	18
● BLF147	SOT-121	150	28	17
● BLF175	SOT-123	30	50	22
● BLF177	SOT-121	150	50	20

v.h.f. transmitters 2–225 MHz



book 1 part 2b

Class B

Type No.	Outline	P_L (W)	V_{DD} (V)	G_p at 175 MHz (dB)	η_d min. (dB)
● BLF242	SOT-123	5	28	13	50
● BLF244	SOT-123	15	28	13	50
● BLF245	SOT-123	30	28	13	50
● BLF146	SOT-121	80	28	13†	50

† Typical at 108 MHz.

R.F. power transistors and modules

h.f. single sideband 1.6–30 MHz book 1 part 2b

Class A

Intermodulation distortion $d_3, d_5 < -40\text{dB}$

Type No.	Outline	P_L PEP (W)	V_{CE} (V)	Power gain (dB)
BLV10	SOT-123	1	12	18
BLY87C	SOT-120	1	12	18
BLV11	SOT-123	2	12	18
BLY88C	SOT-120	2	12	18
BLW87	SOT-123	6	12	18
BLY89C	SOT-120	6	12	18
BLV20	SOT-123	1.3	26	20
BLY91C	SOT-120	1.3	26	20
BLV21	SOT-123	2.5	26	20
BLY92C	SOT-120	2.5	26	20
BLX13C	SOT-120	8	26	20
BLW83	SOT-123	10	26	20
BLX39	SOT-120	15	26	20
BLW86	SOT-123	17	26	22
BLW78	SOT-121	35	26	19.5
BLW50F	SOT-123	16	45	19.5
BLW96	SOT-121	50	40	19

Class AB

Intermodulation distortion $d_3, d_5 < -30\text{dB}$

Type No.	Outline	P_L PEP (W)	V_{CE} (V)	Power gain (dB)
BLV11	SOT-123	10	13.5	18
BLY88C	SOT-120	10	13.5	18
BLW87	SOT-123	15	13.5	18
BLY89C	SOT-120	15	13.5	18
BLW85	SOT-123	30	12.5	19.5
BLW60C	SOT-120	30	12.5	19.5
BLW99	SOT-121	80	12.5	12.5
BLV21	SOT-123	10	28	20
BLY92C	SOT-120	10	28	20
BLW83	SOT-123	25	28	21
BLX13C	SOT-120	25	28	21
BLX39	SOT-120	37.5	28	19
BLW86	SOT-123	42.5	28	19
BLW76	SOT-121	80	28	13
BLW78	SOT-121	100	28	19
BLW77	SOT-121	130	28	12
BLW97	SOT-121	175	28	11.5
BLW50F	SOT-123	65	50	18
BLX15	SOT-55	150	50	14
BLW95	SOT-121	160	50	14
BLW96	SOT-121	200	50	13.5

R.F. power transistors and modules

v.h.f. mobile transmitters 25–174 MHz

book 1 part 2b

Class B 7.5–9.6V supply

Type No.	Outline	P_L^1 (W)	Power gain (dB)	
2N4427	TO-39/1	0.7	8	
BFQ42	TO-39/1	1.5	8.4	
BGY93	SOT-182	2	17.5	module
BFQ43	TO-39/3	3	9.4	
BLY87C	SOT-120	4.8	9.4	
BGY94	SOT-182	6	21	module
BLW29	SOT-120	9	7.4	

¹⁾ Measured with a 7.5V supply; 9.6V for modules

Class B 12.5–13.5V supply

Type No.	Outline	P_L^2 (W)	Power gain (dB)	
2N4427	TO-39/1	1*	10	
BFQ42	TO-39/1	2	11	
BLW79	SOT-122	2*	13.5	
BLX65E	TO-39/3	2	16	
BFQ43	TO-39/3	4	12	
BFS22A	TO-39/1	4	8	
BLW80	SOT-122	4*	15	
BLV10	SOT-123	8	9	
BLY87C	SOT-120	8	12	
BLW81	SOT-122	10*	13.5	
BGY43	SOT-132B	13	19.3	module
BLV11	SOT-123	15	8	
BLW29	SOT-120	15	10	
BLY88C	SOT-120	15	8	
BGY32	SOT-132B	18	22.5	module
BGY35	SOT-132B	18	21	module
BGY36	SOT-132B	18	21	module
BLW87	SOT-123	25	6	
BLY89C	SOT-120	25	6	
BLW31	SOT-120	28	9	
BGY45A	SOT-183	30	21.7	module
BGY45B	SOT-183	30	21.7	module
BLW60C	SOT-120	45*	5	
BLW85	SOT-123	45*	4.5	
BLV45/12	SOT-119	45*	6.5	
BLV75/12	SOT-119	75*	6.5	

²⁾ Measured with a 13.5V supply; 12.5V where marked *

Class B 28V supply (base stations)

Type No.	Outline	P_L (W)	Power gain (dB)
2N3866	TO-39	1	15
2N3553	TO-39	2.5	10
BFS23A	TO-39/1	4	10
BLV20	SOT-123	8	12
BLY91C	SOT-120	8	12
BLV21	SOT-123	15	10
BLY92C	SOT-120	15	10
BLW84	SOT-123	25	9
BLY93C	SOT-120	25	9
BLW86	SOT-123	45	7.5
BLX39	SOT-120	45	7.5
BLW80/28	SOT-121	80	6.5
BLW78	SOT-121	100	6
BLW77	SOT-121	130	7.5

v.h.f. mobile transmitters 174-225MHz

Class B 12.5–13.5V supply

Type No.	Outline	P_L (W)	Power gain (dB)	
2N4427	TO-39/1	1	8	
BLX65E	TO-39/3	2	13.8	
BLW80	SOT-122	4	14.0	
BLY87C	SOT-120	8	10.7	
BLW29	SOT-120	15	10	
● BGY45C	SOT-183	18	20.8	module
● BGY45D	SOT-183	21	21.5	module
BLW31	SOT-120	28	8	

R.F. power transistors and modules

u.h.f. mobile transmitters 400-512MHz

book 1 part 2a, b

Class B 7.5-9.6V supply

Type No.	Outline	P_L ¹⁾ (W)	Power gain (dB)	
BFR96S	SOT-37(2)	0.4	11	
BLV90	SOT-172	0.75	10.5	
BGY46	SOT-181	1.4	14.9	module
● BLX65ES	TO-39/3	1.4	6.5	
BLW79	SOT-122	1.7	7	
BGY47	SOT-181	3	18	module
BLW80	SOT-122	3	6	
BGY48	SOT-182	5	20	module
BLV93	SOT-171	6	7.4	

¹⁾ Measured with a 7.5V supply; 9.6V for modules

Class B 12.5V supply

Type No.	Outline	P_L (W)	Power gain (dB)	
2N4427	TO-39/1	0.4	6	
● BLX65ES	TO-39/3	2	9	
BLW79	SOT-122	2	9	
BLU11/SL	SOT-122	2	11	
BLW80	SOT-122	4	8	
BLU99	SOT-122	5	10.5	
BLU97	SOT-122	7	9	
BLX68	SOT-48/1	7	5	
BGY40	SOT-132C	10	18.8	module
BLW81	SOT-122	10	6	
BGY41	SOT-132C	15	19.4	module
BLU20/12	SOT-119	20	6.5	
BLU30/12	SOT-119	30	5.7	
BLU45/12	SOT-119	45	4.8	
BLU60/12	SOT-119	60	4.4	

Class B 28V supply

Type No.	Outline	P_L (W)	Power gain (dB)
2N3866	TO-39/1	1	10
BLX91A	SOT-48/1	1	11
BLW89	SOT-122	2	12
BLW90	SOT-122	4	11
BLW91	SOT-122	10	9
BLX94C	SOT-122	25	6.5
BLX95	SOT-56	40	4.5

Air communication broadband transistors 100-400 MHz

Type No.	Outline	P_L (W)	Power gain (dB)
BLU50	SOT-161	30	10
BLU51	SOT-161	45	9
BLU52	SOT-161	60	9
BLU53	SOT-161	100	7

Continued

R.F. power transistors and modules

u.h.f. mobile transmitters (cont.) 960MHz

book 1 part 2b

Class B 7.5-9.6V supply

Type No.	Outline	P _L (W)	Power gain (dB)	
BFR90A	SOT-37(2)	0.075 ¹⁾	7.5	
BFR91A	SOT-37(2)	0.16 ¹⁾	7	
BLU98	SOT-103(2)	0.4 ¹⁾	6.8	
● BLT90/SL*	SOT-172	0.75 ¹⁾	7.0	
● BLT91/SL*	SOT-172	1.5 ¹⁾	6.0	
● BLV90/SL*	SOT-172	1.0	7.0	
● BLV91/SL*	SOT-172	1.5	6.6	
● BLT92/SL*	SOT-122	3.0 ¹⁾	8.0	
BGY95	A	2.5 ¹⁾	21	module
BGY96	A	2.5	21	module
BLV92	SOT-171	3 ¹⁾	5.8	

¹⁾ Measured with a 7.5V supply

* SL means studless envelope.

Class B 12.5V supply

Type No.	Outline	P _L (W)	Power gain (dB)	
BLU98	SOT-103(2)	0.5	8.5	
BLV90	SOT-172	1	7.5	
● BLV90/SL*	SOT-172	1	7.5	
BLV91	SOT-172	2	6.5	
● BLV91/SL*	SOT-172	2	6.5	
BLU99	SOT-122	4	7	
BLV92	SOT-171	4	7.5	
BGY90	SOT-197	8	17	module
BLV93	SOT-171	8	6.5	
BLV94	SOT-171	12.5	6	
BLV95	SOT-171	25	5.5	

* SL means studless envelope.

Class B 24V supply (base stations)

Type No.	Outline	P _L (W)	Power gain (dB)
BLV99	SOT-172	2	9
BLV98	SOT-171	14	8.5
BLV97	SOT-171	30	7

f.m. radio 87-108 MHz

book 1 part 2b

Class B 28V supply

Type No.	Outline	P _L (W)	Power gain (dB)	
2N3866	TO-39	1.8	15	
BLW90	SOT-122	4	20	
BLV21	SOT-123	15	15	
BGY33²⁾	SOT-132B	22	23	module
BLW86	SOT-123	45	11	

²⁾ Supply voltage 12.5V

Type No.	Outline	P _L (W)	Power gain (dB)
BLX39	SOT-120	45	11
BLV80/28	SOT-121	80	10
BLW76	SOT-121	80	7.9
BLW78	SOT-121	100	8
BLV25	SOT-119	175	10

R.F. power transistors and modules

tv transposers and transmitters book 1 part 2b

BANDS I(41-68 MHz) AND III(174-230MHz)

Class A 25V supply

Type No.	Outline	$P_{o\ sync}$ (W)	Power gain (dB)	d_{im} (dB)
BGY55 ¹⁾	SOT-115	0.25	17	-60
		0.45		-55
BLV30	SOT-122	1.5	18	-60
BLV31	SOT-122	5	15	-58
BLV32F	SOT-160	10	16	-55
BLV33F	SOT-119	16	13.5	-55
BLV33	SOT-147	19	9	-55

¹⁾ Module

BANDS I(41-68 MHz) AND III(174-230MHz)

Class AB 28V supply

Type No.	Outline	$P_{o - 1dB}$ (W)	Power gain (dB)
BLV30	SOT-122	10	15
BLV31	SOT-122	20	12
BLV32F	SOT-160	30	13
BLV33F	SOT-119	85	10.5
BLV33	SOT-147	90	6.5
BLV36	SOT-161	115	11

BANDS IV AND V(470-860 MHz)

Class A 25V supply

Type No.	Outline	$P_{o\ sync}$ (W)	Power gain (dB)	d_{im} (dB)
BFQ34	SOT-122	0.3	11	-60
BLW32	SOT-122	0.5	11	-60
BFQ68	SOT-122	0.7	10	-60
BLW33	SOT-122	1	10	-60
BLW34	SOT-122	1.8	9	-60
BLW98	SOT-122	3.5	6.5	-60
BLV57	SOT-161	6	8	-60

BANDS IV AND V(470-860 MHz)

Class AB 25V supply

Type No.	Outline	$P_{o - 1dB}$ (W)	Power gain (dB)
BFR96S	SOT-37(2)	0.12	10
BLV59	SOT-171	30	7
BLV57	SOT-161	30	6.5

R.F. power transistors and modules

broadband r.f. power modules

book 1 part 2b

Type No.	Description	Outline	Frequency range (MHz)	Supply voltage V_{S1} (V)	V_{S2} (V)	Min. power output (W)	at P_{DR} (mW)	Efficiency typ. (%)
BGY22	U.H.F. amplifier modules for mobile communications equipment	SOT-75A	380-512	13.5		2.5	50	50
BGY23			380-512	13.5		7	2.5W	70
BGY32	V.H.F. amplifier modules designed for mobile communications equipment	SOT-132B	68-88	12.5	12.5	18	100	> 40
BGY33			80-108				100	
BGY35			132-156				150	
BGY36			148-174				150	
BGY40A	U.H.F. amplifier modules designed for mobile communications equipment	SOT-132C	400-440	12.5	12.5	7.5	100	> 35
BGY41A			400-440			13	150	
BGY40B			440-470			7.5	100	
BGY41B			440-470			13	150	
BGY43	V.H.F. amplifier module designed for mobile communications equipment	SOT-132B	148-174	12.5	12.5	13	80	48
BGY45A	V.H.F. amplifier modules designed for mobile communications equipment	SOT-183	68-88	12.5	12.5	30	< 150	> 40
BGY45B			148-174	12.5	12.5	30	< 300	> 40
BGY46A	U.H.F. amplifier modules designed for portable equipment	SOT-181	400-440	7.5	9.6	1.4	< 45	> 40
BGY46B			430-470	7.5	9.6	1.4	< 45	> 40
BGY47A			400-440	7.5	7.5	2.0	< 50	> 40
BGY47C			460-512	9.6	9.6	2.0	< 50	> 40
BGY47D			370-420	7.5	9.6	3.2	< 50	> 36
BGY47E			410-470	7.5	9.6	3.2	< 50	> 36
BGY47F			460-512	7.5	9.6	3.2	< 50	> 36
BGY93A	V.H.F. amplifier modules designed for portable equipment	SOT-182	68-88	9.6	9.6	2.0	< 35	> 40
BGY93B			136-156	9.6	9.6	2.0	< 35	> 40
BGY93C			148-174	9.6	9.6	2.0	< 35	> 40
BGY94A			68-88	9.6	9.6	6.0	< 35	> 40
BGY94B			136-156	9.6	9.6	6.0	< 35	> 40
BGY94C			144-175	9.6	9.6	6.0	< 35	> 40
BGY48A	U.H.F. amplifier modules designed for portable transmitters	SOT-182	400-440	9.6		5.0	< 50	> 35
BGY48B			430-470					
BGY48C			460-512					
BGY90A	U.H.F. amplifier modules designed for mobile transmitting equipment	SOT-197	806-890	12.5		7.5	< 200	39
BGY90B			870-950					
BGY95A	U.H.F. amplifier modules designed for mobile transmitting equipment	SOT-200	825-845	≤ 6.0	7.5	2.5	< 20	> 35
BGY95B			890-915					
BGY96A	U.H.F. amplifier modules designed for mobile transmitting equipment	SOT-200	825-845	≤ 6.0	9.6	2.5	< 20	> 35
BGY96B			890-915					

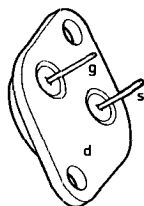
power mos transistors

book 1 part 1f

V_{DS} max. (V)	Type No.	$R_{DS(on)}$ max. (Ω)	P_{tot} max. $T_{mb} = 25^{\circ}C$ (W)	I_D max. (A)	I_{DM} max. (A)	g_{fs} typ. (A/V)	t_r typ. (ns)	Outline
50	BUZ71A	0.12	40	12	36	4.8	150	TO-220
	BUZ71	0.1	40	12	36	4.8	150	TO-220
	BUZ10	0.1	75	12	36	4.8	60	TO-220
	BUZ11A	0.06	75	25	75	8	450	TO-220
	BUZ11	0.04	75	30	90	8	450	TO-220
	BUZ14	0.04	125	39	115	12	200	TO-3(3)
	BUZ15	0.03	125	45	135	12	200	TO-3(3)
100	BUZ72A	0.25	40	9	27	3.8	150	TO-220
	BUZ72	0.2	40	10	30	3.8	150	TO-220
	BUZ21	0.1	75	18	54	6	60	TO-220
	BUZ25	0.1	78	19	57	8	320	TO-3(3)
	BUZ24	0.06	125	32	95	10	200	TO-3(3)
200	BUZ73A	0.6	40	5.8	17	3.5	130	TO-220
	BUZ32	0.4	75	9.5	28	5	60	TO-220
	BUZ35	0.4	78	9.9	29	5	60	TO-3(2)
	BUZ31	0.2	75	12.5	37	5	60	TO-220
	BUZ34	0.2	125	17	50	5	200	TO-3(3)
	BUZ36	0.12	125	22	65	13	200	TO-3(3)
400	BUZ76A	2.5	40	2.6	7.5	2.5	100	TO-220
	BUZ76	1.8	40	3	9	2.5	100	TO-220
	BUZ60	1.0	75	5.5	16	2.5	100	TO-220
	BUZ63	1.0	78	5.9	17	2.5	100	TO-3(2)
	BUZ64	0.4	125	10.5	31	4.5	100	TO-3(2)
500	BUZ74A	4.0	40	2	6	2.5	100	TO-220
	BUZ74	3.0	40	2.4	7	2.5	100	TO-220
	BUZ42	2.0	75	4	12	2.5	100	TO-220
	BUZ46	2.0	78	4.2	12	2.5	100	TO-3(2)
	BUZ41A	1.5	75	4.5	13	2.5	100	TO-220
	BUZ44A	1.5	78	4.8	14	2.5	100	TO-3(2)
	BUZ45A	0.8	125	8.3	24	5	100	TO-3(2)
	BUZ45	0.6	125	9.6	28	5	100	TO-3(2)
	BUZ45B	0.5	125	10	30	5	100	TO-3(2)

All types: $\pm V_{GSmax} = 20V$

Continued



TO-3



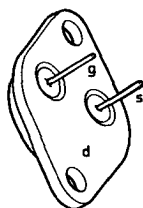
TO-220

power mos transistors (cont.)

book 1 part 1f

V_{DS} max. (V)	Type No.	$R_{DS(on)}$ max. (Ω)	P_{tot} max. $T_{mb} = 25^\circ\text{C}$ (W)	I_D max. (A)	I_{DM} max. (A)	g_{fs} typ. (A/V)	t_f typ. (ns)	Outline
800	BUZ80	4.0	75	2.6	7.5	1.8	100	TO-220
	BUZ83	4.0	78	2.9	8.5	1.8	100	TO-3(2)
	BUZ80A	3.0	75	3	9	1.8	100	TO-220
	BUZ83A	3.0	78	3.4	10	1.8	100	TO-3(2)
	BUZ84	2.0	125	5.3	15	3.0	100	TO-3(2)
	BUZ84A	1.5	125	6	18	3.0	100	TO-3(2)
1000	BUZ50B	8.0	75	2	6	1.5	100	TO-220
	● BUZ50C	6.0	75	2.5	7.5	1.5	100	TO-220
	BUZ50A	5.0	75	2.5	7.5	1.5	100	TO-220
	BUZ53A	5.0	78	2.6	7.5	1.5	100	TO-3(2)
	BUZ54A	2.6	125	4.6	13	2.0	100	TO-3(2)
	BUZ54	2.0	125	5.3	15	2.0	100	TO-3(2)

All types: $\pm V_{GSmax} = 20V$



TO-3



TO-220

Power semiconductors

n-p-n switching power transistors book 1 part 1e

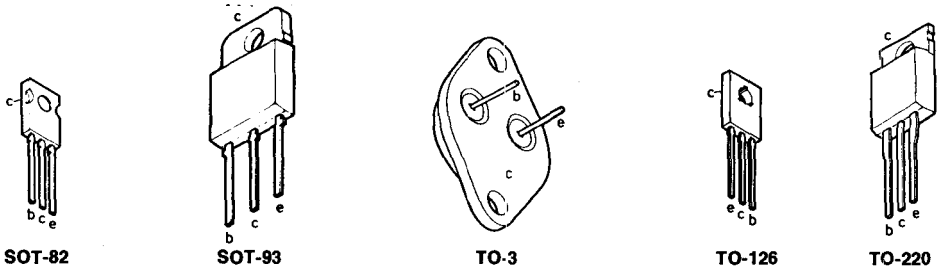
For information on isolated TO-220 equivalents, see page 225.

$I_{C(AV)}$ max.	Type No.	Maximum ratings					Characteristics					Outline
		V_{CBO}	V_{CEO}	I_{CM}	P_{tot} $T_{mb} = 25^\circ C$ (W)	$t_{\dagger\dagger}$ max. (μs)	$V_{CE(sat)}$ max. (V)	at I_C/I_B	h_{FE} min.	h_{FE} max.	at I_C (mA)	
(A)	BUX86	800†	400	1	20	0.4	1.0	0.2/0.02	50*	—	50	TO-126
	BUX87	1000†	450									
1	TIP47	350	250	2	40	—	1.0	1/0.2	30	150	300	TO-220
	TIP48	400	300									
	TIP49	450	350									
	TIP50	500	400									
2	BUW84	800†	400	3	50	0.4	1.0	1/0.2	50*	—	100	SOT-82
	BUW85	1000†	450									
2	BUX84	800†	400	3	40	0.4	1.0	1/0.2	50*	—	100	TO-220
	BUX85	1000†	450									
5	BUT11	850†	400	10	100	0.8	1.5	3/0.6	30*	—	300	TO-220
	BUT11A	1000†	450				1.5	2.5/0.5				
5	BUW11	850†	400	10	100	0.8	1.5	3/0.6	30*	—	300	SOT-93
	BUW11A	1000†	450				1.5	2.5/0.5				
5	BUS11	850†	400	10	100	0.8	1.5	3/0.6	30*	—	500	TO-3
	BUS11A	1000†	450				1.5	2.5/0.5				
5	BUP21	—	300	10	100	0.25*	1.5	3/0.3	25*	—	0.5	SOT-93
	BUP21A	—	350			0.25*		3/0.34				
	BUP21B	—	400			0.3*		3/0.4				
	BUP21C	—	450			0.3*		3/0.5				

*Typical

† V_{CESM} max.

†† Under resistive conditions



n-p-n switching power transistors (cont.)

book 1 part 1e

For information on isolated TO-220 equivalents, see page 225.

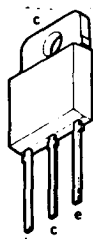
$I_{C(AV)}$ max.	Type No.	Maximum ratings					Characteristics					Outline
		V_{CBO}	V_{CEO}	I_{CM}	P_{tot} $T_{mb} = 25^\circ C$	$t_f^{\dagger\dagger}$ max.	$V_{CE(sat)}$ max.	at I_C/I_B	min. h_{FE}	max. h_{FE}	at I_C	
(A)		(V)	(V)	(A)	(W)	(μs)	(V)	(A)			(mA)	
5	BUT21	—	300	10	100	0.25*	1.5	3/0.3	25*	—	0.5	TO-220
	BUT21A	—	350			0.25*		3/0.34				
	BUT21B	—	400			0.3 *		3/0.4				
	BUT21C	—	450			0.3 *		3/0.5				
6	● BUT18	800†	400	12	110	0.8	1.5	4/0.8	10	—	10	TO-220
	● BUT18A	1000†	450									
6	BUY89	1500†	800	10	80	0.5 *	1.0	4.5/2	2.5	—	4.5A	TO-3
8	BUW12	850†	400	20	125	0.8	1.5	6/1.2	30*	—	1	SOT-93
	BUW12A	1000†	450				1.5	5/1				
8	BUS12	850†	400	20	125	0.8	1.5	6/1.2	30*	—	1	TO-3
	BUS12A	1000†	450				1.5	5/1				
8	BUP22	500†	300	20	125	0.25*	1.5	6/0.6	25*	—	1	SOT-93
	BUP22A	650†	350			0.25*		6/0.67				
	BUP22B	750†	400			0.3 *		6/0.8				
	BUP22C	850†	450			0.3 *		6/1				

*Typical

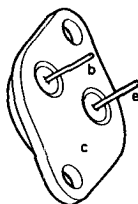
† V_{CESM} max.

†† Under resistive conditions

Continued



SOT-93



TO-3



TO-220

n-p-n switching power transistors (cont.)

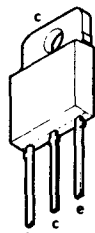
book 1 part 1e

For information on isolated TO-220 equivalents, see page 225.

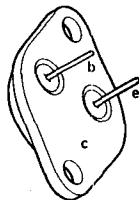
$I_{C(AV)}$ max.	Type No.	Maximum ratings					Characteristics					Outline
		V_{CBO}	V_{CEO}	I_{CM}	P_{tot} $T_{mb} = 25^\circ C$	$t_{\dagger\dagger}$ max.	$V_{CE(sat)}$ max.	at I_C/I_B	min.	h_{FE} max.	at I_C	
(A)		(V)	(V)	(A)	(W)	(μs)	(V)	(A)			(mA)	
8	BUV89	1200†	800	15	125	0.5 *	1.0	4.5/2	2.5	–	4.5	SOT-93
10	BDY90	120	100	15	40	0.2	0.5	5/0.5	30	120	5	TO-3
	BDY91	100	80									
	BDY92	80	60									
10	BUW86	150	120	15	62.5	0.2	0.5	5/0.5	30	120	5	TO-3
10	BUW87	300	150	15	62.5	0.3	1.0	7/0.7	20	–	4	TO-3
	BUW87A	400	200				1.0	5/0.5	20	–	3	
10	BUV28	400†	200	15	65	0.25	1.5	6/0.6	–	–	–	TO-220
	BUV28A	450†	225				1.5	4/0.4				
12	BDY90A	120	100	15	40	0.2	0.5	5/0.5	30	120	5	TO-3
12	BUV27	240‡	120	20	65	0.4	1.5	8/0.8	–	–	–	TO-220
	BUV27A	300†	150				1.0	7/0.7				
14	BUV26	180†	90	25	65	0.25	1.5	12/1.2	–	–	–	TO-220
	BUV26A	200†	100				1.0	10/1				

*Typical † V_{CESM} max. ††Under resistive conditions

Continued



SOT-93



TO-3



TO-220

n-p-n switching power transistors (cont.)

book 1 part 1e

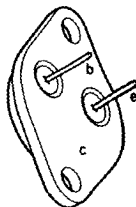
For information on isolated TO-220 equivalents, see page 225.

$I_{C(AV)}$ max.	Type No.	Maximum ratings					Characteristics					Outline
		V_{CBO}	V_{CEO}	I_{CM}	$P_{tot} = T_{mb}^{25^\circ C}$	$t_1^{\dagger\dagger}$ max.	$V_{CE(sat)}$ max.	at I_C/I_B	min.	h_{FE} max.	at I_C	
(A)		(V)	(V)	(A)	(W)	(μ s)	(V)	(A)			(mA)	
15	BUW13 BUW13A	850† 1000†	400 450	30	175	0.8	1.5 1.5	10/2 8/1.6	30*	—	1	SOT-93
15	BUS13 BUS13A	850† 1000†	400 450	30	175	0.8	1.5 1.5	10/2 8/1.6	30*	—	1	TO-3
15	BUP23B BUP23C	750† 850†	400 450	30	175	0.27*	1.5	10/1.33 10/1.67	25*	—	1.5	SOT-93
15	BUS23B BUS23C	750† 850†	400 450	30	175	0.27*	1.5	10/1.33 10/1.67	25*	—	1.5	TO-3
30	BUS14 BUS14A	850† 1000†	400 450	50	250	0.8	1.5 1.5	20/4 16/3.2	30*	—	5	TO-3
30	BUS24B BUS24C	— —	400 450	50	250	0.27*	1.5	20/2.66 20/3.34	25*	—	3	TO-3

*Typical † V_{CESM} max. ‡ V_{CEX} max. ††Under resistive conditions



SOT-93



TO-3

n-p-n deflection power transistors

book 1 part 1e

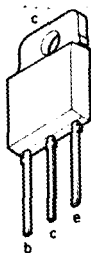
For information on isolated TO-220 equivalents, see page 225.

$I_{C(AV)}$ max.	Type No.	Maximum ratings					Characteristics					Outline
		V_{CBO}	V_{CEO}	I_{CM}	P_{tot} $T_{mb} = 25^{\circ}C$	$t_f^{\dagger\dagger}$ max.	$V_{CE(sat)}$ max.	at I_C/I_B	min.	h_{FE} max.	at I_C	
(A)		(V)	(V)	(A)	(W)	(μs)	(V)	(A)			(mA)	
2.5	BU505	1500†	700	4	75	0.7*	5.0	2/0.9	2.2	—	2A	TO-220
2.5	BU705	1500†	700	4	75	0.9*	5.0	2/0.9	2.2	—	2A	SOT-93
4	BU506	—	700	6	78	0.7*	5.0	3/1.33	—	—	—	TO-220
	BU706	—	700									
8	BU508A	1500†	700	15	125	0.7 *	1.0	4.5/2	—	—	—	SOT-93

*Typical

† V_{CESM} max.

†† Under resistive conditions



SOT-93



TO-220

n-p-n high-voltage darlington

book 1 part 1e

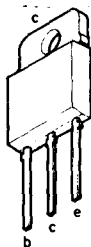
For information on isolated TO-220 equivalents, see page 225.

$I_{C(AV)}$ max.	Type No.	Outline	Maximum ratings				Characteristics				Special features			
			V_{CBO} V_{CER} (V)	V_{CEO} (V)	I_{CM} (A)	P_{tot} max. (W)	h_{FE} min.	at I_C (A)	$V_{CE(sat)}$ max. (V)	at I_C (A)	at I_B (mA)	t_{on} typ. (μ s)	t_{off} typ. (μ s)	at I_C (A)
0.75A	BU724	SOT-82	—	375	—	25	1000*	200	5	0.4	1	—	—	—
	BU724A	—	—	400	—	—	—	—	—	—	—	—	—	—
6A	BU826	SOT-93	800†	375	8	125	—	—	2	2.5	55	<1.3	0.2	2.5
	BU826A	—	900†	400	—	—	—	—	—	—	—	—	(t_f)	—
8A	BU806	TO-220	400	200	15	60	—	—	1.5	5	50	0.35	0.2	5
	BU807	—	330	150	—	—	—	—	—	—	—	—	(t_f)	—
12A	BUV90	SOT-93	650†	400	30	125	—	—	1.5	5	50	—	—	—
	BUV90-A	—	650†	400	—	—	—	—	1.7	—	—	—	—	—

† V_{CESM} max. *Typical



SOT-82



SOT-93



TO-220

low-voltage power transistors

book 1 part 1b

For information on isolated TO-220 equivalents, see page 225.

I _{C(AV)} max.	Type No.		Maximum ratings					Characteristics				Outline	
			V _{CBO}	V _{CEO}	I _{CM}	P _{tot} T _{mb} = 25°C (W)	h _{FE} min. max.	at I _C (mA)	f _T min. (MHz)	V _{CE(sat)} max. (V)	at I _C /I _B (A)		
(A)	N-P-N	P-N-P	(V)	(V)	(A)								
1	TIP29	TIP30	80	40	3	30	15	75	1A	3	0.7	1/0.125	TO-220
	TIP29A	TIP30A	100	60									
	TIP29B	TIP30B	120	80									
	TIP29C	TIP30C	140	100									
2	BD233	BD234	45	45	6	25	25	-	1A	3	0.6	1/0.1	TO-126
	BD235	BD236	60	60									
	BD237	BD238	100	80									
2	BD813	BD814	45	45	6	2‡	40	250	150	3	0.6	1/0.1	TO-202
	BD815	BD816	60	60									
	BD817	BD818	100	80									
3	TIP31	TIP32	80	40	5	40	10	50	3A	3	1.2	3/0.375	TO-220
	TIP31A	TIP32A	100	60									
	TIP31B	TIP32B	120	80									
	TIP31C	TIP32C	140	100									
3	BD933	BD934	45	45	7	30	40	250	150	3	0.6	1/0.1	TO-220
	BD935	BD936	60	60									
	BD937	BD938	100	80									
	BD939	BD940	120	100									
	BD941	BD942	140	120									

‡ In free air

Continued



TO-126



TO-202



TO-220

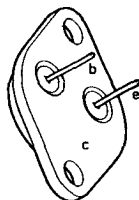
low-voltage power transistors (cont.)

book 1 part 1b

For information on isolated TO-220 equivalent, see page 225.

I _{C(AV)} max.	Type No.		Maximum ratings				Characteristics					Outline	
			V _{CBO}	V _{CEO}	I _{CM}	P _{tot} T _{amb} = 25°C	min.	h _{FE} max.	at I _C	f _T min.	V _{CE(sat)} max.		at I _C /I _B
(A)	N-P-N	P-N-P	(V)	(V)	(A)	(W)			(mA)	(MHz)	(V)	(A)	
4	BD433	BD434	22	22	7	36	50	—	2A	7	0.5	2/0.2	TO-126
	BD435	BD436	32	32			50				0.5	2/0.2	
	BD437	BD438	45	45			40				0.7	3/0.3	
5	BD943	BD944	22	22	8	40	85	475	500	3	0.5	2/0.2	TO-220
	BD945	BD946	32	32							0.5	2/0.2	
	BD947	BD948	45	45							0.7	3/0.3	
5	BD949	BD950	60	60	8	40	40	—	500	3	1.0	2/0.2	TO-220
	BD951	BD952	80	80									
	BD953	BD954	100	100									
	BD955	BD956	120	120									
6	TIP41	TIP42	80	40	10	65	15	75	3	3	1.5	6/0.6	TO-220
	TIP41A	TIP42A	100	60									
	TIP41B	TIP42B	120	80									
	TIP41C	TIP42C	140	100									
8	BD201	BD202	60	45	12	60	30	—	3	7	1.0	3/0.3	TO-220
	BD203	BD204	60	60					2				
	BDX77		100	80					2				
		BDX78	80	80					2				
8	BDX91	BDX92	60	60	12	90	20	—	3	4	1.0	5/1	TO-3
	BDX93	BDX94	80	80									
	BDX95	BDX96	100	100									

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TO-3



TO-126



TO-220

Power semiconductors

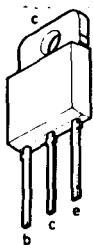
low-voltage power transistors (cont.)

book 1 part 1b

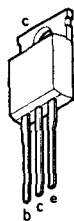
For information on isolated TO-220 equivalents, see page 225.

I _{C(AV)} max.	Type No.		Maximum ratings				Characteristics					Outline	
	N-P-N	P-N-P	V _{CBO}	V _{CEO}	I _{CM}	P _{tot} T _{mb} = 25°C	h _{FE} min.	h _{FE} max.	at I _C	f _T min.	V _{CE(sat)} max.		at I _C /I _B
(A)			(V)	(V)	(A)	(W)			(mA)	(MHz)	(V)	(A)	
10	BDT91	BDT92	60	60	20	90	20	200	4	4	1.0	4/0.4	TO-220
	BDT93	BDT94	80	80									
	BDT95	BDT96	100	100									
10	BDV91	BDV92	60	60	20	100	20	—	4	3	1.0	4/0.4	SOT-93
	BDV93	BDV94	80	80									
	BDV95	BDV96	100	100									
10	TIP33	TIP34	80	40	15	80	20	100	3	3	1.0	3/0.3	SOT-93
	TIP33A	TIP34A	100	60									
	TIP33B	TIP34B	120	80									
	TIP33C	TIP34C	140	100									
10	TIP3055T	TIP2955T	70	60	12	75	20	70	4	2	0.8	4/0.4	TO-220
15	TIP3055	TIP2955	100	60	—	100	20	70	4	3	1.1	4/0.4	SOT-93
15	BDT81	BDT82	60	60	20	125	20	50	5	—	1.0	5/0.5	TO-220
	BDT83	BDT84	80	80									
	BDT85	BDT86	100	100									
	BDT87	BDT88	120	120									

*Typical



SOT-93



TO-220

low-voltage darlingtontons book 1 parts 1a and 1b

For information on isolated TO-220 equivalents, see page 225.

$I_{C(AV)}$ max.	Type No.		Outline	Maximum ratings				Characteristics				Special features			
	N-P-N	P-N-P		V_{CBO} (V)	V_{CEO} V_{CER} (V)	I_{CM} (A)	P_{tot} max. (W)	h_{FE} min.	at I_C (A)	$V_{CE(sat)}$ max. (V)	at I_C (A)	I_B (mA)	t_{on} typ. (μ s)	t_{off} typ. (μ s)	at I_C (A)
	BD675		TO-126	60	45	6	40	750	1.5	2.5	1.5	6	BD675-683: 0.8 4.5 1.5		
	BD676	BD676		-45	-45										
	BD677			80	60										
	BD678	BD678		-60	-60										
4A	BD679			100	80								BD636-684: 0.3 1.5 1.5		
	BD680	BD680		-80	-80										
	BD681			120	100										
	BD682	BD682		-100	-100										
	BD683			140	120										
	BD684	BD684		-120	-120										
	TIP110		TO-220	60	60	6	50	500	2	2.5	2	8	2.6	4.5	2
	TIP111	TIP111		-60	-60										
4A	TIP112	TIP112		80	80										
	TIP116	TIP116		-80	-80										
	TIP117	TIP117		100	100										
	TIP117	TIP117		-100	-100										

Continued



TO-126



TO-220

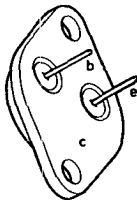
low-voltage darlingtontons (cont.)

book 1 part 1b

For information on isolated TO-220 equivalents, see page 225.

$I_{C(AV)}$ max.	Type No.		Outline	Maximum ratings				Characteristics				Special features		
	N-P-N	P-N-P		V_{CBO} V_{CER} (V)	V_{CEO} (V)	I_{CM} (A)	P_{tot} max. (W)	h_{FE} min.	at I_C (A)	$V_{CE(sat)}$ max. (V)	at I_C (A)	I_B (mA)	t_{on} typ. (μ s)	t_{off} typ. (μ s)
4A	BDT61		TO-220	60	60	6	50	750	1.5	2.5	1.5	6	BDT60, A, B, C: 0.3 1.5 1.5 BDT61, A, B, C: 0.8 4.5 1.5	
		BDT60		-60	-60									
	BDT61A			80	80									
		BDT60A		-80	-80									
	BDT61B			100	100									
		BDT60B		-100	-100									
5A	BDT61C			120	120									
		BDT60C		-120	-120									
	TIP120		TO-220	60	60	8	65	1000	3	2.0	3	12	1.5 8.5 3	
		TIP125		-60	-60									
	TIP121			80	80									
		TIP126		-80	-80									
TIP122			100	100										
	TIP127		-100	-100										
8A	BD645		TO-220	80	60	12	62.5	750	3	2.0	3	12	1 5 3	
		BD646		-60	-60									
	BD647			100	80									
		BD648		-80	-80									
	BD649			120	100									
		BD650		-100	-100									
8A	BD651			140	120									
		BD652		-120	-120									
	TIP130		TO-220	60	60	12	70	1000	4	2.0	4	16	TIP130, 131, 132: 1 5 3 TIP135, 136, 137: 0.5 2.5 3	
		TIP135		-60	-60									
	TIP131			80	80									
		TIP136		-80	-80									
TIP132			100	100										
	TIP137		-100	-100										
8A	BDX63		TO-3	80	60	12	90	1000	3	2.0	3	12	BDX62, A, B, C: 0.5 2.5 3	
		BDX62		-60	-60									
	BDX63A			100	80									
		BDX62A		-80	-80									
	BDX63B			120	100									
		BDX62B		-100	-100									
8A	BDX63C			140	120									
		BDX62C		-120	-120									

Continued



TO-3



TO-220

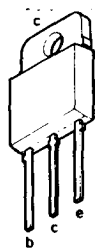
low-voltage darlingtontons (cont.)

book 1 part 1b

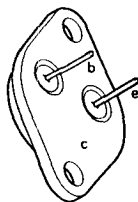
For information on isolated TO-220 equivalents, see page 225.

$I_{C(AV)}$ max.	Type No.		Outline	Maximum ratings					Characteristics				Special features			
	N-P-N	P-N-P		V_{CB0} V_{GER} (V)	V_{CEO} (V)	I_{CM} (A)	P_{tot} max. (W)	h_{FE} min.	at I_C (A)	$V_{CE(sat)}$ max. (V)	at I_C (A)	I_B (mA)	t_{on} typ. (μ s)	t_{off} typ. (μ s)	at I_C (A)	
10A	BDT63		TO-220	60	60	15	90	1000	3	2.5	8	80	BDT62, A, B, C: 0.5 2.5 3			
		BDT62		-60	-60											
	BDT63A			80	80											
		BDT62A		-80	-80											
	BDT63B			100	100											
		BDT62B		-100	-100											
	BDT63C		120	120								BDT63, A, B, C: 1 5 3				
		BDT62C	-120	-120												
10A	TIP140		SOT-93	60	60	15	125	1000	5	2.0	5	10	0.9	11	10	
		TIP145		-60	-60											
	TIP141			80	80											
		TIP146		-80	-80											
	TIP142			100	100											
		TIP147	-100	-100												
12A	BDX65		TO-3	80	60	16	117	1000	5	2	5	20	BDX64, A, B, C: 1 2.5 5			
		BDX64		-60	-60											
	BDX65A			100	80											
		BDX64A		-80	-80									BDX65, A, B, C: 1 6 5		
	BDX65B			120	100											
		BDX64B		-100	-100											
	BDX65C		140	120												
		BDX64C	-120	-120												
12A	BDT65		TO-220	60	60	20	125	1000	5	3	10	100	BDT64, A, B, C: 0.5 2.5 5			
		BDT64		-60	-60											
	BDT65A			80	80											
		BDT64A		-80	-80									BDT65, A, B, C: 1 6 5		
	BDT65B			100	100											
		BDT64B		-100	-100											
	BDT65C		120	120												
		BDT64C	-120	-120												
12A	BDV65		SOT-93	60	60	20	125	1000	5	2	5	20	BDV64, A, B, C: 0.5 2 5			
		BDV64		-60	-60											
	BDV65A			80	80											
		BDV64A		-80	-80									BDV65, A, B, C: 1 6 5		
	BDV65B			100	100											
		BDV64B		-100	-100											
	BDV65C		120	120												
		BDV64C	-120	-120												

Continued



SOT-93



TO-3



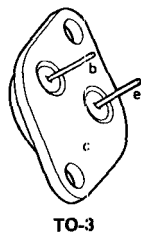
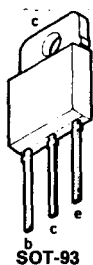
TO-220

low-voltage darlingtontons (cont.)

book 1 part 1b

For information on isolated TO-220 equivalents, see page 225.

$I_{C(AV)}$ max.	Type No.		Outline	Maximum ratings					Characteristics				Special features		
	N-P-N	P-N-P		V_{CBO} V_{CER} (V)	V_{CEO} (V)	I_{CM} (A)	P_{tot} max. (W)	h_{FE} min.	at I_C (A)	$V_{CE(sat)}$ max. (V)	at I_C (A)	I_B (mA)	t_{on} typ. (μ s)	t_{off} typ. (μ s)	at I_C (A)
16A	BDX67		TO-3	80	60	20	150	1000	10	2	10	40	1	3.5	10
		BDX66		-60	-60										
	BDX67A			100	80										
		BDX66A		-80	-80										
	BDX67B			120	100										
		BDX66B		-100	-100										
16A	BDX67C			140	120										
		BDX66C		-120	-120										
	BDV67A		SOT-93	100	80	20	200	1000	10	2	10	40	1	3.5	10
		BDV66A		-100	-80										
	BDV67B			120	100										
		BDV66B		-120	-100										
25A	BDX69B			140	120										
		BDV66C		-140	-120										
	BDV67D			160	150										
		BDV66D		-160	-150										
25A	BDX69		TO-3	80	60	40	200	1000	20	2	20	80	1	3.5	20
		BDX68		-60	-60										
	BDX69A			100	80										
		BDX68A		-80	-80										
	BDX69B			120	100										
		BDX68B		-100	-100										
25A	BDX69C			140	120										
		BDX68C		-120	-120										



general purpose rectifiers

book 1 part 4a

For information on isolated TO-220 equivalents, see page 225.

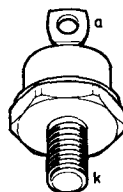
$I_{F(AV)}$ max. (A)	Type No.	Approvals	Outline	V_{RRM} max. (V)	$I_{FSM}^{(1)}$ max. (A)	V_F max. ⁽²⁾ at I_F
6	†BYX38-300 -600 -1200	CECC 50 009-019	DO-4 metal (UNF thread)	300 600 1200	50	1.7V at 20A
6.5	†BY249-300 -600		TO-220AC plastic	300 600	60	1.6V at 20A
10	†BYX98-300 -600 -1200	CECC 50 009-004	DO-4 metal (UNF thread)	300 600 1200	75	1.7V at 20A
12	†BYX42-300 -600 -1200	CECC 50 009-020	DO-4 metal (UNF thread)	300 600 1200	125	1.4V at 15A
15	†BYX99-300 -600 -1200	CECC 50 009-005	DO-4 metal (UNF thread)	300 600 1200	180	1.55V at 50A
30	†BYX96-300 -600 -1200 -1600	BS9331-F129	DO-4 metal (Metric thread)	300 600 1200 1600	400	1.7V at 100A
47	†BYX97-300 -600 -1200 -1600	BS9331-F130	DO-5 metal (Metric thread)	300 600 1200 1600	800	1.45V at 150A
48	†BYX52-300 -600 -1200	CECC 50 009 024	DO-5 metal (UNF thread)	300 600 1200	800	1.8V at 150A

⁽¹⁾At $T_j = T_j$ max. ⁽²⁾At $T_j = 25^\circ\text{C}$. ⁽³⁾ $t = 10\mu\text{s}$.
 $t = 10\text{ms}$

† Reverse polarity types (stud anode) are also available. They are denoted by the final letter R, e.g. BYX38-600R.



DO-4



DO-5



TO-220AC

avalanche rectifiers

book 1 part 4a

$I_{F(AV)}$ max. (A)	Type No.	Approvals	Outline	V_{RWM} max. (V)	$I_{FSM}^{(1)}$ max. (A)	$P_{RRM}^{(3)}$ max. (kW)	$P_{RSM}^{(3)}$ max. (kW)	V_F max. at $I_F^{(2)}$
9.5	†BYX39-600	BS9333-F005	DO-4 metal (UNF thread)	600	125	2	4	1.7V at 20A
	-800			800				
	-1000			1000				
	-1200			1200				
	-1400			1400				
14	§†BYX30-200	BS9333-F002	DO-4 metal (UNF thread)	200	250	5.5	18	3.2V at 50A
	-300			300				
	-400			400				
	-500			500				
	-600			600				
20	†BYX25-600	CECC 50 009-022	DO-4 metal (UNF thread)	600	360	3	18	1.8V at 50A
	-800			800				
	-1000			1000				
	-1200			1200				
	-1400			1400				
22	§†BYX46-200		DO-4 metal (UNF thread)	200	300	9.5	18	2.0V at 50A
	-300			300				
	-400			400				
	-500			500				
	-600			600				
48	†BYX56-600	CECC 50 009-023	DO-5 metal (UNF thread)	600	800	6.5	40	1.8V at 150A
	-800			800				
	-1000			1000				
	-1200			1200				
	-1400			1400				

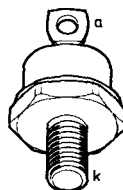
⁽¹⁾ At $T_j = T_j$ max. ⁽²⁾ At $T_j = 25^\circ\text{C}$. ⁽³⁾ $t = 10\mu\text{s}$.
 $t = 10\text{ms}$

§ Fast-recovery types; see also page [214].

† Reverse polarity types (stud anode) are also available. They are denoted by the final letter R, e.g. BYX25-600R.



DO-4



DO-5

fast-recovery rectifier diodes book 1 part 4a

For information on isolated TO-220 equivalents, see page 225.

$I_{F(AV)}$ max. (A)	Type No.	Approvals	Outline	V_{RRM} max. (V)	$I_{FSM}^{(1)}$ max. (A)	t_{rr} max. (ns)	V_F at $I_F^{(2)}$ max.
EPITAXIAL TYPES							
8	BYW29-100	CECC 50 009-014	TO-220 AC plastic	100	80	25	0.8V at 8A
	-150			150			
	-200			200			
9	BYV29-300		TO-220 AC plastic	300	100	50	1.05V at 5A ⁽³⁾
	-400			400			
	-500			500			
9	BYR29-600		TO-220 AC plastic	600	60	75	1.3V at 10A
	-800			800			
2 × 5	BYQ28-100		TO-220 AB plastic	100	2 × 50	20	0.85V at 5A
	-150			150			
	-200			200			
2 × 5	BYT28-300		TO-220 AB plastic	300	2 × 50	50	1.05V at 5A
	-400			400			
	-500			500			
2 × 5	BYR28-600†		TO-220 AB plastic	600	2 × 50	75	1.3V at 5A
	-800			800			
14	BYV79-100		TO-220 AC plastic	100	200	35	0.85V at 10A ⁽³⁾
	-150			150			
	-200			200			
14	BYT79-300		TO-220 AC plastic	300	150	50	1.05V at 15A
	-400			400			
	-500			500			
14	BYR79-600†		TO-220 AC plastic	600	150	75	1.3V at 10A
	-800			800			

⁽¹⁾At $T_j = T_j$ max. ⁽²⁾At $T_j = 150^\circ\text{C}$. ⁽³⁾At $T_j = 100^\circ\text{C}$.
 $t = 10\text{ms}$

† Development information.

Continued



TO-220AB



TO-220AC

fast-recovery rectifier diodes

(cont.)

book 1 part 4a

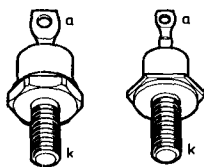
For information on isolated TO-220 equivalents, see page 225.

EPITAXIAL TYPES continued

$I_{F(AV)}$ max. (A)	Type No.	Approvals	Outline	V_{RRM} max. (V)	$I_{FSM}^{(1)}$ max. (A)	t_{rr} max. (nS)	V_F at $I_F^{(2)}$ max.
14	BYW30-100 -150 -200	CECC 50 009-001	DO-4 metal (Metric thread*)	100 150 200	200	30	0.8V at 15A
14	BYV30-300 -400 -500		DO-4 metal (Metric thread*)	300 400 500	150	50	1.05V at 15A
2 × 10	BYV32-100 -150 -200	CECC 50 009-026	TO-220 AB plastic	100 150 200	2 × 150	35	0.85V at 5A ⁽³⁾
2 × 10	BYV34-300 -400 -500		TO-220 AB plastic	300 400 500	2 × 120	50	0.93V at 10A
2 × 10	BYR34-600† -800		TO-220 AB plastic	600 800	2 × 120	75	1.3V at 10A
28	BYW31-100 -150 -200	CECC 50 009-002	DO-4 metal (Metric thread*)	100 150 200	320	40	0.8V at 30A
28	BYV31-300 -400 -500		DO-4 metal (Metric thread*)	300 400 500	200	60	1.05V at 30A
2 × 15	BYV42-100 -150 -200		TO-220AB plastic	100 150 200	2 × 200	35	0.85V at 10A ⁽³⁾
2 × 15	BYV44-300 -400 -500		TO-220AB plastic	300 400 500	2 × 150	50	1.05V at 15A

⁽¹⁾At $T_j = T_{j,max}$. ⁽²⁾At $T_j = 150^\circ\text{C}$. * UNF thread available on request. †Development information
 $t = 10\text{ms}$ ⁽³⁾At $T_j = 100^\circ\text{C}$.

Continued



DO-4



TO-220AB

fast-recovery rectifier diodes

(cont.)

book 1 part 4a

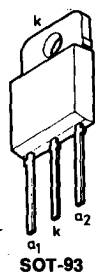
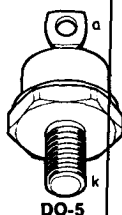
$I_{F(AV)}$ max. (A)	Type No.	Approvals	Outline	V_{RRM} max. (V)	$I_{FSM}^{(1)}$ max. (A)	t_{rr} max. (ns)	V_F at $I_F^{(2)}$ max.
EPITAXIAL TYPES continued							
2 × 15	BYV72-100		SOT-93	100	2 × 150	35	0.85V at 10A ⁽³⁾
	-150		plastic	150			
	-200			200			
2 × 15	BYV74-300†		SOT-93	300	2 × 200	50	1.05V at 10A
	-400		plastic	400			
	-500			500			
40	BYW92-100	CECC	DO-5 metal	100	500	40	0.8V at 35A
	-150	50 009-003	(Metric thread*)	150			
	-200			200			
40	BYV92-300		DO-5 metal	300	500	50	1.05V at 35A
	-400		(Metric thread*)	400			
	-500			500			
60	BYW93-100	CECC	DO-5 metal	100	800	60	0.8V at 50A
	-150	50 009-028	(Metric thread*)	150			
	-200			200			

⁽¹⁾At $T_j = T_{jmax}$.
 $t = 10ms$

⁽²⁾At $T_j = 150^\circ C$.
⁽³⁾At $T_j = 100^\circ C$

*UNF thread available on request.

Continued



fast-recovery rectifier diodes

(cont.)

book 1 part 4a

For information on isolated TO-220 equivalents, see page 225.

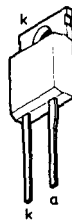
$I_{F(AV)}$ max. (A)	Type No.	Approvals	Outline	V_{RRM} max. (V)	$I_{FSM}^{(1)}$ max. (A)	t_{rr} max. (nS)	V_F at $I_F^{(2)}$ max.
FAST TYPES (double-diffused)							
6.5	BY359-1000 -1300 -1500		TO-220AC plastic	1000 1300 1500	60	600	2.3V at 20A
7	†BY229-200 -400 -600 -800	CECC 50 009-021	TO-220AC plastic	200 400 600 800	60	450	1.8V at 20A
8	BY329-800 -1000 -1200		TO-220 AC plastic	800 1000 1200	80	150	1.85V at 20A
14	†BYV24-800 -1000		DO-4 metal	800 1000	150	1000	1.7V at 20A
14	‡BYX30-200 -300 -400 -500 -600	BS9333-F002	DO-4 metal (UNF thread)	200 300 400 500 600	250	200	3.2V at 50A
22	‡BYX46-200 -300 -400 -500 -600		DO-4 metal (UNF thread)	200 300 400 500 600	300	200	2.0V at 50A

⁽¹⁾At $T_j = T_j \text{max.}$ ⁽²⁾At $T_j = 25^\circ\text{C.}$ † Reverse polarity types (stud anode) are also available. They are denoted by the final letter R, e.g. BYX30-600R.

‡ Types incorporate avalanche capability; see page [210].



DO-4



TO-220AC

Schottky-barrier rectifiers

book 1 part 4a

For information on isolated TO-220 equivalents, see page 225.

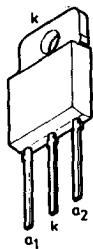
$I_{F(AV)}$ max. (A)	Type No.	Approvals	Outline	V_{RRM} max. (V)	$I_{FSM}^{(1)}$ max. (A)	C_d typ. (pF)	V_F max at I_F ($T_j = 100^\circ\text{C}$)
2×5	BYV18-35 -40(A) -45		TO-220AB plastic	35 40 45	2×50	100	0.6V at 5A
10	BYV19-35 -40(A) -45		TO-220AC plastic	35 40 45	150	200	0.6V at 5A
2×10	BYV33-35 -40(A) -45		TO-220AB plastic	35 40 45	2×200	300	0.6V at 7A
15	BYV20-35 -40(A) -45	CECC 50 009-033	DO-4 metal (UNF Thread)	35 40 45	300	520	0.6V at 15A
2×15	BYV43-35 -40(A) -45		TO-220AB plastic	35 40 45	2×200	500	0.6V at 15A
2×15	BYV73-35 -40(A) -45		SOT-93 plastic	35 40 45	2×150	500	0.6V at 15A
16	BYV39-35 -40(A) -45		TO-220AC plastic	35 40 45	150	520	0.6V at 15A
28	BYV21-35 -40(A) -45	CECC 50 009-018	DO-4 metal (UNF thread)	35 40 45	600	1150	0.55V at 30A

⁽¹⁾ $T_j = 125^\circ\text{C}$; $t = 10\text{ms}$

Continued



DO-4



SOT-93



TP-220AB



TO-220AC

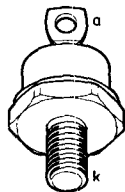
schottky-barrier rectifiers

(cont.)

book 1 part 4a

$I_{F(AV)}$ max. (A)	Type No.	Approvals	Outline	V_{RRM} max. (V)	$I_{FSM}^{(1)}$ max. (A)	C_d typ. (pF)	V_F max at I_F ($T_j = 100^\circ\text{C}$)
60	BYV22-35	CECC 50	DO-5 metal (UNF Thread)	35	1000	2100	0.55V at 50A
	-40(A)	009-034		40			
	-45			45			
80	BYV23-35	CECC 50	DO-5 metal (UNF Thread)	35	1500	2500	0.55V at 70A
	-40(A)	009-036		40			
	-45			45			

⁽¹⁾ $T_j = 125^\circ\text{C}$; $t = 10\text{ms}$

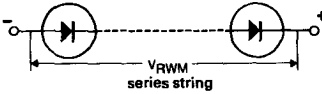


DO-5

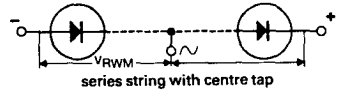
high-voltage rectifier stacks

book 1 part 4a

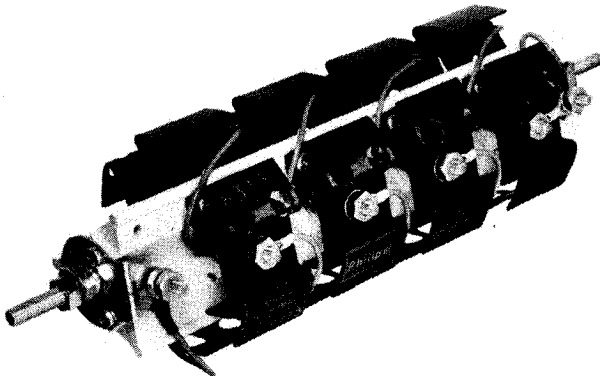
Series-connected rectifier assembly



Series-connected centre-tap rectifier assembly



V_{RWM} (kV)	Type description			Type description			
	OSS9115-	OSS9215-	OSS9415-	OSM9510-	OSM9115-	OSM9215-	OSM9415-
3	-	-	-	-	OSM9115-4	OSM9215-4	OSM9415-4
3	-	-	-	OSM9510-8	-	-	-
4.5	OSS9115-3	OSS9215-3	OSS9415-3	-	OSM9115-6	OSM9215-6	OSM9415-6
6	-	-	-	OSM9510-12	OSM9115-8	OSM9215-8	OSM9415-8
7.5	-	-	-	-	OSM9115-10	OSM9215-10	OSM9415-10
9	OSS9115-6	OSS9215-6	OSS9415-6	-	OSM9115-12	OSM9215-12	OSM9415-12
10.5	-	-	-	-	OSM9115-14	OSM9215-14	OSM9415-14
12	-	-	-	-	OSM9115-16	OSM9215-16	OSM9415-16
13.5	OSS9115-9	OSS9215-9	OSS9415-9	-	OSM9115-18	OSM9215-18	OSM9415-18
15	-	-	-	-	OSM9115-20	OSM9215-20	OSM9415-20
16.5	-	-	-	-	OSM9115-22	OSM9215-22	OSM9415-22
18	OSS9115-12	OSS9215-12	OSS9415-12	-	OSM9115-24	OSM9215-24	OSM9415-24
19.5	-	-	-	-	OSM9115-26	OSM9215-26	OSM9415-26
21	-	-	-	-	OSM9115-28	OSM9215-28	OSM9415-28
22.5	OSS9115-15	OSS9215-15	OSS9415-15	-	OSM9115-30	OSM9215-30	OSM9415-30
24	-	-	-	-	OSM9115-32	OSM9215-32	OSM9415-32
25.5	-	-	-	-	OSM9115-34	OSM9215-34	OSM9415-34
27	OSS9115-18	OSS9215-18	OSS9415-18	-	OSM9115-36	OSM9215-36	OSM9415-36
31.5	OSS9115-21	OSS9215-21	OSS9415-21	-	-	-	-
36	OSS9115-24	OSS9215-24	OSS9415-24	-	-	-	-
40.5	OSS9115-27	OSS9215-27	OSS9415-27	-	-	-	-
45	OSS9115-30	OSS9215-30	OSS9415-30	-	-	-	-
49.5	OSS9115-33	OSS9215-33	OSS9415-33	-	-	-	-
54	OSS9115-36	OSS9215-36	OSS9415-36	-	-	-	-
$I_{F(AV)}$	3.5A	5.0A	10A	1.5A	3.5A	5.0A	10A



general purpose thyristors

book 1 part 4b

For information on isolated TO-220 equivalents, see page 225.

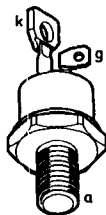
$I_{T(RMS)}$ ⁽¹⁾ max. (A)	Type No.	Approvals	Outline	$I_{T(AV)}$ ⁽¹⁾ max. (A)	V_{RRM} max. (V)	I_{TSM} ⁽²⁾ max. (A)	di_T/dt max. (A/ μ s)	dV_D/dt max. (V/ μ s)	V_{GT} ⁽³⁾ min. (V)	I_{GT} ⁽³⁾ min. (mA)
4	● BT150		TO-220 AB plastic	2.5	500	25	50	5 typ.	1.5	0.2
12	BT151-500R -650R -800R	CECC 50 011-003	TO-220 AB plastic	7.5	500 650 800	100	50	200	1.5	15
16	BTY79-400R -500R -600R -800R -1000R	CECC 50 011-006	TO-64 metal (UNF thread)	10	400 500 600 800 1000	150	50	200	1.5	30
20	BT152-400R -600R -800R		TO-220AB plastic	13	400 600 800	200	200	200	1.0	32
25	● BT145-500R -600R -800R		TO-220AB plastic	16	500 600 800	300	200	200	1.0	35
25	BTW45-400R -600R -800R -1000R -1200R	CECC 50 011-002	TO-48 metal (Metric thread**)	16	400 600 800 1000 1200	300	100	200*	1.5	75
32	BTW40-400R -600R -800R	BS9341-FO83	TO-48 metal (Metric thread**)	20	400 600 800	400	100	100	1.5	75

⁽¹⁾At $T_{mb} = 85^\circ\text{C}$ ⁽²⁾At $T_j = T_j \text{ max.}$
 $t = 10\text{ms}$

⁽³⁾ $V_D = 6\text{V}$; $T_j = 25^\circ\text{C}$
(BT145, 150, 152:
 $V_D = 12\text{V}$)

*Types with dV_D/dt of $1000\text{V}/\mu\text{s}$ available on request.

**UNF thread available on request.



TO-48



TO-64



O-220AB

fast turn-off thyristors

book 1 part 4b

For information on isolated TO-220 equivalents, see page 225.

$I_{T(RMS)}$ max. (A)	Type No.	Outline	$I_{T(AV)}$ ⁽¹⁾ max. (A)	V_{DRM} max. (V)	I_{TSM} ⁽²⁾ max. (A)	di_T/dt max. (A/ μ s)	dV_D/dt max. (V/ μ s)	V_{GT} ⁽³⁾ min. (V)	I_{GT} ⁽³⁾ min. (mA)	t_q max. (μ s)
6	BT153	TO-220AB plastic	4	500	40	200	200	2.5	40	20
40	BTW63-600RK	TO-48 metal (UNF thread)	25	600	370	50	500	2.0	250	4
	-600RN			600						6
	-600RP			600						8
	-800RK			800						4
	-800RN			800						6
	-800RP			800						8
	-1000RK			1000						4
	-1000RN			1000						6
	-1000RP			1000						8

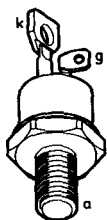
⁽¹⁾At $T_{mb} = 85^\circ\text{C}$

⁽²⁾At $T_J = T_J \text{max.}$
 $t = 10\text{ms}$

⁽³⁾ $V_D = 6\text{V}; T_J = 25^\circ\text{C}$
(BT155: $V_D = 12\text{V}$)

*With -25V gate bias

†At $T_{mb} = 72^\circ\text{C}$



TO-48



TO-220AB

gate turn-off thyristors

book 1 part 4b

For information on isolated TO-220 equivalents, see page 225.

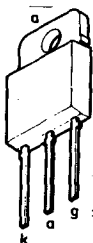
$I_{TCRM}^{(1)}$ max. (A)	Type No.	Outline	$dV_p/dt = 500V/\mu s$ max. (A)	$I_{T(AV)}$ max. (A)	$I_{TSM}^{(2)}$ max. (A)	V_{DRM} max. (V)	I_{GT} min. (mA)	$t_{off}^{(3)}$ max. (μs)
12	BT157-1300R -1500R	TO-220AB plastic	4	3.2	20	1300 1500	200	0.70
25	BTW58-1000R -1300R -1500R	TO-220AB plastic	8	6.5	50	1000 1300 1500	200	0.75
25	BTV58-600R -850R -1000R	TO-220AB plastic	8	10	75	600 850 1000	200	0.75
50	†BTV59-600R -850R -1000R	TO-238AA isolated	14	15	100	600 850 1000	200	0.85
*50	BTW65-1300R -1500R	SOT-93 plastic	20	15	100	1300 1500	300	0.85
50	†BTW70-850R -1000R -1200R	TO-238AA isolated	27	15	100	850 1000 1200	300	0.85
50	BTS59-850R -1000R -1200R	SOT-93 plastic	27	15	100	850 1000 1200	300	0.85
50	BTR59-800R -1300R	SOT-93 plastic	27	15	—	800 1300	500	—
120	†BTW60-850R -1000R -1200R	TO-238AA isolated	90	25	150	850 1000 1200	500	1.3

⁽¹⁾ I_{TCRM} is the maximum controllable anode current.

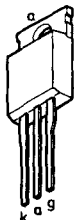
⁽²⁾at $T_{mb} = 120^\circ C$; $t = 10ms$. ⁽³⁾When switching off $0.2 \times I_{TCRM} \max$; $V_{GR} = 10V$; $T_j = 25^\circ C$.

*Information based on development samples.

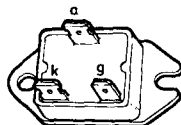
† These types available with integral anti-parallel diodes. Add suffix 'D' after Type No.
e.g. BTW70D-1000R.



SOT-93



TO-220AB



TO-238AA

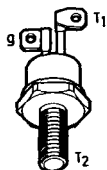
triacs

book 1 part 4b

For information on isolated TO-220 equivalents, see page 225.

$I_{T(RMS)}$ max. (A)	Type No.	Ap- provals	Outline	V_{DRM}	I_{TSM}	di_T/dt	dV_T/dt	dV_{com}/dt	V_{GT} min.	$I_{GT, min.}$		
				max. (V)	max. (A)	max. (A/ μ s)	max. (V/ μ s)	max. at - di_T/dt (V/ μ s) at (A/ms)		I +	I -	I III +
4	BT136-500G	TO-220AB plastic		500	25	10		100	10 at 1.8	1.5	50	100
	-600G											
	-800G											
4	BT136-500	TO-220AB plastic		500	25	10		50	10 at 1.8	1.5	35	70
	-600											
	-800											
8	BT137-500G	TO-220AB plastic		500	55	20		100	10 at 3.6	1.5	50	100
	-600G											
	-800G											
8	BT137-500	TO-220AB plastic		500	55	20		50	10 at 3.6	1.5	35	70
	-600											
	-800											
12	BT138-500G	TO-220AB plastic		500	90	30		100	10 at 5.4	1.5	50	100
	-600G											
	-800G											
12	BT138-500	TO-220AB plastic		500	90	30		50	10 at 5.4	1.5	35	70
	-600											
	-800											
12	BTW43-600H	BS9343 F001	TO-64 metal (Metric thread)	600	120	50	200	10 at 12	2.5	5.0	100	200
	-800H											
	-1000H											
12	BTW43-600G	BS9343 F001	TO-64 metal (Metric thread)	600	120	50	200	10 at 5	2.5	5.0	100	200
	-800G											
	-1000G											
	-1200G			1200								

Continued



TO-64



TO-220AB

triacs

For information on isolated TO-220 equivalents, see page 225.

$I_{T(RMS)}$ max. (A)	Type No.	Ap- provals	Outline	V_{DRM} max.	I_{TSM} max.	di_T/dt max.	dV_T/dt max.	dV_{com}/dt max. at $-di_T/dt$ (V/ μ s) at (A/ms)	V_{GT} min.	$I_{GT}min.$	
										I+, I-, III-	III+
				(V)	(A)	(A/ μ s)	(V/ μ s)		(V)	(mA)	(mA)
16	BT139-500G -600G -800G		TO-220AB plastic	500 600 800	115	50	100	10 at 7.2	1.5	50	100
	BT139-500 -600 -800	500 600 800		50							
25	● BTA140-500 -600 -800		TO-220AB plastic	500 600 800	180	30	100	10 at 9.0	1.5	35	70

Continued



TO-220AB

power surge suppressor and voltage regulator diodes book 1 part 4a

P_{tot} up to T_{amb} up to T_{mb}	W °C °C	20	75	—
Voltage tolerance	%	5	5	15
P_{ZSM}	W	500	4400	25000
T_{jmax}	°C	175	175	175
Case		DO-4	DO-5	DO-30
Approvals		BS9305-FO51	BS9305-FO52	—
Series number		BZY93-(R)	BZY91-(R)	BZW86-(R)
Suppression stand-off voltage	Operating voltage			
5.6	7.5	— C7V5	— C7V5	—
6.2	8.2	2000 mA C8V2	5000 mA C8V2	—
6.8	9.1	— C9V1	— C9V1	—
7.5	10	— C10	— C10	— 7V5
8.2	11	— C11	— C11	— 8V2
9.1	12	1000 mA C12	2000 mA C12	— 9V1
10	13	— C13	— C13	10000 mA 10
11	15	— C15	— C15	— 11
12	16	— C16	— C16	— 12
13	18	— C18	— C18	— 13
15	20	— C20	— C20	— 15
16	22	500 mA C22	1000 mA C22	— 16
18	24	— C24	— C24	— 18
20	27	— C27	— C27	5000 mA 20
22	30	— C30	— C30	— 22
24	33	— C33	— C33	— 24
27	36	— C36	— C36	— 27
30	39	— C39	— C39	— 30
33	43	— C43	— C43	— 33
36	47	— C47	— C47	— 36
39	51	200 mA C51	500 mA C51	2000 mA 39
43	56	— C56	— C56	— 43
47	62	— C62	— C62	— 47
51	68	— C68	— C68	— 51
56	75	— C75	— C75	— 56

Current in mA at which voltage is specified

Note:

For acceptance testing purposes it is important to appreciate that V_z is measured using a pulse method with a pulse width $\leq 100\mu s$ and duty cycle ≤ 0.001 so that the values correspond to a $T_j = 25^\circ C$. A V_z measurement made on a curve tracer will produce a rise in junction temperature to make V_z appear out of specification.

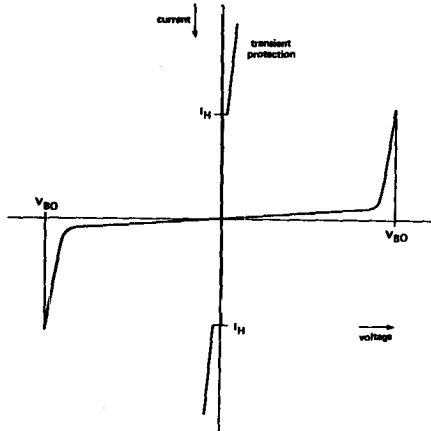
breakover diodes

book 1 part 4a

For information on isolated TO-220 equivalents, see page 225.

A new transient suppressor for protecting data transmission equipment from line voltage transients has been developed: the breakover diode (BOD).

Unlike a zener diode, where transients are absorbed at the zener voltage, a breakover diode absorbs a transient at a much lower voltage. For this reason BODs are able to absorb higher impulse powers than zener diodes in the equivalent package size. Mullard offer two series of BOD.



Type No.	Description	I_{TRM1}^* (A)	I_{TRM2}^\dagger (A)	I_{TSM}^\S (A)	$V_{(BO)}$ nom. (V)	I_H min. (mA)	Outline
● BR210 series	Single bidirectional BODs	150	40	40	100-280	150	TO-220AC
● BR220 series	Dual bidirectional BODs	150	40	40	100-280	150	TO-220AB

* $8/20\mu s$ exponential impulse.

† $10/320\mu s$ exponential impulse (equivalent to $10/700\mu s$ 1.6kV voltage impulse CCITT K17).

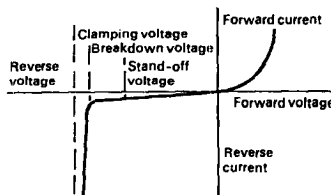
§ $t = 10ms$; half sine-wave.

power zener diodes

book 1 part 4a

Mullard power zeners will switch in less than 5ns and are therefore recommended for transient suppressor as well as voltage regulator duty.

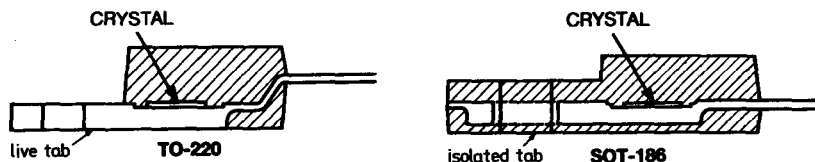
Suppressors are normally chosen with a stand-off voltage equal to that of the steady-state voltage of the line on which they will be used. The stand-off voltage is the maximum reverse voltage that can be applied without causing significant reverse dissipation.



Isolated TO-220 power devices

Mullard offers the following range of devices in isolated TO-220 package. Designated 'F'-Pack this package offers isolation to users of the popular TO-220 outline. Isolation is achieved by moulding a very thin layer of plastic (0.3mm) around the metal heatsink, as shown in the drawings below. This enables isolated mounting of the device without the need for insulating washers – and still offers thermal characteristics comparable with conventional isolating methods. Indeed in free-air operation the 'F'-Pack performs better than a standard TO-220.

Cross-section TO-220 versus SOT-186 (TO-220 'F' PACK).



TO-220 type	SOT-186 equivalent	TO-220 type	SOT-186 equivalent	TO-220 type	SOT-186 equivalent
BD201	BD201F	BDT60B	BDT60BF	BT137-500	BT137F-500
BD202	BD202F	BDT60C	BDT60CF	BT137-600	BT137F-600
BD203	BD203F	BDT61	BDT61F	BT137-800	BT137F-800
BD204	BD204F	BDT61A	BDT61AF	BT138-500	BT138F-500
BD643	BD643F	BDT61B	BDT61BF	BT138-600	BT138F-600
BD644	BD644F	BDT61C	BDT61CF	BT138-800	BT138F-800
BD645	BD645F	BDT62	BDT62F	BT139-500	BT139F-500
BD646	BD646F	BDT62A	BDT62AF	BT139-600	BT139F-600
BD647	BD647F	BDT62C	BDT62CF	BT139-800	BT139F-800
BD648	BD648F	BDT63	BDT63F	BT151-500R	BT151F-500R
BD649	BD649F	BDT63A	BDT63AF	BT151-600R	BT151F-600R
BD650	BD650F	BDT63B	BDT63BF	BT151-800R	BT151F-800R
BD651	BD651F	BDT63C	BDT63CF	BU806	BU806F
BD652	BD652F	BDT64	BDT64F	BU807	BU807F
BD933	BD933F	BDT64A	BDT64AF	BUT11	BUT11F
BD934	BD934F	BDT64B	BDT64BF	BUT11A	BUT11AF
BD935	BD935F	BDT64C	BDT64CF	BUT18	BUT18F
BD936	BD936F	BDT65	BDT65F	BUT18A	BUT18AF
BD937	BD937F	BDT65A	BDT65AF	BUX84	BUX84F
BD938	BD938F	BDT65B	BDT65BF	BUX85	BUX85F
BD939	BD939F	BDT65C	BDT65CF	BY229-200	BY229F-200
BD940	BD940F	BDT81	BDT81F	BY229-400	BY229F-400
BD941	BD941F	BDT82	BDT82F	BY229-600	BY229F-600
BD942	BD942F	BDT83	BDT83F	BYV32-100	BYV32F-100
BD943	BD943F	BDT84	BDT84F	BYV32-150	BYV32F-150
BD944	BD944F	BDT85	BDT85F	BYV32-200	BYV32F-200
BD945	BD945F	BDT86	BDT86F	BYV33-35	BYV33F-35
BD946	BD946F	BDT87	BDT87F	BYV33-40	BYV33F-40
BD947	BD947F	BDT88	BDT88F	BYV33-40A	BYV33F-40A
BD948	BD948F	BDT91	BDT91F	BYV33-45	BYV33F-45
BD949	BD949F	BDT92	BDT92F	BYW29-100	BYW29F-100
BD950	BD950F	BDT93	BDT93F	BYW29-150	BYW29F-150
BD951	BD951F	BDT94	BDT94F	BYW29-200	BYW29F-200
BD952	BD952F	BDT95	BDT95F		
BD953	BD953F	BDT96	BDT96F		
BD954	BD954F	BDX77	BDX77F		
BD955	BD955F	BDX78	BDX78F		
BD956	BD956F	BT136-500	BT136F-500		
BDT60	BDT60F	BT136-600	BT136F-600		
BDT60A	BDT60AF	BT136-800	BT136F-800		

Microwave transistors

book 1 part 5b

LOW NOISE SILICON TRANSISTOR

Type No.	Description	Outline	V _{CB0} max (V)	I _c max (mA)	P _{tot} max (mW)	f _T typ (GHz)	N _o typ (dB)	at f (GHz)
BFQ33	N-P-N silicon transistor for use up to C-band frequencies	SOT-100	9	20	140	12	3.8 2.5	4.0 2.0

CLASS A BIPOLAR POWER TRANSISTORS without prematching. All values typical

Type No.	Package	Microwave performance						Characteristics						
		f (GHz)	V _{CE} (V)	I _c (mA)	P _{L1} min (mW)	G _{PO} min (dB)	I _{CB0} max (μA)	V _{CB} (V)	C _{CB} typ (pF)	V _{CB} (V)	h _{FE} typ	V _{CE} (V)	I _c (mA)	R _{th} (°C/W)
LBE2003S	FO45													
LCE2003S	FO46	2	18	30	200	10	0.1	20	0.3	18	80	5	30	65
● LUE2003S	FO163													
LBE2009S	FO45													
LCE2009S	FO46	2	18	110	700	9	0.1	20	0.6	18	100	5	110	36
● LUE2009S	FO163													
LWE2015R	FO93	2.3	16	250	1200	7.5	10	25	2	16	40	5	230	12
LWE2025R	FO93	2.3	16	400	2000	7	15	25	3	16	40	5	400	8
LAE4001R	SOT-100	4	15	25	85	8.5	0.1	15	0.25	15	100	5	25	210
LAE4002S	SOT-100	4	18	30	125	7.5	0.1	20	0.3	18	80	5	30	200
● LTE4002S	FO41B	4	18	30	125	7.5	0.1	20	0.3	18	80	5	30	65
LAE6000Q*	SOT-100	2	10	4	NF _{typ} 1.8dB	G _{a,typ} 12dB	0.1	10	0.15	10	110	10	4	300

*low noise device

CLASS A BIPOLAR POWER TRANSISTORS with input prematching. All values typical

Type No.	Package	Microwave performance						Characteristics						
		f (GHz)	V _{CE} (V)	I _c (mA)	P _{L1} min (mW)	G _{PO} min (dB)	I _{CB0} max (μA)	V _{CB} (V)	C _{CB} typ (pF)	V _{CB} (V)	h _{FE} typ	V _{CE} (V)	I _c (mA)	R _{th} (°C/W)
● LTE21009R	FO41B	2.1	16	150	1000†	8.5†	50	20	—	—	150	5	150	36
● LTE21015R	FO41B	2.1	16	250	1600†	8.1†	150	20	—	—	150	5	250	12
● LTE21025R	FO41B	2.1	16	400	2800†	7.8†	225	20	—	—	150	5	400	10
● LVE21050R	FO83	2.1	16	1100	5500†	8.0†	500	20	—	—	150	5	1100	4
LTE42005S	FO41B	4.2	18	110	450	6.6	0.1	20	0.5	20	80	5	110	36
LTE42008R	FO41B	4.2	16	250	800	7	150	20	2	16	80	5	250	12
LTE42012R	FO41B	4.2	16	400	1000	6	200	20	3	16	80	5	400	10

† typical

CLASS A BIPOLAR POWER TRANSISTORS with input and output prematching. All values typical

Type No.	Package	Microwave performance					Characteristics					
		f (GHz)	V _{CE} (V)	I _C (A)	P _{L1} min (W)	G _{PO} min (dB)	I _{CBO} max (μA)	V _{CB} (V)	h _{FE} typ	V _{CE} (V)	I _C (mA)	R _{th} (°C/W)
LZ1418E100R	FO57C	1.4 to 1.8	16	2	9	10	1000	20	30	3	2000	2.2
LV1721E50R	FO83	1.7 to 2.1	16	1.2	5	7	500	20	30	3	1000	4
LV2024E45R	FO83	2.0 to 2.4	16	1.2	4.5	7	500	20	30	3	1000	4
LV2327E40R	FO83	2.3 to 2.7	16	1	4.5	7	500	20	30	3	1000	4
● LV2931E50S	FO83	2.9 to 3.1	18	1.0	5	6.5	60	30	30	5	1000	6
LV3742E16R	FO83	3.7 to 4.2	16	0.5	1.3	5.5	300	20	30	3	500	6.5
LV3742E24R	FO83	3.7 to 4.2	16	0.8	2	5	400	20	30	3	800	5

CLASS B BIPOLAR POWER TRANSISTORS with prematching. All values typical

Type No.	Package	Microwave performance					Characteristics				
		f (GHz)	V _{CC} (V)	P _L min (W)	G _p min (dB)	η _C min (%)	I _{CBO} max (μA)	V _{CB} (V)	C _{CB} typ (pF)	V _{CB} (V)	R _{th} (°C/W)
● PEE1001X	FO38	1	24	1.5	6	55	50	24	1.3	24	25
● PDE1001X	FO58										
● PEE1003X	FO38	1	24	3.7	5.9	49	100	24	1.5	24	18
● PDE1003X	FO58										
● PEE1005X	FO38	1	24	7	5.4	53	200	24	2.6	24	10
● PDE1005X	FO58										
● PEE1010X	FO38	1	24	9	6.5	60	1000	24	5	24	6
● PDE1010X	FO58										

Microwave transistors

book 1 part 5b

CLASS B BIPOLAR POWER TRANSISTORS with input and output prematching. All values typical

Type No.	Package	Microwave performance					Characteristics			
		f (GHz)	V _{CC} (V)	P _L min (W)	G _{PO} min (dB)	η _C min (%)	I _{CBO} max (μA)	V _{CB} (V)	R _{th} (°C/W)	
PZ1418B15U	FO57C	1.4 to 1.8	28	12.5	7	38	2500	30	4	
PZ1418B30U	FO57C	1.4 to 1.8	28	27	7.3	38	5000	30	2.2	
PZ1721B12U	FO57C	1.7 to 2.1	28	12	6.8	35	2500	30	4	
PZ1721B25U	FO57C	1.7 to 2.1	28	25	7	35	5000	30	2.2	
PZ2024B10U	FO57C	2.0 to 2.4	28	9	5.6	30	2500	30	4	
PZ2024B20U	FO57C	2.0 to 2.4	28	20	6	35	5000	30	2.2	
PV3742B4X	FO83	3.7 to 4.2	24	4	6	25	50	24	6.5	

CLASS B BIPOLAR POWER TRANSISTORS with input prematching. All values typical

Type No.	Package	Microwave performance					Characteristics				
		f (GHz)	V _{CC} (V)	P _L min (W)	G _p min (dB)	η _C min (%)	I _{CBO} max (μA)	V _{CB} (V)	C _{CB} typ (pF)	V _{CB} (V)	R _{th} (°C/W)
PZB16035U	FO57C	1.55	28	35	8	45	5000	30	12	28	2.2
PTB23001X	FO41B	2	24	1.8	9	50	10	40	2.2	40	22
PTB23003X	FO41B	2	24	4	10	50	20	40	3	40	12
PTB23005X	FO41B	2	24	7	11	50	30	40	3.8	40	8.5
PTB32001X	FO41B	3	24	1.8	9.5	45	10	40	2.2	40	22
PTB32003X	FO41B	3	24	3	9.5	40	20	40	3	40	12
PTB32005X	FO41B	3	24	5.5	9.5	40	30	40	3.8	40	8.5
PZB27020U	FO57C	3	28	22	5	25	1000	40	23	40	1.8
PVB42004X	FO83	4	24	5†	6†	30†	50	24	50	24	6.5
PTB42001X	FO41B	4.2	24	0.8	5	28	10	24	2.2	24	22
PTB42002X	FO41B	4.2	24	1.6	5	28	20	24	3	24	12
PTB42003X	FO41B	4.2	24	3	6	30	30	24	3.8	24	8.5

BIPOLAR OSCILLATOR TRANSISTORS without prematching. All values typical

Type No.	Package	Microwave performance ¹						Characteristics						
		f (GHz)	V _{CE} (V)	I _C (mA)	P _L typ (mW)	η _{osc} typ (%)	I _{CBO} max (μA)	V _{CB} (V)	C _{CB} typ (pF)	V _{CB} (V)	h _{FE} typ	V _{CE} (V)	I _C (mA)	R _{th} (°C/W)
PPC5001T	FO102	5	20	200	450	11	100	24	1.4	18	80	5	200	24
PQC5001T	FO85	5	20	200	450	11	100	24	1.4	18	80	5	200	24

† typical

¹) Typical performance in a microstrip oscillator (common collector)

BIPOLAR PULSED POWER TRANSISTORS FOR RADAR AND NAVAIDS

Type No.	Package	Applica- tion	Microwave performance							Characteristics				
			f (GHz)	V _{CC} (V)	t _{on} (μs)	δ (%)	P _L min (W)	G _p min (dB)	η _C min (%)	I _{CBO} max (mA)	V _{CB} (V)	C _{CB} typ (pF)	V _{CB} (V)	R _{th} (°C/W)
● MRB11080Y	FO67A	IFF	1.09	50	10	1	80	8.5	35	2.5	50	22	50	0.20
● MRB11175Y	FO67A		1.09	50	10	1	175	8.5	35	5.0	50	45	50	0.08
● MRB11350Y	FO67A		1.09	50	10	1	350	7.0	30	10	50	90	50	0.04
● MRB11900Y	FO96		1.09	50	10	1	800	7.5	30	10	50	2x160	50	0.12
● MRB11040W	FO67A		1.09	45	10	1	40	8.5	35	1.5	45	12	45	0.50
RXB12350Y	FO91	JTIDS	1.09	50	100	10	350	7.8	38	7	50	-	50	0.7
RZB12100Y	FO57C		1.09	50	100	10	100	10	45	2	50	-	50	2.5
RZB12250Y	FO57C		1.09	50	100	10	250	7.5	25	5	50	-	50	1
● RZB12050Y	FO57C		1.09	50	100	10	50†	10†	45†	1	50	-	-	5.0
● MZ0912B80Y	FO57C	TACAN	0.96	50	10	10	75	7.8	30	5	50	-	-	0.2
● MZ0912B160Y	FO57C		to 1.215	50	10	10	150	7	30	10	50	-	-	0.1
RZ1214B35Y	FO57C	L-Band Radar	42	50	10	40	7.8	40	1	60	-	-	5	
RZ1214B65Y	FO57C		42	50	10	80	7	38	2	60	-	-	2.5	
RZ1214B125Y	FO57C		1.2	42	50	10	150	7	38	4	60	-	-	1.25
RZ1214B150Y	FO57C		to	42	50	10	200	7	38	5	60	-	-	1
RX1214B300Y	FO91		1.4	50	150	5	250	7	35	7	60	-	-	0.7
RZ1214B300Y	FO57C		42	50	10	380	7	40	5	60	-	-	0.5	
RV3135B5X	FO83	S Band	3.1	24	100	10	4	4.3	30	0.1	24	-	-	6.5
● RZ3135B15W	FO57C		to	42	100	10	15	5	30	0.5	30	-	-	3.50
● RZ3135B30W	FO57C		3.5	42	100	10	30	5	30	1.0	30	-	-	1.75
● RZ3135B40W	FO57C		40	100	10	43†	6.8†	33	1.5	30	-	-	1.40	
● RZ2833B45W	FO57C		2.8 to 3.3	40	100	10	45†	5.5†	25	1.0	40	-	-	2.00

* Note: for t_{on} and δ listed under Microwave Performance

LOW NOISE AND CLASS A POWER GaAs FETs. All values typical

Type No.	Package	Microwave performance							Characteristics								
		f (GHz)	V _{DS} (V)	I _D (mA)	P _{L1} min (mW)	G _{PO} min (dB)	N _F max (dB)	G _A min (dB)	I _{DSS} typ (mA)	V _{DS} (V)	V _P typ (V)	V _{DS} (V)	I _D (mA)	g _m typ (mA/V)	V _{DS} (V)	I _D (mA)	R _{th} (°C/W)
● CFX16	FO92	12	3	10	-	-	2.6	7	50	3	-1.5	3	0.1	27	3	10	200
● CFX17	FO92	12	3	10	-	-	2.3	8	50	3	-1.5	3	0.1	30	3	10	200
● CFX22	FO92	12	5	50	17	8	-	-	80	3	-1.5	3	0.1	35	3	50	200
CFX30	FO85	11	8	50	100	7	-	-	80	3	-2.5	3	1	40	3	65	90
CFX31	FO85	11	8	100	250	7	-	-	160	3	-4	3	1	60	3	130	90
CFX32	FO85	8.5	8	180	500	7	-	-	350	3	-4	3	3	120	3	300	60
CFX33	FO85	8.5	8	370	1000	5	-	-	700	3	-4	3	5	240	3	600	30

These types are also available in chip form by adding the suffix X, e.g. CFX16X

† typical

Microwave diodes

schottky barrier mixer diodes

book 1 part 5a

Type No.	Maximum operating frequency (GHz)	Typical noise figure † (dB)	Typical impedance Z_{if} (Ω)	Operating temperature ($^{\circ}\text{C}$)	Outline
BAT10	12	7.0	350	-55 to +150	MO-28
BAT11	12	6.5	320	-55 to +150	MO-27
BAT38	40	8.5	900	-55 to +100	SOD-42
BAT39 (CV7762)	18	6.0	350	-55 to +100	SOD-42
BAT50 BAT50R*	12	6.2	400	-55 to +100	MO-74
BAT51 (CV7776) ** BAT51R* (CV7777) **	18	7.0	350	-55 to +100	SOD-49
BAT52 BAT52R*	18	8.0	350	-55 to +100	DO-37 SOD-49
BAV72	40	8.5	900	-55 to +150	SOD-50
BAV96A BAV96B BAV96C BAV96D	12	7.0 6.5 6.0 5.5	325	-55 to +150	SOD-50
BAW95D BAW95E BAW95F BAW95G 1N415E	12	7.8 7.2 6.8 6.3 7.2	415 400	-55 to +150	SOD-47

MOTT MIXER DIODES

CAY18**	40	7.0	50	-45 to +85	Coplanar chip
CAY19**	110	8.0	-	-40 to +85	Coplanar chip

*Reverse polarity version

† includes 1.5dB i.f. noise contribution

** Available as a matched pair, (BAT51 & BAT51R as CV7778), 2CAY18M, 2CAY19M

schottky barrier detector diodes book 1 part 5a

Type No.	Description	Frequency range (GHz)	Typical tangential sensitivity (dBm)*	Typical 1/f noise (dB)	Typical video impedance (Ω)	Outline
BAS46	For user in X-band Doppler radar systems	1 to 12	-55	10	850	DO-23** SOD-48
BAV75		1 to 12	-50	10	310	BS SO-86 SOD-31
BAV97	Low level detector applications	1 to 12	-54	10	500	SOD-50
BAT10		1 to 12	-50	12	600	MO-28
BAT11		1 to 12	-52	10	320	MO-27

* Bandwidth 2Mz.

** Other packages available.

Microwave diodes

backward diode

book 1 part 5a

Type No.	Description	Outline	Frequency range (GHz)	Typical tangential sensitivity (dBm)	Min. figure of merit	Typical video impedance (Ω)
AEY33	Germanium bonded backward diode	SOD-49	12 to 18	-53	50 †	300

† Measured at 16.5 GHz in JAN 201 holder.

gunn effect diodes

book 1 part 5a

Type No.	Description	Outline	Operating voltage (V)	Frequency range (GHz)	P_{out} (typ.) (mW)	P_{tot} max. (25°C) (W)
CXY11A CXY11B CXY11C	Ga As bulk effect devices employing the Gunn effect to produce c.w. oscillations in X-band	(BS) SO-86 SOD-31	7.0	8 to 12	8.0 12 20	1.0
CXY14A CXY14B	Ga As bulk effect devices employing the Gunn effect to produce c.w. oscillations in J-band	(BS) SO-86 SOD-31	7.0	12 to 18	8.0 12	1.0
CXY19 CXY19A CXY19B	Ga As bulk effect devices employing the Gunn effect to produce c.w. oscillations in X-band	(BS) SO-86 SOD-31	10	8 to 12	150 250 325	6.0 6.0 7.5
CXY21	Ga As bulk effect device employing the Gunn effect to produce c.w. oscillations in X-band	(BS) SO-86 SOD-31	8.0	8 to 12	30	2.5
CXY24A CXY24B	Ga As bulk effect devices employing the Gunn effect to produce c.w. oscillations in Q-band	MO-75	3.5	30 to 38	30 60	4.0

impatt diodes

book 1 part 5a

Type No.	Description	Outline	Frequency range (GHz)	Power output (min.) (mW)	Operating voltage (V)
BXY50 BXY51 BXY52 BXY60	High power diodes for use as oscillators or negative resistance amplifiers	SOD-45	8 to 10 10 to 12 12 to 14 6 to 8	500 400 300 650	90 80 70 120

multiplier varactor diodes

book 1 part 5a

Type No.	Description	Outline	Capacitance at V_R		V_R max. (V)	Maximum transit time (ps)	Typical cut-off frequency (GHz)
			(pF)	(V)			
BAY96	Silicon planar diode for use in high efficiency multiplier circuits, input powers up to 30W	DO-4	16 35	40 6	120	—	25
BXY27	Silicon planar epitaxial varactor diode for use in multipliers up to S-band and input powers up to 10W	SOD-31	4.5	6	45	—	100
BXY28	Silicon planar epitaxial varactor diode for use in high efficiency multipliers in the 2 to 4 GHz range	SOD-31	1.5	6	45	—	120
BXY29	Silicon planar epitaxial varactor diode for use in frequency multiplier circuits in the 4 to 8 GHz range	SOD-31	1.0	6	25	—	120
BXY32	Silicon planar step recovery diode for high order frequency multipliers with outputs in X-Band	SOD-31	0.75	6	20	150	150
BXY35A	Silicon planar epitaxial varactor diodes for frequency multipliers up to 18 GHz, available in a variety of outlines		9	6	100	—	25
BXY36B,C,D,E			5	6	70	500	75
BXY37B,C,D,E			3	6	70	350	100
BXY38B,C,D,E			1.6	6	50	300	120
BXY39B,C,D,E			1.0	6	40	200	150
BXY40B,C,D,E			0.65	6	25	150	180
BXY41B,C,D,E		0.4	6	25	100	200	
	Suffix A = O'line	SOD-4/8					
	B =	SOD-31					
	C =	SOD-43					
	D =	SOD-44					
	E =	SOD-45					
BXY56	High efficiency silicon diodes for multipliers with output frequencies in C- and X-bands	(BS) SO-86	2.0	6	60	—	160
BXY57			3.0	6	60	—	140
1N5152	Silicon planar epitaxial varactor diodes for use in multipliers up to S-band	(BS) SO-86	6	6	75	—	100
1N5153		SOD-31 SOD-43	6	6	75	—	100
1N5155	Silicon planar epitaxial varactor diode for use in multipliers up to C-band	(BS) SO-86 SOD-31	2	6	35	—	120
1N5157	Silicon planar epitaxial varactor diode for use in multipliers up to X-band	(BS) SO-86 SOD-31	0.8	6	20	—	200

Microwave diodes

special purpose varactor diodes book 1 part 5a

Type No.	Description	Outline	Capacitance at V_R		V_R max. (V)	Series resonant frequency (GHz)	Typical cut-off frequency (GHz)
			(pF)	(V)			
CAY10	Gallium arsenide diode, diffused mesa type, for use in microwave parametric amplifiers, frequency multipliers and switches	(BS) SO-86 SOD-31	0.4	0	6	10	240
CXY10	Gallium arsenide diode with a high cut-off frequency for use in parametric amplifiers, frequency multipliers and switches	SOD-46	0.2	0	6	30	350
CXY12	Gallium arsenide diode with a high cut-off frequency for use in frequency multipliers up to Q-band	SOD-46	0.25	6	10	29	500

Type No.	Description	Outline	Frequency range (GHz)	Attenuation (dB)	Insertion loss (dB)
CXY22A	Gallium arsenide devices for limiter applications from C- to X-band	SOD-31	2-7	20	0.2
CXY22B			7-12	16	0.3

Type No.	Description	Outline	Excess noise ratio (dB)	C_i (pF)	I_R (mA)
BAT31	Silicon avalanche device for use as noise source from 10Hz to 18GHz	(BS) SO-86 SOD-31	34	0.6	15.0

tuning varactor diodes book 1 part 5a

Type No.	Description	Outline	Range of Q at -4V	Capacitance at -4V min. (pF)	Capacitance at -4V max. (pF)	V_R typ. (V)
BXY48 Series	Silicon planar tuning diodes. Highly reproducible abrupt junction performance	Various	1000 to 2500	0.3	4.5	25 to 48
CXY23 Series	Gallium arsenide tuning diodes. Highly reproducible abrupt junction performance	Various	6000 typ.	0.3	2.0	30
CXY26 Series	Gallium arsenide hyperabrupt tuning diodes for linear applications	Various	3000 at -2V	0.8 at -2V	10	15 min

solid state oscillators

book 1 part 5a

This selection represents only a part of the Mullard range of solid state sources. Custom-built sources, including many with higher output powers, are available on request. Mullard offers a comprehensive capability in the area of general solid state oscillators, with complex phase locked and frequency agile sources for military applications.

Type No.	Description	Nominal centre frequency (GHz)	P _{out} (mW)	Minimum mechanical tuning range (MHz)	Typical electronic tuning range (MHz)	Output coupling to
CL8030 Series	A range of c.w./pulsed FET oscillators for miniature Doppler radars	9.47 to 10.687	8	—	—	WG16/WR90
CL8630	Fixed frequency Gunn effect oscillators for miniature radar systems	10.687	8	—	—	WG16/WR90
CL8632		9.47	8	—	—	WG16/WR90
CL8633		10.525	8	—	—	WG16/WR90
CL8630S	Fixed frequency Gunn effect oscillators for self oscillating mixer (auto-detector) use in proximity switching	10.687	8	Typical output voltage for input 66dB down on output power (at 12dB min. <u>signal + noise</u> noise = 120μV)		WG16/WR90
CL8632S		9.47	8			WG16/WR90
CL8633S		10.525	8			WG16/WR90

NOTE: All the oscillators described above require a negative 7V stabilised power supply, with the exception of the **CL8630** series (+7V)

mixer/detector modules

book part 5a

Mullard offers a large-scale production capability for custom-built and standard microwave integrated circuits on alumina, sapphire, quartz and ferrite substrates, integrating passive microwave components with unpackaged semiconductor devices in chip and beam lead form.

Type No.	Description	Frequency range (GHz)	Noise Level (μV)	Mixer* sensitivity (μV)	Tangential † sensitivity (dBm)	Output coupling to
CL7500	Waveguide single ended mixers or microwave detectors for use in doppler control systems in conjunction with CL8630 or CL8632	10.687	1.0	40	— 50	WG16/WR90
CL7520		9.35	1.0	40	— 50	WG16/WR90

*For -90dBm input signal

† 32μA d.c. bias. Bandwidth 0 to 2 MHz

Microwave sub-assemblies

x-band Doppler radar modules

book 1 part 5a

Type No.	Description	Centre frequency (GHz)	Power output (mW)	Typical output voltage (μ V)
CL8060 Series	A range of FET Doppler modules for c.w. and pulsed miniature radars	9.47 to 10.687	8	25
CL8960	Doppler twin cavity modules for volumetric presence detection, industrial process control, proximity switching and similar applications using a Gunn diode transmitter	10.687	10	40
CL8960U		10.687 + 3MHz		
CL8960L		10.687 - 3MHz		
CL8962		9.470		
CL8963		10.525		
CL8964		9.900		
CL8965		10.565		
CL8966		10.450		
CL8967	10.365			
CL8968	9.520			

Note: Upper and lower frequency variants (+ 3MHz or - 3MHz) are available to special order with all types.

microwave horn antenna

book 1 part 5a

Type No.	Description	Frequency range (GHz)	Gain (dB)	Flange
ACX-01A	Cast construction, low v.s.w.r.	9 to 11	16	UBR100

Microwave sub-assemblies

ferrite components – circulators and isolators book 1 part 5a

Type No.	Frequency range (GHz)	Max. insertion loss (dB)	Min. isolation (dB)	v.s.w.r.	C.W. power rating (W)	Coaxial terminals	Waveguide flange type
V.H.F. circulators for television band III							
CL5861	0.17 to 0.20	0.35	20	1.2	1000	EIA 1 5/8	—
CL5851	0.20 to 0.23	0.35	20	1.25	500	N Female	—
CL5931	0.225 to 0.27	0.35	20	1.25	100	N Female	—
U.H.F. circulators for television bands IV and V							
CL5941	0.27 to 0.33	0.35	20	1.25	100	N Female	—
CL5951	0.33 to 0.40	0.35	20	1.25	100	N Female	—
CL5411	0.40 to 0.47	0.5	20	1.25	100	N Female	—
CL5571	0.40 to 0.47	0.35	20	—	300	N Female	—
CL5621	0.40 to 0.47	0.35	20	1.25	300	HF7/16D1N47223	—
CL5551	0.47 to 0.60	0.5	20	1.25	100	N Female	—
CL5631	0.47 to 0.60	0.35	20	1.25	300	HF7/16D1N47223	—
CL5581	0.47 to 0.60	0.35	20	1.25	300	N Female	—
CL5027	0.47 to 0.60	0.35	22	1.2	500	N Female	—
CL5261	0.47 to 0.60	0.35	20	1.25	2000	HF7/16D1N47223	—
CL5641	0.59 to 0.72	0.35	20	1.25	300	HF7/16D1N47223	—
CL5591	0.59 to 0.72	0.35	20	1.25	300	N Female	—
CL5028	0.59 to 0.72	0.35	22	1.2	500	N Female	—
CL5282	0.59 to 0.72	0.35	22	1.2	2000	HF7/16D1N47223	—
CL5561	0.60 to 0.80	0.5	20	1.25	100	N Female	—
CL5651	0.60 to 0.80	0.35	20	1.25	300	HF7/16D1N47223	—
CL5601	0.60 to 0.80	0.35	20	1.25	300	N Female	—
CL5331	0.60 to 0.80	0.35	20	1.25	2000	HF7/16D1N47223	—
CL5611	0.71 to 0.86	0.35	20	1.25	300	N Female	—
CL5661	0.71 to 0.86	0.35	20	1.25	300	HF7/16D1N47223	—
CL5029	0.71 to 0.86	0.35	22	1.2	500	N Female	—
CL5271	0.71 to 0.86	0.35	22	1.2	2000	HF7/16D1N47223	—
CL5262	0.79 to 1.0	0.5	20	1.25	100	N Female	—
Broadband microwave coaxial circulators							
CL5501	2.0 to 4.0	0.5	20	1.25	50	SMA	—
CL5491	2.0 to 4.0	0.5	20	1.25	50	N Female	—
CL5511	3.0 to 6.0	0.5	20	1.25	20	SMA	—
CL5811	4.0 to 8.0	0.5	20	1.25	10	SMA	—
CL5821	7.0 to 12.7	0.6	20	1.25	10	SMA	—
CL5301	12 to 18	0.5	20	1.3	5	SMA	—

Continued

A comprehensive range of microstrip circulators and isolators is available. Full details may be obtained on request to: Solid State Microwave, Mullard Ltd, Mullard House, Torrington Place, London WC1E 7HD.

Microwave sub-assemblies

ferrite components – circulators and isolators (cont.) book 1 part 5a

Type No.	Frequency range (GHz)	Max. insertion loss (dB)	Min. isolation (dB)	v.s.w.r.	C.W. power rating (W)	Coaxial terminals	Waveguide flange type
Coaxial isolators							
CL6041	1.48 to 1.95	0.3	20	1.2	*50	N Female	—
CL6091	2.0 to 4.0	0.5	20	1.25	**50	N Female	—
CL6101	2.0 to 4.0	0.5	20	1.25	**50	SMA	—
CL6071	3.0 to 6.0	0.5	20	1.25	**20	SMA	—
CL6111	4.0 to 8.0	0.5	20	1.25	**10	SMA	—
CL6122	7.0 to 12.7	0.6	20	1.25	*10	SMA	—
CL6232	7.9 to 10.4	0.4	20	1.25	**5	SMA	—
CL6223	12 to 18	0.5	20	1.25	**5	SMA	—
Maximum permissible power reflected into port 2: *2W **5W ***1W							
Waveguide isolators							
CL6240	3.8 to 4.2	0.5	30	1.05	10	—	UER40
CL6202	4.2 to 4.6	0.5	30	1.05	10	—	UER48
CL6203	4.6 to 5.0	0.8	30	1.05	10	—	UER48
CL6206	5.925 to 6.425	0.3	30	1.05	20	—	UER70
CL6251	6.425 to 7.15	0.3	30	1.05	20	—	UER70
CL6231	6.825 to 7.425	0.3	30	1.05	20	—	UER70
CL6291	7.125 to 7.75	0.3	30	1.05	20	—	UER70
CL6241	7.25 to 7.75	0.3	30	1.05	20	—	UER70
CL6214	7.7 to 8.5	0.5	30	1.05	10	—	UBR84
CL6222	8.5 to 9.6	0.5	30	1.05	10	—	UBR100
CL6221	8.5 to 9.6	0.6	15	1.15	1	—	UBR100
CL6261	8.5 to 9.6	1.2	55	1.2	10	—	UER100
CL6271	8.5 to 9.6	1.0	20	1.15	10	—	UBR100
CL6215	10.7 to 11.7	0.8	30	1.05	5	—	UBR100
CL6217	12.5 to 13.5	0.5	30	1.05	10	—	UBR140
3-port waveguide circulators							
CL5232	3.8 to 4.2	0.2	28	1.08	50	—	UER40
CL5101	5.925 to 6.425	0.2	30	1.06	100	—	1541EC/UER70
CL5281	6.425 to 7.125	0.15	30	1.07	100	—	1541EC/UER70
CL5291	7.125 to 7.75	0.2	30	1.06	100	—	1541EC/UER70
CL5283	7.7 to 8.5	0.5	25	1.1	50	—	UER84/UBR84
4-port cross junction waveguide circulators							
CL5081	5.925 to 6.175	0.1	33	1.05	150	—	UER70
CL5091	6.125 to 6.425	0.1	30	1.06	150	—	UER70
CL5053	6.575 to 6.875	0.4	25	1.1	100	—	UER70
CL5051	6.825 to 7.125	0.4	25	1.08	100	—	UER70
CL5050	7.125 to 7.425	0.3	25	1.1	100	—	UER70
CL5054	7.425 to 7.725	0.4	30	1.1	100	—	UER70
CL5056	10.7 to 11.7	0.3	30	1.1	25	—	UBR100
CL5055	12.5 to 13.5	0.3	25	1.1	25	—	UBR140
							UBR140 }

A comprehensive range of microstrip circulators and isolators is available. Full details may be obtained on request to: Solid State Microwave, Mullard Ltd, Mullard House, Torrington Place, London WC1E 7HD.

Optoelectronic devices book 1 parts 6a and 6c

PHOTODIODE AND PHOTOTRANSISTOR

Type No.	Spectral response		Description	Outline	Max. dark current (μA)	Light switching time (ns)	T_j max. ($^{\circ}\text{C}$)	V_R max. (V)	I_R max. (mA)
	Peak (nm)	Cut-off (nm)							
BPW22A	800	1050	Silicon phototransistor	SOD-53D	0.1	3000	100	50	0.1
BPW50	930	1100	Silicon photo p-i-n diode	F	0.03	50	100	32	0.1

LIGHT EMITTING DIODES (INFRARED)

Type No.	Spectral emission (nm)	Description	Outline	I_{FRM} max. (mA)	I_F max. (mA)	I_p min. at 20mA ($\mu\text{W/sr}$)	t_r typ. (ns)	T_{stg} temperature range ($^{\circ}\text{C}$)	
								-55	+150
CQY58A	930	Plastic encapsulation	SOD-53D	200	50	1000	3000	-55	+150
CQY89A series	930	Plastic encapsulation	SOD-63	1000	130	9000*	-	-55	to +100

*at $I_F = 100\text{mA}$

LIGHT EMITTING DIODES (VISIBLE)

all types are available in light class selections

Type No.	Lens	Luminous intensity			Forward voltage		Outline
		min. (mcd)	typ. (mcd)	at I_F (mA)	max. (V)	at I_F (mA)	
T-1 types							
CQY54Z	Red diffused	0.7	1.6	20	2.0	20	SOD-53E
CQY95Z	Green diffused	1.0	3.5	10	2.0	20	SOD-63A
CQY97Z	Yellow diffused	1.0	3.5	10	3.0	10	SOD-53E
T-1½ types							
CQX51 series	Super red	1.6	7.0	10	3.0	10	SOD-63
CQY24Z	Red diffused	0.7	2.2	20	2.0	20	SOD-63
CQY94Z	Green diffused	1.0	7.0	10	3.0	10	SOD-63
CQY96Z	Yellow diffused	1.0	7.0	10	3.0	10	SOD-63

RECTANGULAR LIGHT EMITTING DIODES (SUPER-RED, GREEN AND YELLOW)

5 × 3 mm

Type No.	Description	Luminous intensity			Forward voltage		Outline
		min. (mcd)	typ. (mcd)	at I_F (mA)	max. (V)	at I_F (mA)	
CQV70A	Red diffused	1.0	3.5	10	2.2	10	SOD-77
CQV71A	Green diffused	1.0	3.5	10	3.0	10	SOD-77
CQV72	Yellow diffused	1.0	3.5	10	3.0	10	SOD-77

BI-COLOURED LIGHT EMITTING DIODES (HYPER-RED OR SUPER GREEN)

5 × 3 mm rectangular

CQT10	Diffused	1.0	1.5	10/20	2.2/3.0	10/20	SOD-65
T-1½							
CQT24	Diffused	3.0	10	10/20	2.2/3.0	10/20	SOD-63

Optoelectronic devices (cont.)

book 1 part 6c

LOW CURRENT LIGHT EMITTING DIODE

Type No.	Lens form	Luminous intensity				Forward voltage		Outline
		typ. (mcd)	at I_F (mA)	typ. (mcd)	at I_F (mA)	typ. (V)	at I_F (mA)	
● CQS51	red	3	10	2	4	2.00	10	SOD-63

HIGH INTENSITY LIGHT EMITTING DIODES (SUPER-RED, GREEN AND YELLOW)

Type No.	Lens form	Luminous intensity		Forward voltage		Outline
		typ. (mcd)	at I_F (mA)	max. (V)	at I_F (mA)	
T-1½						
CQX54	Super-red non-diffused colourless	50	10	3	10	SOD-63
CQX64	Green non-diffused colourless	50	10	3	10	SOD-63
CQX74	Yellow non-diffused colourless	50	10	3	10	SOD-63

Long lead versions (26mm) are available with the suffix L

Continued

Optoelectronic devices (cont.)

book 1 part 6a

LASER AND FIBRE-OPTIC DEVICES

Light emitting diode (infrared)

Type No.	Spectral emission (nm)	Description	I_{FRM} max. (mA)	I_F max. (mA)	I_B min. at 100mA (μ W/sr)	t_r typ. (ns)	T_{atg} Temperature range ($^{\circ}$ C)
CQF24	830	Modified TO-18 with coupling lens	300	100	5000	10	-65 to +150

P-I-N photodiode (Infrared)

Type No.	Wavelength at peak response (nm)	Description	Max. dark current (nA)	Light switching time (ns)	T_j max. ($^{\circ}$ C)	V_R max. (V)	P_{tot} max. (mW)
BPF24	750	Modified TO-18 with coupling lens	0.8	1	150	50	300

Laser diodes

Type No.	Wavelength at peak response (nm)	Description	Outline	Operating mode	Radiant output power \varnothing_e (mW)
● 512CQL-A	820	SOT-148 with window		CW	40
● 513CQL-A	820	Collimated		CW	20
● 514CQL-A	820	Collimated		CW	5
● 515CQL-A	820	SOT-148 with window		CW	2
CQL16	780	Collimated		CW	2

Fibre coupled laser diodes for fibre-optic communications

A range of fibre coupled semiconductor laser diodes, i.e.d.s., emitters and receivers is currently in development, for operation in 800nm and 1300nm applications. Contact Mullard Ltd for information.

Continued

Optoelectronic devices (cont.)

book 1 part 6a

PHOTOCOUPLERS

Type No.	Description	Current transfer ratio (%)	at V_{CE} (V)	& I_F (mA)	Test isolation voltage (max.) (kV)	t_{on} (typ.) (μs)	t_{off} (typ.) (μs)	Outline
CNX35	Optically coupled isolators with transistor output	40	0.4	10	4.4	3	3	H
CNX36		80	0.4	10	4.4	3	3	H
CNX37		150	5	10	5.3	12	12	H
CNX38		70 to 210	10	10	4.3	5	5	H
CNX48		> 600	1	1	4.4	—	—	H
CNX62		150	4	10	5.3	12	12.5	H
CNY50-1		25	0.4	10	1.0	—	—	SOT-104B
CNY62		25	0.4	10	5.3	3	3	SOT-91B
CNY63		50	0.4	10	4.3	5	5	SOT-91B
H11A1		> 50	10	10	1.5	2	2	H
H11A2	> 20	10	10	0.95	2	2	H	
H11A3	> 20	10	10	1.5	2	2	H	
H11A4	> 10	10	10	0.95	2	2	H	
PO40A	Post Office approved couplers with transistor output	60 to 150	0.5	10	1.5*	7	7	H
PO41A		25	0.4	20	1.5*	7	7	H
PO42A		25	10	10	1.5*	7	7	H
PO43A		30	5	5	1.5*	7	7	H
PO44A		30	1	3	1.5*	10	10	H
4N25	Optically coupled isolators with transistor output	> 20	10	10	2.5	2	2	H
4N25A		> 20	10	10	2.5	2	2	H
4N26		> 20	10	10	1.5	2	2	H
4N27		> 10	10	10	1.5	2	2	H
4N28		> 10	10	10	0.5	2	2	H

*d.c. continuous operation

Continued

Optoelectronic devices (cont.)

book 1 part 6a

PYROELECTRIC SENSORS FOR MOVEMENT DETECTION

Type No.	Typ. Noise Equivalent Power (10 μ m, 10, 1) (WHz ^{-1/2})	Wavelength range (μ m)	Typical responsivity (10 μ m, 10) (VW ⁻¹)	Frequency range	Sensitive area (mm)	Outline
● KRX10	*	6.5-14	*	0.1Hz-20Hz	2 x 1	
● KRX11	*	optimized 8.0	*	0.1Hz-20Hz	2 x 1	
● RPW100	2.0 x 10 ⁻⁹	6.5-14	220	0.1Hz-20Hz	2 x 1	SOT-49E
● RPW10Z	2.0 x 10 ⁻⁹	6.5-14	220	0.1Hz-20Hz	2 x 1	SOT-49E
● RPW103	2.0 x 10 ⁻⁹	6.5-14	220	0.1Hz-20Hz	2 x 1	SOT-49H
● RPY97	2.5 x 10 ⁻⁹	6.5-14	150	0.1Hz-20Hz	2.1 x 0.9	SOT-49H
RPY98†	5.0 x 10 ⁻¹⁰	1.0-70	5000	0.1Hz-20Hz	2 x 2	SOT-49G
RPY99†	5.0 x 10 ⁻¹⁰	1.0-70	5000	0.1Hz-20Hz	2 x 2	SOT-49G
RPY100	2.5 x 10 ⁻⁹	6.5-14	150	0.1Hz-20Hz	2 x 1	SOT-49H
RPY101	3.8 x 10 ⁻⁹	6.5-14	150	0.1Hz-20Hz	2.1 x 1.5	SOT-49H
RPY102	5.0 x 10 ⁻⁹	6.5-14	75	0.1Hz-20Hz	2 x 2	SOT-49H
RPY109†	6.0 x 10 ⁻⁹	1.0-15	65	0.1Hz-20Hz	2 x 2	SOT-49H

† Pyroelectric sensors also suitable for spectroscopy, gas analysis and remote radiometry.

* These devices are specified at 1Hz as follows:

Typ. peak signal (500K, 1)	KRX10	KRX11
with incident energy of 25 μ Wcm ⁻²	930 μ V	850 μ V
Typ. noise, peak-to-peak (bandwidth 0.4Hz to 5Hz)	25 μ V	30 μ V

The above types are examples of the Mullard range of infrared sensors. Mullard offers devices customised to your requirements. Further information from Mullard Ltd.

INFRARED PHOTOCONDUCTIVE DETECTORS

Mullard manufactures a range of photoconductive Cadmium Mercury Telluride detectors for the 8-14 micron regions. Further information available from Mullard Ltd.

silicon sensors

TEMPERATURE SENSORS

Type No.	Outline	Temperature range (°C)	Resistance at 25°C (Ω)	Temperature coefficient (%/°C)
KTY81-100 series KTY81-200 series	TO-92	-55 to +150	1000 nom. 2000 nom.	0.75
KTY83-100 series KTY84-100 series	DO-34 DO-34	-55 to +175 -0 to +300	1000 nom. 1000 nom.	0.75 0.60

PRESSURE SENSORS

Type No.	Description	Pressure range (bar)	Sensitivity (mV/Vbar)
KP101A	Monolithic absolute pressure gauge	0 to 1.2	20
KPZ20G	Thin film relative pressure gauge	-1 to 2	10.5
KPZ21G	Thin film relative pressure gauge	-1 to 10	3.5

STRAIN/FORCE SENSORS

The above relative pressure gauge units can also be applied to measure strain up to 50 micron or force up to 30 newton.

MAGNETORESISTIVE SENSORS

Type No.	Supply voltage max (V)	Sensitivity (mV/V)/(kA/m)	H_{\max} (A/m)
KMZ10A	9	14	500
KMZ10B	12	4	2000
KMZ10C	10	1.5	7500

Optoelectronic and special semiconductors

professional surface wave devices

Type No.	Outline	Application	Insertion loss typ (dB)	Reference frequency (MHz)	System or bandwidth
RW600	TO-8	Satellite i.f.	28	134	28*
RW601	TO-8	Satellite i.f.	28	134	30*
RW651			28	39.0	B/G
RW652			24	37.5	B/G
RW661		TV	27	39.5	I
RW662	24	transmitters	26	39.0	I
RW663	pin	and	28	33.0	I
RW664	DIL	transposers	28	37.0	I
RW671			25	45.9	M
RW672			22	37.5	M
RW681			27	37.5	D/K
RW691	4 pin DIL	Digital radio links	22.5	70	5.6
RW700	4 pin DIL	Delay line	20	10.7	1.4
RW800	TO-8	Carrier recovery	21.5	324.3	1.5
SWF70-25	TO-8	Digital transmission	35	70	23
SWF678-1	TO-8 (8 pin)	Clock recovery	34	678	1
SWF4075	TO-8	TV transposer	34	37	6.5

* bandwidth at 1dB points (MHz)

Mullard have the facility to manufacture a wide range of surface wave devices to meet individual customer requirements. For full details of this service, please contact Mullard Ltd.

Liquid crystal displays

Mullard offer a wide range of standard and custom-designed liquid crystal displays, including alphanumeric and full graphic modules. For full details of our custom service, please contact the Special Products Discrete Semiconductors Group at Mullard House.

- Very low power consumption
- Low operating voltage
- Flat and light
- Excellent readability in any ambient light
- Wide temperature range
- High quality, high reliability
- Expected life time more than 10 years
- Large selection of standard designs
- Advanced technology due to inhouse research and development
- Worldwide consulting and distribution
- Complete service for custom design LCDs

Lcd modules (standard product range)

	7-Segment Type	Character Type (5 × 7 dot, built-in character generator)				Graphic Type (full dot)	
Type number	LTN233-N01	LTN111-N01	LTN211-N01	LTN241-N01	LTG201-N01	LTG401-D02	
Display format	16 dig. × 1 line	16 char. × 1 line	16 char. × 2 lines	40 char. × 2 lines	240 × 64 dots	640 × 200 dots	
Character size	3.2 × 6.0 mm	3.07 × 5.73 mm	2.96 × 4.86 mm	3.2 × 4.85 mm	2.6 × 3.66 mm	1.71 × 3.39 mm	
Dot size	—	0.55 × 0.75 mm	0.56 × 0.66 mm	0.6 × 0.65 mm	0.48 × 0.48 mm	0.31 × 0.45 mm	
Outline dimensions	92.5 × 25 × 10.5 mm	80 × 36 × 12 mm	84 × 44 × 12 mm	182 × 33.5 × 11 mm	180 × 75 × 10.5 mm	256 × 125 × 18 mm	
Viewing area	65.8 × 11.2 mm	64.5 × 13.8 mm	61.0 × 15.8 mm	154.4 × 15.8 mm	132.6 × 39 mm	232 × 106 mm	
Supply voltage	+ 3V	+ 5V	+ 5V	+ 5, - 5V	+ 5, - 11V	+ 5, - 18V	
Viewing mode	reflective	reflective	reflective	reflective	reflective	transflective (EL backlighting)	
Data interface	serial (C-bus)	parallel (4 or 8 bit)	parallel (4 or 8 bit)	parallel (4 or 8 bit)	serial	2 × 4 bit parallel	

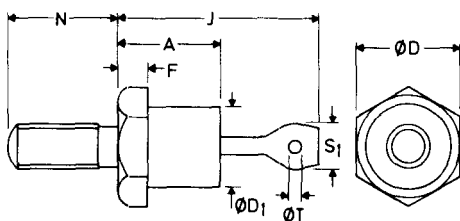
246

Outlines and Dimensions

OUTLINES and DIMENSIONS (millimetres)

DO-4 SOD-4/8

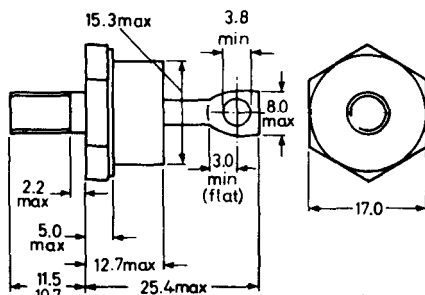
B.S.3934 SO-10



A	10.3max	J	20.3max.
ØD	11.1max	N	11.5max.
ØD ₁	9.3max	S ₁	5.2max.
F	3.2	ØT	1.6min.

DO-5

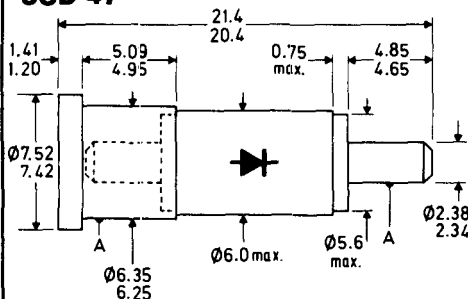
B.S.3934 SO-14A



DO-22

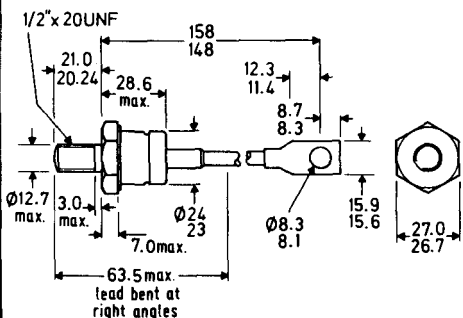
DO-23 (without collet)

SOD-47



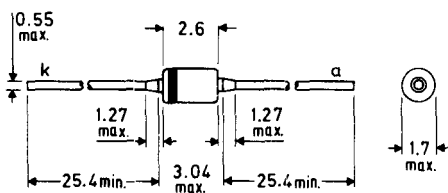
A = concentricity tolerance = ±0.20.

DO-30

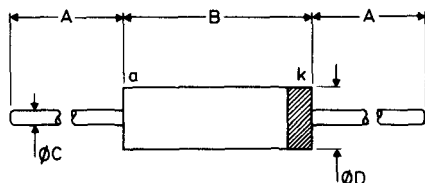


BZW86 Blue sleeve - anode to eyelet.
BZW86R Red sleeve - anode to stud.

DO-34



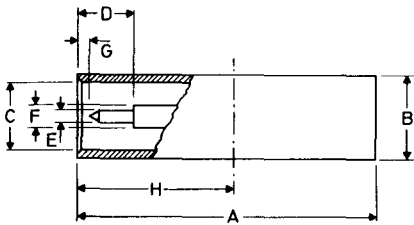
DO-35



A	B	ØC	ØD
min.	max.	max.	max.
25.4	4.25	0.56	1.85

These drawings give limited information for quick reference purposes. For equipment design more complete information should be obtained from individual data sheets in the Technical Handbook or from standard B.S. or JEDEC outline drawings.

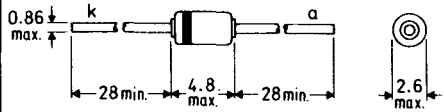
DO-37
SOD-49



A	19.43/18.67	∅E	0.84/0.79
∅B*	5.59/5.49	∅F	1.57/1.52
∅C	4.80/4.72	G	0.71/0.15
D	3.73 min.	H	10.32 nom.

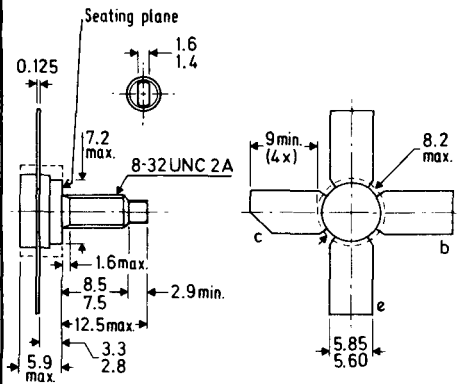
* These tolerances apply only over H.

DO-41

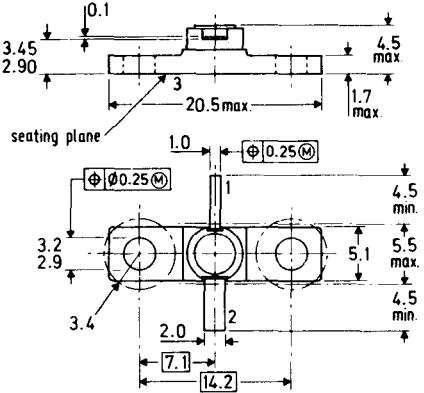


Cathode indicated by coloured band.

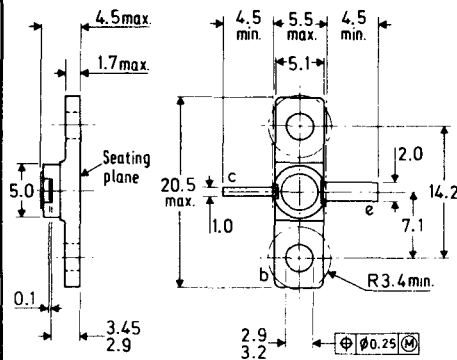
FO-38



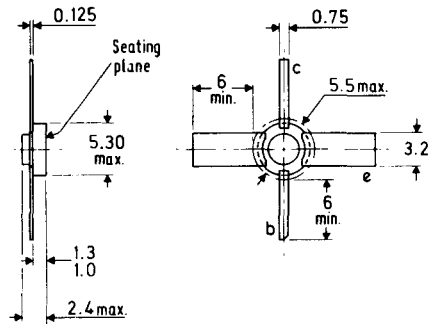
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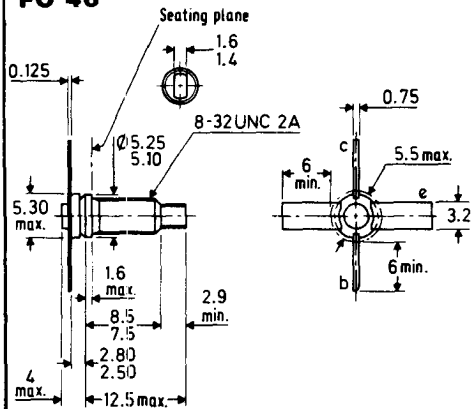
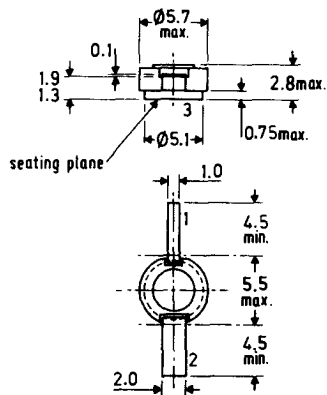
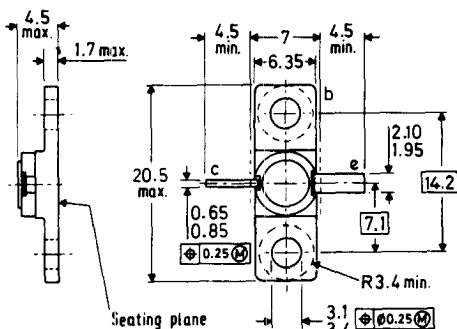
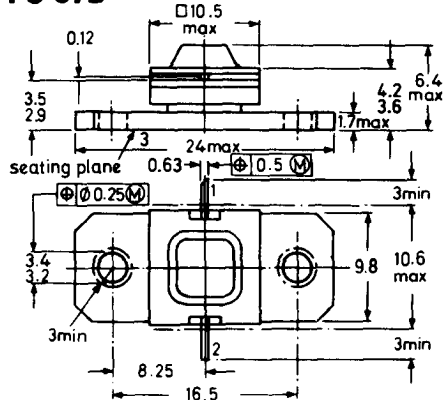
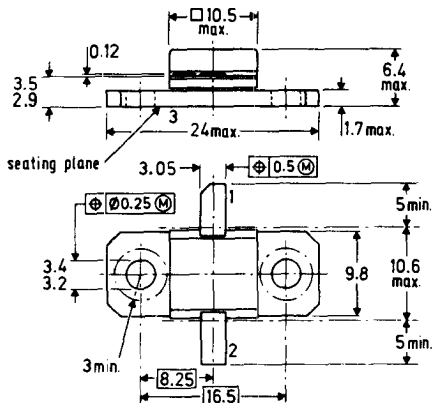
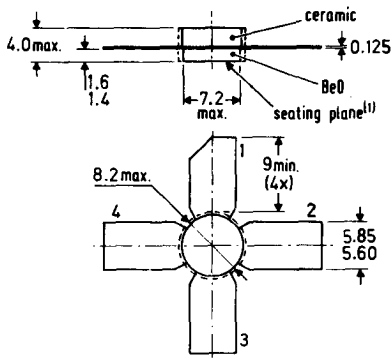


FO-41B



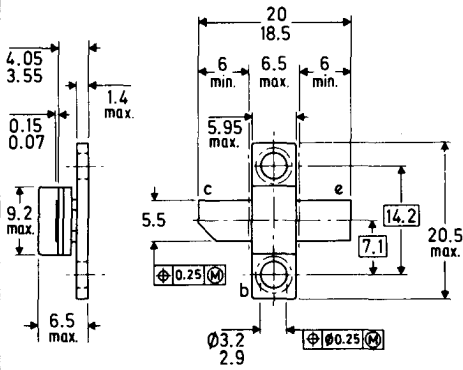
FO-45



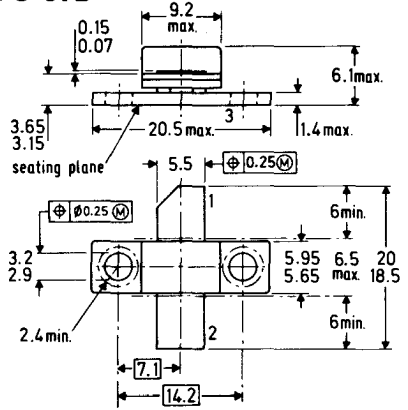
FO-46**FO-49A****FO-53****FO-57B****FO-57C****FO-58**

These drawings give limited information for quick reference purposes. For equipment design more complete information should be obtained from individual data sheets in the Technical Handbook or from standard B. S. or JEDEC outline drawings.

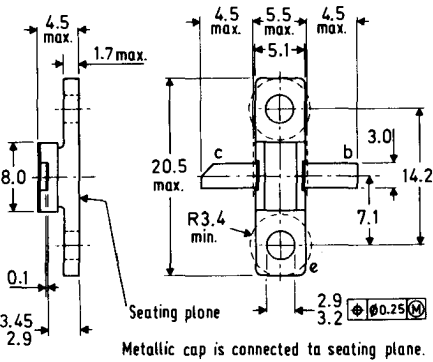
FO-67A



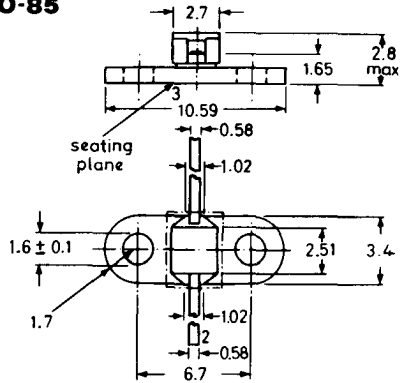
FO-67B



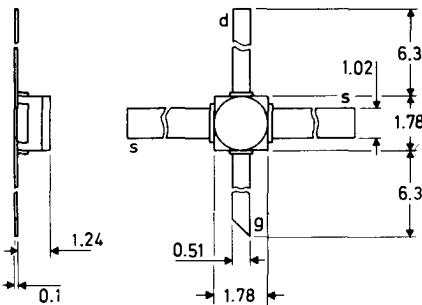
FO-83



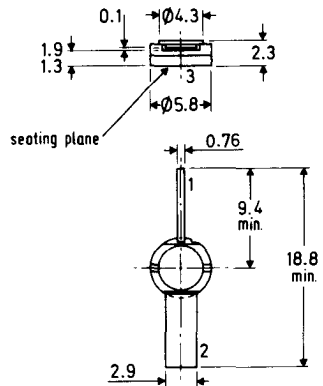
FO-85



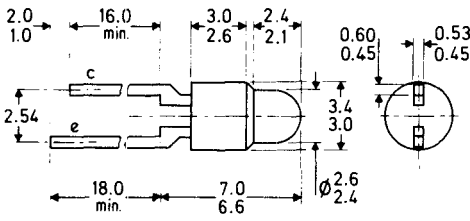
FO-92



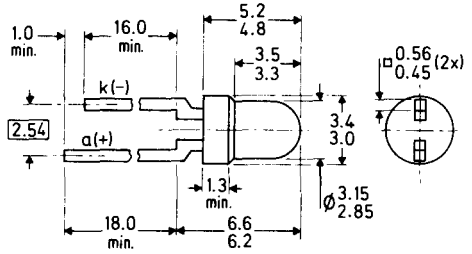
FO-93



SOD-53D

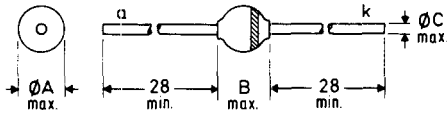


SOD-53E



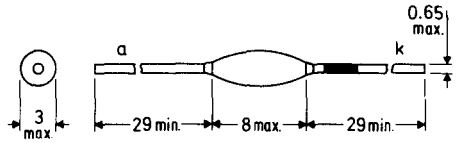
SOD-57 SOD-64

	ϕA	B	ϕC
SOD-57	3.81	4.57	0.81
SOD-64	4.5	5.0	1.35



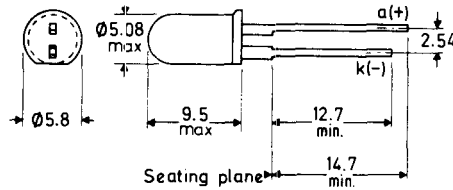
The marking band indicates the cathode.

SOD-61

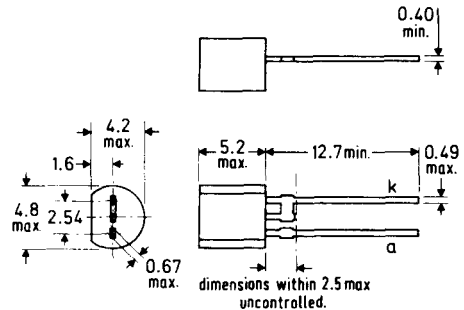


Cathode indicated by coloured band.

SOD-63

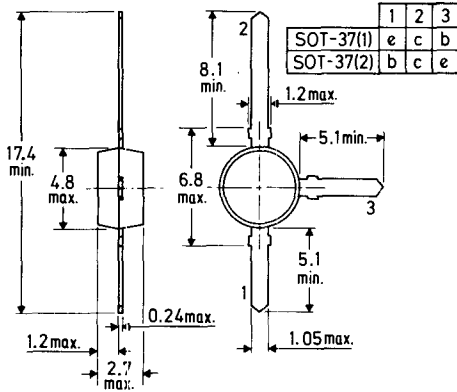


SOD-69

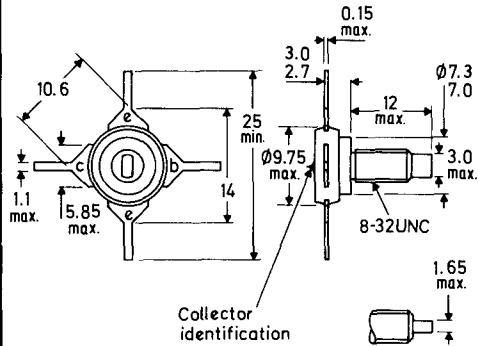


These drawings give limited information for quick reference purposes. For equipment design more complete information should be obtained from individual data sheets in the Technical Handbook or from standard B. S. or JEDEC outline drawings.

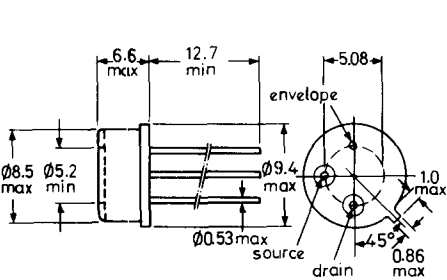
SOT-37



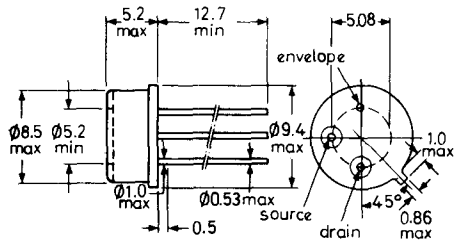
SOT-48/1



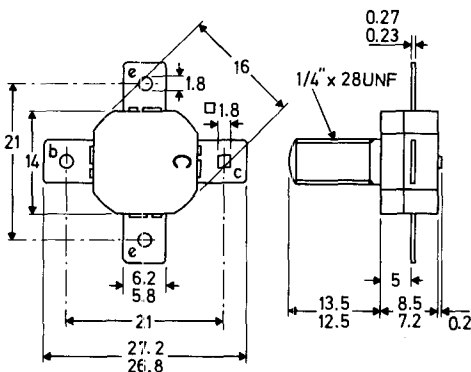
SOT-49G



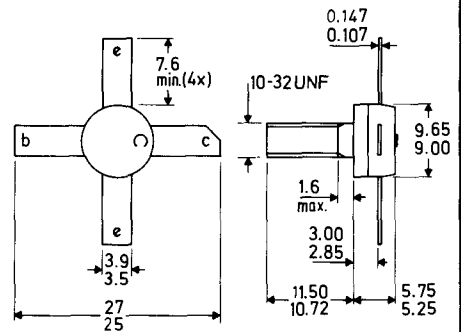
SOT-49H



SOT-55

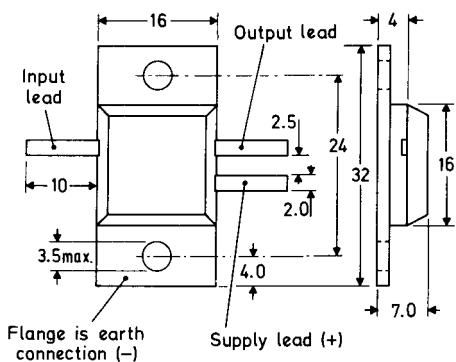


SOT-56

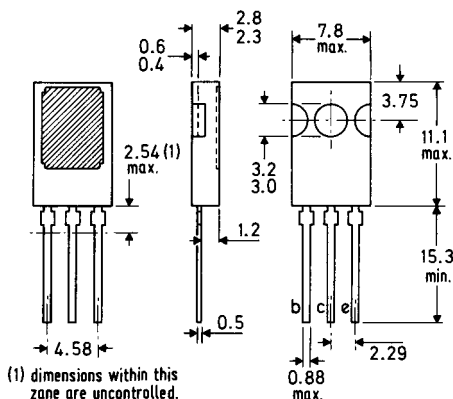


These drawings give limited information for quick reference purposes. For equipment design more complete information should be obtained from individual data sheets in the Technical Handbook or from standard B.S. or JEDEC outline drawings.

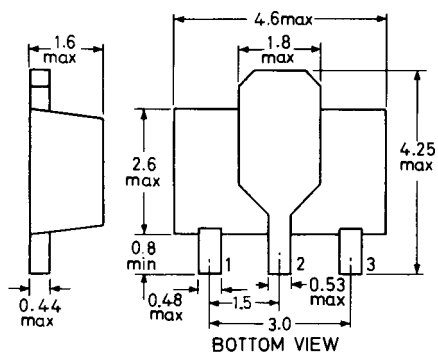
SOT-75A



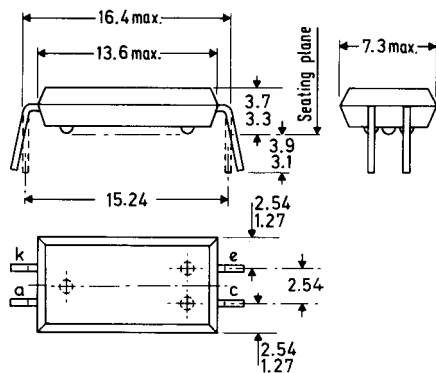
SOT-82



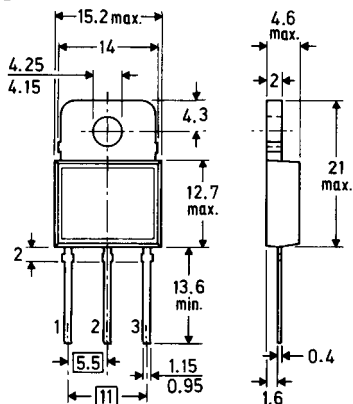
SOT-89



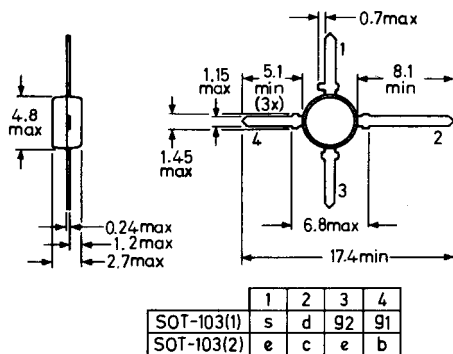
SOT-91B



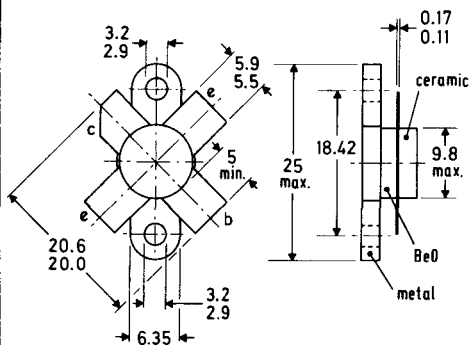
SOT-93



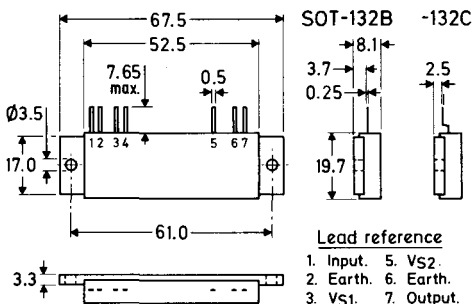
SOT-103



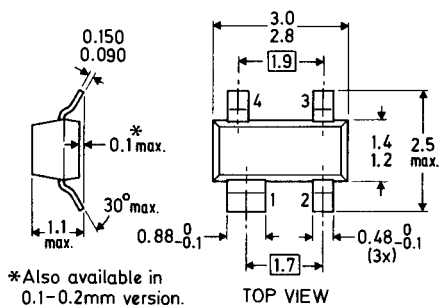
SOT-123



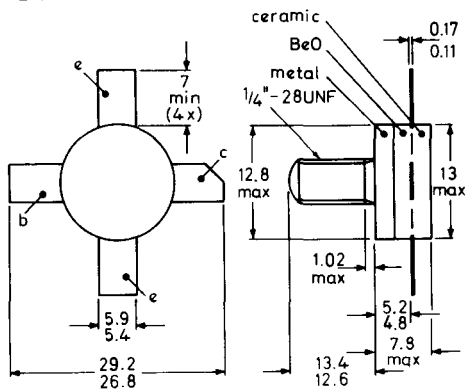
SOT-132B, -132C



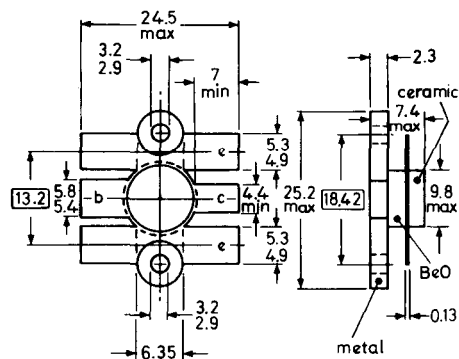
SOT-143



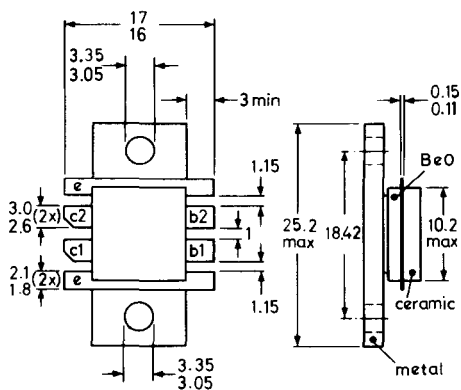
SOT-147



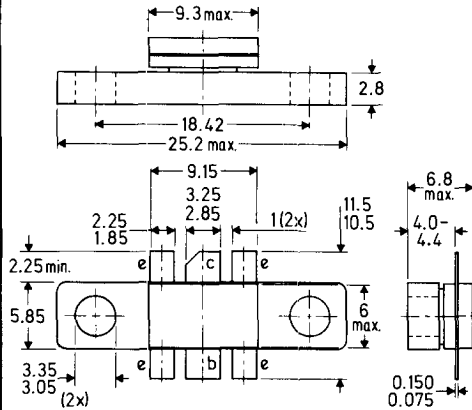
SOT-160



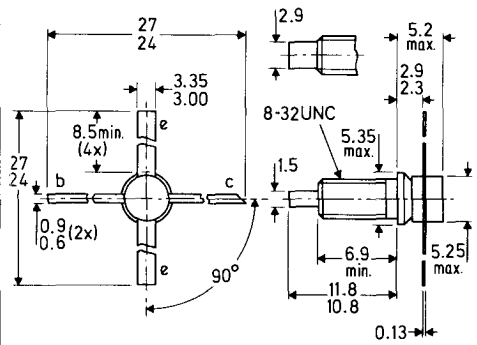
SOT-161



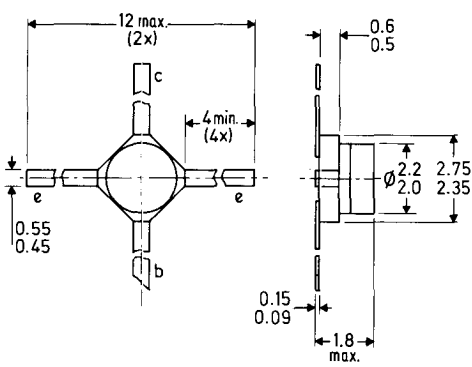
SOT-171



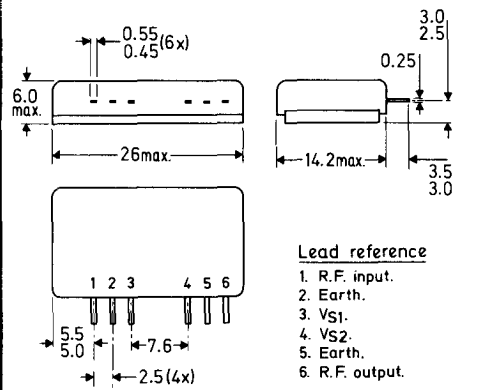
SOT-172



SOT-173

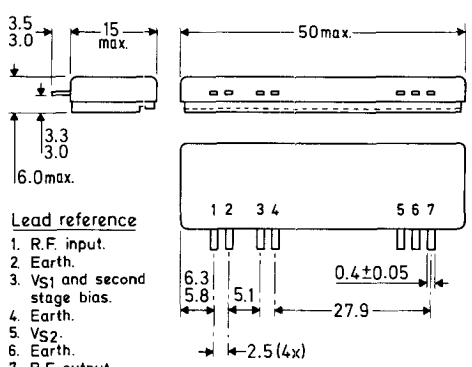


SOT-181



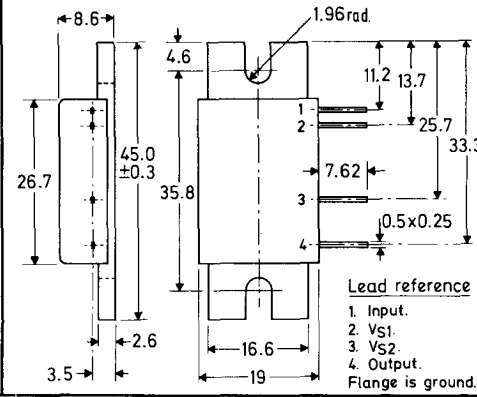
- Lead reference**
1. R.F. input.
 2. Earth.
 3. VS1.
 4. VS2.
 5. Earth.
 6. R.F. output.

SOT-182



- Lead reference**
1. R.F. input.
 2. Earth.
 3. VS1 and second stage bias.
 4. Earth.
 5. VS2.
 6. Earth.
 7. R.F. output.

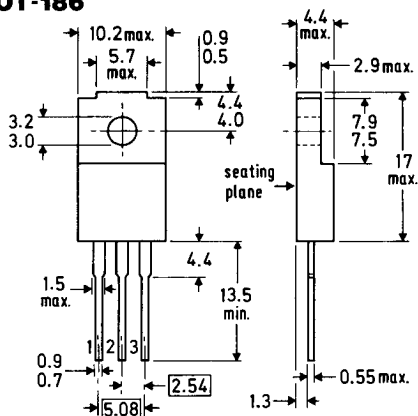
SOT-183



- Lead reference**
1. Input.
 2. VS1.
 3. VS2.
 4. Output.
- Flange is ground.

These drawings give limited information for quick reference purposes. For equipment design more complete information should be obtained from individual data sheets in the Technical Handbook or from standard B. S. or JEDEC outline drawings.

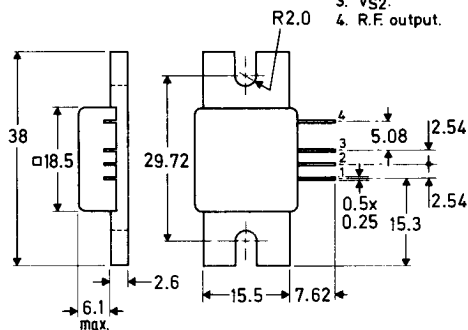
SOT-186



SOT-197

Lead reference

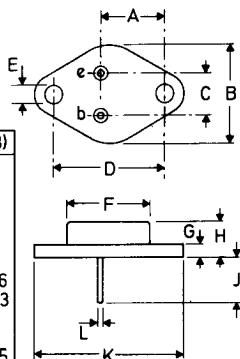
1. R.F. input.
2. V_{S1} .
3. V_{S2} .
4. R.F. output.



TO-3

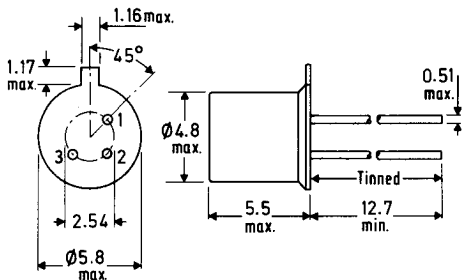
B.S.3934 SO-5B/SB2-2

	TO-3(1)	(2)	(3)
A	16.9		
B	26.6 max		
C	10.9		
D	30.1		
E	4.2 max		
F	20.3 max		
G	2.5	1.6	1.6
H	9.0 max	8.3	8.3
J	12.0		
K	39.5 max		
L	1.0		1.5



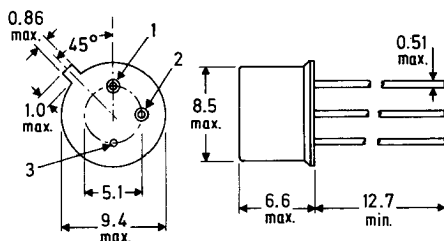
TO-18

B.S.3934 SO-12A/SB3-6A



TO-39

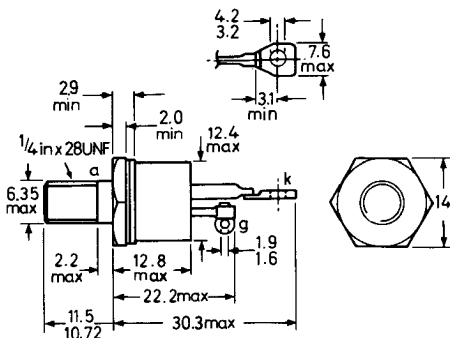
B.S.3934 SO-3/SB3-3A



Pin	1	2	3
TO-39/1	e	b	c
TO-39/3	c	b	e

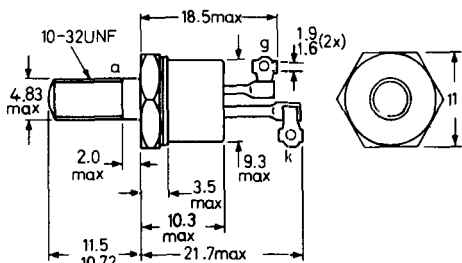
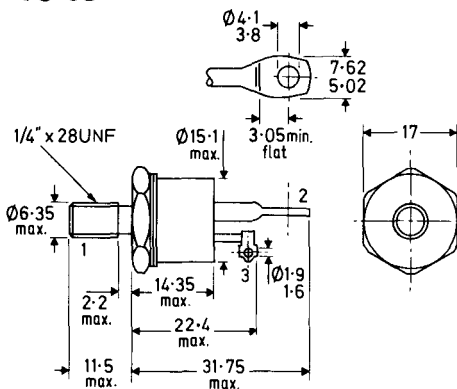
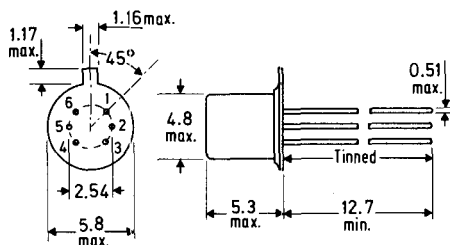
TO-48

B.S.3932 SO-36

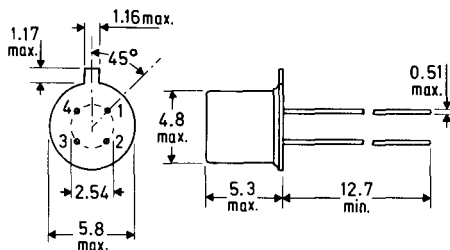
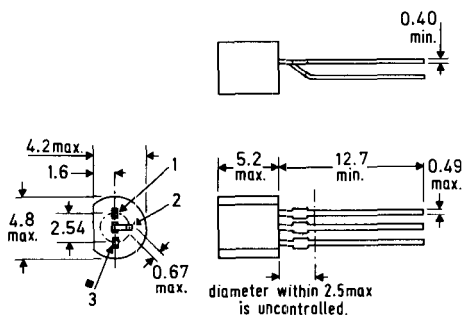
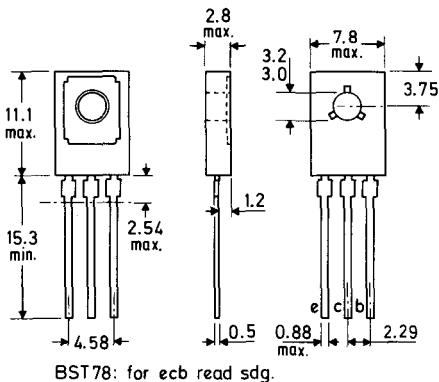


TO-64

B.S.3934 SO-35A

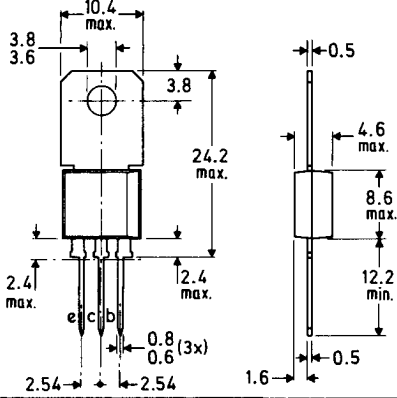
**TO-65****TO-71****TO-72**

B.S.3934 SO-12A/SB4-3

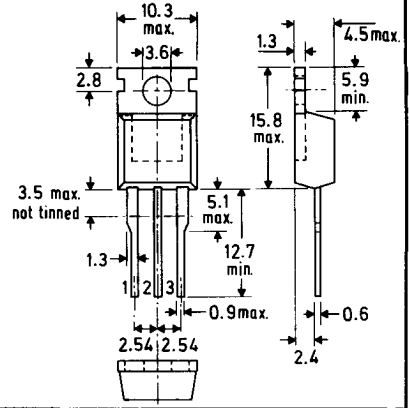
**TO-92
variant****TO-126**

These drawings give limited information for quick reference purposes. For equipment design more complete information should be obtained from individual data sheets in the Technical Handbook or from standard B.S. or JEDEC outline drawings.

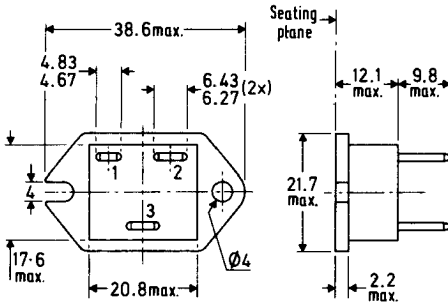
TO-202



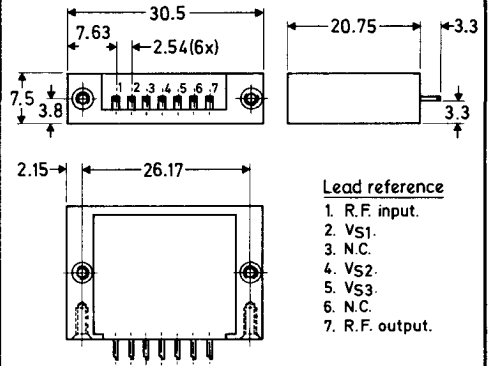
TO-220



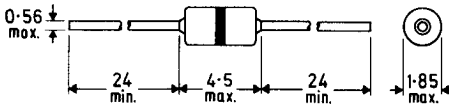
TO-238A



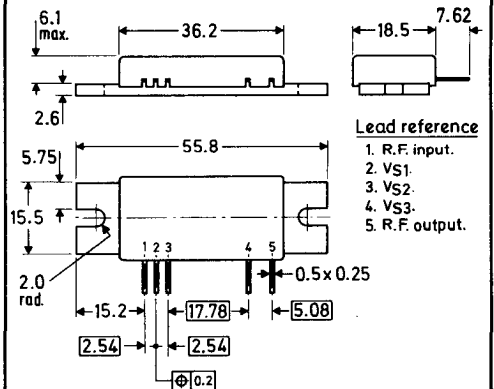
A



B



E



Mullard Electronic Tubes

- Products included for the first time in this guide are indicated both in the index pages and data pages by a black dot alongside the type number.

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colour picture tubes (in-line)

book 2 part 1a

All types: Slotted shadow mask. Three guns in line. Hi-Bri screen with push-through super square presentation. Soft-Flash technology. $V_h = 6.3V$. Quick heating (5 seconds).

Type No.	Tube diagonal		Final anode voltage*		Typical operating conditions**			I_h (mA)	Light transmission (%)	Neck diameter (mm)	Base	Deflection unit
	(cm)	(in)	max. (kV)	min. (kV)	V_{g2} (V)	$+V_k$ (V)	Focusing electrode (V)					
45AX series (flatter and squarer)												
110° deflection angle												
A59EAK00X	59	23	27.5	20	575 to 825	105 to 130	29 to 33†	310	62	29	B10-277	AT6010
A66EAK00X	66	26	27.5	20	575 to 825	105 to 130	29 to 33†	310	65	29	B10-277	AT6000
90° deflection angle, raster correction free												
A51EAL00X	51	20	27.5	20	575 to 825	105 to 130	29 to 33†	300	64.5	29	B10-277	AT6035
● A36EAM00X	36	14	27.5	20	310 to 650	125	29 to 33†	300	65	22.5	38-288	AT6060
● A41EAM00X	41	16	27.5	20	310 to 650	125	29 to 33†	300	64	22.5	B8-288	AT6050
30AX types 110° deflection angle												
A51-540X	51	20	27.5	22.5	560 to 800	140	6500 to 7450	720	64	36.5	B12-246	AT1250
A56-540X	56	22	27.5	22.5	560 to 800	140	6500 to 7450	720	64	36.5	B12-246	AT1260
A66-540X	66	26	27.5	22.5	560 to 800	140	6500 to 7450	720	68	36.5	B12-246	AT1270
Mini-neck types 90° deflection angle, raster correction free												
A34EACOOX	34	14	27.5	20	310 to 600	125	6100 to 6900	290	68	22.5	B8-288	AT1625 series
A38EACOOX	38	16	27.5	20	310 to 600	125	6100 to 6900	290	67	22.5	B8-288	AT1635 series
A43EACOOX	43	18	27.5	20	310 to 630	125	7600 to 8400	290	64	22.5	B8-288	AT1645 series
A48EACOOX	48	20	27.5	20	310 to 650	120	7300 to 8300	300	64	22.5	B8-288	AT1645 series
Narrow neck types 90° deflection angle, raster correction free												
A37-590X	37	14	27.5	20	390 to 760	140	6600 to 7500	685	68	29.1	B10-277	AT1206
● A42-592X	42	16	27.5	20	390 to 760	140	6600 to 7500	685	68.8	29.1	B10-277	AT1216
A51-590X	51	20	27.5	20	390 to 760	140	6600 to 7500	685	64	29.1	B10-277	AT1236

* Design maximum rating.

** Cathode drive.

† As a percentage of anode voltage.

monochrome picture tubes

All types: 110° deflection. Short unipotential gun. Push-through presentation. Quick heating (5 seconds).

Type No.	Screen diagonal		Max. final anode voltage* (kV)	Typical operating conditions**			V _h (V)	I _h (mA)	Light transmission (%)	Neck diameter (mm)	Base
	(cm)	(in)		V _{a1} (V)	+V _k (V)	Focusing electrode (V)					
A31-510W	31	12	17	130	30 to 50	0 to +130	11	140	50	20	B7G special
A34-510W	34	14	17	130	30 to 50	0 to +130	11	140	48	20	B7G special
A44-510W	44	17	17	130	30 to 50	0 to +130	11	140	48	20	B7G special
A50-520W	50	20	23	130	42 to 62	0 to +130	6.3	240	45	28.6	B8H
A61-520W	61	24	23	130	42 to 62	0 to +130	6.3	240	42	28.6	B8H

*Design maximum rating.

**Cathode drive.

Voltages with respect to g₁.

deflection units

book 2 part 1a

Type No.	Recommended picture tube	Line deflection current (A p-p)	Line inductance (μH)	Field deflection current (A p-p)	Field resistance (Ω)
AT1206/20	A37-590X	3.21	1.78	0.97	11
AT1216/20	A42-592X	3.28	1.73	0.94	11
AT1236/20	A51-590X	3.00	1.91	0.895	13.2
AT1625/20	A34EAC00X	2.15	2.50	0.75	13.6
AT1625/30	A34EAC00X	2.07	2.50	0.38	54.4
AT1625/31	A34EAC00X	2.07	2.50	0.75	13.6
AT1635/00	A38EAC00X	2.07	2.50	0.78	11.8
AT1635/20	A38EAC00X	2.21	2.50	0.78	11.8
AT1635/30	A38EAC00X	2.07	2.50	0.39	47
AT1645/00	A48EAC00X	2.23	2.50	0.81	11.8
AT1645/20	A48EAC00X	2.38	2.34	0.81	11.8
AT1645/30	A48EAC00X	2.23	2.50	0.40	47.2
AT1850	A51-540X	4.80	1.53	2.00	6.2
AT1860	A56-540X	5.00	1.50	1.95	5.9
AT1870	A66-540X	5.10	1.50	2.0	5.85
AT6000/01	A66EAK00X01, 02	4.10	1.85	1.70	6.5
AT6000/11	A66EAK00X03	4.10	1.85	1.70	6.5
AT6010	A59EAK00X01, 02	4.10	1.85	1.70	6.5
AT6010/11	A59EAK00X03	4.10	1.85	1.70	6.5
AT6035/04	A51EAL00X, 10X, 20X, 30X	2.85	2.00	1.09	9.7
AT6035/11	A51EAL00X	3.09	1.70	1.09	9.7
AT6050/00	A41EAM00X	2.11	2.43	0.82	12.2
AT6050/30	A41EAM00X	2.11	2.43	0.41	50
AT6050/42	A41EAM00X	2.57	1.64	0.41	50
AT6060/00	A36EAM00X	2.11	2.43	0.82	12.2
AT6060/30	A36EAM00X	2.11	2.43	0.41	49
AT6060/42	A36EAM00X	2.57	1.64	0.41	49

Electro-optical devices

* Plumbicon camera tubes

book 2 part 2a

Basic Type No.	Quality grade	Application	Spectral response cut-off (nm)	Loading	Typical mod. depth B/W or L		
					(%)	(MHz)	
14mm (1/2") dia. Plumbicon tube (55mA 9V heater), high stability (HS) diode gun, low output capacitance (LOC), electrostatic focusing							
XQ4087	Broadcast	B/W RGB	650	Rear	40	4	
18mm (3/8") dia. Plumbicon tubes (95mA 6.3V heater)							
XQ1427	Broadcast	B/W RGB	850	Rear	60	4	
XQ1428	Industrial	B/W RGB	850	Rear	60	4	
18mm (3/8") dia. Plumbicon tubes with diode gun							
XQ2427	Broadcast	B/W RGB	650 to 850	Rear	50	5	
XQ2428	Industrial	B/W RGB	650 to 850	Rear	50	5	
18mm (3/8") dia. Plumbicon tubes with diode gun and low output capacitance (LOC)							
XQ3427	Broadcast	B/W RGB	650 to 850	Rear	50	5	
XQ3428	Industrial	B/W RGB	650 to 850	Rear	50	5	
18mm (3/8") dia. Plumbicon tube (95mA 6.3V heater) with diode gun, low output capacitance (LOC), magnetic focus and electrostatic deflection							
XQ3457	Broadcast	B/W RGB	650	Rear	50	5	
18mm (3/8") dia. Plumbicon tube (95mA 6.3V heater) with electrostatic focusing							
XQ3467	Broadcast	B/W RGB	650	Rear	45	4	
18mm (3/8") dia. Plumbicon tube (55mA 9V heater), high stability (HS) diode gun, low output capacitance (LOC), electrostatic focusing							
XQ4187	Broadcast	B/W RGB	650	Rear	45	4	
25mm (1") dia. Plumbicon tubes – standard range (95mA 6.3V heater)							
†XQ1070	Broadcast	B/W LRGB	650	Front	} Rear loading types are available	40	5
†XQ1071	Industrial	B/W RGB	650	Front		40	5
XQ1072	Medical	–	650	Front		–	–
†XQ1073	Broadcast	B/W R	850 to 950	Front		50	5
†XQ1074	Industrial	B/W R	850 to 950	Front		50	5
‡XQ1075	Broadcast	B/W R	750	Front		50	5
‡XQ1076	Industrial	B/W R	750	Front	50	5	

Can be supplied with provision for light bias.

*Registered Trade Mark for television camera tubes

† Can be supplied without anti-halation disc denoted by suffix /01 to type number

‡ Supplied with infrared filter on disc.

Type numbers: No letter suffix for black/white application; L suffix for luminance; R for red image; G for green image; B for blue image. Where a /01 suffix is also used, the complete type number of an example would be XQ1070/01G.

Continued

Electro-optical devices

* Plumbicon camera tubes (cont.) book 2 part 2a

Basic Type No.	Quality grade	Application	Spectral response cut-off (nm)	Loading	Typical mod. depth	
					(%)	(MHz)
25mm (1") dia. Plumbicon tubes – technically advanced range (95mA 6.3V heater)						
XQ1080	Broadcast	B/W LRGB	650	Rear	40	5
XQ1081	Industrial	B/W RGB	650	Rear	40	5
XQ1083	Broadcast	B/W R	850 to 950	Rear	50	5
XQ1084	Industrial	B/W R	850 to 950	Rear	50	5
‡XQ1085	Broadcast	B/W R	750	Rear	50	5
‡XQ1086	Industrial	B/W R	750	Rear	50	5
XQ1090	Broadcast	B/W LRGB	650	Front	40	5
XQ1091	Industrial	B/W RGB	650	Front	40	5
XQ1093	Broadcast	B/W R	850 to 950	Front	50	5
XQ1094	Industrial	B/W R	850 to 950	Front	50	5
‡XQ1095	Broadcast	B/W R	750	Front	50	5
‡XQ1096	Industrial	B/W R	750	Front	50	5
25mm (1") dia. Plumbicon tubes with diode gun						
XQ2070/02	Broadcast	B/W RGB	650	Rear	60	5
XQ2073/02	Broadcast	B/W RGB	850 to 950	Rear	65	5
‡XQ2075/02	Broadcast	B/W RGB	750	Rear	65	5
25mm (1") dia. Plumbicon tubes with diode gun and low output capacitance (LOC)						
XQ3070/02	Broadcast	B/W RGB	650	Rear	60	5
XQ3073/02	Broadcast	B/W RGB	850 to 950	Rear	65	5
XQ3075/02	Broadcast	B/W RGB	750	Rear	65	5
25mm (1") dia. high resolution Plumbicon tubes with anti-comet-tail (ACT) (190mA 6.3V heater)						
XQ1500	Broadcast	B/W LRGB	650	Rear	50	5
XQ1501	Industrial	B/W RGB	650	Rear	50	5
XQ1503	Broadcast	B/W R	850 to 950	Rear	55	5
XQ1504	Industrial	B/W R	850 to 950	Rear	55	5
XQ1505	Broadcast	B/W R	750	Rear	55	5
XQ1506	Industrial	B/W R	750	Rear	55	5
30mm (1¼") dia. Plumbicon tubes – standard range (300mA 6.3V heater)						
XQ1020	Broadcast	B/W LRGB	650	Rear	40	5
XQ1021	Industrial	B/W RGB	650	Rear	40	5
XQ1022	Medical	–	650	Rear	–	–
XQ1023	Broadcast	B/W LR	850	Rear	55	5
XQ1024	Industrial	B/W R	850	Rear	55	5
‡XQ1025	Broadcast	B/W LR	750	Rear	55	5
‡XQ1026	Industrial	B/W R	750	Rear	55	5

*Registered Trade Mark for television camera tubes

† Can be supplied without anti-halation disc denoted by suffix /01 to type number

‡ Supplied with infrared filter on disc.

Type numbers: No letter suffix for black/white application; L suffix for luminance; R for red image; G for green image; B for blue image. Where a /01 suffix is also used, the complete type number of an example would be XQ1070/01G.

Continued

Electro-optical devices

* Plumbicon camera tubes (cont.) book 2 part 2a

Basic Type No.	Quality grade	Application	Spectral response cut-off (nm)	Loading	Typical mod. depth	
					B/W or L (%)	(MHz)
30mm (1¼") dia. Plumbicon tubes – technically advanced range (300mA 6.3V heater)						
XQ1410	Broadcast	B/W LRGB	650	Rear	55	5
XQ1411	Industrial	B/W RGB	650	Rear	55	5
XQ1413	Broadcast	B/W LR	900	Rear	60	5
XQ1414	Industrial	B/W R	850	Rear	60	5
†XQ1415	Broadcast	B/W LR	750	Rear	60	5
†XQ1416	Industrial	B/W R	750	Rear	60	5
30mm (1¼") dia. high resolution Plumbicon tubes with anti-comet-tail (ACT) (190mA 6.3V heater)						
XQ1520	Broadcast	B/W LRGB	650	Rear	55	5
XQ1521	Industrial	B/W RGB	650	Rear	55	5
XQ1523	Broadcast	B/W R	900	Rear	55	5
XQ1524	Industrial	B/W R	900	Rear	55	5
‡XQ1525	Broadcast	B/W R	750	Rear	55	5
‡XQ1526	Industrial	B/W R	750	Rear	55	5
30mm (1¼") dia. Plumbicon tubes (190mA 6.3V heater), diode gun						
XQ3440	Broadcast	B/W GB	650	–	65	5
XQ3443	Broadcast	R	850	–	60	5
XQ3445	Broadcast	R	950	–	60	5
XQ4502	X-ray, Medical	–	950	–	95	5

*Registered Trade Mark for television camera tubes

† Can be supplied without anti-halation disc denoted by suffix /01 to type number

‡ Supplied with infrared filter on disc.

Type numbers: No letter suffix for black/white application; L suffix for luminance; R for red image; G for green image; B for blue image. Where a /01 suffix is also used, the complete type number of an example would be XQ1070/01G.

camera tubes

book 2 part 2c

Type No.	Application	Feature	Max. length (mm)	Focus	Spectral response (nm)	Limiting resolution (tv lines)
½" Vidicon						
XQ1600	Surveillance, consumer	Ultra-compact cameras	85	E	550	450
⅔" Vidicons						
XQ1270	Surveillance	Int. mesh I, 110 mA	108	M	550	500
XQ1271	Surveillance	Improved resolution	108	M	550	600
XQ1272	Surveillance, consumer	Compact cameras	108	E	550	550
XQ1590	Surveillance, consumer	Compact cameras	108	E	550	550
1" Vidicons						
XQ1031	Educational	Integral mesh	130	M	550	600
XQ1032	Industrial	Integral mesh	130	M	550	600
XQ1240	Telecine, X-ray	High resolution	159	M	550	800
XQ1241	Industrial, surveillance	High resolution	159	M	550	800
XQ1280	Med./ind., X-ray	Very high resolution	159	M	480	1600
XQ1285	X-ray image intensifier	Fibre optic	189	M	480	1200
½" Newvicons*						
XQ1601	Security surveillance	Ultra-compact cameras	85	E	750	450
XQ1602	Radiation environment	Ultra-compact cameras	85	E	750	450
⅔" Newvicons*						
XQ1274	Security surveillance	High sensitivity	108	M	750	650
XQ1275	Security surveillance	High sensitivity	108	E	750	600
XQ1276	Security surveillance	Extended red	108	M	775	650
XQ1277	Security surveillance	Extended red	108	E	775	550
XQ1278	Security surveillance	High sensitivity	108	E	750	550
XQ1380	Radiation environment	High sensitivity	108	M	750	650
XQ1381	Radiation environment	High sensitivity	108	E	750	600
1" Newvicons*						
XQ1440	Surveillance, X-ray	High resolution	159	M	750	750
XQ1442	Image intensifier	Fibre optic	160	M	750	650
XQ1443	Security surveillance	Extended red	159	M	775	750
XQ1444	Radiation environment	High resolution	159	M	750	750

*Registered Trade Mark for television camera tubes.

All tubes have 6.3V 95mA heaters apart from XQ1270 which is 6.3V at 110mA

All tubes have magnetic deflection and separate mesh unless otherwise indicated.

Electro-optical devices

solid-state image sensors

Frame transfer-ccd

Type No.	System	Effective display horiz. vert.	Total number of active elements
● NXA1011	625-line monochrome	604 × 576	347, 904
● NXA1021	625-line colour	604 × 576	347, 904
● NXA1031	525-line monochrome	610 × 492	300, 120
● NXA1041	525-line colour	610 × 492	300, 120

All sensors are designed for the ½inch format with a 4:3 aspect ratio.

All sensors are available in four grades, depending on the number of defective pixels:

Grade

01 : zero defective pixels.

02 : 1 to 2 defective pixels.

03 : 3 to 10 defective pixels.

04 : > 11, < 600 defective pixels or two column defects.

Peripheral ICs are available for both driving the sensors and for video processing.

For further information regarding the sensors and peripheral ICs, please contact the Professional Products Group, Mullard Ltd.

camera tube deflection assemblies

book 2 parts 2a & c

Tube dia-meter	Type No.	triplet or single	Inductance (mH)		Resistance (Ω)			Current (mA)			Remarks
			line coils	frame coils	line coils	frame coils	focus coils	p-p line	p-p frame	d.c. focus	
30mm (1 1/4")	AT1130	T	0.84	5.5	2.1	14.5	1125	180	55	35	Rear loading + alignment coils
	AT1130S	S	0.84	5.5	2.1	14.5	1125	180	55	35	Rear loading + alignment coils
25mm (1")	AT1115/01	T	0.79	26	2.2	62	1718	260	36	32	Rear loading + alignment coils
	AT1119/01	S	0.79	26	2.2	62	1718	260	36	32	Rear loading + alignment coils
	AT1116/06	T	0.79	28	2.2	62	140	280	34	108	Front loading + alignment coils
	AT1116S	S	0.79	28	2.2	62	140	280	34	108	Front loading + alignment coils
	AT1126	T	0.8	4.4	2.2	10	1300	230	80	30	Rear loading + alignment coils
	AT1126S	S	0.8	4.4	2.2	10	1300	230	80	30	Rear loading + alignment coils
	KV9G	S	1.6	70	4.4	125	104	200	29	140	For vidicon tube
18mm (3/4")	AT1109/01	T	0.91	2.8	3.8	12.7	60	260	114	120	Front loading + alignment rings
	AT1109/01S	S	0.91	2.8	3.8	12.7	60	260	114	120	Rear loading + alignment rings
	AT1109/10	T	0.91	2.8	3.8	12.7	60	230	104	115	For low output-capacitance tubes
	AT1109/13S	S	0.91	2.8	3.8	12.7	60	230	104	-	For low output-capacitance tubes
	AT1109/13T	T	0.91	2.8	3.8	12.7	60	230	104	-	For low output-capacitance tubes
	KV12S	S	0.86	28.7	3.2	146	55	160	25	120	For vidicon tube
	KV19G	S	0.9	23	4.6	146	-	160	25	-	For electrostatic vidicon tube
	KV19L	S	0.9	26	4.4	145	-	-	-	-	For vidicon and Newvicon* tubes
	KV22B	S	0.86	28	3.2	146	55	-	-	-	For vidicon and Newvicon* tubes
	KV4722	S	-	-	-	-	22.7	-	-	201	For Plumbicon* MS tubes
	KV4736-3AS	S	1.15	2.41	4.5	24	-	185	95	-	For Plumbicon* HS tubes
	KV4736-3AT	T	1.15	2.41	4.0	24.8	-	185	95	-	For Plumbicon* HS tubes
	KV4780	S	1.17	5.3	5.03	33	-	75	30	-	For Plumbicon* with ES focus

*Registered Trade Mark for television camera tubes.

Continued

Electro-optical devices

camera tube deflection assemblies (cont.) book 2 parts 2a & c

Tube diameter	Type No.	triplet or single	Inductance (mH)		Resistance (Ω)			Current (mA)			Remarks
			line coils	frame coils	line coils	frame coils	focus coils	p-p line	p-p frame	d.c. focus	
14mm ($\frac{1}{2}$ ")	AT1120S	S	0.33	1.1	6.2	14.1	-	90	92	-	For Plumbicon* HS tubes
	AT1120T	T	0.33	1.1	6.2	14.1	-	190	92	-	For Plumbicon* HS tubes
13.5mm ($\frac{1}{2}$ ")	KV29E	S	1.4	5.7	11.3	80.7	-	70	26	-	For vidicon and Newvicon* tubes

Camera tube sockets – a range of sockets for Plumbicon*, vidicon and Newvicon* tubes is available from Mullard Ltd.

* Registered Trade Mark for television camera tubes.

night vision components

Mullard manufacture a wide range of night vision components, including image intensifiers and thermal imaging detectors. Full details may be obtained on request to the Night Vision Department, Mullard Ltd., Mullard House, Torrington Place, London WC1E 7HD.

instrument tubes

book 2 part 1b

Type No.	Description, application	Screen diag.		Deflection sensitivity (V/cm)		Abs. max. final anode voltage (kV)	Operation y-plates x-plates		Post def. acc.	Ih at 6.3V (mA)	Base
		(cm)	(in)	Sy	Sx						
D7-222GY	Inexpensive oscilloscopes Monitoring devices	7	2½ × 2 (Rectangular)	21	13 ($V_{a1+a3} = 1.0kV$)	2.2	Sym.	Sym.	None	300	B12-246
D7-221GY	Low consumption heater version										
D10-180GY	Short length with dynamic focus	10	2.8 × 2.2 (Rectangular)	23	40	2.0	Sym.	Sym.	None	240	55566
D10-181GY	Low consumption heater version									95	55589
D12-130GY/119	Portable oscilloscopes	12	3.2 × 2.5 (Rectangular)	21	32	2.2	Sym.	Sym.	None	100	55595
D14-361GH	Inexpensive oscilloscopes Medical applications Low consumption heater	14	4½ × 4 (Rectangular)	11.5	22 ($V_{a1+a3} = 2.0kV$)	2.2	Sym.	Sym.	None	95	Special 14-pin 55589
D14-364GH/123	Inexpensive oscilloscopes	14	4½ × 4 (Rectangular)	11.5	19 ($V_{a1+a3} = 2.0kV$)	2.2	Sym.	Sym.	None	240	12-pin 55594
D14-372GH/123	Compact oscilloscopes	14	10 × 8 (Rectangular)	4	8	10	Sym.	Sym.	Yes	240	12-pin 55594 55595
D14-380GH/93	Compact oscilloscopes	14	10 × 8 (Rectangular)	4	8.3	16.5	Sym.	Sym.	None	240	12-pin 55594 55595
L14-131GH/55	Dual trace storage oscilloscopes	14	9 × 7.2 (Rectangular)	8.5	9.5	8.5	Sym.	Sym.	None	300	Special 14-pin 55566
L14-140GH/95	Transfer storage oscilloscopes	14	9 × 7.2 (Rectangular)	4.8	18.5	10	Sym.	Sym.	None	240	Special 14-pin 55572
L14-150GH/95	Storage oscilloscopes	14	9 × 7.2 (Rectangular)	4.1	9.5	8.5	Sym.	Sym.	Yes	240	Special 14-pin 55566

Continued

Designation of preferred Mullard phosphors

Present System (Pro-Electron)	Old System	Fluorescent colour	Phosphorescent colour	Persistence	Equivalent JEDEC designation
BA	C	Purplish-blue	—	Very short	—
BE	B	Blue	Blue	Medium short	P11
BF	U	Blue	—	Medium short	—
GH	H	Green	Green	Medium short	P31
GK	C*	Yellowish-green	Yellowish-green	Medium	—
GM	P	Purplish-blue	Yellowish-green	Long	P7
GR	—	Green	Green	Long	P39
GU	—	White	White	Very short	—
GY	—	Green	Green	—	P43
W	W	White	—	—	P4
WA	—	White	—	—	—
WE	—	White	White	Medium short	P45
YA	Y	Yellowish-orange	Yellowish-orange	Medium	—

*Used in projection tubes

flying spot scanner tube

book 2 part 1b

Type No.	Description	Screen dia. (cm) (in)	Resolution (lines)	V_a (kV)	$-V_g$ (V)	I_h at 6.3V (mA)	Base
Q13-110GU	Magnetic tube for colour television. Metal backed screen and white phosphor.	13 5	1000	25	50 to 100	300	B12A

television monitor tubes

book 2 part 1b

All types: magnetic deflection. electrostatic focusing. metal-backed rectangular screen.

Type No.	Description	Screen diagonal		Deflection angle (deg.)	Max. final anode voltage (kV)	Typical operating conditions					Base
		(cm)	(in)			V_{a1} (kV)	$-V_g$ (V)	focusing electrode (V)	V_h (V)	I_h (mA)	
M17-142WE	Television viewfinder tube	17	7	70	16	400	32 to 62	0 to +400	6.3	300	B8H
M17-143W	As M17-142WE but with reinforced faceplate	17	7	70	18	400	32 to 62	0 to +400	6.3	300	B8H
M17-144WE	Photographic recording	17	7	70	16	400	32 to 62	0 to +400	6.3	300	B8H
M17-145WE	As M17-144WE but with reinforced faceplate	17	7	70	16	400	32 to 62	0 to +400	6.3	300	B8H

very high resolution data display tube

book 2 part 1b

M38-201WA	Facsimile display tube A4 format 1728 × 2288 pixels resolution	38	15	70	20	800	50 to 110	5 to 7kV	6.3	90	55589A
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Datagraphic display components

high resolution monochrome c.r.t.s for datagraphic displays

book 2 part 1d

All tubes have quick heat cathodes

Type No.	Approx. screen diagonal (in)	Deflection angle	Approx. screen curvature radius (mm)	Approx. neck diameter (mm)	Approx. mounting lugs position (mm)	Overall length (mm)	V _i (V)	I _i (mA)	V _{g2} (V)	V _a (kV)
M24-306	9	90°	690	20	212 × 160	227.0	12	130	400	12
M31-326	12	110°	635	29	273 × 190	241.0	6.3	240	400	17
M31-336	12	90°	510	20	273 × 190	280.0	12	130	400	12
M31-340	12	90°	635	20	273 × 190	277.0	12	130	400	12
M38-328	15	110°	635	29	311 × 245	279.0	6.3	240	400	17

Phosphor options are:

- W = white medium short persistence (P4)
- WD = white medium persistence
- GH = green medium short persistence (P31)
- GR = green long persistence (P39)
- LA = orange medium persistence

Anti-glare options are:

- /P = ground finish with 50% transmission glass
- /PD = ground finish with 30% transmission glass
- /ED = etched finish with 30% transmission glass

deflection coils for high resolution monochrome c.r.t.s

book 2 part 1d

Type No.	Deflection angle	Approx. tube neck diameter (mm)	Inductance line (mH)	Inductance field (mH)	Resistance line (Ω)	Resistance field (Ω)	EHT (kV)	Sensitivity line (A p-p)	Sensitivity field (A p-p)
AT 1077/09	90°	20	0.48	18	0.8	10.0	12	2.91	0.51
AT 1077/05	90°	20	0.47	18	0.86	10.0	12	3.12	0.49
AT 1071/03	90°	29*	0.93	56/14	0.15	6.75	15	9.3	0.90
AT 1038/42	110°	29	0.7	58/15	1.2	7.6	17	4.4	1.08
AT1039/01	110°	29	0.2	9.7/2.4	0.39	2.7	17	8.4	1.02
					1.56	10.6			
AT1039/00	110°	29	0.2	9.1/4.3	0.4	2.55	17	6.4	1.35
					1.64	10.2			
AT1039/03	110°	29	0.23	9.2/2.3	0.14	2.55	17	7.95	1.21
					1.64	10.2			

*Packing piece available for 20mm neck.

Datagraphic display components

line output transformers for high resolution monochrome c.r.t.s

book 2 part 1d

Type No.	Supply		EHT output		R ₁ (MΩ)	Line deflection current (A p-p)
	volts (V)	current (mA)	volts (kV)	current (μA)		
AT 2240/16	12	620	12	100	7	3.2
AT 2102/02	12	1800	15	100	10	8.5
AT 2102/04C	24	820	17	100	6.5	4.6
AT 2102/06C	24	955	17	100	8	4.4
AT 2076/53	150	450	25	100	2	5.3
AT 2076/84	55	300	17	500	1.3	3.1
DT 2076/54	130	210	17	500	1.3	3.8

Datagraphic display components

linearity controls for high resolution monochrome c.r.t.s book 2 part 1d

Type No.	Correction voltage (V)	Deflection current (A p-p)	Damping resistor (Ω)
AT4042/46	6	3	820
AT4036/00A	0.95-2.15	6	560
AT4042/08A	8-15	4.65	820

line driver transformers for high resolution monochrome c.r.t.s book 2 part 1d

Type No.	Supply voltage (V)	Primary inductance (mH)	Secondary leakage inductance (μ H)	Transformation ratio
AT4043/59	24	≥ 61	≤ 12	4.18:1
AT4043/64	12	1.2	≤ 5	2:1
AT4043/83	70	80	6	12.1:1
AT4043/87	105	76	≤ 2	29:1

recommended combinations for high resolution monochrome monitor design book 2 part 1d

Designation	C2	C3	C5	C6T	C7	C52 (portrait)	C64
Deflection Angle	110°	90°	110°	70°	110°	70°	
Tube Type	M38-328	M24-306	M38-328	M31-336	M31-326	M38-200	M31-326
	M31-326	M31-336	M31-326	M24-306	M38-328		M38-328
Deflection Coil				AT1077/05	AT1038/42		AT1039/01
LOPT	AT1038/42	AT1071/03	AT1038/42			AT1991	AT1039/00
Line driver transformer	AT2102/04C	AT2102/02	AT2102/06C	AT2240/16	AT2076/84	DT2076/54	AT2076/84
Dynamic focus transformer	AT4042/08A	AT4036/00A	AT4042/08A	AT4042/08A	AT4042/08A	-	AT4042/08A
D.C. picture shift transformer	AT4043/59	AT4043/64	AT4043/59	-	AT4043/64	AT4043/87	AT4043/64
Characters per row	-	-	AT4043/67	-	AT4043/67	-	-
Supply (V)	-	-	-	-	-	AT4043/29	AT4043/29
EHT (kV)	80	80	80	40-80	80	192	100-132
Line deflection frequency (kHz)	24	11	24	12	20-80	120	30-120
	17	15	17	11	17	17	-
	15.6	15.6	21.3	15-22	15-25	125	30-120

Datagraphic display components

high resolution colour c.r.t.s for datagraphic displays

Pre-aligned tube-coil assemblies

Type No.	Screen diagonal (viewable) (in)	Deflection angle	Transmission (%)	Dot triplet pitch (mm)	Min. resolution (pixels)
M37-108X/N/1000 series	14(13)	90°	60	0.29	800 × 600

This high resolution colour tube has a dot trio mask and an in-line gun.

deflection coils for high resolution colour c.r.t.s book 2 part 1d

Suffix No.	L _H	R _H	L _V	R _V	Line defl. current edge-edge (A)	Field defl. current (A)	Pin cushion (max.)	
	(mH)	(Ω)	(mH)	(Ω)			N-S (%)	E-W (%)
/1020	1.2	1.5	6.5	6.5	3.62	1.36	1	8
/1030	0.6	0.8	6.5	6.5	5.12	1.36	1	8
/1031	0.6	0.8	12.9	11.7	5.12	0.95	1	8
/1040	0.3	0.4	6.5	6.5	7.24	1.36	1	8
/1050	0.15	0.2	6.5	6.5	10.24	1.36	1	8

All tubes and coils are supplied as matched packages.

Use line transformer **AT2076/51** and linearity control **AT4042/04**.

Application reports **EDS8202, 8203, 8204, 8205** and **8302** dealing with colour DGD designs are available on request.

medium resolution colour c.r.t. assemblies book 2 part 1a

Pre-aligned tube-coil

Type No.	Screen diagonal (viewable) (in)	Deflection angle	Transmission (%)	Stripe pitch (mm)	Min. resolution (pixels)
M34EAQ00X	14(13)	90°	46	0.42	480 × 360
M34EAQ10X	14(13)	90°	46	0.42	480 × 360

Coils for above tubes:

Suffix No.	L _H	R _H	L _V	R _V	Line defl. current edge-edge (A)	Field defl. current (A)	Pin cushion (max.)	
	(mH)	(Ω)	(mH)	(Ω)			N-S (%)	E-W (%)
00X	1.89	2.0	29	13.5	3.0	0.83	1	1
10X	1.89	2.0	116	54	3.0	0.41	1	1

All c.r.t.s. have safety approvals from the major test-houses i.e. British Standards Institution and/or V.D.E. Prüfstelle, Underwriter's Laboratories and Canadian Standards Authority.

Photosensitive devices

photomultipliers

book 2 part 3

Type No.	Description	Photocathode diam. (mm)	type	No. of stages	Average cathode sensitivity white light ($\mu\text{A/lm}$)	mono-chromatic * (mA/W)	Anode sensitivity or Gain sensitivity (A/lm) or (kA/W)	Gain	V_b (kV)	Rise time (ns)
XP1117	Rugged construction suitable for optical applications	14	T(S20)	9	140	13	30A/lm	1×10^6	1.52	3.5
XP1911	Scintillation counting in limited space	14	D	10	85	80	80kA/W	1×10^6	1.25	2.3
XP1920	Optical measurements and industrial applications in limited space	14	A(S11)	6	60	60	0.2kA/W	—	0.80	2.0
XP2962	8-stage variation of XP2982. Specially developed for linearity at 10^5 gain	23	D	8	65	75	7kA/W	—	1.10	1.8
XP2963	S20 photocathode version of XP2962. For laser reading, etc	23	T(S20)	8	200	20	6A/lm	3×10^4	1.12	1.8
XP2972	High energy physics and scintillation counting	23	D	10	65	75	40kA/W	—	1.30	1.9
XP2982	Bi-alkali photocathode for high-energy experiments	23	D	11	65	75	210kA/W	—	1.35	2.2
150CVP	Laser detection and pollution monitoring; has good response in the red and near infra-red regions	32	C(S1)	10	20	1.4	10A/lm	—	1.60	3.5
XP2018B	UV spectrophotonic applications. Replaces 150UVP	32	U(S13)	10	85	75	60kA/W	—	1.35	2.5
XP2012 ● XP2012B	X-ray and γ spectrometry, and other applications requiring low background noise and/or dark current	32	D	10	—	90	60kA/W	—	1.35	2.5

* At wavelength λ : T and TU = 698nm, C = 903nm, S20R = 858nm, A, super A and U = 437nm, D and DU = 401nm.

Note: The suffix B in the type description denotes blue plastic base version.

Continued

photomultipliers (cont.)

book 2 part 3

Type No.	Description	Photocathode diam. (mm)	type	No. of stages	Average cathode sensitivity white light ($\mu\text{A}/\text{lm}$)	mono-chromatic * (mA/W)	Anode sensitivity or Gain sensitivity (A/lm) or (kA/W)	Gain	V_b (kV)	Rise time (ns)
XP2023B	General purpose tube for low light level use in the visible spectrum. Replaces XP2013B	32	T(S20)	8	200	20	6A/lm	—	1.12	2.5
XP1017	Extended-red response version of XP1016	32	S20R	10	210	6.5	60A/lm	1×10^6	1.47	3.5
XP2011 XP2011B	Scintillation counting, laboratory and industrial photometry	32	D	10	110	85	7.5A/lm	1×10^6	1.30	2.5
XP2061 XP2061B	For high energy experiments, scintillation counting, laboratory and industrial photometry	32	D	10	110	85	7.5A/lm	—	1.30	2.5
XP2202 XP2202B	Linear focused CuBe dynode offering high cathode sensitivity, very low dark current and high gain stability	44	D	10	—	75	60kA/W	—	1.70	3.5
XP2212 XP2212B	12-stage version of XP2202 with high gain. Pin compatible with XP2232B and XP2262B	44	D	12	—	75	—	3×10^7	1.90	4.0
XP2203B	Low light level measurements of visible part of spectrum	44	T(S20)	10	165	16	60	—	1.35	3.5
● XP2102 ● XP2102B	Detection/measurement of nuclear radiation	44	D	10VB	—	85	12kA/W	—	1.25	10.0
XP2020	For applications requiring good time resolution	44	D	12	—	85	—	3×10^7	2.20	1.6
XP2020Q		44	DU	12	—	80	—	3×10^7	2.60	1.6

* At wavelength γ : T and TU = 698nm, C = 903nm, S20R = 858nm, A, super A and U = 437nm, D and DU = 401nm.

Notes: 1. The suffix B in the type description denotes blue plastic base version.

2. The letter VB (in No. of stages column) indicate Venetian Blind.

3. The suffix Q in the Type No. indicates a fused quartz window.

Continued

photomultipliers (cont.)

book 2 part 3

Type No.	Description	Photocathode diam. (mm)	type	No. of stages	Average cathode sensitivity white light ($\mu\text{A/lm}$)	mono-chromatic sensitivity * (mA/W)	Anode sensitivity or Gain sensitivity (A/lm) or (kA/W)	Gain	V_b (kV)	Rise time (ns)
XP2262 XP2262B	Replaces XP2232: good linearity and time characteristics plus good single electron resolution	44	D	12	—	80	—	3×10^7	1.85	2.3
XP2242B	6-stage tube with good pulse linearity and time characteristics of high amplitude pulses at high count rates	44	D	6	70	80	—	—	1.1	1.6
XP2020Q	Quartz window version of XP2020 for extended UV applications	44	D	12	—	80	—	$3 \cdot 10^7$	2.60	1.6
● XP2252 ● XP2252B	Applications requiring very high gain and very good time characteristics	44	D	12	70	80	—	$3 \cdot 10^7$	1.85	2.3
XP2254B	Useful in applications where high sensitivity from UV to near infrared is required	44	TU	12	150	15	—	3×10^7	2.30	1.7
XP2233	For use where high sensitivity in visible and UV regions is required; also suitable for laser applications	44	T(S20)	12	150	15	—	$3 \cdot 10^7$	2.05	2.0
● XP3102 ● XP3102B	For nuclear medicine applications	44	D	8	70	90	—	1.3×10^5	0.95	3
● XP3202 ● XP3202B	For scintillation, laboratory and industrial photometry applications	44	D	8	70	85	—	1.3×10^5	0.95	3

* At wavelength γ : T and TU=698nm, C=903nm, S20R=858nm, A, super A and U=437nm, D and DU=401nm.

Notes: 1. The suffix B in the type description denotes blue plastic base version.

2. The letter VB (in No. of stages column) indicate Venetian Blind.

Continued

photomultipliers (cont.)

book 2 part 3

Type No.	Description	Photocathode diam. (mm)	type	No. of stages	Average cathode sensitivity white light ($\mu\text{A/lm}$)	mono-chromatic * (mA/W)	Anode sensitivity or Gain sensitivity (A/lm) or (kA/W)	Gain	V_b (kV)	Rise time (ns)
XP2422 XP2422B	Hexagonal tube for detection and measurement of nuclear radiation especially in gamma cameras where good pulse resolution is required	56	D	10VB	72	90	11kA/W	—	1.25	10
● XP2432 ● XP2432B	Detection and measurement of nuclear radiation especially in gamma cameras where good pulse resolution is required	56	D	10VB	72	90	12kA/W	—	1.25	10
● XP3422 ● XP3422B	For nuclear medicine applications	56	—	8	70	90	—	1.3×10^5	0.95	3
XP2402 XP2402B	Detection and measurement of nuclear radiation especially in gamma cameras where good pulse resolution is required	61	D	10VB	—	90	11kA/W	—	1.25	10
XP2312 XP2312B	Fast tube for use in nuclear physics; features high cathode sensitivity, good linearity and time characteristics	68	D	12	—	85	—	3.10^7	2.00	2.5
XP3462 XP3462B	For scintillation detection in high energy physics	68	D	8	75	85	—	1×10^6	1.35	3.0
XP3468 XP3468B	For BaF ₂ scintillators in high energy physics	68	DU	8	10.5	80	—	1×10^6	1.65	3.0

* At wavelength γ : T and TU=698nm, C=903nm, S20R=858nm, A, super A and U=437nm, D and DU=401nm.

Notes: 1. The suffix B in the type description denotes blue plastic base version.
2. The letter VB (in No. of stages column) indicate Venetian Blind.

Continued

Photosensitive devices

photomultipliers (cont.)

book 2 part 3

Type No.	Description	Photocathode diam. type	No. of stages	Average cathode sensitivity white light	mono-chromatic * (A/lm) or (mA/W)	Anode sensitivity or Gain (A/lm) or (kA/W)	Gain	V _b (kV)	Rise time (ns)
XP2442 XP2442B	Hexagonal tube for detection and measurement of nuclear radiation especially in gamma cameras where good pulse resolution is required	70 D	10VB	78	105	12kA/W	-	1.25	11
XP2412 ● XP2412B	Detection/measurement of nuclear radiation	70 D	10VB	-	105	12kA/W	-	1.25	11
XP2040 XP2040Q	Replaced by XP2041 Replaced by XP2041Q								
XP2041 ● XP2041Q	Bi-alkali cathode version of XP2040; both tubes may be supplied with plano-concave quartz adaptor enabling transmission at >200nm and identified by suffix Q. For low photon detection with good time characteristics	110 D	14	-	85	-	3 × 10 ⁷	2.70	2.5
XP2050	Intended for detection/measurement of nuclear radiation	110 D	10	-	95	12kA/W	-	1.50	16

* At wavelength γ : T and TU = 698nm, C = 903nm, S20R = 858nm, A, super A and U = 437nm, D and DU = 401nm.

- Notes: 1. The suffix B in the type description denotes blue plastic base version.
2. The letter VB (in No. of stages column) indicate Venetian Blind.

photomultipliers (cont.)

book 2 part 3

Obsolete type	Replacement type
56AVP/56DVP	XP2230
56DVP	XP2020Q
56TUVP	XP2254B
56AVP/56DVP	XP2020
PM1911	XP1911
PM2102	XP2102
PM2233B	XP2233B
PM2242B	XP2242B
PM2312	XP2312
PM2312B	XP2312B
PM2402	XP2402
PM2402B	XP2402B
PM2412	XP2412
PM2422	XP2422
PM2422B	XP2422B
PM2432	XP2432
PM2432B	XP2432B
PM2442	XP2442
PM2442B	XP2442B
PM2962	XP2962
PM2963	XP2963
PM2982	XP2982
XP1931	no replacement
XP2008	XP2011B
XP2008UB	XP2011
XP2010	XP2012B
XP2013B	XP2023B
XP2030	XP2041
XP2030UB	XP2041Q
XP2040	XP2412B
XP2040Q	XP2412
XP2060	XP2061
XP2060B	XP2061B
XP2230	XP2252
XP2230B	XP2252B
XP2102	XP2262
XP2102B	XP2262B
XP2202	XP3102
XP2202B	XP3102B
XP2232	XP3202
XP2232B	XP3202B

phototubes

book 2 part 3

PHOTOMETRIC APPLICATIONS

Type No.	Photocathode spectral response	Average sensitivity white light ($\mu\text{A}/\text{lm}$)	Sensitive surface area (cm^2)	Dark current at $V = \text{IV}$ (pA)	Rise time min. (ns)	Tube dia. (mm)	Tube length (mm)
AV29	A blue 390 to 450nm	100	3.15	< 100	3	29	68.5 max.
150AV	A blue (S11) 300 to 600nm	70	7.0	< 2	14	39.5	85

Particle and radiation detectors

high current Geiger-Müller tubes book 2 part 2b

Type No.	Gamma sensitivity at 0.1mGy/h ¹³⁷ Cs source (counts/min)	Wall thickness (mg/cm ²)	Recommended working voltage (V)	Max.* background (counts/min)	Dead time (approx.) (μs)
ZP1300**	180	80 to 100	550	1	11
ZP1310†	1200	80 to 100	575	2	15
ZP1320††	10000	32 to 40	575	12	45

*Shielded with 50mm lead and 3mm aluminium.

**This tube is available in an energy compensated filter as type ZP1301.

† This tube is available in an energy compensated filter as type ZP1313.

†† This tube is available in an energy compensated filter as type ZP1321.

end window beta Geiger-Müller tubes book 2 part 2b

Type No.	Window diameter (mm)	Window thickness (mg/cm ²)	Recommended working voltage (V)	Max.* background (counts/min)	Dead time (approx.) (μs)
ZP1400	9	2.0 to 3.0	500	10	90
ZP1480	17	2.5 to 3.0	450	30	120
ZP1481	17	2.5 to 3.0	450	30	120
ZP1442	19.8	2.0 to 3.0	600	8	65
ZP1470	24.1	1.5 to 2.5	600	25	70
ZP1431	27.8	2.0 to 3.0	575	25	190
ZP1452	27.8	2.0 to 3.0	625	18	60

*Shielded with 50mm lead and 3mm aluminium.

end window alpha Geiger-Müller tubes book 2 part 2b

Type No.	Window diameter (mm)	Window thickness (mg/cm ²)	Recommended working voltage (V)	Max.* background (counts/min)	Dead time (approx.) (μs)
ZP1401	9	1.5 to 2.0	500	10	90
ZP1430	27.8	1.5 to 2.0	575	25	190
ZP1441	19.8	1.5 to 2.0	600	5†	65
ZP1451	27.8	1.5 to 2.0	625	9†	60
ZP1410	19.8	1.5 to 2.0	575	15	175
● ZP1490	28	1.5 to 2.0	575	15	55

*Shielded with 50mm lead and 3mm aluminium.

† When used in anti-coincidence applications with guard counter tube ZP1700 shielded with 100mm iron (outside) and 300 mm lead, the background is < 1.2 counts/min for ZP1441 and < 2 counts/min for ZP1451.

Particle and radiation detectors

gamma Geiger-Müller tubes

book 2 part 2b

Type No.	Gamma sensitivity at 0.1 mGy/h (counts/min)	Recommended working voltage (V)	Max. * background (counts/min)	Dead time (approx.) (µs)
ZP1200**	13 500 (¹³⁷ Cs)	500	10	90
ZP1210	78 000 (⁶⁰ Co)	450	70	200
ZP1220	110 000 (⁶⁰ Co)	450	90	210

*Shielded with 50mm lead and 3mm aluminium.

**This tube is available in an energy compensated filter as type ZP1201.

X-ray counter tubes

book 2 part 2b

Type No.	Energy range (keV)	Wave length range (nm)	Window diameter (mm)	Window thickness (mg/cm ²)	Recommended working voltage (V)	Max. * background (counts/min)	
ZP1600	6 to 20	0.06 to 0.20	19.8	2.5 to 3.5	1800	25	Halogen quenched
ZP1610	2.5 to 40	0.03 to 0.50	7 × 18 (rect.)	2.0 to 2.5	1500 to 1800	—	Organic quenched

*Shielded with 50mm lead and 3mm aluminium.

cosmic ray guard counter tube

book 2 part 2b

Type No.	Wall thickness (mg/cm ²)	Recommended working voltage (V)	Background* (counts/min)	Dead time (ms)
ZP1700	760	1000	70	1

*Shielded with 50mm lead and 3mm aluminium.

high temperature gamma Geiger-Müller tubes

book 2 part 2b

Type No.	Temperature range (°C)	Dose rate range (mGy/h)	Recommended voltage (V)	Max. * background (counts/min)	Dead time (approx.) (µs)
● ZP1800	-40 to 200	2×10^{-4} to 4	775	25	75
● ZP1810	-40 to 200	3×10^{-3} to 40	775	25	75
● ZP1820	-40 to 100	3×10^{-4} to 4	575	65	100
● ZP1830	-40 to 100	2×10^{-4} to 2	575	100	100
● ZP1840	-40 to 175	4×10^{-3} to 10^2	950	15	50

*Shielded with 50mm lead and 3mm aluminium.

high temperature beta Geiger-Müller tubes

book 2 part 2b

● ZP1850	-35 to 75	10^{-3} to 20	975	50	100
● ZP1860	-35 to 75	4×10^{-4} to 4	975	75	100

*Shielded with 50mm lead and 3mm aluminium.

pulsed channel electron multipliers

book 2 part 3

Type No.	Input configuration	Dimensions mm (nominal)	Max. operating voltage (kV)	Output	Nominal resistance (Ω)	Nominal gain	†Nominal background count rate (pulse/s)	‡Pulse height distribution resolution (%)
B310AL/01 B310BL/01	tubular	$\phi 1.25$	4.0	Open-ended Closed	3×10^9	1.2×10^8 at 3kV	0.03† at 3kV	50
B312AL/01 B312BL/01	rectangular	2.0×8.0	4.0	Open-ended Closed	3×10^9	1.2×10^8 at 3kV	0.03† at 3kV	50
B314AL/01 B314BL/01	rectangular	2.0×8.0	4.0	Open-ended Closed	3×10^9	1.2×10^8 at 3kV	0.03† at 3kV	50
B318AL/01 B318BL/01	conical	$\phi 5$	4.0	Open-ended Closed	3×10^9	1.2×10^8 at 3kV	0.03† at 3kV	50
B410AL/01 B410BL/01	tubular	$\phi 2.2$	3.5	Open-ended Closed	3×10^9	1.2×10^8 at 2.5kV	0.03† at 2.5kV	50
B413AL/01 B413BL/01	rectangular	3.5×15.5	3.5	Open-ended Closed	3×10^9	1.2×10^8 at 2.5kV	0.03† at 2.5kV	50
B419AL/01 B419BL/01	conical	$\phi 10$	3.5	Open-ended Closed	3×10^9	1.2×10^8 at 2.5kV	0.03† at 2.5kV	50
X710AL X710BL	tubular	$\phi 2.2$	3.5	Open-ended Closed	3×10^8	1.5×10^8	0.05* at 2.5kV	50
X713AL X713BL	rectangular	3.5×15.5	3.5	Open-ended Closed	3×10^8	1.5×10^8	0.05* at 2.5kV	50
X714AL X714BL	rectangular	3.5×15.5	3.5	Open-ended Closed	3×10^8	1.5×10^8	0.05* at 2.5kV	50
X719AL X719BL	conical	$\phi 10$	3.5	Open-ended Closed	3×10^8	1.5×10^8	0.05* at 2.5kV	50

† Above an equivalent threshold of 2×10^7 electrons. ‡ At a modal gain of 10^8 and 1000 pulse/s.
All the above channel electron multipliers can be vacuum baked to 400°C.

* Above an equivalent threshold of 2×10^6 electrons.

Continued

pulsed channel electron multipliers (cont.)

book 2 part 3

Type No.	Input configuration	Dimensions mm (nominal)	Max. operating voltage (kV)	Output	Nominal resistance (Ω)	Nominal gain at 2.5kV	†Nominal background count rate* (pulse/s)	‡Pulse height distribution resolution (%)
X810AL X810BL	tubular	ϕ 1.25	3.5	Open-ended Closed	7×10^8	1×10^8	0.05 at 2.5kV	40
X812AL X812BL	rectangular	2.0×8.0	3.5	Open-ended Closed	7×10^8	1×10^8	0.05 at 2.5kV	40
X814AL X814BL	rectangular	2.0×8.0	3.5	Open-ended Closed	7×10^8	1×10^8	0.05 at 2.5kV	40
X818AL X818BL	conical	ϕ 5	3.5	Open-ended Closed	7×10^8	1×10^8	0.05 at 2.5kV	40
X910AL X910BL	tubular	ϕ 2.2	4.0	Open-ended Closed	6×10^8	1.5×10^8	0.05 at 2.5kV	50
X913AL X913BL	rectangular	3.5×15.5	4.0	Open-ended Closed	6×10^8	1.5×10^8	0.05 at 2.5kV	50
X914AL X914BL	rectangular	3.5×15.5	4.0	Open-ended Closed	6×10^8	1.5×10^8	0.05 at 2.5kV	50
X919AL X919BL	conical	ϕ 10	4.0	Open-ended Closed	6×10^8	1.5×10^8	0.05 at 2.5kV	50
X959AL X959BL	conical	ϕ 15	4.0	Open-ended Closed	6×10^8	1.5×10^8	0.05 at 2.5kV	50

* Above an equivalent threshold of 2×10^6 electrons. † At a modal gain of 10^8 and 1000 pulse/s. All the above channel electron multipliers can be vacuum baked to 400°C.

analogue channel electron multipliers

book 2 part 3

Type No.	Input configuration	dimensions mm (nominal)	Nominal resistance	Nominal gain at 2.0kV	Max. average output current (μ A)	Max. operating voltage (kV)
● X636AL (1,2,3)	elliptical	12.5×11.5	1.5×10^8	5×10^7	7	3.0
● X645AL	conical	ϕ 15	1.0×10^8	1×10^6	10	3.0
X646AL (1,2)	elliptical	12.5×11.5	1.0×10^8	1.0×10^6	10	3.0

● **X650 series** – various mounted types available

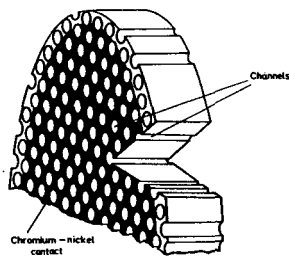
- 1 Different cone sizes and angles available.
- 2 A guard ring collector and connecting strips can be supplied; replace AL with CL when ordering.
- 3 Can also be operated in the pulsed mode.

Particle and radiation detectors

channel electron multiplier plates book 2 part 3

Type No.	Channel diameter (μm)	Diameter of disc (mm)	Thickness of disc (mm)	Current gain at 1kV	Resistance ($\text{M}\Omega$)	Channel pitch (μm)
G12-20 \times 50	12.5	20 \times 50 (rectangle)	0.5	10^3	80 to 300	15
G12-25SE	12.5	25	0.5	10^3	200 to 750	15
G12-25SE/A pair of plates resistance matched						
G12-36	12.5	36	0.5	10^3	80 to 300	15
G12-36/A pair of plates resistance matched						
G12-36DT/0 G12-36DT/13	12.5	36	1.0	10^4	160 to 600	15
G12-46	12.5	46	0.5	10^4	30 to 100	15
G12-46/A pair of plates resistance matched						
G12-46DT/0 G12-46DT/13	12.5	46	1.0	10^4	60 to 250	15
G12-70	12.5	70	0.5	10^3	20	15
G25-20 \times 50	25	20 \times 50 (rectangle)	1.0	10^3	35	31
G25-25	25	27.1	1.0	10^3	30 to 150	31
G25-25/A pair of plates resistance matched						
G25-50	25	53	1.0	10^3	7 to 40	31
G25-70	25	70	1.0	10^3	5	31

A channel electron multiplier plate is an array of channels fused into either a rectangular disc or a rectangular shape. They are for use in the detection of charged particles, X-rays and UV radiation, and offer several advantages over conventional discrete dynode multipliers; in particular, high electron gain, low background count rate and low power consumption. They are very rugged, small in size and offer simplicity in use.



micro dry reed switches

All types have normally-open contacts and are inert gas-filled

Type No.	Operate range (At)	Release range (At)	Switch power (W)	Contact resistance (typ.) (mΩ)
Ri-22 series (2.8 mm dia. max.)				
Ri-22AAA	8 to 16	4 to 14	10	60
Ri-22AA	14 to 23	7.5 to 17.5	10	60
● Ri-22A	18 to 32	8 to 22	10	60
● Ri-22B	28 to 52	12 to 29	10	60
● Ri-22C	46 to 70	12 to 32	10	60
Ri-23 series (2.54 mm dia. max.)				
Ri-23AAA	8 to 16	4 to 14	10	70
Ri-23AA	14 to 23	7.5 to 17.5	10	70
● Ri-23A	18 to 32	8 to 22	10	70
● Ri-23B	28 to 52	12 to 29	10	70
● Ri-23C	46 to 70	16 to 32	10	70
Ri-26 series (2.54mm dia. max.)				
● Ri-26AAA	8 to 16	4 to 14	15	70
● Ri-26AA	14 to 23	7.5 to 17.5	15	70
● Ri-26A	18 to 32	8 to 22	15	70
Ri-27A (1.8 mm dia. max.)				
Ri-27AA	20 to 34	8 to 19	10	90
Ri-27AA	16 to 25	10 to 26	10	90
Ri-27AAA	10 to 19	5 to 14	10	90
Ri-45 (2.8 mm dia. max.)				
	27 to 59	8 to 21	40	90
Ri-46 series (2.8 mm dia. max.)				
Ri-46AA	10.5 to 19	4 to 12	30	60
Ri-46A	15 to 28	5 to 16	30	60
● Ri-46B	24 to 51	8 to 20.5	40	60
Ri-46C	46 to 70	12 to 22.5	40	60

Transmitting tubes

telecommunications power tetrodes book 2 part 4

Type No.	Description	Approx. output at full ratings (kW)	Max. frequency at full ratings (MHz)	Max. frequency at reduced ratings (MHz)	p_a max. (kW)	V_a max. (kV)	V_{g2} max. (V)	I_a max. (A)	V_f or V_h (V)	I_f or I_h (A)	Base
QY3-65 (CV6122)	Radiation cooled	0.23	150	250	0.06	3.0	600	0.15	6	3.5	B7A
QV08-100	Radiation cooled	0.29	30	—	0.1	1.0	300	0.4	6.3	3.9	B5F
QY3-125 (CV2130)	Radiation cooled	0.375	120	200	0.12	3.0	400	0.3	5.0	6.5	B5F
QY4-500A	External anode Forced-air cooled	0.93	110	220	0.5	4.0	500	0.44	5.0	13.5	Special
QY4-250 (CV2131)	Forced-air cooled	1.0	75	120	0.25	4.0	600	0.42	5.0	14.1	B5F
QY4-400 (CV5959)	Forced-air cooled	1.1	110	—	0.4	4.0	600	0.42	5.0	14.5	B5F
YL1540	Forced-air cooled	1.1	260	175	2.0	4.2	750	1.2	4.2	53	Coaxial
YL1590	Forced-air cooled	1.2	860	1000	1.5	4.5	1000	0.75	3.5	50	—
QY5-500	Radiation cooled	1.76	75	110	0.5	5.0	700	0.6	10	9.9	B5K
YL1541	External anode Forced-air cooled Ceramic/metal	2.1	110	—	2.0	4.5	750	1.2	4.2	53	Coaxial
YL1440	Forced-air cooled Ceramic/metal	2.4	250	—	1.5	4.0	600	1.2	4.2	55	Coaxial
QY5-3000A (CV5219)	Forced-air cooled Water cooled	4.1	75	220	3.0	5.0	800	1.3	6.3	32.5	Special
QY5-3000W											
YL1560	Forced-air cooled	6.0	860	1000	6.0	6.0	1000	2.5	5.0	130	Coaxial
YL1420	Forced-air cooled Ceramic/metal	8.6	260	—	6.0	6.0	1000	4.5	6.3	120	Coaxial
YL1690	Forced-air cooled Ceramic/metal	10	120	—	18	9.0	1000	7.0	10.4	120	Coaxial
YL1610	Forced-air cooled Ceramic/metal	11	225	—	14	7.0	800	4.0	8.0	113	Coaxial
YL1470	Forced-air cooled Ceramic/metal	11	110	—	6.0	7.0	1000	4.5	6.3	120	Coaxial
YL1430	Forced-air cooled Ceramic/metal	18.4	250	—	12	8.0	1000	8.5	8.0	120	Coaxial

Continued

telecommunications power tetrodes (cont.)

book 2 part 4

Type No.	Description	Approx. output at full ratings (kW)	Max. frequency at full ratings (MHz)	Max. frequency at reduced ratings (MHz)	p_a max. (kW)	V_a max. (kV)	V_{g2} max. (V)	I_a max. (A)	V_f or V_h (V)	I_f or I_h (A)	Base
YL1520	External anode Forced-air cooled Ceramic/metal	27.5	250	—	18	9.0	1000	9.0	11.5	120	Coaxial
YL1530	External anode Forced-air cooled Ceramic/metal	35.0	250	—	30	12	1200	8.0	7.5	180	Coaxial
YL1531	Water cooled Ceramic/metal	50	250	—	30	14	1200	8.0	7.5	180	Coaxial
YL1680	Water cooled Ceramic/metal	120	250	—	100	14	1200	21	12	265	Coaxial
YL1640	Water cooled Ceramic/metal	125	30	—	150	13	1200	17	10	280	Coaxial
YL1740	Water cooled Ceramic/metal	235	30	—	200	12	1200		15	320	Coaxial
YL1650	Water cooled Ceramic/metal	300	30	—	300	30	1200		18	430	Coaxial
YL1660	Water cooled Ceramic/metal	520	30	—	500	13.5	1250	65	23	500	Coaxial

double tetrodes

book 2 part 4

Type No.	Approx. output at full ratings (W)	Max. frequency at full ratings (MHz)	Max. frequency at reduced ratings (MHz)	p_a max. (W)	V_a max. (V)	V_{g2} max. (V)	I_a max. (mA)	V_h (V)	I_h (A)	Base
QQV02-6 (CV2466)	5.8	500	—	2 × 3.0	250	200	2 × 45	6.3 12.6	0.6 0.3	B9A
QQV03-10 (CV2798)	16	100	225	2 × 5.0	300	200	2 × 50	6.3 12.6	0.83 0.42	B9A

Transmitting tubes

telecommunications power triodes book 2 part 4

Type No.	Approx. output full ratings (kW)	Max. frequency at full ratings (MHz)	Max. frequency at reduced ratings (MHz)	p_a max. (kW)	V_a max. (kV)	I_a max. (A)	V_f or V_h (V)	I_f or I_h (A)	Base
TY2-125 (CV1924)	0.39	150	200	0.135	2.5	0.25	6.3	5.4	B5F
TY4-400	1.2	100	—	0.35	4.0	0.49	5.0	14	B5F
TY4-500	1.69	100	120	0.45	4.0	0.65	10	9.9	B5K
TY6-5000A (CV3926)	6.9	75	220	5.0	6.0	1.85	12.6	33	—
TY6-5000W				6.0					
TY7-6000A (CV5239)	10	30	—	6.0	7.2	2.8	12.6	33	—
TY7-6000W									
TY7-6000H									
TY12-15A	41	30	—	15	13	4.0	8.0	130	—

Suffixes A, W, and H to power triode type numbers indicate forced-air, water cooled and water cooled (integral helix) respectively.

triode for television translator service

book 2 part 4e

Type No.	Description	Typical output power (W)	Power gain (dB)	Max. frequency (GHz)	p_a max. (W)	V_a max. (kV)	I_a max. (mA)	Inter-modulation product (dB)
YD1336	Amplifier	220	16.5	1.0	1800	3.5	550	-53

tetrodes for television translator service

book 2 part 4e

Type No.	Description	Typical output power (kW)	Power gain (dB)	Max. frequency (MHz)	p_a max. (kW)	V_a max. (kV)	I_a max. (mA)	Inter-modulation product (dB)
YL1590*	Amplifier	0.22	15.6	1000	2	4.0	1.0	-54
YL1440	Amplifier	0.55	15	260	1.5	4.0	0.73	-52
YL1560	Amplifier	2.2	16	1000	6.0	6.0	1.5	-55
YL1420	Amplifier	2.5	15	260	6.0	6.5	1.0	-52
YL1430	Amplifier	7.0	15	260	12	9.0	1.2	-52
YL1631	Amplifier	10	16	250	17	9.0	7.0	-54
YL1520	Amplifier	10.5	16	260	18	9.0	1.8	-55
YL1610	Amplifier	11	17	250	14	7.0	4.0	—
YL1630	Amplifier	30	17	250	26	8.5	8.0	-54

*Data derived from development samples.

ceramic triodes for industrial heating

book 2 part 4a

Type No.	Cooling	Approx. output at full ratings (kW)	Max. frequency at full ratings (MHz)	p_a max. (kW)	V_a max. (kV)	I_a max. (A)	V_f (V)	I_f (A)
YD1240	Forced-air	2.7	250	1.5	5.5	1.1	6.3	33
YD1244	Forced-air							
● YD1150A	Forced-air	4.75	85	2.5	7.2	1.1	6.3	33
YD1152	Water (helix)							
YD1160	Forced-air	8.8	85	5.0	7.2	2.2	6.3	66
YD1162	Water (helix)							
YD1170	Forced-air	15.4	120	10	7.2	4.0	5.8	130
YD1172	Water (helix)							
YD1173	Forced-air	13.2	50	10	12	2.0	5.4	65
YD1175	Forced-air	26.5	120	10	12	4.0	5.8	130
YD1177	Water (helix)	26.5	120	15	12	4.0	5.8	130
YD1180	Forced-air	31.6	100	20	9.0	6.0	7.0	175
YD1182	Water (integral jacket)							
YD1185	Forced-air	50	100	15	14.4	6.0	7.0	175
YD1187	Water (integral jacket)			20				
YD1192	Water (integral jacket)	62.7	100	40	9.6	12	8.4	235
YD1195	Forced-air	108	30	30	14.4	12	8.4	235
YD1197	Water (integral jacket)			40		15		
YD1202	Water (integral jacket)	163	30	80	15	19	12.2	250
YD1212	Water (integral jacket)	240	30	120	16.8	25	12.6	380
YD1342	Water (integral jacket)	480	30	240	19.2	45	14	555

u.h.f. disc-seal triodes

Type No.	Description	Typical power output at f (W)	Max. f (GHz)	Max. f (GHz)	p_a max. (W)	V_a max. (V)	g_m (mA/V)	I_f (A)
EC157	Oscillator or amplifier	1.8	4.0	4.0	12.5	300	21	0.74
EC158	Oscillator or amplifier	5.0	4.0	—	30	300	22	0.9

Transmitting tubes

triodes for industrial heating

book 2 part 4

Type No.	Description	Approx. output at full ratings (kW)	Max. frequency at full ratings (MHz)	p_a max. (kW)	V_a max. (kV)	I_k max. (A)	V_f or V_h (V)	I_f or I_h (A)	Base
TY2-125 (CV1924)	R.F. power triode for general purpose industrial heating applications	0.32	150	0.135	2.5	0.2	6.3	5.4	B5F
TY4-400	R.F. power triode	1.1	50	0.35	3.8	0.45	5	14.1	B5F
TY4-350 (8330)	R.F. power triode for general purpose industrial heating applications	1.4	30	0.4	4.0	0.6	10	10	-
TY5-500	Radiation cooled triode for general purpose industrial heating applications	1.58	50	0.5	7.0	0.56	5.0	32.5	4-pin Special
TY4-500	Radiation cooled triode for general purpose industrial heating applications	1.63	100	0.45	4.0	0.53	10	9.9	B5K
TY6-800	Radiation cooled triode for general purpose industrial heating applications	2.73	50	0.8	6.0	0.75	6.3	32.5	4-pin Special
TY6-1250A	External anode power triode for general purpose industrial heating applications	4.85	50	2.1	8.0	1.0	6.3	65	-
TY8-6000A TY8-6000H	External anode power triodes for general purpose industrial heating applications	7.2	50	6.0	8.0	1.8	12.6	33	-
TY7-6000A (CV5239) TY7-6000W TY7-6000H	External anode power triodes for general purpose industrial heating applications	8.25	55	6.0	7.2	1.8	12.6	33	-
TY8-15A TY8-15W	External anode power triodes for general purpose industrial heating applications	17.7	30	10 15	8.0	4.0	6.3	136	-
TY12-15A TY12-15W	External anode power triodes for general purpose industrial heating applications	41	30	15	13	5.8	8.0	130	-

Suffixes A, W and H to the type number indicate forced-air cooled, water cooled and water cooled (integral helix) respectively.

u.h.f. high power klystrons – tv operation

book 2 part 4c

Type No.	Description	Frequency range (MHz)	Power output (kW)	Gain (dB)	Cooling	Focusing system	Beam voltage (kV)	Beam current (A)
YK1190	Multi-cavity amplifier	470 to 610	45	44	Vapour	Electromagnetic	20.5 to 22	5.7 to 6.3
YK1191	Multi-cavity amplifier	590 to 720	45	44	Vapour	Electromagnetic	20.5 to 22	5.7 to 6.3
YK1210	Multi-cavity amplifier	11800 to 12200	1.15	43	Air, water or vapour	Permanent magnet	10.5	0.4
YK1220 YK1223	Multi-cavity amplifiers	470 to 860	16.5	42	Air, water or vapour	Electromagnetic	16.5 to 19	2 to 2.35
YK1230 YK1233	Multi-cavity amplifiers	470 to 860	27	43	Air, water or vapour	Electromagnetic	21 to 23.5	2.5 to 3.0
YK1263 YK1265	Multi-cavity amplifiers	470 to 860 470 to 860	55 64	40 40	Air, water or vapour	Electromagnetic	23 to 26 24 to 27	4.2 to 6.0 4.2 to 6.0

heating magnetrons

book 2 part 4d

Type No.	Frequency range (GHz)	Power output (kW)	Anode voltage (kV)	Anode current (mA)	Pre-heat time (s)	Cooling
YJ1511	2.46±0.010	0.31	3.0	150	0	Forced air
YJ1530	2.46±0.010	0.31	3.0	150	0	Forced air
YJ1540	2.445±2.470	1.26	4.5	400	0	Forced air
YJ1600	2.46±0.010	5.0	7.2	950	10	Water

304

Mullard

Passive Components

- Products included for the first time in this guide are indicated both in the index pages and data pages by a black dot alongside the type number.
- Devices for surface mounting are indicated in both the Index pages and the data pages by a black square alongside the type number.
- € Devices approved and available to CECC specifications.

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Capacitors and resistors

conversion list – catalogue numbers to type numbers

For customers receiving our components under Mullard catalogue numbers, this conversion list indicates the equivalent Mullard type numbers.

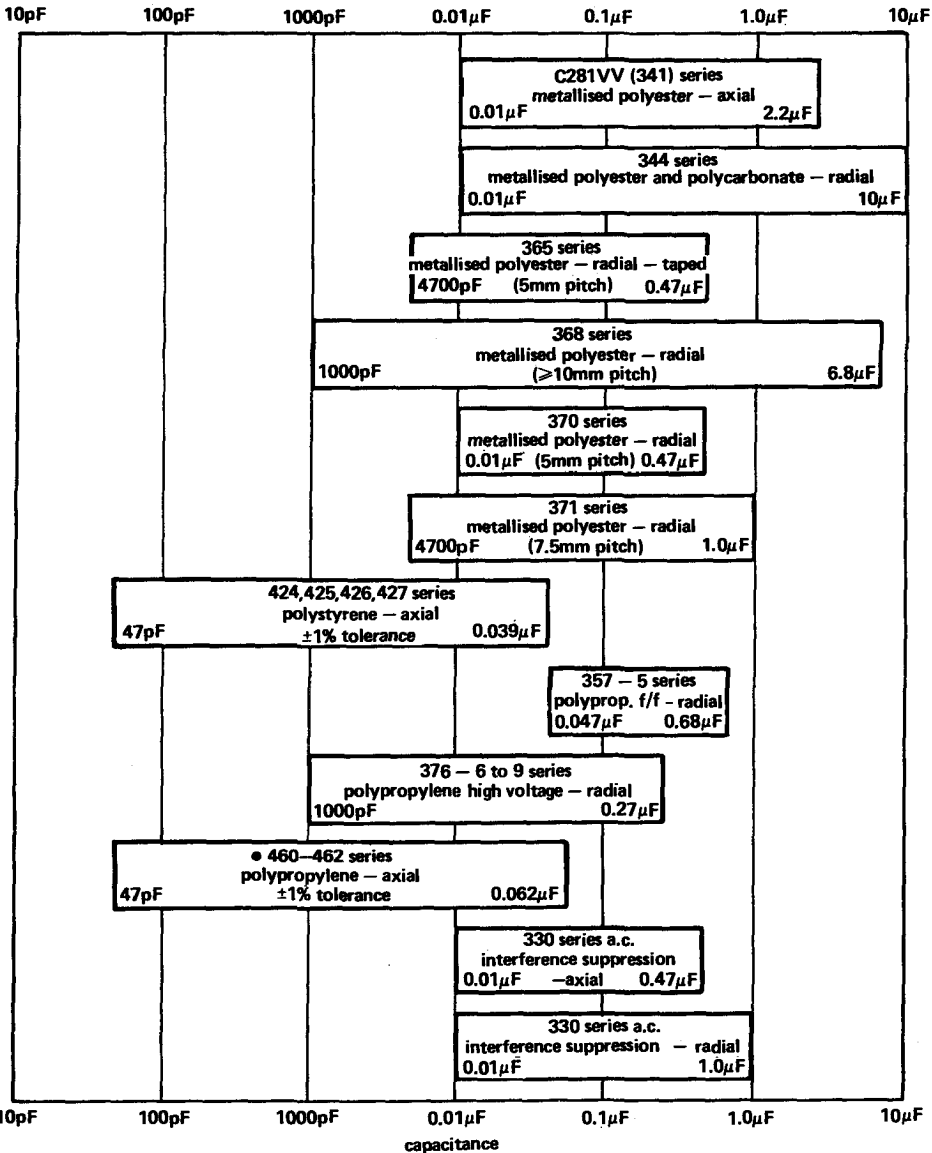
Capacitors		Fixed resistors		Non-linear resistors	
catalogue number	type number	catalogue number	type number	catalogue number	type number
2222 341 05103	C281VV/A10K	2322 157 series	MRS16T series	2322 600 95001	ORP12
2222 341 05104	C281VV/A100K	2322 150 series	MRS25 series	2322 610 11131	VA1040
2222 341 05105	C281VV/A1M	2322 180 series	SFR16T series	2322 610 11132	VA1038
2222 341 05153	C281VV/A15K	2322 181 series	SFR25 series	2322 610 11159	VA1100
2222 341 05154	C281VV/A150K	2322 183 series	ES-SFR25 series	2322 610 11408	VA1033
2222 341 05155	C281VV/A1M5	2322 191 series	PR37 series	2322 610 11501	VA1039
2222 341 05223	C281VV/A22K	2322 192 series	PR52 series	2322 610 11509	VA1034
2222 341 05224	C281VV/A220K	2322 241 series	VR25 series	2322 610 11608	VA1074
2222 341 05225	C281VV/A2M2	2322 242 series	VR37 series	2322 610 11808	VA1053
2222 341 05333	C281VV/A33K	2322 244 series	VR68 series		
2222 341 05334	C281VV/A330K	2322 712 series	RC-01 series	2322 661 91002	E220ZZ/03
2222 341 05473	C281VV/A47K	2322 141/2 series	MPR24, MPR34	2322 661 91003	E220ZZ/04
2222 341 05474	C281VV/A470K	2322 186 series	SFR25H	2322 661 91004	E220ZZ/02
2222 341 05683	C281VV/A68K	2322 205 series	NFR25	2322 661 91005	E220ZZ/01
2222 341 05684	C281VV/A680K	2322 329 series	AC03, AC04, AC05, AC07, AC10, AC20	2322 662 93037	VA8650
4322 043 03301	B127122				
4322 043 04272	B127124				
4322 043 03331	B127125				
4322 043 03291	B127121				
4322 043 03501	B127122				

preferred values

The figures given in the tables below, and their decimal multiples and submultiples, are the series of preferred values for capacitors and resistors, in accordance with BS2488 and IEC publication 63.

E6 series:	10	15	22	33	47	68						
E12 series:	10	12	15	18	22	27	33	39	47	56	68	82
E24 series:	10	11	12	13	15	16	18	20	22	24	27	30
	33	36	39	43	47	51	56	62	68	75	82	91
E48/E96* series:	100	102	105	107	110	113	115	118	121	124	127	130
	133	137	140	143	147	150	154	158	162	165	169	174
	178	182	187	191	196	200	205	210	215	221	226	232
	237	243	249	255	261	267	274	280	287	294	301	309
	316	324	332	340	348	357	365	374	383	392	402	412
	422	432	442	453	464	475	487	499	511	523	536	549
	562	576	590	604	619	634	649	665	681	698	715	732
	750	768	787	806	825	845	866	887	909	931	953	976

* E48 values are encompassed by the E96 series. E48 values are the alternate values highlighted by bold print.



Metallised film capacitors

metallised polyester (PETP*) MKT, moulded, axial leads

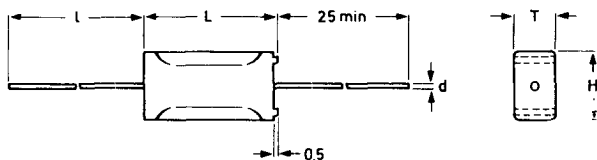
book 3 part 1e

C281VV/8017Ei (341) Series, U_R (d.c.) = 250V

Type No.	Code No.	Capacitance (μF)	Dimensions (mm)				
			L_{\max}	T_{\max}	H_{\max}	d	l_{\min}
C281VV/A10K	341 05103	0.01	14.6	4.8	8.8	0.8	40
C281VV/A15K	341 05153	0.015	14.6	4.8	8.8	0.8	40
C281VV/A22K	341 05223	0.022	14.6	4.8	8.8	0.8	40
C281VV/A33K	341 05333	0.033	14.6	4.8	8.8	0.8	40
C281VV/A47K	341 05473	0.047	14.6	5.1	8.8	0.8	40
C281VV/A68K	341 05683	0.068	14.6	5.1	8.8	0.8	40
C281VV/A100K	341 05104	0.10	14.6	5.7	9.5	0.8	40
C281VV/A150K	341 05154	0.15	18.1	6.6	10.4	0.8	40
C281VV/A220K	341 05224	0.22	18.1	6.6	10.4	0.8	40
C281VV/A330K	341 05334	0.33	23.5	7.8	11.6	0.8	40
C281VV/A470K	341 05474	0.47	23.5	7.8	11.6	0.8	40
C281VV/A680K	341 05684	0.68	23.5	9.2	12.9	0.8	40
C281VV/A1M	341 05105	1.0	31.0	10.7	14.6	0.8	50
C281VV/A1M5	341 05155	1.5	31.0	12.5	19.5	0.8	50
C281VV/A2M2	341 05225	2.2	31.0	12.5	19.5	0.8	50

C281VV are approved to British Telecom Specification D2283 and marked with B.T. type number "8017B". They are otherwise identical to the 341 89 ... series detailed in Book 3 Part 1e.

*polyethylene terephthalate



Capacitance tolerance $\pm 10\%$
Losses (at 10kHz) $\tan \delta \leq 150 \times 10^{-4}$

Insulation resistance at 20°C for $C \leq 0.33 \mu\text{F}$ $R > 30\,000 \text{ M}\Omega$
for $C \geq 0.33 \mu\text{F}$ $R > 10\,000 \text{ s}$

Temperature range -55 to $+85^\circ\text{C}$ at rated voltage U_R
 $+86$ to $+100^\circ\text{C}$ at $0.8 U_R$

Climatic category (IEC68) 55/100/56

C281 series are also available with polycarbonate dielectric and 400V (d.c.) rating to special order.

Metallised film capacitors

metallised polyester (PETP*) MKT and metallised polycarbonate MKC radial, moulded

book 3 part 1e

344 Series, U_R (d.c.) = 63V (not CECC approved)

Type No. Polyester	Capacitance (μF)	Dimensions (mm)			
		$P \pm 0.3$	L_{max}	T_{max}	H_{max}
344 15224	0.22	10	13	4.5	10
344 15334	0.33	10	13	5	11
344 15474	0.47	10	13	6	12
344 15684	0.68	15	17.5	6	11.5
344 15105	1.0	15	17.5	7	13
344 15155	1.5	15	17.5	8.5	14.5
344 15225	2.2	22.5	26	6.5	15.5
344 15335	3.3	22.5	26	8.5	17.5
344 15475	4.7	22.5	26	9.5	19
344 15685	6.8	27.5	31	11	20
344 15106	10.0	27.5	31	13	22.5

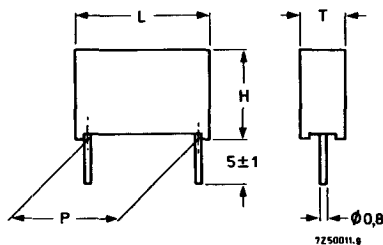
344 Series, U_R (d.c.) = 100V. Polyester range approved to CECC 30401-023 and -039, and to B.T. D2596

Polyester	Type No. Polycarbonate	Capacitance (μF)	Dimensions (mm)†			
			$P \pm 0.3$	L_{max}	T_{max}	H_{max}
ES-344 25104	344 21104	0.1	10	13	4.5	10
ES-344 25154		0.15	10	13	4.5	10
ES-344 25224	344 21224	0.22	10	13	4.5	10
ES-344 25334		0.33	15	17.5	5	11
ES-344 25474	344 21474	0.47	15	17.5	5	11
ES-344 25684		0.68	15	17.5	6	11.5
ES-344 25105	344 21105	1	15	17.5	7	13
ES-344 25155		1.5	22.5	26	6.5	15.5
ES-344 25225	344 21225	2.2	22.5	26	8.5	17.5
ES-344 25335		3.3	22.5	26	9.5	19
ES-344 25475	344 21475	4.7	27.5	31	11	20
ES-344 25685		6.8	27.5	31	13	22.5
ES-344 25106		10	27.5	31	15	25

*polyethylene terephthalate

†Dimensions refer to polyester types

Continued



Metallised film capacitors

metallised polyester (PETP*) MKT, radial, moulded E (cont.) book 3 part 1e

344 Series, U_R (d.c.) = 250V Range approved to CECC 30401-023 and -039, and to B.T. D2596

Type No. Polyester	Capacitance (μF)	Dimensions (mm)			
		$P \pm 0.3$	L_{max}	T_{max}	H_{max}
ES-344 41473	0.047	10	13	4.5	10
ES-344 41683	0.068	10	13	4.5	10
ES-344 90188	0.10	10	13	5.0	11
344 41104**	0.10	15	17.5	5.0	11
ES-344 41154	0.15	15	17.5	5.0	11
ES-344 41224	0.22	15	17.5	6.0	11.5
ES-344 41334	0.33	15	17.5	7.0	13
ES-344 41474	0.47	22.5	26	6.5	15.5
ES-344 41684	0.68	22.5	26	6.5	15.5
ES-344 41105	1.0	22.5	26	8.5	17.5
ES-344 41155	1.5	27.5	31	11	20
ES-344 41225	2.2	27.5	31	11	20

* polyethylene terephthalate

** 0.1 μF , 250V. PETP capacitor type 344 41104 is not approved to CECC 30401-023 and to B.T. D2596 for dimensional reasons.

ES-344 Series, U_R (d.c.) = 400V Range approved to CECC 30401-023 and -039, and to B.T. D2596

Type No. Polyester	Capacitance (μF)	Dimensions (mm)			
		$P \pm 0.3$	L_{max}	T_{max}	H_{max}
ES-344 55103	0.010	10	13	4.5	10
ES-344 55153	0.015	10	13	4.5	10
ES-344 55223	0.022	10	13	4.5	10
ES-344 55333	0.033	10	13	4.5	10
ES-344 55473	0.047	15	17.5	5.0	11
ES-344 55683	0.068	15	17.5	6.0	11.5
ES-344 55104	0.10	15	17.5	7.0	13
ES-344 55154	0.15	15	17.5	8.5	14.5
ES-344 55224	0.22	22.5	26	6.5	15.5
ES-344 55334	0.33	22.5	26	7.5	16.5
ES-344 55474	0.47	22.5	26	9.5	19
ES-344 55684	0.68	27.5	31	11	20
ES-344 55105	1.0	27.5	31	13	22.5

* polyethylene terephthalate

Note: With the exception of the 63V version, the standard range of PETP dielectric capacitors are approved to CECC 30401-023/CECC 30401-039 and to British Telecom specification D2596. Capacitors Type 9621, 9622, and 9623. In addition to CECC and B.T. approvals these capacitors are recommended by RSRE.

Note: Polycarbonate versions with 100V, 250V, 400V and 630V ratings are available to special order. These are particularly suitable in applications requiring stability of capacitance in relation to temperature and frequency changes.

Capacitance tolerance	$\pm 10\%$ ($\pm 5\%$ and $\pm 20\%$ to special order)
Temperature range	-55 to $+85^\circ\text{C}$ at rated voltage (U_R) $+86$ to $+100^\circ\text{C}$ at $0.8 U_R$
Losses (at 10kHz)	$\tan \delta \leq 150 \times 10^{-4}$
Insulation resistance at 20°C	
63V and 100V versions	for $C \leq 0.33\mu\text{F}$; $R > 15\,000\ \text{M}\Omega$ for $C > 0.33\mu\text{F}$; $RC > 5\,000\ \text{s}$
250V and 400V versions	for $C \leq 0.33\mu\text{F}$; $R > 30\,000\ \text{M}\Omega$ for $C \leq 0.33\mu\text{F}$; $RC > 10\,000\ \text{s}$
Climatic category (IEC 68)	55/100/56

Note: Electrical details refer to polyester (PETP) types. Continued

Metallised film capacitors

metallised polyester (PETP*) MKT, radial, moulded, 5mm pitch E (cont.) book 3 part 1e

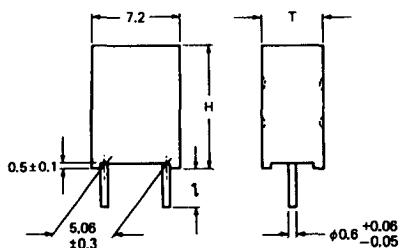
Approved to CECC 30401-039

370 Series, U_R (d.c.) = 63V

Type No.	Capacitance (μF)	Dimensions (mm)	
		T_{max}	H_{max}
370 11683	0.068	2.5	6.5
370 11104	0.10	2.5	6.5
370 11154	0.15	3.5	8
370 11224	0.22	3.5	8
370 11334	0.33	4.5	9
370 11474	0.47	5.0	10
370 11684	0.68	6.0	11
370 11105	1.0	6.0	11

370 Series, U_R (d.c.) = 100V

Type No.	Capacitance (μF)	Dimensions (mm)	
		T_{max}	H_{max}
370 21472	0.0047	2.5	6.5
370 21682	0.0068	2.5	6.5
370 21103	0.010	2.5	6.5
370 21153	0.015	2.5	6.5
370 21223	0.022	2.5	6.5
370 21333	0.033	2.5	6.5
370 21473	0.047	2.5	6.5
370 21683	0.068	3.5	8
370 21104	0.10	3.5	8



Lead length (l) = 4 ± 0.5 mm

Capacitance tolerance	$\pm 10\%$ ($\pm 5\%$ and $\pm 20\%$ to special order)
Temperature range	- 55 to $+85^\circ\text{C}$ at rated voltage (U_R) + 86 to $+100^\circ\text{C}$ at $0.8 U_R$
Losses (at 10kHz)	$\tan \delta \leq 130 \times 10^{-4}$
Insulation resistance	$C \leq 0.33 \mu\text{F}$ $R > 15\,000 \text{ M}\Omega$ $C > 0.33 \mu\text{F}$ $RC > 5\,000 \text{ s}$
Climatic category (IEC 68)	55/100/56

371 Series

A 7.62mm pitch version of the 370 series is also available to special order. It is approved to CECC 30401-039 and has the same basic electrical properties. The range spans 0.0039 μF to $1 \mu\text{F} \pm 10\%$ tolerance, 63V to 400V.

metallised polyester (PETP*) MKT, dipped, radial

book 3 part 1e

365 Series

Two styles of epoxy dipped, radial-leaded capacitors are available tape-packaged.

1. The first style has a body length of 10.5 mm max. The leads have a natural pitch of 7.62 mm, formed down to 5.08 mm (3e/2e style), Fig. 1.

Capacitance values range from 0.0039 μF (at 400V) to 1.0 μF (at 63V); see Table 1.

2. The second style is a miniature version with a maximum body length of 7.5 mm, with leads on a 5.08 mm pitch (2e style), Fig. 2.

Capacitance values range from 0.01 μF (at 100V) to 1.0 μF (at 63V); see Table 2.

Both styles are available only tape-packaged in accordance with IEC286 Part 2 for radially-taped components.

These products are supplied against special order, full details on request.

*polyethylene terephthalate

Dimensions in mm

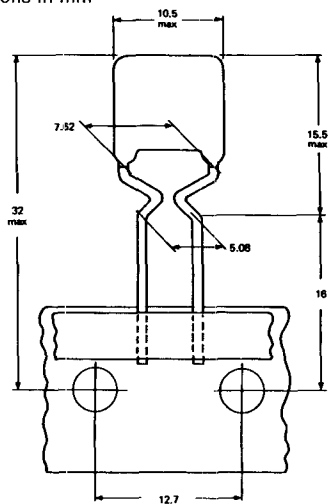


Fig. 1

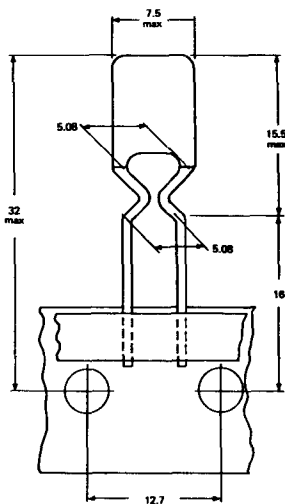


Fig. 2

Table 1 3e/2e style

U_R (d.c.) (V)	Capacitance range (μF)
63	0.12 to 1.0
100	0.039 to 0.47
250	0.018 to 0.047
400	0.0039 to 0.015

Table 2 2e style

U_R (d.c.) (V)	Capacitance range (μF)
63	0.047 to 1.0
100	0.01 to 0.1

Capacitance tolerance $\pm 10\%$ ($\pm 5\%$ and $\pm 20\%$ to special order)

Continued

Metallised film capacitors

metallised polyester (PETP*) MKT, dipped, radial (cont.)

book 3 part 1e

368 Series, U_R (d.c.) = 100V

Style A (long leads)		Style B (short leads)		Capacitance (μF)	Dimensions (mm)			
Type No.	Type No.	L_{max}	H_{max}		T_{max}	$\varnothing d$	$P \pm 0.3$	
368 21104	368 25104 **	0.10	12.5	12.0	4.0	0.6	10.16	
368 21154	368 25154	0.15	12.5	12.0	4.0	0.6	10.16	
368 21224	368 25224 **	0.22	12.5	13.0	5.0	0.6	10.16	
368 21334	368 25334	0.33	17.5	14.0	5.0	0.8	15.24	
368 21474	368 25474 **	0.47	17.5	14.5	5.5	0.8	15.24	
368 21684	368 25684	0.68	17.5	15.0	6.0	0.8	15.24	
368 21105	368 25105 **	1.0	17.5	16.5	7.5	0.8	15.24	
368 21155	368 25155	1.5	26.0	18.0	6.0	0.8	22.86	
368 21225	368 25225 **	2.2	26.0	18.5	6.5	0.8	22.86	
368 21335	368 25335 **	3.3	26.0	20.5	8.5	0.8	22.86	
368 21475	368 25475	4.7	30.0	21.5	9.5	0.8	27.94	
368 21685	368 25685	6.8	30.0	23.5	11.5	0.8	27.94	

368 Series, U_R (d.c.) = 250V

Style A (long leads)		Style B (short leads)		Capacitance (μF)	Dimensions (mm)			
Type No.	Type No.	L_{max}	H_{max}		T_{max}	$\varnothing d$	$P \pm 0.3$	
368 41333	368 45333	0.033	12.5	12.0	4.0	0.6	10.16	
368 41473	368 45473 **	0.047	12.5	12.0	4.0	0.6	10.16	
368 41683	368 45683	0.068	12.5	12.5	4.5	0.6	10.16	
368 41104 **	368 45104 **	0.10	12.5	13.0	5.0	0.6	10.16	
368 41154	368 45154	0.15	17.5	14.0	5.0	0.8	15.24	
368 41224	368 45224 **	0.22	17.5	15.0	6.0	0.8	15.24	
368 41334	368 45334	0.33	17.5	16.0	7.0	0.8	15.24	
368 41474	368 45474 **	0.47	26.0	17.5	5.5	0.8	22.86	
368 41684	368 45684	0.68	26.0	18.5	6.5	0.8	22.86	
368 41105	368 45105 **	1.0	26.0	19.5	7.5	0.8	22.86	
368 41155	368 45155	1.5	30.0	20.5	8.5	0.8	27.94	
368 41225	368 45225	2.2	30.0	22.5	10.5	0.8	27.94	

368 Series, U_R (d.c.) = 400V

Style A (long leads)		Style B (short leads)		Capacitance (μF)	Dimensions (mm)			
Type No.	Type No.	L_{max}	H_{max}		T_{max}	$\varnothing d$	$P \pm 0.3$	
368 51102	368 55102	0.001	12.5	12.0	4.0	0.6	10.16	
368 51152	368 55152	0.0015	12.5	12.0	4.0	0.6	10.16	
368 51222	368 55222	0.0022	12.5	12.0	4.0	0.6	10.16	
368 51332	368 55332	0.0033	12.5	12.0	4.0	0.6	10.16	
368 51472	368 55472	0.0047	12.5	12.0	4.0	0.6	10.16	
368 51682	368 55682	0.0068	12.5	12.0	4.0	0.6	10.16	
368 51103	368 55103 **	0.010	12.5	12.0	4.0	0.6	10.16	
368 51153	368 55153	0.015	12.5	12.0	4.0	0.6	10.16	
368 51223	368 55223 **	0.022	12.5	12.0	4.0	0.6	10.16	
368 51333	368 55333	0.033	12.5	12.5	4.5	0.6	10.16	
368 51473	368 55473	0.047	17.5	14.0	5.0	0.8	15.24	
368 51683	368 55683	0.068	17.5	14.0	5.0	0.8	15.24	

*polyethylene terephthalate

**Also available to $\pm 20\%$ tolerance

Continued

Metallised film capacitors

metallised polyester (PETP*) MKT, dipped, radial (cont.)

book 3 part 1e

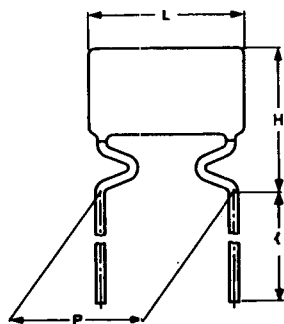
368 Series, U_R (d.c.) = 400V

Style A (long leads)		Style B (short leads)		Capacitance (μF)	Dimensions (mm)			
Type No.	Type No.	L_{max}	H_{max}		T_{max}	$\varnothing d$	$P \pm 0.3$	
368 51104	368 55104	0.10	17.5	15.0	6.0	0.8	15.24	
368 51154	368 55154	0.15	17.5	16.0	7.0	0.8	15.24	
368 51224	368 55224	0.22	26.0	17.5	5.5	0.8	22.86	
368 51334	368 55334	0.33	26.0	18.5	6.5	0.8	22.86	
368 51474	368 55474**	0.47	26.0	20.0	8.0	0.8	22.86	
368 51684	368 55684	0.68	30.0	20.5	8.5	0.8	27.94	
368 51105	368 55105	1.0	30.0	23	11	0.8	27.94	

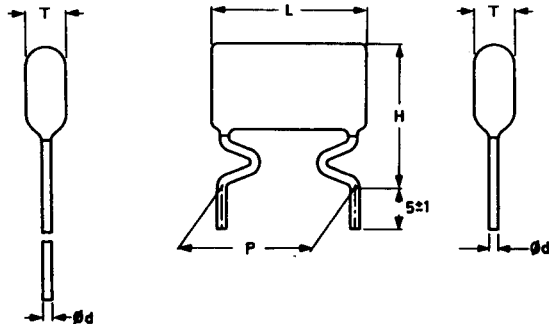
*polyethylene terephthalate

**Also available to $\pm 20\%$ tolerance

Style A
Long leads



Style B
Short leads



Lead length l for Style A

Pitch (P)	l
10.16	17 ± 4
15.24	17 ± 4
22.86	25 ± 4
27.94	24 ± 4

Capacitance tolerance
Temperature range

$\pm 10\%$ ($\pm 20\%$ to special order)
-40 to +85°C at rated voltage (U_R)
+86 to +100°C at $0.8U_R$

Losses (at 10kHz)
Insulation resistance at 20°C
100V versions

$\tan \delta \leq 130 \times 10^{-4}$
 $C \leq 0.33\mu\text{F}$ $R > 15\,000\ \text{M}\Omega$
 $C > 0.33\mu\text{F}$ $RC > 5\,000\ \text{s}$
 $C \leq 0.33\mu\text{F}$ $R > 30\,000\ \text{M}\Omega$
 $C > 0.33\mu\text{F}$ $RC > 10\,000\ \text{s}$

250V, 400V versions

Climatic category (IEC 68) 40/100/56

A 630V range (0.01 μF to 0.47 μF) is also available against special order.

Interference suppression capacitors

metallised polyester (PETP*) and paper dual dielectric, MKT-P

(approved to VDE 0565, part 1 and SEMKO)

book 3 part 1e

330 Series, U_R (a.c.) = 250V (Class X2)

Axial Leads (Fig. 1)

Type No.	Capacitance (μF)	Dimensions (mm)				
		T_{max}	L_{max}	H_{max}	l_{min}	$\varnothing d$
330 00103	0.01	6.6	18.1	10.4	40	0.8
330 00223	0.022	6.6	18.1	10.4	40	0.8
330 00473	0.047	6.6	18.1	10.4	40	0.8
330 00104	0.1	7.8	23.5	11.6	40	0.8
330 00224	0.22	10.8	23.5	14.5	40	0.8
330 00474	0.47	12.5	31	19.5	50	1.0

Intermediate E6 values available to special order.

Radial Leads (Fig. 2)

Type No.	Capacitance (μF)	Dimensions (mm)				
		T_{max}	L_{max}	H_{max}	P + 0.4	$\varnothing d$
330 40103	0.010	5	17.5	11	15	0.8
330 40153	0.015	5	17.5	11	15	0.8
330 40223	0.022	5	17.5	11	15	0.8
330 40333	0.033	5	17.5	11	15	0.8
330 40473	0.047	6	17.5	11.5	15	0.8
330 40683	0.068	7	17.5	13	15	0.8
330 40104	0.10	8.5	17.5	14.5	15	0.8
330 40154	0.15	7	26	16	22.5	0.8
330 40224	0.22	8.5	26	17.5	22.5	0.8
330 40334	0.33	10	26	18.5	22.5	0.8
330 40474	0.47	13.5	31	22.5	27.5	0.8
330 40684	0.68	15	31	25	27.5	0.8
330 40105	1.0	18	31	28	27.5	1.0

A long lead version (25mm length) is available to special order.

Insulated radial leads (Fig. 3)

Type No.	Capacitance (μF)	Dimensions (mm)		Type No.	Capacitance (μF)	Dimensions (mm)	
		T_{max}	H_{max}			T_{max}	H_{max}
330 84103	0.010	6	12	330 84473	0.047	6	12
330 84223	0.022	6	12	330 84104	0.10	8.5	14.5

Intermediate E6 values available to special order.

*polyethylene terephthalate

Continued

Interference suppression capacitors

metallised polyester (PETP*) and paper dual dielectric, MKT-P (approved to VDE 0565, part 1 and SEMKO) (cont.) book 3 part 1e

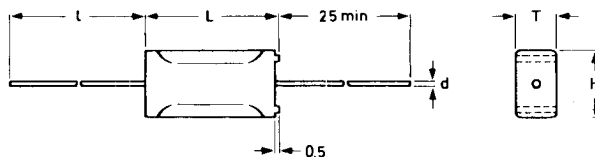


Fig. 1

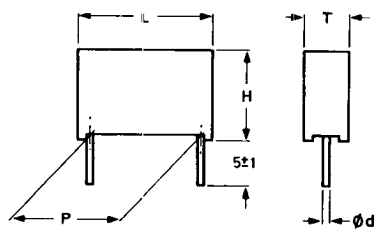


Fig. 2

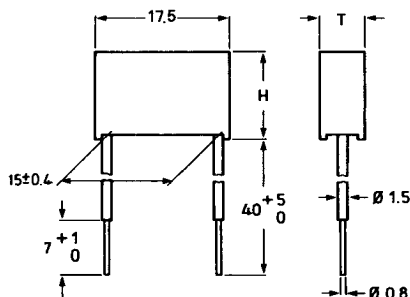


Fig. 3

All capacitors are intended for operation directly across the incoming mains supply.

Capacitance tolerance	$\pm 20\%$ ($\pm 10\%$ to special order)
Temperature range	-40 to $+85^\circ\text{C}$ at rated voltage (U_R)
Losses (at 10kHz)	$\tan \delta \leq 130 \times 10^{-4}$
Insulation resistance at 20°C	$C \leq 0.33\mu\text{F}$ $R > 15\,000\ \text{M}\Omega$
	$C > 0.33\mu\text{F}$ $RC > 5\,000\ \text{s}$
Climatic category (IEC 68)	40/085/21

*polyethylene terephthalate

Film/foil capacitors, (extended foil) axial leads

miniature, polystyrene, KS

book 3 part 1e

Type No.	Capacitance (pF)	Dimensions (mm)		
		L_{max}	D_{max}	l_{min}
424 Series, U_R (d.c.) = 63V				
424 49102	9 100	15	5.0	28
424 41003	10 000	15	5.0	28
424 41103	11 000	15	5.5	28
424 41203	12 000	15	5.5	28
424 41303	13 000	15	5.5	28
424 41503	15 000	15	5.5	28
424 41603	16 000	15	6.0	28
424 41803	18 000	15	6.0	28
424 42003	20 000	15	6.0	28
424 42203	22 000	15	6.5	28
424 42403	24 000	15	6.5	28
424 42703	27 000	15	7.0	28
424 43003	30 000	15	7.0	28
424 43303	33 000	15	7.5	28
424 43603	36 000	15	7.5	28
424 43903	39 000	15	8.0	28

425 Series, U_R (d.c.) = 160V				
Type No.	Capacitance (pF)	L_{max}	D_{max}	l_{min}
425 41102	1 100	11	3.8	30
425 41202	1 200	11	4.0	30
425 41302	1 300	11	4.0	30
425 41502	1 500	11	4.0	30
425 41602	1 600	11	4.0	30
425 41802	1 800	11	4.0	30
425 42002	2 000	11	4.5	30
425 42202	2 200	11	4.5	30
425 42402	2 400	11	4.5	30
425 42702	2 700	11	4.5	30
425 43002	3 000	11	5.0	30
425 43302	3 300	11	5.0	30
425 43602	3 600	11	5.0	30
425 43902	3 900	11	5.0	30
425 44302	4 300	15	5.0	28
425 44702	4 700	15	5.0	28
425 45102	5 100	15	5.0	28
425 45602	5 600	15	5.0	28
425 46202	6 200	15	5.0	28
425 46802	6 800	15	5.5	28
425 47502	7 500	15	5.5	28
425 48202	8 200	15	6.0	28

426 Series, U_R (d.c.) = 250V				
Type No.	Capacitance (pF)	L_{max}	D_{max}	l_{min}
426 48201	820	11	4.0	30
426 49101	910	11	4.0	30
426 41002	1 000	11	4.0	30

Type No.	Capacitance (pF)	Dimensions (mm)		
		L_{max}	D_{max}	l_{min}
427 Series, U_R (d.c.) = 630V				
427 44709	47	11	3.8	30
427 45109	51	11	3.8	30
427 45609	56	11	3.8	30
427 46209	62	11	3.8	30
427 46809	68	11	3.8	30
427 47509	75	11	3.8	30
427 48209	82	11	3.8	30
427 49109	91	11	3.8	30
427 41001	100	11	3.8	30
427 41101	110	11	3.8	30
427 41201	120	11	3.8	30
427 41301	130	11	3.8	30
427 41501	150	11	3.8	30
427 41601	160	11	3.8	30
427 41801	180	11	3.8	30
427 42001	200	11	3.8	30
427 42201	220	11	3.8	30
427 42401	240	11	3.8	30
427 42701	270	11	3.8	30
427 43001	300	11	3.8	30
427 43301	330	11	4.0	30
427 43601	360	11	4.0	30
427 43901	390	11	4.0	30
427 44301	430	11	4.0	30
427 44701	470	11	4.5	30
427 45101	510	11	4.5	30
427 45601	560	11	4.5	30
427 46201	620	11	4.5	30
427 46801	680	11	4.5	30
427 47501	750	11	5.0	30

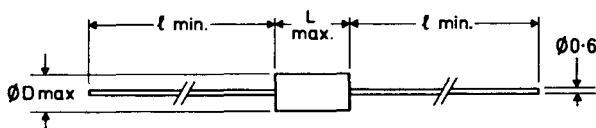
Capacitance tolerance $\pm 1\%$ ($\pm 5\%$ to order)

Losses (at 1kHz) $C > 20\,000\text{pF}$ $\tan \delta \leq 5 \times 10^{-4}$
 (at 100kHz) $10\,000\text{pF} < C < 20\,000\text{pF}$ $\tan \delta \leq 15 \times 10^{-4}$
 (at 100kHz) $1\,000\text{pF} < C < 10\,000\text{pF}$ $\tan \delta \leq 10 \times 10^{-4}$
 (at 1MHz) $C \leq 1\,000\text{pF}$ $\tan \delta \leq 10 \times 10^{-4}$

Insulation resistance at 20°C $> 10^5 \text{M}\Omega$
 Temperature range 630V, 250V, 160V -40 to $+85^\circ\text{C}$
 63V -40 to $+70^\circ\text{C}$

Climatic category (IEC68)
 160V, 250V, 630V versions 40/085/21
 63V versions 40/070/21

Also available tape-packaged in accordance with IEC286 Part 1 (BS6062 Part 1) to special order.



Film/foil capacitors (extended foil) radial

polypropylene, KP, high pulse

book 3 part 1e

357 Series, U_R (d.c.) = 250V, U_R (a.c.) = 160V

Type No.	Capacitance (μ F)	Dimensions (mm)			
		P \pm 0.3	L _{max}	T _{max}	H _{max}
357 51473	0.047	15.0	21.5	8	15
357 51683	0.068	15.0	21.5	10	17
357 51104	0.10	22.5	29	8.5	18.5
357 51154	0.15	22.5	29	8.5	18.5
357 51224	0.22	27.5	34	10	20
357 51334	0.33	27.5	34	12	22
357 51474	0.47	27.5	34	15	25
357 51684	0.68	27.5	34	15	25

376 Series, U_R (d.c.) = 630V, U_R (a.c.) = 300V

376 62473	0.047	22.5	26	8.5	17.5
376 62563	0.056	22.5	26	9.5	18.5
376 62683	0.068	27.5	31	11	20
376 62823	0.082	27.5	31	11	20
376 62104	0.10	27.5	31	11	20
376 62124	0.12	27.5	31	13	22.5
376 62154	0.15	27.5	31	13	22.5
376 62184	0.18	27.5	31	15	25
376 62224	0.22	27.5	31	18	28
376 62274	0.27	27.5	31	18	28

376 Series, U_R (d.c.) = 1000V, U_R (a.c.) = 400V

376 72183	0.018	22.5	26	7.5	16
376 72223	0.022	22.5	26	8.5	17.5
376 72273	0.027	22.5	26	8.5	17.5
376 72333	0.033	22.5	26	8.5	17.5
376 72393	0.039	22.5	26	9.5	18.5
376 72473	0.047	27.5	31	11	20
376 72563	0.056	27.5	31	11	20
376 72683	0.068	27.5	31	11	20
376 72823	0.082	27.5	31	13	22.5
376 72104	0.10	27.5	31	13	22.5
376 72124	0.12	27.5	31	15	25
376 72154	0.15	27.5	31	18	28
376 72184	0.18	27.5	31	18	28

Continued

Film/foil capacitors (extended foil) radial

polypropylene, KP, high pulse (cont.) book 3 part 1e

376 Series, U_n (d.c.) = 1600V, U_n (a.c.) = 500V

Type No.	Capacitance (μ F)	Dimensions (mm)			
		P \pm 0.3	L _{max}	T _{max}	H _{max}
376 82822	0.0082	22.5	26	6.5	15
376 82103	0.010	22.5	26	7.5	16
376 82123	0.012	22.5	26	8.5	17.5
376 82153	0.015	22.5	26	9.5	18.5
● 376 82183	0.018	27.5	31	11	20
● 376 82223	0.022	27.5	31	11	20
● 376 82273	0.027	27.5	31	13	22.5
● 376 82333	0.033	27.5	31	13	22.5
● 376 82393	0.039	27.5	31	15	25
● 376 82473	0.047	27.5	31	18	28
● 376 82563	0.056	27.5	31	18	28

376 Series, U_n (d.c.) = 2000V, U_n (a.c.) = 600V

376 92102	0.001	22.5	26	6.5	15
376 92122	0.0012	22.5	26	6.5	15
376 92152	0.0015	22.5	26	6.5	15
376 92182	0.0018	22.5	26	6.5	15
376 92222	0.0022	22.5	26	6.5	15
376 92272	0.0027	22.5	26	6.5	15
376 92332	0.0033	22.5	26	6.5	15
376 92392	0.0039	22.5	26	6.5	15
376 92472	0.0047	22.5	26	6.5	15
376 92562	0.0056	22.5	26	7.5	16
376 92682	0.0068	22.5	26	7.5	16
376 92752	0.0075	22.5	26	8.5	17.5
376 92822	0.0082	22.5	26	8.5	17.5
376 92103	0.010	22.5	26	9.5	18.5
● 376 92123	0.012	27.5	31	11	20
● 376 92153	0.015	27.5	31	11	20
● 376 92183	0.018	27.5	31	13	22.5
● 376 92223	0.022	27.5	31	13	22.5
● 376 92273	0.027	27.5	31	15	25
● 376 92333	0.033	27.5	31	18	28

Capacitance tolerance:

250V ranges $\pm 10\%$
 630V, 1000V } ranges $\pm 5\%$
 1600V, 2000V }

Losses at 100kHz

250V range

For pitches P = 15 or 22.5 mm $\tan \delta \leq 15 \times 10^{-4}$

For pitches P = 27.5 mm

$C \leq 0.33 \mu\text{F}$ $\tan \delta \leq 15 \times 10^{-4}$

$0.33 \mu\text{F} < C \leq 0.47 \mu\text{F}$ $\tan \delta \leq 20 \times 10^{-4}$

$C > 0.47 \mu\text{F}$ $\tan \delta \leq 25 \times 10^{-4}$

630V range

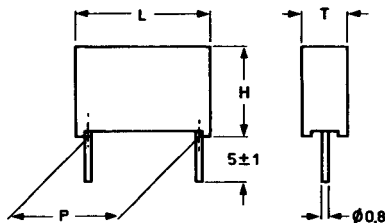
For pitch P = 22.5 mm $\tan \delta \leq 15 \times 10^{-4}$

For pitch P = 27.5 mm $\tan \delta \leq 20 \times 10^{-4}$

1000V, 1600V, 2000V ranges

For pitch P = 22.5 mm $\tan \delta \leq 10 \times 10^{-4}$

For pitch P = 27.5 mm $\tan \delta \leq 15 \times 10^{-4}$



Insulation resistance (23°C)

Temperature range

Climatic category (IEC68)

> 100,000 M Ω

-55 to +85°C

55/085/56

Film/foil capacitors

polypropylene, KP, axial leads, epoxy lacquer

book 3 part 1e

● 462 Series, U_R (d.c.) = 250V, U_R (a.c.) = 125V

Type No.	Capacitance (pF)	Dimensions (mm)		
		L_{max}	$\varnothing D_{max}$	l_{min}
462 44709	47	5.0	11.0	30
462 46809	68	5.0	11.0	30
462 41001	100	5.0	11.0	30
462 41501	150	5.0	11.0	30
462 42201	220	5.0	11.0	30
462 43301	330	5.0	11.0	30
462 44701	470	5.0	11.0	30
462 46801	680	5.0	11.0	30
462 41002	1000	5.0	11.0	30
462 41502	1500	5.0	11.0	30
462 42202	2200	5.0	11.0	30
462 43302	3300	5.0	11.0	30

Values up to 22000pF are available in the 250V range to special order.

● 461 Series, U_R (d.c.) = 160V, U_R (a.c.) = 63V

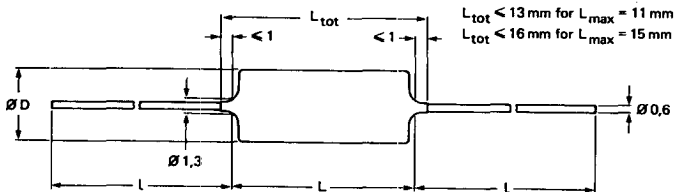
461 44702	4700	5.0	11.0	30
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The 160V range spans 3600pF to 39000pF. Other values are available to special order.

● 460 Series, U_R (d.c.) = 63V, U_R (a.c.) = 40V

460 46802	6800	5.0	11.0	30
460 41003	10000	5.5	15.0	28
460 41503	15000	5.5	15.0	28
460 42203	22000	5.5	15.0	28
460 43303	33000	6.5	15.0	28
460 44703	47000	7.5	15.0	28

The 63V range spans 6800pF to 62000pF. Other values are available to special order.



polypropylene, KP, axial leads, epoxy lacquer

book 3 part 1e

460–462 Series continued

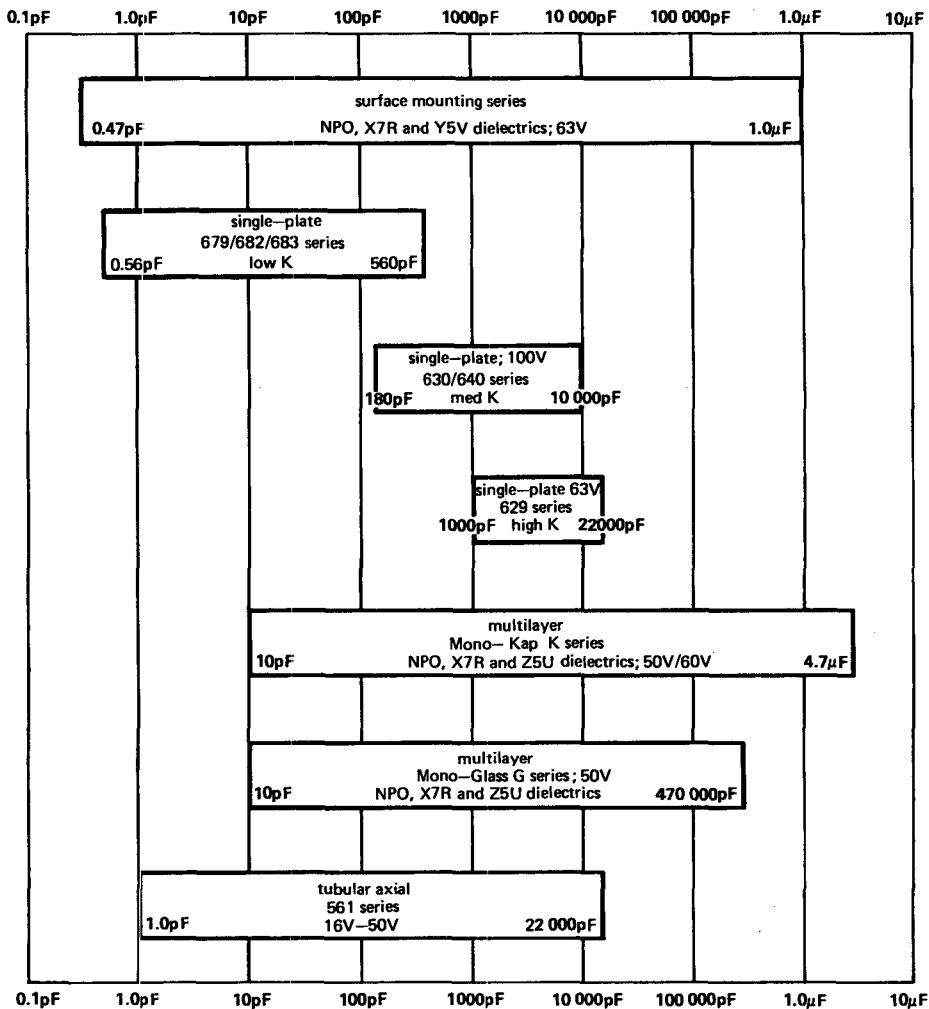
Capacitance tolerance	$\pm 1\%$ ($\pm 5\%$ to order)
Losses at 100kHz	
$1\,000 \leq C \leq 5\,000$ pF	$\tan \delta \leq 10 \times 10^{-4}$
$5\,000 < C \leq 20\,000$ pF	$\tan \delta \leq 15 \times 10^{-4}$
$20\,000 < C \leq 47\,000$ pF	$\tan \delta \leq 25 \times 10^{-4}$
$C > 47\,000$ pF	$\tan \delta \leq 40 \times 10^{-4}$
Insulation resistance at 23°C	$> 100\,000$ M Ω
Temperature coefficient	
between -40 and $+20$ °C	$-(125 \pm 60) 10^{-6}/\text{K}$
between $+20$ and 100 °C	$-(250 \pm 120) 10^{-6}/\text{K}$
Temperature range	-40 to $+100$ °C
Climatic category (IEC68)	40/100/56

The blue epoxy lacquer coating makes the 460–462 series water repellent, and solvent and acid resistant. The series also has particularly good resistance to thermal shock. In addition to the E6 series values quoted, intermediate E24 values are available to order and E96 series values to special order.

Ceramic capacitors

selection guide

book 3 part 1a



Ceramic capacitors, dipped radial

miniature, plate (medium/high-K) book 3 part 1a

629 Series, U_R (d.c.) = 63V

Type No.		Capacitance (pF)	W_{max}	Dimensions (mm)	
0.1in (2.54mm)* lead pitch version	0.2in (5.08mm) lead pitch version			0.1in lead pitch version	0.2in lead pitch version
629 18102	629 19102	1 000	3.6	5.0	6.3
629 18222	629 19222	2 200	3.6	5.0	6.3
629 18472	629 19472	4 700	3.6	5.0	6.3
629 18103	629 19103	10 000	4.5	6.0	7.3
629 18223	629 19223	22 000	6.2	7.7	9.0

630 Series, U_R (d.c.) = 100V

630 18181	630 19181	180**	3.6	5.0	6.3
630 18221	630 19221	220	3.6	5.0	6.3
630 18271	630 19271	270	3.6	5.0	6.3
630 18331	630 19331	330	3.6	5.0	6.3
630 18391	630 19391	390	3.6	5.0	6.3
630 18471	630 19471	470	3.6	5.0	6.3
630 18561	630 19561	560	3.6	5.0	6.3
630 18681	630 19681	680	3.6	5.0	6.3
630 18821	630 19821	820	3.6	5.0	6.3
630 18102	630 19102	1 000	3.9	5.3	6.7
630 18122	630 19122	1 200	3.9	5.3	6.7
630 18152	630 19152	1 500	4.5	6.0	7.3
630 18182	630 19182	1 800	4.5	6.0	7.3
630 18222	630 19222	2 200	5.1	6.6	7.9
630 18272	630 19272	2 700	5.1	6.6	7.9
630 18332	630 19332	3 300	6.2	7.7	9.0
630 18392	630 19392	3 900	6.2	7.7	9.0
630 18472	630 19472	4 700	6.2	7.7	9.0

● 640 Series, U_R (d.c.) = 100V

640 18682	640 19682	6 800	5.1	6.6	7.9
640 18103	640 19103	10 000	6.2	7.7	9.0

*Also available with long (≥ 13 mm) leads to special order (629 08 ..., 630 08 ..., 640 08 ...).

**Capacitor thickness 2.5mm max. All other types 2.3mm max.

	629 series	630 series	640 series
Voltage U_R (d.c.)	63V	100V	100V
Tolerance on capacitance	-20/+80%	$\pm 10\%$	-20/+50%
Insulation resistance at 20°C	$\geq 4000 M\Omega$	$\geq 4000 M\Omega$	$\geq 3000 M\Omega$
Losses at 1kHz	$\leq 6.5\%$	$\leq 3.5\%$	$\leq 3.5\%$
Temperature range	-10 to +55°C	-55 to +85°C	-55 to +85°C
Climatic category (IEC68)	10/55/21	55/085/21	55/085/21
Body colour	Tan	Tan	Tan
Colour band	green	yellow	blue

Ceramic capacitors, dipped radial

miniature, plate (low-K)

book 3 part 1a

682 Series, 100V d.c. working (lead pitch 0.1in, 2.54mm)

683 Series, 100V d.c. working (lead pitch 0.2in, 5.08mm)

Type No.		Capacitance (pF)	Temperature coefficient	Dimensions (mm)		
0.1in (2.54mm) lead pitch version	0.2in (5.08mm) lead pitch version			W _{max}	H _{max}	
				0.1in lead pitch version	0.2in lead pitch version	
682 03567	683 03567	0.56*	P100	3.6	5.0	6.3
682 03687	683 03687	0.68**	P100	3.6	5.0	6.3
682 03827	683 03827	0.82***	P100	3.6	5.0	6.3
682 03108	683 03108	1.0	P100	3.6	5.0	6.3
682 03128	683 03128	1.2	P100	3.6	5.0	6.3
682 09188	683 09188	1.8	NP0	3.6	5.0	6.3
682 09228	683 09228	2.2	NP0	3.6	5.0	6.3
682 09278	683 09278	2.7	NP0	3.6	5.0	6.3
682 09338	683 09338	3.3	NP0	3.6	5.0	6.3
682 09398	683 09398	3.9	NP0	3.6	5.0	6.3
682 09478	683 09478	4.7	NP0	3.6	5.0	6.3
682 09568	683 09568	5.6	NP0	3.6	5.0	6.3
682 09688	683 09688	6.8	NP0	3.6	5.0	6.3
682 09828	683 09828	8.2	NP0	3.6	5.0	6.3
682 10109	683 10109	10	NP0	3.6	5.0	6.3
682 10129	683 10129	12	NP0	3.6	5.0	6.3
682 10159	683 10159	15	NP0	3.6	5.0	6.3
682 10189	683 10189	18	NP0	3.6	5.0	6.3
682 34229	683 34229	22	N150	3.6	5.0	6.3
682 34279	683 34279	27	N150	3.6	5.0	6.3
682 34339	683 34339	33	N150	3.6	5.0	6.3
682 34399	683 34399	39	N150	3.9	5.3	6.7
682 34479	683 34479	47	N150	3.9	5.3	6.7
682 34569	683 34569	56	N150	4.5	6.0	7.3
682 34689	683 34689	68	N150	4.5	6.0	7.3
682 34829	683 34829	82	N150	4.5	6.0	7.3
682 34101	683 34101	100	N150	5.1	6.6	7.9
682 34121	683 34121	120	N150	5.1	6.6	7.9
682 34151	683 34151	150	N150	6.2	7.7	9.0
682 58181	683 58181	180	N750	6.2	7.7	9.0
682 58221	683 58221	220	N750	6.2	7.7	9.0
682 58271	683 58271	270	N750	6.2	9.9	11.2
682 58331	683 58331	330	N750	6.2	9.9	11.2
682 70391	683 70391	390	N1500	6.2	7.7	9.0
682 70471	683 70471	470	N1500	6.2	9.9	11.0
682 70561	683 70561	560	N1500	6.2	9.9	11.0

Capacitor thickness:

* max. 3.0 mm

** max. 2.7 mm

*** max. 2.5 mm

All other values: max. thickness 2.3 mm

Capacitor body colour: Grey

T.C. colour band: P100 = Red/Violet

NP0 = Black

N150 = Orange

N750 = Violet

N1500 = Orange/Orange

For dimensions, see outlines.

The 0.2" lead pitch version is also available tape-packaged on reels to special order against the code number 679...

The NP0 temperature coefficient range also covers E6 values from 22 to 120pF. These are available to special order.

Capacitance tolerance:

0.56pF to 8.2pF

10pF to 560pF

± 0.25pF

± 2%

Insulation resistance at 20°C > 10 000 MΩ

Losses at 1 MHz C ≤ 50pF tan δ ≤ 55 × 10⁻⁴

C > 50pF tan δ ≤ 15 × 10⁻⁴

Temperature range - 55 to + 85°C

Climatic category (IEC68) 55/085/21

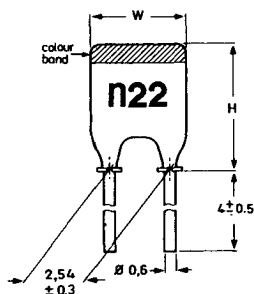
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Ceramic capacitors, dipped radial

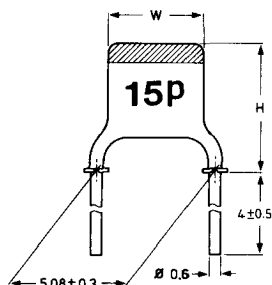
miniature, plate (low-K) (cont.)

book 3 part 1a

Outlines for 629, 630, 682 and 683 Series



0.1in (2.54mm) lead pitch version



0.2in (5.08mm) lead pitch version

The 0.1in lead pitch version is also available with long leads (≥ 13 mm) to special order.
The 0.2in lead pitch version is also available tape-packaged on reels against special order.

The following code numbers refer to the various lead configurations and packaging.

Specification	Loose packing			Tape packaged on reels 5.08mm pitch
	short leads 2.54mm pitch	long leads 2.54mm pitch	short leads 5.08mm pitch	
Class II , high-K 63V	629 18 ...	629 08 ...	629 19 ...	629 53 ...
Class II , med-K 100V	630 18 ...	630 08 ...	630 19 ...	630 53 ...
Class II , high-K 100V	640 18 ...	640 08 ...	640 19 ...	640 53 ...
Class I , P100 100V	682 03 ...	680 03 ...	683 03 ...	679 03 ...
NPO (< 10pF) 100V	682 09 ...	680 09 ...	683 09 ...	679 09 ...
NPO (≥ 10 pF) 100V	682 10 ...	680 10 ...	683 10 ...	679 10 ...
N150 100V	682 34 ...	680 34 ...	683 34 ...	679 34 ...
N750 100V	682 58 ...	680 58 ...	683 58 ...	679 58 ...
N1500 100V	682 70 ...	680 70 ...	683 70 ...	679 70 ...

500V Ceramic Plate Capacitors

A range of 500V devices covering a capacitance range of 0.47pF to 2700pF are available to order. The series numbers 652 ... and 655 ... refer to the 500V range.

Ceramic capacitors, dipped radial

MONO-KAP miniature, monolithic, multilayer

book 3 part 1a

CN Series, $U_R = 50V$ d.c., NPO dielectric material

Type No. (Order code)	Maptic's code	Capacitance (pF)	Size code	Lead pitch P (± 0.79) (mm)
CN15C100J	K100J15COGFVAWA	10	15	2.54
CN15C220J	K220J15COGFVAWA	22	15	2.54
CN15C470J	K470J15COGFVAWA	47	15	2.54
CN15C101J	K101J15COGFVAWA	100	15	2.54
CN15C221J	K221J15COGFVAWA	220	15	2.54
CN15C471J	K471J15COGFVAWA	470	15	2.54
CN20C102J	K102J20COGFVBWA	1 000	20	2.54
CN20C222J	K222J20COGFVBWA	2 200	20	2.54
CN30C472J	K472J30COGFVCWA	4 700	30	5.08
CN30C103J	K103J30COGFVCWA	10 000	30	5.08
CN40C223J	K223J40COGFVCWA	22 000	40	5.08

CN Series, $U_R = 100V$ d.c., NPO dielectric material

CN15A100J	K100J15COGHVAWA	10	15	2.54
CN15A220J	K220J15COGHVAWA	22	15	2.54
CN15A470J	K470J15COGHVAWA	47	15	2.54
CN15A101J	K101J15COGHVAWA	100	15	2.54
CN15A221J	K221J15COGHVAWA	220	15	2.54
CN20A471J	K471J20COGHVBWA	470	20	2.54
CN20A102J	K102J20COGHVBWA	1 000	20	2.54
CN30A222J	K222J30COGHVCWA	2 200	30	5.08
CN30A472J	K472J30COGHVCWA	4 700	30	5.08
CN40A103J	K103J40COGHVCWA	10 000	40	5.08

Capacitance tolerance	$\pm 5\%$
Rated d.c. voltage	50V, 100V
Temperature coefficient	NPO (COG)
Basic specification	IEC384-10
Climatic category (IEC68)	55/125/56

Continued

Ceramic capacitors, dipped radial

MONO-KAP miniature, monolithic, multilayer (cont.)

book 3 part 1a

CW Series, $U_R = 50V$ d.c., X7R dielectric material

Type No. (Order code)	Mapic's code	Capacitance (pF)	Capacitance tolerance (%)	Size code	Lead pitch P (± 0.79) (mm)
CW15C221K	K221K15X7RFVAWA	220	10	15	2.54
CW15C471K	K471K15X7RFVAWA	471	10	15	2.54
CW15C102K	K102K15X7RFVAWA	1 000	10	15	2.54
CW15C102M	K102M15X7RFVAWA	1 000	20	15	2.54
CW15C222K	K222K15X7RFVAWA	2 200	10	15	2.54
CW15C222M	K222M15X7RFVAWA	2 200	20	15	2.54
CW15C472K	K472K15X7RFVAWA	4 700	10	15	2.54
CW15C472M	K472M15X7RFVAWA	4 700	20	15	2.54
CW15C103K	K103K15X7RFVAWA	10 000	10	15	2.54
CW15C103M	K103M15X7RFVAWA	10 000	20	15	2.54
CW20C223K	K223K20X7RFVBWE	22 000	10	20	2.54
CW20C223M	K223M20X7RFVBWE	22 000	20	20	2.54
CW20C473K	K473K20X7RFVBWJ	47 000	10	20	2.54
CW20C473M	K473M20X7RFVBWJ	47 000	20	20	2.54
CW20C104K	K104K20X7RFVBWN	100 000	10	20	2.54
CW20C104M	K104M20X7RFVBWN	100 000	20	20	2.54
CW30C224K	K224K30X7RFVCWT	220 000	10	30	5.08
CW30C224M	K224M30X7RFVCWT	220 000	20	30	5.08
CW40C474K	K474K40X7RFVCWY	470 000	10	40	5.08
CW50C105K	K105K50X7RFVHXD	1 000 000	10	50	10.16

CW Series, $U_R = 100V$ d.c., X7R dielectric material

CW15A221K	K221K15X7RHVAWA	220	10	15	2.54
CW15A471K	K471K15X7RHVAWA	470	10	15	2.54
CW15A102K	K102K15X7RHVAWA	1 000	10	15	2.54
CW15A222K	K222K15X7RHVAWA	2 200	10	15	2.54
CW15A472K	K472K15X7RHVAWA	4 700	10	15	2.54
CW20A103K	K103K20X7RHVBWA	10 000	10	20	2.54
CW20A223K	K223K20X7RHVBWA	22 000	10	20	2.54
CW30A473K	K473K20X7RHVCWA	47 000	10	30	5.08
CW30A104K	K104K30X7RHVCWN	100 000	10	30	5.08
CW40A224K	K224K40X7RHVCWT	220 000	10	40	5.08
CW40A474K	K474K40X7RHVCWY	470 000	10	40	5.08

Capacitance tolerance $\pm 10\%$; $\pm 20\%$
 Rated d.c. voltage 50V; 100V
 Temperature characteristic X7R
 Basic specification IEC384-10
 Climatic category (IEC68) 55/125/56

Continued

Ceramic capacitors, dipped radial

MONO-KAP miniature, monolithic, multilayer (cont.)

book 3 part 1a

CZ Series, $U_R = 50V$ d.c., Z5U dielectric material

Type No. (Order code)	Mapic's code	Capacitance (μF)	Tolerance (%)	Size code	Lead pitch P ± 0.79 (mm)
CZ15C102M	K102M15Z5UFVAWA	0.001	20	15	2.54
CZ15C102Z	K102Z15Z5UFVAWA	0.001	80/20	15	2.54
CZ15C222M	K222M15Z5UFVAWA	0.0022	20	15	2.54
CZ15C222Z	K222Z15Z5UFVAWA	0.0022	80/20	15	2.54
CZ15C472M	K472M15Z5UFVAWA	0.0047	20	15	2.54
CZ15C472Z	K472Z15Z5UFVAWA	0.0047	80/20	15	2.54
CZ15C103M	K103M15Z5UFVAWA	0.01	20	15	2.54
CZ15C103Z	K103Z15Z5UFVAWA	0.01	80/20	15	2.54
CZ15C223M	K223M15Z5UFVAWE	0.022	20	15	2.54
CZ15C223Z	K223Z15Z5UFVAWE	0.022	80/20	15	2.54
CZ20C473M	K473M20Z5UFVBWJ	0.047	20	20	2.54
CZ20C473Z	K473Z20Z5UFVBWJ	0.047	80/20	20	2.54
CZ20C104M	K104M20Z5UFVBWN	0.10	20	20	2.54
CZ20C104Z	K104Z20Z5UFVBWN	0.10	80/20	20	2.54
CZ20C224M	K224M20Z5UFVBWT	0.22	20	20	2.54
CZ20C224Z	K224Z20Z5UFVBWT	0.22	80/20	20	2.54
CZ30C474M	K474M30Z5UFVCWY	0.47	20	30	5.08
CZ30C474Z	K474Z30Z5UFVCWY	0.47	80/20	30	5.08
CZ30C105M	K105M30Z5UFVCXD	1.0	20	30	5.08
CZ30C105Z	K105Z30Z5UFVCXD	1.0	80/20	30	5.08
CZ40C225M	K225M40Z5UFVCXF	2.2	20	40	5.08
CZ50C475M	K475M50Z5UFVCXJ	4.7	20	50	10.16

CZ Series, $U_R = 100V$ d.c., Z5U dielectric material

CZ15A102M	K102M15Z5UHVAWA	0.001	20	15	2.54
CZ15A222M	K222M15Z5UHVBWA	0.0022	20	15	2.54
CZ15A472M	K472M15Z5UHVBWA	0.0047	20	15	2.54
CZ15A103M	K103M15Z5UHVBWA	0.01	20	15	2.54
CZ15A223M	K223M15Z5UHVBWE	0.022	20	15	2.54
CZ20A473M	K473M20Z5UHVBWJ	0.047	20	20	2.54
CZ20A104M	K104M20Z5UHVBWN	0.10	20	20	2.54
CZ30A224M	K224M30Z5UHVCWT	0.22	20	30	5.08
CZ30A474M	K474M30Z5UHVCWY	0.47	20	30	5.08
CZ40A105M	K105M40Z5UHVCXD	1.0	20	40	5.08
CZ40A225M	K225M40Z5UHVCXJ	2.2	20	40	10.16

Capacitance tolerance +20%; +80/-20%
 Rated d.c. voltage 50V; 100V
 Temperature characteristic Z5U

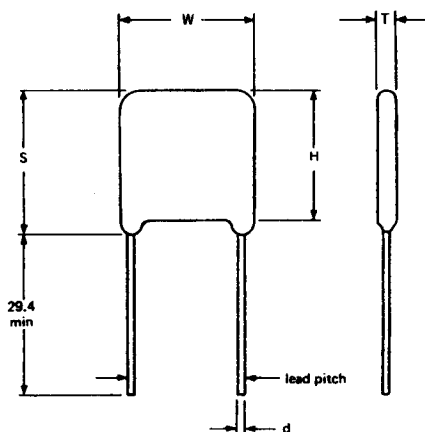
Basic specification IEC384-10
 Climatic category (IEC68) 55/125/56

Continued

Ceramic capacitors, dipped radial

MONO-KAP miniature, monolithic, multilayer (cont.)

book 3 part 1a



MECHANICAL DATA

MONO-KAP size codes

Size code	Suffix	H_{\max}	S_{\max}	W_{\max}	T_{\max}	lead pitch (± 0.79)	$\varnothing d$
15		3.81	5.39	3.81	2.54	2.54	0.40
15*	244**	3.81	6.71	3.81	2.54	5.08	0.50
20		5.08	6.66	5.08	3.18	2.54	0.50
20*	244**	5.08	7.37	5.08	3.18	5.08	0.50
30*		7.62	9.20	7.62	3.81	5.08	0.50
40*		10.16	11.74	10.16	3.81	5.08	0.50
50		12.70	14.28	12.70	5.08	10.16	0.63

Dimensions in mm

*Sizes 15, 20, 30 and 40 with a 5.08mm lead spacing are also available tape-packed on reels to special order. The suffix '-DRM' should be used to indicate this. The '244' suffix should not be used for tape-packed types. Example: CW20C104-DRM.

**Capacitors in body sizes 15 and 20 have a natural 2.54mm lead spacing. They are also available with a 5.08mm lead spacing. To indicate this a '244' suffix is added to the type number. Example: CW20C104-244.

Ceramic capacitors

MONO-GLASS miniature, monolithic multilayer, axial leads

book 3 part 1a

C40 Series, $U_R = 50V$ d.c., NPO dielectric material

Type No. (Order code)	Mapic's code	Capacitance (pF)	Dimensions (mm)	
			L_{max}	D_{max}
C40C100J-DRM	G100J17COGFVVA	10	4.32	2.54
C40C220J-DRM	G220J17COGFVVA	22	4.32	2.54
C40C470J-DRM	G470J17COGFVVA	47	4.32	2.54
C40C101J-DRM	G101J17COGFVVA	100	4.32	2.54
C40C221J-DRM	G221J17COGFVVA	220	4.32	2.54
C40C471J-DRM	G471J17COGFVVA	470	4.32	2.54
C40C102J-DRM	G102J25COGFVVA	1 000	6.35	2.54

Capacitance tolerance	$\pm 5\%$
Rated d.c. voltage	50V
Temperature coefficient	NPO (COG)
Basic specification	EIA RS198-B
Climatic category (IEC68)	55/125/56

C41 Series, $U_R = 50V$ d.c., X7R dielectric material

C41C101K-DRM	G101K17X7RFVVA	100	4.32	2.54
C41C221K-DRM	G221K17X7RFVVA	220	4.32	2.54
C41C471K-DRM	G471K17X7RFVVA	470	4.32	2.54
C41C102K-DRM	G102K17X7RFVVA	1 000	4.32	2.54
C41C222K-DRM	G222K17X7RFVVA	2 200	4.32	2.54
C41C472K-DRM	G472K17X7RFVVA	4 700	4.32	2.54
C41C103K-DRM	G103K17X7RFVVA	10 000	4.32	2.54
C41C223K-DRM	G223K20X7RFVVE	22 000	5.08	2.54
C41C473K-DRM	G473K30X7RFVWJ	47 000	7.62	3.81
C41C104K-DRM	G104K30X7RFVWN	100 000	7.62	3.81

Capacitance tolerance	$\pm 10\%$
Rated d.c. voltage	50V
Temperature characteristic	X7R
Basic specification	EIA RS198-B
Climatic category (IEC68)	55/125/56

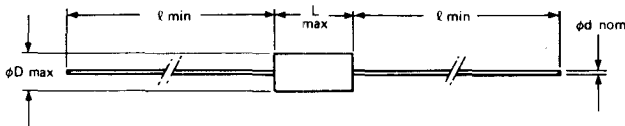
PACKING (see following pages)

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MONO-GLASS miniature, monolithic multilayer, axial leads (cont.) book 3 part 1a

C43 Series, $U_R = 50V$ d.c., Z5U dielectric material

Type No. (Order code)	Mapiç's code	Capacitance (μF)	Dimensions (mm)			
			L_{max}	D_{max}	l_{min}	d_{nom}
C43C102M-DRM	G102M17Z5UFVVA	0.001	4.32	2.54	30.48	0.51
C43C222M-DRM	G222M17Z5UFVVA	0.0022	4.32	2.54	30.48	0.51
C43C472M-DRM	G472M17Z5UFVVA	0.0047	4.32	2.54	30.48	0.51
C43C103M-DRM	G103M17Z5UFVVA	0.01	4.32	2.54	30.48	0.51
C43C223M-DRM	G223M17Z5UFVWE	0.022	4.32	2.54	30.48	0.51
C43C473M-DRM	G473M25Z5UFVWJ	0.047	6.35	2.54	30.48	0.51
C43C104M-DRM	G104M25Z5UFVWN	0.1	6.35	2.54	30.48	0.51
C43C224M-DRM	G224M30Z5UFVWT	0.22	7.62	3.81	30.48	0.51
C43C474M-DRM	G474M40Z5UFVWY	0.47	10.16	3.81	30.48	0.51
C43C473MDP-DRM	G473M17Z5UFVWJ	0.047	4.32	2.54	30.48	0.51
C43C104MDP-DRM	G104M17Z5UFVWN	0.1	4.32	2.54	30.48	0.51



Capacitance tolerance	$\pm 20\%$
Rated d.c. voltage	50V d.c.
Temperature characteristic	Z5U
Basic specification	EIA RS198-B
Climatic category (IEC68)	55/085/56

PACKING

MONO-GLASS capacitors are only supplied tape-packed on reels of 5000 pieces. The suffix '-DRM' has been added to the type number to indicate this packing.

Ceramic capacitors

miniature, tubular, axial leads

book 3 part 1a

561 Series – Type 1, U_R (d.c.) = 50V

Type No.	Temperature coefficient†	Type No.	Temperature coefficient†	Nominal capacitance C_{nom} (pF)	Tolerance on C_{nom}
–	–	561 47108	SL	1.0	±20%
–	–	561 47158	SL	1.5	±20%
–	–	561 48228	SL	2.2	±10%
561 31338	NPO	561 48338	SL	3.3	±10%
561 31398	NPO	–	–	3.9	±10%
561 31478	NPO	561 48478	SL	4.7	±10%
561 31568	NPO	–	–	5.6	±10%
561 31688	NPO	561 48688	SL	6.8	±10%
561 31828	NPO	–	–	8.2	±10%
561 32109	NPO	561 49109	SL	10	±5%
561 32119	NPO	–	–	11	±5%
561 32129	NPO	–	–	12	±5%
561 32139	NPO	–	–	13	±5%
561 32159	NPO	561 49159	SL	15	±5%
561 32169	NPO	–	–	16	±5%
561 32189	NPO	–	–	18	±5%
561 32209	NPO	–	–	20	±5%
561 32229	NPO	561 49229	SL	22	±5%
561 32249	NPO	–	–	24	±5%
561 32279	NPO	–	–	27	±5%
561 32309	NPO	–	–	30	±5%
561 32339	NPO	561 49339	SL	33	±5%
561 32369	NPO	–	–	36	±5%
561 32399	NPO	–	–	39	±5%
561 32439	NPO	–	–	43	±5%
561 32479*	NPO	561 49479	SL	47	±5%
561 32519*	NPO	–	–	51	±5%
561 32569*	NPO	–	–	56	±5%
561 32629*	NPO	–	–	62	±5%
561 32689*	NPO	561 49689	SL	68	±5%
561 40759*	N220	–	–	75	±5%
561 40829*	N220	–	–	82	±5%
561 46919*	N750	–	–	91	±5%
561 46101*	N750	561 49101	SL	100	±5%
561 46121*	N750	561 49121	SL	120	±5%
–	–	561 49151*	SL	150	±5%
–	–	561 49181*	SL	180	±5%

*These capacitors are size 250; all other capacitors are size 125.

†Temperature Coefficient of Capacitance

NPO = 0 ± 60 ppm per °C

N220 = -220 ± 60 ppm per °C

N750 = -750 ± 60 ppm per °C

SL = $+100$ to -750 ppm per °C

Other values in a variety of temperature coefficients are available to special order.

Continued

miniature, tubular, axial leads (cont.) book 3 part 1a

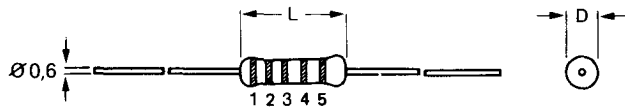
561 Series – Type 2

Type No.	Nominal capacitance C_{nom} (pF)	Tolerance on C_{nom}	U_R (d.c.) (V)	Temperature characteristic	Size
561 50151	150	± 10%	50	SB	125
561 50181	180	± 10%	50	SB	125
561 50221	220	± 10%	50	SB	125
561 50331	330	± 10%	50	SB	125
561 50391	390	± 10%	50	SB	125
561 50471	470	± 10%	50	SB	125
561 50561	560	± 10%	50	SB	125
561 50681	680	± 10%	50	SB	125
561 50821	820	± 10%	50	SB	125
561 50102	1000	± 10%	50	SB	125
561 50122	1200	± 10%	50	SB	250
561 50152	1500	± 10%	50	SB	250
561 51152	1500	± 10%	50	V	125
561 51222	2200	± 10%	50	V	125
561 51332	3300	± 10%	50	V	125
561 51472	4700	± 10%	50	V	125
561 54682	6800	± 20%	25	X	125
561 54103	10000	± 20%	25	X	125
561 57153	15000	± 30%	25	X	125
561 59223	22000	± 30%	16	Y	125

MECHANICAL DATA

Size	L max.	D max.
125	7.1	2.8
250	9.1	3.0

Dimensions in mm



PACKAGING

561 series capacitors are only supplied bandoliered with a tape spacing of 52 mm. Those values with a body size of 125 are 5 000 pieces per reel; body size 250 are 4 000 pieces per reel.

MARKING

Bands 1 and 2 show the first and second digit of the capacitance value. Band 3 is a multiplier to give the value of the capacitance in pF; band 4 indicates the tolerance on the capacitance value and band 5 indicates the temperature coefficient or the temperature characteristic.

Band colour	Bands 1 and 2 1st and 2nd digits	Band 3 multiplier	Band 4 tolerance on C_{nom}	Band 5	
				temperature coefficient	temperature characteristic
black	0	10^0	± 20%	NP0	–
brown	1	10^1	–	–	Y
red	2	10^2	–	–	SD
orange	3	10^3	–	–	–
yellow	4	10^4	–	N220	–
green	5	–	–	–	–
blue	6	–	–	–	–
purple	7	–	–	N750	–
grey	8	–	± 30%	–	X
white	9	–	–	SL	–
gold	–	10^{-1}	± 5%	–	V
silver	–	10^{-2}	± 10%	–	SB

Ceramic capacitors

S.M.D. multilayer chip capacitors book 3 part 1a

Three preferred dielectrics are offered (NPO, X7R and Y5V), the range covers the capacitance spectrum from 0.47pF to 1 μ F in six sizes. Tape packing for automatic placement is offered for almost all the range. With a basic specification meeting IEC384-10 and EIA RS198-B the range is approved to British Telecom D2988 and to specification IQHA 10049 AAJ-YY. Full CECC approval is pending and is expected during 1987. The range also meets the essential requirements of BS9075.

Silver-palladium terminals are available as standard. A notable feature is the minimum 35% palladium content of the terminations. This gives excellent resistance to soldering heat (260°C for a maximum 40 seconds). The noble metal alloy also minimises the risk of termination corrosion.

Terminations with a nickel barrier layer and solder-coated finish are available for X7R types and during 1987 for NPO and Y5V types.

Summary of the data

Dielectric	Capacitance range	Tolerance	Climatic category
NPO (= COG)	0.47–10000pF	$\pm 0.25\text{pF}$, $\pm 0.5\text{pF}$ $\pm 5\%$, $\pm 10\%$ ($\pm 2\%$, $\pm 1\%$ to special order)	55/125/56
X7R	180pF–1 μ F	$\pm 10\%$, $\pm 20\%$ ($\pm 5\%$ to special order)	55/125/56
Y5V (supersedes Z5U)	2200–100000pF	$\pm 20\%$, $-20/+80\%$	25/085/56

Rated voltage: 63V

Resistance to soldering heat: 260°C for 10 seconds (maximum 40 seconds)
235°C for maximum 100 seconds

selection guide S.M.D. multilayer chip capacitors

Class 1 capacitors (63V)

Dielectric NPO

C pF	Tolerance	Capacitance code	Size code					
			0805	1206	1210	1808	1812	2220
0.47	±0.25pF	478	●	●				
0.56		568	●	●				
0.68		688	●	●				
0.82		828	●	●				
1.0		109	●	●				
1.2		129	●	●				
1.5		159	●	●				
1.8		189	●	●				
2.2		229	●	●				
2.7		279	●	●				
3.3	339	●	●					
3.9	399	●	●					
4.7	479	●	●					
5.6	569	●	●					
6.8	689	●	●					
8.2	829	●	●					
10	±0.5pF	100	●	●				
12		120	●	●				
15		150	●	●				
18		180	●	●				
22		220	●	●				
27		270	●	●				
33		330	●	●				
39		390	●	●				
47		470	●	●				
56		560	●	●				
68	680	●	●					
82	820	●	●					
100	101	●	●					
120	121	●	●					
150	151	●	●					
180	181	●	●					
220	221	●	●					
270	271	●	●					
330	±5%	331	●	●				
390		391	●	●				
470		471	●	●				
560		561	●	●				
680		681	●	●				
820		821	●	●				
1000		102	●	●				
1200		122	●	●				
1500		152	●	●				
1800		182	●	●				
2200	222	●	●					
2700	272	●	●					
3300	332	●	●					
3900	392	●	●					
4700	472	●	●					
5600	562	●	●					
6800	682	●	●					
8200	822	●	●					
10000	103	●	●					



Preferred values



Available loose-packed (1000 per box) or in 8mm plastic blister tape (4000 per reel)



Available loose-packed (1000 per box)

Values in size 1808, 1812, and 2220 are available tape-packed to special order.

NPO size 0805 680-1000pF and 1206 2200-3300pF are not available tape-packed because of chip geometry.

NPO values $\geq 10\text{pF}$ are also available in $\pm 2\%$ and $\pm 10\%$ tolerance to special order.

selection guide S.M.D. multilayer chip capacitors

Class 2 capacitors (63V)

Dielectric X7R

C pF	Tolerance	Capacitance code	Size code						
			0805	1206	1210	1808	1812	2220	
180	±10%	181	●						
220		221	●						
270		271	●						
330		331	●						
390		391	●						
470		471	●						
560		561	●						
680		681	●	●					
820		821	●	●					
1000		102	●	●					
1200		122	●	●					
1500		152	●	●					
1800		182	●	●					
2200		222	●	●	●				
2700		272	●	●	●	●			
3300		332	●	●	●	●	●		
3900		392	●	●	●	●	●	●	
4700		472	●	●	●	●	●	●	●
5600		562	●	●	●	●	●	●	●
6800		682	●	●	●	●	●	●	●
8200		822	●	●	●	●	●	●	●
10000		103	●	●	●	●	●	●	●
12000		123	●	●	●	●	●	●	●
15000		153	●	●	●	●	●	●	●
18000		183	●	●	●	●	●	●	●
22000		223	●	●	●	●	●	●	●
27000		273	●	●	●	●	●	●	●
33000	333	●	●	●	●	●	●	●	
39000	393	●	●	●	●	●	●	●	
47000	473	●	●	●	●	●	●	●	
56000	563	●	●	●	●	●	●	●	
68000	683	●	●	●	●	●	●	●	
82000	823	●	●	●	●	●	●	●	
100000	104	●	●	●	●	●	●	●	
120000	124	●	●	●	●	●	●	●	
150000	154	●	●	●	●	●	●	●	
180000	184	●	●	●	●	●	●	●	
220000	224	●	●	●	●	●	●	●	
270000	274	●	●	●	●	●	●	●	
330000	334	●	●	●	●	●	●	●	
390000	394	●	●	●	●	●	●	●	
470000	474	●	●	●	●	●	●	●	
560000	564	●	●	●	●	●	●	●	
680000	684	●	●	●	●	●	●	●	
820000	824	●	●	●	●	●	●	●	
1 μ F	105	●	●	●	●	●	●	●	

Tolerance $\pm 10\%$, selected values also in $\pm 20\%$;
 $\pm 5\%$ tolerance available to special order.



Preferred values



Available loose-packed (1000 per box) or in 8mm plastic blister tape (4000 per reel).



Available loose-packed (1000 per box).

Values in sizes 1808, 1812 and 2220 available tape-packed to special order.

Ceramic capacitors

selection guide S.M.D. multilayer chip capacitors

Class 2 capacitors (63V)

Dielectric Y5V
(supersedes Z5U dielectric)

C pF	Tolerance	Capacitance code	Size code	
			0805	1206
2200	±20%	222	●	
3300		332	■	
4700		472	●	
6800		682	●	
10000		103	●	
15000		153	●	●
22000		223	●	●
33000		333	●	●
47000		473	●	●
68000		683	●	●
100000	104		●	

Tolerance $\pm 20\%$, selected values also in $-20/+80\%$.



Preferred values

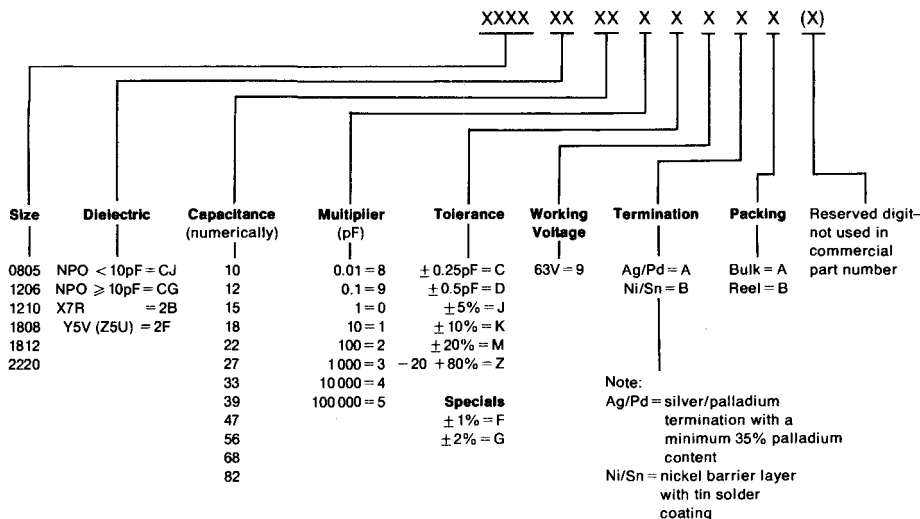


Available loose-packed (1000 per box) or in 8mm plastic blister tape (4000 per reel).

S.M.D. multilayer chip capacitors (cont.)

book 3 part 1a

COMPOSITION OF TYPE NUMBER



PACKING QUANTITIES

Bulk — 1000 pieces/bag

Reel — 4000 pieces/reel (0805, 1206 and 1210 sizes)

(except NPO 0805 size, 680-1000pF
 NPO 1206, 2200-3300pF)

EXAMPLES OF CAPACITANCE CODES

478 = 0.47pF

109 = 1.0pF

339 = 3.3pF

100 = 10pF

560 = 56pF

101 = 100pF

471 = 470pF

102 = 1 000pF = 1nF

392 = 3 900pF = 3n9

103 = 10 000pF = 10nF

333 = 33 000pF = 33nF

104 = 100 000pF = 100nF = 0.1μF

474 = 470nF = 0.47μF

105 = 1μF

Ceramic capacitors

S.M.D. multilayer chip capacitors (cont.)

book 3 part 1a

■ NPO dielectric material		0.47pF–10 000pF	
General properties			
	Rated voltage	63V d.c.	
	Temperature coefficient	NPO, $(0 \pm 120) \times 10^{-6}/K$	
	Losses $C \leq 30pF$ at 1MHz	$\tan \delta \leq 27 \times 10^{-4}$	
	$30pF < C \leq 1000pF$ at 1MHz	$\tan \delta \leq 10 \times 10^{-4}$	
	$C > 1000pF$ at 1kHz	$\tan \delta \leq 10 \times 10^{-4}$	
	Insulation resistance	$> 100\ 000M\Omega$	
	Climatic category (IEC68)	55/125/56	
Preferred values:			
Size	Capacitance value (pF)	Tolerance	Type No.
0805	0.47	$\pm 0.25pF$	0805 CJ478C9AA *
	1.0	$\pm 0.25pF$	0805 CJ109C9AA *
	2.2	$\pm 0.25pF$	0805 CJ229C9AA *
	4.7	$\pm 0.25pF$	0805 CJ479C9AA *
	10	$\pm 5\%$	0805 CG100J9AA *
	22	$\pm 5\%$	0805 CG220J9AA *
	47	$\pm 5\%$	0805 CG470J9AA *
	100	$\pm 5\%$	0805 CG101J9AA *
	220	$\pm 5\%$	0805 CG221J9AA *
	470	$\pm 5\%$	0805 CG471J9AA *
	1 000	$\pm 5\%$	0805 CG102J9AA *
1206	0.47	$\pm 0.25pF$	1206 CJ478C9AA *
	0.68	$\pm 0.25pF$	1206 CJ688C9AA *
	1.0	$\pm 0.25pF$	1206 CJ109C9AA *
	1.5	$\pm 0.25pF$	1206 CJ159C9AA *
	2.2	$\pm 0.25pF$	1206 CJ229C9AA *
	3.3	$\pm 0.25pF$	1206 CJ339C9AA *
	4.7	$\pm 0.25pF$	1206 CJ479C9AA *
	6.8	$\pm 0.5pF$	1206 CJ689D9AA *
	10	$\pm 5\%$	1206 CG100J9AA *
	15	$\pm 5\%$	1206 CG150J9AA *
	22	$\pm 5\%$	1206 CG220J9AA *
	33	$\pm 5\%$	1206 CG330J9AA *
	47	$\pm 5\%$	1206 CG470J9AA *
	68	$\pm 5\%$	1206 CG680J9AA *
	100	$\pm 5\%$	1206 CG101J9AA *
	150	$\pm 5\%$	1206 CG151J9AA *
	220	$\pm 5\%$	1206 CG221J9AA *
	330	$\pm 5\%$	1206 CG331J9AA *
470	$\pm 5\%$	1206 CG471J9AA *	
680	$\pm 5\%$	1206 CG681J9AA *	
1 000	$\pm 5\%$	1206 CG102J9AA *	
1 500	$\pm 5\%$	1206 CG152J9AA *	
2 200	$\pm 5\%$	1206 CG222J9AA *	
3 300	$\pm 5\%$	1206 CG332J9AA *	
1210	1 000	$\pm 5\%$	1210 CG102J9AA *
	1 500	$\pm 5\%$	1210 CG152J9AA *
	2 200	$\pm 5\%$	1210 CG222J9AA *
	3 300	$\pm 5\%$	1210 CG332J9AA *
	4 700	$\pm 5\%$	1210 CG472J9AA *
1812	3 300	$\pm 5\%$	1812 CG332J9AA *
	4 700	$\pm 5\%$	1812 CG472J9AA *
2220	6 800	$\pm 5\%$	2220 CG682J9AA *
	10 000	$\pm 5\%$	2220 CG103J9AA *

Note: Selected values are also available with a capacitance tolerance of $\pm 2\%$ to special order.

* Also available tape-packed (4000 pieces per reel). With the exception of 0805 size 680pF to 1000pF and 1206 size 2200pF to 3300pF; all intermediate values and sizes 1812 and 2220 are available tape-packed to special order.

S.M.D. multilayer chip capacitors (cont.) book 3 part 1a

■ ● N750 dielectric material (SL characteristic) 6.8pF–1200pF

General properties	Rated voltage	63V d.c.
	Temperature coefficient	$(-750 \pm 120) \times 10^{-6}/K$
	Losses at 1MHz, $C \leq 30pF$	$\tan \delta \leq 27 \times 10^{-4}$
	$30pF < C \leq 1000pF$	$\tan \delta \leq 10 \times 10^{-4}$
	Insulation resistance	$> 100\,000M\Omega$
Climatic category (IEC68)	55/125/56	

Preferred values:

Size	Capacitance value (pF)	Tolerance	Type No.
1206	10	+ 10%	1206 UJ100K9AA*
	22	+ 10%	1206 UJ220K9AA*
	47	+ 10%	1206 UJ470K9AA*
	100	+ 10%	1206 UJ101K9AA*
	220	+ 10%	1206 UJ221K9AA*
	470	+ 10%	1206 UJ471K9AA*
	1000	+ 10%	1206 UJ102K9AA*

Note: * Also available tape-packed (4000 pieces per reel).
Intermediate values are available tape-packed to special order.

Ceramic capacitors

S.M.D. multilayer chip capacitors (cont.)

book 3 part 1a

■ X7R dielectric material 180pF-1μF

General properties	Rated voltage	63V d.c.
	Temperature coefficient	X7R *
	Losses at 1kHz	≤ 2.5%
	Insulation resistance	C ≤ 10 000pF R > 100 000MΩ C > 10 000pF RC > 1 000s
	Climatic category (IEC68)	55/125/56

* Max. variation of capacitance as a function of temperature: ± 15%

Preferred values:

Size	Capacitance value (pF)	Tolerance	Type No.
0805	220	± 10%	0805 2B221K9AA *
	330	± 10%	0805 2B331K9AA *
	470	± 10%	0805 2B471K9AA *
	680	± 10%	0805 2B681K9AA *
	1 000	± 10%	0805 2B102K9AA *
	1 500	± 10%	0805 2B152K9AA *
	2 200	± 10%	0805 2B222K9AA *
	4 700	± 10%	0805 2B472K9AA *
	10 000	± 10%	0805 2B103K9AA *
	22 000	± 10%	0805 2B223K9AA *
	1206	680	± 10%
1 000		± 10%	1206 2B102K9AA *
1 500		± 10%	1206 2B152K9AA *
2 200		± 10%	1206 2B222K9AA *
3 300		± 10%	1206 2B332K9AA *
4 700		± 10%	1206 2B472K9AA *
6 800		± 10%	1206 2B682K9AA *
10 000		± 10%	1206 2B103K9AA *
10 000		± 20%	1206 2B103M9AA *
15 000		± 10%	1206 2B153K9AA *
22 000		± 10%	1206 2B223K9AA *
22 000		± 20%	1206 2B223M9AA *
33 000		± 10%	1206 2B333K9AA *
47 000		± 10%	1206 2B473K9AA *
47 000		± 20%	1206 2B473M9AA *
68 000		± 10%	1206 2B683K9AA *
100 000		± 10%	1206 2B104K9AA *
100 000	± 20%	1206 2B104M9AA *	
1210	10 000	± 10%	1210 2B103K9AA *
	22 000	± 10%	1210 2B223K9AA *
	47 000	± 10%	1210 2B473K9AA *
	100 000	± 10%	1210 2B104K9AA *
	150 000	± 10%	1210 2B154K9AA *
	220 000	± 10%	1210 2B224K9AA *
1812	100 000	± 10%	1812 2B104K9AA *
	150 000	± 10%	1812 2B154K9AA *
	220 000	± 10%	1812 2B224K9AA *
	330 000	± 10%	1812 2B334K9AA *
	470 000	± 10%	1812 2B474K9AA *
	470 000	± 20%	1812 2B474M9AA *
2220	100 000	± 10%	2220 2B104K9AA *
	150 000	± 10%	2220 2B154K9AA *
	220 000	± 10%	2220 2B224K9AA *
	330 000	± 10%	2220 2B334K9AA *
	470 000	± 10%	2220 2B474K9AA *
	470 000	± 20%	2220 2B474M9AA *
	680 000	± 10%	2220 2B684K9AA *
	1μF	± 10%	2220 2B105K9AA *
	1μF	± 20%	2220 2B105M9AA *

Note: Selected values in X7R are also available with a capacitance tolerance of ± 5% to special order.

* Also available tape-packed (4000 pieces per reel).

All other X7R devices are also available tape-packed to special order.

S.M.D. multilayer chip capacitors (cont.)

book 3 part 1a

■ **Y5V dielectric material** 2 200pF–100 000pF (ultimately 1 μ F)

Y5V material supersedes Z5U material and now offers an extended operating temperature range of –25°C to +85°C.

Rated voltage	63V d.c.
Temperature characteristic	Y5V*
Losses at 1kHz	$\tan \delta \leq 2.5\%$
Insulation resistance $C \leq 25\text{nF}$	$R > 4\,000\text{M}\Omega$
$C > 25\text{nF}$	$RC > 100\text{s}$
Climatic category (IEC68)	25/085/56

*Max. variation of capacitance as a function of temperature: +30% to –80%.

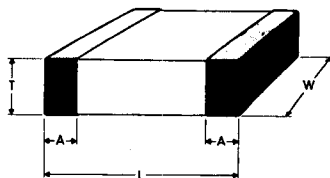
Preferred values:

Size	Capacitance value (pF)	Tolerance	Type No.
0805	2 200	$\pm 20\%$	0805 2F222M9AA *
	4 700	$\pm 20\%$	0805 2F472M9AA *
	10 000	$\pm 20\%$	0805 2F103M9AA *
	22 000	$\pm 20\%$	0805 2F223M9AA *
1206	10 000	$\pm 20\%$	1206 2F103M9AA *
	10 000	–20/ +80%	1206 2F103Z9AA *
	15 000	$\pm 20\%$	1206 2F153M9AA *
	22 000	$\pm 20\%$	1206 2F223M9AA *
	22 000	–20/ +80%	1206 2F223Z9AA *
	33 000	$\pm 20\%$	1206 2F333M9AA *
	47 000	$\pm 20\%$	1206 2F473M9AA *
	47 000	–20/ +80%	1206 2F473Z9AA *
	68 000	$\pm 20\%$	1206 2F683M9AA *
	100 000	$\pm 20\%$	1206 2F104M9AA *
	100 000	–20/ +80%	1206 2F104Z9AA *

Note: Values covering 68 000pF in size 1210 to 1 μ F in size 2 220 in Y5V dielectric are under development and will be available during late 1987.

*Also available tape-packed (4000 pieces per reel).

Other Y5V devices are available tape-packed to special order.



MECHANICAL DATA (dimensions in mm)

Size	L	W	T		A	
			min.	max.	min.	max.
0805	2.0 ± 0.15	1.25 ± 0.15	0.51	1.27	0.25	0.75
1206	3.2 ± 0.15	1.6 ± 0.15	0.51	1.60	0.25	0.75
1210	3.2 ± 0.2	2.5 ± 0.2	0.51	1.90	0.3	1.0
1808	4.5 ± 0.2	2.0 ± 0.2	0.51	1.90	0.3	1.0
1812	4.5 ± 0.2	3.2 ± 0.2	0.51	1.90	0.3	1.0
2220	5.7 ± 0.2	5.0 ± 0.2	0.51	1.90	0.3	1.0

Packaging Capacitors are available loose-packed in 1000 pieces or tape-packed. For availability of tape-packed types, see appropriate tables.

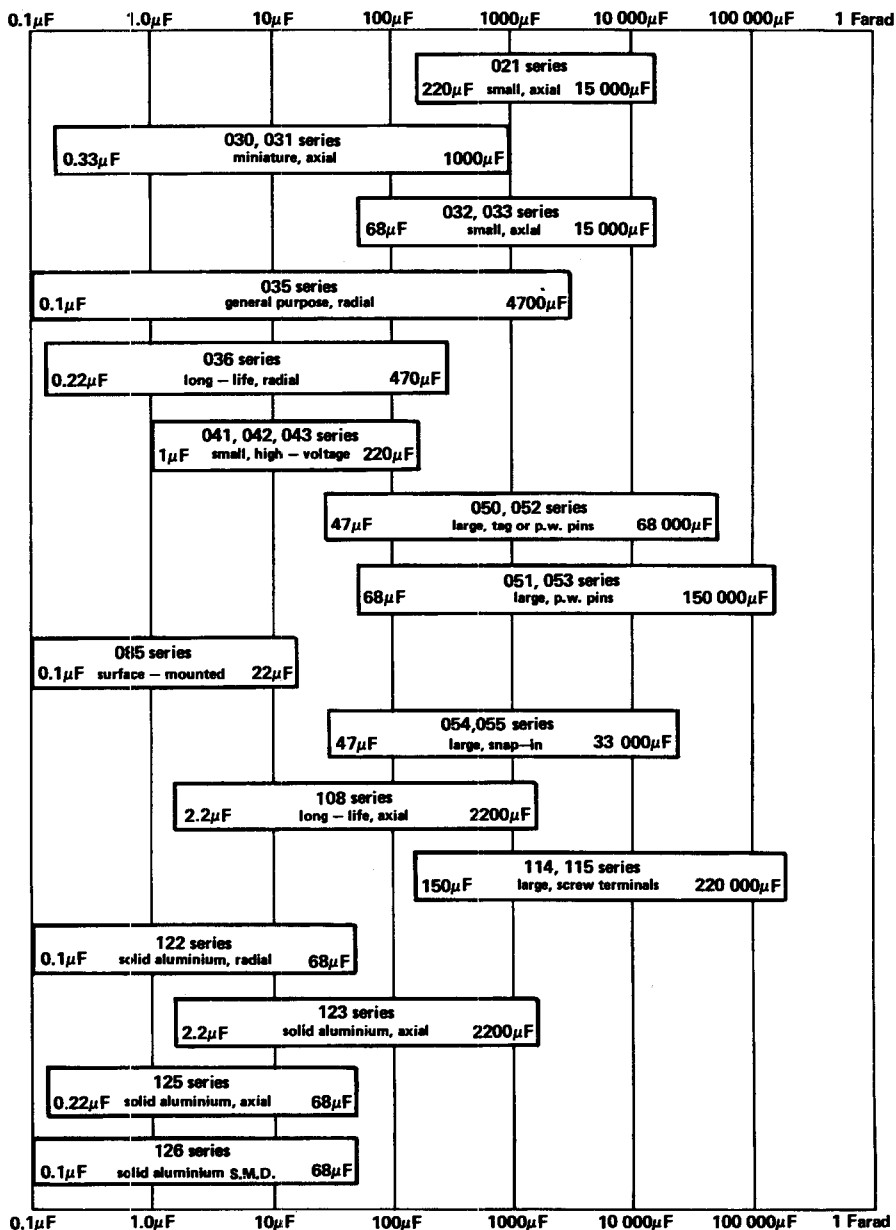
Capacitors in size 0805, 1206 and 1210 are also available in plastic blister tape in reels of 4000 pieces. Except NPO, size 0805 680–1000pF, size 1206 2200–3300pF.

Capacitors in size 1808, 1812 and 2220 are also available tape-packed to special order.

Electrolytic capacitors

selection guide

book part 1b



long life, small, axial leads

book 3 part 1b

021 Series

Type No.	Rated voltage U_R (V _{dc})	Capacitance (μ F)	Case size
021 14152	10	1 500	00
021 14222	10	2 200	01
021 14332	10	3 300	01
021 14472	10	4 700	02
021 14682	10	6 800	03
021 14103	10	10 000	04
021 14153	10	15 000	05
<hr/>			
021 15102	16	1 000	00
021 15152	16	1 500	01
021 15222	16	2 200	01
021 15332	16	3 300	02
021 15472	16	4 700	03
021 15682	16	6 800	04
021 15103	16	10 000	05
<hr/>			
021 16681	25	680	00
021 16102	25	1 000	01
021 16152	25	1 500	01
021 16222	25	2 200	02
021 16332	25	3 300	03
021 16472	25	4 700	04
021 16682	25	6 800	05

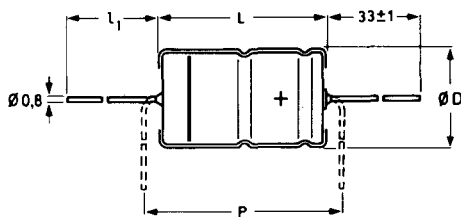
Type No.	Rated voltage U_R (V _{dc})	Capacitance (μ F)	Case size
021 17471	40	470	00
021 17681	40	680	01
021 17102	40	1 000	01
021 17152	40	1 500	02
021 17222	40	2 200	03
021 17332	40	3 300	04
021 17472	40	4 700	05
<hr/>			
021 18221	63	220	00
021 18331	63	330	01
021 18471	63	470	01
021 18681	63	680	02
021 18102	63	1 000	03
021 18152	63	1 500	04
021 18222	63	2 200	05
<hr/>			
● 021 19101	100	100	00
● 021 19151	100	150	01
● 021 19221	100	220	01
● 021 19331	100	330	02
● 021 19471	100	470	03
● 021 19681	100	680	04
● 021 19102	100	1 000	05

Capacitance tolerance: $\pm 20\%$
 Temperature range: -55 to $+85^\circ$
 Basic specification: IEC384-4 long life grade
 Detailed specification: DIN 41316
 Climatic category (IEC68) 55/085/56

021 Series axial leads

Case size	D_{max}	L_{max}	l_{1min}	P_{min}
00	10.5	30.5	54	35.0
01	13.0	30.5	54	35.0
02	15.5	30.5	54	35.0
03	18.5	30.5	54	35.0
04	18.5	41.5	33	45.0
05	21.5	41.5	33	45.0

Dimensions in mm



axial leads

NOTE: Non-solid electrolyte capacitors may contain chemicals which can be regarded as hazardous if incorrectly handled. Caution is necessary should the outer case be fractured.

PACKING

Capacitors are supplied loose in boxes of 200 pieces for case sizes 00 to 03 and 100 pieces for case sizes 04 to 05.

Electrolytic capacitors

long life, miniature, axial leads

book 3 part 1b

030, 031 Series

Type No.	Rated voltage U_R (V _{dc})	Capacitance (μ F)	Case size
030 33109	6.3	10	1
030 33339	6.3	33	2
030 33689	6.3	68	2
030 33151	6.3	150	3
031 33471	6.3	470	5
031 33681	6.3	680	6
031 33102	6.3	1 000	7
<hr/>			
030 34688	10	6.8	1
030 34229	10	22	2
030 34479	10	47	2
030 34101	10	100	3
030 34221	10	220	5a
031 34221	10	220	4
031 34331	10	330	5
031 34471	10	470	6
031 34681	10	680	7
<hr/>			
030 35478	16	4.7	1
030 35159	16	15	2
030 35339	16	33	2
030 35689	16	68	3
030 35151	16	150	5a
031 35151	16	150	4
031 35221	16	220	5
031 35331	16	330	6
031 35471	16	470	7
<hr/>			
030 36338	25	3.3	1
030 36109	25	10	2
030 36229	25	22	2
030 36479	25	47	3
030 36101	25	100	5a
031 36101	25	100	4
031 36151	25	150	5
031 36221	25	220	6
031 36331	25	330	7

Packing quantities

Case size	Quantity per box
1	1 000
2	1 000
3	1 000
5a	500
4	1 000
5	500
6	500
7	500

PACKING

All capacitors are supplied bandoliered in boxes in the quantities shown. Bandoliered and reel packing is available against special order.

Type No.	Rated voltage U_R (V _{dc})	Capacitance (μ F)	Case size
030 37228	40	2.2	1
030 37688	40	6.8	2
030 37109	40	10	2
030 37159	40	15	2
030 37229	40	22	3
030 37339	40	33	3
030 37479	40	47	5a
031 37479	40	47	4
031 37101	40	100	5
031 37151	40	150	6
031 37221	40	220	7
<hr/>			
030 38337	63	0.33	2
030 38477	63	0.47	2
030 38687	63	0.68	2
030 38108	63	1.0	2
030 38158	63	1.5	2
030 38228	63	2.2	2
030 38338	63	3.3	2
030 38478	63	4.7	2
030 38688	63	6.8	2
030 38109	63	10	3
030 38159	63	15	3
030 38229	63	22	5a
031 38229	63	22	4
031 38479	63	47	5
031 38689	63	68	6
031 38101	63	100	7
<hr/>			
030 39108	100	1.0	2
030 39228	100	2.2	2
030 39338	100	3.3	2
030 39478	100	4.7	3
030 39688	100	6.8	3
030 39109	100	10	5a
031 39109	100	10	4
031 39229	100	22	5
031 39339	100	33	6
031 39479	100	47	7

Capacitance tolerance: - 10 to + 50%
 Temperature range: - 55 to + 85°C
 Basic specification: IEC384-4 long-life grade*
 Detailed specification:
 U_R = 6.3 to 63V, DIN 41316
 U_R = 100V, DIN 41332
 Climatic category (IEC68) 55/085/56

*Case size 1 is general purpose grade.

Case sizes are given on the following page.

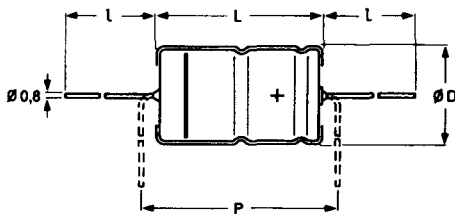
long life, miniature, axial leads (cont.)

book 3 part 1b

030, 031 Series

Table 1

Case Size	Dimensions (mm)			
	D_{max}	L_{max}	P_{min}	d
1	3.5	11.0	15	0.6
2	5.0	10.5	15	0.6
3	6.3	10.5	15	0.6
5a	8.5	11.5	15	0.6
4	6.9	18.5	25	0.8
5	8.5	18.5	25	0.8
6	10.5	18.5	25	0.8
7	10.5	25.0	30	0.8



lead length l depends on bandoliering format
(see published data)

NOTE:

Non-solid electrolyte capacitors may contain chemicals which can be regarded as hazardous if incorrectly handled. Caution is necessary should the outer case be fractured.

Electrolytic capacitors

long life, small, axial leads

book 3 part 1b

032, 033 Series

Type No.	Rated voltage U_R (Vdc)	Capacitance (μ F)	Case size	Max. ripple current at 100Hz and 85°C (mA)
032 13152	6.3	1 500	00	450
032 13222	6.3	2 200	01	610
032 13332	6.3	3 300	02	790
032 13472	6.3	4 700	03	1 000
033 13682	6.3	6 800	04	1 280
033 13103	6.3	10 000	05	1 570
033 13153	6.3	15 000	05	1 600
032 14102	10	1 000	00	430
032 14152	10	1 500	01	570
032 14222	10	2 200	02	740
032 14332	10	3 300	03	950
033 14472	10	4 700	04	1 220
033 14682	10	6 800	05	1 500
033 14103	10	10 000	05	1 520
032 15681	16	680	00	400
032 15102	16	1 000	01	550
032 15152	16	1 500	02	680
032 15222	16	2 200	03	880
033 15332	16	3 300	04	1 160
033 15472	16	4 700	05	1 430
033 15682	16	6 800	05	1 460
032 16471	25	470	00	360
032 16681	25	680	01	500
032 16102	25	1 000	02	660
032 16152	25	1 500	03	810
033 16222	25	2 200	04	1 060
033 16332	25	3 300	05	1 340
033 16472	25	4 700	05	1 370
032 17221	40	220	00	260
032 17331	40	330	01	370
032 17471	40	470	01	440
032 17681	40	680	02	580
032 17102	40	1 000	03	780
033 17152	40	1 500	04	970
033 17222	40	2 200	05	1 220
033 17332	40	3 300	05	1 284
032 18151	63	150	00	260
032 18221	63	220	01	350
032 18331	63	330	02	480
032 18471	63	470	02	570
032 18681	63	680	03	770
033 18102	63	1 000	05	1 140
033 18152	63	1 500	05	1 170

Capacitance tolerance: - 10 to + 50%
Temperature range: - 40 to + 85°C
Basic specification: IEC 384-4 long-life grade

Detail specification: 6.3 to 63V versions, DIN41316;
100V versions, DIN41332
Climatic category (IEC68) 40/085/56

Continued

general purpose long life, small, axial leads (cont.)

book 3 part 1b

032, 033 Series, axial leads

Type No.	Rated voltage U_R (Vdc)	Capacitance (μF)	Case size	Max. ripple current at 100Hz and 85°C (mA)
032 19689	100	68	00	130
032 19101	100	100	01	190
032 19151	100	150	02	250
032 19221	100	220	03	330
033 19331	100	330	04	460
033 19471	100	470	05	600
033 19681	100	680	05	650

Capacitance tolerance: - 10 to + 50%

Temperature range: - 40 to + 85°C

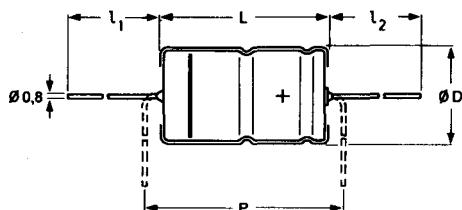
Basic specifications: IEC 384-4 long-life grade

Detail specification: 6.3 to 63V versions, DIN41316;
100V version, DIN41332

Climatic category (IEC68) 40/085/56

Case size	D_{\max}	L_{\max}	$l_{1\min}$	$l_{2\min}$	P_{\min}
00	10.5	30.5	54	32	35
01	13.0	30.5	54	32	35
02	15.5	30.5	54	32	35
03	18.5	30.5	54	32	35
04	18.5	41.5	33	32	45
05	21.5	41.5	33	32	45

Dimensions in mm



NOTE: Non-solid electrolyte capacitors may contain chemicals which can be regarded as hazardous if incorrectly handled. Caution is necessary should the outer case be fractured.

PACKING

Capacitors are supplied loose in boxes of 200 pieces for case sizes 00 to 03 and 100 pieces for case sizes 04 and 05.

Electrolytic capacitors

general purpose, miniature and
small, single ended

book 3 part 1b

035 Series

Type No.	Rated voltage U_R (V _{dc})	Nominal capacitance (μ F)	Case size	Type No.	Rated voltage U_R (V _{dc})	Nominal capacitance (μ F)	Case size
035 53151	6.3	150	12	035 57221	40	220	16
035 53331	6.3	330	13	035 57331	40	330	17
035 53681	6.3	680	15	035 57471	40	470	18
035 53102	6.3	1 000	16	035 57681	40	680	19
035 53152	6.3	1 500	17				
035 53222	6.3	2 200	18	035 90008	50	10	11
035 53332	6.3	3 300	19	035 90012	50	22	12
035 53472	6.3	4 700	20	035 90015	50	47	13
				035 90017	50	68	14
035 54479	10	47	11	035 90019	50	100	15
035 54101	10	100	12	035 90022	50	150	16
035 54221	10	220	13	035 90024	50	220	17
035 54331	10	330	14	035 90026	50	330	18
035 54471	10	470	15	035 90028	50	680	19
035 54681	10	680	16	035 90031	50	1 000	20
035 54102	10	1 000	17				
035 54152	10	1 500	18	035 58107	63	0.1	11
				035 58157	63	0.15	11
035 55339	16	33	11	035 58227	63	0.22	11
035 55689	16	68	12	035 58337	63	0.33	11
035 55151	16	150	13	035 58477	63	0.47	11
035 55221	16	220	14	035 58687	63	0.68	11
035 55331	16	330	15	035 58108	63	1.0	11
035 55471	16	470	16	035 58158	63	1.5	11
035 55681	16	680	17	035 58228	63	2.2	11
035 55102	16	1 000	18	035 58338	63	3.3	11
035 55152	16	1 500	19	035 58478	63	4.7	11
035 55222	16	2 200	19	035 58688	63	6.8	11
035 55332	16	3 300	20	035 58109	63	10	12
				035 58159	63	15	12
035 56479	25	47	12	035 58229	63	22	13
035 56101	25	100	13	035 58339	63	33	13
035 56151	25	150	14	035 58479	63	47	14
035 56221	25	220	15	035 58689	63	68	15
035 56331	25	330	16	035 58101	63	100	16
035 56471	25	470	17	035 58151	63	150	17
035 56681	25	680	18	035 58221	63	220	18
035 56102	25	1 000	19	035 58331	63	330	19
035 56152	25	1 500	20	035 58471	63	470	19
				035 58681	63	680	20
035 90003	35	22	11				
035 90059	35	100	14	035 59227	100	0.22	11
035 90006	35	1 000	19	035 59477	100	0.47	11
				035 59108	100	1.0	11
035 57159	40	15	11	035 59158	100	1.5	11
035 57229	40	22	12	035 59228	100	2.2	11
035 57339	40	33	12	035 59338	100	3.3	11
035 57689	40	68	13	035 59478	100	4.7	12
035 57151	40	150	15	035 59688	100	6.8	12

Continued

general purpose, miniature and small, single ended (cont.)

book 3 part 1b

Type No.	Rated voltage $U_R (V_{dc})$	Nominal capacitance (μF)	Case size
035 59109	100	10	13
035 59159	100	15	13
035 59229	100	22	14
035 59339	100	33	15
035 59479	100	47	16

Type No.	Rated voltage $U_R (V_{dc})$	Nominal capacitance (μF)	Case size
035 59689	100	68	17
035 59101	100	100	18
035 59151	100	150	18
035 59221	100	220	19
035 59331	100	330	20

Capacitance tolerance: $\pm 20\%$
 Climatic category (IEC68) 40/085/56
 Basic specifications: IEC 384-4 G.P. grade
 DIN 41332

Table 1

Case size	Dimensions (mm)			
	d	D_{max}	L_{max}	P
11	0.5	5.5	12.0	2.0
12	0.6	6.5	12.0	2.5
13	0.6	8.5	12.5	3.5
14	0.6	10.5	12.5	5.0
15	0.6	10.5	17.0	5.0
16	0.6	10.5	21.0	5.0
17	0.6	13.0	21.0	5.0
18	0.6	13.0	26.0	5.0
19	0.8	16.5	26.0	7.5
20	0.8	16.5	32.0	7.5

± 0.5

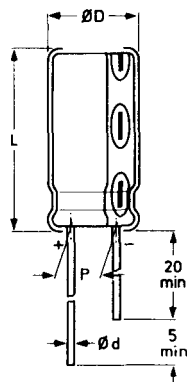


Fig. 1 See Table 1 for dimensions d, D, L and P

PACKING

Capacitors are supplied in boxes in the quantities given in Table 2.

Capacitors in case sizes 11, 12 and 13 are also available tape-packaged on reels against special order.

NOTE: Non-solid electrolyte capacitors may contain chemicals which can be regarded as hazardous if incorrectly handled. Caution is necessary should the outer case be fractured.

Table 2

Case size	Box quantity
11	1 000
12	1 000
13	1 000
14	1 000
15	500
16	500
17	200
18	200
19	200
20	200

Electrolytic capacitors

long life, miniature, single ended book 3 part 1b

036 Series

Type No.	Rated voltage U_R (V _{dc})	Nominal capacitance (μ F)	Case size
036 53101	6.3	100	11
036 53331	6.3	330	13
036 54479	10	47	11
036 54689	10	68	11
036 54151	10	150	11
036 54221	10	220	13
036 54471	10	470	13
036 55339	16	33	11
036 55101	16	100	11
036 55151	16	150	13
036 55331	16	330	13
036 56689	25	68	11
036 56101	25	100	13
036 56221	25	220	13
036 90001	35	22	11
036 90094	35	47	11
036 90099	35	150	13

Type No.	Rated voltage U_R (V _{dc})	Nominal capacitance (μ F)	Case size
036 57159	40	15	11
036 57689	40	68	13
036 90004	50	10	11
036 90104	50	33	11
036 90011	50	47	13
036 90109	50	100	13
036 58227	63	0.22	11
036 58337	63	0.33	11
036 58477	63	0.47	11
036 58687	63	0.68	11
036 58108	63	1.0	11
036 58158	63	1.5	11
036 58228	63	2.2	11
036 58338	63	3.3	11
036 58478	63	4.7	11
036 58688	63	6.8	11
036 58109	63	10	11
036 58229	63	22	11
036 58339	63	33	13
036 58689	63	68	13

Capacitance tolerance: $\pm 20\%$
 Climatic category (IEC68) 55/085/56
 Basic specification: IEC 384-4, long life grade

Table 1

Case size	Dimensions (mm)			
	d	D_{max}	L_{max}	P
11	0.5	5.5	12.0	2.5
13	0.6	8.7	12.0	5.0

PACKING

Capacitors are supplied in boxes of 1 000 pieces. They are also available tape-packaged on reels against special order.

NOTE: Non-solid electrolyte capacitors may contain chemicals which can be regarded as hazardous if incorrectly handled. Caution is necessary should the outer case be fractured.

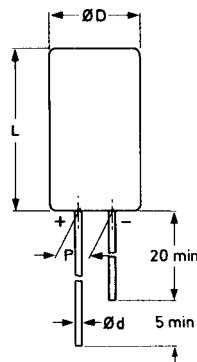


Fig. 1 See Table 1 for dimensions d, D, L and P

long life, miniature, high voltage, axial leads

book 3 part 1b

041/042/043 Series

Type No.		Rated voltage U_R (V_{dc})	Capacitance (μF)	Case size
axial banded (in boxes)	axial (loose packed)			
041 31478	-	160	4.7	4
041 31109	-	160	10	5
041 31229	-	160	22	7
-	042 11229	160	22	00
-	042 11339	160	33	01
-	042 11479	160	47	02
-	042 11689	160	68	03
-	042 11101	160	100	03
-	043 11151	160	150	04
-	043 11221	160	220	05

041 33228	-	250	2.2	4
041 33478	-	250	4.7	5
041 33109	-	250	10	7
-	042 13109	250	10	00
-	042 13159	250	15	01
-	042 13229	250	22	01
-	042 13339	250	33	02
-	042 13479	250	47	03
-	043 13689	250	68	04
-	043 13101	250	100	05

Type No.		Rated voltage U_R (V_{dc})	Capacitance (μF)	Case size
axial banded (in boxes)	axial (loose packed)			
041 38108	-	385	1.0	4
041 38228	-	385	2.2	5
041 38478	-	385	4.7	7
-	042 18688	385	6.8	00
-	042 18109	385	10	01
-	042 18159	385	15	02
-	042 18229	385	22	03
-	043 18339	385	33	04
-	043 18479	385	47	04
-	043 18689	385	68	05

Capacitance tolerance: - 10 to + 50%
 Temperature range: - 40 to + 85°C
 Climatic category (IEC68) 40/085/56
 Basic specification IEC384-4, long-life grade

NOTE: Non-solid electrolyte capacitors may contain chemicals which can be regarded as hazardous if incorrectly handled. Caution is necessary should the outer case be fractured.

Continued

Electrolytic capacitors

long life, miniature, high voltage, axial leads (cont.)

book 3 part 1b

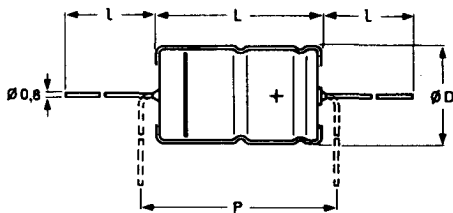
041 Series, axial leads, bandoliered

Case size	D_{max}	L_{max}	P_{min}
4	6.9	18.5	25
5	8.5	18.5	25
6	10.5	18.5	25
7	10.5	25	30

Dimensions in mm

Packing quantities, 041 Series

Case size	Bandoliered in boxes
4	1 000
5	500
6	500
7	500



041 Series
lead length depends on bandoliering format
(see published data)

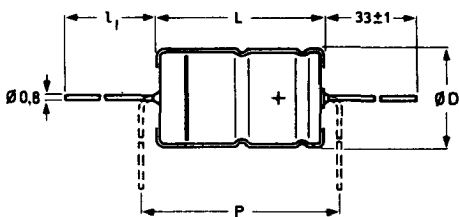
042/043 Series, axial leads, loose packed

Case size	D_{max}	L_{max}	P_{min}	$l_{1(min)}$
00	10.5	30.5	35	54
01	13.0	30.5	35	54
02	15.5	30.5	35	54
03	18.5	30.5	35	54
04	18.5	41.5	45	33
05	21.5	41.5	45	33

dimensions in mm

Packing quantities, 042/043 series

Case size	Loose packed
00	200
01	200
02	200
03	200
04	100
05	100



042/043 Series

Electrolytic capacitors

Industrial, large, solder terminals or p.w. pins book 3 part 1b

050 Series

Type No.			Rated voltage U_R (V _{dc})	Capacitance (μ F)	Max. r.m.s. ripple current at 100Hz and 85°C (A)	Case size
solder-tag version	printed-wiring version case size 6*	printed-wiring version				
050 14472	-	050 54472	10	4 700	2.4	1
050 14682	-	050 54682	10	6 800	3.2	2
050 14103	-	050 54103	10	10 000	3.8	3
050 14153	-	050 54153	10	15 000	4.1	4
050 14223	-	050 54223	10	22 000	5.0	5
-	050 44223	-	10	22 000	4.2	6
050 14333	-	050 54333	10	33 000	5.0	7
050 14473	-	050 54473	10	47 000	6.8	8
050 14683	-	050 54683	10	68 000	9.2	9
050 15332	-	050 55332	16	3 300	2.4	1
050 15472	-	050 55472	16	4 700	3.1	2
050 15682	-	050 55682	16	6 800	3.7	3
050 15103	-	050 55103	16	10 000	4.1	4
050 15153	-	050 55153	16	15 000	5.0	5
-	050 45153	-	16	15 000	4.2	6
050 15223	-	050 55223	16	22 000	5.0	7
050 15333	-	050 55333	16	33 000	6.7	8
050 15473	-	050 55473	16	47 000	9.1	9
050 16222	-	050 56222	25	2 200	2.3	1
050 16332	-	050 56332	25	3 300	3.1	2
050 16472	-	050 56472	25	4 700	3.7	3
050 16682	-	050 56682	25	6 800	4.1	4
050 16103	-	050 56103	25	10 000	5.0	5
-	050 46103	-	25	10 000	4.2	6
050 16153	-	050 56153	25	15 000	5.0	7
050 16223	-	050 56223	25	22 000	6.8	8
050 16333	-	050 56333	25	33 000	9.2	9
050 17152	-	050 57152	40	1 500	2.0	1
050 17222	-	050 57222	40	2 200	2.7	2
050 17332	-	050 57332	40	3 300	3.3	3
050 17472	-	050 57472	40	4 700	3.8	4
050 17682	-	050 57682	40	6 800	4.7	5
-	050 47682	-	40	6 800	4.1	6
050 17103	-	050 57103	40	10 000	4.9	7
050 17153	-	050 57153	40	15 000	6.6	8
050 17223	-	050 57223	40	22 000	9.0	9
050 18102	-	050 58102	63	1 000	1.8	1
050 18152	-	050 58152	63	1 500	2.5	2
050 18222	-	050 58222	63	2 200	3.1	3
050 18332	-	050 58332	63	3 300	3.6	4
050 18472	-	050 58472	63	4 700	4.4	5
-	050 48472	-	63	4 700	3.8	6
050 18682	-	050 58682	63	6 800	4.7	7
050 18103	-	050 58103	63	10 000	6.2	8
050 18153	-	050 58153	63	15 000	8.5	9

*Not available in solder tag version.

Continued

Electrolytic capacitors

industrial, large, solder terminals or p.w. pins (cont.) book 3 part 1b

050, 052 Series

solder-tag version	Type No.		Rated voltage U_R (V _{dc.})	Capacitance (μ F)	Max. r.m.s. ripple current at 100Hz and 85°C (A)	Case size
	printed-wiring version case size 6*	printed-wiring version				
050 19471	—	050 59471	100	470	1.2	1
050 19681	—	050 59681	100	680	1.7	2
050 19102	—	050 59102	100	1 000	2.2	3
050 19152	—	050 59152	100	1 500	2.6	4
050 19222	—	050 59222	100	2 200	3.2	5
—	050 49222	—	100	2 200	3.0	6
050 19332	—	050 59332	100	3 300	3.6	7
050 19472	—	050 59472	100	4 700	5.0	8
050 19682	—	050 59682	100	6 800	6.9	9
<hr/>						
052 13101	—	052 53101	250	100	0.6	1
052 13151	—	052 53151	250	150	0.8	2
052 13221	—	052 53221	250	220	1.0	3
052 13331	—	052 53331	250	330	1.4	4
052 13471	—	052 53471	250	470	1.8	5
—	052 43471	—	250	470	1.8	6
052 13681	—	052 53681	250	680	2.3	7
052 13102	—	052 53102	250	1 000	3.0	8
<hr/>						
052 18479	—	052 58479	385	47	0.4	1
052 18689	—	052 58689	385	68	0.6	2
052 18101	—	052 58101	385	100	0.8	3
052 18151	—	052 58151	385	150	1.0	4
052 18221	—	052 58221	385	220	1.3	5
—	052 48221	—	385	220	1.3	6
052 18331	—	052 58331	385	330	1.7	7
052 18471	—	052 58471	385	470	2.8	8

*Not available with solder tags.

NOTE:
 Non-solid electrolyte capacitors may contain chemicals which can be regarded as hazardous if incorrectly handled. Caution is necessary should the outer case be fractured.

Case sizes are the same for printed wiring and solder tag versions. (Case size 6 is *not* available with solder tags.)

See following pages for positioning and dimensioning of printed wiring pins.

Capacitance tolerance: -10 to +30%

Temperature range: -40 to +85°C

Basic specification: IEC384-4 long-life grade
 DIN 41240

Dimensional specification: DIN41238

Climatic category (IEC68) 40/085/56

Approved to CECC 30301-033

Continued

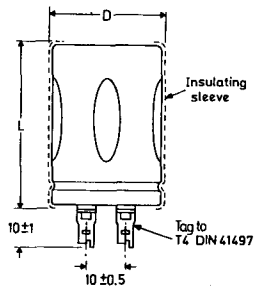
industrial, large, solder terminals or p.w. pins ≡ (cont.) book 3 part 1b

050, 052 Series

Case sizes and mounting clips – solder tag version

Case size	D _{max}	L _{max}	Mounting clips type number
1	25.6	36.3	4322 043 03301
2	25.6	46.3	4322 043 03301
3	30.6	46.3	4322 043 03311
4	35.6	46.3	4322 043 04272
5	35.6	56.3	4322 043 04272
6	40.6	46.3	
7	40.6	56.3	4322 043 03331
8	40.6	76.3	4322 043 03331
9	40.6	106.3	4322 043 03331

Dimensions in mm



Solder tag version

Electrolytic capacitors

Industrial, large, p.w. pins

book 3 part 1b

051, 053 Series Development Sample Data

Type No.	Rated voltage U_R (V _{dc})	Nominal capacitance (μF)	I_R max. at 100Hz/85°C (A)	Case size	Type No.	Rated voltage U_R (V _{dc})	Nominal capacitance (μF)	I_R max. at 100Hz/85°C (A)	Case size
051 54103	10	10 000	3.1	1	051 58222	63	2 200	2.5	1
051 54153	10	15 000	4.1	2	051 58332	63	3 300	3.3	2
051 54223	10	22 000	5.0	3	051 58472	63	4 700	4.1	3
051 54333	10	33 000	5.5	4	051 58682	63	6 800	4.5	4
051 54473	10	47 000	6.8	5	051 58103	63	10 000	5.4	5
051 44473	10	47 000	5.8	6	051 48103	63	10 000	4.6	6
051 54683	10	68 000	7.1	7	051 58153	63	15 000	7.5	8
051 54104	10	100 000	9.2	8	051 58223	63	22 000	10.0	9
051 54154	10	150 000	12.0	9					
051 55682	16	6 800	3.1	1	051 59681	100	680	1.74	1
051 55103	16	10 000	4.0	2	051 59102	100	1 000	2.34	2
051 55153	16	15 000	5.0	3	051 59152	100	1 500	2.95	3
051 55223	16	22 000	5.5	4	051 59222	100	2 200	3.69	4
051 45333	16	33 000	6.7	5	051 59332	100	3 300	4.37	5
051 55333	16	33 000	5.7	6	051 49332	100	3 300	4.16	6
051 55473	16	47 000	7.0	7	051 59472	100	4 700	5.21	7
051 55683	16	68 000	9.2	8	051 59682	100	6 800	6.97	8
051 55104	16	100 000	12.0	9	051 59103	100	10 000	9.50	9
051 56472	25	4 700	2.9	1	053 52151	200	150	0.70	1
051 56682	25	6 800	3.9	2	053 52221	200	220	0.94	2
051 56103	25	10 000	4.8	3	053 52331	200	330	1.27	3
051 56153	25	15 000	5.3	4	053 52471	200	470	1.66	4
051 56223	25	22 000	6.5	5	053 52681	200	680	2.19	5
051 46223	25	22 000	5.7	6	053 42681	200	680	2.17	6
051 56333	25	33 000	7.0	7	053 52102	200	1 000	2.86	7
051 56473	25	47 000	9.2	8	053 52152	200	1 500	3.81	8
051 56683	25	68 000	12.0	9	053 52222	200	2 200	5.20	9
051 57332	40	3 300	2.9	1	053 58689	385	68	0.47	1
051 57472	40	4 700	3.8	2	053 58101	385	100	0.64	2
051 57682	40	6 800	4.7	3	053 58151	385	150	0.90	3
051 57103	40	10 000	5.2	4	053 58221	385	220	1.15	4
051 57153	40	15 000	6.3	5	053 58331	385	330	1.53	5
051 47153	40	15 000	5.6	6	053 48331	385	330	1.52	6
051 57223	40	22 000	5.8	7	053 58471	385	470	1.96	7
051 57333	40	33 000	7.8	8	053 58681	385	680	2.70	8
051 57473	40	47 000	10.4	9	053 58102	385	1 000	3.70	9

Capacitance tolerance: ±20%

Temperature range: -40 to +85°C

Basic specification: IEC 384-4 long-life grade

Climatic category (IEC68) 40/085/56

NOTE: Non-solid electrolyte capacitors may contain chemicals which can be regarded as hazardous if incorrectly handled. Caution is necessary should the outer case be fractured.

Continued

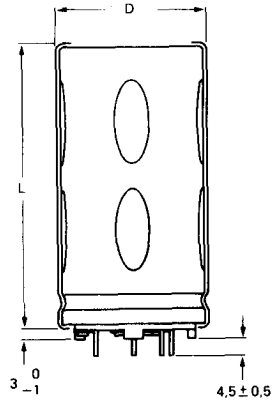
industrial, large, p.w. pins (cont). book 3 part 1b

051, 053 Series Development Sample Data

Case sizes

Case size	D_{max}	L_{max}
1	25.6	36.3
2	25.6	46.3
3	30.6	46.3
4	35.6	46.3
5	35.6	56.3
6	40.6	46.3
7	40.6	56.3
8	40.6	76.3
9	40.6	106.3

Dimensions in mm



See next page for positioning of the p.w. pins.

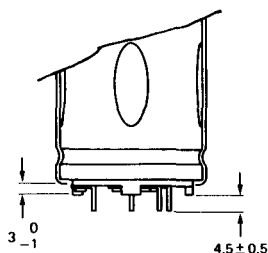
Continued

Electrolytic capacitors

industrial, large, p.w. pins (cont.) book 3 part 1b

Pin configuration for 050/051/052/053 ranges

Fig.1 Pin dimensions.
Applicable to all case sizes.



Piercing diagrams viewed from component side.

Fig.2 Case sizes 1 and 2.
Nominal diameter 25 mm.

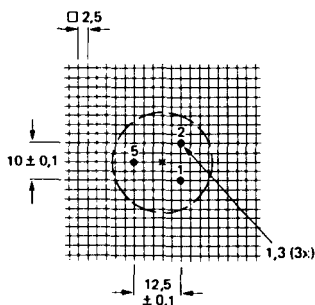


Fig.3 Case size 3.
Nominal diameter 30 mm.

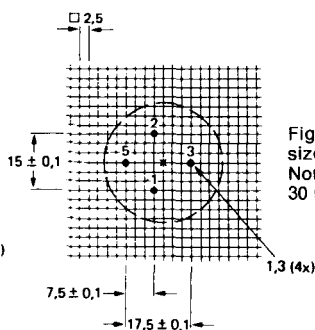


Fig.4 Case sizes 4 and 5.
Nominal diameter 35 mm.

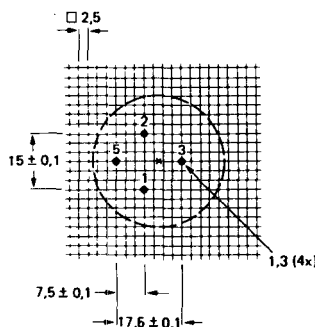
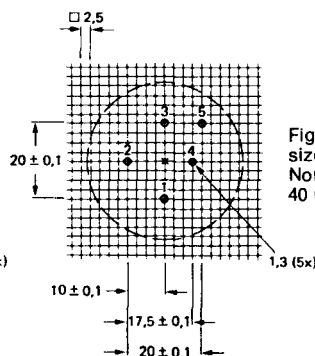


Fig.5 Case sizes 6 to 9.
Nominal diameter 40 mm.



Pin connections

Pin 1 = positive terminal

Pin 5 = negative terminal

Intermediate numbered pins should be connected to pin 5 (-ve) or left 'floating'.

industrial, large, snap-in pins

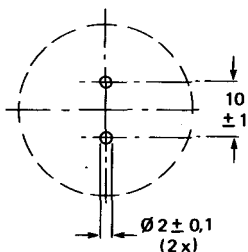
book 3 part 1b

● 054, 055 Series; Development Sample Data

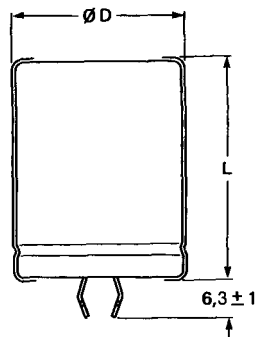
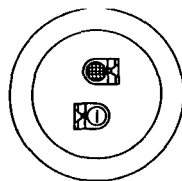
Type No.	U_R (V)	Nom. cap. (μF)	Max. r.m.s. ripple current (A) at 100 Hz, 80°C	Case size
054 54682	10	6 800	1.98	18
054 54103		10 000	2.31	19
054 54153		15 000	3.18	22
054 54223		22 000	4.15	23
054 54333		33 000	4.94	24
<hr/>				
054 55472	16	4 700	1.94	18
054 55682		6 800	2.26	19
054 55103		10 000	3.15	22
054 55153		15 000	4.10	23
054 55223		22 000	4.87	24
<hr/>				
054 56332	25	3 300	1.81	18
054 56472		4 700	2.19	19
054 56682		6 800	2.96	22
054 56103		10 000	3.91	23
054 56153		15 000	4.73	24
<hr/>				
054 57222	40	2 200	1.64	18
054 57332		3 300	1.95	19
054 57472		4 700	2.70	22
054 57682		6 800	3.43	23
054 57103		10 000	4.05	24
<hr/>				
054 58102	63	1 000	1.61	18
054 58152		1 500	1.86	19
054 58222		2 200	2.68	22
054 58332		3 300	3.47	23
054 58472		4 700	4.01	24
<hr/>				
054 59471	100	470	1.07	18
054 59681		680	1.29	19
054 59102		1 000	1.75	22
054 59152		1 500	2.40	23
054 59222		2 200	2.93	24

Capacitance tolerance $\pm 20\%$
 Temperature range - 40 to + 85°C
 Basic specification IEC 384-4 long life grade
 Climatic category (IEC 68) 40/085/56

Mounting holes



Type No.	U_R (V)	Nom. cap. (μF)	Max. r.m.s. ripple current (A) at 100 Hz, 85°C	Case size
055 52101	200	100	0.47	18
055 52151		150	0.63	19
055 52221		220	0.86	22
055 52331		330	1.17	23
055 52471		470	1.54	24
<hr/>				
055 58479	385	47	0.32	18
055 58689		68	0.43	19
055 58101		100	0.58	22
055 58151		150	0.79	23
055 58221		220	1.05	24



Case size	$\varnothing D_{\text{max}}$	L_{max}
18	22	32
19	26	32
22	26	42
23	31	42
24	36	42

Dimensions in mm

Electrolytic capacitors

S.M.D. general purpose

book 3 part 1b

■ 085 Series

Type No.	Rated voltage U_R (V _{dc})	Capacitance (μ F)	Case size
085 33109	6.3	10	1a
085 33229	6.3	22	1
085 34688	10	6.8	1a
085 34159	10	15	1
085 35478	16	4.7	1a
085 35109	16	10	1
085 36338	25	3.3	1a
085 36688	25	6.8	1
085 37228	40	2.2	1a
085 37478	40	4.7	1
085 38107	63	0.1	1a
085 38157	63	0.15	1a
085 38227	63	0.22	1a
085 38337	63	0.33	1a
085 38477	63	0.47	1a
085 38687	63	0.68	1a
085 38108	63	1	1a
085 38158	63	1.5	1a
085 38228	63	2.2	1
085 38338	63	3.3	1

Capacitance tolerance: -10 to +50%

Climatic category (IEC68) 40/085/56

Basic specification: IEC 384-4, general purpose

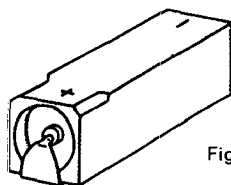


Fig. 2

MARKING

The capacitors are marked on top with nominal capacitance +ve and -ve sign for polarity, and a code letter for voltage. The numbers are those for capacitance in μ F. The voltage code letter takes the place of the decimal point in the capacitance value, e.g.

3H3 indicates 3.3 μ F, 63V

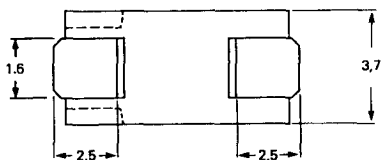


Fig. 1a Case size 1a

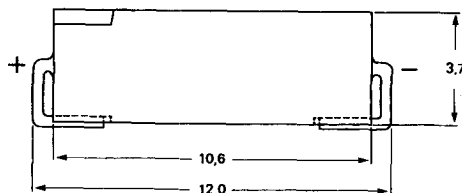
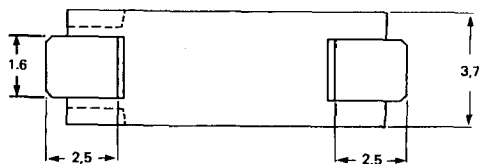
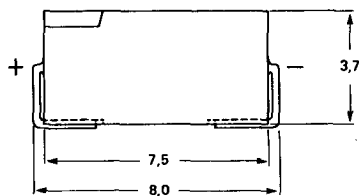


Fig. 1b Case size 1

Dimensions in mm

Rated voltage V	Code letter
6.3	C
10	D
16	E
25	F
40	G
63	H

NOTE: Non-solid electrolyte capacitors may contain chemicals which can be regarded as hazardous if incorrectly handled. Caution is necessary should the outer case be fractured.

Continued

S.M.D. general purpose (cont.)

book 3 part 1b

PACKING

The capacitors are packed in slides of 100 pieces, with 10 slides to a box.

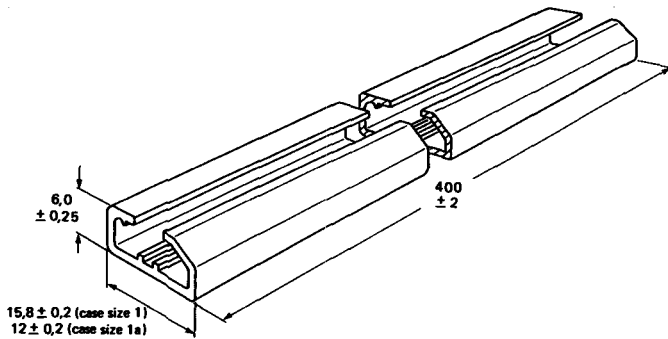


Fig. 3 Packing slide

Electrolytic capacitors

long life, small, axial leads



book 3 part 1b

108 Series U_R (d.c.) = 6.3V to 100V

Type No.	Rated voltage U_R (V_{dc})	Capacitance (μF)	Case size	I_R max. at 100Hz and 85°C (mA)
108 33151	6.3	150	5	130
108 33331	6.3	330	6	220
108 33471	6.3	470	00	325
108 33102	6.3	1 000	01	470
108 33152	6.3	1 500	02	630
108 33222	6.3	2 200	03	920
108 34101	10	100	5	120
108 34221	10	220	6	205
108 34331	10	330	00	325
108 34681	10	680	01	470
108 34102	10	1 000	02	630
108 34152	10	1 500	03	920
108 35689	16	68	5	110
108 35151	16	150	6	190
108 35221	16	220	00	270
108 35471	16	470	01	360
108 35681	16	680	02	500
108 35102	16	1 000	03	650
108 36339	25	33	5	85
108 36479	25	47	5	100
108 36101	25	100	6	170
108 36151	25	150	00	270
108 36221	25	220	01	360
108 36471	25	470	02	500
108 36681	25	680	03	650

Type No.	Rated voltage U_R (V_{dc})	Capacitance (μF)	Case size	I_R max. at 100Hz and 85°C (mA)
108 37159	40	15	5	65
108 37229	40	22	5	80
108 37339	40	33	6	110
108 37479	40	47	6	130
108 37689	40	68	00	195
108 37101	40	100	01	245
108 37151	40	150	01	280
108 37221	40	220	02	360
108 37331	40	330	03	495
108 38228	63	2.2	5	25
108 38338	63	3.3	5	30
108 38478	63	4.7	5	35
108 38688	63	6.8	5	45
108 38109	63	10	5	50
108 38159	63	15	6	75
108 38229	63	22	6	90
108 38339	63	33	00	125
108 38479	63	47	00	150
108 38689	63	68	01	195
108 38101	63	100	02	275
108 38151	63	150	03	355
108 39478	100	4.7	5	40
108 39668	100	4.8	5	50
108 39109	100	10	5	60
108 39159	100	15	6	80
108 39229	100	22	6	90
108 39339	100	33	00	105
108 39479	100	47	00	125
108 39689	100	68	01	165
108 39101	100	100	02	225
108 39151	100	100	03	300

Approved to British Telecom specification D2541, Type 4511A and to RSRE Specification 070/8/03 (except 100V range)
Approved to CECC 30301-027 (except 100V range)

NOTE

Non-solid electrolyte capacitors may contain chemicals which can be regarded as hazardous if incorrectly handled. Caution is necessary should the outer case be fractured.

Capacitance tolerance: - 10 to +50%
Temperature range: -40 to +85°C
Basic specification: IEC384-4, long-life grade
Climatic category (IEC68) 40/085/56

PACKING

Case sizes 5 and 6 supplied on bandoliers in boxes of 500 pieces. Case sizes 00 to 03 supplied loose in boxes of 200 pieces.

Continued

long life, small, axial leads
(cont.)



book 3 part 1b

108 Series U_R (d.c.) = 6.3V to 100V

Case size	L_{max}	D_{max}	P_{min}
5	18.5	8.5	25
6	18.5	10.5	25
00	30.5	10.5	35
01	30.5	13	35
02	30.5	15.5	35
03	30.5	18.5	35

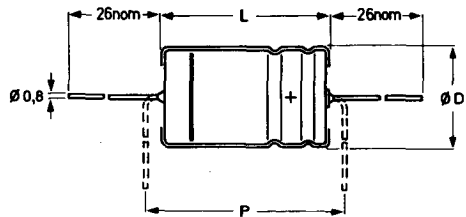


Fig.1 case sizes 5 and 6

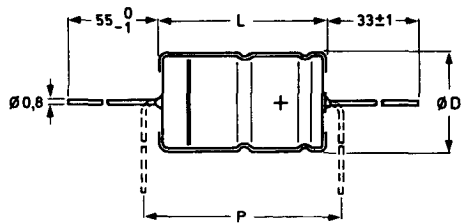


Fig.2 case sizes 00, 01, 02 and 03

Electrolytic capacitors

computer grade, large, screw terminal

book 3 part 1b

114, 115 Series

Type No.	Rated voltage U_R (V_{dc})	Capacitance (μF)	Case size	I_R max. at 100Hz $T_{amb} = 85^\circ C$ (A_{rms})
114 14153	10	15 000	10	6
114 14223	10	22 000	11	7.5
114 14333	10	33 000	12a	10
114 14473	10	47 000	14	14
114 14683	10	68 000	15a	18
114 14104	10	100 000	16a	30
114 14154	10	150 000	16a	30
114 14224	10	220 000	17	37
114 15103	16	10 000	10	6
114 15153	16	15 000	11	7.5
114 15223	16	22 000	12a	10
114 15333	16	33 000	14	13
114 15473	16	47 000	15a	18
114 15683	16	68 000	16a	28
114 15104	16	100 000	16a	28
114 15154	16	150 000	17	37
114 16472	25	4 700	10	5.2
114 16682	25	6 800	10	5.2
114 16103	25	10 000	11	6.7
114 16153	25	15 000	12a	9.7
114 16223	25	22 000	14	12.5
114 16333	25	33 000	15a	18
114 16473	25	47 000	16a	27
114 16683	25	68 000	16a	27
114 16104	25	100 000	17	37
114 17332	40	3 300	10	4.5
114 17472	40	4 700	10	4.5
114 17682	40	6 800	11	6
114 17103	40	10 000	12a	7.5
114 17153	40	15 000	14	10
114 17223	40	22 000	15a	15
114 17333	40	33 000	16a	21
114 17473	40	47 000	16a	22
114 17683	40	68 000	17	30
114 18222	63	2 200	10	3.7
114 18332	63	3 300	10	3.7
114 18472	63	4 700	11	5.2
114 18682	63	6 800	12a	7.5
114 18103	63	10 000	14	9.5
114 18153	63	15 000	15a	13.5
114 18223	63	22 000	16a	21
114 18333	63	33 000	16a	22
114 18473	63	47 000	17	30

Continued

computer grade, large, screw terminal (cont.) book 3 part 1b

114, 115 Series

Type No.	Rated voltage U_R (V_{dc})	Capacitance (μF)	Case size	I_R max. at 100Hz $T_{amb} = 85^\circ C$ (A_{rms})
114 19102	100	1 000	10	2.2
114 19152	100	1 500	10	2.2
114 19222	100	2 200	11	3.3
114 19332	100	3 300	12a	4.5
114 19472	100	4 700	14	5.7
114 19682	100	6 800	15a	8.0
114 19103	100	10 000	16a	13.5
114 19153	100	15 000	16a	13.5
114 19223	100	22 000	17	15.0
<hr/>				
115 13331	250	330	10	1.8
115 13471	250	470	11	2.5
115 13681	250	680	12a	3.5
115 13102	250	1 000	14	4.2
115 13152	250	1 500	15a	6.3
115 13222	250	2 200	16a	8.8
115 13332	250	3 300	16a	10.5
115 13472	250	4 700	17	14
<hr/>				
115 18151	385	150	10	1.2
115 18221	385	220	11	1.6
115 18331	385	330	12a	2.2
115 18471	385	470	14	2.7
115 18681	385	680	15a	4.8
115 18102	385	1 000	16a	7
115 18152	385	1 500	16a	7
115 18222	385	2 200	17	9

Details of case sizes and mounting clamps are shown in Table 1

Capacitance tolerance: -10 to $+30\%$

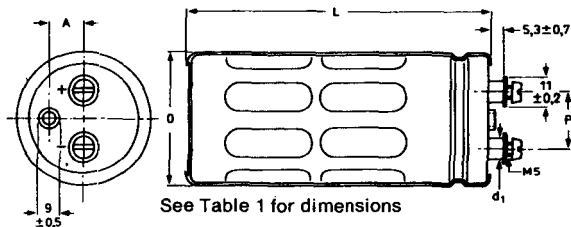
Temperature range: -40 to $+85^\circ C$

Basic specification: IEC 384-4 long-life grade

Detail specification: DIN 41240
DIN 41248

Climatic category (IEC68) 40/085/56

Endurance test: 5000 h's



Di dimensions in mm

See Table 1 for dimensions

Table 1

Case size	D_{max}	L_{max}	P (± 0.1)	A	d_1	Mounting clamps
10	36.5	63	13.0	8.4	8	4322 043 04272
11	36.5	83	13.0	8.4	8	4322 043 04272
12a	36.5	108	13.0	8.4	8	4322 043 04272
14	51.5	83	22.0	14.3	8	4322 043 04281
15a	51.5	108	22.0	14.3	8	4322 043 04281
16a	66.5	108	28.5	19.0	11	4322 043 04291
17	76.5	108	32.0	21.0	11	4322 043 12990

NOTE: Non-solid electrolyte capacitors may contain chemicals which can be regarded as hazardous if incorrectly handled. Caution is necessary should the outer case be fractured.

Electrolytic capacitors

solid aluminium, miniature, 
single ended, dipped

book 3 part 1b

122 Series

Type No.	Rated voltage U_R (V_{dc})	Capacitance (μF)	Case size
122 53109	6.3	10	1
122 53159	6.3	15	2
122 53229	6.3	22	2
122 53339	6.3	33	3
122 53479	6.3	47	4
122 53689	6.3	68	4
<hr/>			
122 54478	10	4.7	1
122 54688	10	6.8	1
122 54109	10	10	2
122 54159	10	15	2
122 54229	10	22	3
122 54339	10	33	4
<hr/>			
122 55228	16	2.2	1
122 55338	16	3.3	1
122 55478	16	4.7	2
122 55688	16	6.8	2
122 55109	16	10	3
122 55159	16	15	4

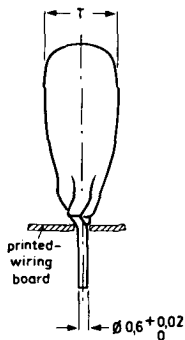
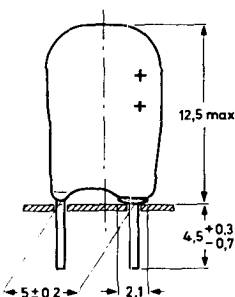
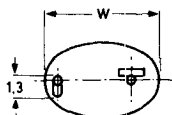
Type No.	Rated voltage U_R (V_{dc})	Capacitance (μF)	Case size
122 56687	25	0.68	1
122 56108	25	1.0	1
122 56158	25	1.5	1
122 56228	25	2.2	2
122 56338	25	3.3	2
122 56478	25	4.7	3
122 56688	25	6.8	4
122 56109	25	10	4
<hr/>			
122 50108	35	1	2
<hr/>			
122 57107	40	0.1	1
122 57157	40	0.15	1
122 57227	40	0.22	1
122 57337	40	0.33	1
122 57477	40	0.47	2
122 57687	40	0.68	2
122 57108	40	1.0	3
122 57158	40	1.5	4
122 57228	40	2.2	4

122 Series capacitors are approved to CECC 30-302-002 and are approved for British Telecom use

Capacitance tolerance: $\pm 20\%$
Category temp. range: 6.3 to 40V ranges -55 to $+125^\circ C$
40V range derates to 25V in temperature range $+85$ to $+125^\circ C$

Basic specification: IEC 384-4 long-life grade

Climatic category (IEC68) 55/125/56



Case size	W_{max}	H_{max}	T_{max}
1	8	12.5	3.5
2	8	12.5	4.5
3	8	12.5	5
4	8	12.5	6

Dimensions in mm

PACKING

Capacitors are loose-packed in boxes of 1000 pieces, 200 pieces per plastic bag, 5 bags per box. They are also available tape-packaged on reels against special order.

solid aluminium, small, axial leads,
metal case



book 3 part 1b

123 Series

Type No.	Rated voltage U_R (V _{dc})	Capacitance (μ F)	Case size	Type No.	Rated voltage U_R (V _{dc})	Capacitance (μ F)	Case size
123 12689	4	68	1	123 90037	20	10	1
123 12221	4	220	2a	123 90038	20	15	1
123 12471	4	470	4	123 90042	20	47	2a
123 12102	4	1000	5	123 90044	20	100	4
123 12152	4	1500	6	123 90045	20	150	5
123 12222	4	2200	6	123 90046	20	220	5
				123 90047	20	330	6
				123 90048	20	470	6
123 13479	6.3	47	1				
123 13151	6.3	150	2a	123 16109	25	10	1
123 13331	6.3	330	4	123 16229	25	22	2a
123 13681	6.3	680	5	123 16339	25	33	2a
123 13102	6.3	1000	6	123 16689	25	68	4
123 13152	6.3	1500	6	123 16101	25	100	4
				123 16151	25	150	5
				123 16221	25	220	6
123 14339	10	33	1				
123 14479	10	47	1	123 10228	35	2.2	1
123 14689	10	68	2a	123 10338	35	3.3	1
123 14101	10	100	2a	123 10478	35	4.7	1
123 14151	10	150	4	123 10688	35	6.8	1
123 14221	10	220	4	123 10109	35	10	2a
123 14331	10	330	5	123 10159	35	15	2a
123 14471	10	470	5	123 10229	35	22	4
123 14681	10	680	6	123 10339	35	33	4
123 14102	10	1000	6	123 10479	35	47	4
				123 10689	35	68	5
123 15109	16	10	1	123 10101	35	100	6
123 15159	16	15	1	123 10151	35	150	6
123 15229	16	22	1				
123 15339	16	33	2a	123 17228	40	2.2	1
123 15479	16	47	2a	123 17338	40	3.3	1
123 15689	16	68	2a	123 17478	40	4.7	1
123 15101	16	100	4	123 17688	40	6.8	1
123 15151	16	150	4	123 17109	40	10	2a
123 15221	16	220	5	123 17159	40	15	2a
123 15331	16	330	5	123 17229	40	22	4
123 15471	16	470	6	123 17339	40	33	4
123 15681	16	680	6	123 17479	40	47	5
				123 17689	40	68	5
				123 17101	40	100	6

123 Series are approved to CECC 30302-003

Capacitance tolerance: $\pm 20\%$

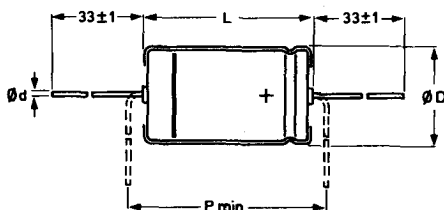
Category temperature range: -55 to $+125^\circ\text{C}$

Basic specification: IEC384-4, long-life grade

Climatic category (IEC68) 55/125/56

Case size	D_{\max}	r_{\max}	P_{\min}	$\varnothing d$
1	6.7	15.3	17.5	0.6
2a	7.6	20.4	22.5	0.6
4	9.3	23.3	25	0.6
5	10.3	32	35	0.8
6	12.9	32	35	0.8

Dimensions in mm



Electrolytic capacitors

solid aluminium, miniature, axial leads, metal cased

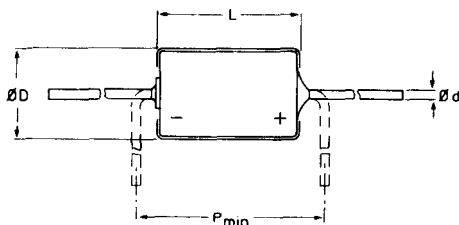
125 Series

Type No.	Rated voltage U_R (V _{d.c.})	Capacitance (μ F)	Case size	Type No.	Rated voltage U_R (V _{d.c.})	Capacitance (μ F)	Case size
125 22339	4	33	A2	125 26478	25	4.7	A2
125 90502	4	68	A3	125 90518	25	10	A3
125 22689	4	68	B	125 26109	25	10	B
125 23229	6.3	22	A2	125 20227	35	0.22	A2
125 90504	6.3	47	A3	125 20337	35	0.33	A2
125 23479	6.3	47	B	125 20477	35	0.47	A2
125 24159	10	15	A2	125 20687	35	0.68	A2
125 90506	10	33	A3	125 20108	35	1	A2
125 24339	10	33	B	125 20158	35	1.5	A2
125 25109	16	10	A2	125 20228	35	2.2	A2
125 90508	16	22	A3	125 20338	35	3.3	A2
125 25229	16	22	B	125 90522	35	4.7	A3
125 90511	20	6.8	A2	125 20478	35	4.7	B
125 90513	20	15	A3	125 90524	35	6.8	A3
125 90515	20	15	B	125 20688	35	6.8	B

Capacitance tolerance: $\pm 20\%$
 Category temperature range: -55 to $+125^\circ\text{C}$
 Basic specification: IEC384-4, long-life grade
 Climatic category (IEC68) 55/125/56

Case size	$\varnothing D_{\max}$	L_{\max}	P_{\min}	$\varnothing d$
A2	5.1	10.2	12.5	0.6
A3	6.3	10.2	12.5	0.6
B	5.1	15	17.5	0.6

Dimensions in mm



PACKING

The capacitors are supplied bandoliered on reels of 1000 pieces.

S.M.D. solid aluminium

■ ● 126 Series; Development Sample Data

Type No.		U _R up to 125°C (V)	Nom. cap. (μF)	Case size	
in box	in tape				
126 13109	126 23109	6.3	10	20	
126 13159	126 23159		15	30	
126 13229	126 23229		22	30	
126 13339	126 23339		33	40	
126 13479	126 23479		47	50	
126 13689	126 23689		68	60	
126 14478	126 24478	10	4.7	20	
126 14688	126 24688		6.8	20	
126 14109	126 24109		10	30	
126 14159	126 24159		15	30	
126 14229	126 24229		22	40	
126 14339	126 24339		33	50	
126 14479	126 24479		47 ▲	60	
126 15228	126 25228		16	2.2	20
126 15338	126 25338			3.3	20
126 15478	126 25478			4.7	30
126 15688	126 25688	6.8		30	
126 15109	126 25109	10		40	
126 15159	126 25159	15		50	
126 15229	126 25229	22 ▲		60	
126 16687	126 26687	25		0.68	20
126 16108	126 26108			1.0	20
126 16158	126 26158			1.5	20
126 16228	126 26228		2.2	30	
126 16338	126 26338		3.3	40	
126 16478	126 26478		4.7	50	
126 16688	126 26688		6.8	60	
126 16109	126 26109		10	60	

Type No.		U _R up to 125°C (V)	Nom. cap. (μF)	Case size
in box	in tape			
126 10477	126 20477	35	0.47 ▲	20
126 10687	126 20687		0.68 ▲	30
126 10108	126 20108		1.0	40
126 10158	126 20158		1.5	50
126 10338	126 20338		3.3 ▲	60
126 17107	126 27107	40 ▲ ▲	0.1	20
126 17157	126 27157		0.15	20
126 17227	126 27227		0.22	20
126 17337	126 27337		0.33	20
126 17477	126 27477		0.47	30
126 17687	126 27687		0.68	40
126 17108	126 27108		1.0	50
126 17158	126 27158		1.5	60
126 17228	126 27228		2.2	60

▲ Under consideration.

▲ ▲ Up to 85°C; from 85 to 125°C this value is 25V.

Capacitance tolerance: ±20%

Temperature range: -55 to +125°C

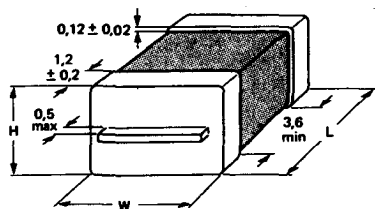
Basic specification: IEC 384-4, long life grade

Climatic category: (IEC68) 55/125/56

Case size	H _{max}	W _{max}	L _{max}	No. per reel
20	3.0	4.5	6.7	3000
30	3.5	5.8	6.7	2000
40	4.1	5.8	6.7	1500
50	4.1	7.9	6.7	1500
60	5.2	7.9	6.7	1000

PACKING

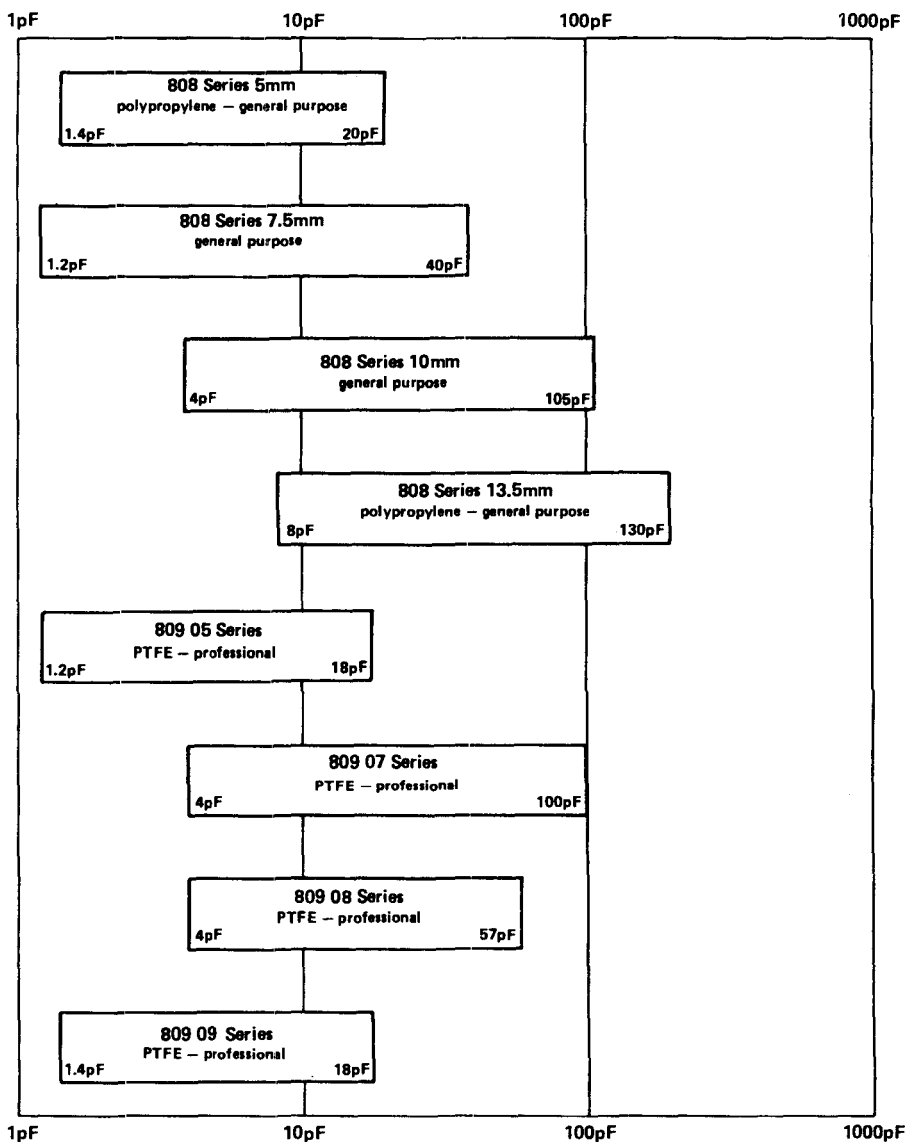
Loose in boxes of 1000 pieces or on 12mm blister tape in quantities as in the table.



Variable capacitors

selection guide

book 3 part 1d



film dielectric trimmers, miniature, general purpose

book 3 part 1d

808 Series (7.5 mm dia.)

Type No.	Maximum capacitance (pF)	Minimum capacitance (pF)	Rated voltage (V _{dc})	Maximum dimensions (mm)			Colour of base
				Length	Width	Height above board	
808 11558	6	1.2	250	8.8	8	10	grey
808 11109	10	1.4	250	8.8	8	10	yellow
808 11159	15	1.6	250	8.8	8	10	blue
808 11229	22	1.8	250	8.8	8	10	green
808 11279	27	1.8	250	8.8	8	10	red
808 11409	40	2	250	8.8	8	10	violet

808 Series (5.0 mm dia.)

808 23109	10	1.4	150	7	5.5	7	yellow
808 23159	15	1.6	150	7	5.5	8.8	blue
808 23209	20	3.5	150	7	5.5	8.8	green

808 Series (10.0 mm dia.)

808 32409*	40	4	250	11.5	10.6	11	grey
808 32659*	70	4.5	250	11.5	10.6	11	yellow
808 32809*	90	5	250	11.5	10.6	11	red
808 32101*	105	5	250	11.5	10.6	11	violet

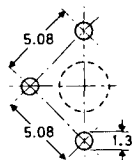
808 Series (13.5 mm dia.)

808 41121	130	8	150	14.9	14.1	11	green
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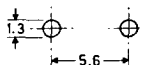
*Not for new designs.

Climatic category (IEC68) 40/070/21, 40/085/21 depending on type

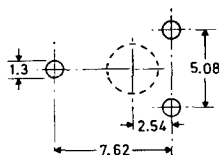
PIERCING DIAGRAMS FOR PWB MOUNTING



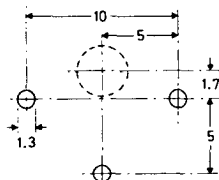
808 11... SERIES



808 23... SERIES



808 32... SERIES



Variable capacitors

film dielectric trimmers, miniature, professional book 3 part 1d

809 05 Series

Type No.	Maximum capacitance (pF)	Minimum capacitance (pF)	Rated voltage (V_{dc})	Maximum dimensions (mm)			Colour of dot
				Length	Width	Height above board	
809 05001	3.5	1.2	300	7.4	6.7	9	orange
809 05002	10	1.8	300	7.4	6.7	9	white
809 05003	18	2	300	7.4	6.7	9	red

809 07 Series

Type No.	Maximum capacitance (pF)	Minimum capacitance (pF)	Rated voltage (V_{dc})	Maximum dimensions (mm)			
				Length	Width	Height above board	
809 07008	40	4	200	14	11.5	9.2	**
809 07011	60	5	200	14	11.5	9.2	**
809 07013	80	6	200	14	11.5	9.2	**
809 07015	100	7	200	14	11.5	9.2	**

809 08 Series

Type No.	Maximum capacitance (pF)	Minimum capacitance (pF)	Rated voltage (V_{dc})	Maximum dimensions (mm)			
				Length	Width	Height above board	
809 08002	37	4	300	10.9	10.5	11	yellow
809 08003	57	5	300	10.9	10.5	11	blue

809 09 Series

Type No.	Maximum capacitance (pF)	Minimum capacitance (pF)	Rated voltage (V_{dc})	Maximum dimensions (mm)			
				Length	Width	Height above board	
809 09001	5.5	1.4	300	8.8	8	10.2	green
809 09002	9	2	300	8.8	8	10.2	white
809 09003	18	2	300	8.8	8	10.2	red

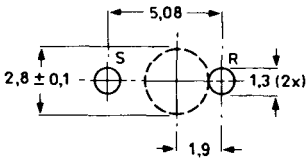
Category temperature range - 40 to + 125°C
**C_{max} marked in pF.

Continued

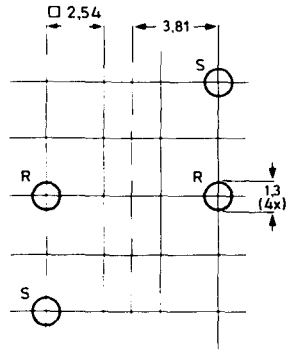
film dielectric trimmers, miniature, professional (cont.)

book 3 part 1d

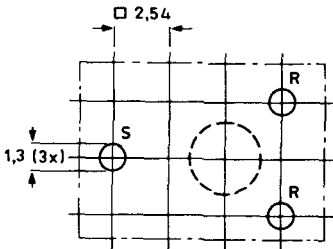
PIERCING DIAGRAMS FOR PWB MOUNTING



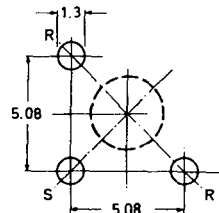
809 05... Series



809 07... Series



809 08... Series



809 09... Series

Fixed resistors

selection guide

book 3 part 1c

0.1Ω	1Ω	10Ω	100Ω	1kΩ	10kΩ	100kΩ	1MΩ	10MΩ	100MΩ
	1.2Ω	16W	AC20	±5%, ±10%	33kΩ				
	0.82Ω	12.5W	AC15	±5%, ±10%	22kΩ				
	0.68Ω	8.4W	AC10	±5%, ±10%	15kΩ				
0.1Ω	5.8W	AC07	±5%, ±10%	10kΩ					
0.1Ω	4.7W	AC05	±5%, ±10%	5.6kΩ					
0.1Ω	3.5W	AC04	±5%, ±10%	4.7kΩ					
0.1Ω	2.5W	AC03	±5%, ±10%	3kΩ					
	2.2Ω	1.6 or 2.5W	PR37,52	±5%	1MΩ				
						100kΩ	1W VR68	±5%	68MΩ
1Ω	0.6W	MRS25	±1%	1MΩ					
						220kΩ	0.5W VR37	±5%	33MΩ
1Ω	0.5W	SFR25H	±5%	10MΩ					
	10Ω	0.5W	SFR16T	±5%	3MΩ				
	10Ω	0.4W	MRS16T	±1%	100kΩ				
1Ω	0.4W	ES-SFR25	±5%	1MΩ					
1Ω	0.4W	SFR25	±5%	10MΩ					
1Ω	0.33W	NFR25	±5%	15kΩ					
	24Ω	0.25, 0.4W	MPR34	0.01-0.5%	1MΩ				
						220kΩ	0.25W VR25	±5%	10MΩ
1Ω	0.25W	RC01	±5%, ±2%	1MΩ					
	24Ω	0.125, 0.25W	MPR24	0.01-0.5%	1MΩ				

* A zero-ohm jumper is also available.

surface mounting, chip

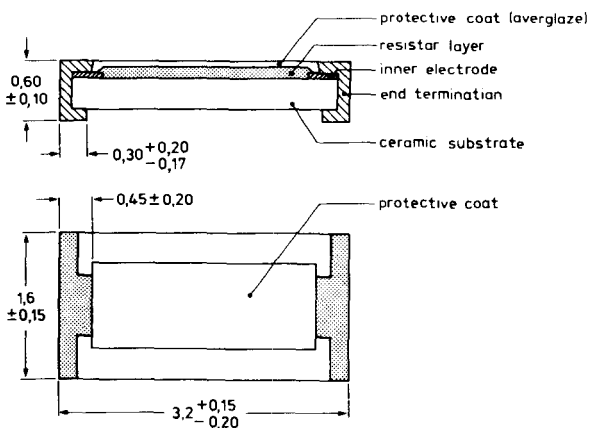
book 3 part 1c

The RC-01 is a 1206 size chip resistor available with $\pm 2\%$, and $\pm 5\%$ selection tolerances over the range 1Ω to $10M\Omega$

Style	Dimensions		Resistance range	Tolerance (%)	Preferred value series	Max. power dissipation at 70°C (W)	Temperature coefficient (ppm/°C)
	W(max)	L(max)					
■ RC-01 Series	1.75	3.35	1Ω to $10M\Omega$	± 5	E24	0.25	$< \pm 200$
			10Ω to $1M\Omega$	± 2	E24	0.25	$< \pm 200$

The chips are supplied on 8mm tape on reels of 4000 pieces.

A zero-ohm jumper, $R_{\max} = 50m\Omega$, $I_{\max} = 2A$ is also available. Type No. RC01-0R-0.



Resistor dimensions in mm

Two sizes of resistor, MPR24 and the MPR34 are available with resistance values between 4.99Ω and 1MΩ, selection tolerances from 0.5% down to 0.01% and temperature coefficients from ±25 ppm/°C down to ±5 ppm/°C.

Due to the large combinations of value, tolerance and temperature coefficient available, these resistors tend to be manufactured against order only.

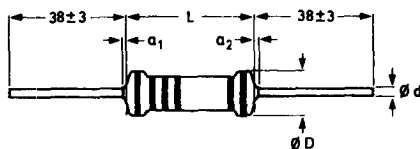
Style	Dimensions				Resistance range (Ω)	Tolerance (%)	Temp. coeff. (ppm/°C)	Power rating (W)
	∅D(max)	L(max)	d(nom)	a ₁ + a ₂				
MPR24 Series	2.5	6.5	0.6	≤1	4.9 to 100k > 100k to 1M 24 to 100k	0.5, 0.25, 0.1 0.5, 0.25, 0.1 0.05, 0.02, 0.01	25, 15, 10, 5 25, 15 25, 15, 10, 5	0.25 0.25 0.125
MPR34 Series	3.0	10	0.6	≤1	4.9 to 100k > 100k to 1M 24 to 100k	0.5, 0.25, 0.1 0.5, 0.25, 0.1 0.05, 0.02, 0.01	25, 15, 10, 5 25, 15 25, 15, 10, 5	0.4 0.4 0.25

Resistance values

Any resistance value within the above ranges can be manufactured with the associated tolerances and temperature coefficients. Resistors can also be supplied in matched sets for both tolerance and temperature coefficients.

MECHANICAL DATA

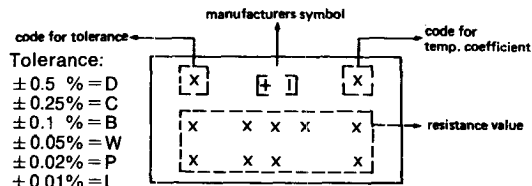
Colour Coding



Colour	Significant figures	Multiplier	Tol. %	TC .10 ⁻⁶ /K
black	0	1 ×		
brown	1	10 ×		
red	2	100 ×		50
orange	3	1 000 ×		15
yellow	4	10 000 ×		25
green	5	100 000 ×	±0.5	
blue	6	1 000 000 ×	±0.25	10
violet	7		±0.1	5
grey	8			
white	9			
silver	-	0.01 ×		
gold	-	0.1 ×		

MARKING

When marked, the following details are printed on the resistors:



Resistance value:

Nine positions are available for the resistance value

Example: 4R99 = 4.99Ω
 K2751 = 275.1Ω
 27R83 = 27.83Ω

Temperature coefficient:

TC 25 = 1
 TC 15 = 2
 TC 10 = 3
 TC 5 = 4

standard metal film

book 3 part 1c

(2% and 5% tolerance)

SFR16T is a miniature resistor similar in size to the CR16 and SFR16 which it has replaced.

SFR25 is available with a 5% tolerance over the range 1Ω to $10M\Omega$. As the ES-SFR25 it is available with 2% and 5% tolerances approved to CECC 40101-019 Style FX and British Telecom D2452 Style 91F over the range 1Ω to $1M\Omega$. It replaces the MR25 2% tolerance.

SFR25H is a 0.5 watt, 5% tolerance resistor replacing the CR37 and SFR30.

A 'zero ohm jumper', SFR25-0R, provides a bridging link which can be auto inserted into p.c.b.'s.

Style	Dimensions (Fig.1)			Resistance range	Tolerance (%)	Preferred value series	Nominal power rating (W)	Max. voltage (V)	Temperature coefficient (ppm/°C)
	D(max)	L(max)	d(nom)						
SFR16T Series	1.9	3.7	0.5	10Ω to $3M\Omega$	± 5	E24	0.5	200	$R \leq 100k\Omega < \pm 100$ $R > 100k\Omega < \pm 250$
SFR25 Series	2.5	6.5	0.6	1Ω to $10M\Omega$	± 5	E24	0.4	250	$R \leq 1M\Omega < \pm 100$ $R > 1M\Omega < \pm 250$
ES-SFR25 Series	2.5	6.5	0.6	1Ω to $1M\Omega$	± 5	E24	0.4	250	$< \pm 100$
SFR25-0R Series	2.5	6.5	0.6	zero ohm	+10m Ω	-	5 amp	250	
SFR25H Series	2.5	6.5	0.6	1Ω to $10M\Omega$	± 5	E24	0.5	350	$R \leq 1M\Omega < \pm 100$ $R > 1M\Omega < \pm 250$

The SFR16T, SFR25 and SFR25-0R are coated with a light green lacquer. The SFR25H has a red-brown lacquer. All are colour coded with four colour bands giving value and tolerance in accordance with IEC62.

Resistors are supplied in either 1000 piece (5000 for SFR16T and SFR25) ammpacks or 5000 piece reels.

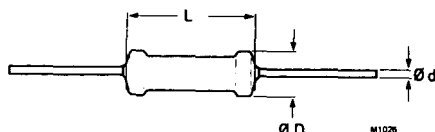


Fig. 1 Resistor dimensions in mm.

metal film

(1% tolerance)

MRS16T is a miniature resistor similar in size to the MR16 which it replaced. It is rated at 0.4W.

MRS25 is similar in size to the MR25. It is rated at 0.6 watt and replaced MR25 (1% tolerance), MR30 and MR30-8.

Style	Dimensions (Fig. 1)			Resistance range	Tolerance (%)	Preferred value series	Nominal power rating (W)	Max. voltage (V)	Temperature coefficient (ppm/°C)
	D(max)	L(max)	d(nom)						
MRS16T Series	1.9	3.7	0.5	10Ω to $100k\Omega$	± 1	E24; E96	0.4	200	$< \pm 50$
MRS25 Series	2.5	6.5	0.6	1Ω to $1M\Omega$	± 1	E24; E96	0.6	250	$< \pm 50\ddagger$

† Less than 4.99Ω t.c. $< \pm 100$ ppm.

The MRS16T and MRS25 are coated with a green lacquer.

The MRS16T is coded for resistance value and tolerance using five colour bands, giving the first, second and third significant figure; the multiplier and tolerance.

The MRS25 is coded for resistance value, tolerance and temperature coefficient, using six bands giving the first, second and third significant figures; multiplier; tolerance and temperature coefficient. A temperature coefficient of 50 ppm is a red band; a t.c. of 100 ppm is brown.

Resistors are supplied bandoliered in either 1000 piece ammpacks or 5000 piece drums.

Fixed resistors

fusible

book 3 part 1c

NFR25 is a range of resistors with defined fusing characteristics under overload conditions. Typically a power overload of 10 times causes the resistor to fail open-circuit within less than 10s without fire risk.

Style	Dimensions (Fig.1)			Resistance range	Tolerance (%)	Preferred value series	Nominal power rating (W)	Max. voltage (V)	Temperature coefficient (ppm/°C)
	D(max)	L(max)	d(nom)						
NFR25 Series	2.5	6.5	0.6	1Ω to 15kΩ	±5	E24	0.33	250	≤ 100

The NFR25 is coated with a grey lacquer and colour coded with four bands giving resistance value and tolerance.*

Resistors are supplied bandoliered either in 1000 piece ammpacks or 5000 pieces on a drum.

*According to IEC 62.

metal glaze, high ohmic

book 3 part 1c

The VR series of metal glaze resistors offers a range of high ohmic values combined with high working voltages.

Style	Dimensions (Fig.1)			Resistance range	Tolerance (%)	Preferred value series	Nominal power rating (W)	Max. voltage (Vrms)
	D(max)	L(max)	d(nom)					
VR25 Series	2.5	6.5	0.6	220kΩ to 10MΩ	±5	E24	0.25	1150
VR37 Series	3.7	9.0	0.7	220kΩ to 33MΩ	±5	E24	0.5	2500
VR68 Series	6.8	16.5	0.8	100kΩ to 68MΩ	±5	E24	1.0	7000

Coated with a light-blue lacquer and colour coded in accordance with IEC 62 except that the 4th (tolerance) band is yellow.

The series is packed on bandoliers in ammpacks of 1000 pieces.

metal film, high power

book 3 part 1c

The PR series of metal film resistors are rated at 1.6 watt or 2.5 watt and offer a high power rating in a small body size.

Style	Dimensions (Fig.1)			Resistance range	Tolerance (%)	Preferred value series	Nominal power rating at 70°C	Max. voltage (Vrms)
	D(max)	L(max)	d(nom)					
PR37 Series	3.9	10	0.6	2.2Ω to 1MΩ	±5	E24	R ≤ 27kΩ, 1.6W R > 27kΩ, 1.2W	500
PR52 Series	5.2	16.7	0.6	2.2Ω to 1MΩ	±5	E24	R ≤ 51kΩ, 2.5W R > 51kΩ, 2.0W	750

Coated with a red-brown high temperature silicon paint, with the value and tolerance printed on the body.

PR37 are supplied in 1000 piece ammpacks; PR52 in 500 piece ammpacks.

wire wound

book 3 part 1c

The AC series of resistors covers the power ratings from 3 watt to 20 watt in seven body sizes from 0.1Ω to 33kΩ. The resistors are coated with a green non-flammable silicon cement.

Style	Dimensions (Fig.1)			Resistance range	Tolerance (%)	Preferred value series	Max. power rating at 70°C (W)
	D(max)	L(max)	d(nom)				
AC03 Series	5.5	13	0.8	0.1Ω to 8.2Ω 10Ω to 3kΩ	± 10 ± 5	E24 E24	2.5
AC04 Series	5.5	17	0.6	0.1Ω to 8.2Ω 10Ω to 4.7kΩ	± 10 ± 5	E24 E24	3.5
AC05 Series	7.5	17	0.8	0.1Ω to 8.2Ω 10Ω to 5.6kΩ	± 10 ± 5	E24 E24	4.7
AC07 Series	7.5	25	0.8	0.1Ω to 8.2Ω 10Ω to 10kΩ	± 10 ± 5	E24 E24	5.8
AC10 Series	8	44	0.8	0.68Ω to 8.2Ω 10Ω to 15kΩ	± 10 ± 5	E24 E24	8.4
AC15 Series	10	51	0.8	0.82Ω to 8.2Ω 10Ω to 22kΩ	± 10 ± 5	E24 E24	12.5
AC20 Series	10	67	0.8	1.2Ω to 8.2Ω 10Ω to 33kΩ	± 10 ± 5	E24 E24	16

The AC03 to AC07 series are supplied bandoliered in ammpacks of 500 pieces. The three larger sizes are supplied loose in boxes of 100 pieces.

Resistor kits

To assist in laboratory development work, resistor kits can be made available. They are based on the standard film ranges; the metal film ranges; the VR25 range of metal glaze and the PR52 range of high power film. Each kit consists of 100 pieces of either the E12 or E24 values over the available resistor range. Further details are available on request.

Preferred Value Series for Resistors and Capacitors

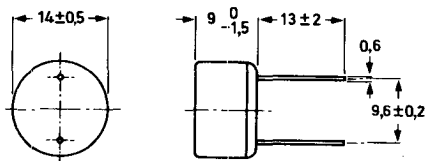
E 12 series:	10	12	15	18	22	27	33	39	47	56	68	82
E24 series:	10	11	12	13	15	16	18	20	22	24	27	30
	33	36	39	43	47	51	56	62	68	75	82	91
E96 series:	100	102	105	107	110	113	115	118	121	124	127	130
	133	137	140	143	147	150	154	158	162	165	169	174
	178	182	187	191	196	200	205	210	215	221	226	232
	237	243	249	255	261	267	274	280	287	294	301	309
	316	324	332	340	348	357	365	374	383	392	402	412
	422	432	442	453	464	475	487	499	511	523	536	549
	562	576	590	604	619	634	649	665	681	698	715	732
	750	768	787	806	825	845	866	887	909	931	953	976

light dependent resistor

book 3 part 1f

Type No.	Catalogue No.	R_{dark} ($M\Omega$)	R_{light} (Ω)	P_{max} (W)	Recovery rate ($k\Omega/s$)
ORP12	2322 600 95001	> 10	75 to 300	0.2	> 200

Dimensions in mm



APPLICATION

Cadmium sulphide cell for end-on illumination. Intended for non-critical on-off general purpose applications in which a lamp or relay is either operated directly or in conjunction with a suitable amplifier. It may also be used for automatic contrast and brightness control in television receivers. The device is mounted in a clear plastic housing filled with synthetic resin.

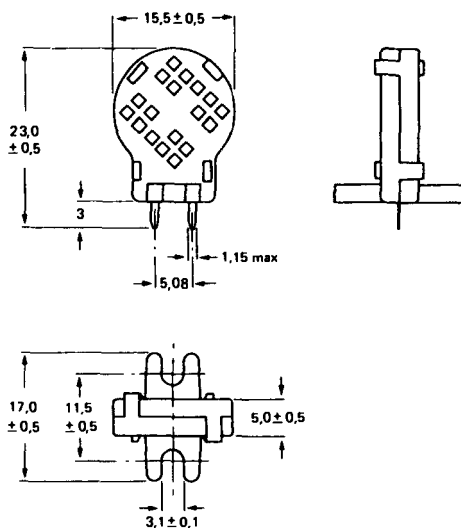
humidity sensor

book 3 part 1f

Type No.	Capacitance at 25°C (pF)	Humidity range (% R.H.)	Frequency range (kHz)	Sensitivity** (pF/% R.H.)
2322 691 90001	122 ± 15%	10 to 90	1 to 1000	0.4

** Measured with relative humidity in the range 33 to 43%.

Dimensions in mm



APPLICATION

For humidity measurements in e.g. electronic hygrometers for domestic use, laundry driers with automatic switch-off, self-regulating air humidifiers.

DESCRIPTION

This capacitive atmospheric humidity sensor consists of a non-conductive foil, which is covered on both sides with a layer of gold. The dielectric constant of the foil changes as a function of the relative humidity of the ambient atmosphere and, accordingly, the capacitance value of the sensor is a measure for relative humidity.

The characteristics are not affected by an incidental condensation of water on the sensor foil. It should not be exposed to acetone vapour.

negative temperature coefficient (NTC)

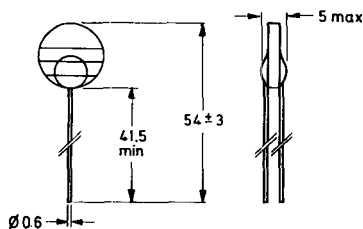
book 3 part 1f

Disc types 1W dissipation for temperature compensation

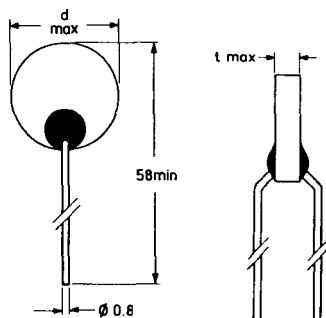
Type No.	Code No. 2322...	Resistance at 25°C (R ₂₅) (Ω)	B value (K)	Approx. resistance at maximum dissipation (Ω)	Approx. operating current at maximum dissipation (mA)	Approx. dissipation factor (mW/°C)
VA1033	610 11408	4	2800	0.25	2000	10
VA1053	610 11808	8	2900	0.8	1100	10
VA1100	610 11159	15	3125	0.7	1200	10
VA1034	610 11509	50	3300	2.6	600	10
VA1040	610 11131	130	4600	2.6	600	10
VA1039	610 11501	500	5200	6.8	380	10
VA1038	610 11132	1300	5450	10.3	300	10
2322 610 12339		33	3250	0.58	620	10

Disc types for surge current limiting

Type No.	R ₂₅ (Ω)	P _{max} (W)	I _{max} (A)	Dimensions (mm)	
				d	t
2322 644 90005 (was VA1104)	15	1.5	2.2	16	5



VA1000 Series



2322 644 90005

Dimensions in mm

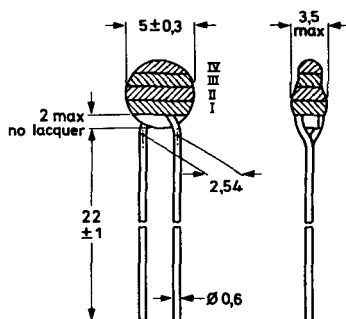
negative temperature coefficient (NTC) (cont.)

book 3 part 1f

Temperature measurement and control types

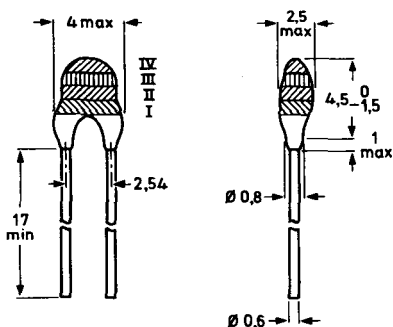
0.5W small disc types (resistance tolerance is $\pm 10\%$)

Type No.	Resistance at 25°C (Ω)	B _{25/85} (K)	Remarks
2322 642 62338	3.3	2675	-
2322 642 62478	4.7	2750	-
2322 642 62109	10	2875	-
2322 642 62229	22	3025	-
2322 642 62479	47	3150	-
2322 642 62101	100	3300	-
2322 642 62151	150	3375	replaces VA1096
2322 642 62221	220	3475	-
2322 642 62471	470	3650	replaces VA1097
2322 642 62102	1 000	3825	-
2322 642 62152	1 500	3975	replaces VA1098
2322 642 62222	2 200	4125	replaces VA1106
2322 642 62472	4 700	4350	replaces VA1109
2322 642 62103	10 000	4275	-
2322 642 62153	15 000	4200	replaces VA1108
2322 642 62223	22 000	4275	replaces VA1112
2322 642 62333	33 000	4350	replaces VA1111
2322 642 62473	47 000	4400	-
2322 642 62104	100 000	4500	-
2322 642 62224	220 000	4600	-
2322 642 62474	470 000	4650	-



0.25W miniature disc types (resistance tolerance is $\pm 5\%$)

Type No.	Resistance at 25°C (Ω)	B _{25/85} (K)
2322 640 13272	2 700	4000
2322 640 13472	4 700	3660
2322 640 13123	12 000	3700
2322 640 13223	22 000	3700
2322 640 13473	47 000	3850
2322 640 13683	68 000	3880
2322 640 13334	330 000	4150



Dimensions in mm

MARKING

The thermistors are marked with three or four colour code bands giving their resistance at 25°C.

negative temperature coefficient (NTC) (cont.)

book 3 part 1f

Temperature measurement and control types

For accurate temperature sensing and control up to 110°C

Type No.	Resistance at 25°C R_{25} (k Ω)	Max. power (W)	Fig.	Dimensions			
				D	$\varnothing d$	b	l
● 2322 645 03502	5	0.1	1	—	0.6	2.2	—
● 2322 645 03602	6	0.1	1	—	0.6	2.3	—
● 2322 645 03802	8	0.1	1	—	0.6	2.5	—
● 2322 645 03103	10	0.1	1	—	0.6	2.8	—
● 2322 645 23202	2	0.25	2	6	0.6	2.8	30.5
● 2322 645 23252	2.5	0.25	2	6	0.6	3.1	30.5
● 2322 645 23302	3	0.25	2	6	0.6	3.3	30.5
● 2322 645 23502	5	0.25	2	6	0.6	4.4	30.5
● 2322 645 43102	1	0.75	2	8.5	0.6	3.0	28
● 2322 645 43202	2	0.75	2	8.5	0.6	4.1	28

MECHANICAL DATA

Outlines

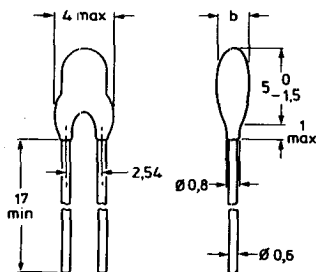


Fig. 1

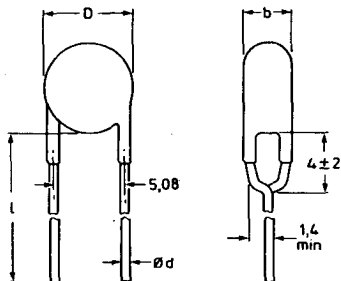


Fig. 2

Resistance tolerance

The tolerance on resistance at 25°C (R_{25}) is $\pm 5\%$.

B value

The B value (the slope of the resistance/temperature characteristic) is $3965 \pm 50K$.

Continued

negative temperature coefficient (NTC) (cont.)

book 3 part 1f

● 2322 645 Series (continued)

Resistance/Temperature Characteristic

The nominal resistance value (R_T) expressed as the ratio to the resistance at 25°C (R_{25}) is given over the range -40°C to +110°C in 10°C steps in the following table.

The total resistance tolerance, R_{tol} , (the combination of the tolerance on R_{25} and on B) and the temperature tolerance, T_{tol} , (the deviation in temperature over which the nominal resistance value may be achieved) are also given.

Temp. (°C)	$\frac{R_T}{R_{25}}$	R_{tol} ± %	T_{tol} ± %
-40	32.84	9.5	1.44
-30	17.39	8.7	1.41
-20	9.589	7.9	1.37
-10	5.489	7.2	1.33
0	3.251	6.5	1.28
10	1.986	5.9	1.23
20	1.249	5.3	1.18
25	1.000	5.0	1.14
30	0.806	5.3	1.25
40	0.5331	5.8	1.44
50	0.3606	6.3	1.66
60	0.2490	6.8	1.89
70	0.1753	7.2	2.11
80	0.1256	7.6	2.34
90	0.9155	8.0	2.59
100	0.06775	8.4	2.86
110	0.05086	8.8	2.32

negative temperature coefficient (NTC) (cont.)

book 3 part 1f

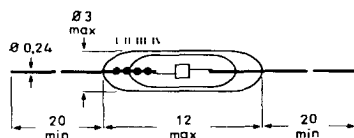
Temperature measurement and control types

Miniature bead types for use in fluids

Type No.	Replaces type	Resistance at 25°C $R_{25}(\Omega)$	B-value (K)
----------	---------------	--	-------------

gas-filled glass tube version (replaces VA3200 family)

2322 633 22102	VA3200	1 000	2075
2322 633 22222	VA3202	2 200	2285
2322 633 22472	VA3204	4 700	2485
2322 633 22103	VA3206	10 000	3750
2322 633 22223	VA3208	22 000	3560
2322 633 22473	VA3210	47 000	3750
2322 633 22104	VA3212	100 000	3900
2322 633 22224	VA3214	220 000	3860
2322 633 22474	VA3216	470 000	3950
2322 633 22105		1 000 000	4100



gas-filled glass tube

Type No.	Replaces type	Resistance $R_{25}(\Omega)$	B-value (K)
----------	---------------	--------------------------------	-------------

glass dipped bead version (replaces VA3400 family)

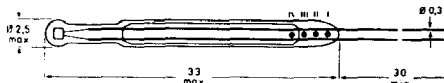
2322 626 22102	VA3400	1 000	2075
2322 626 22222	VA3402	2 200	2285
2322 626 22472	VA3404	4 700	2485
2322 626 22103	VA3406	10 000	3750
2322 626 22223	VA3408	22 000	3560
2322 626 22473	VA3410	47 000	3750
2322 626 22104	VA3412	100 000	3900
2322 626 22224	VA3414	220 000	3860
2322 626 22474	VA3416	470 000	3950
2322 626 22105		1 000 000	4100



glass dipped bead

thermometer version (replaces VA3700 family)

2322 626 12102	VA3700	1 000	2075
2322 626 12222	VA3702	2 200	2285
2322 626 12472	VA3704	4 700	2485
2322 626 12103	VA3706	10 000	3750
2322 626 12223	VA3708	22 000	3560
2322 626 12473	VA3710	47 000	3750
2322 626 12104	VA3712	100 000	3900
2322 626 12224	VA3714	220 000	3860
2322 626 12474	VA3716	470 000	3950
2322 626 12105		1 000 000	4100



thermometer version

Dimensions in mm

Family characteristics

Configuration	P_{max} (mW)	Dissipation constant (mW/°C)	T_{max} (°C)	Stability after 1000h (%)
gas-filled glass tube	60	0.5	200	3
glass dipped bead	25	0.8	200	3
thermometer version	25	1.2	200	3

positive temperature coefficient (PTC)

book 3 part 1f

Temperature sensitive switching types

Type No.	Code No.	Resistance at 25°C (R_{25})	Switch temp. (°C)	App. res. at switch temp. (Ω)	Temp. coef. at switch temp. (% per °C)	Dissipation factor (mW per°C)	Max. voltage (V)	Dimensions (mm)	
								Max body dimension	Lead length (min)
E220ZZ/01	661 91005	50	+25	50	9	6	40	7.5	39
E220ZZ/02	661 91004	30	+45	60	16	8.5	50	7.5	39
E220ZZ/03	661 91002	50	+80	150	18	8.5	50	7.5	39
E220ZZ/04	661 91003	40	+110	80	75	8.5	50	7.5	39
VA8650	662 93037	80	+75	220	23	21	265	12.6	38.4

MECHANICAL DATA

Dimensions in mm.

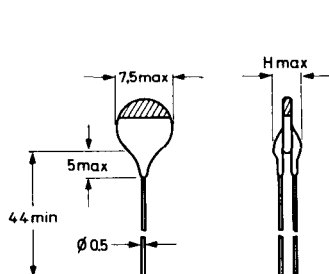


Fig. 1 E220ZZ/01 to 04

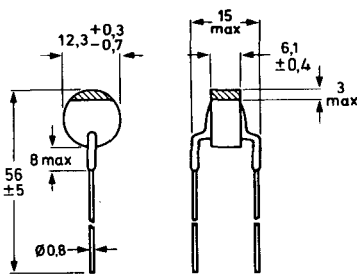


Fig. 2 VA8650

Table 1

Catalogue number	Colour band	H_{max}
2322 661 91002	yellow	6
2322 661 91003	green	6
2322 661 91004	orange	6
2322 661 91005	red	5

MARKING

E220ZZ/01 to 04: The thermistors are marked with a colour band at the top of the body according to Fig. 1.
VA8650: Yellow band on top of the body.

positive temperature coefficient (PTC) (cont.)

book 3 part 1f

Dual degaussing types for colour tv tubes

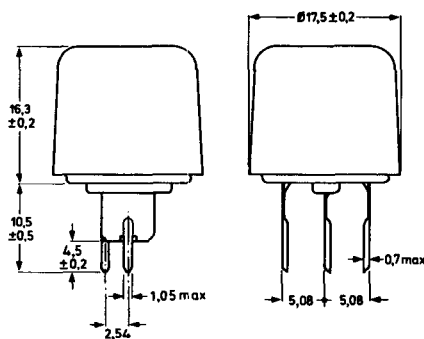
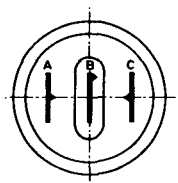
Type No.	Min. inrush current (A)	Max. voltage (Vrms)	Residual current (mA)		Construction
			after 30 seconds	after 3 minutes	
2322 662 98009	5	265	5	2	Parallel-series element
2322 662 98013	10	145	10	5	Parallel-series element
● 2322 662 98011	{ £ 6.5 \$ 3.6 }	{ 265 120 }	5	2	Parallel-series element

The 2322 662 98011 may be used on either American (110V) or European (220V, 240V) supplies.

MECHANICAL DATA

Dimensions in mm.

A and B are to be connected to the mains;
A and C are to be connected to the
degaussing coil.



Continued

positive temperature coefficient (PTC) (cont.)

book 3 part 1f

Overload protection – high voltage

switch temperature = 120°C, V_{max} at 55°C = 265V

Type No.	I_{nt} at	I_l (mA)		I_{max} at	I_{res}	R_{25}	Dimensions (mm)		
	55°C (mA)	10°C	25°C	at 0°C (mA)	(mA)	at 25°C (Ω)	d	b	l
2322 660 11293	12	24	21.9	110	5	1900	4.5	5	20
2322 660 11593	15	30	27.4	130	5	1200	4.5	5	20
2322 660 11893	18	36	32.9	165	5	850	4.5	5	20
2322 660 12293	22	44	40.2	200	6	560	4.5	5	20
2322 660 12793	27	54	49.3	250	6	380	4.5	5	20
2322 661 13393	33	66	60.2	290	7	280	6.5	5	20
2322 661 13993	39	78	71.2	350	7	200	6.5	5	20
2322 661 14793	47	94	85.8	420	7	140	6.5	5	20
2322 661 15693	56	112	102.2	500	8	100	6.5	5	20
2322 661 16893	68	136	124.2	600	8	72	8	5	20
2322 661 18293	82	164	149.7	730	9	50	8	5	20
2322 661 11013	100	200	182.6	900	9	33	8	5	20
2322 662 11213	120	240	219.1	1100	12	26	10	5	20
2322 662 11513	150	300	273.7	1300	12	20	12	5	20
2322 662 11813	180	360	328.6	1700	14	14	12	5	20
2322 663 12213	220	440	401.7	2100	16	10	13	5	20
2322 663 12713	270	540	493.0	2500	19	8	16	5	20
2322 664 13313	330	660	602.5	3000	25	7	20	6	16
2322 664 13913	390	780	712.0	3600	25	5	20	6	16
2322 664 14713	470	940	858.1	4300	25	3.5	20	6	16

I_{nt} = guaranteed non-trip current, I_{max} = maximum inrush current.

I_l = guaranteed trip current, I_{res} = residual current after tripping.

Varistors, thermistors & sensors

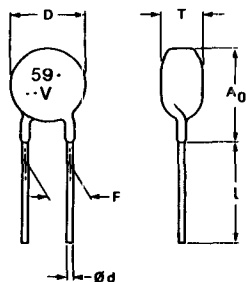
voltage dependent resistors (VDR)

book 3 part 1f

Type No.	Nom. mains voltage	Max. voltage ratings	Volts at 1mA	2322 592 family Max. non-repetitive transient current (8/20 μ s): 400A	2322 593 family Max. non-repetitive transient current (8/20 μ s): 1200A	2322 594 family Max. non-repetitive transient current (8/20 μ s): 2500A	2322 595 family Max. non-repetitive transient current (8/20 μ s): 4500A	
2322 592 ...				Max. clamping voltage at 50A (V)	Max. clamping voltage at 100A (V)	Max. clamping voltage at 100A (V)	Max. clamping voltage at 100A (V)	
2322 593 ...	(V) r.m.s.	(V) r.m.s.	(V) d.c.	min. (V)				
2322 594 ...								
2322 595 ...								
56006		60	85	90	220	210	185	175
57506		75	100	108	240	250	225	210
59506		95	125	135	295	310	285	270
51316	110	130	170	185	405	425	385	360
51516		150	200	216	470	485	455	415
51716		175	225	243	525	550	520	480
52316		230	300	324	675	720	686	650
52516	220	250	320	351	745	780	740	695
52716	240	275	350	387	820	850	815	765
53016		300	385	423	905	930	880	835
54216	380	420	560	612	1340	1350	1310	1225
54616	415	460	615	675	1480	1490	1440	1342

Outlines

Dimensions in mm



Series	D max.	T max.	A ₀ max.	l min.	d $\pm 10\%$	F
2322 592	7	7	11	20	0.6	5 ^{+0.8} _{-0.2}
2322 593	9	7	13	19	0.6	5 ^{+0.8} _{-0.2}
2322 594	12.5	7	16	17	0.8	7.62 ± 1
2322 595	16	7	19	16	0.8	7.62 ± 1

The 2322 592 and 593 ranges are available on radial tape bandoliers, to special order. Normally supplies are loose-packed in boxes.

preset carbon potentiometers

book 3 part 1d

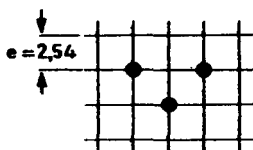
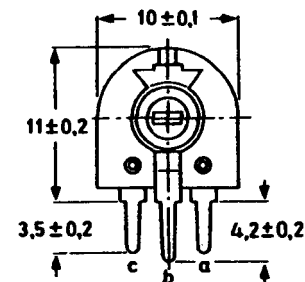
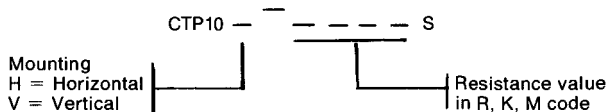
Preset potentiometers are mainly used for preset resistance control with provision for re-adjustment. They are particularly suitable for use in radio and television receivers and are available in both horizontal and vertical mounting positions.

CTP10 Series

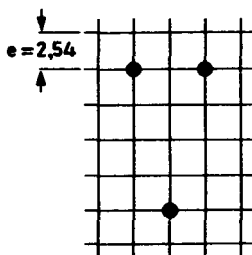
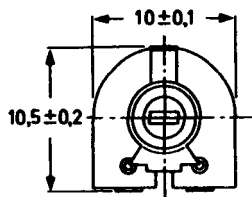
Open construction

Resistance range (E3 series)	47Ω to 4.7MΩ
Resistance law	Linear
Resistance tolerance	±20%
Max. power dissipation	0.1 watt at 70°C

Type number



Vertically mounted



Horizontally mounted

Continued

preset cermet potentiometers

book 3 part 1d

Preset potentiometers are mainly used for preset resistance control with provision for re-adjustment. Preset cermet potentiometers are particularly suitable for use in professional apparatus and/or in those applications where stability is of extreme importance. The EMP10 series is completely enclosed rendering them suitable for applications in unfavourable environments.

MTP10 Series

Open construction

Resistance range (E3 series)	47Ω to 10MΩ
Resistance law	Linear
Resistance tolerance	±20%
Max. power dissipation	0.5 watt at 70°C

Type number

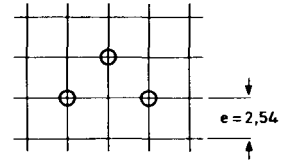
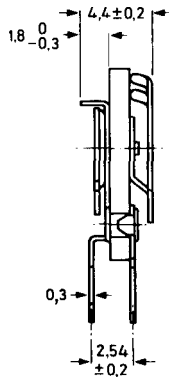
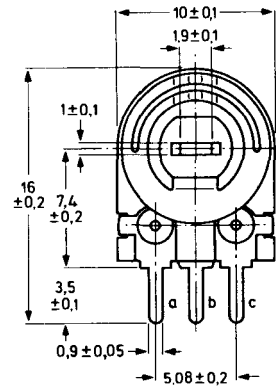
MTP10 --- S

Mounting

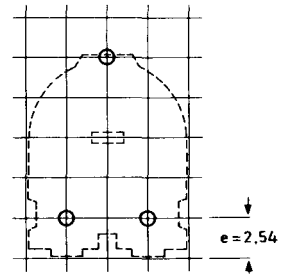
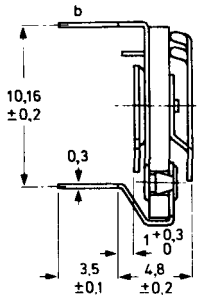
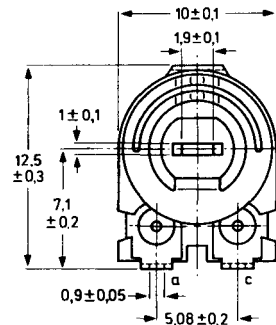
H = Horizontal

V = Vertical

Resistance value
in R, K, M code



Vertically mounted



Horizontally mounted

Continued

Potentiometers

preset cermet potentiometers (cont.)

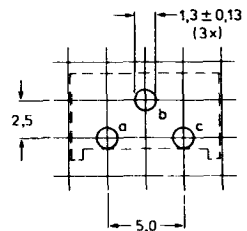
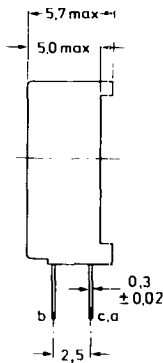
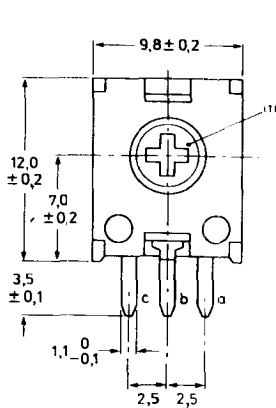
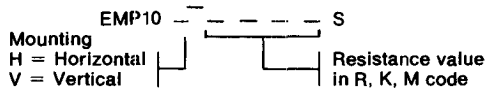
book 3 part 1d

EMP10 Series

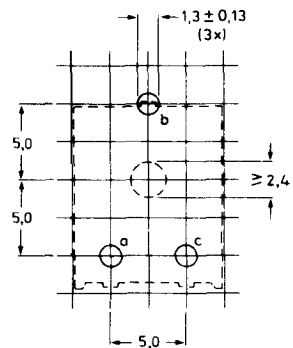
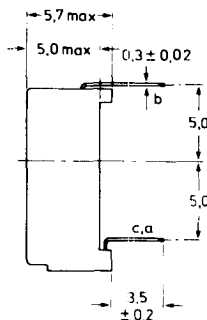
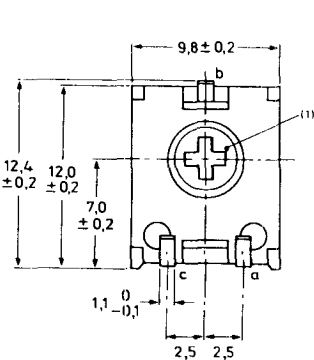
Enclosed construction

Resistance range (E3 series)	47Ω to 10MΩ
Resistance law	Linear
Resistance tolerance	±20%
Max. power dissipation	0.5 watt at 40°C

Type number



Vertically mounted



Horizontally mounted

pot packs, carbon and cermet

book 3 part 1d

PP17 Series

The PP17 series is a range of modular based potentiometers. The series includes resistance elements (linear and logarithmic), battery switches, drive units, mounting brackets, detents, shielding covers and heatsinks which can be assembled to customer's order to form an almost infinite variety of carbon and cermet control potentiometers.

The potentiometer series can be divided into two groups:
versions without spindle, to be activated by snap-in devices of customer versions with one of many available spindle types

Quick reference data

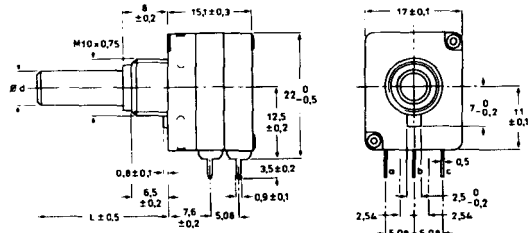
Resistance range (E3 series)

carbon, linear law	470 Ω to 1M Ω
carbon, logarithmic law	2.2k Ω to 470k Ω
cermet, linear law	470 Ω to 1M Ω

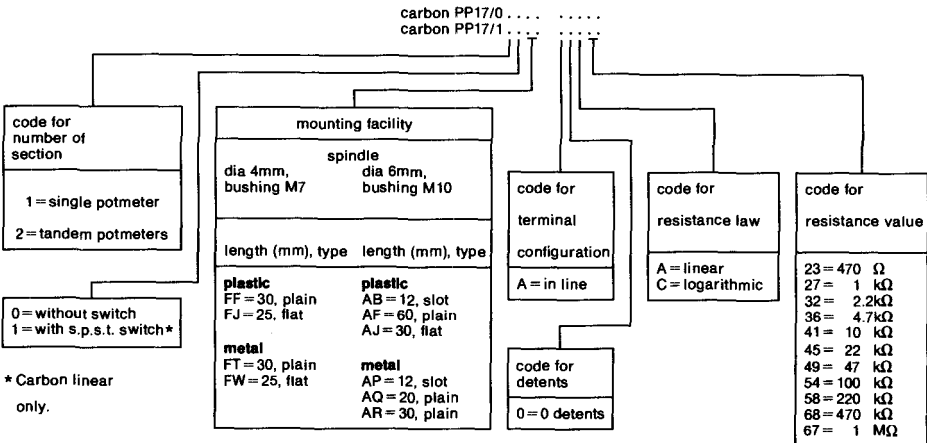
Maximum dissipation

carbon, linear law	0.2W
carbon, logarithmic law	0.1W
cermet, linear law	1.25 to 3W

Outline: version with spindle, tandem vertical with mounting bush M10 \times 0.75mm



COMPOSITION OF THE PART NUMBER for versions with spindle



402

Mullard Materials

- **Products included for the first time in this guide are indicated both in the index pages and data pages by a black dot alongside the type number.**

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LA4129	423	4313 059 66100	429		
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LA4145	422	● 4313 059 66200	429		
LA4146	422	● 4313 059 67030	429		
LA4147	422	● 4313 059 67050	429		
LA4148	422	● 4313 059 67060	429		
LA4228	423	4313 059 68080	428		
LA4229	423	● 4313 059 68140	428		
LA4230	423	4313 059 68270	428		
LA4245	422	4313 059 68300	428		
LA4246	422	4313 059 68330	428		
LA4247	422	4313 059 68350	428		
LA4248	422	4313 059 68370	428		
LA4328	423	● 4313 059 68380	428		
LA4329	423	● 4313 059 68400	428		
LA4344	422	● 4313 059 68440	428		
LA4345	422	● 4313 059 68500	428		
LA4346	422	4322 020 05590	431		
LA4347	422	4322 020 06040	431		
LA4348	422	4322 020 34400	416		
LA4528	423	4322 020 34420	416		
LA4529	423	4322 020 36750	416		
LA4543	422	432202055010	411		
LA4544	422	4322 021 33850	410		
LA4545	422	4322 021 33860	410		
LA4546	422	4322 021 33870	410		
1DT2630	424	4322 021 33880	410		
3122 104 90490	416	4322 021 33890	410		
3122 104 91110	416	4322 021 33900	410		
3122 104 91150	416	4322 021 33910	410		
3122 104 93760	416	4322 021 33920	410		
3122 134 90110	416	4322 021 34040	411		
● 431202034110	409	4322 021 34050	411		
4312 020 36630	417	4322 021 34060	411		
4312 020 36640	417	4322 021 34070	411		
4312 020 36650	417	4322 021 34110	411		
4312 020 36690	417	● 4322 021 34170	411		
4312 020 36700	417	4322 022 67560	422		
4312 020 36710	417	4322 022 67570	422		
4312 020 37000	410	4322 022 67580	422		
4312 020 37010	410	432202506050	411		
4312 020 37020	410	432202506060	411		
4312 020 37030	410	432202506070	411		
4312 020 37040	410	432202506080	411		

APPLICATION NOTES FOR MANGANESE-ZINC FERROXCUBE

- Grade A8 (3E4*) High permeability material suitable for pulse applications, where the pulse repetition frequency is less than about 500 kHz and for wideband applications where the lowest frequency of the transmission band does not exceed about 1 MHz.
- Grade A10 (3D3*) This is a low-loss high-stability material for use at frequencies between 200 kHz and 2 MHz. Normally available in pot core or RM core form.
- Grade A13 (3H1*) A low-loss high permeability, high stability material. Used in the form of pot cores or RM cores for frequencies up to 300 kHz, or in toroidal form for pulse and wideband transformers where the lowest frequency of the transmission band does not exceed about 10 MHz.
- Grade A14 (3H3*) A very low-loss, high permeability material with excellent long term stability characteristics. Used in the form of RM cores for frequencies up to 300 kHz.
- Grade A16(3C8*) Suitable for power applications where a high operating flux density and low total core-loss are required. Generally available in U-core and E-core forms, for use in tv line output transformers, switched-mode power supplies and inverters.
- Grade 3C85 An enhanced version of material grade A16(3C8) for SMPS power cores up to 200 kHz.
- Grade 3F3 A low loss high frequency material for SMPS power cores up 500 kHz.
- Grade 3B
Grade 3C6 } Materials for extruding as rods and tubes, for use in wideband chokes.
- Grade 3E1
Grade 3E2 } High permeability materials for general purpose toroids.
- Grade 3H2 Material for general purpose toroids.
- Grade 3S1
Grade 3S2 } Materials exclusively for RFI suppression beads.

APPLICATION NOTES FOR NICKEL-ZINC FERROXCUBE

- Grade B1 A relatively high permeability material with a high intrinsic resistivity. For use at frequencies up to 1 MHz and in applications where the eddy-current loss of a manganese-zinc Ferroxcube becomes unacceptable. It is available as single and double aperture cores.
- Grade B2 (4B1*) This grade is widely used for applications in the frequency range 500 kHz to 2 MHz. It is available in the form of double aperture cores and extruded as rods and tubes, for use in wideband chokes.
- Grade B10 (4C6*) A low-loss high-stability material for use in the frequency range 1 to 15 MHz. Normally available in the form of toroids, pot cores and RM cores for inductor and transformer applications.
- Grade 4S3 Material exclusively for RFI suppression beads.

Obsolete materials

Grades A4 and A5 are obsolete materials replaced by grade A13.
Grade A9 is an obsolete material replaced by grade A16.
Grades A19, B4 and B5 have been withdrawn.

*Similar Philips material grades.

cores for power applications Ferroxcube grade A16(3C8)

book 3 part 2a

For use in switched-mode power supplies and Inverters

Description and nominal dimensions	Type No.	Accessories		Max. throughput power in push-pull configuration at 25 kHz (W)	Other features	
		coil former	other			
E-CORES						
E42/21/15**	● 4312 020 34110	-	-	300	transformer core	
	● FX3781	-	-	-	1.0mm gapped core	
	● FX3782	-	-	-	0.5mm gapped core	
E42/21/20**	FX3607	-	-	330	transformer core gapped core	
	FX3687	-	-	-	1.5mm gapped core	
	● FX3787	-	-	-	-	
E55/28/21**	FX3608	-	-	600	transformer core gapped core	
	FX3688	-	-	-	-	
E55/28/25**	FX3609	-	-	700	transformer core gapped core	
	FX3689	-	-	-	-	
E65/33/27**	FX3845	-	-	1000	transformer core gapped core	
	FX3865	-	-	-	-	
E25/9/6	FX3591*	-	-	-	core pair EE25/19/6	
E25/9/12	FX3590*	-	-	-	core pair EE25/19/12	
E34/13/8	FX3579*	-	-	-	core pair EE34/26/8	
E41/22/9	FX3574*	-	-	-	core pair EE41/44/9	
E44/17/18	FX3838/9†	-	clamp DT2640†	-	circular centre pole; for telephony line hybrid transformer	
EC-CORES						
EC35/17/10**	FX3720	{ DT2723 DT2724	solder tag	DT2700 -	100	transformer core gapped core
	FX3721					
EC41/19/12**	FX3730	{ DT2733 DT2734	solder tag	DT2700 DT2701	150	transformer core gapped core
	FX3731					
EC52/24/14**	FX3740	{ DT2743 DT2744	solder tag	DT2700 DT2702	300	transformer core gapped core
	FX3741					
EC70/34/17**	FX3750	{ DT2753 DT2754	solder tag	DT2700 DT2702	700	transformer core gapped core
	FX3751					

* Maintenance types. Available for the maintenance of existing equipments.

** Current types. For new designs please consider cores from the ETD series.

† Special types.

Continued

cores for power applications (cont.) Ferroxcube grade A16(3C8) book 3 part 2a

For use in switched-mode power supplies and inverters

Description and nominal dimensions	Type No.	Accessories		Max. throughput power in push-pull configuration at 25 kHz (W)	Other features
		coil former	other		
ETD CORES					
ETD34/17/11†	4312 020 37000		stainless steel clips		nominal gap length = zero
	4312 020 37010				nominal gap length = 0.1 mm
	4312 020 37020	4322 021 33850	2 per transformer		nominal gap length = 0.2 mm
	4312 020 37030		4322 021 33890		nominal gap length = 0.5 mm
	4312 020 37040				nominal gap length = 1.0 mm
ETD39/20/13*	4312 020 37050		stainless steel clips		nominal gap length = zero
	4312 020 37060				nominal gap length = 0.1 mm
	4312 020 37070	4322 021 33860	2 per transformer		nominal gap length = 0.2 mm
	4312 020 37080		4322 021 33900		nominal gap length = 0.5 mm
	4312 020 37090				nominal gap length = 1.0 mm
ETD44/22/15*	4312 020 37100		stainless steel clips		nominal gap length = zero
	4312 020 37110				nominal gap length = 0.2 mm
	4312 020 37120		2 per transformer		nominal gap length = 0.5 mm
	4312 020 37130	4322 021 33870	4322 021 33910		nominal gap length = 1.0 mm
	4312 020 37140				nominal gap length = 1.5 mm
ETD49/25/16*	4312 020 37150		stainless steel clips		nominal gap length = zero
	4312 020 37160				nominal gap length = 0.2 mm
	4312 020 37170		2 per transformer		nominal gap length = 0.5 mm
	4312 020 37180	4322 021 33880	4322 021 33920		nominal gap length = 1.0 mm
	4312 020 37190				nominal gap length = 2.0 mm

† These types are also available in material grades 3C85 and 3F3.

* These types are also available in material grade 3C85.

Continued

cores for power applications (cont.) Ferroxcube grade 3C85

book 3 part 2a

For use in switched-mode power supplies and inverters

Description and nominal dimensions	Type No.	Accessories			Other features			
		coil former	No. of pins	clips*				
RM CORES (to IEC Publication 431)								
RM6-S	FX3970	}	DT2491	4	}	transformer core (half)		
	LA1661		DT2492	6		DT2398 **	gapped core pair $A_L = 63$	
	LA1662					or	gapped core pair $A_L = 100$	
	LA1663				DT2498	gapped core pair $A_L = 160$		
RM8	FX3670	}	DT2470	4	}	transformer core (half)		
	LA1630		DT2480	8		DT2396 **	gapped core pair $A_L = 100$	
	LA1631					or	gapped core pair $A_L = 160$	
	LA1632					DT2496	gapped core pair $A_L = 250$	
RM10	FX3920	}	DT2534	DT2614	0	}	transformer core (half)	
	LA1641		DT2641	5	DT2406 **		gapped core pair $A_L = 160$	
	LA1642				or		gapped core pair $A_L = 250$	
	LA1643		DT2535	DT2642	8		DT2506	gapped core pair $A_L = 315$
	LA1644							gapped core pair $A_L = 400$
	LA1645					gapped core pair $A_L = 630$		
RM12/i	<ul style="list-style-type: none"> ● 4322 020 55010 ● 4322 025 06050 ● 4322 025 06060 ● 4322 025 06070 ● 4322 025 06080 	}	See DIL COILFORMERS FOR RM CORES below		}	● 4322 021 34170	transformer core (half)	
							gapped core pair $A_L = 160 \pm 5\%$	
							gapped core pair $A_L = 250 \pm 5\%$	
							gapped core pair $A_L = 315 \pm 5\%$	
							gapped core pair $A_L = 400 \pm 5\%$	
RM14	FX3980	}	DT2631	12	}	transformer core (half)		
	LA1671					DT2633	gapped core pair $A_L = 160$	
	LA1672						gapped core pair $A_L = 250$	
	LA1674		DT2632	0			gapped core pair $A_L = 400$	
	LA1675						gapped core pair $A_L = 630$	
	LA1676				gapped core pair $A_L = 1000$			

*Clips, 2 required per transformer.

**Current types. Available for equipment in current production and in service. Not recommended for new designs.

DIL COILFORMERS FOR RM CORES

RM6-S	4322 021 34040	8
RM8	4322 021 34050	12
RM10	4322 021 34060	12
● RM12/i	4322 021 34110	12
RM14	4322 021 34070	12

Continued

Ferroxcube

cores for power applications (cont.) Ferroxcube grade A16 (3C8)

book 3 part 2a

For use in switched-mode power supplies and inverters

Description and nominal dimensions	Type No.	Accessories			Other features
		coil former	No. of pins	clips*	
U-CORES					
U10/8/3	FX3676	DT2606	4	—	rectangular section
U15/11/6	FX3604	DT2607	4	—	rectangular section
U20/16/7	FX3605	DT2608	4	—	rectangular section
U25/20/13	FX3606	DT2609	10	—	rectangular section
U30/25/16	FX3837	DT2610	10	—	rectangular section
U60/35/15	FX3234	—	—	—	rectangular section
U60/55/15	FX3235	—	—	—	rectangular section
U,I-CORES					
U93/76/30	FX3862	—	—	—	rectangular section
I 93/30/30	FX3863	—	—	—	rectangular section
U100/57/25	FX3860	—	—	—	rectangular section
I 100/25/25	FX3861	—	—	—	rectangular section
TOROIDS – SPECIAL RANGE: intended for use in a.c. motor speed control; nylon coated: purple					
13.2 × 5.4	FX3848				
× 4.1					
27.6 × 17.1	FX3849				
× 6.3					

* Clips, two required per transformer.

cores for small-signal applications book 3 part 2b

Transformer pot cores

Size (mm)		Grade A13 (3H1)		Grade A8 (3E4)		Accessories				
dia.	height	type no.	A _L min (µe min)	type no.	A _L min	coil former		pressure ring	clips (4 per transformer)	tag board
						1 section	2 section			
10	3.4	FX2501*	1205	FX3280	2493	DT2169	-	DT2341	DT2342	DT2344
12	3.9	FX2502*	(900)	-	-	DT2170	-	DT2346	DT2347	DT2349
14	4.5	FX2236*	(950)	-	-	DT2202	DT2279	DT2351	DT2352	DT2354
18	5.6	FX2238*	(1150)	-	-	DT2178	DT2281	DT2356	DT2357	DT2359
21	6.8	FX2239*	(1150)	-	-	DT2204	DT2282	DT2361	DT2362	DT2364
25	8.0	FX2240*	(1200)	-	-	DT2179	DT2283	DT2366	DT2367	DT2389
30	9.4	FX2241*	5815	FX3286	11250	DT2205	DT2284	DT2371	DT2372	DT2374
35	11.4	FX2242*	6950	FX3287	13350	DT2180	DT2285	DT2376	DT2377	DT2379
45	14.6	FX2243*	8830	FX3288	15000	DT2206	-	DT2501	DT2502	DT2504

*Maintenance types. For new designs please refer to small signal transformer RM cores.

Transformer RM cores (to IEC Publication 431)

Size	Grade A13 (3H1)		Grade A8 (3E4)		Accessories					
	type no.	A _L min	type no.	A _L min	coil former		clips (2 per transformer)			
					No. of pins	1 section	2 section	plain		with earth tags
RM5	-	-	†*LA1577	2587	4	DT2612	-	-	-	DT2630
	-	-	LA1578	3731	6	DT2602	-	-	-	-
RM6-S	FX3432	1900	FX3437	3300	4	DT2491	-	-	-	-
			-	-	6	DT2492	-	-	DT2398†	DT2498
			LA1522	4125	4	-	DT2494	-	-	-
RM6-R	FX3433	2000	FX3438	3560	4	DT2467	-	-	-	-
			LA1523	5400	6	DT2517	DT2477	DT2398†	DT2498	
RM7	FX3434	2230	FX3439	4200	4	DT2468	-	-	-	-
					5	DT2391	-	-	DT2387†	DT2487
					8	DT2392	DT2523	-	-	
RM8	FX3435	2400	FX3440	4725	4	DT2470	-	-	-	-
			LA1524	6000	8	DT2480	DT2481	DT2396†	DT2496	
RM10	FX3436	3260	FX3441	6450	5	DT2534	-	-	-	-
			†**FX3971	7875	8	DT2535	DT2539	-	-	
			-	-	5	DT2641	-	DT2406†	DT2506	
			-	-	8	DT2642	DT2643	-	-	
			-	-	12	DT2644	DT2645	-	-	

*LA1577 manufactured in 3E1 material.

**FX3971 - special product.

† Current types. Available for equipment in current production and in service. Not recommended for new designs.

Note: RM5 Clip DT2630 has replaced DT2601.

Continued

cores for small-signal applications (cont.)

book 3 part 2b

Small pressed cores

Toroids – design range nylon coated

Nominal dimensions (mm)	Design data (mm)	Type No.			
		grade 3H2 (A13) (grey)	grade 3E1 (green)	grade 3E2 (blue)	grade 4C6 (violet)
4.3 × 1.9 × 1.4	4 × 2.2 × 1.1	FX4060	–	FX4050	–
6.3 × 3.7 × 2.3	6 × 4 × 2	FX4061	–	FX4051	FX3850
9.4 × 5.6 × 3.4	9 × 6 × 3	FX4062	–	FX4052	FX3851
14.5 × 8.5 × 5.5	14 × 9 × 5	FX4063	–	FX4053	FX3852
23.6 × 13.4 × 7.6	23 × 14 × 7	FX4064	–	FX4054	FX3853
29.6 × 18.4 × 8.1	29 × 19 × 7.5	–	FX4072	–	–
36.6 × 22.4 × 10.6	36 × 23 × 10	–	FX4073	–	–
36.6 × 22.4 × 15.6	36 × 23 × 15	–	FX4074	–	FX3854

Toroids – non-preferred range: not coated

Nominal dimensions (mm)	Type No.		
	grade A13	grade A8	grade B2
12.7 × 6.3 × 3.2	FX2691	FX3311	–
	FX3008*†	–	–
	FX3009*	–	–
25.4 × 19 × 4.8	–	FX3312	–
38.1 × 25.4 × 6.3	–	FX3313	● FX1588

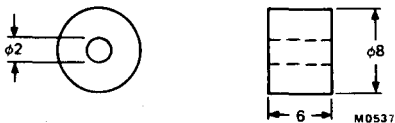
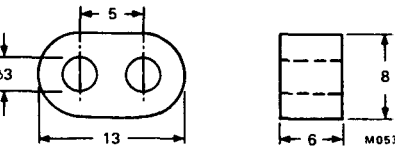
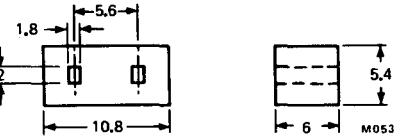
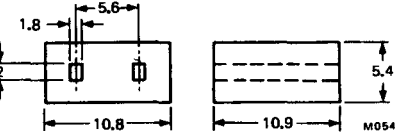
*coated types; †**FX3008** – special product.

Continued

cores for small-signal applications (cont.)

book 3 part 2b

Single and double aperture cores

Basic shape and nominal dimensions (mm)	Ferroxcube grade	Type No.
	<p>A13</p> <p>B1</p>	<p>FX2633</p> <p>FX2431 *</p>
	<p>A13</p> <p>B2</p>	<p>FX2754</p> <p>FX2049 *</p>
	<p>A8</p> <p>A13</p>	<p>FX3316 (half channel)</p> <p>FX3391 *</p>
	<p>A8</p> <p>A13</p> <p>B1</p>	<p>FX2837 (half channel)</p> <p>FX2634 *</p> <p>FX2249 (full channel)</p>

*Current types. Available for equipment in current production and in service. Not recommended for new designs.

Continued

cores for small-signal applications (cont.)

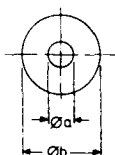
book 3 part 2b

Extruded cores

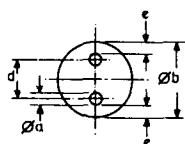
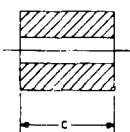
Screening beads

Ferroxcube beads with 1, 2 or 6 holes which can be used to introduce, in a simple way, additional impedance for the suppression of unwanted parasitic oscillations, or to provide screening.

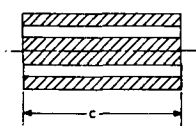
Nominal dimensions (mm)			Ferroxcube	Nominal dimensions (mm)					Ferroxcube
a	b	c	grade	a	b	c	d	e	grade
1.55	4.15	5.6	3B	0.7	5.9	12.4	2.6	0.8	B2



FX1115



FX1516

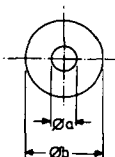


1.55 4.15 5.6

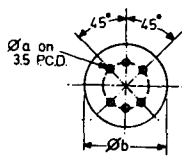
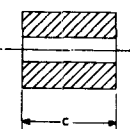
B2

0.6 6.3 10.5

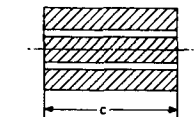
B2



FX1242



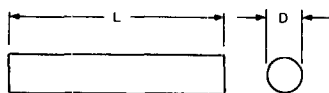
FX1898



Rods and tubes

Ferroxcube rods and tubes are available in a limited range of sizes and materials. As the available range is subject to change, Mullard Ltd. will be pleased to discuss requirements for rods and tubes in significant quantities.

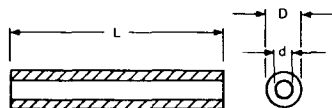
Rods



Nominal dimensions (mm)

Type No.	Ferroxcube grade	D_{max}	L_{max}
3122 104 91110	4B1	1.65	12.2
3122 104 91150	4B1	1.75	18.5
3122 104 90490	3C8	4.95	36.0
3122 134 90110	3C8	4.95	50.0
4330 030 30080	4B1	5.00	25.0
4330 030 30110	4B1	5.00	14.0

Tubes



Nominal dimensions (mm)

Type No.	Ferroxcube grade	D_{max}	d_{max}	L_{max}
4322 020 34400	3B	3.7	1.2	3.5
4322 020 34420	4B1	3.7	1.2	3.5
4322 020 36750	3B	4.3	2.0	15.4
3122 104 93760	3C8	4.95	2.9	36.0
● FX1128	3B	9.8	6.7	17.4

Mullard Ltd. will be pleased to discuss requirements for other rods and tubes in significant quantities.

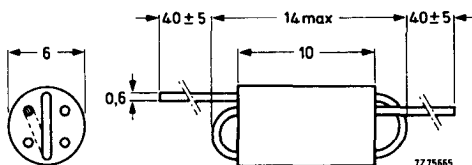
cores for small-signal applications (cont.)

book 3 part 2b

Extruded cores (cont.)

Wideband h.f. chokes

Wideband h.f. chokes are used for interference suppression, for example, in electric motors. Double chokes are used for twin leads, in which case the advantages of mutual induction can be realized. The chokes are supplied with six axial holes through which 1.5, 2.5 or 2×1.5 (double chokes) turns of tinned copper wire are threaded.



Number of turns	Z_{max} (k Ω)	f at Z_{max} (MHz)	Decrease of impedance in the freq. range (MHz)		Grade	Catalogue number
				(dB)		
1.5	≥ 0.3	120	10-300	≤ 7	3B	4312 020 36630
1.5	≥ 0.35	250	80-300	≤ 3	4B1	4312 020 36690
2.5	≥ 0.6	50	10-200, 30-100	$\leq 7, \leq 3$	3B	4312 020 36640
2.5	≥ 0.7	180	50-300, 80-220	$\leq 6, \leq 3$	4B1	4312 020 36700
2×1.5	$\geq 0.7^*$	50	10-220, 30-100	$\leq 7, \leq 3$	3B	4312 020 36650
2×1.5	$\geq 0.8^*$	110	50-300, 80-220	$\leq 7, \leq 3$	4B1	4312 020 36710

*Measure with two 1.5 turn windings in series.

Continued

cores for small-signal applications (cont.)

book 3 part 2b

R.F.I. suppression beads

The suppression of radio frequency interference can often be achieved by the use of Ferroxcube beads. A simple bead combination of beads threaded on the leads of one or two components in the circuit can give the required damping or attenuation characteristic.

FX4000 Series

Material grade	Type No.	Dimensions (mm)	Minimum Z (Ω) at different frequencies					
			D × d × l	1 MHz	3 MHz	10 MHz	30 MHz	100 MHz
3S1 plain	FX4000	3 × 0.7 × 4	19	38	39	31	26	23
	FX4001	3 × 0.7 × 10	58	95	97	77	66	58
	→ FX4002	3 × 1.0 × 4	14	29	30	24	20	18
	FX4003	3 × 1.0 × 10	33	72	73	59	50	44
	→ FX4004	5 × 0.7 × 4	27	52	53	42	36	32
	FX4005	5 × 0.7 × 10	70	125	128	90	70	50
	FX4006	5 × 1.5 × 4	10	20	32	26	22	20
	FX4007	5 × 1.5 × 10	40	72	80	64	55	48
	→ FX4008	5 × 2.0 × 4	10	18	24	20	17	15
	FX4009	5 × 2.0 × 10	29	51	61	49	42	37
3S2 blue tint	FX4010	3 × 0.7 × 4	2	8	25	32	42	27
	FX4011	3 × 0.7 × 10	9	20	63	81	104	67
	→ FX4012	3 × 1.0 × 4	3	9	19	25	32	20
	FX4013	3 × 1.0 × 10	7	23	48	61	79	51
	→ FX4014	5 × 0.7 × 4	5	16	24	44	57	37
	FX4015	5 × 0.7 × 10	12	40	75	110	142	91
	FX4016	5 × 1.5 × 4	3	10	21	27	35	22
	FX4017	5 × 1.5 × 10	7	25	52	68	87	55
	→ FX4018	5 × 2.0 × 4	2	8	16	20	26	17
	FX4019	5 × 2.0 × 10	6	19	40	51	66	43
	FX4020	8 × 1.5 × 4	4	14	29	38	48	31
	FX4021	8 × 1.5 × 10	10	34	72	93	90	77
	→ FX4022	8 × 2.0 × 4	4	11	24	31	33	26
	FX4023	8 × 2.0 × 10	9	28	60	77	100	64
→ FX4024	8 × 3.0 × 4	2	8	17	22	28	18	
FX4025	8 × 3.0 × 10	6	20	42	55	62	45	
4S3 red tint	FX4026	3 × 0.7 × 4	1	3	11	27	50	57
	FX4027	3 × 0.7 × 10	2	9	28	67	126	140
	→ FX4028	3 × 1.0 × 4	1	3	9	20	38	43
	FX4029	3 × 1.0 × 10	2	8	21	50	95	107
	→ FX4030	5 × 0.7 × 4	2	5	16	36	68	77
	FX4031	5 × 0.7 × 10	4	12	38	90	170	190
	FX4032	5 × 1.5 × 4	1	3	9	22	41	47
	FX4033	5 × 1.5 × 10	2	7	23	55	104	116
	→ FX4034	5 × 2.0 × 4	1	2	7	17	32	36
	FX4035	5 × 2.0 × 10	2	6	18	42	80	89
	FX4036	8 × 1.5 × 4	1	4	13	31	57	65
	FX4037	8 × 1.5 × 10	3	10	32	77	145	161
	→ FX4038	8 × 2.0 × 4	1	3	11	26	49	55
	FX4039	8 × 2.0 × 10	2	9	27	64	121	134
	→ FX4040	8 × 3.0 × 4	1	3	8	18	34	38
	FX4041	8 × 3.0 × 10	2	6	19	45	85	95

→ Preferred types, normally available from Mullard Limited and franchised distributors. All other products listed will be subjected to a minimum manufacturing quantity.

Continued

cores for small-signal applications (cont.)

book 3 part 2b

Miscellaneous cores

E-cores Grade A13(3H1)

Type No.	Minimum effective permeability (μ_e) for two 'E' cores at 25°C	Dimensions for two E cores (mm)		
		length	height	width
FX1052*	900	13	13	3
FX1652*	1020	20	19	5
FX1238*	1100	25	19	6
FX1007*	1150	41	44	9
FX1239*	1150	34	26	8
FX1818*	1150	42	35	9
FX1653*	1150	90	63	24

*Maintenance types. Available for the maintenance of existing equipments.

H core assembly

Type No.	Minimum effective permeability (μ_e) at 25°C	Dimensions (mm)			No. of pins
		length	width	height	
LA1246 (H10)*	3820	12.4	11.2	6.1	8

*Current type. Available for equipment in current production and in service. Not recommended for new designs.

Cross cores (X cores) Grade A13(3H1)

Type No.	Minimum effective permeability (μ_e) at 25°C	Dimensions (mm)				coil former
		length	width	height (pair)	centre hole (min)	
FX2856 (X 22)	1440	21.3	21.3	14.2	∅3	● DT2265
FX2857 (X 30)	1525	29.6	29.6	23.6	∅4.5	● DT2266
FX2858 (X 35)	1580	34.6	34.6	28	∅5.5	● DT2267

Vinkor pot cores (to BS4061 range 1)

book 3 part 3

Size (mm)	Violet range Ferroxcube grade A13 (3H1)			Red range Ferroxcube grade A10 (3D3)			Blue range Ferroxcube grade B10 (4C6)		
	Type No.	Standard adjuster	Effective permeability (μ_e) with adjuster in mid-range position	Type No.	Standard adjuster	Effective permeability (μ_e) with adjuster in mid-range position	Type No.	Standard adjuster	Inductance factor (A_L) (nH)
10	LA1421	LA1383	100				LA1378	LA1384	33.8
	LA1422	LA1383	63				LA1379	LA1384	32.0
	LA1423	LA1383	40				LA1380	LA1384	30.0
12	LA1418	LA1383	100						
	LA1419	LA1383	63						
	LA1420	LA1383	40						
14	LA1228	LA1505	250	LA1157	LA1506	63	LA1375	LA1526	55.0
	LA1229	LA1505	160	LA1158	LA1506	40	LA1376	LA1526	45.7
	LA1230	LA1505	100				LA1377	LA1526	37.0
18	LA1417	LA1506	63						
	LA1225	LA1502	250	LA1161	LA1503	63	LA1372	LA1525	76.2
	LA1226	LA1502	160	LA1162	LA1503	40	LA1373	LA1525	59.4
	LA1227	LA1502	100	LA1163	LA1503	25	LA1374	LA1525	45.4
	LA1416	LA1503	63						
21	LA1222	LA1502	250	LA1164	LA1503	63			
	LA1223	LA1502	160	LA1165	LA1503	40			
	LA1224	LA1502	100						
25	LA1415	LA1503	63	LA1167	LA1432	63			
	LA1218	LA1428	400	LA1169	LA1432	25			
	LA1219	LA1428	250						
	LA1220	LA1428	160						
	LA1221	LA1428	100	LA1171	LA1432	40			
30	LA1414	LA1432	63	LA1172	LA1432	25			
	LA1214	LA1428	400						
	LA1215	LA1428	250						
	LA1216	LA1428	160	LA1173	LA1428	63			
	LA1217	LA1428	100	LA1174	LA1432	40			
35	LA1413	LA1428	63	LA1175	LA1432	25			
	LA1210	LA1362	400						
	LA1211	LA1362	250						
	LA1212	LA1362	160						
	LA1213	LA1428	100						
45	LA1412	LA1428	63						
	LA1409	LA1362	250						
	LA1410	LA1362	160						
	LA1411	LA1362	100						

The Vinkor range is available for maintenance only. For new designs refer to RM inductor core range.

Continued

Vinkor pot cores (to BS4061 range 1) (cont.)

book 3 part 3

ACCESSORIES

Size (mm)	Coil former		Clips (4 per assembly)	Ring (1 per assembly)	Tag board (1 per assembly)
	1 section	2 section			
10	DT2169 †DT2309	—	DT2342	DT2341	DT2344
12	DT2170	—	DT2347	DT2346	DT2349
14	DT2202 †DT2311	DT2279 —	DT2352	DT2351	{ DT2354* DT2382**
18	DT2178 †DT2312	DT2281 —	DT2357	DT2356	DT2359
21	DT2204	DT2282	DT2362	DT2361	DT2364
25	DT2179	DT2283	DT2367	DT2366	DT2369
30	DT2205	DT2284	DT2372	DT2371	DT2374
35	DT2180	DT2285	DT2377	DT2376	DT2379
45	DT2206	—	DT2502	DT2501	DT2504

†Spaced-off coil former for blue range Ferroxcube grade B10 (4C6).

*Tag board with 5 pins.

**Tag board with 4 pins.

RM inductor cores (to IEC 431)

book 3 part 4

The LA4000 'RM' range of high quality inductor cores for direct mounting on printed-wiring boards, is designed to achieve a greater packing density and to reduce the time and cost of assembly. Each core consists of two halves, held together by metal clips, thus providing a quick and easy method of assembly on a printed-wiring board with a grid spacing of 2.54mm (0.1 in) by means of pins in the coil former.

Size	Grey range Ferroxcube grade A14 (3H3)			Violet range Ferroxcube grade A13 (3H1)		
	type no.	inductance factor A_L (nH)	standard adjuster	type no.	inductance factor A_L (nH)	standard adjuster
RM5 (LA4000 Series)	LA4076	250	LA1519 (Grey)	LA4046	250	LA1519 (Grey)
	LA4077	160	LA1495 (Brown)	LA4047	160	LA1495 (Brown)
	LA4078	100	LA1494 (Yellow)	LA4048	100	LA1494 (Yellow)
RM6-S Series	4322 022 67580	400	4322 021 38600 (Black)	LA1530	630	LA1501 (Blue)
	4322 022 67570	315	4322 021 38610 (Brown)	LA1487	400	LA1501 (Blue)
	4322 022 67560	250	4322 021 38670 (Violet)	LA1436	315	LA1501 (Blue)
	—	—	—	LA1437	250	LA1429 (Natural)
	—	—	—	LA1441	160	LA1429 (Natural)
—	—	—	LA1442	100	LA1500 (Red)	
RM6-R (LA4100 Series)	—	—	—	LA4145	400	LA1501 (Blue)
	—	—	—	LA4146	250	LA1429 (Natural)
	—	—	—	LA4147	160	LA1429 (Natural)
	—	—	—	LA4148	100	LA1500 (Red)
RM7 (LA4200 Series)	—	—	—	LA4245	400	LA1400 (Blue)
	—	—	—	LA4246	250	LA1399 (Natural)
	—	—	—	LA4247	160	LA1399 (Natural)
	—	—	—	LA4248	100	LA1427 (Red)
RM8 (LA4300 Series)	—	—	—	LA4344	630	LA1430 (Blue)
	—	—	—	LA4345	400	LA1424 (Natural)
	—	—	—	LA4346	250	LA1424 (Natural)
	—	—	—	LA4347	160	LA1431 (Red)
	—	—	—	LA4348	100	LA1431 (Red)
RM10 (LA4500 Series)	—	—	—	LA4543	1000	LA1433 (Blue)
	—	—	—	LA4544	630	LA1428 (Natural)
	—	—	—	LA4545	400	LA1428 (Natural)
	—	—	—	LA4546	250	LA1432 (Red)
	—	—	—	LA4547	160	LA1432 (Red)

NOTE: The design range of RM inductor cores in A14 (3H3) material comprises RM5 and RM6-S outlines. One core half is fitted with a moulded-in nut and a spigot type adjuster is specified. The original Mullard Limited range of inductor cores in A14 (3H3) material, fitted with the stud type adjuster system have been withdrawn.

Continued

RM inductor cores (to IEC 431) (cont.)

book 3 part 4

Size	Red range Ferroxcube grade A10 (3D3)			Blue range Ferroxcube grade B10 (4C6)		
	type no.	inductance factor A_L (nH)	standard adjuster	type no.	inductance factor A_L (nH)	standard adjuster
RM5 (LA4000 Series)	LA4028	100	LA1494 (Yellow)	—	—	—
	LA4029	63	LA1493 (Red)	—	—	—
	LA4030	40	LA1492 (Natural)	—	—	—
RM6-S Series	LA1497	100	LA1500 (Red)	LA1562	36	LA1555
	LA1498	63	LA1500 (Red)	LA1563	51	LA1555
	LA1485	40	LA1500	—	—	—
	—	—	—	—	—	—
	—	—	—	—	—	—
RM6-R (LA4100 Series)	LA4128	100	LA1500 (Red)	LA4161	47	LA1555
	LA4129	63	LA1500 (Red)	LA4162	40	LA1555
	LA4130	40	LA1500 (Red)	LA4163	34	LA1555
	—	—	—	—	—	—
RM7 (LA4200 Series)	LA4228	100	LA1427 (Red)	—	—	—
	LA4229	63	LA1427 (Red)	—	—	—
	LA4230	40	LA1427 (Red)	—	—	—
	—	—	—	—	—	—
RM8 (LA4300 Series)	LA4328	100	LA1431 (Red)	—	—	—
	LA4329	63	LA1431 (Red)	—	—	—
	—	—	—	—	—	—
	—	—	—	—	—	—
RM10 (LA4500 Series)	LA4528	100	LA1432 (Red)	—	—	—
	LA4529	63	LA1432 (Red)	—	—	—
	—	—	—	—	—	—
	—	—	—	—	—	—

Continued

RM inductor cores (to IEC 431) (cont.)

book 3 part 4

ACCESSORIES

Size	Coil formers			Clips (2 per assembly)		Aligning plug (Note 2)
	1 section	No. of pins	2 section	without earth tag	with earth tag	
RM5	DT2612	4	—	—	DT2630	DT2500
	DT2602	6	—			
RM6-S	DT2491	4	—	DT2398*	DT2498	DT2505
	DT2492	6	—			
RM6-R	DT2467	4	—	DT2398*	DT2498	DT2505
	DT2605†	4	—			
	DT2517	6	DT2477			
RM7	DT2468	4	—	DT2387*	DT2487	DT2505
	DT2391	5	—			
	DT2392	8	DT2523			
RM8	DT2470	4	—	DT2396*	DT2496	DT2518
	DT2480	8	DT2481			
	DT2484	8	DT2485			
	DT2483	12	—			
RM10	DT2534	5	—	DT2406*	DT2506	DT2519
	DT2535	8	DT2539			
	DT2641	5	—			
	DT2642	8	DT2643			
	DT2644	12	DT2645			

*Current types. Available for equipment in current production and in service. Not recommended for new designs.

† Spaced-off coil former for blue range Ferroxcube grade B10 (4C6).

Note 1: RM5 clip **DT2630** has replaced **DT2601**.

Note 2: Aligning plugs will no longer be supplied by Mullard Limited, after exhaustion of current stocks. Dimensions of the expanding type of aligning plugs are published in introductory Notes RM5 to RM10.

Permanent magnets

In addition to designs produced in consultation with the customer, using our design and application facilities, Mullard provide a service for the design and manufacture of RARE EARTH and ceramic (FERROXDURE) magnets to customers' specialised requirements. A range of standard shapes and sizes is also available, including segments, rings, discs and blocks. Please consult Mullard House for your requirements.

material properties – Ferroxdure

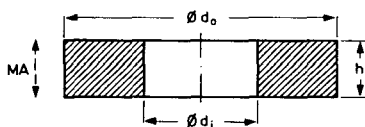
Material	$(BH)_{\max}$ (kJ/m ³)	Br (typ) (mT)	H _c J (typ) (kA/m)
Ferroxdure 300	29.5	400	150 (H _c B) min
Ferroxdure 330	25.5	370	240
Ferroxdure 270	22.8	350	335
Ferroxdure 380	28.2	390	275
Ferroxdure 400	31.3	410	275
Ferroxdure 480	26.8	380	320
Ferroxdure 425	33.0	420	240

Permanent magnets

preferred loudspeaker rings in Ferroxdure 300 material

Type No.	Nominal dimensions (mm)			Type No.	Nominal dimensions (mm)		
	o.diam.	i.diam.	height		o.diam.	i.diam.	height
FD5390†	36	18	8	FD5134	90	36	17
FD501	45	22	8	FD5555	90	42	17
FD5026	51	24	9	FD505	102	51	14
FD5556	53	24	11	FD5383	102	51	18
FD5422	55	24	8	FD5410	102	51	20
FD5551	60	24	9	FD5397	110	45	18
FD5406	60	24	14	FD506	121	57	12
FD5018	60	30	10	FD5328	121	57	17.5
FD5269	72	32	10	FD5424	121	57	20
FD5112	72	32	15	FD5363	134	57	20
FD5407	73	38.5	16	FD5387	224	122	25.3
FD5356	84	32	15				

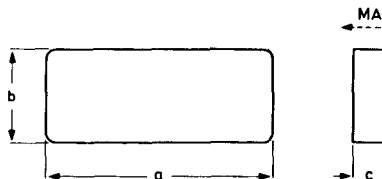
SUPPLIED NOT MAGNETISED, except where marked †, magnetisation direction is h.



Preferred loudspeaker rings

blocks in Ferroxdure 330 material

Type No.	Nominal dimensions (mm)		
	a	b	c
FD538	50	19	4.9
FD539†	50	19	4.9
FD541†	50	19	6.1
FD5306†	40	25	10
FD5286	152.4	101.6	25.4
FD5288	131	51	17.5
FD5323	102	76	25

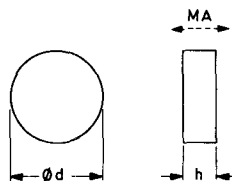


FXD blocks

SUPPLIED NOT MAGNETISED, except where marked †, magnetisation direction is c.

discs in Ferroxdure 330 material

Type No.	Nominal dimensions (mm)	
	ϕd	h
FD5345†	12.1	6.0
FD5351†	29.25	10.5
FD5557†	39.0	7.0



FXD discs

SUPPLIED NOT MAGNETISED, except where marked †, magnetisation direction is h.

Rare earth magnets

Introduction

Rare earth permanent magnets are capable of providing more magnetic energy than magnets made from any other available material. This high energy combined with high coercivity enables designers to reduce the volume of magnetic material used, which complements the trend to miniaturisation of electronic/electrical equipment.

Our magnetic materials containing rare earth elements are distinguished by the designation RES (rare earth sintering)

The intermetallic compound of cobalt and the rare earth element samarium is designated RES190. Another intermetallic compound containing iron, boron and the rare earth element neodymium is currently under development and is designated RES270.

Typical magnetic characteristics

Material	B_r (mT)	H_cB (kA/m)	H_cJ min. (kA/m)	$(BH)_{max}$ (kJ/m ³)
RES 190	890	670	1100	154 (19 MG _s O _e)
RES 270 (development data)	1100	750	835	216 (27 MG _s O _e)

Test conditions: ambient $25 \pm 2^\circ\text{C}$

Typical material properties

Property	Material		Unit
	RES190	RES270	
Temperature coefficient of B_r (20 to 150°C)	-0.04	-0.14	%/K
Temperature coefficient of H_cJ (20 to 150°C)	-0.05	-0.6	%/K
Recoil permeability	1.05	1.05	
Curie point	720	310	°C
Recommended initial magnetising field	1800	> 1600	kA/m
Maximum continuous operating temperature	250	140	°C
Density	8.3	7.2	$\times 10^3\text{kg/m}^3$
Hardness (Vickers)	500	600	

Continued

Permanent magnets

Rare earth magnets (cont.)

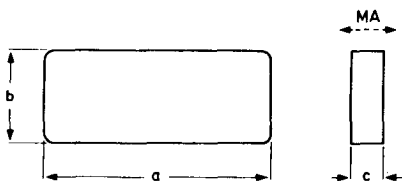
Standard sizes

BLOCKS – RES190

Orientation: perpendicular to $a \times b$

State: M – Magnetised

U – Unmagnetised



a (mm)	b (mm)	c (mm)	Mass (g)	Type Number	State
3 ± 0.1	2 ± 0.1	1 ± 0.1	0.05	4313 059 68080	M
3 ± 0.1	3 ± 0.1	1 ± 0.1	0.07	● 4313 059 68140	M
4 ± 0.1	4 ± 0.1	2 ± 0.15	0.25	4313 059 68330	M
8 ± 0.2	5 ± 0.2	3 ± 0.1	1.0	4313 059 68350	M
13 ± 0.2	7 ± 0.2	2.5 ± 0.1	1.9	4313 059 68370	M
18.5 ± 0.4	8.3 ± 0.3	4.3 ± 0.05	5.5	● 4313 059 68380	M
24 ± 0.7	7.3 ± 0.05	2 ± 0.05	2.9	● 4313 059 68440	M
30 ± 0.7	8.5 ± 0.05	2 ± 0.05	4.2	● 4313 059 68400	M
42 ± 1.5	42 ± 1.5	10 ± 0.1	148	4313 059 68300	U
52 ± 1.5	48 ± 1.5	10 ± 0.1	207	● 4313 059 68500	U
63 ± 1.5	36 ± 1.5	10 ± 0.1	188	4313 059 68270	U

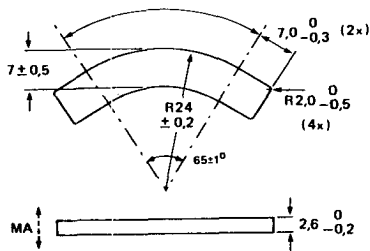
SEGMENT – RES190

State: unmagnetised

mass 5.6 g

type number:

● 4313 059 69020



Continued

Rare earth magnets (cont.)

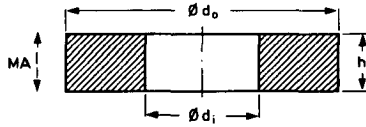
Standard sizes

DISCS and RINGS – RES190

Orientation: axial

State: M – Magnetised

U – Unmagnetised



d_o (mm)	d_i (mm)	h (mm)	Mass (g)	Type Number	State
5 ± 0.15		1.5 ± 0.05	0.25	4313 059 66040	M
5 ± 0.15		2.0 ± 0.05	0.35	4313 059 66070	M
6 ± 0.2		4.0 ± 0.2	0.9	4313 059 66000	M
8 ± 0.05		5 ± 0.1	2.1	● 4313 059 66190	M
10.5 ± 0.5		1.5 ± 0.1	1.0	● 4313 059 66030	M
10 ± 0.2		4 ± 0.2	2.6	4313 059 66020	M
14 ± 0.2		4.0 ± 0.2	5.1	4313 059 66010	M
17.5 ± 0.5		2.5 ± 0.05	5.0	4313 059 66100	U
25 ± 0.1		10 ± 0.05	41	● 4313 059 66200	U
14.2 ± 0.2	10.8 ± 0.3	2.65 ± 0.05	1.4	● 4313 059 67060	M
19.5 ± 0.05	5.4 ± 0.3	2 ± 0.05	4.6	● 4313 059 67050	U
72 ± 0.2	38 ± 0.3	4 ± 0.1	97	● 4313 059 67030	U

RING – RES190

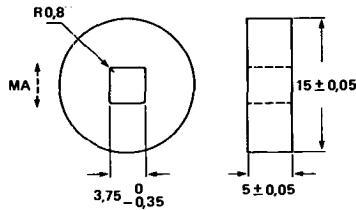
Orientation: diametrical

State: unmagnetised

mass: 6.8g

type number:

● 4203 031 60100



To supplement this standard product range which is based upon existing tooling, intermediate sizes can be produced by fabrication (grinding, slitting). In addition, to meet more specific requirements, Mullard are prepared to manufacture to customer's drawings.

PXE piezoelectric ceramic components

Piezoelectricity is 'pressure' electricity, a property of certain crystalline materials and of man-made poly-crystalline ceramic materials. It provides a simple, direct method for electro-mechanical, and mechano-electrical energy transformations. Mullard have introduced into their range of electrical ceramics piezoelectric elements chosen from three main grades of material. These elements are robust and have a high mechanical stiffness. They have the advantage that element shapes and their piezoelectric properties are formed during manufacture, and can be chosen to meet the requirements for particular applications. There are many fields in which modern piezoelectric elements have already been applied, and these materials are now of increasing importance to industry.

material properties

Material	PXE5	PXE21	PXE41	PXE42	PXE43	PXE52	Unit	
Thermal and mechanical data								
Curie temperature	285	270	315	325	300	165	°C	
Density ρ_m	7.7	7.75	7.90	7.7	7.7	7.8	10 ³ kg/m ³	
Mechanical quality factor for radial mode Q_m^E	≈ 80	≈ 80	≈ 1000	≈ 750	≈ 1000	≈ 65	—	
Frequency constants	N_p^E	2000	2000	2200	2200	2350	1950	Hz m or m/s
	N_j^D	1850	1900	2000	2015	2050	1900	
	N_i^E	1450	—	1620	—	—	1400	
	N_b^E	930	—	950	—	—	—	
Electrical data								
Relative permittivity $\epsilon_{33}^T/\epsilon_0$	2000	1750	1200	1300	1000	3500	—	
Dielectric loss factor $\tan \delta$	20	18	2.5	2.5	2.0	16	10 ⁻³	
Electro-mechanical data								
Coupling factors	k_p	0.63	0.62	0.58	0.58	0.5	0.65	—
	k_{33}	0.69	0.72	0.68	0.68	0.63	0.74	
	k_{31}	0.37	0.37	0.34	0.34	0.3	0.39	
	k_{15}	0.66	—	0.7	—	—	—	
Piezoelectric charge constants	d_{33}	390	385	268	285	210	580	10 ⁻¹² C/N or m/V
	d_{31}	-190	-180	-119	-130	-95	-270	
	d_{15}	515	—	480	—	—	—	
Piezoelectric voltage constants	g_{33}	22.0	25.0	25.2	25.0	25.0	19.0	10 ⁻³ Vm/N or m ² /C
	g_{31}	-10.9	-11.6	-11.6	-11.0	-10.7	-8.7	
	g_{15}	32.5	—	38.5	—	—	—	

PXE piezoelectric ceramic components

preferred types

Ultrasonic cleaning and welding

Type No.	PXE	Dimensions (mm)		
		o.d.	i.d.	thickness
4322 020 05590 (MB1109)	41	50	—	3
4322 020 06040 (MB2023)	42	38.1	12.7	6.35

Special PXE products

Some special products have been developed for specific applications. For applications of small movement transducers, fluid valves, high power actuators and automobile 'knock' sensing, please send written enquiries direct to Mullard House.

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Mullard

Special products and Assemblies

- Products included for the first time in this guide are indicated both in the Index pages and data pages by a black dot alongside the type number.

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Special Products and Assemblies

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high fidelity applications

book 3 part 6

DOME TWEETERS

Type No.	Size (in)	Power handling capacity (W) (note 1)	Sound power level (dB/m per W)	Resonance frequency (Hz)	Impedance (Ω)	Dome, cone, surround material
AD11800/T8	1	20/4	89	1700	8	textile
AD11810/T8	1	20/4	89	1700	8	polycarbonate
AD11400/T8	1	20/4	92	1500	8	textile
AD11410/T8	1	20/4	92	1500	8	polycarbonate
AD11600/T8	1	50/6	95	1300	8	textile
AD11610/T8	1	50/6	95	1300	8	polycarbonate

CONE TWEETERS

AD20302/T8	2	40/4	88	2000	8	paper
AD22302/T8	2	40/4	88	2000	8	paper (note 2)
AD20850/T8	2	40/4	91	1700	8	paper
AD22850/T8	2	40/4	91	1700	8	paper (note 3)

MID RANGE (note 4)

AD33801/SQ8	3	60/10	89	470	8	paper cone textile surround
AD50800/SQ8	5	60/15	89	280	8	paper cone textile surround
AD50600/SQ8	5	60/20	90	260	8	paper cone textile surround
AD50800/DSQ8 (note 5)	5	60/15	89	280	8	paper cone textile surround
AD50600/DSQ8 (note 5)	5	60/20	90	260	8	paper cone textile surround

Notes

1. Where the power handling capacity (PHC) is expressed as two figures, the first figure is for a typical two or three way system, the second figure is the PHC is of the loudspeaker alone.
2. As AD20302/T8 but with a square front plate.
3. As AD20850/T8 but with a square front plate.
4. AD33801/SQ8 is without damping pot.
AD50800/SQ8 and AD50600/SQ are with damping pot.
5. Cone-dome versions.

Continued

Loudspeakers

high fidelity applications (cont.)

book 3 part 6

Type No.	Size (in)	Power handling capacity (W)	Sound power level (dB/m per W)	Resonance frequency (Hz)	Impedance (Ω)	Dome, cone, surround material
WOOFERS						
AD12201/W8	12	80	—	—	8	paper cone foam surround
AD10652/W8	10	60	—	—	8	paper cone foam surround
AD80606/W8	8	50	91	38	8	paper cone foam surround
AD80605/W8	8	40	90	50	8	paper cone foam surround
AD80405/W8	8	35	87.5	50	8	paper cone foam surround
AD70801/W8	6½	25	89	68	8	paper cone textile surround
AD70802/W8	6½	20	88	78	8	paper cone paper surround
AD70612/W8	6½	45	86	50	8	paper cone textile surround
AD70680/W8	6½	50	87	48	8	paper cone foam surround
AD51610/W8	6¼	30	89	62	8	paper cone foam surround
AD4060/W8	4	30	88	68	8	paper cone rubber surround
FULL RANGE (dual cone)						
AD12201/M8	12	60	—	—	8	paper cone
AD12652/M8	12	40	—	—	8	paper cone
AD80800/M8	8	15	89	85	8	paper cone paper surround
AD70800/M8	6½	12	89	105	8	paper cone paper surround
AD70850/M8	6½	7	89	105	8	paper cone paper surround
AD50800/M8	5	6	91	140	8	paper cone paper surround

medium power – 3 to 10W tv applications (screened)

book 3 part 6

Type No. (note 1)	Size (in)	Power handling capacity (W) (note 2)	Sound power level (dB/m per W)	Resonance frequency (Hz)	Impedance (Ω)	Dome, cone, surround material
AD20310/T8 AD20310/T15	2	40/4	88	2000	8 15	paper cone (note 3)
AD22310/T8 AD22310/T15	2	40/4	88	2000	8 15	paper cone (note 4)
AD2274/T4 AD2274/T8 AD2274/T15 AD2274/T25	2½	20/1	83	1000	4 8 15 25	paper cone paper surround
AD44860/X8 AD44860/X15	4	4	90.5	175	8 15	paper cone treated surround
AD44900/X8 AD44900/X15	4	8	91.5	100	8 15	paper cone foam surround
AD44900/P8 AD44900/P15	4	8	88	110	8 15	paper cone foam surround
AD44900/W8 AD44900/W15	4	8	86	82	8 15	paper cone foam surround
AD46860/X8 AD46860/X15	4 × 6	4	90	140	8 15	paper cone paper surround
AD46950/X8 AD46950/X15	4 × 6	5	90.5	140	8 15	paper cone paper surround
AD46900/M8 AD46900/M15	4 × 6	8	90	150	8 15	paper cone paper surround
AD36901/X8 AD36901/X15	3 × 6	8	87	95	8 15	paper cone textile surround
AD36900/P8 AD36900/P15	3 × 6	8	88	85	8 15	paper cone textile surround
AD38900/X8 AD38900/X15	3 × 6	8	87	95	8 15	paper cone textile surround
AD38900/P8 AD38900/P15	3 × 6	8	88	95	8 15	paper cone textile surround

Notes

1. T = tweeter, X = full range, P = open application woofer.
2. Where the power handling capacity (P.H.C.) is expressed as two figures, the first figure is for a typical two or three way system, the second figure is the P.H.C. of the loudspeaker alone.
3. AD20310/T8, T15 are screened tweeters.
4. As AD20310/T8, T15, but with square front plate.

Loudspeakers

car radio applications

book 3 part 6

Type No.	Size (in)	Power handling capacity (W)	Sound power level (dB/m per W)	Resonance frequency (Hz)	Impedance (Ω)	Dome, cone, surround material
AD44830/X4	4	8	90	140	4	paper cone textile surround
AD44401/M4	4	15	90	110	4	paper cone textile surround
AD46801/X4	4 × 6	8	89	120	4	paper cone textile surround
AD51400/M4	5	15	92	90	4	paper cone treated surround

plastic frame, unscreened (dome, cone, surround material: paper) book 3 part 6

Type No. (note 1)	Size (in)	Power handling capacity (W)	Operating power (sound level 90dB, 0.5m) (W)	Resonance frequency (Hz)	Impedance (Ω)	Comments
AD0198/Z..	1¼	0.3	0.09	500	8, 15, 25	
AD01980/Y..	1¼	0.3	0.055	600	8, 15, 25	
AD01985/Y..	1½	0.3	0.05	600	8, 15, 25	
AD2099/Z..	2	0.5	0.04*	420	8, 15, 25	
AD2071/Z..	2½	1	0.55	360	(note 2), 50, 150	
AD3071/Y..	3	2	0.6	250	(note 2), 50, 150	
AD3371/Y..	3	2	0.6	250	(note 2), 50	
AD4072/X..	4	3	0.45	170	(note 2)	
AD4472/X..	4	3	0.45	170	(note 2)	
AD40725/X	4	5	0.45	170	(note 2)	note 4
AD44725/X	4	5	0.45	170	(note 2)	note 4
AD50720/X..	5¼	3	0.3	130	(note 2)	
AD55720/X..	5¼	3	0.3	130	(note 2)	
AD50725/X..	5¼	5	0.3	130	(note 2)	
AD55725/X..	5¼	5	0.3	130	(note 2)	
AD70720/X..	7	3	0.4	100	(note 2)	
AD77720/X..	7	3	0.4	100	(note 2)	
AD77721/X..	7	5	0.4	100	(note 2)	
AD70725/X..	7	5	0.4	100	(note 2)	
AD77725/X..	7	5	0.4	100	(note 2)	
AD77726/X..	7	5	0.4	100	(note 2)	
AD35720/X..	3×5	3	0.65	160	(note 2)	
AD35721/X..	3×5	3	0.65	160	(note 2)	
AD35722/X..	3×5	3	0.65	160	(note 2)	
AD35725/X..	3×5	5	0.65	160	(note 2)	note 4
AD35726/X..	3×5	5	0.65	160	(note 2)	note 4
AD35727/X..	3×5	5	0.65	160	(note 2)	note 4
AD36720/X..	3×6	3	0.45	130	(note 2)	
AD36722/X..	3×6	3	0.45	130	(note 2)	
AD36725/X..	3×6	5	0.45	130	(note 2)	
AD36727/X..	3×6	5	0.45	130	(note 2)	
AD46720/X..	4×6	4	0.4	130	(note 2)	
AD46721/X..	4×6	4	0.4	130	(note 2)	
AD46722/X..	4×6	4	0.4	130	(note 2)	
AD46725/X..	4×6	5	0.4	130	(note 2)	note 4
AD46726/X..	4×6	5	0.4	130	(note 2)	note 4
AD46727/X..	4×6	5	0.4	130	(note 2)	note 4
AD2273/T..	2¼	20/1 (note 3)	0.5	1000	(note 2)	
AD01700/T..	½	20	1.3†	2000	(note 2)	
AD11700/T..	½	20	1.3†	2000	(note 2)	

*Sound level 74dB, 0.5m. † Sound level 90dB, 1m.

Notes

1. Impedance value should be included in type number, following last letter.
2. Impedance values of 4, 8, 15 and 25 Ω available. See note 1 for type number construction.
3. Where power handling capacity (P.H.C.) is expressed as two figures, the first figure is for a typical two- or three-way system, the second figure is the P.H.C. of the loudspeaker alone.
4. High thermal stability plastic.

Loudspeakers

plastic frame for tv applications, screened;
(dome, cone, surround material: paper)

book 3 part 6

Type No. (note 1)	Size (in)	Power handling capacity (W)	Operating power (sound level 90dB, 0.5m) (W)	Resonance frequency (Hz)	Impedance (Ω)	Comments
AD3074/Z..	3	2	0.6	250	(note 2), 50, 150	
AD3374/Y..	3	2	0.6	250	(note 2), 50, 150	
AD4074/X..	4	2.5	0.45	170	(note 2)	
AD40745/X..	4	5	0.45	170	(note 2)	note 4
AD4474/X..	4	2.5	0.45	170	(note 2)	
AD44745/X..	4	5	0.45	170	(note 2)	note 4
AD50740/X..	5½	2.5	0.3	130	(note 2)	
AD50745/X..	5½	5	0.3	130	(note 2)	
AD55740/X..	5½	2.5	0.3	130	(note 2)	
AD55745/X..	5½	5	0.3	130	(note 2)	
AD70740/X..	7	2.5	0.4	100	(note 2)	
AD70745/X..	7	5	0.4	100	(note 2)	
AD77740/X..	7	3	0.4	100	(note 2)	
AD77741/X..	7	3.5	0.4	100	(note 2)	
AD77745/X..	7	3.5	0.4	100	(note 2)	
AD77746/X..	7	3.5	0.4	100	(note 2)	
AD35740/X..	3×5	2.5	0.65	160	(note 2)	
AD35741/X..	3×5	2.5	0.65	160	(note 2)	
AD35742/X..	3×5	2.5	0.65	160	(note 2)	
AD35746/X..	3×5	3.5	0.65	160	(note 2)	note 4
AD35747/X..	3×5	3.5	0.65	160	(note 2)	note 4
AD35748/X..	3×5	3.5	0.65	160	(note 2)	note 4
AD36740/X..	3×6	2.5	0.45	130	(note 2)	
AD36742/X..	3×6	2.5	0.45	130	(note 2)	
AD36746/X..	3×6	4.5	0.45	130	(note 2)	
AD36748/X..	3×6	4.5	0.45	130	(note 2)	
AD46740/X..	4×6	2.5	0.4	130	(note 2)	
AD46741/X..	4×6	2.5	0.4	130	(note 2)	
AD46742/X..	4×6	2.5	0.4	130	(note 2)	
AD46746/X..	4×6	3.5	0.4	130	(note 2)	note 4
AD46747/X..	4×6	3.5	0.4	130	(note 2)	note 4
AD46748/X..	4×6	3.5	0.4	130	(note 2)	note 4
AD2274/T..	2½	20/1 (note 3)	0.5	1000	(note 2)	
AD01740/T..	½	20	—	2000	(note 2)	
AD11740/T..	½	20	—	2000	(note 2)	

Notes

1. Impedance value should be included in type number following last letter.
2. Available with impedances of 4 Ω , 8 Ω , 15 Ω and 25 Ω (see note 1 for type number construction.)
3. Where power handling capacity (P.H.C.) is expressed as two figures, the first figure is the P.H.C. of a typical two or three way system, the second figure is that of the loudspeaker alone.
4. High thermal stability plastic.

Television assemblies

tuners (with diode tuning)

book 3 part 5

Type No.	Channel coverage		Supply voltage (V)		Noise figure (dB)	Power gain (dB)
			transistors	tuning diodes		
U341/U341LO (note 1)	u.h.f.	E21 to E69	+12	+1 to +28	6.5	23
U342/U342LO (note 1)	u.h.f.	E21 to E69	+12	+1 to +28	6.0 to 6.5	25 to 27
U343 U344 (note 2)	u.h.f.	E21 to E69	+12	+1 to +28	6.5	47 (voltage gain)
U411/U412 (note 3)	u.h.f.	E21 to E69	+12	+1 to +28	10 max.	20 min.
● U743 U744	u.h.f.	E21 to E69 (U744 has frequency divider)	+12	+1 to +28	6 to 7.5	40
UV411 UV412 (note 4)	v.h.f./u.h.f.	NZ1 to C, M4 to E12 E21 to E69	+12	+1 to +28	4 to 10 depending on channel	21 to 28 depending on channel
UV417 UV418 (note 5)	v.h.f./u.h.f.	E2 to S1, S2 to S20 E21 to E69	+12	+1 to +28	8 to 13 depending on channel	16 to 20 depending on channel
UV617 UV618 (note 6)	v.h.f./u.h.f.	off-air cable E2 to C S2 to S20 E5 to E12 E21 to E69	+12	+0.8 to +28	5 to 8 depending on channel	40 to 50 depending on channel (voltage gain)
UVF10	v.h.f./u.h.f.	A to E4 (including A to C) M4 to E12 (including 1 to 6) E21 to E69	+12	+0.5 to +28	5 to 10 depending on channel	19 to 22 depending on channel
V317/V317LO	v.h.f.	E2 to R5 S2 to S19	+12	+1 to +28	5.5 to 8	26 to 28
V334/V334LO	v.h.f.	NZ1 to C M4 to E12	+12	+1 to +28	6 to 8	23 to 24

- Notes.**
1. Mark II version.
 2. U344 equivalent to U343 but with an integral frequency divider.
 3. U412 equivalent to U411 but with an integral frequency divider.
 4. UV412 equivalent to UV411 but with an integral frequency divider.
 5. UV418 equivalent to UV417 but with an integral frequency divider.
 6. UV618 equivalent to UV617 but with an integral frequency divider.

Television assemblies

delay lines (colour)

book 2 part 1d

Type No.	Phase delay time (μ s)	Insertion loss (dB)	Unwanted reflections relative to 1τ signal (dB)		Storage temperature range
			3τ	others	
DL701	63.943	9	-25 max.	-33 max.	-40 to +70°C
DL711	63.943	9	-33 max.	-33 max.	-40 to +70°C

quartz crystals

Type No.	Frequency (MHz)	Mode of Vibration	Cut	Case	Application
143 04090	4.0	fundamental	AT	RW-43	CITAC
143 04040	4.433619	fundamental	AT	RW-43	TV sub-carrier
143 04100	6.0	fundamental	AT	RW-43	Text
143 04050	8.867238	fundamental	AT	RW-43	TV sub-carrier
143 04890	13.875	fundamental	AT	RW-43	Text

hybrid v.h.f./u.h.f. wideband amplifiers

book 1 part 2a

A range of hybrid v.h.f./u.h.f. wideband amplifiers designed for use as masthead booster amplifiers in antenna systems, preamplifiers and trunk amplifiers in MATV systems and as instrumentation amplifiers. Frequency range 40 to 860 MHz.

Source and load impedance 75 ohms.

The range covers types which operate from both 12V and 24V supplies.

Types of v.h.f./u.h.f. hybrid wideband amplifiers – 40 MHz to 860 MHz

Type No.	Stages	Gain (dB)	min. $V_{o(rms)}$ (dB μ V)		Noise figure (dB)	VSWR (note 3)		Dimensions (mm)	
			-60dB IMD (note 1)	1dB comp. (note 2)		input	output		
24 volt types (24V \pm 10%)									
low output	OM320	2	15.5	92	111	5.5	2.2	2.5	30 \times 12 \times 4
	OM321	2	15.5	98	113	6.0	2.5	2.0	30 \times 12 \times 4
	OM335	3	27	98	115	5.5	1.9	3.2	30 \times 12 \times 4
medium output	OM322	2	15	103	119	7.0	1.7	1.7	40 \times 22 \times 5
	OM336	3	22	105	122	7.0	1.4	1.6	30 \times 19 \times 4
high output	OM323	2	15	113	127	9.0	1.0	2.3	30 \times 18 \times 15
	OM337	3	26	112	126	9.8	2.3	1.8	30 \times 18 \times 15
12 volt types (12V \pm 10%)									
low output	OM345	1	12	99	114	5.5	2.0	1.4	14 \times 8* \times 3
	OM350	2	18	100	116	6.0	1.5	1.9	18 \times 9* \times 3
medium output	OM360	3	23	105	123	7.0	1.3	1.5	27 \times 9* \times 3
	OM361	3	28	105	122	6.0	1.5	1.7	27 \times 9* \times 3
high output	OM370	3	28	112	129	7.0	1.5	1.7	27 \times 22* \times 5

- Notes:**
1. Measured at -60dB intermodulation distortion (DIN 45 004, par.6.3: 3 tone), $f = 470$ MHz.
 2. Measured at saturation for 1dB gain compression.
 3. The typical maximum VSWR occurring in the frequency range 40-860 MHz, for a sample connected to a 75 Ω line.

*Seated height

All modules are of single in-line construction except OM322 which has stripline format. OM323 and 337 have an integral mounting bracket.

All amplifiers have a flat frequency response (40 to 860 MHz) within ± 1 dB except OM335 which is typically ± 1.6 dB, OM322 which is typically ± 0.3 dB, and OM360 which is typically ± 0.5 dB.

hybrid 14-bit digital-to-analogue converter

Type No.	Resolution (bits)	Signal-to-noise ratio (dB)	Linearity $T_{amb} = 25^{\circ}\text{C}$	Supply-voltage (V)
OM901	14	85	$\pm \frac{1}{2} \leq \leq \downarrow$	$\pm 5, -17$

This hybrid integrated circuit is intended for use in digital signal processing; for sound reproduction, electronic telephones, graphic displays; for distortion meters, signal generators and other test equipment.

Assemblies and modules

hybrid ICs for inductive proximity detectors

Type No.	Physical dimensions (mm)	Supply voltage (Vdc)	Output current (mA)	Switching distance (mm)
OM286	35.0 × 4.8	+ 4.5 to +30	250	1 to 5
OM287	35.0 × 4.8	- 4.5 to -30	250	1 to 5
● OM286M	22.4 × 4.8	+ 4.5 to +30	250	1 to 5
● OM287M	22.4 × 4.8	- 4.5 to -30	250	1 to 5
● OM386B	43.4 × 4.8	+ 10 to +30	250	1 to 5
● OM387B	43.4 × 4.8	- 10 to -30	250	1 to 5
● OM386M	22.3 × 4.8*	+ 10 to +30	200	1 to 5
● OM387M	22.3 × 4.8*	- 10 to -30	200	1 to 5
● OM388B	25.4 × 8.0	+ 10 to +30	250	2 to 5
● OM389B	25.4 × 8.0	- 10 to -30	250	2 to 5

teletext modules

Type No.	Supply voltage (Vdc)	Description	Dimensions (mm)
			L × W × H
VM6600 series	+ 5V + 12V (both ±5%)	Teletext decoder module fulfills the requirement for teletext processing in tv circuits. Used in conjunction with remote control ICs. Various language options are available. Manufactured using latest surface-mounted component techniques for minimum size.	110 × 110 × 17

customised P.C.B. service

Property	Unit	Format			
		single-sided rigid	double-sided rigid	multilayer	flexible and flex-rigid
base material	–	paper/phenolic, paper/epoxy glass/epoxy glass/polyester	paper/phenolic, paper/epoxy glass/epoxy glass/polyester Teflon*/polyimide	glass/epoxy glass/polyimide	glass/epoxy, polyimide (copper-clad)
laminate thickness	mm	0.6 to 3.2	0.6 to 3.2mm	–	0.1 to 3.2mm
cladding thickness	µm	105, 70, 35, 17.5, 5	105, 70, 35, 17.5, 5	70, 35, 17.5	70, 35, 17.5
max. standard size (note 1)	mm	540 × 460	540 × 460	540 × 460	540 × 460
min. hole diameter drilled punched	mm	0.3 half-board thickness	0.3 half-board thickness	0.3	0.5
max. ratio of thickness to hole diameter		–	4:1	4:1	4:1
min. track width/ spacing	µm	80/125	80/125	80/125	80/125
tolerance on track width spacing	µm	down to ±30	down to ±30	down to ±30	(note 2)

Notes (1) for larger sizes please enquire. (2) depends on material and construction

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Customised P.C.B.s from Mullard Ltd also feature:

- o surface finish of external layer
 - PbSn (with or without reflow)
 - selective Au and Ni plating
 - selective PbSn plating
 - roller tinning
 - solder lacquer
 - hot air levelling
- o silk-screen or photo process solder resist
- o silk-screen legend print
- o profiling: cutting, sawing, punching, routing
- o 100% electrical testing for short and open circuits on purpose-designed or standard nailed.

Contact P.C.B. Product Marketing for further details

The Mullard Technical Handbook

The Mullard Technical Handbook is made up of four sets of Books, each comprising several parts:

Book 1 (light blue)	Semiconductor devices	Book 2 (orange)	Electronic tubes
Book 3 (green)	Components, materials and assemblies	Book 4 (dark blue)	Integrated circuits

Book 1, Semiconductor devices

- Part 1a Small-signal transistors
- Part 1b Low-frequency power transistors
- Part 1c Field-effect transistors
- Part 1e High-voltage and switching power transistors
- Part 1f Power MOS transistors
- Part 2a R.F. wideband devices
- Part 2b R.F. power transistors and modules
- Part 3 Diodes
- Part 4a Power diodes
- Part 4b Thyristors and triacs
- Part 5a Microwave diodes and sub-assemblies
- Part 5b Microwave transistors
- Part 6a Optoelectronic devices
- Part 6b Liquid crystal displays
- Part 6c Light emitting diodes

Book 2, Electronic tubes

- Part 1a Colour tv, data and graphic display tubes
- Part 1b Cathode-ray tubes
- Part 1c Monochrome tubes and deflection units
- Part 1d Wirewound components for tv and monitors
- Part 2a Plumbicon camera tubes and accessories
- Part 2b Geiger-Müller tubes
- Part 2c Vidicon and Newvicon camera tubes and deflection units
- Part 3 Photo and electron multipliers
- Part 4a Tubes for r.f. heating
- Part 4b Transmitting tubes for communications
- Part 4c High-power klystrons
- Part 4d Magnetrons for microwave heating
- Part 4e Ceramic tubes for communications

The Mullard Technical Handbook (cont.)

Book 3, Components, materials and assemblies

- Part 1a Ceramic capacitors
- Part 1b Electrolytic and solid capacitors
- Part 1c Fixed resistors
- Part 1d Potentiometers, encoders and switches
- Part 1e Film capacitors
- Part 1f Varistors, thermistors and sensors
- Part 2a Ferroxcube cores and components for power applications
- Part 2b Ferroxcube cores and components for small-signal applications
- Part 3 Vinkor inductor cores
- Part 6 Loudspeakers

Book 4, Integrated circuits

- Part 1 Radio, audio and associated systems: bipolar, MOS
- Parts 2a and 2b Television, video and associated systems: bipolar, MOS (2 books)
- Part 3 Integrated circuits for telephony
- Part 4 CMOS logic: 4000 series
- Part 5 High-speed CMOS logic, HC/HCT family
- Part 5 High-speed CMOS Designer's Supp. Guide and Applications Handbook
- Part 6 Linear LSI
- Part 6 Supp. Linear LSI Supplement 1986
- Part 7 Memories, MOS, TTL, ECL
- Part 7a Programmable Logic Devices
- Part 8 TTL digital ICs
- Part 8a FAST TTL digital ICs
- Part 9a Microprocessors and peripherals
- Part 9b Microcontrollers and peripherals
- Part 10 ECL 100 000 family



The Mullard Data Base

For the equipment designer, technical information on electronic components is vital. Mullard market the widest range of components in the U.K., supported by a comprehensive information service – the Mullard Data Base.

Brief details are given here. For further information and an order form, please write to:-

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New Road, Mitcham,
Surrey CR4 4XY.

Regular Publications

Mullard Bulletin

A must for designers, this bi-monthly, newspaper-style publication briefly describes new components and offers further information on subjects of interest.

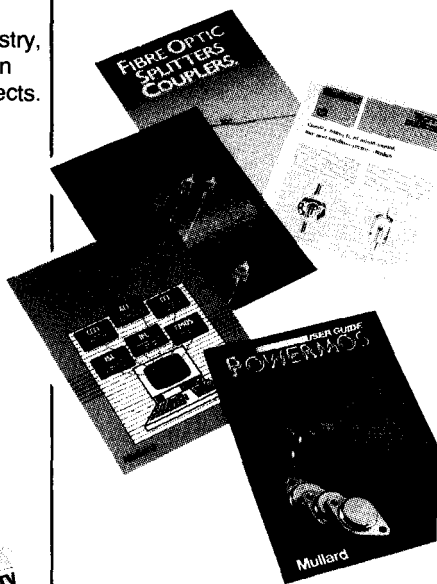
Consumer Electronics

A review, in newspaper style, published every four months. Articles and features of interest to those in the consumer electronics industry, with emphasis on television technology and allied subjects.

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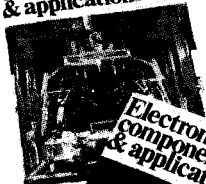
The Mullard Data Base begins, on page 556201.

Electronic Components and Applications

A quarterly technical journal covering, in depth, developments in electronics based on the work of Philips, Signetics and Mullard laboratories. Please ask for a sample copy and subscription form.

Electronic components & applications

Vol 6, No 3
1984



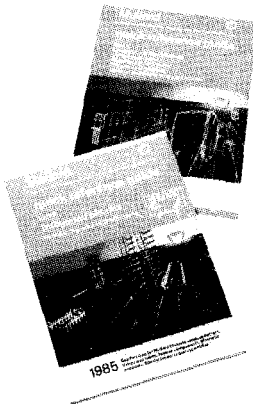
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Quick Reference Guide

All products marketed by Mullard are listed alpha-numerically and described briefly in our Quick Reference Guide.



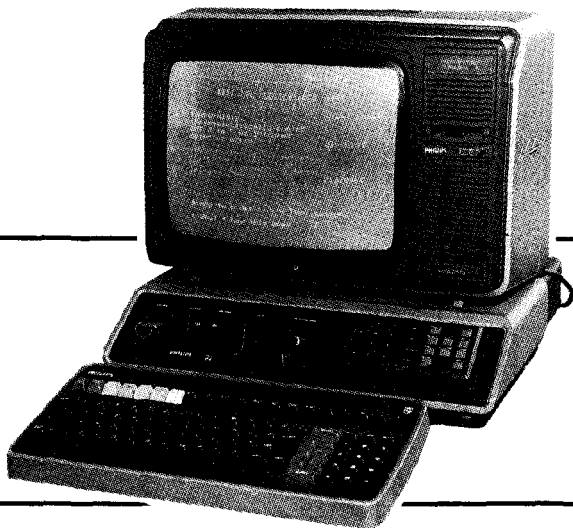
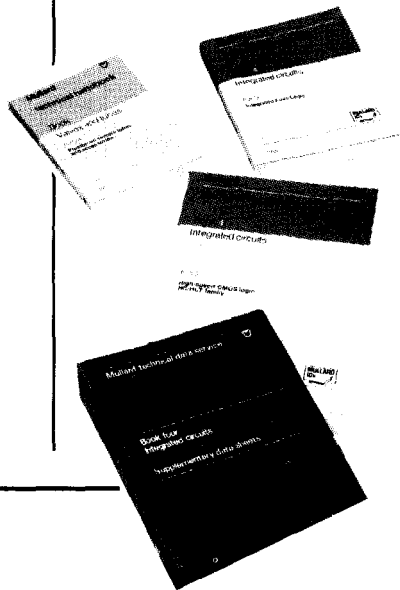
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Mullard

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Integrated circuits



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