

DATA SHEET

PCF8577C

LCD direct/duplex driver with
I²C-bus interface

Product specification
Supersedes data of 1995 Jun 08
File under Integrated Circuits, IC12

1997 Mar 28

LCD direct/duplex driver with I²C-bus interface

PCF8577C**CONTENTS**

| | |
|--------|--|
| 1 | FEATURES |
| 2 | GENERAL DESCRIPTION |
| 3 | ORDERING INFORMATION |
| 4 | BLOCK DIAGRAM |
| 5 | PINNING |
| 6 | FUNCTIONAL DESCRIPTION |
| 6.1 | Hardware subaddress A0, A1, A2 |
| 6.2 | Oscillator A0/OSC |
| 6.3 | User-accessible registers |
| 6.4 | Auto-incremented loading |
| 6.5 | Direct drive mode |
| 6.6 | Duplex mode |
| 6.7 | Power-on reset |
| 6.8 | Slave address |
| 6.9 | I ² C-bus protocol |
| 6.10 | Display memory mapping |
| 7 | CHARACTERISTICS OF THE I ² C-BUS |
| 7.1 | Bit transfer |
| 7.2 | Start and stop conditions |
| 7.3 | System configuration |
| 7.4 | Acknowledge |
| 8 | LIMITING VALUES |
| 9 | HANDLING |
| 10 | DC CHARACTERISTICS |
| 11 | AC CHARACTERISTICS |
| 12 | APPLICATION INFORMATION |
| 13 | CHIP DIMENSIONS AND BONDING PAD LOCATIONS |
| 14 | PACKAGE OUTLINES |
| 15 | SOLDERING |
| 15.1 | Plastic dual in-line packages |
| 15.1.1 | By dip or wave |
| 15.1.2 | Repairing soldered joints |
| 15.2 | Plastic small outline packages |
| 15.2.1 | By wave |
| 15.2.2 | By solder paste reflow |
| 15.2.3 | Repairing soldered joints (by hand-held soldering iron or pulse-heated solder tool) |
| 16 | DEFINITIONS |
| 17 | LIFE SUPPORT APPLICATIONS |
| 18 | PURCHASE OF PHILIPS I ² C COMPONENTS |



LCD direct/duplex driver with I²C-bus interface

PCF8577C

1 FEATURES

- Direct/duplex drive modes with up to 32/64 LCD-segment drive capability per device
- Operating supply voltage: 2.5 to 6 V
- Low power consumption
- I²C-bus interface
- Optimized pinning for single plane wiring
- Single-pin built-in oscillator
- Auto-incremented loading across device subaddress boundaries
- Display memory switching in direct drive mode
- May be used as I²C-bus output expander
- System expansion up to 256 segments
- Power-on reset blanks display
- I²C-bus address: 0111 0100.

2 GENERAL DESCRIPTION

The PCF8577C is a single chip, silicon gate CMOS circuit. It is designed to drive liquid crystal displays with up to 32 segments directly, or 64 segments in a duplex configuration.

The two-line I²C-bus interface substantially reduces wiring overheads in remote display applications. I²C-bus traffic is minimized in multiple IC applications by automatic address incrementing, hardware subaddressing and display memory switching (direct drive mode). To allow partial V_{DD} shutdown the ESD protection system of the SCL and SDA pins does not use a diode connected to V_{DD}.

3 ORDERING INFORMATION

| TYPE NUMBER | PACKAGE | | |
|--------------|---------|--|----------|
| | NAME | DESCRIPTION | VERSION |
| PCF8577CP | DIP40 | plastic dual in-line package; 40 leads (600 mil) | SOT129-1 |
| PCF8577CT | VSO40 | plastic very small outline package; 40 leads | SOT158A |
| PCF8577CT | – | VS040 in blister tape | – |
| PCF8577CU/10 | – | chip on film-frame-carrier (FFC) | – |

4 BLOCK DIAGRAM

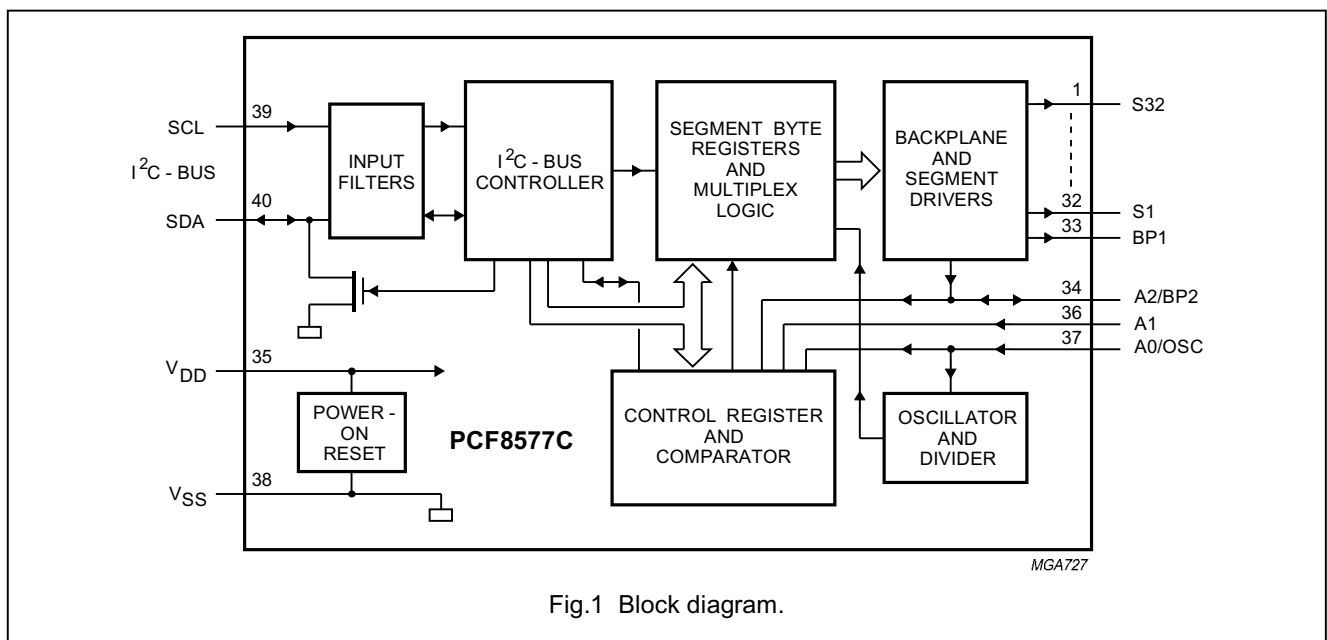


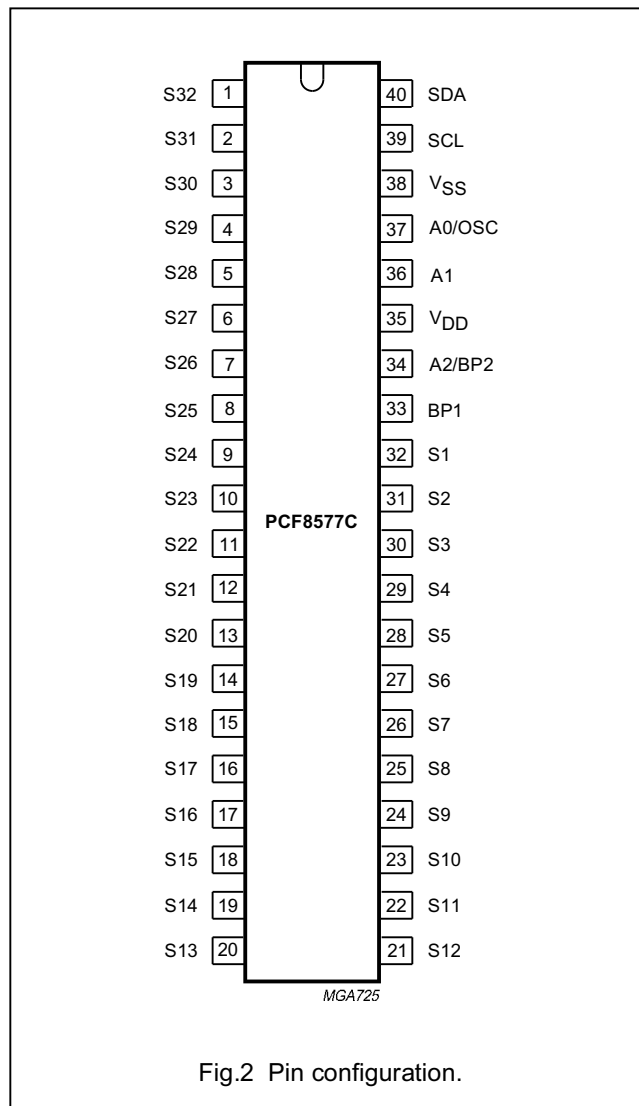
Fig.1 Block diagram.

LCD direct/duplex driver with I²C-bus interface

PCF8577C

5 PINNING

| SYMBOL | PIN | DESCRIPTION |
|-----------------|---------|---|
| S32 to S1 | 1 to 32 | segments outputs |
| BP1 | 33 | cascade sync input/backplane output |
| A2/BP2 | 34 | hardware address line and cascade sync input/backplane output |
| V _{DD} | 35 | positive supply voltage |
| A1 | 36 | hardware address line input |
| A0/OSC | 37 | hardware address line and oscillator pin input |
| V _{SS} | 38 | negative supply voltage |
| SCL | 39 | I ² C-bus clock line input |
| SDA | 40 | I ² C-bus data line input/output |



LCD direct/duplex driver with I²C-bus interface

PCF8577C

6 FUNCTIONAL DESCRIPTION

6.1 Hardware subaddress A0, A1, A2

The hardware subaddress lines A0, A1 and A2 are used to program the device subaddress for each PCF8577C connected to the I²C-bus. Lines A0 and A2 are shared with OSC and BP2 respectively to reduce pin-out requirements.

1. Line A0 is defined as LOW (logic 0) when this pin is used for the local oscillator or when connected to V_{SS}. Line A0 is defined as HIGH (logic 1) when connected to V_{DD}.
2. Line A1 must be defined as LOW (logic 0) or as HIGH (logic 1) by connection to V_{SS} or V_{DD} respectively.
3. In the direct drive mode the second backplane signal BP2 is not used and the A2/BP2 pin is exclusively the A2 input. Line A2 is defined as LOW (logic 0) when connected to V_{SS} or, if this is not possible, by leaving it unconnected (internal pull-down). Line A2 is defined as HIGH (logic 1) when connected to V_{DD}.
4. In the duplex drive mode the second backplane signal BP2 is required and the A2 signal is undefined. In this mode device selection is made exclusively from lines A0 and A1.

6.2 Oscillator A0/OSC

The PCF8577C has a single-pin built-in oscillator which provides the modulation for the LCD segment driver outputs. One external resistor and one external capacitor are connected to the A0/OSC pin to form the oscillator (see Figs 15 and 16). For correct start-up of the oscillator after power on, the resistor and capacitor must be connected to the same V_{SS}/V_{DD} as the chip. In an expanded system containing more than one PCF8577C the backplane signals are usually common to all devices and only one oscillator is required. The devices which are not used for the oscillator are put into the cascade mode by connecting the A0/OSC pin to either V_{DD} or V_{SS} depending on the required state for A0. In the cascade mode each PCF8577C is synchronized from the backplane signal(s).

6.3 User-accessible registers

There are nine user-accessible 1-byte registers. The first is a control register which is used to control the loading of data into the segment byte registers and to select display options. The other eight are segment byte registers, split into two banks of storage, which store the segment data. The set of even numbered segment byte registers is called BANK A. Odd numbered segment byte registers are called BANK B.

There is one slave address for the PCF8577C (see Fig.6). All addressed devices load the second byte into the control register and each device maintains an identical copy of the control byte in the control register at all times (see I²C-bus protocol, Fig.7), i.e. all addressed devices respond to control commands sent on the I²C-bus.

The control register is shown in more detail in Fig.3. The least-significant bits select which device and which segment byte register is loaded next. This part of the register is therefore called the Segment Byte Vector (SBV).

The upper three bits of the SBV (V5 to V3) are compared with the hardware subaddress input signals A2, A1 and A0. If they are the same then the device is enabled for loading, if not the device ignores incoming data but remains active.

The three least-significant bits of the SBV (V2 to V0) address one of the segment byte registers within the enabled chip for loading segment data.

The control register also has two display control bits. These bits are named MODE and BANK. The MODE bit selects whether the display outputs are configured for direct or duplex drive displays. The BANK bit allows the user to display BANK A or BANK B.

6.4 Auto-incremented loading

After each segment byte is loaded the SBV is incremented automatically. Thus auto-incremented loading occurs if more than one segment byte is received in a data transfer.

Since the SBV addresses both device and segment registers in all addressed chips, auto-incremented loading may proceed across device boundaries provided that the hardware subaddresses are arranged contiguously.

LCD direct/duplex driver with I²C-bus interface

PCF8577C

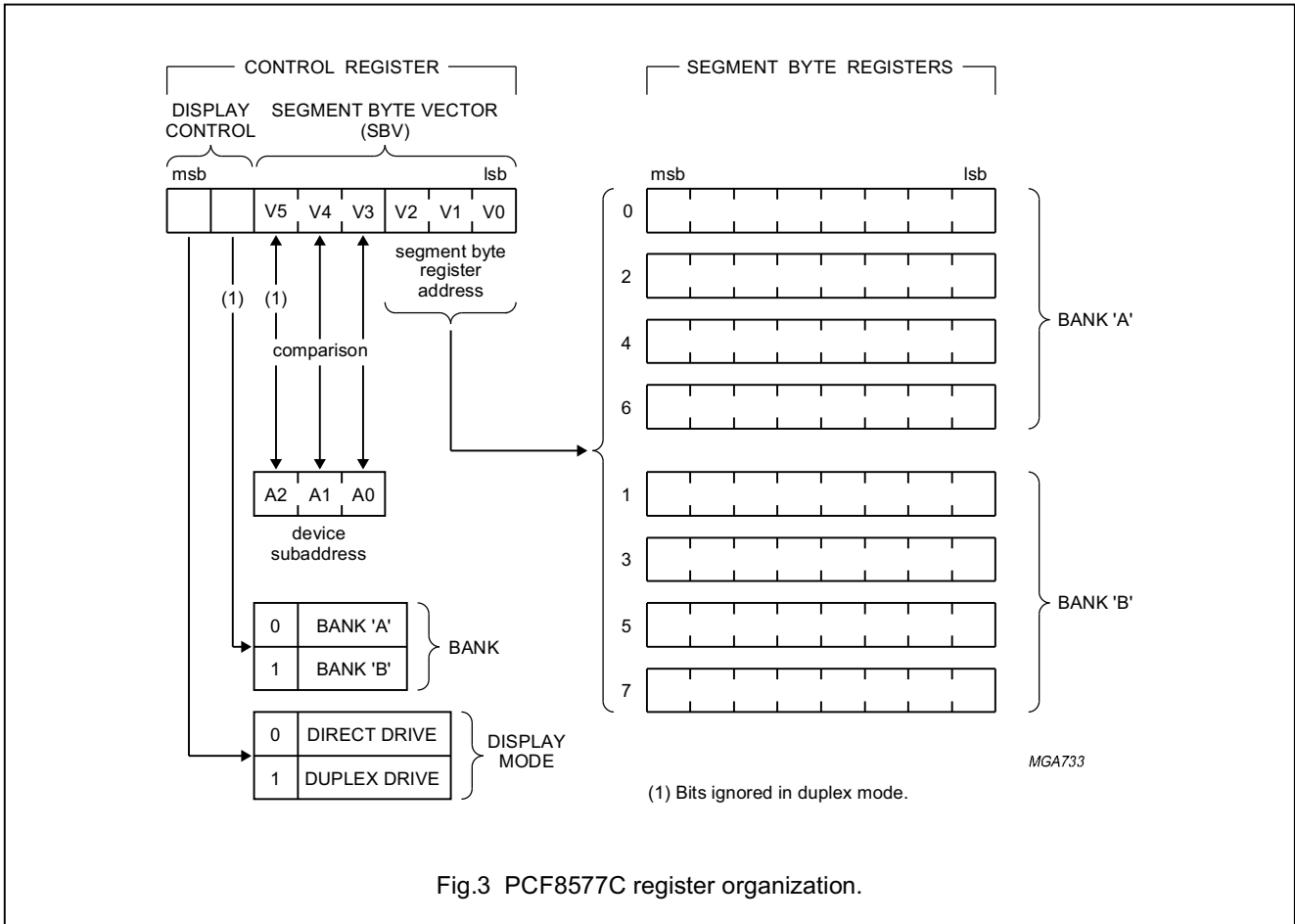
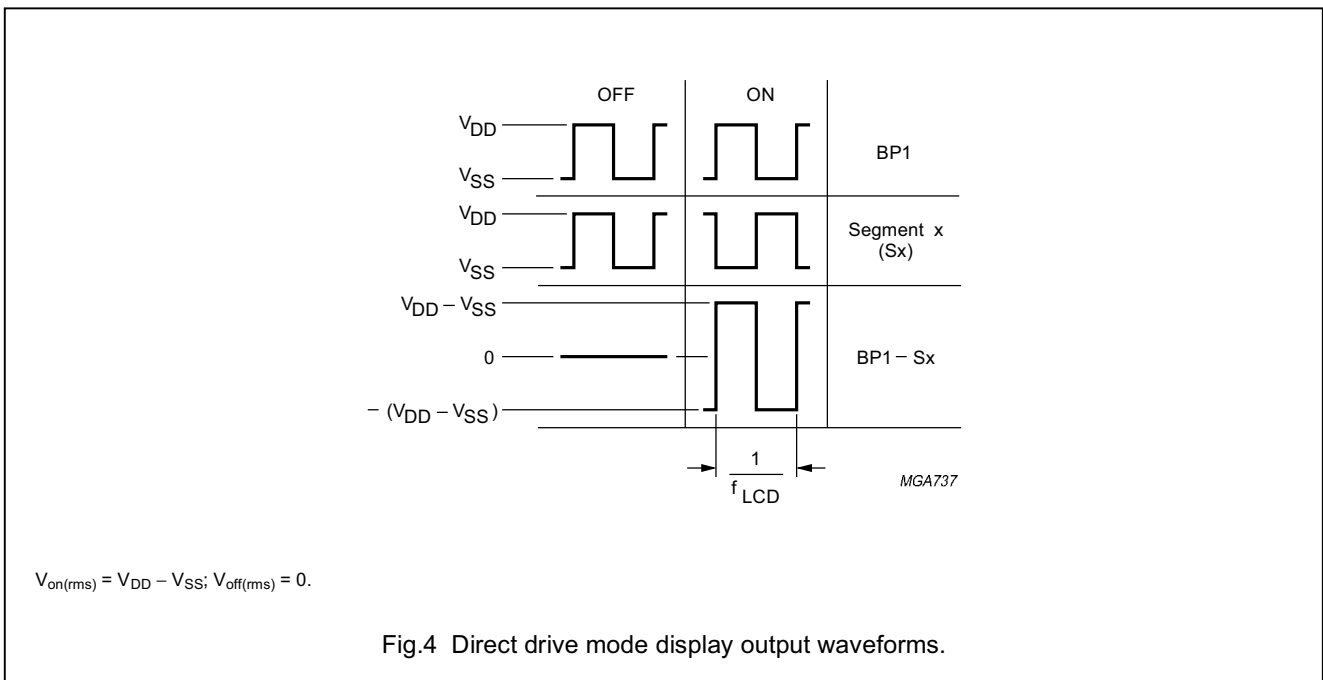


Fig.3 PCF8577C register organization.



$$V_{on(rms)} = V_{DD} - V_{SS}; V_{off(rms)} = 0.$$

Fig.4 Direct drive mode display output waveforms.

LCD direct/duplex driver with I²C-bus interface

PCF8577C

6.5 Direct drive mode

The PCF8577C is set to the direct drive mode by loading the MODE control bit with logic 0. In this mode only four bytes are required to store the data for the 32 segment drivers. Setting the BANK bit to logic 0 selects even bytes (BANK A), setting the BANK bit to logic 1 selects odd bytes (BANK B).

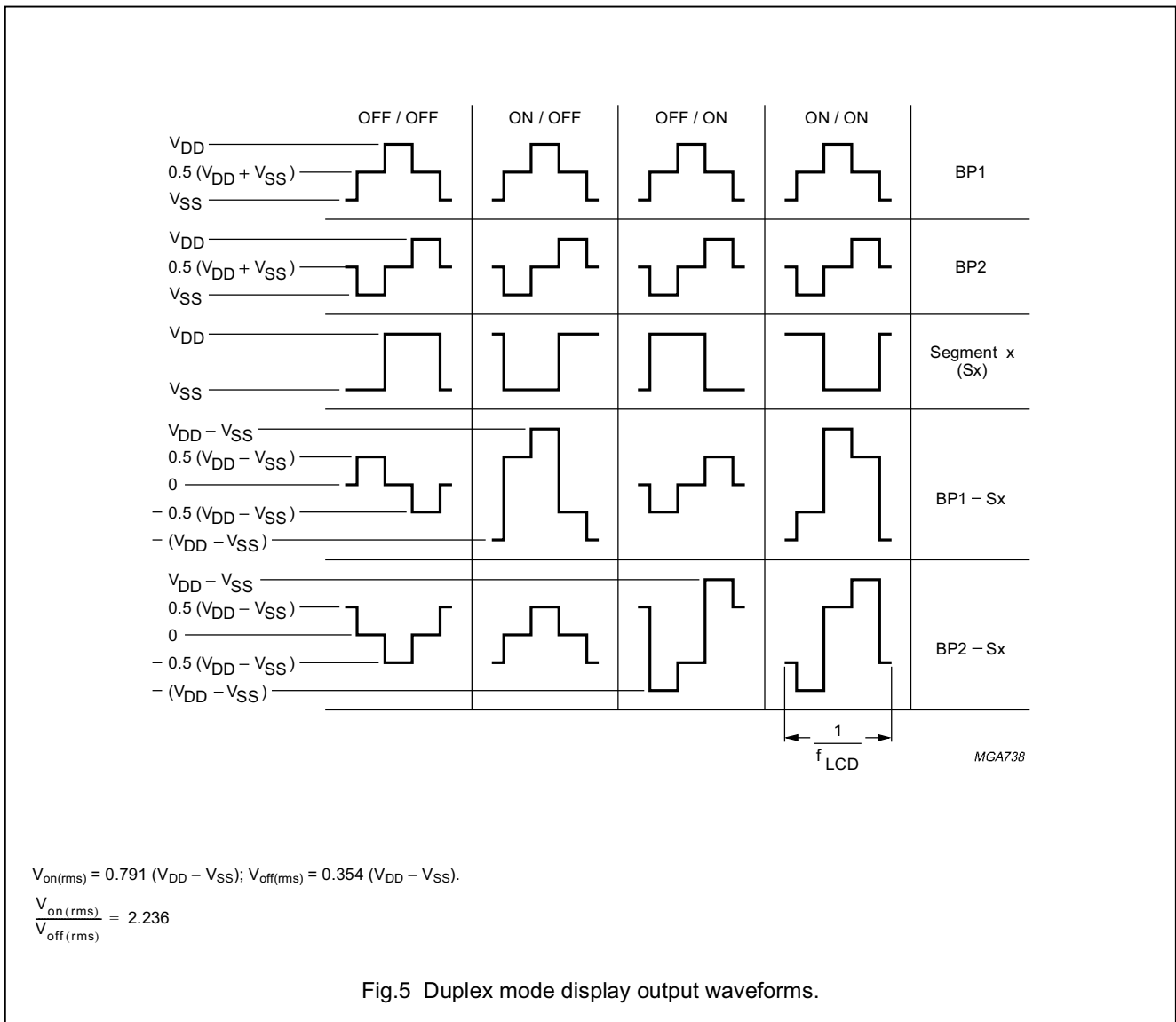
In the direct drive mode the SBV is auto-incremented by two after the loading of each segment byte register. This means that auto-incremented loading of BANK A or BANK B is possible. Either bank may be completely or partially loaded irrespective of which bank is being displayed. Direct drive output waveforms are shown in Fig.4.

6.6 Duplex mode

The PCF8577C is set to the duplex mode by loading the MODE bit with logic 1. In this mode a second backplane signal (BP2) is needed and pin A2/BP2 is used for this; therefore A2 and its equivalent SBV bit V5 are undefined. The SBV auto-increments by one between loaded bytes.

All of the segment bytes are required to store data for the 32 segment drivers and the BANK bit is ignored.

Duplex mode output waveforms are shown in Fig.5.



LCD direct/duplex driver with I²C-bus interface

PCF8577C

6.10 Display memory mapping

The mapping between the eight segment registers and the segment outputs S1 to S32 is given in Tables 1 and 2.

Since only one register bit per segment is needed in the direct drive mode, the BANK bit allows swapping of display information. If BANK is set to logic 0 even bytes (BANK A) are displayed; if BANK is set to logic 1 odd bytes (BANK B) are displayed. BP1 is always used for the backplane output in the direct drive mode. In duplex mode even bytes (BANK A) correspond to backplane 1 (BP1) and odd bytes (BANK B) correspond to backplane 2 (BP2).

Table 1 Segment byte-segment driver mapping in direct drive mode

| MODE | BANK | V 2 | V 1 | V 0 | SEGMENT/ BIT/ REGISTER | MSB 7 | 6 | 5 | 4 | 3 | 2 | 1 | LSB 0 | BACK- PLANE |
|------|------|--------|--------|--------|------------------------------|----------|-----|-----|-----|-----|-----|-----|----------|----------------|
| 0 | 0 | 0 | 0 | 0 | 0 | S8 | S7 | S6 | S5 | S4 | S3 | S2 | S1 | BP1 |
| 0 | 1 | 0 | 0 | 1 | 1 | S8 | S7 | S6 | S5 | S4 | S3 | S2 | S1 | BP1 |
| 0 | 0 | 0 | 1 | 0 | 2 | S16 | S15 | S14 | S13 | S12 | S11 | S10 | S9 | BP1 |
| 0 | 1 | 0 | 1 | 1 | 3 | S16 | S15 | S14 | S13 | S12 | S11 | S10 | S9 | BP1 |
| 0 | 0 | 1 | 0 | 0 | 4 | S24 | S23 | S22 | S21 | S20 | S19 | S18 | S17 | BP1 |
| 0 | 1 | 1 | 0 | 1 | 5 | S24 | S23 | S22 | S21 | S20 | S19 | S18 | S17 | BP1 |
| 0 | 0 | 1 | 1 | 0 | 6 | S32 | S31 | S30 | S29 | S28 | S27 | S26 | S25 | BP1 |
| 0 | 1 | 1 | 1 | 1 | 7 | S32 | S31 | S30 | S29 | S28 | S27 | S26 | S25 | BP1 |

Mapping example: bit 0 of register 7 controls the LCD segment S25 if BANK bit is a logic 1.

Table 2 Segment byte-segment driver mapping in duplex mode

| MODE | BANK ⁽¹⁾ | V 2 | V 1 | V 0 | SEGMENT/ BIT/ REGISTER | MSB 7 | 6 | 5 | 4 | 3 | 2 | 1 | LSB 0 | BACK- PLANE |
|------|---------------------|--------|--------|--------|------------------------------|----------|-----|-----|-----|-----|-----|-----|----------|----------------|
| 1 | X | 0 | 0 | 0 | 0 | S8 | S7 | S6 | S5 | S4 | S3 | S2 | S1 | BP1 |
| 1 | X | 0 | 0 | 1 | 1 | S8 | S7 | S6 | S5 | S4 | S3 | S2 | S1 | BP2 |
| 1 | X | 0 | 1 | 0 | 2 | S16 | S15 | S14 | S13 | S12 | S11 | S10 | S9 | BP1 |
| 1 | X | 0 | 1 | 1 | 3 | S16 | S15 | S14 | S13 | S12 | S11 | S10 | S9 | BP2 |
| 1 | X | 1 | 0 | 0 | 4 | S24 | S23 | S22 | S21 | S20 | S19 | S18 | S17 | BP1 |
| 1 | X | 1 | 0 | 1 | 5 | S24 | S23 | S22 | S21 | S20 | S19 | S18 | S17 | BP2 |
| 1 | X | 1 | 1 | 0 | 6 | S32 | S31 | S30 | S29 | S28 | S27 | S26 | S25 | BP1 |
| 1 | X | 1 | 1 | 1 | 7 | S32 | S31 | S30 | S29 | S28 | S27 | S26 | S25 | BP2 |

Note

- Where X = don't care.

Mapping example: bit 7 of register 5 controls the LCD segment S24/BP2.

LCD direct/duplex driver with I²C-bus interface

PCF8577C

7 CHARACTERISTICS OF THE I²C-BUS

The I²C-bus is for 2-way, 2-line communication between different ICs or modules. The two lines are a serial data line (SDA) and a serial clock line (SCL). Both lines must be connected to a positive supply via a pull-up resistor when connected to the output stages of a device. Data transfer may be initiated only when the I²C-bus is not busy.

7.1 Bit transfer

One data bit is transferred during each clock pulse. The data on the SDA line must remain stable during the HIGH period of the clock pulse as changes in the data line at this time will be interpreted as control signals.

7.2 Start and stop conditions

Both data and clock lines remain HIGH when the I²C-bus is not busy. A HIGH-to-LOW transition of the data line, while the clock is HIGH is defined as the start condition (S). A LOW-to-HIGH transition of the data line while the clock is HIGH is defined as the stop condition (P).

7.3 System configuration

A device generating a message is a 'transmitter', a device receiving a message is the 'receiver'. The device that controls the message is the 'master' and the devices which are controlled by the master are the 'slaves'.

7.4 Acknowledge

The number of data bytes transferred between the start and stop conditions from transmitter to receiver is not limited. Each byte is followed by one acknowledge bit. The acknowledge bit is a HIGH level put on the I²C-bus by the transmitter whereas the master generates an extra acknowledge related clock pulse. A slave receiver which is addressed must generate an acknowledge after the reception of each byte. Also a master must generate an acknowledge after the reception of each byte that has been clocked out of the slave transmitter. The device that acknowledges has to pull down the SDA line during the acknowledge clock pulse, set-up and hold times must be taken into account. A master receiver must signal an end of data to the transmitter by not generating an acknowledge on the last byte that has been clocked out of the slave. In this event the transmitter must leave the data line HIGH to enable the master to generate a stop condition.

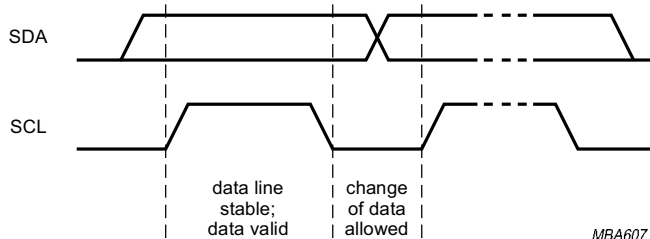


Fig.8 Bit transfer.

LCD direct/duplex driver with I²C-bus interface

PCF8577C

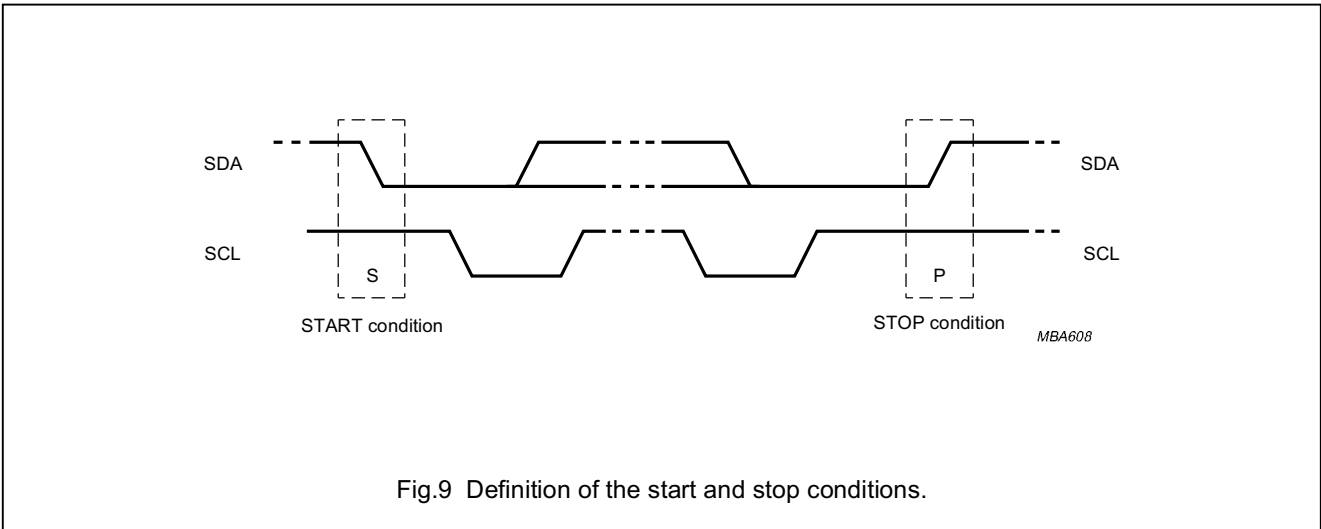


Fig.9 Definition of the start and stop conditions.

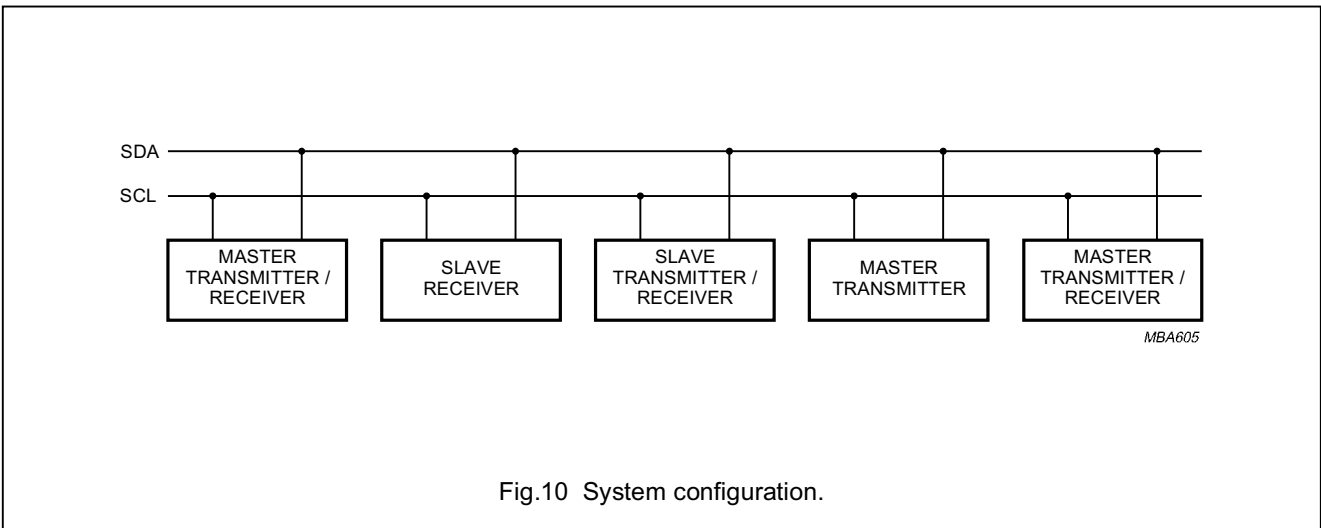


Fig.10 System configuration.

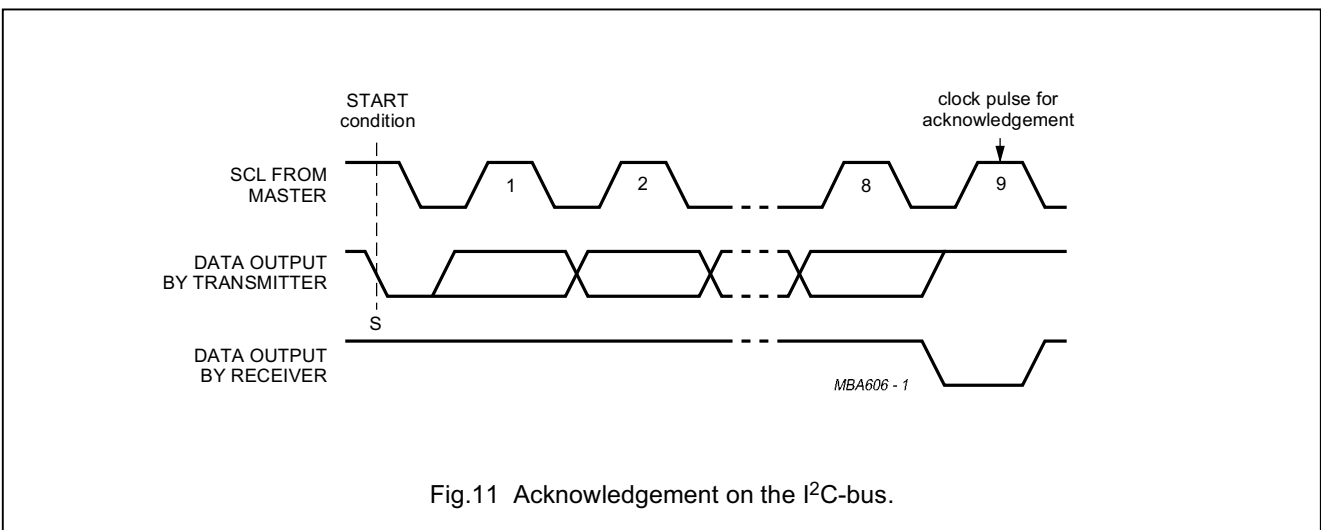


Fig.11 Acknowledgement on the I²C-bus.

LCD direct/duplex driver with I²C-bus interface

PCF8577C

8 LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|-----------------------------------|--|------------|------|-----------------------|------|
| V _{DD} | supply voltage | | -0.5 | +8.0 | V |
| V _I | input voltage on pin | | -0.5 | V _{DD} + 0.5 | V |
| I _{DD} ; I _{SS} | V _{DD} or V _{SS} current | | -50 | +50 | mA |
| I _I | DC input current | | -20 | +20 | mA |
| I _O | DC output current | | -25 | +25 | mA |
| P _{tot} | power dissipation per package | note 1 | - | 500 | mW |
| P _O | power dissipation per output | | - | 100 | mW |
| T _{stg} | storage temperature | | -65 | +150 | °C |

Note

1. Reduce by 7.7 mW/K when T_{amb} > 60 °C.

9 HANDLING

Inputs and outputs are protected against electrostatic discharge in normal handling. However, to be totally safe it is desirable to take normal precautions appropriate to handling MOS devices. Advice can be found in Data Handbook IC12 under "Handling MOS Devices".

10 DC CHARACTERISTICS

V_{DD} = 2.5 to 6 V; V_{SS} = 0 V; T_{amb} = -40 to 85 °C; unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. ⁽¹⁾ | MAX. | UNIT |
|---------------------|---|---|------------------------|---------------------|-----------------|------|
| Supply | | | | | | |
| V _{DD} | supply voltage | | 2.5 | - | 6 | V |
| I _{DD} | supply current for non-specified inputs at V _{DD} or V _{SS} | no load; f _{SCL} = 100 kHz; R _{osc} = 1 MΩ; C _{osc} = 680 pF | | 50 | 125 | μA |
| | | no load; f _{SCL} = 0; R _{osc} = 1 MΩ; C _{osc} = 680 pF | - | 25 | 75 | μA |
| | | no load; f _{SCL} = 0; R _{osc} = 1 MΩ; C _{osc} = 680 pF; V _{DD} = 5 V; T _{amb} = 25 °C | - | 25 | 40 | μA |
| | | no load; f _{SCL} = 0; direct mode; A0/OSC = V _{DD} ; V _{DD} = 5 V; T _{amb} = 25 °C | - | 10 | 20 | μA |
| V _{POR} | power-on reset level | note 2 | - | 1.1 | 2.0 | V |
| Input A0 | | | | | | |
| V _{IL(A0)} | LOW level input voltage | | 0 | - | 0.05 | V |
| V _{IH(A0)} | HIGH level input voltage | | V _{DD} - 0.05 | - | V _{DD} | V |

LCD direct/duplex driver with I²C-bus interface

PCF8577C

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. ⁽¹⁾ | MAX. | UNIT |
|---------------------------|--|--|------------------------|---------------------|--------------------|------|
| Input A1 | | | | | | |
| V _{IL(A1)} | LOW level input voltage | | 0 | – | 0.3V _{DD} | V |
| V _{IH(A1)} | HIGH level input voltage | | 0.7V _{DD} | – | V _{DD} | V |
| Input A2 | | | | | | |
| V _{IL(A2)} | LOW level input voltage | | 0 | – | 0.10 | V |
| V _{IH(A2)} | HIGH level input voltage | | V _{DD} – 0.10 | – | V _{DD} | V |
| Input SCL; SDA | | | | | | |
| V _{IL(SCL; SDA)} | LOW level input voltage | | 0 | – | 0.3V _{DD} | V |
| V _{IH(SCL; SDA)} | HIGH level input voltage | | 0.7V _{DD} | – | 6 | V |
| C _i | input capacitance | note 3 | – | – | 7 | pF |
| Output SDA | | | | | | |
| I _{OL} | LOW level output current | V _{OL} = 0.4 V; V _{DD} = 5 V | 3 | – | – | mA |
| A1; SCL; SDA | | | | | | |
| I _{L1} | leakage current | V _I = V _{DD} or V _{SS} | –1 | – | +1 | μA |
| A2/BP2; BP1 | | | | | | |
| I _{L2} | leakage current | V _I = V _{DD} or V _{SS} | –5 | – | +5 | μA |
| A2/BP2 | | | | | | |
| I _{pd} | pull-down current | V _I = V _{DD} | –5 | –1.5 | – | μA |
| A0/OSC | | | | | | |
| I _{L3} | leakage current | V _I = V _{DD} | –1 | – | – | μA |
| Oscillator | | | | | | |
| I _{osc} | start-up current | V _I = V _{SS} | – | 1.2 | 5 | μA |
| LCD outputs | | | | | | |
| V _{DC} | DC component of LCD driver | | – | ±20 | – | mV |
| I _{OL1} | LOW level segment output current | V _{DD} = 5 V; V _{OL} = 0.8 V; note 4 | 0.3 | – | – | mA |
| I _{OH1} | HIGH level segment output current | V _{DD} = 5 V; V _{OH} = V _{DD} – 0.8 V; note 4 | – | – | –0.3 | mA |
| R _{BP} | backplane output resistance (BP1; BP2) | V _O = V _{SS} or V _{DD} or ½(V _{SS} + V _{DD}); note 5 | – | 0.4 | 5 | kΩ |

Notes

1. Typical conditions: V_{DD} = 5 V; T_{amb} = 25 °C.
2. Resets all logic when V_{DD} < V_{POR}.
3. Periodically sampled, not 100% tested.
4. Outputs measured one at a time.
5. Outputs measured one at a time; V_{DD} = 5 V; I_{load} = 100 μA.

LCD direct/duplex driver with I²C-bus interface

PCF8577C

11 AC CHARACTERISTICS

$V_{DD} = 2.5$ to 6 V; $T_{amb} = -40$ to 85 °C; unless otherwise specified. All the timing values are valid within the operating supply voltage and ambient temperature range and refer to V_{IL} and V_{IH} with an input voltage swing of V_{SS} to V_{DD} .

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. ⁽¹⁾ | MAX. | UNIT |
|---------------------------|---|--|------|---------------------|------|---------|
| f_{LCD} | display frequency | $C_{osc} = 680$ pF; $R_{osc} = 1$ M Ω | 65 | 90 | 120 | Hz |
| t_{BS} | driver delays with test loads | $V_{DD} = 5$ V | – | 20 | 100 | μ s |
| I²C-bus | | | | | | |
| f_{SCL} | SCL clock frequency | | – | – | 100 | kHz |
| t_{SW} | tolerable spike width on I ² C-bus | $T_{amb} = 25$ °C | – | – | 100 | ns |
| t_{BUF} | I ² C-bus free time | | 4.7 | – | – | μ s |
| $t_{SU;STA}$ | START condition set-up time | | 4.0 | – | – | μ s |
| $t_{HD;STA}$ | START condition hold time | | 4.0 | – | – | μ s |
| t_{LOW} | SCL LOW time | | 4.7 | – | – | μ s |
| t_{HIGH} | SCL HIGH time | | 4.0 | – | – | μ s |
| t_r | SCL and SDA rise time | | – | – | 1.0 | μ s |
| t_f | SCL and SDA fall time | | – | – | 0.3 | μ s |
| $t_{SU;DAT}$ | data set-up time | | 250 | – | – | ns |
| $t_{HD;DAT}$ | data hold time | | 0 | – | – | ns |
| $t_{SU;STO}$ | STOP condition set-up time | | 4.0 | – | – | μ s |

Note

1. Typical conditions: $V_{DD} = 5$ V; $T_{amb} = 25$ °C.

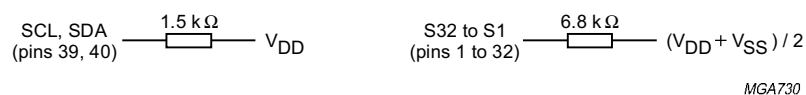


Fig.12 Test loads.

LCD direct/duplex driver with I²C-bus interface

PCF8577C

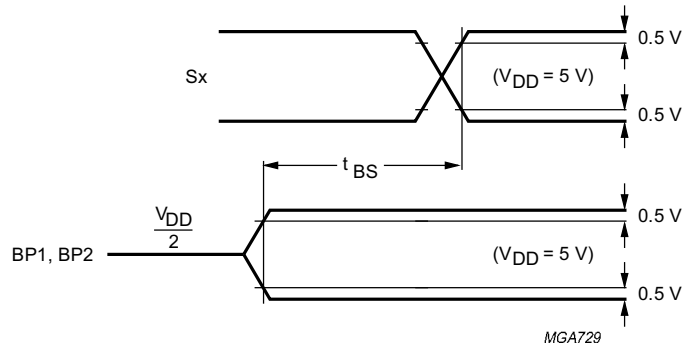


Fig.13 Driver timing waveforms.

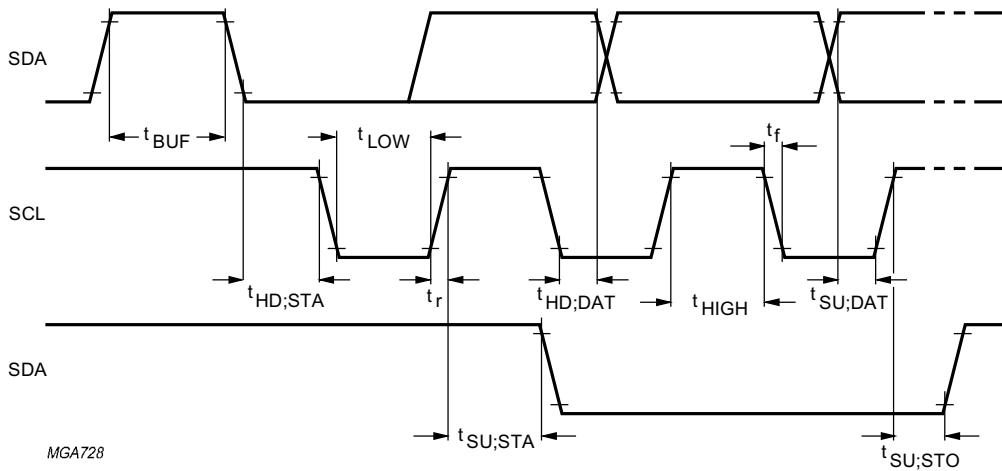


Fig.14 I²C-bus timing diagram; rise and fall times refer to V_{IL} and V_{IH}.

LCD direct/duplex driver with I²C-bus interface

PCF8577C

12 APPLICATION INFORMATION

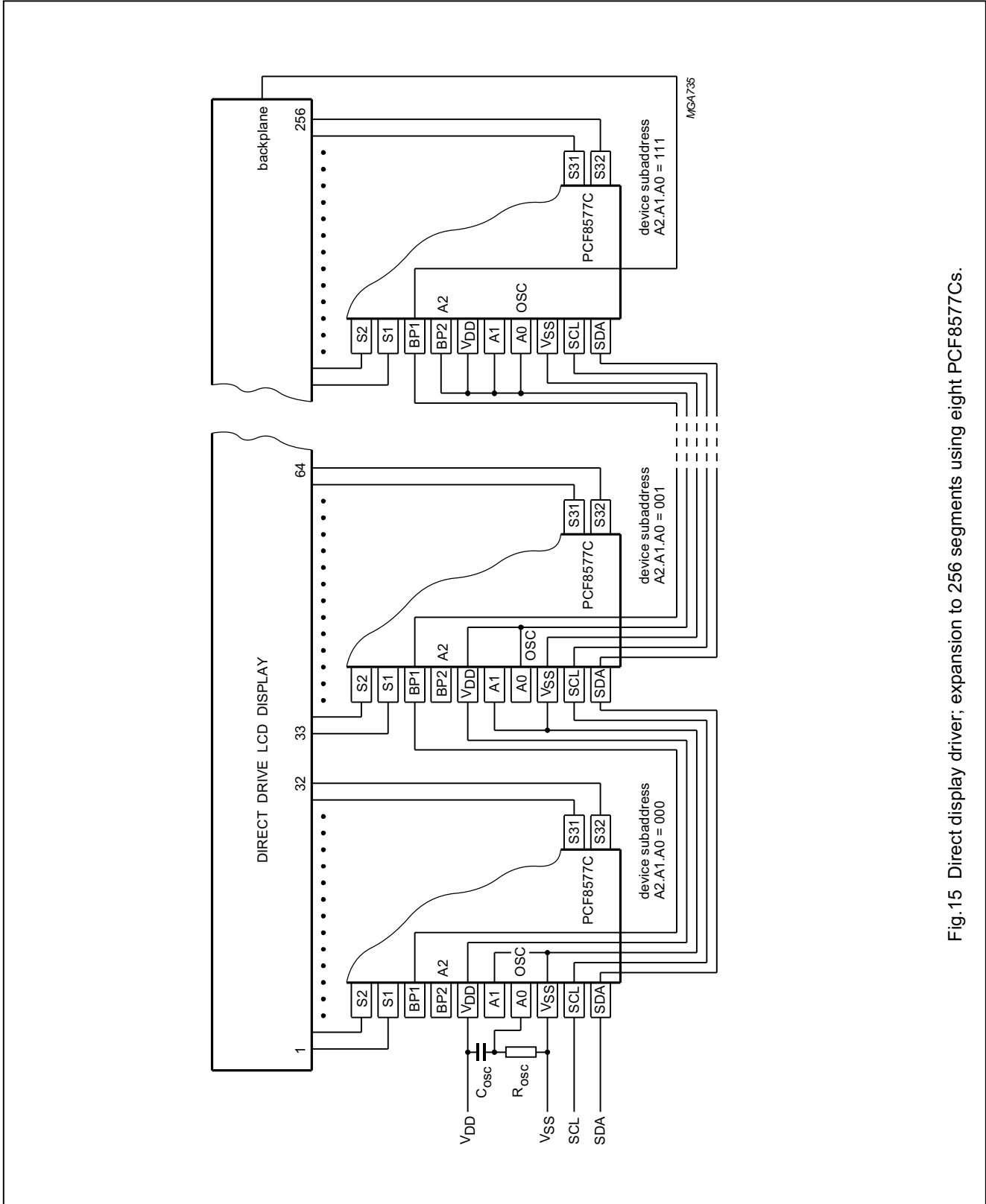


Fig.15 Direct display driver; expansion to 256 segments using eight PCF8577Cs.

LCD direct/duplex driver with I²C-bus interface

PCF8577C

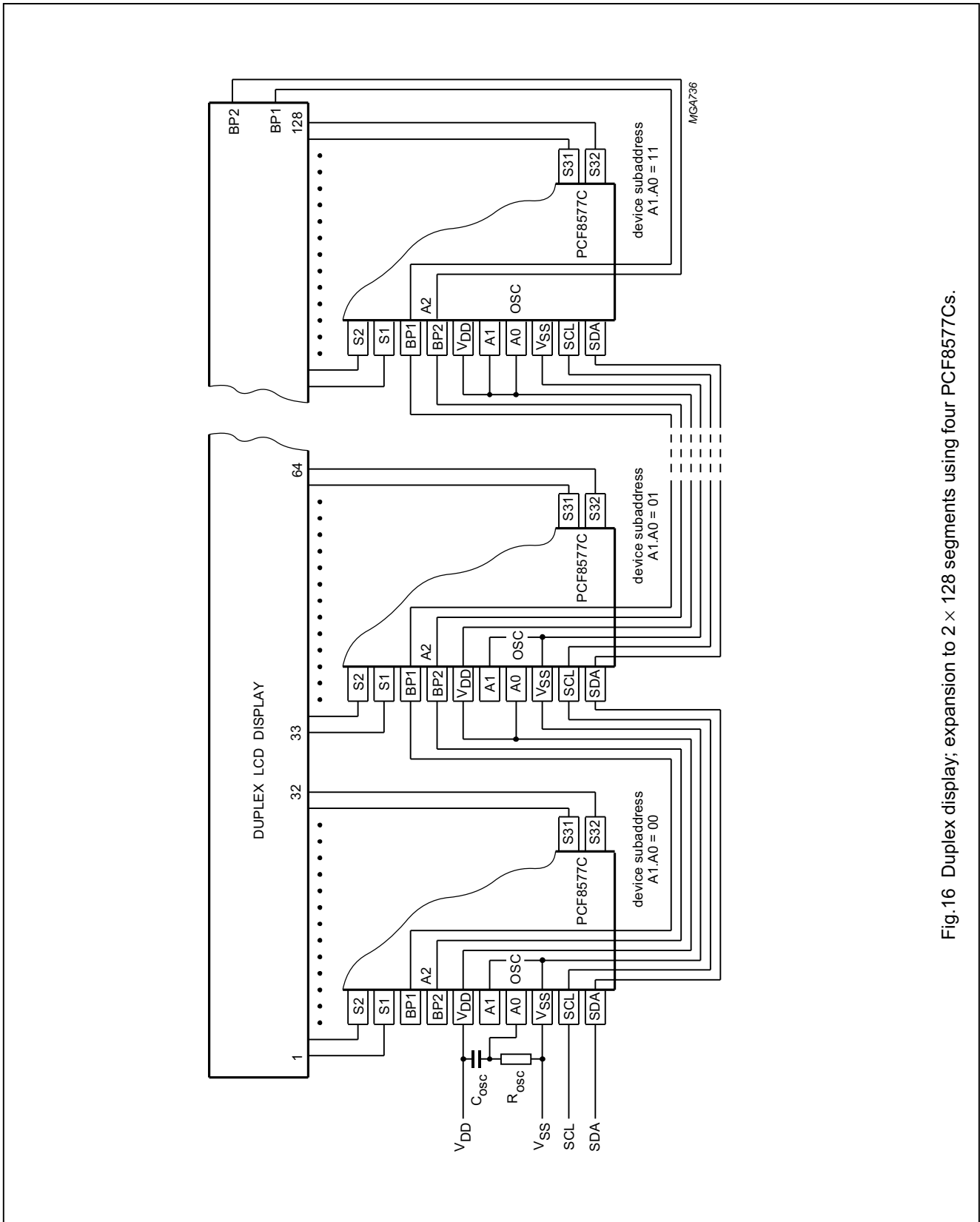
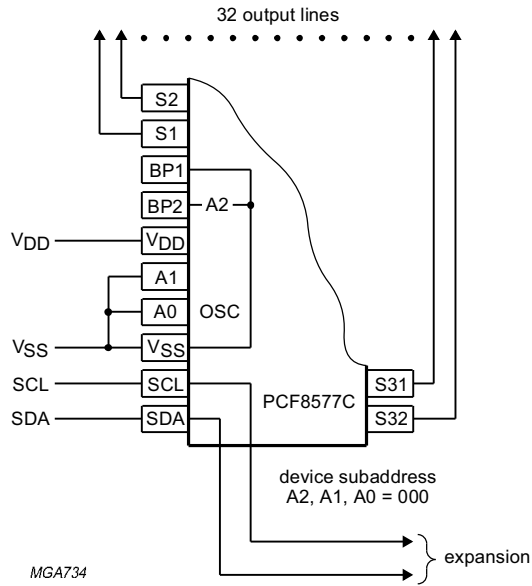


Fig.16 Duplex display; expansion to 2 x 128 segments using four PCF8577Cs.

LCD direct/duplex driver with I²C-bus interface

PCF8577C



MGA734

MODE bit must always be set to logic 0 (direct drive).

BANK switching is permitted.

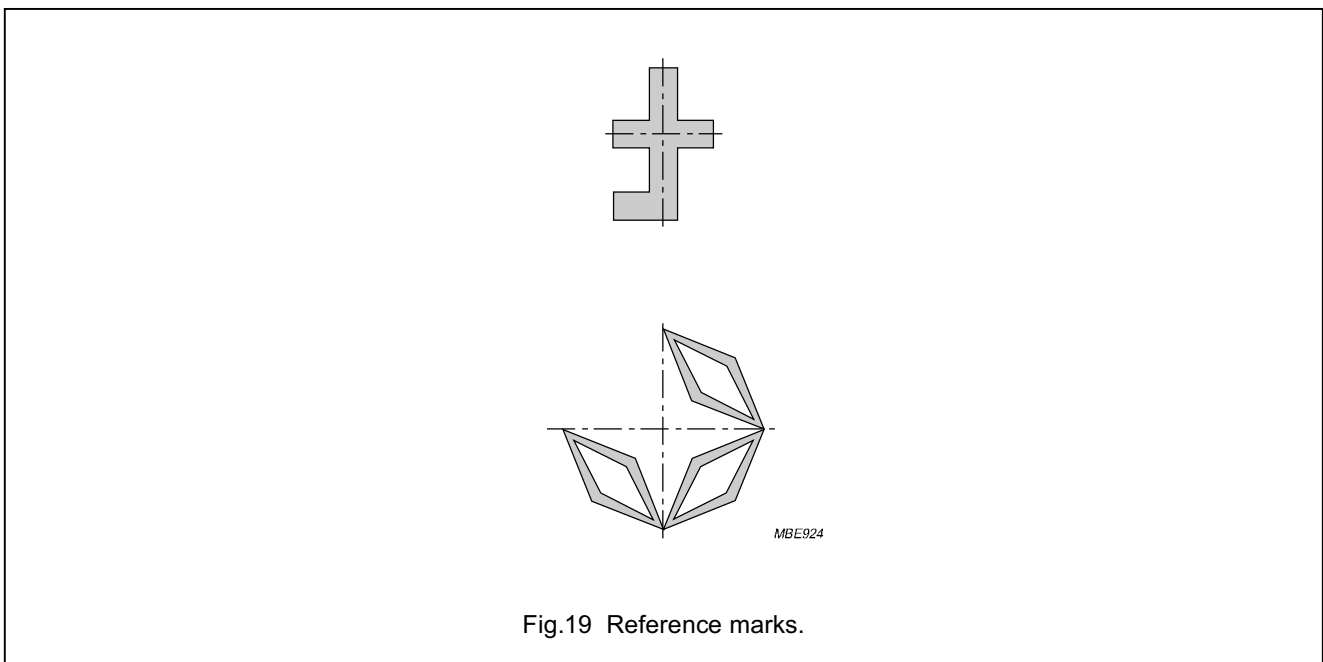
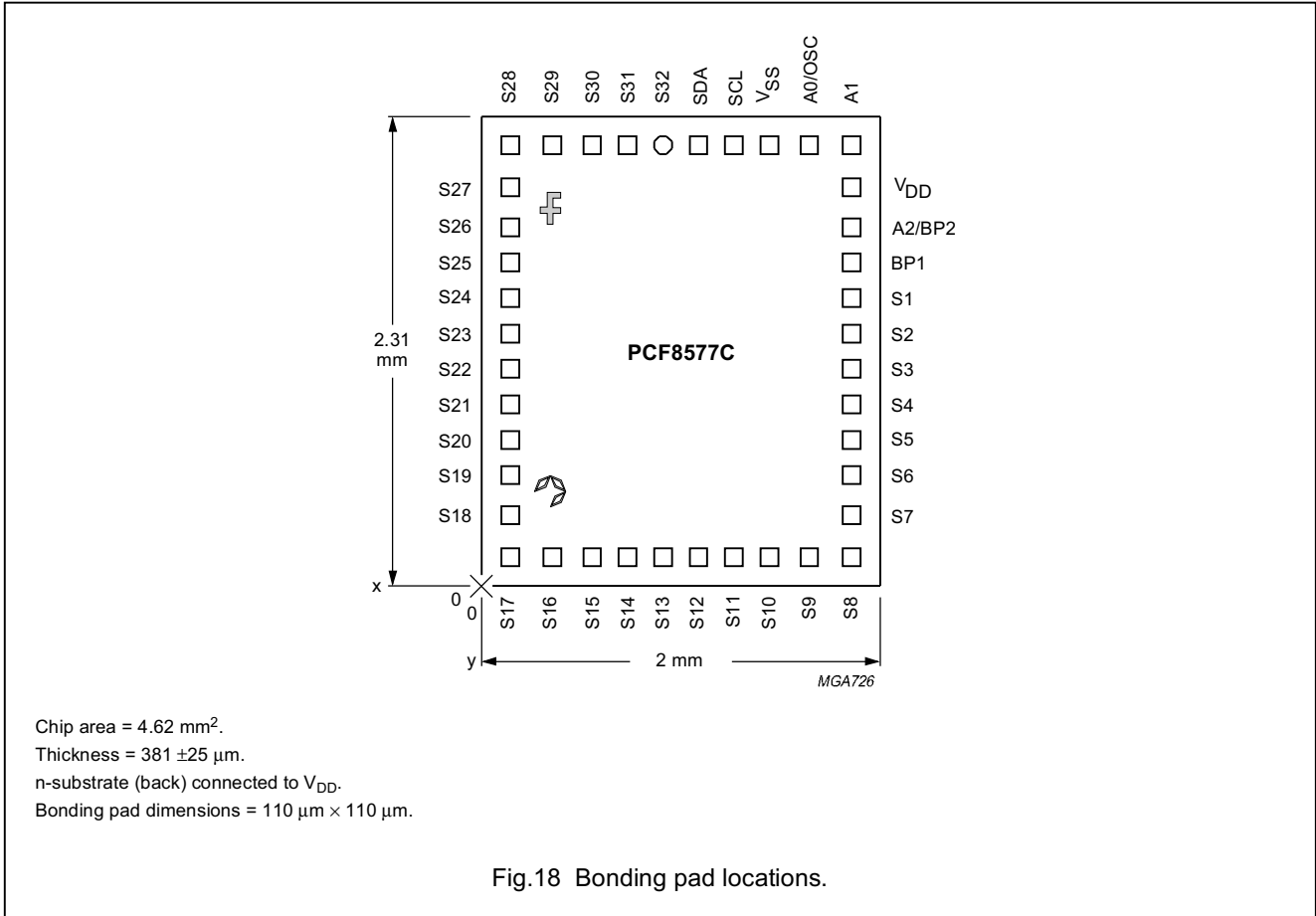
BP1 must always be connected to V_{SS} and A0/OSC must be connected to either V_{DD} or V_{SS} (no LCD modulation).

Fig.17 Use of PCF8577C as a 32-bit output expander in I²C-bus application.

LCD direct/duplex driver with I²C-bus interface

PCF8577C

13 CHIP DIMENSIONS AND BONDING PAD LOCATIONS



LCD direct/duplex driver with I²C-bus interface

PCF8577C

Table 3 Bonding pad locations (dimensions in μm)

All x and y co-ordinates are referenced to bottom left corner, see Fig.18.

| SIGNAL | PAD POSITION CENTRED | |
|--------|----------------------|------|
| | x | y |
| S32 | -86 | 941 |
| S31 | -257 | 941 |
| S30 | -428 | 941 |
| S29 | -599 | 941 |
| S28 | -836 | 941 |
| S27 | -836 | 769 |
| S26 | -836 | 598 |
| S25 | -836 | 427 |
| S24 | -836 | 256 |
| S23 | -836 | 85 |
| S22 | -836 | -86 |
| S21 | -836 | -257 |
| S20 | -836 | -428 |
| S19 | -836 | -599 |
| S18 | -836 | -770 |
| S17 | -836 | -941 |
| S16 | -599 | -941 |
| S15 | -428 | -941 |
| S14 | -257 | -941 |
| S13 | -86 | -941 |
| S12 | 85 | -941 |
| S11 | 256 | -941 |

| SIGNAL | PAD POSITION CENTRED | |
|-----------------|----------------------|------|
| | x | y |
| S10 | 427 | -941 |
| S9 | 598 | -941 |
| S8 | 836 | -941 |
| S7 | 836 | -770 |
| S6 | 836 | -599 |
| S5 | 836 | -428 |
| S4 | 836 | -257 |
| S3 | 836 | -86 |
| S2 | 836 | 85 |
| S1 | 836 | 256 |
| BP1 | 836 | 427 |
| A2/BP2 | 836 | 598 |
| V _{DD} | 836 | 769 |
| A1 | 836 | 941 |
| A0/OSC | 598 | 941 |
| V _{SS} | 427 | 941 |
| SCL | 256 | 941 |
| SDA | 85 | 941 |
| Recpats | | |
| C | -586 | -699 |
| F | -580 | 663 |

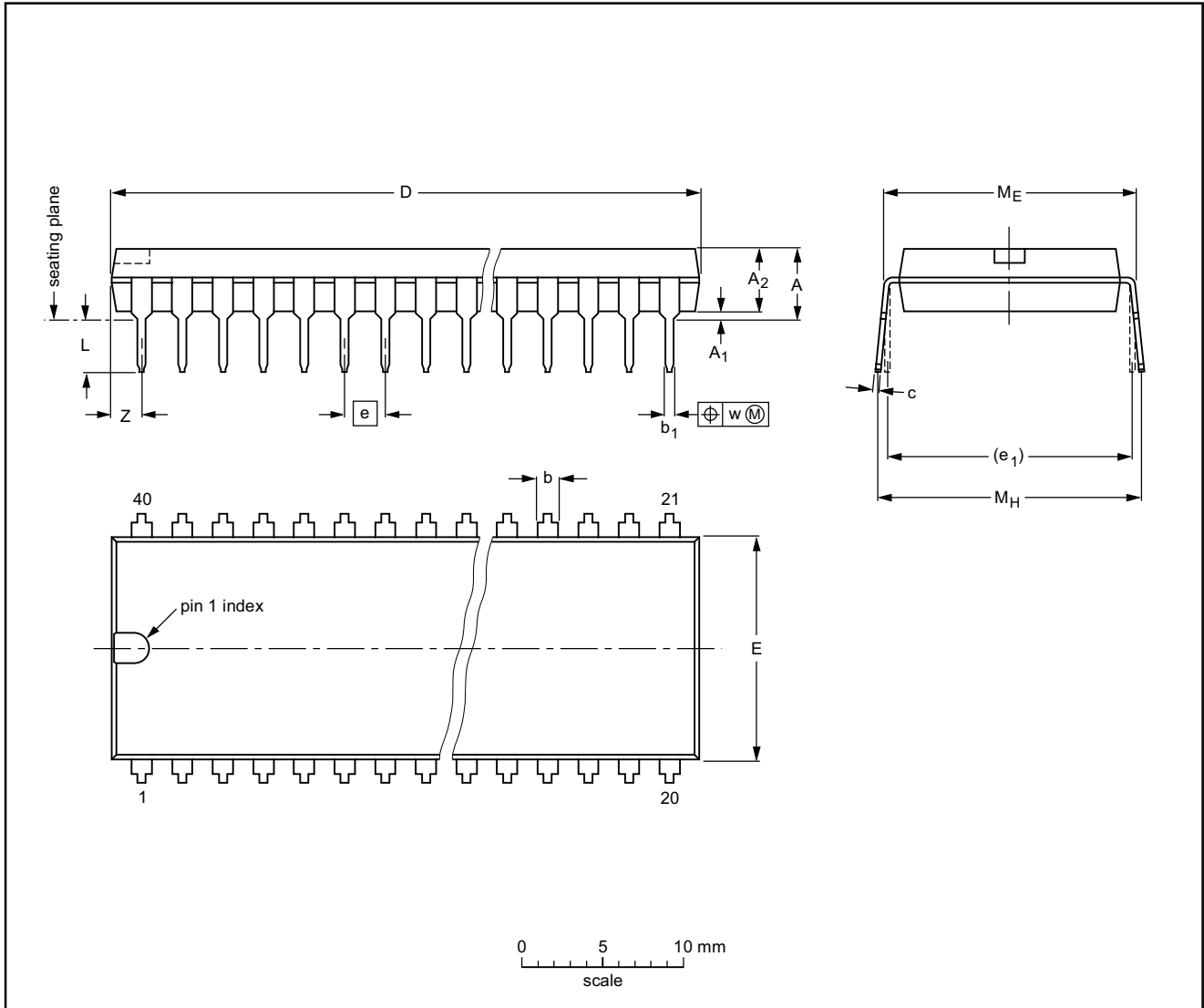
LCD direct/duplex driver with I²C-bus interface

PCF8577C

14 PACKAGE OUTLINES

DIP40: plastic dual in-line package; 40 leads (600 mil)

SOT129-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

| UNIT | A max. | A ₁ min. | A ₂ max. | b | b ₁ | c | D ⁽¹⁾ | E ⁽¹⁾ | e | e ₁ | L | M _E | M _H | w | Z ⁽¹⁾ max. |
|--------|--------|---------------------|---------------------|----------------|----------------|----------------|------------------|------------------|------|----------------|--------------|----------------|----------------|-------|-----------------------|
| mm | 4.7 | 0.51 | 4.0 | 1.70 1.14 | 0.53 0.38 | 0.36 0.23 | 52.50 51.50 | 14.1 13.7 | 2.54 | 15.24 | 3.60 3.05 | 15.80 15.24 | 17.42 15.90 | 0.254 | 2.25 |
| inches | 0.19 | 0.020 | 0.16 | 0.067 0.045 | 0.021 0.015 | 0.014 0.009 | 2.067 2.028 | 0.56 0.54 | 0.10 | 0.60 | 0.14 0.12 | 0.62 0.60 | 0.69 0.63 | 0.01 | 0.089 |

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

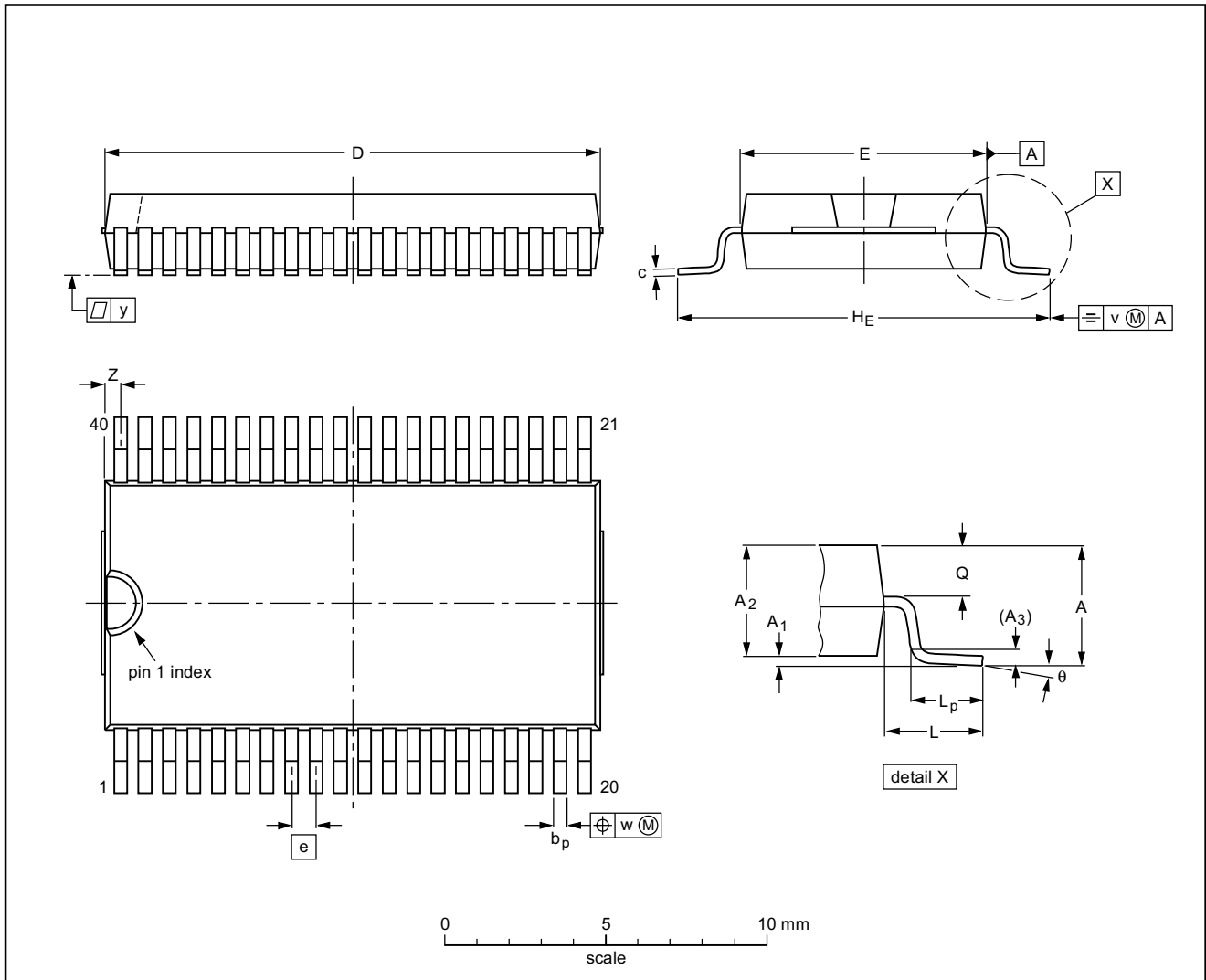
| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|-----------------|------------|----------|------|--|---------------------|----------------------|
| | IEC | JEDEC | EIAJ | | | |
| SOT129-1 | 051G08 | MO-015AJ | | | | 92-11-17 95-01-14 |

LCD direct/duplex driver with I²C-bus interface

PCF8577C

VSO40: plastic very small outline package; 40 leads

SOT158-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

| UNIT | A max. | A ₁ | A ₂ | A ₃ | b _p | c | D ⁽¹⁾ | E ⁽²⁾ | e | H _E | L | L _p | Q | v | w | y | Z ⁽¹⁾ | θ |
|--------|--------|----------------|----------------|----------------|----------------|------------------|------------------|------------------|-------|----------------|-------|----------------|----------------|-------|-------|-------|------------------|----------|
| mm | 2.70 | 0.3 0.1 | 2.45 2.25 | 0.25 | 0.42 0.30 | 0.22 0.14 | 15.6 15.2 | 7.6 7.5 | 0.762 | 12.3 11.8 | 2.25 | 1.7 1.5 | 1.15 1.05 | 0.2 | 0.1 | 0.1 | 0.6 0.3 | 7° 0° |
| inches | 0.11 | 0.012 0.004 | 0.096 0.089 | 0.010 | 0.017 0.012 | 0.0087 0.0055 | 0.61 0.60 | 0.30 0.29 | 0.03 | 0.48 0.46 | 0.089 | 0.067 0.059 | 0.045 0.041 | 0.008 | 0.004 | 0.004 | 0.024 0.012 | |

Notes

1. Plastic or metal protrusions of 0.4 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | EUROPEAN PROJECTION | ISSUE DATE |
|-----------------|------------|-------|------|---------------------|----------------------|
| | IEC | JEDEC | EIAJ | | |
| SOT158-1 | | | | | 92-11-17 95-01-24 |

LCD direct/duplex driver with I²C-bus interface

PCF8577C

15 SOLDERING

15.1 Introduction

There is no soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and surface mounted components are mixed on one printed-circuit board. However, wave soldering is not always suitable for surface mounted ICs, or for printed-circuits with high population densities. In these situations reflow soldering is often used.

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our "IC Package Databook" (order code 9398 652 90011).

15.2 DIP

15.2.1 SOLDERING BY DIPPING OR BY WAVE

The maximum permissible temperature of the solder is 260 °C; solder at this temperature must not be in contact with the joint for more than 5 seconds. The total contact time of successive solder waves must not exceed 5 seconds.

The device may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the specified maximum storage temperature ($T_{stg\ max}$). If the printed-circuit board has been pre-heated, forced cooling may be necessary immediately after soldering to keep the temperature within the permissible limit.

15.2.2 REPAIRING SOLDERED JOINTS

Apply a low voltage soldering iron (less than 24 V) to the lead(s) of the package, below the seating plane or not more than 2 mm above it. If the temperature of the soldering iron bit is less than 300 °C it may remain in contact for up to 10 seconds. If the bit temperature is between 300 and 400 °C, contact may be up to 5 seconds.

15.3 SO

15.3.1 REFLOW SOLDERING

Reflow soldering techniques are suitable for all SO packages.

Reflow soldering requires solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the printed-circuit board by screen printing, stencilling or pressure-syringe dispensing before package placement.

Several techniques exist for reflowing; for example, thermal conduction by heated belt. Dwell times vary between 50 and 300 seconds depending on heating method. Typical reflow temperatures range from 215 to 250 °C.

Preheating is necessary to dry the paste and evaporate the binding agent. Preheating duration: 45 minutes at 45 °C.

15.3.2 WAVE SOLDERING

Wave soldering techniques can be used for all SO packages if the following conditions are observed:

- A double-wave (a turbulent wave with high upward pressure followed by a smooth laminar wave) soldering technique should be used.
- The longitudinal axis of the package footprint must be parallel to the solder flow.
- The package footprint must incorporate solder thieves at the downstream end.

During placement and before soldering, the package must be fixed with a droplet of adhesive. The adhesive can be applied by screen printing, pin transfer or syringe dispensing. The package can be soldered after the adhesive is cured.

Maximum permissible solder temperature is 260 °C, and maximum duration of package immersion in solder is 10 seconds, if cooled to less than 150 °C within 6 seconds. Typical dwell time is 4 seconds at 250 °C.

A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

15.3.3 REPAIRING SOLDERED JOINTS

Fix the component by first soldering two diagonally-opposite end leads. Use only a low voltage soldering iron (less than 24 V) applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C. When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds between 270 and 320 °C.

LCD direct/duplex driver with I²C-bus interface

PCF8577C

16 DEFINITIONS

| Data sheet status | |
|---|---|
| Objective specification | This data sheet contains target or goal specifications for product development. |
| Preliminary specification | This data sheet contains preliminary data; supplementary data may be published later. |
| Product specification | This data sheet contains final product specifications. |
| Limiting values | |
| Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability. | |
| Application information | |
| Where application information is given, it is advisory and does not form part of the specification. | |

17 LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.

18 PURCHASE OF PHILIPS I²C COMPONENTS



Purchase of Philips I²C components conveys a license under the Philips' I²C patent to use the components in the I²C system provided the system conforms to the I²C specification defined by Philips. This specification can be ordered using the code 9398 393 40011.

LCD direct/duplex driver with
I²C-bus interface

PCF8577C

NOTES

LCD direct/duplex driver with
I²C-bus interface

PCF8577C

NOTES

LCD direct/duplex driver with
I²C-bus interface

PCF8577C

NOTES

Philips Semiconductors – a worldwide company

Argentina: see South America

Australia: 34 Waterloo Road, NORTH RYDE, NSW 2113,
Tel. +61 2 9805 4455, Fax. +61 2 9805 4466

Austria: Computerstr. 6, A-1101 WIEN, P.O. Box 213,
Tel. +43 1 60 101, Fax. +43 1 60 101 1210

Belarus: Hotel Minsk Business Center, Bld. 3, r. 1211, Volodarski Str. 6,
220050 MINSK, Tel. +375 172 200 733, Fax. +375 172 200 773

Belgium: see The Netherlands

Brazil: see South America

Bulgaria: Philips Bulgaria Ltd., Energoproject, 15th floor,
51 James Bourchier Blvd., 1407 SOFIA,
Tel. +359 2 689 211, Fax. +359 2 689 102

Canada: PHILIPS SEMICONDUCTORS/COMPONENTS,
Tel. +1 800 234 7381

China/Hong Kong: 501 Hong Kong Industrial Technology Centre,
72 Tat Chee Avenue, Kowloon Tong, HONG KONG,
Tel. +852 2319 7888, Fax. +852 2319 7700

Colombia: see South America

Czech Republic: see Austria

Denmark: Prags Boulevard 80, PB 1919, DK-2300 COPENHAGEN S,
Tel. +45 32 88 2636, Fax. +45 31 57 1949

Finland: Sinikalliontie 3, FIN-02630 ESPOO,
Tel. +358 9 615800, Fax. +358 9 61580/xxx

France: 4 Rue du Port-aux-Vins, BP317, 92156 SURESNES Cedex,
Tel. +33 1 40 99 6161, Fax. +33 1 40 99 6427

Germany: Hammerbrookstraße 69, D-20097 HAMBURG,
Tel. +49 40 23 53 60, Fax. +49 40 23 536 300

Greece: No. 15, 25th March Street, GR 17778 TAVROS/ATHENS,
Tel. +30 1 4894 339/239, Fax. +30 1 4814 240

Hungary: see Austria

India: Philips INDIA Ltd, Shivsagar Estate, A Block, Dr. Annie Besant Rd.
Worli, MUMBAI 400 018, Tel. +91 22 4938 541, Fax. +91 22 4938 722

Indonesia: see Singapore

Ireland: Newstead, Clonskeagh, DUBLIN 14,
Tel. +353 1 7640 000, Fax. +353 1 7640 200

Israel: RAPAC Electronics, 7 Kehilat Saloniki St, TEL AVIV 61180,
Tel. +972 3 645 0444, Fax. +972 3 649 1007

Italy: PHILIPS SEMICONDUCTORS, Piazza IV Novembre 3,
20124 MILANO, Tel. +39 2 6752 2531, Fax. +39 2 6752 2557

Japan: Philips Bldg 13-37, Kohnan 2-chome, Minato-ku, TOKYO 108,
Tel. +81 3 3740 5130, Fax. +81 3 3740 5077

Korea: Philips House, 260-199 Itaewon-dong, Yongsan-ku, SEOUL,
Tel. +82 2 709 1412, Fax. +82 2 709 1415

Malaysia: No. 76 Jalan Universiti, 46200 PETALING JAYA, SELANGOR,
Tel. +60 3 750 5214, Fax. +60 3 757 4880

Mexico: 5900 Gateway East, Suite 200, EL PASO, TEXAS 79905,
Tel. +9-5 800 234 7381

Middle East: see Italy

Netherlands: Postbus 90050, 5600 PB EINDHOVEN, Bldg. VB,
Tel. +31 40 27 82785, Fax. +31 40 27 88399

New Zealand: 2 Wagener Place, C.P.O. Box 1041, AUCKLAND,
Tel. +64 9 849 4160, Fax. +64 9 849 7811

Norway: Box 1, Manglerud 0612, OSLO,
Tel. +47 22 74 8000, Fax. +47 22 74 8341

Philippines: Philips Semiconductors Philippines Inc.,
106 Valero St. Salcedo Village, P.O. Box 2108 MCC, MAKATI,
Metro MANILA, Tel. +63 2 816 6380, Fax. +63 2 817 3474

Poland: Ul. Lukiska 10, PL 04-123 WARSZAWA,
Tel. +48 22 612 2831, Fax. +48 22 612 2327

Portugal: see Spain

Romania: see Italy

Russia: Philips Russia, Ul. Usatcheva 35A, 119048 MOSCOW,
Tel. +7 095 755 6918, Fax. +7 095 755 6919

Singapore: Lorong 1, Toa Payoh, SINGAPORE 1231,
Tel. +65 350 2538, Fax. +65 251 6500

Slovakia: see Austria

Slovenia: see Italy

South Africa: S.A. PHILIPS Pty Ltd., 195-215 Main Road Martindale,
2092 JOHANNESBURG, P.O. Box 7430 Johannesburg 2000,
Tel. +27 11 470 5911, Fax. +27 11 470 5494

South America: Rua do Rocio 220, 5th floor, Suite 51,
04552-903 São Paulo, SÃO PAULO - SP, Brazil,
Tel. +55 11 821 2333, Fax. +55 11 829 1849

Spain: Balmes 22, 08007 BARCELONA,
Tel. +34 3 301 6312, Fax. +34 3 301 4107

Sweden: Kottbygatan 7, Akalla, S-16485 STOCKHOLM,
Tel. +46 8 632 2000, Fax. +46 8 632 2745

Switzerland: Allmendstrasse 140, CH-8027 ZÜRICH,
Tel. +41 1 488 2686, Fax. +41 1 481 7730

Taiwan: Philips Semiconductors, 6F, No. 96, Chien Kuo N. Rd., Sec. 1,
TAIPEI, Taiwan Tel. +886 2 2134 2870, Fax. +886 2 2134 2874

Thailand: PHILIPS ELECTRONICS (THAILAND) Ltd.,
209/2 Sanpavuth-Bangna Road Prakanong, BANGKOK 10260,
Tel. +66 2 745 4090, Fax. +66 2 398 0793

Turkey: Talatpasa Cad. No. 5, 80640 GÜLTEPE/ISTANBUL,
Tel. +90 212 279 2770, Fax. +90 212 282 6707

Ukraine: PHILIPS UKRAINE, 4 Patrice Lumumba str., Building B, Floor 7,
252042 KIEV, Tel. +380 44 264 2776, Fax. +380 44 268 0461

United Kingdom: Philips Semiconductors Ltd., 276 Bath Road, Hayes,
MIDDLESEX UB3 5BX, Tel. +44 181 730 5000, Fax. +44 181 754 8421

United States: 811 East Arques Avenue, SUNNYVALE, CA 94088-3409,
Tel. +1 800 234 7381

Uruguay: see South America

Vietnam: see Singapore

Yugoslavia: PHILIPS, Trg N. Pasica 5/v, 11000 BEOGRAD,
Tel. +381 11 625 344, Fax. +381 11 635 777

For all other countries apply to: Philips Semiconductors, Marketing & Sales Communications,
Building BE-p, P.O. Box 218, 5600 MD EINDHOVEN, The Netherlands, Fax. +31 40 27 24825

Internet: <http://www.semiconductors.philips.com>

© Philips Electronics N.V. 1997

SCA53

All rights are reserved. Reproduction in whole or in part is prohibited without the prior written consent of the copyright owner.

The information presented in this document does not form part of any quotation or contract, is believed to be accurate and reliable and may be changed without notice. No liability will be accepted by the publisher for any consequence of its use. Publication thereof does not convey nor imply any license under patent- or other industrial or intellectual property rights.

Printed in The Netherlands

417067/1200/03/pp28

Date of release: 1997 Mar 28

Document order number: 9397 750 01651

Let's make things better.

Philips
Semiconductors



PHILIPS