

## THREE TERMINAL LOW DROPOUT VOLTAGE REGULATOR

The  $\mu$ PC24A00 Series is a low dropout voltage three terminal regulator that has realized a minimum voltage differential between the I/O of no more than 1 V when the output current is 2 A through the employment of a PNP transistor at the output stage.

Due to its ability to achieve a greater reduction in the power loss compared with conventional three-terminal regulators, the  $\mu$ PC24A00 Series is ideal for use as the secondary side smoothing circuit of a power supply.

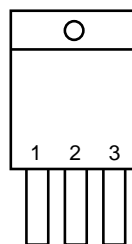
### FEATURES

- Output current in excess of 2.0 A
- High accuracy of output voltage  
 $\Delta V_o = \pm 2\% \text{ MAX. (} T_J = 25^\circ\text{C, } I_o = 1 \text{ A)}$
- Low dropout voltage  
 $V_{DIF} = 1 \text{ V MAX. (} I_o = 2 \text{ A)}$
- On-chip thermal shut down circuit, over-current protection circuit and safe operating area protection circuit

### PIN CONFIGURATION (Marking Side)

3-pin plastic SIP (MP-45G)

$\mu$ PC24A05HF, 24A12HF, 24A15HF



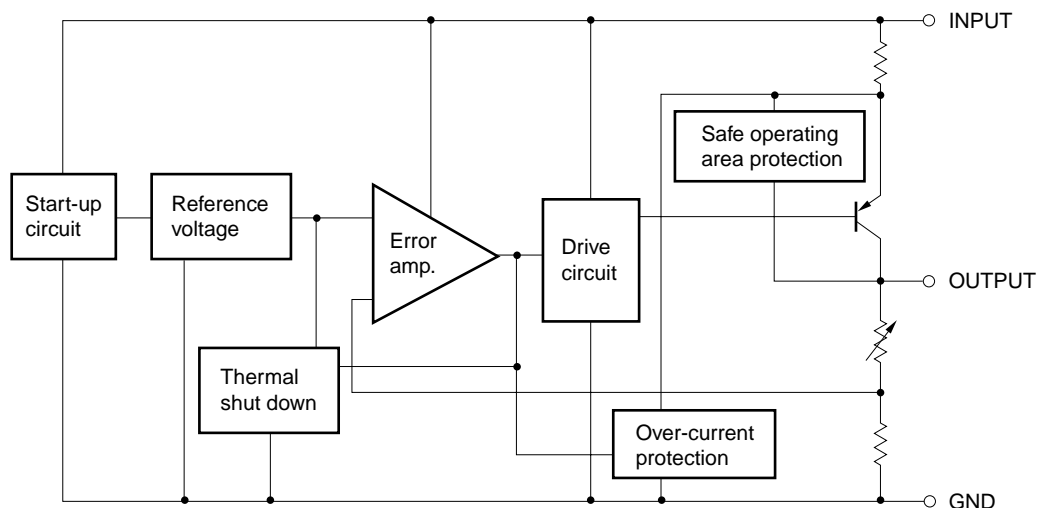
1: INPUT  
 2: GND  
 3: OUTPUT

### ORDERING INFORMATION

Part Number	Package	Output Voltage
$\mu$ PC24A05HF	3-pin plastic SIP (MP-45G) (isolated TO-220)	5 V
$\mu$ PC24A12HF	3-pin plastic SIP (MP-45G) (isolated TO-220)	12 V
$\mu$ PC24A15HF	3-pin plastic SIP (MP-45G) (isolated TO-220)	15 V

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 Not all devices/types available in every country. Please check with local NEC representative for availability and additional information.

**BLOCK DIAGRAM**



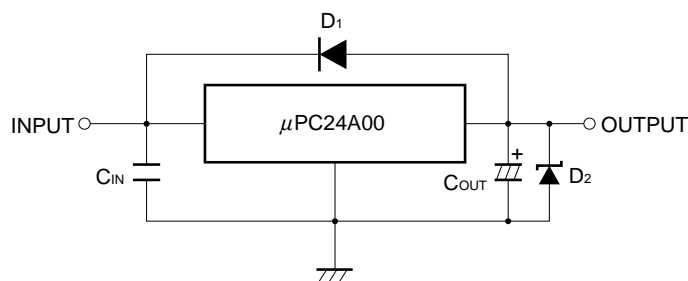
**ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 25°C, Unless Otherwise Specified)**

Parameter	Symbol	Rating	Unit
Input voltage	V <sub>IN</sub>	-0.3 to +36	V
Total power consumption	P <sub>T</sub>	20 <sup>Note</sup>	W
Operating ambient temperature	T <sub>A</sub>	-20 to +85	°C
Storage temperature	T <sub>stg</sub>	-55 to +150	°C
Operating junction temperature	T <sub>J</sub>	-20 to +150	°C
Thermal resistance (junction to case)	R <sub>th (J-C)</sub>	5	°C/W
Thermal resistance (junction to ambient)	R <sub>th (J-A)</sub>	65	°C/W

**Note** Internally limited. When operating junction temperature rise up to 150°C, the internal circuit shutdown output voltage.

**Caution** Product quality may suffer if the absolute maximum rating is exceeded even momentarily for any parameter. That is, the absolute maximum ratings are rated values at which the product is on the verge of suffering physical damage, and therefore the product must be used under conditions that ensure that the absolute maximum ratings are not exceeded.

TYPICAL CONNECTION



C<sub>IN</sub>: 0.1 to 0.47 μF. Be sure to connect to prevent abnormal oscillation. When using capacitors, film capacitors with excellent voltage and temperature characteristics are recommended. Be aware that some monolithic ceramic capacitors have inferior temperature and voltage characteristics. When using a monolithic ceramic capacitor, C<sub>IN</sub> requires a capacitor that can secure this capacity within the voltage and temperature range used.

C<sub>OUT</sub>: 10 μF or higher. Be sure to connect to prevent oscillation and to improve transient load stabilization.

**Remark** Connect C<sub>IN</sub> and C<sub>OUT</sub> as close as possible to the IC pins (within 2 cm).

D<sub>1</sub>: V<sub>O</sub> > V<sub>IN</sub> required

D<sub>2</sub>: Schottky barrier diode required for when V<sub>O</sub> < GND.

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Input voltage	V <sub>IN</sub>	μPC24A05HF	6	9	15	V
		μPC24A12HF	13	18	22	V
		μPC24A15HF	16	22	25	V
Output current	I <sub>O</sub>	All	0		2	A
Operating junction temperature	T <sub>J</sub>	All	-20		+125	°C

**Caution** The recommended operating range may be exceeded without causing any problems provided that the absolute maximum ratings are not exceeded. However, if the device is operated in a way that exceeds the recommended operating conditions, the margin between the actual conditions of use and the absolute maximum ratings is small, and therefore thorough evaluation is necessary. The recommended operating conditions do not imply that the device can be used with all values at their maximum values.

ELECTRICAL CHARACTERISTICS

$\mu$ PC24A05 ( $T_J = 25^\circ\text{C}$ ,  $V_{IN} = 9\text{ V}$ ,  $I_o = 1\text{ A}$ , Unless Otherwise Specified)

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Output voltage	$V_o$		4.9	5.0	5.1	V
		$0^\circ\text{C} \leq T_J \leq 125^\circ\text{C}$ , $6\text{ V} \leq V_{IN} \leq 15\text{ V}$ , $5\text{ mA} \leq I_o \leq 2\text{ A}$	4.85		5.15	V
Line regulation	$REG_{IN}$	$6\text{ V} \leq V_{IN} \leq 15\text{ V}$		6	50	mV
Load regulation	$REG_L$	$5\text{ mA} \leq I_o \leq 2\text{ A}$		3	50	mV
Quiescent current	$I_{BIAS}$	$I_o = 0\text{ A}$		3	5.0	mA
		$I_o = 2\text{ A}$		15	30	mA
Quiescent current change	$\Delta I_{BIAS}$	$6\text{ V} \leq V_{IN} \leq 15\text{ V}$ , $I_o = 2\text{ A}$			20	mA
Output noise voltage	$V_n$	$10\text{ Hz} \leq f \leq 100\text{ kHz}$		150		$\mu\text{V}_{r.m.s.}$
Ripple rejection	R·R	$f = 120\text{ Hz}$ , $6.5\text{ V} \leq V_{IN} \leq 16.5\text{ V}$	50	60		dB
Dropout voltage	$V_{DIF}$	$0^\circ\text{C} \leq T_J \leq 125^\circ\text{C}$ , $I_o = 2\text{ A}$			1.0	V
Short circuit current	$I_{O\text{ short}}$	$V_{IN} = 15\text{ V}$		1.3		A
Peak output current	$I_{O\text{ peak}}$	$V_{IN} = 9\text{ V}$	2.8	3.5	4.2	A
Temperature coefficient of output voltage	$\Delta V_o/\Delta T$	$0^\circ\text{C} \leq T_J \leq 125^\circ\text{C}$ , $I_o = 5\text{ mA}$		0.5		mV/ $^\circ\text{C}$

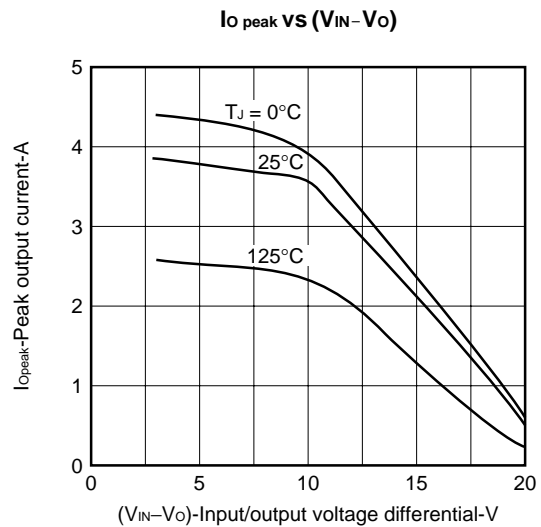
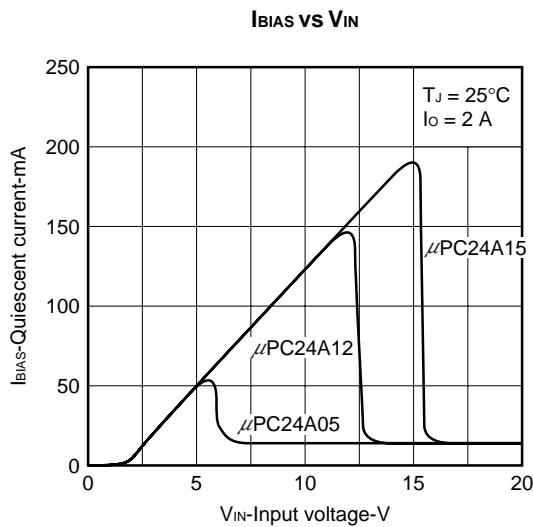
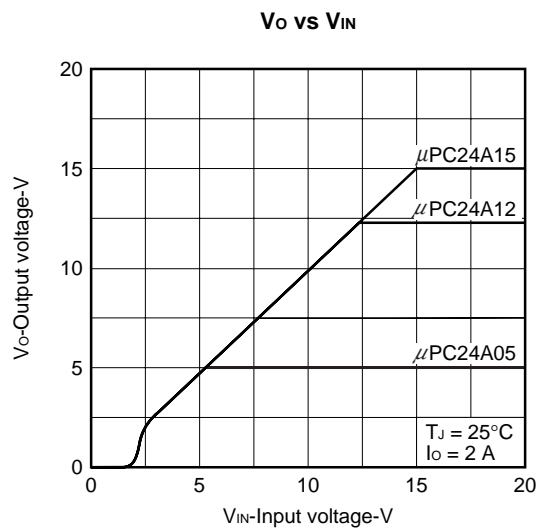
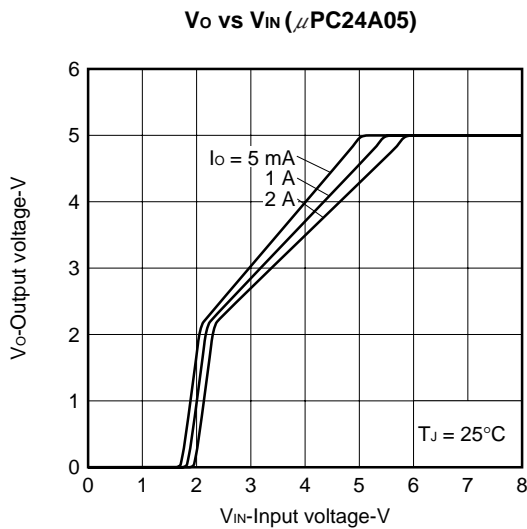
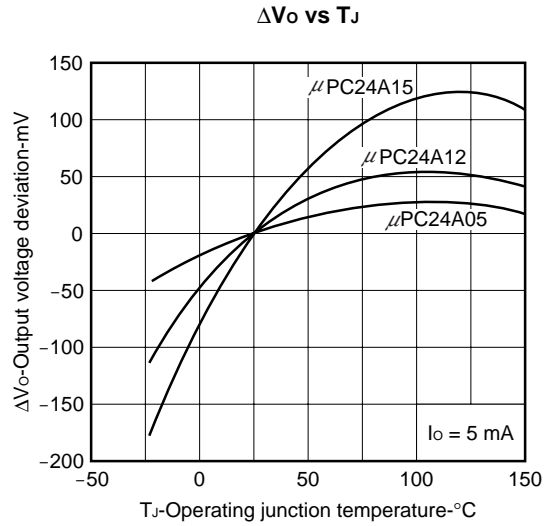
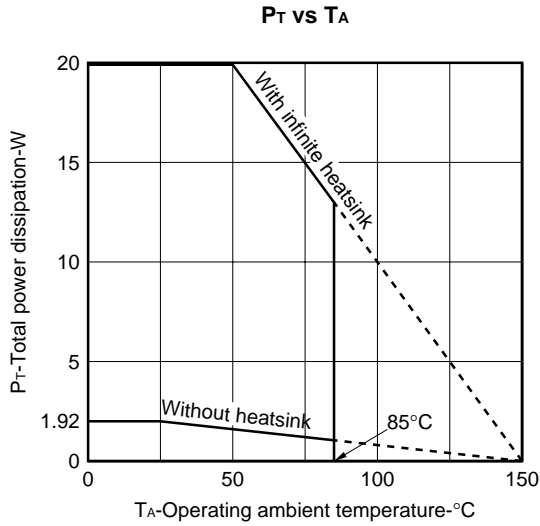
$\mu$ PC24A12 ( $T_J = 25^\circ\text{C}$ ,  $V_{IN} = 18\text{ V}$ ,  $I_o = 1\text{ A}$ , Unless Otherwise Specified)

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Output voltage	$V_o$		11.75	12.0	12.25	V
		$0^\circ\text{C} \leq T_J \leq 125^\circ\text{C}$ , $13\text{ V} \leq V_{IN} \leq 22\text{ V}$ , $5\text{ mA} \leq I_o \leq 2\text{ A}$	11.65		12.35	V
Line regulation	$REG_{IN}$	$13\text{ V} \leq V_{IN} \leq 22\text{ V}$		12	100	mV
Load regulation	$REG_L$	$5\text{ mA} \leq I_o \leq 2\text{ A}$		6	100	mV
Quiescent current	$I_{BIAS}$	$I_o = 0\text{ A}$		3	5.0	mA
		$I_o = 2\text{ A}$		15	30	mA
Quiescent current change	$\Delta I_{BIAS}$	$13\text{ V} \leq V_{IN} \leq 22\text{ V}$ , $I_o = 2\text{ A}$			20	mA
Output noise voltage	$V_n$	$10\text{ Hz} \leq f \leq 100\text{ kHz}$		220		$\mu\text{V}_{r.m.s.}$
Ripple rejection	R·R	$f = 120\text{ Hz}$ , $13.5\text{ V} \leq V_{IN} \leq 23.5\text{ V}$	43	50		dB
Dropout voltage	$V_{DIF}$	$0^\circ\text{C} \leq T_J \leq 125^\circ\text{C}$ , $I_o = 2\text{ A}$			1.0	V
Short circuit current	$I_{O\text{ short}}$	$V_{IN} = 15\text{ V}$		1.4		A
Peak output current	$I_{O\text{ peak}}$	$V_{IN} = 18\text{ V}$	2.8	3.5	4.2	A
Temperature coefficient of output voltage	$\Delta V_o/\Delta T$	$0^\circ\text{C} \leq T_J \leq 125^\circ\text{C}$ , $I_o = 5\text{ mA}$		1.0		mV/ $^\circ\text{C}$

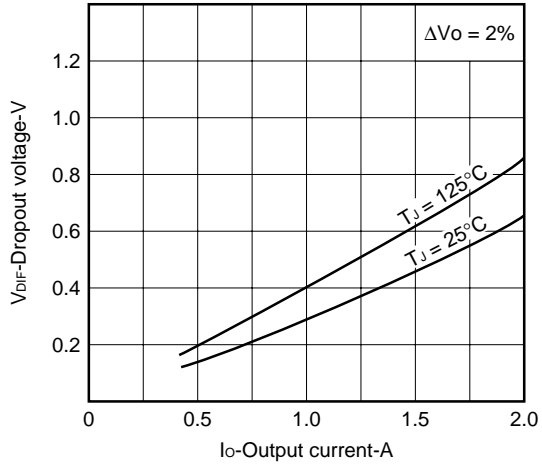
$\mu$ PC24A15 ( $T_J = 25^\circ\text{C}$ ,  $V_{IN} = 22\text{ V}$ ,  $I_o = 1\text{ A}$ , Unless Otherwise Specified)

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Output voltage	$V_o$		14.7	15.0	15.3	V
		$0^\circ\text{C} \leq T_J \leq 125^\circ\text{C}$ , $16\text{ V} \leq V_{IN} \leq 25\text{ V}$ , $5\text{ mA} \leq I_o \leq 2\text{ A}$	14.55		15.45	V
Line regulation	$REG_{IN}$	$17\text{ V} \leq V_{IN} \leq 25\text{ V}$		18	150	mV
Load regulation	$REG_L$	$5\text{ mA} \leq I_o \leq 2\text{ A}$		10	150	mV
Quiescent current	$I_{BIAS}$	$I_o = 0\text{ A}$		3	5.0	mA
		$I_o = 2\text{ A}$		15	30	mA
Quiescent current change	$\Delta I_{BIAS}$	$17\text{ V} \leq V_{IN} \leq 25\text{ V}$ , $I_o = 2\text{ A}$			20	mA
Output noise voltage	$V_n$	$10\text{ Hz} \leq f \leq 100\text{ kHz}$		260		$\mu\text{V}_{r.m.s.}$
Ripple rejection	R-R	$f = 120\text{ Hz}$ , $17\text{ V} \leq V_{IN} \leq 27\text{ V}$	40	48		dB
Dropout voltage	$V_{DIF}$	$0^\circ\text{C} \leq T_J \leq 125^\circ\text{C}$ , $I_o = 2\text{ A}$			1.0	V
Short circuit current	$I_{O\text{ short}}$	$V_{IN} = 16\text{ V}$		1.4		A
Peak output current	$I_{O\text{ peak}}$	$V_{IN} = 22\text{ V}$	2.8	3.5	4.2	A
Temperature coefficient of output voltage	$\Delta V_o/\Delta T$	$0^\circ\text{C} \leq T_J \leq 125^\circ\text{C}$ , $I_o = 5\text{ mA}$		1.6		mV/ $^\circ\text{C}$

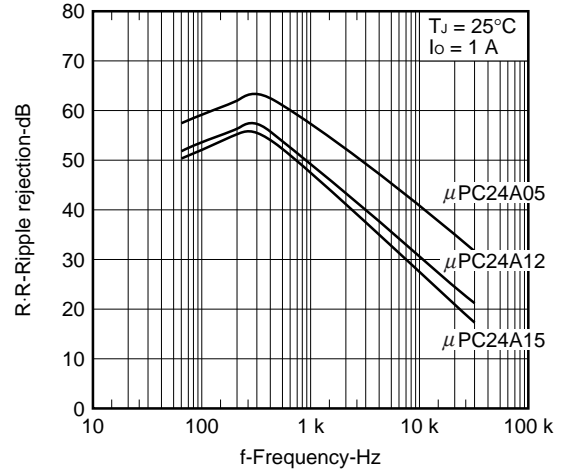
TYPICAL CHARACTERISTICS (REFERENCE VALUES)



V<sub>DIF</sub> vs I<sub>o</sub>

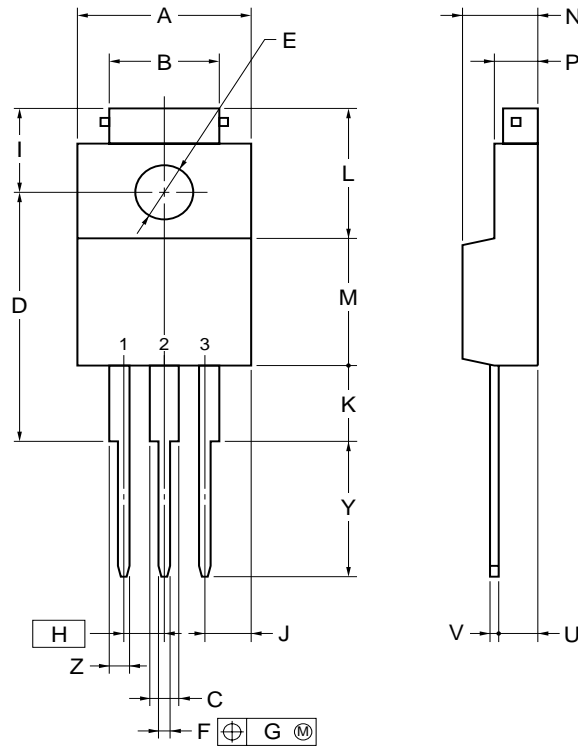


R-R vs f



PACKAGE DRAWINGS

3PIN PLASTIC SIP (MP-45G)



NOTE

Each lead centerline is located within 0.25 mm of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS
A	10.0±0.2
B	7.0±0.2
C	1.50±0.2
D	17.0±0.3
E	<i>f</i> 3.3±0.2
F	0.75±0.10
G	0.25
H	2.54 (T.P.)
I	5.0±0.3
J	2.46±0.2
K	5.0±0.2
L	8.5±0.2
M	8.5±0.2
N	4.5±0.2
P	2.8±0.2
U	2.4±0.5
V	0.65±0.10
Y	8.9±0.7
Z	1.30±0.2

P3HF-254B-4



**RECOMMENDED SOLDERING CONDITIONS**

The μPC2400 Series should be soldered and mounted under the following recommended conditions.

For the details of the recommended soldering conditions, refer to the document **SEMICONDUCTOR DEVICE MOUNTING TECHNOLOGY MANUAL (C10535E)**.

For soldering methods and conditions other than those recommended below, contact your NEC sales representative.

**Through-Hole Device**

**μPC24A05HF, 24A12HF, 24A15HF: 3-Pin Plastic SIP (MP-45G) (Isolated TO-220)**

Process	Conditions
Wave soldering (only to leads)	Solder temperature: 260°C or below, Flow time: 10 seconds or less.

**Caution** Apply wave soldering only to the pins and be careful not to bring solder into direct contact with the package.

**CAUTION ON USE**

- In the μPC24A00 Series, if the output is short-circuited at  $V_{IN} \geq 20$  V, the output may not be restored after the short-circuit is cancelled. In this case, restore the output by lowering and then reapplying  $V_{IN}$ .
- If a lower than recommended input voltage is used in the μPC24A00 Series, a large circuit current will flow due to the saturation of the output stage transistor (refer to the reference characteristic curve of the  $I_{BIAS} - V_{IN}$  characteristics). The capacitance for the input side power supply therefore needs to be only enough to enable the current to flow in this circuit at startup. Note also that a resistor cannot be inserted at the GND pin to adjust the output voltage.

**REFERENCE DOCUMENTS**

QUALITY GRADES ON NEC SEMICONDUCTOR DEVICES	C11531E
SEMICONDUCTOR DEVICE MOUNTING TECHNOLOGY MANUAL	C10535E
SEMICONDUCTORS SELECTION GUIDE	X10679E
SEMICONDUCTORS SELECTION GUIDE -Product and Packages- (CD-ROM)	X13769X

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