

## ADJUSTABLE PRECISION SHUNT REGULATORS

## DESCRIPTION

The  $\mu$ PC1093 are adjustable precision shunt regulators with guaranteed thermal stability. The output voltage can be set to any value between reference voltage (2.495 V) and 36 V by two external resistors.

These ICs can apply to error amplifier of switching regulators.

## FEATURES

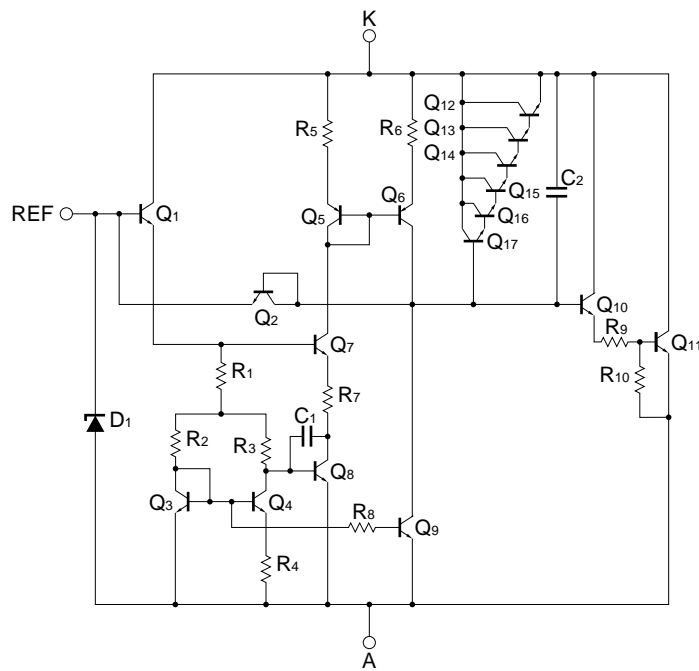
- High Accuracy  $V_{REF} = 2.495 \text{ V} \pm 2 \%$
- Low Temperature Coefficient  $\Delta V_{REF}/\Delta T \leq 100 \text{ ppm}/^\circ\text{C}$
- Adjustable Output Voltage by two External Resistors  $V_{REF} \leq V_O \leq 36 \text{ V}$
- Low Dynamic Impedance  $|Z_{KA}| = 0.1 \Omega \text{ TYP.}$

## ORDERING INFORMATION

	Part Number	Package
	$\mu$ PC1093J	3-pin plastic SIP (TO-92)
	$\mu$ PC1093G	8-pin plastic SOP (225 mil)
★	$\mu$ PC1093T	Power mini mold (SOT-89)
★	$\mu$ PC1093TA	5-pin plastic mini mold (SC-74A)

The information in this document is subject to change without notice.

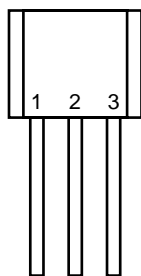
EQUIVALENT CIRCUIT



PIN CONFIGURATION (Marking Side)

3-pin plastic SIP (TO-92)

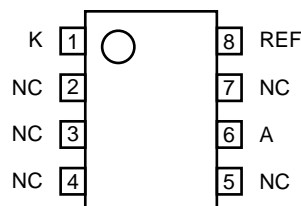
- μPC1093J



1 : REF  
2 : A  
3 : K

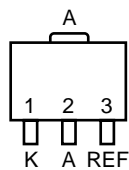
8-pin plastic SOP (225 mil)

- μPC1093G



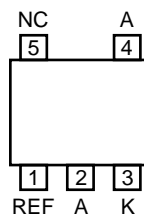
★ Power mini mold (SOT-89)

- μPC1093T



★ 5-pin plastic mini mold (SC-74A)

- μPC1093TA



REF : Reference  
A : Anode  
K : Cathode  
NC : No Connection

**ABSOLUTE MAXIMUM RATING (T<sub>A</sub> = 25 °C, unless otherwise specified.)**

Parameter	Symbol	Ratings	Unit	
Cathode Voltage	V <sub>KA</sub>	37	V	
Cathode Current	I <sub>K</sub>	150	mA	
Cathode-Anode Reverse Current	-I <sub>K</sub>	-100	mA	
Reference Voltage	V <sub>REF</sub>	7	V	
Reference Input Current	I <sub>REF</sub>	50	μA	
Reference-Anode Reverse Current	-I <sub>REF</sub>	-10	mA	
Power Dissipation	μPC1093J	P <sub>T</sub>	mW	
	μPC1093G			700
	μPC1093T			480
	μPC1093TA			400/2 000 <sup>Note 1</sup>
			180/510 <sup>Note 2</sup>	
Operating Ambient Temperature	T <sub>A</sub>	-20 ~ +85	°C	
Storage Temperature	T <sub>stg</sub>	-65 ~ +150	°C	

★  
★

- Notes** 1. with 16 cm<sup>2</sup> × 0.7 mm ceramic substrate  
 2. with 75 mm<sup>2</sup> × 0.7 mm ceramic substrate

**Caution** Exposure to Absolute Maximum Ratings for extended periods may affect device reliability; exceeding the ratings could cause permanent damage. The parameters apply independently. The device should be operated within the limits specified under DC and AC Characteristics.

**RECOMMENDED OPERATING CONDITIONS**

Parameter	Symbol	MIN.	TYP.	MAX.	Unit	
Cathode Voltage	V <sub>KA</sub>	V <sub>REF</sub>	5	36	V	
Cathode Current	I <sub>K</sub>	1	10	100	mA	
Power Dissipation	μPC1093J	P <sub>T</sub>		50	mW	
	μPC1093G					220
	μPC1093T					150
	μPC1093TA					125/640 <sup>Note 1</sup>
				50	58/160 <sup>Note 2</sup>	
Operating Ambient Temperature	T <sub>A</sub>	-20		+85	°C	

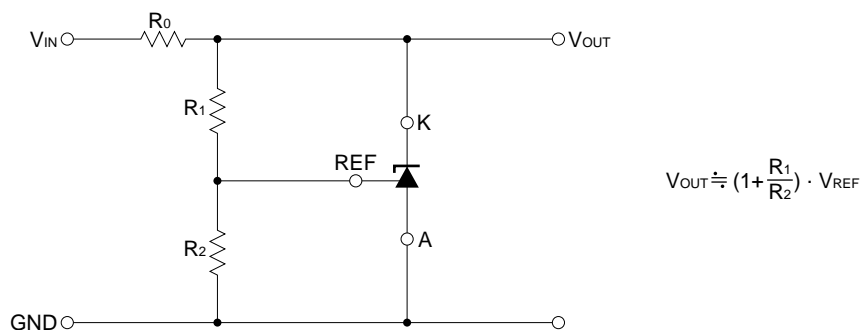
★  
★  
★

- Notes** 1. with 16 cm<sup>2</sup> × 0.7 mm ceramic substrate  
 2. with 75 mm<sup>2</sup> × 0.7 mm ceramic substrate

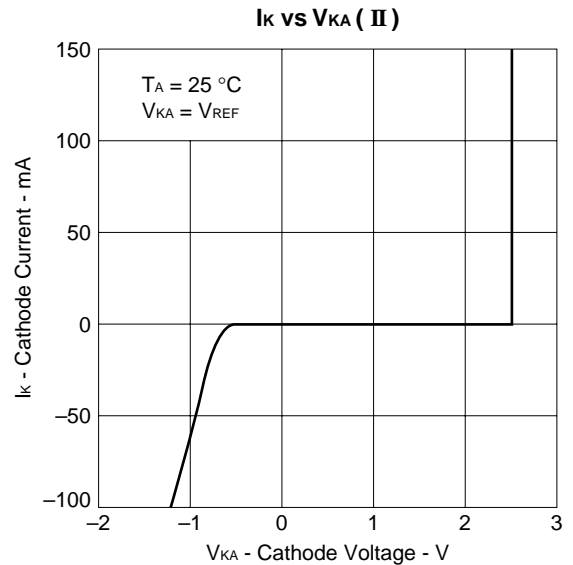
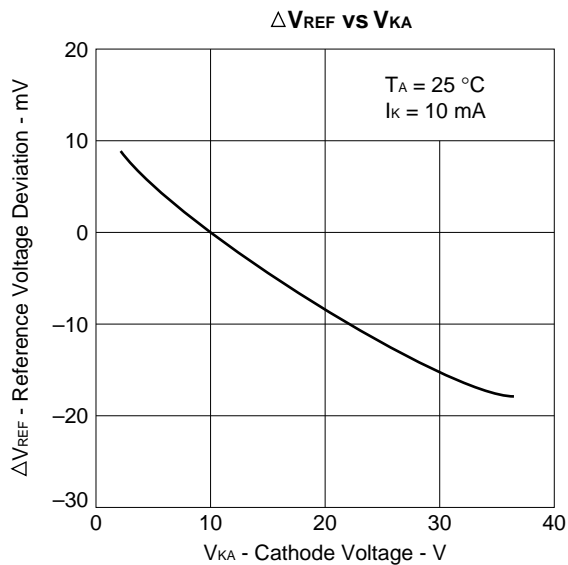
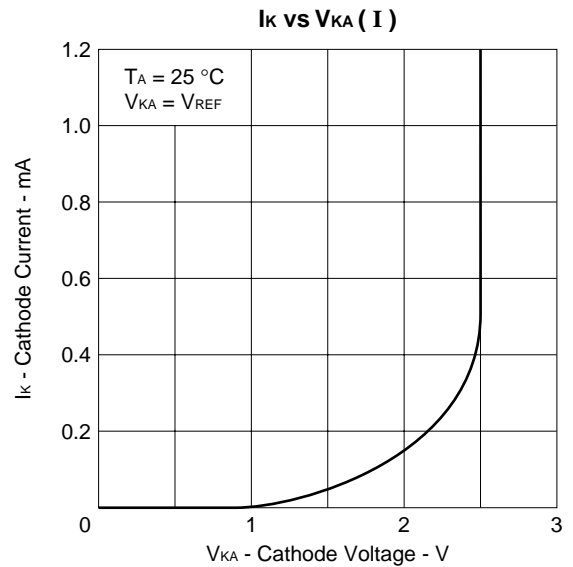
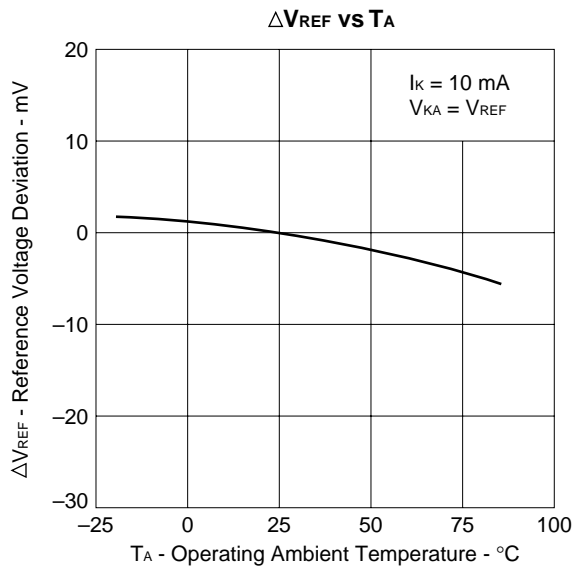
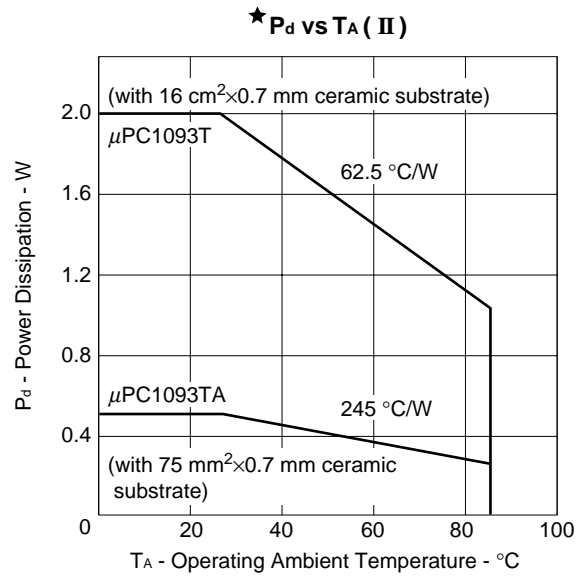
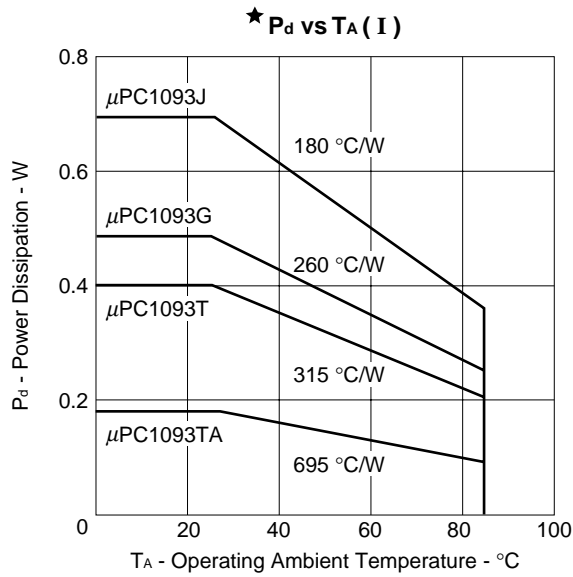
**ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25 °C, I<sub>K</sub> = 10 mA, unless otherwise specified.)**

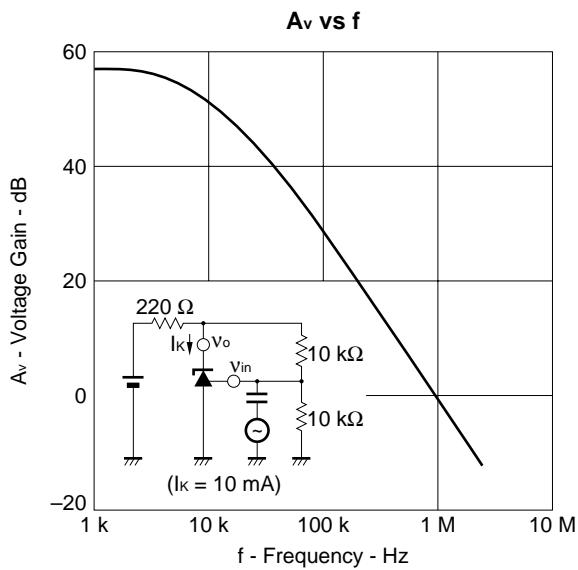
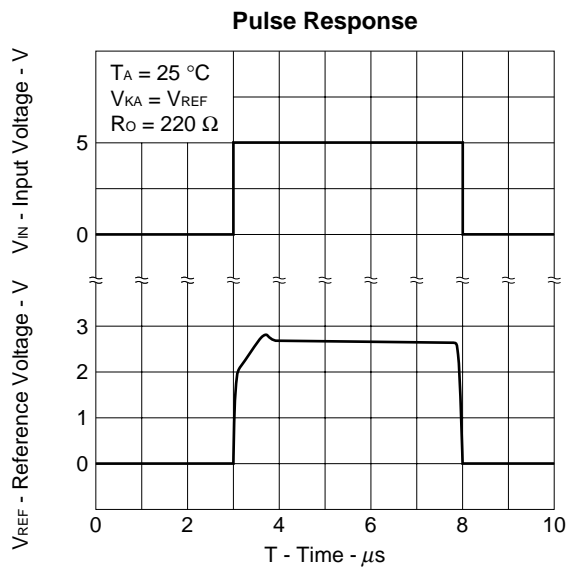
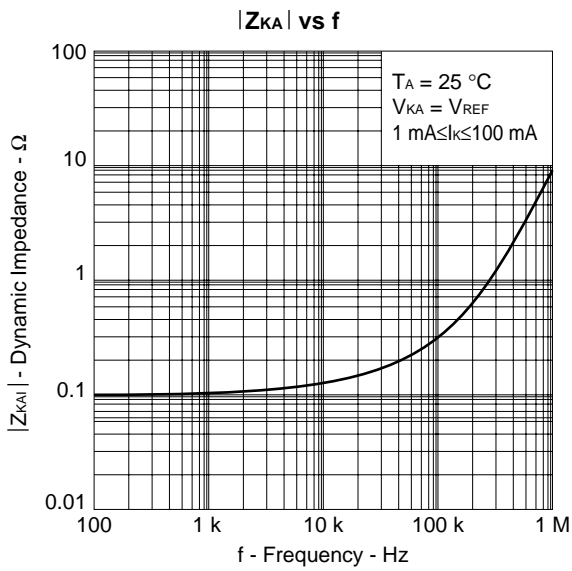
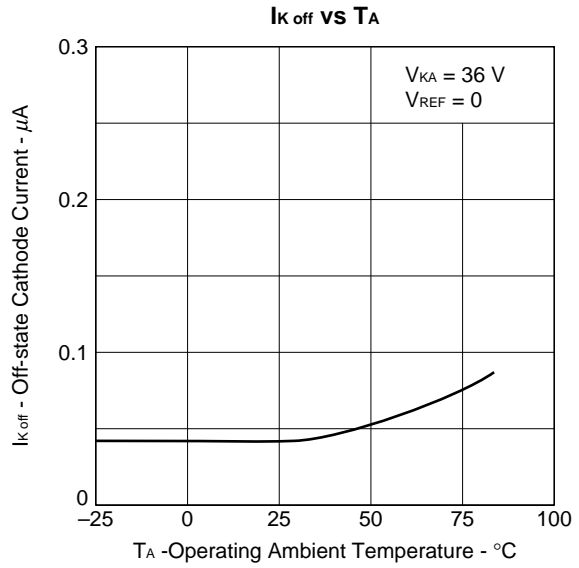
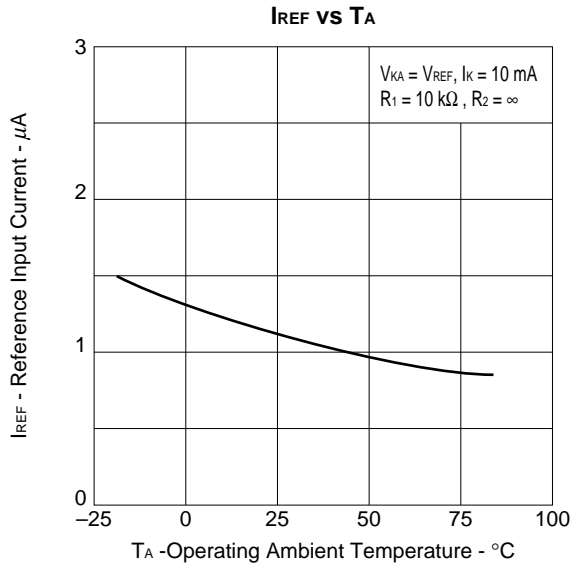
Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Reference Voltage	V <sub>REF</sub>	V <sub>KA</sub> = V <sub>REF</sub>	2.440	2.495	2.550	V
Reference Voltage Deviation Over Temperature	ΔV <sub>REF</sub>	0 °C ≤ T <sub>A</sub> ≤ 70 °C, V <sub>KA</sub> = V <sub>REF</sub>		7	17	mV
Reference Voltage Deviation Over Cathode Voltage	ΔV <sub>REF</sub> /ΔV	V <sub>REF</sub>   ≤ V <sub>KA</sub> ≤ 10 V		1.2	2.7	mV/V
		10 V ≤ V <sub>KA</sub> ≤ 36 V		0.7	2	mV/V
Reference Input Current	I <sub>REF</sub>	V <sub>KA</sub> = V <sub>REF</sub> , R <sub>1</sub> = 10 kΩ, R <sub>2</sub> = ∞		1	4	μA
Reference Input Current Deviation Over Temperature	ΔI <sub>REF</sub>	0 °C ≤ T <sub>A</sub> ≤ 70 °C, V <sub>KA</sub> = V <sub>REF</sub> , R <sub>1</sub> = 10 kΩ, R <sub>2</sub> = ∞		0.4	1.2	μA
Minimum Cathode Current	I <sub>K min.</sub>	V <sub>KA</sub> = V <sub>REF</sub> , ΔV <sub>REF</sub> = 2 %		0.4	1	mA
Off-state Cathode Current	I <sub>K off</sub>	V <sub>KA</sub> = 36 V, V <sub>REF</sub> = 0		0.1	1	μA
Dynamic Impedance	Z <sub>KA</sub>	V <sub>KA</sub> = V <sub>REF</sub> , f ≤ 1 kHz 1 mA ≤ I <sub>K</sub> ≤ 100 mA		0.1	0.5	Ω

**TEST AND APPLICATION CIRCUIT**

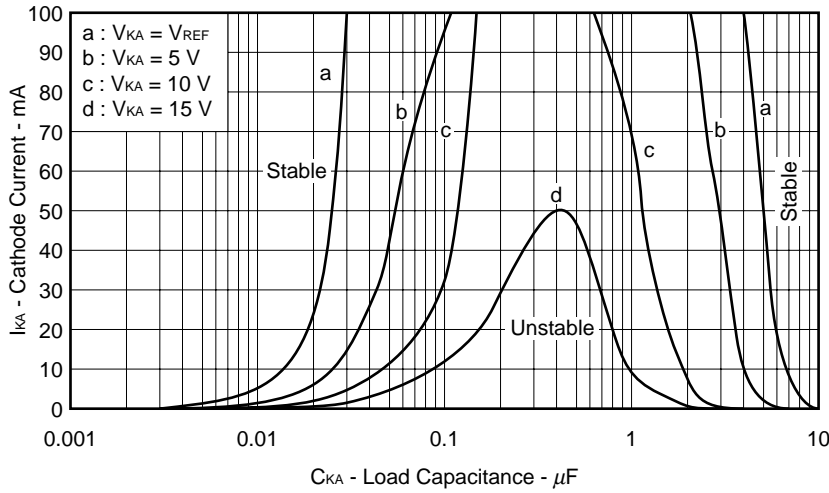


TYPICAL CHARACTERISTICS

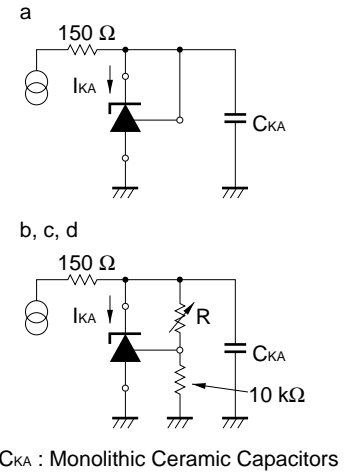




★ STABILITY AREA



★ TEST CIRCUIT



★ Caution of Stability Area

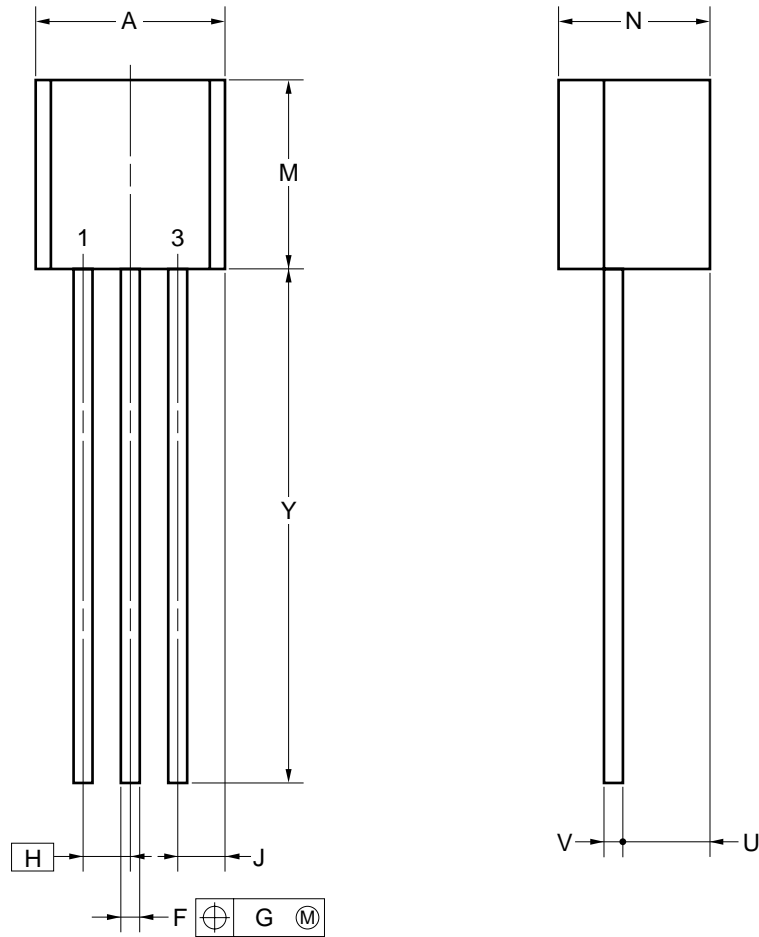
If the Aluminum electrolytic capacitor is used, it should be kept  $C_{KA} \geq 2.2\ \mu\text{F}$ .

When using plural different types of capacitors, each capacitor is needed to be stable independently.

When designing a circuit, take the characteristic variation among devices into consideration, so that the designed circuit has an enough characteristic margin supporting the standard specifications described above.

PACKAGE DRAWINGS

3 PIN PLASTIC SIP (TO-92)



**NOTE**

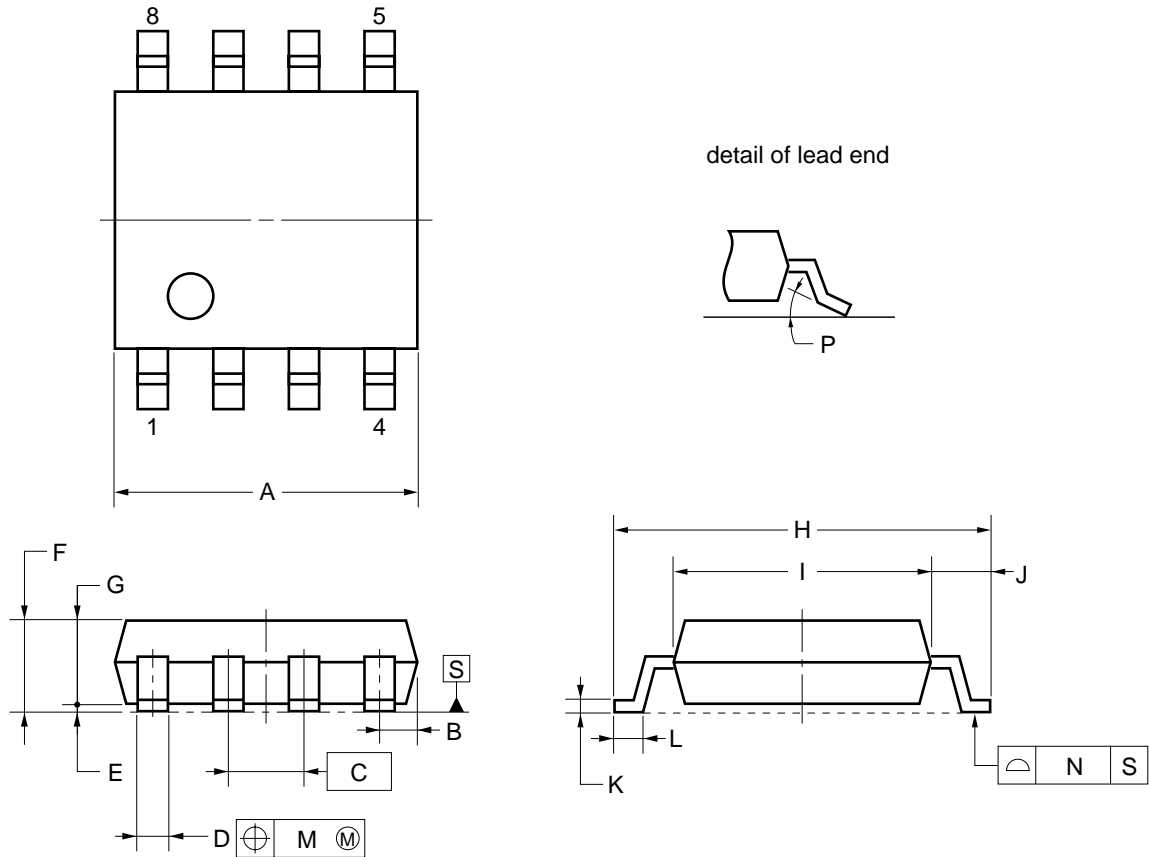
Each lead centerline is located within 0.12 mm of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS
A	5.0±0.2
F	0.5 <sup>+0.3</sup> <sub>-0.1</sub>
G	0.12
H	1.27
J	1.33 MAX.
M	5.0±0.5
N	4.0±0.2
U	2.8 MAX.
V	0.5±0.1
Y	15.0±0.7

P3J-127B-2



8 PIN PLASTIC SOP (225 mil)



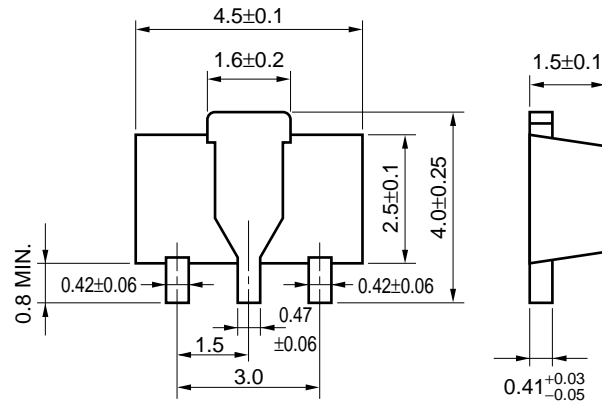
**NOTE**

Each lead centerline is located within 0.12 mm of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS
A	5.2 <sup>+0.17</sup> <sub>-0.20</sub>
B	0.78 MAX.
C	1.27 (T.P.)
D	0.42 <sup>+0.08</sup> <sub>-0.07</sub>
E	0.1±0.1
F	1.59±0.21
G	1.49
H	6.5±0.3
I	4.4±0.15
J	1.1±0.2
K	0.17 <sup>+0.08</sup> <sub>-0.07</sub>
L	0.6±0.2
M	0.12
N	0.10
P	3° <sup>+7°</sup> <sub>-3°</sub>

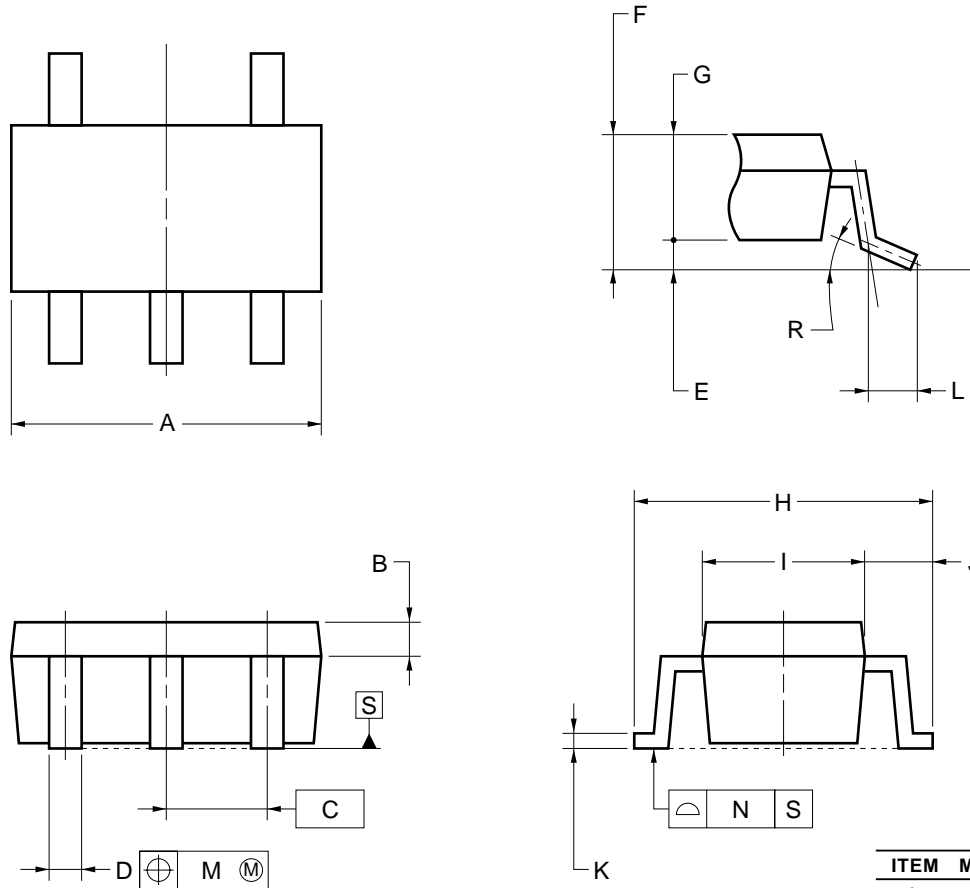
S8GM-50-225B-5

★ POWER MINI MOLD (SOT-89) (Unit: mm)



★ 5 PIN PLASTIC MINI MOLD

detail of lead end



ITEM	MILLIMETERS
A	2.9±0.2
B	0.3
C	0.95 (T.P.)
D	0.32 <sup>+0.05</sup> <sub>-0.02</sub>
E	0.05±0.05
F	1.4 MAX.
G	1.1 <sup>+0.2</sup> <sub>-0.1</sub>
H	2.8±0.2
I	1.5 <sup>+0.2</sup> <sub>-0.1</sub>
J	0.65 <sup>+0.1</sup> <sub>-0.15</sub>
K	0.16 <sup>+0.1</sup> <sub>-0.06</sub>
L	0.4±0.2
M	0.19
N	0.1
R	5°±5°

S5TA-95-15A

★ RECOMMENDED SOLDERING CONDITIONS

When soldering this product, it is highly recommended to observe the conditions as shown below. If other soldering processes are used, or if the soldering is performed under different conditions, please make sure to consult with our sales offices.

For more details, refer to our document “SEMICONDUCTOR DEVICE MOUNTING TECHNOLOGY MANUAL” (C10535E).

Through-hole device

μPC1093J: 3-pin plastic SIP (TO-92)

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

**Caution** For through-hole device, the wave soldering process must be applied only to leads, and make sure that the package body does not get jet soldered.

Surface mount devices

μPC1093G: 8-pin plastic SOP (225 mil)

Process	Conditions	Symbol
Infrared ray reflow	Peak temperature: 230 °C or below (Package surface temperature), Reflow time: 30 seconds or less (at 210 °C or higher), Maximum number of reflow processes: 1 time.	IR30-00-1
VPS	Peak temperature: 215 °C or below (Package surface temperature), Reflow time: 40 seconds or less (at 200 °C or higher), Maximum number of reflow processes: 1 time.	VP15-00-1
Wave soldering	Solder temperature: 260 °C or below, Flow time: 10 seconds or less, Maximum number of flow processes: 1 time, Pre-heating temperature: 120 °C or below (Package surface temperature).	WS60-00-1

**Caution** Apply only one kind of soldering condition to a device, or the device will be damaged by heat stress.

**$\mu$ PC1093T: Power mini mold (SOT-89)**

Process	Conditions	Symbol
Infrared ray reflow	Peak temperature: 235 °C or below (Package surface temperature), Reflow time: 30 seconds or less (at 210 °C or higher), Maximum number of reflow processes: 2 times.	IR35-00-2
VPS	Peak temperature: 215 °C or below (Package surface temperature), Reflow time: 40 seconds or less (at 200 °C or higher), Maximum number of reflow processes: 2 times.	VP15-00-2
Wave soldering	Solder temperature: 260 °C or below, Flow time: 10 seconds or less, Maximum number of flow processes: 1 time, Pre-heating temperature: 120 °C or below (Package surface temperature).	WS60-00-1

**Caution** Apply only one kind of soldering condition to a device, or the device will be damaged by heat stress.

 **$\mu$ PC1093TA: 5-pin plastic mini mold (SC-74A)**

Process	Conditions	Symbol
Infrared ray reflow	Peak temperature: 235 °C or below (Package surface temperature), Reflow time: 30 seconds or less (at 210 °C or higher), Maximum number of reflow processes: 3 times.	IR35-00-3
VPS	Peak temperature: 215 °C or below (Package surface temperature), Reflow time: 40 seconds or less (at 200 °C or higher), Maximum number of reflow processes: 3 times.	VP15-00-3
Wave soldering	Solder temperature: 260 °C or below, Flow time: 10 seconds or less, Maximum number of flow processes: 1 time, Pre-heating temperature: 120 °C or below (Package surface temperature).	WS60-00-1

**Caution** Apply only one kind of soldering condition to a device, or the device will be damaged by heat stress.

**★ REFERENCE DOCUMENTS**

Quality Grades on NEC Semiconductor Devices	C11531E
Semiconductor Device Mounting Technology Manual	C10535E
IC Package Manual	C10943X
Semiconductors Selection Guide	X10679E
NEC Semiconductor Device Reliability/Quality Control System	IEI-1212
-Three Terminal Regulator	

**★ REMARK OF THE PACKAGE MARK**

The package marks of the μPC1093T and the μPC1093TA are the symbols as follows.

Part Number	Mark
μPC1093T	93
μPC1093TA	K93

[MEMO]

## [MEMO]

The application circuits and their parameters are for reference only and are not intended for use in actual design-ins.

No part of this document may be copied or reproduced in any form or by any means without the prior written consent of NEC Corporation. NEC Corporation assumes no responsibility for any errors which may appear in this document.

NEC Corporation does not assume any liability for infringement of patents, copyrights or other intellectual property rights of third parties by or arising from use of a device described herein or any other liability arising from use of such device. No license, either express, implied or otherwise, is granted under any patents, copyrights or other intellectual property rights of NEC Corporation or others.

While NEC Corporation has been making continuous effort to enhance the reliability of its semiconductor devices, the possibility of defects cannot be eliminated entirely. To minimize risks of damage or injury to persons or property arising from a defect in an NEC semiconductor device, customers must incorporate sufficient safety measures in its design, such as redundancy, fire-containment, and anti-failure features.

NEC devices are classified into the following three quality grades:

"Standard", "Special", and "Specific". The Specific quality grade applies only to devices developed based on a customer designated "quality assurance program" for a specific application. The recommended applications of a device depend on its quality grade, as indicated below. Customers must check the quality grade of each device before using it in a particular application.

Standard: Computers, office equipment, communications equipment, test and measurement equipment, audio and visual equipment, home electronic appliances, machine tools, personal electronic equipment and industrial robots

Special: Transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, safety equipment and medical equipment (not specifically designed for life support)

Specific: Aircrafts, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems or medical equipment for life support, etc.

The quality grade of NEC devices is "Standard" unless otherwise specified in NEC's Data Sheets or Data Books. If customers intend to use NEC devices for applications other than those specified for Standard quality grade, they should contact an NEC sales representative in advance.

Anti-radioactive design is not implemented in this product.