NEC

BIPOLAR ANALOG INTEGRATED CIRCUIT

μPC393

LOW POWER DUAL COMPARATORS

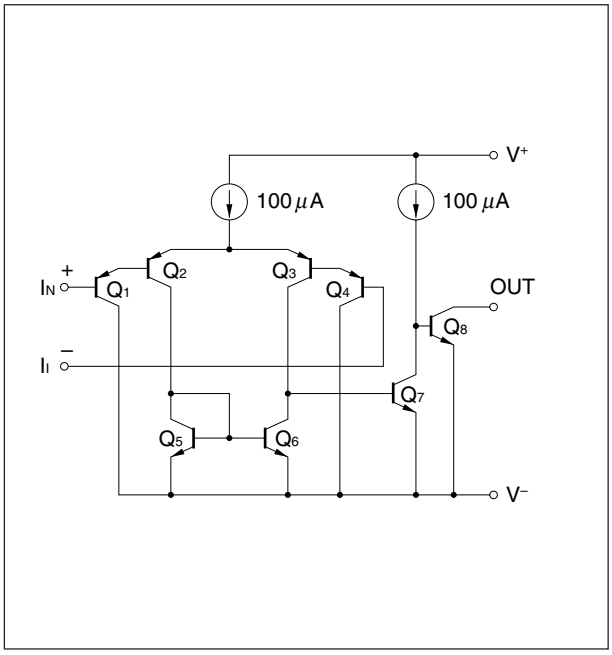
DESCRIPTION

The μPC393 is a dual comparator which is designed to operate from a single power supply over a wide range of voltage. Operation from split power supplies is also possible and the power supply current drain is very low. Further advantage, the input common-mode voltage includes ground, even though operated from a single power supply voltage.

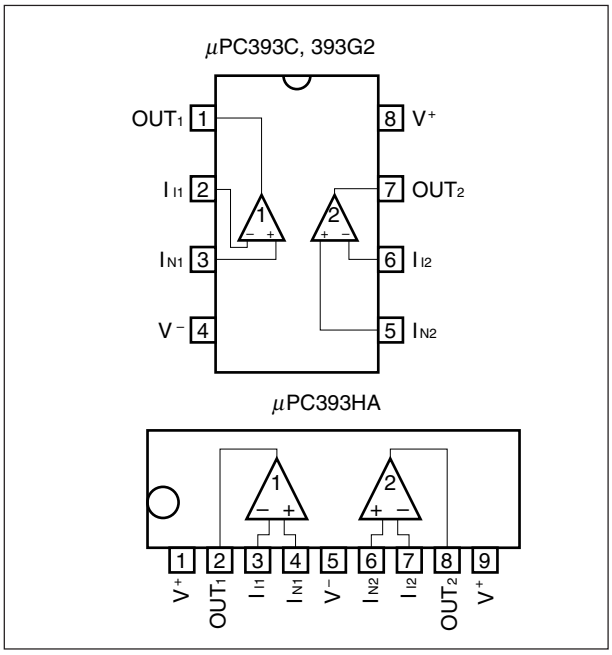
FEATURES

- Common-mode input voltage range includes V⁻
- Wide supply voltage range
  2 V to 32 V (Single)
  ±1 V to ±16 V (Split)
- Low supply current
- Open collector output

EQUIVALENT CIRCUIT (1/2 Circuit)



PIN CONFIGURATION (Top View)



★ **ORDERING INFORAMTION**

Part Number	Package
μPC393C	8-pin plastic DIP (7.62 mm (300))
μPC393G2	8-pin plastic SOP (5.72 mm (225))
μPC393G2(5)	8-pin plastic SOP (5.72 mm (225))
μPC393HA	9-pin plastic slim SIP

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The mark ★ shows major revised points.

ABSOLUTE MAXIMUM RATINGS (T_A = 25 °C)

Parameter			Symbol	Ratings	Unit
Voltage between V^+ and V^-		**Note 1**	$V^+ - V^-$	–0.3 to +36	V
Differential Input Voltage			V_{ID}	±36	V
Input Voltage		**Note 2**	V_I	V^- –0.3 to V^- +36	V
Output Voltage		**Note 3**	V_O	V^- –0.3 to V^- +36	V
Power Dissipation	C Package	**Note 4**	P_T	350	mW
	G2 Package	**Note 5**		440	mW
	HA Package	**Note 4**		350	mW
Output Short Circuit Duration		**Note 6**		Indefinite	sec
Operating Ambient Temperature			T_A	–20 to +80	°C
Storage Temperature			T_{stg}	–55 to + 125	°C

Notes 1. Reverse connection of supply voltage can cause destruction.

2. The input voltage should be allowed to input without damage or destruction independent of the magnitude of V^+. Either input signal should not be allowed to go negative by more than 0.3 V. The normal operation will establish when any input is within the Common Mode Input Voltage Range of electrical characteristics.

3. This specification is the voltage which should be allowed to supply to the output terminal from external without damage or destruction independent of the magnitude of V^+. Even during the transition period of supply voltage, power on/off etc., this specification should be kept.

4. Thermal derating factor is –5.0 mW/°C when operating ambient temperature is higher than 55 °C.

5. Thermal derating factor is –4.4 mW/°C when operating ambient temperature is higher than 25 °C.

6. Short circuits from the output to V^+ can cause destruction. Pay careful attention to the total power dissipation not to exceed the absolute maximum ratings, Note 4 and Note 5.

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage (Split)	$V^{\pm}$	±1		±16	V
Supply Voltage (V^- = GND)	V^+	+2		+32	V

μPC393C, μPC393G2, μPC393HA
ELECTRICAL CHARACTERISTICS (T_A = 25 °C, V^+ = 5 V, V^- = GND)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input Offset Voltage	V_{IO}	V_O = 1.4 V, V_{REF} = 1.4 V, R_S = 0 Ω		±2	±5	mV
Input Offset Current	I_{IO}	V_O ≒ 1.4 V		±5	±50	nA
★ Input Bias Current[Note 7]	I_B	V_O ≒ 1.4 V		25	250	nA
Voltage Gain	A_V	R_L = 15 kΩ		200		V/mV
★ Supply Current[Note 8]	I_{CC}	R_L = ∞, I_O = 0 A		0.6	1	mA
Common Mode Input Voltage Range	V_{ICM}		0		V^+–1.5	V
Output Saturation Voltage	V_{OL}	$V_{IN(-)}$ = 1 V, $V_{IN(+)}$ = 0 V, $I_{O\ SINK}$ = 4 mA		0.2	0.4	V
Output Sink Current	$I_{O\ SINK}$	$V_{IN(-)}$ = 1 V, $V_{IN(+)}$ = 0 V, V_O ≤ 1.5 V	6	16		mA
Output Leakage Current	$I_{O\ LEAK}$	$V_{IN(+)}$ = 1 V, $V_{IN(-)}$ = 0 V, V_O = 5 V		0.1		nA
Response Time		R_L = 5.1 kΩ, V_{RL} = 5 V		1.3		μs

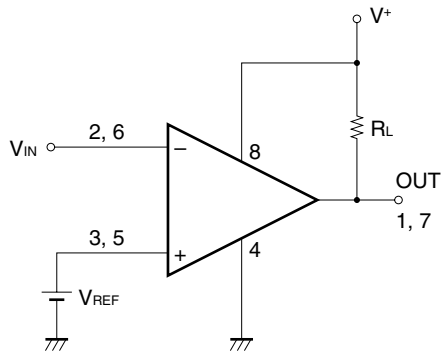
★ μPC393G2(5)
ELECTRICAL CHARACTERISTICS (T_A = 25 °C, V^+ = 5 V, V^- = GND)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input Offset Voltage	V_{IO}	V_O = 1.4 V, V_{REF} = 1.4 V, R_S = 0 Ω		±2	±2.5	mV
Input Offset Current	I_{IO}	V_O ≒ 1.4 V		±5	±50	nA
Input Bias Current[Note 7]	I_B	V_O ≒ 1.4 V		25	60	nA
Voltage Gain	A_V	R_L = 15 kΩ		200		V/mV
Supply Current[Note 8]	I_{CC}	R_L = ∞, I_O = 0 A		0.6	1	mA
Common Mode Input Voltage Range	V_{ICM}		0		V^+–1.4	V
Output Saturation Voltage	V_{OL}	$V_{IN(-)}$ = 1 V, $V_{IN(+)}$ = 0 V, $I_{O\ SINK}$ = 4 mA			0.2	V
Output Sink Current	$I_{O\ SINK}$	$V_{IN(-)}$ = 1 V, $V_{IN(+)}$ = 0 V, V_O ≤ 1.5 V	10	16		mA
Output Leakage Current	$I_{O\ LEAK}$	$V_{IN(+)}$ = 1 V, $V_{IN(-)}$ = 0 V, V_O = 5 V		0.1	100	nA
Response Time		R_L = 5.1 kΩ, V_{RL} = 5 V		1.3		μs

★ **Notes 7.** Input bias currents flow out from IC. Because each currents are base current of PNP-transistor on input stage.

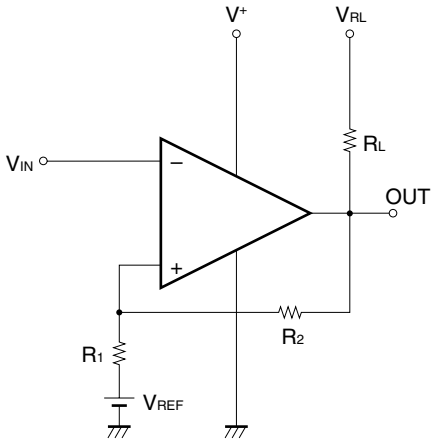
8. This current flows irrespective of the existence of use.

APPLICATION CIRCUIT EXAMPLE



V_{REF}: V^- to $V^+ - 1.5$ (V)

COMPARATOR with HYSTERESIS CIRCUIT



- Threshold voltage

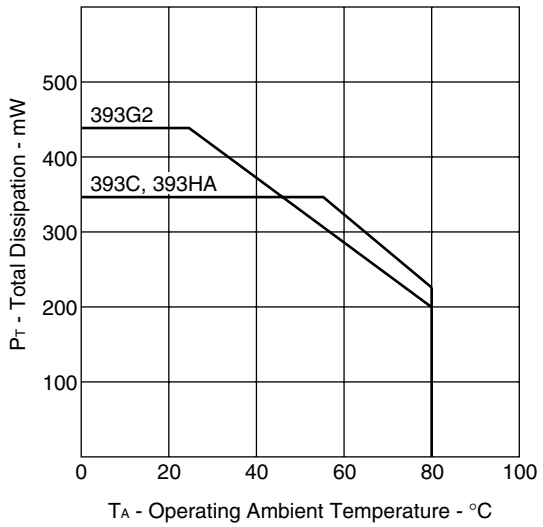
$$V_{TH\,(High)} \fallingdotseq V_{REF} + \frac{R_1}{R_L + R_2 + R_1}\ (V_{RL} - V_{REF})$$

$$V_{TH\,(Low)} \fallingdotseq V_{REF} - \frac{R_1}{R_1 + R_2}\ (V_{REF} - V_{OL})$$

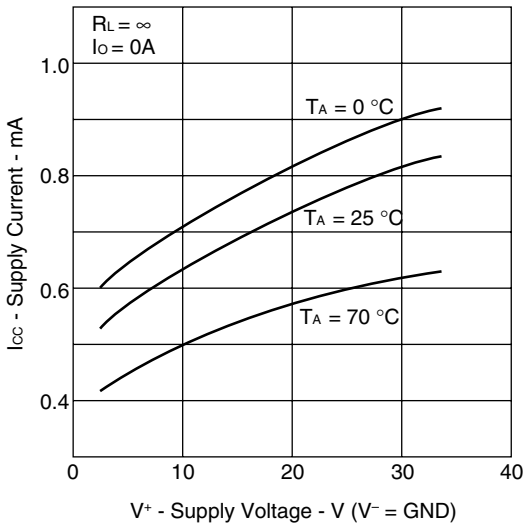
($V_{RL} > V_{REF} > V_{OL}$)

TYPICAL PERFORMANCE CHARACTERISTICS (T_A = 25 °C, TYP.)

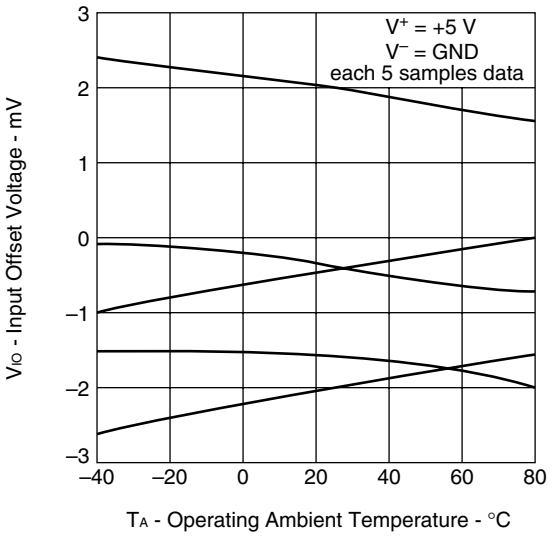
POWER DISSIPATION



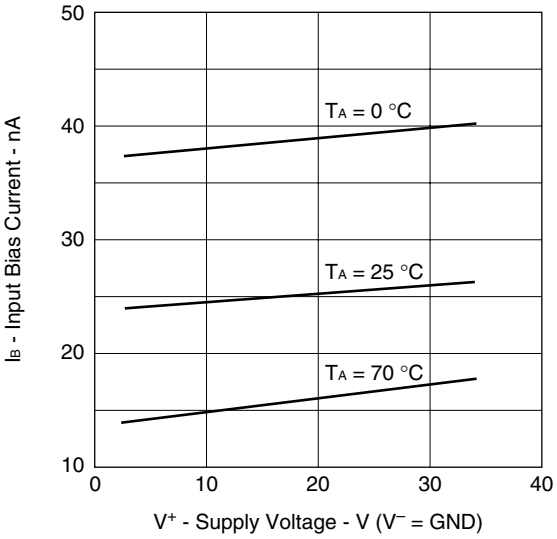
SUPPLY CURRENT



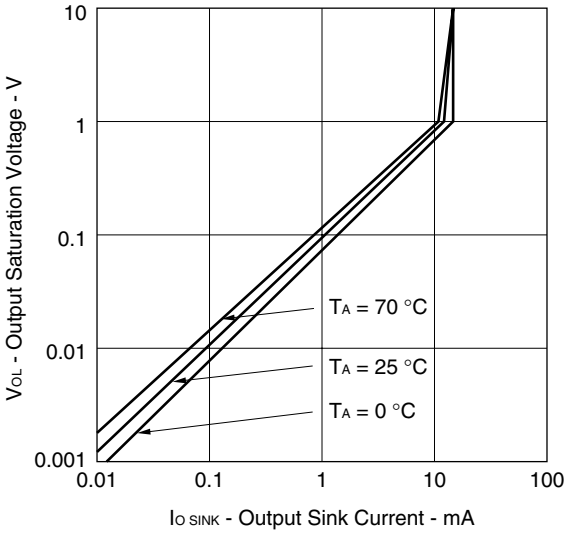
★ INPUT OFFSET VOLTAGE



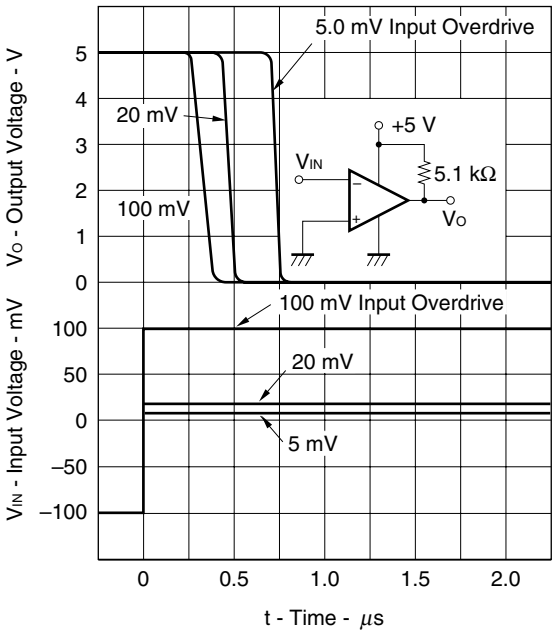
INPUT BIAS CURRENT



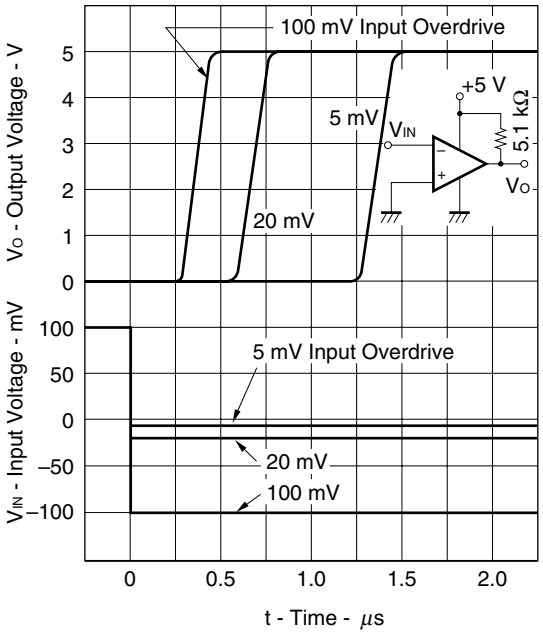
OUTPUT SATURATION VOLTAGE



★ RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES I

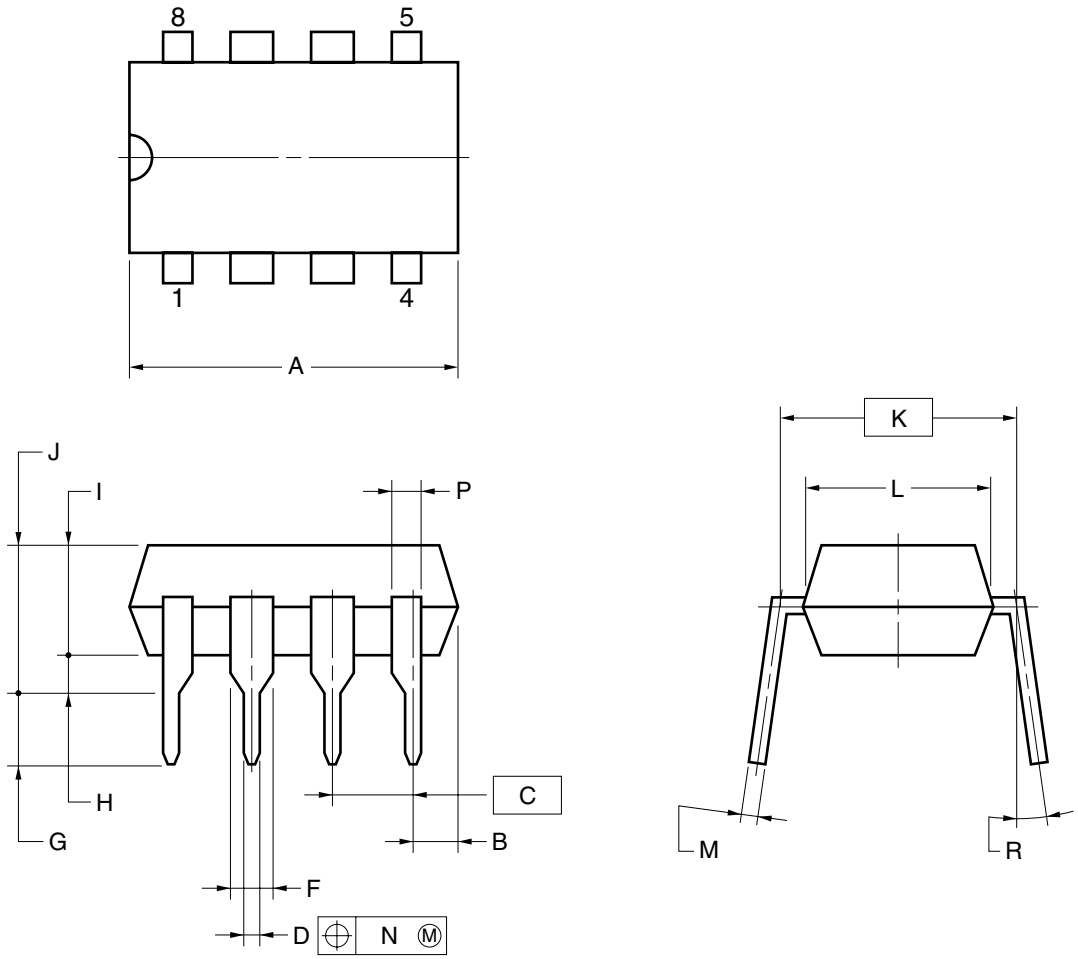


★ RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES II



★ **PACKAGE DRAWINGS (Unit: mm)**

8-PIN PLASTIC DIP (7.62mm(300))



NOTES

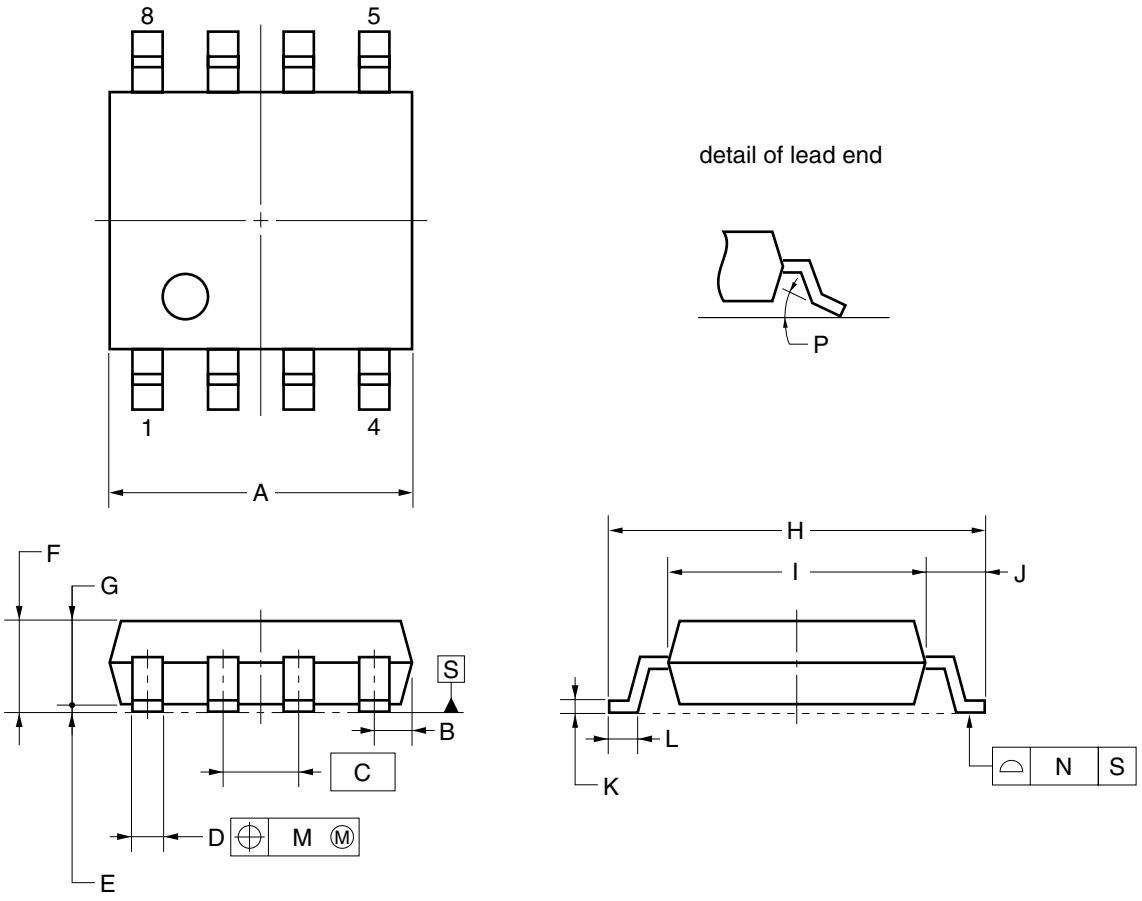
1. Each lead centerline is located within 0.25 mm of its true position (T.P.) at maximum material condition.

2. Item "K" to center of leads when formed parallel.

ITEM	MILLIMETERS
A	10.16 MAX.
B	1.27 MAX.
C	2.54 (T.P.)
D	0.50±0.10
F	1.4 MIN.
G	3.2±0.3
H	0.51 MIN.
I	4.31 MAX.
J	5.08 MAX.
K	7.62 (T.P.)
L	6.4
M	$0.25^{+0.10}_{-0.05}$
N	0.25
P	0.9 MIN.
R	0~15°

P8C-100-300B,C-2

8-PIN PLASTIC SOP (5.72 mm (225))



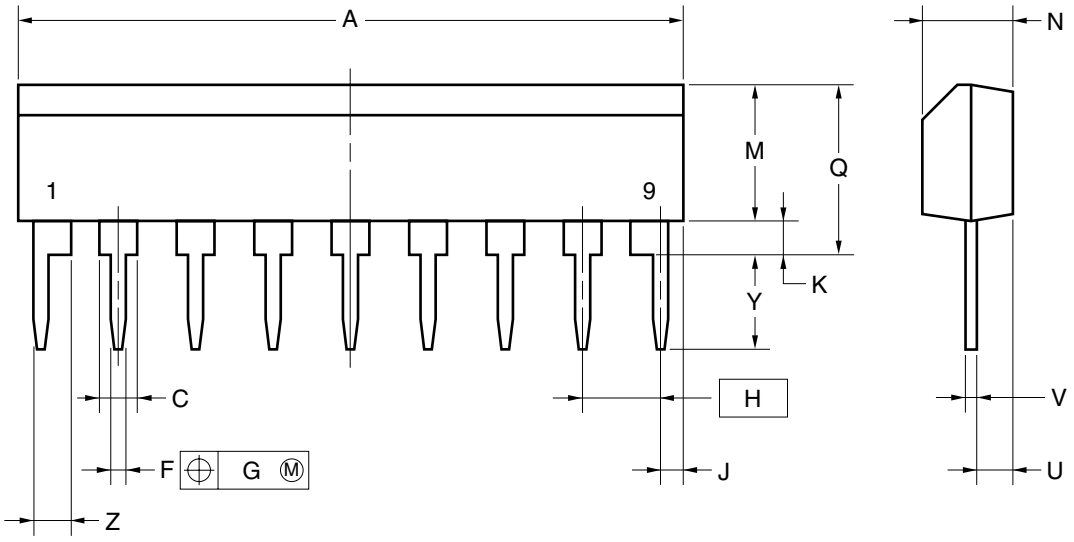
NOTE

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

ITEM	MILLIMETERS
A	$5.2^{+0.17}_{-0.20}$
B	0.78 MAX.
C	1.27 (T.P.)
D	$0.42^{+0.08}_{-0.07}$
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	$0.17^{+0.08}_{-0.07}$
L	0.6±0.2
M	0.12
N	0.10
P	$3^{\circ}{}^{+7^{\circ}}_{-3^{\circ}}$

S8GM-50-225B-6

9-PIN PLASTIC SLIM SIP



NOTE

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

ITEM	MILLIMETERS
A	22.86 MAX.
C	1.1 MIN.
F	0.5±0.1
G	0.25
H	2.54
J	1.27 MAX.
K	0.51 MIN.
M	5.08 MAX.
N	2.8±0.2
Q	5.75 MAX.
U	1.5 MAX.
V	$0.25^{+0.10}_{-0.05}$
Y	3.2±0.5
Z	1.1 MIN.

P9HA-254B-2

★ RECOMMENDED SOLDERING CONDITIONS

The μPC393 should be soldered and mounted under the following recommended conditions.

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

For technical information, see the following website.

Semiconductor Device Mount Manual (http://www.necel.com/pkg/en/mount/index.html)

Type of surface mount device

μPC393G2, μPC393G2(5): 8-pin plastic SOP (5.72 mm (225))

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
Vapor Phase Soldering	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
Partial Heating Method	Pin temperature: 300 °C or below, Heat time: 3 seconds or less (Per each side of the device).	–

Caution Apply only one kind of soldering condition to a device, except for "partial heating method", or the device will be damaged by heat stress.

Type of through-hold device

μPC393C : 8-pin plastic DIP (7.62 mm (300))
μPD393HA : 9-pin plastic slim SIP

Process	Conditions
Wave Soldering (only to leads)	Solder temperature: 260 °C or below, Flow time: 10 seconds or less.
Partial Heating Method	Pin temperature: 300 °C or below, Heat time: 3 seconds or less (per each lead.)

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.

REFERENCE DOCUMENTS

	QUALITY GRADES ON NEC SEMICONDUCTOR DEVICES	C11531E
★	SEMICONDUCTOR DEVICE MOUNT MANUAL	http://www.necel.com/pkg/en/mount/index.html
	NEC SEMICONDUCTOR DEVICE RELIABILITY/ QUALITY CONTROL SYSTEM - STANDARD LINEAR IC	IEI-1212

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