

To our customers,

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## Old Company Name in Catalogs and Other Documents

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Renesas Electronics website: <http://www.renesas.com>

April 1<sup>st</sup>, 2010  
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (<http://www.renesas.com>)

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LOW POWER DUAL OPERATIONAL AMPLIFIERS

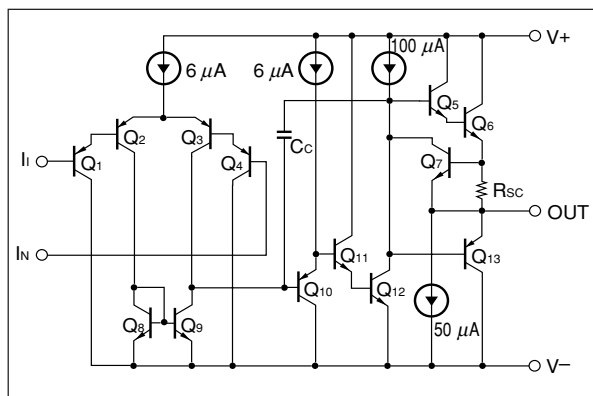
DESCRIPTION

The  $\mu$ PC358 is a dual operational amplifier which is designed to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the power supply current drain is very low. Further advantage, the input common-mode voltage range includes ground in the linear mode.

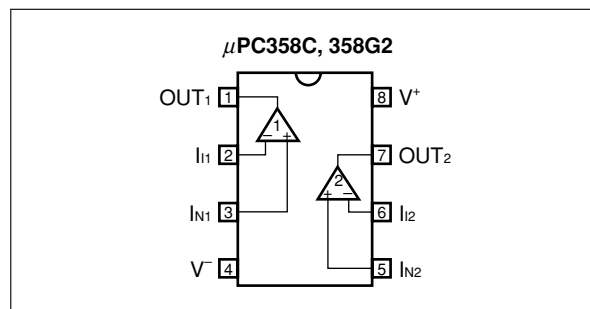
FEATURES

- Internally frequency compensation
- Wide output voltage swing  $V^-$  to  $V^+ - 1.5$  V
- Common mode input voltage range includes  $V^-$
- Wide supply voltage range  
3 V to 30 V (Single)  
 $\pm 1.5$  V to  $\pm 15$  V (Split)
- Output short circuit protection

EQUIVALENT CIRCUIT (1/2 Circuit)



<R> PIN CONFIGURATION (Marking Side)



<R>

ORDERING INFORMATION

Part Number	Package
$\mu$ PC358C	8-pin plastic DIP (7.62 mm (300))
$\mu$ PC358G2	8-pin plastic SOP (5.72 mm (225))
$\mu$ PC358G2(5)	8-pin plastic SOP (5.72 mm (225))

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

Parameter		Symbol	Ratings	Unit
Voltage between V <sup>+</sup> and V <sup>-</sup>		V <sup>+</sup> - V <sup>-</sup>	-0.3 to +32	V
Differential Input Voltage		V <sub>ID</sub>	±32	V
Input Voltage		V <sub>I</sub>	V <sup>-</sup> -0.3 to V <sup>-</sup> +32	V
Output Voltage		V <sub>O</sub>	V <sup>-</sup> -0.3 to V <sup>+</sup> +0.3	V
<R> Power Dissipation	C Package	P <sub>T</sub>	350	mW
	G2 Package		440	mW
Output Short Circuit Duration			Indefinite	s
Operating Ambient Temperature		T <sub>A</sub>	-20 to +80	°C
Storage Temperature		T <sub>stg</sub>	-55 to +125	°C

- Notes**
- Reverse connection of supply voltage can cause destruction.
  - The input voltage should be allowed to input without damage or destruction independent of the magnitude of V<sup>+</sup>. Either input signal should not be allowed to go negative by more than 0.3 V. The normal operation will establish when the both inputs are within the Common Mode Input Voltage Range of electrical characteristics.
  - This specification is the voltage which should be allowed to supply to the output terminal from external without damage or destructive. Even during the transition period of supply voltage, power on/off etc., this specification should be kept. The output voltage of normal operation will be the Output Voltage Swing of electrical characteristics.
  - Thermal derating factor is -5.0 mW/°C when operating ambient temperature is higher than 55 °C.
  - Thermal derating factor is -4.4 mW/°C when operating ambient temperature is higher than 25 °C.
  - 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 <sup>±</sup>	±1.5		±15	V
Supply Voltage (V <sup>-</sup> = GND)	V <sup>+</sup>	+3		+30	V

**μPC358C, μPC358G2**

**ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25 °C, V<sup>+</sup> = +5 V, V<sup>-</sup> = GND)**

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input Offset Voltage	V <sub>IO</sub>	R <sub>S</sub> = 0 Ω		±2	±7	mV
Input Offset Current	I <sub>IO</sub>			±5	±50	nA
Input Bias Current	I <sub>B</sub>			45	250	nA
Large Signal Voltage Gain	A <sub>v</sub>	R <sub>L</sub> ≥ 2 kΩ	25	100		V/mA
Supply Current	I <sub>CC</sub>	R <sub>L</sub> = ∞, I <sub>O</sub> = 0 A		0.7	1.2	mA
Common Mode Rejection Ratio	CMR		65	70		dB
Supply Voltage Rejection Ratio	SVR		65	100		dB
Output Voltage Swing	V <sub>O</sub>	R <sub>L</sub> = 2 kΩ (Connect to GND)	0		V <sup>+</sup> - 1.5	V
Common Mode Input Voltage Range	V <sub>ICM</sub>		0		V <sup>+</sup> - 1.5	V
Output Current (SOURCE)	I <sub>O SOURCE</sub>	V <sub>IN<sup>+</sup></sub> = +1 V, V <sub>IN<sup>-</sup></sub> = 0 V	20	40		mA
Output Current (SINK)	I <sub>O SINK</sub>	V <sub>IN<sup>-</sup></sub> = +1 V, V <sub>IN<sup>+</sup></sub> = 0 V	10	20		mA
		V <sub>IN<sup>-</sup></sub> = +1 V, V <sub>IN<sup>+</sup></sub> = 0 V, V <sub>O</sub> = 200 mV	12	50		μA
Channel Separation		f = 1 kHz to 20 kHz		120		dB

- Notes**
- Input bias currents flow out from IC. Because each currents are base current of PNP-transistor on input stage.
  - This current flows irrespective of the existence of use.

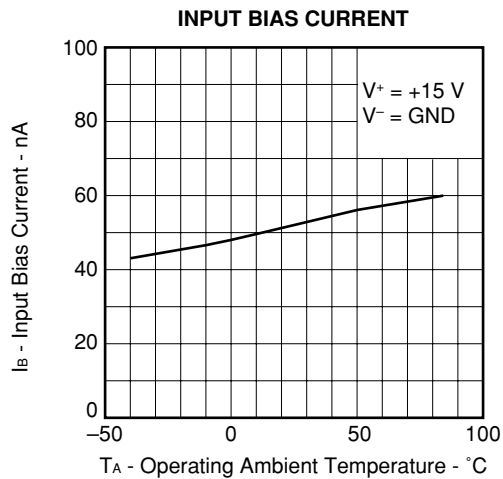
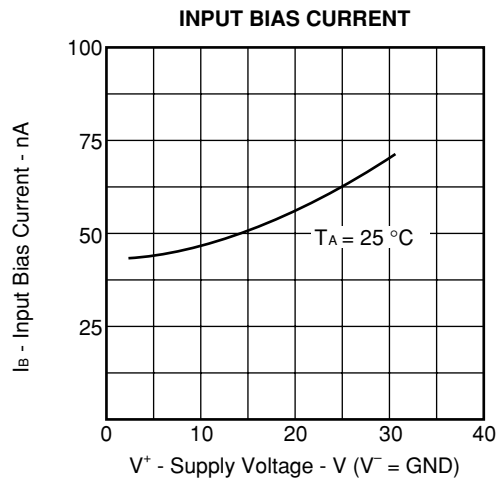
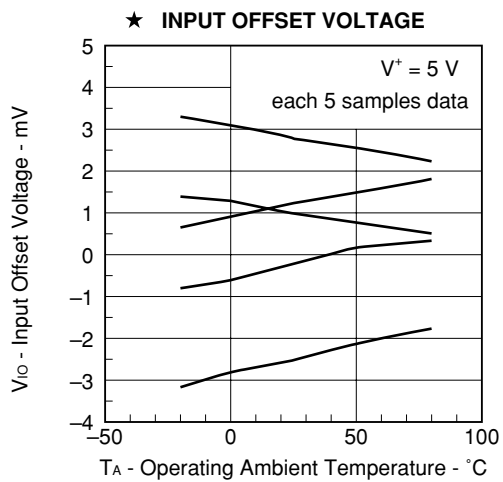
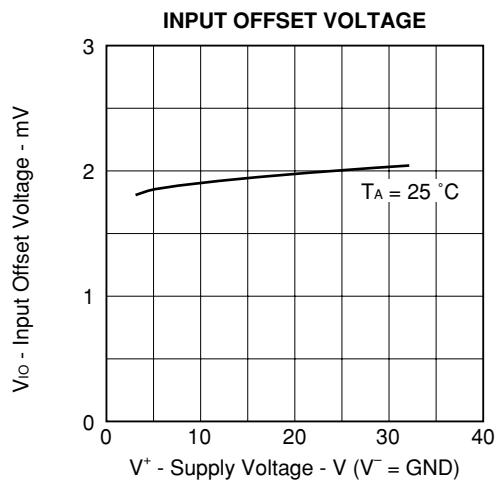
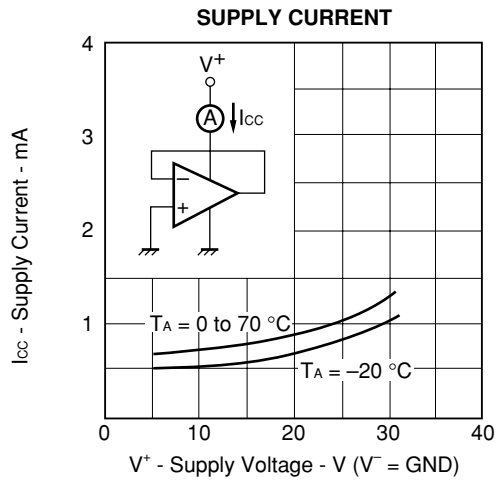
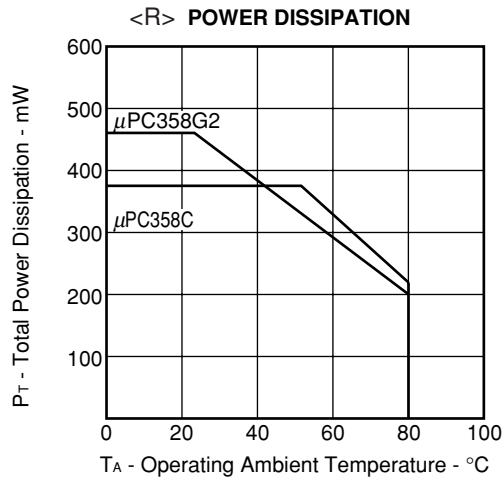
$\mu$ PC358G2(5)ELECTRICAL CHARACTERISTICS ( $T_A = 25\text{ }^\circ\text{C}$ ,  $V^+ = +5\text{ V}$ ,  $V^- = \text{GND}$ )

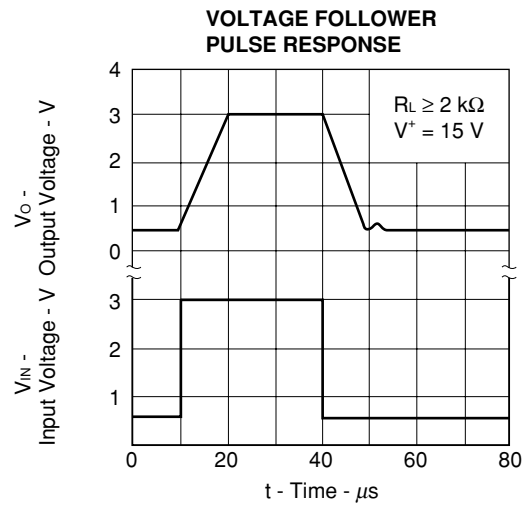
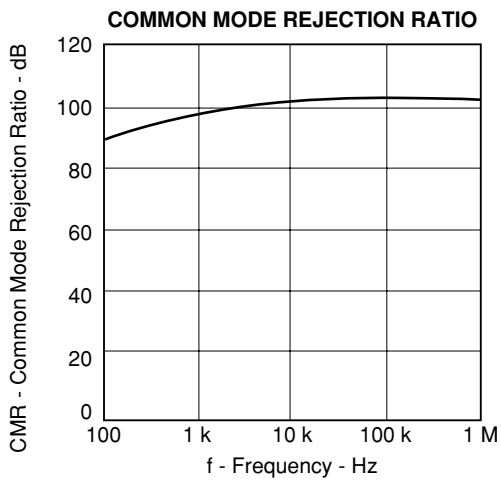
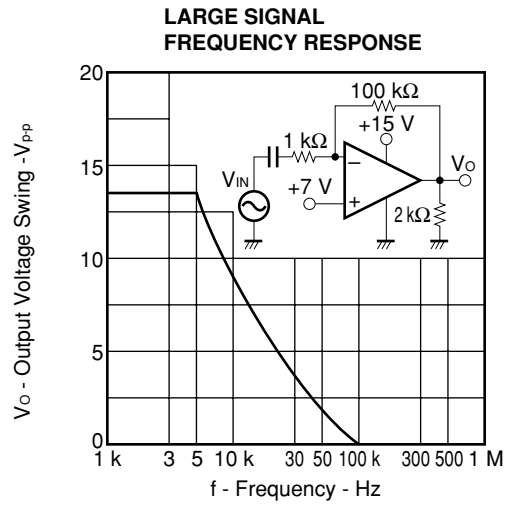
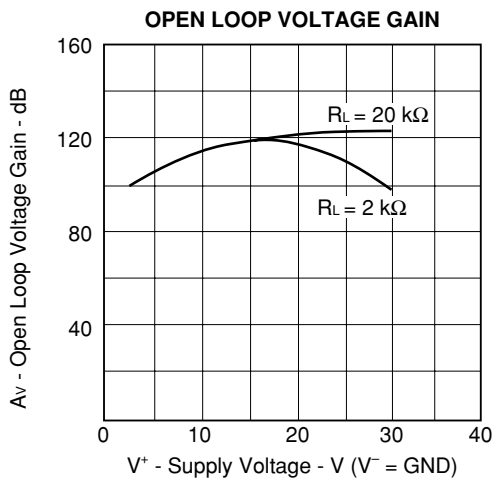
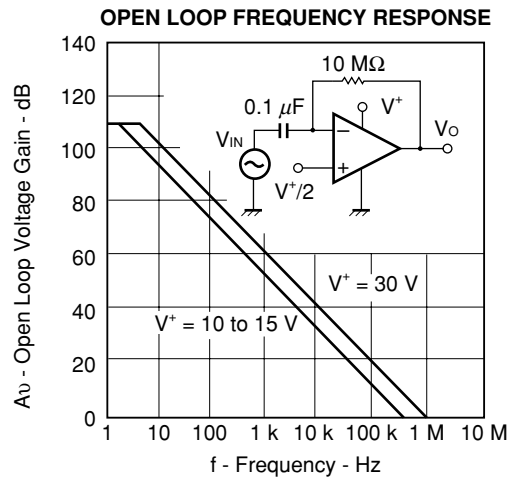
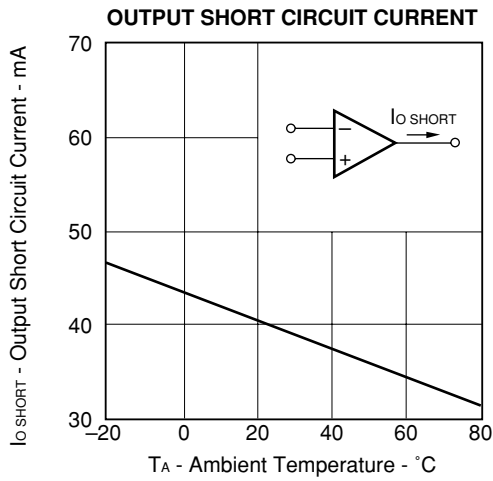
Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input Offset Voltage	$V_{IO}$	$R_S = 0\ \Omega$		$\pm 2$	$\pm 3$	mV
Input Offset Current	$I_{IO}$			$\pm 5$	$\pm 50$	nA
Input Bias Current <b>Note 7</b>	$I_B$			45	60	nA
Large Signal Voltage Gain	$A_V$	$R_L \geq 2\ \text{k}\Omega$	50	100		V/mA
Supply Current <b>Note 8</b>	$I_{CC}$	$R_L = \infty$ , $I_O = 0\ \text{A}$		0.7	0.9	mA
Common Mode Rejection Ratio	CMR		65	70		dB
Supply Voltage Rejection Ratio	SVR		65	100		dB
Output Voltage Swing	$V_O$	$R_L = 2\ \text{k}\Omega$ (Connect to GND)	0		$V^+ - 1.5$	V
Common Mode Input Voltage Range	$V_{ICM}$		0		$V^+ - 1.4$	V
Output Current (SOURCE)	$I_{O\ \text{SOURCE}}$	$V_{IN^+} = +1\ \text{V}$ , $V_{IN^-} = 0\ \text{V}$	30	40		mA
Output Current (SINK)	$I_{O\ \text{SINK}}$	$V_{IN^-} = +1\ \text{V}$ , $V_{IN^+} = 0\ \text{V}$	15	20		mA
		$V_{IN^-} = +1\ \text{V}$ , $V_{IN^+} = 0\ \text{V}$ , $V_O = 200\ \text{mV}$	30	50		$\mu\text{A}$
Channel Separation		$f = 1\ \text{kHz}$ to $20\ \text{kHz}$		120		dB

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

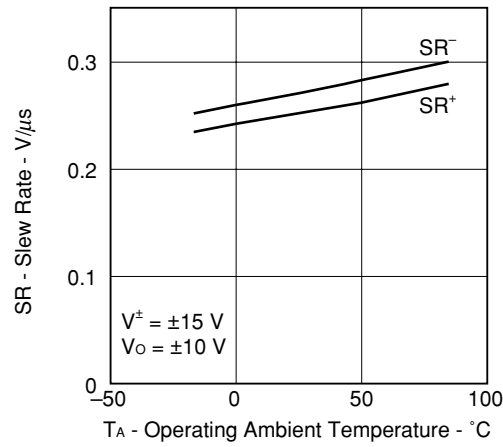
**8.** This current flows irrespective of the existence of use.

TYPICAL PERFORMANCE CHARACTERISTICS ( $T_A = 25\text{ }^\circ\text{C}$ , TYP.)

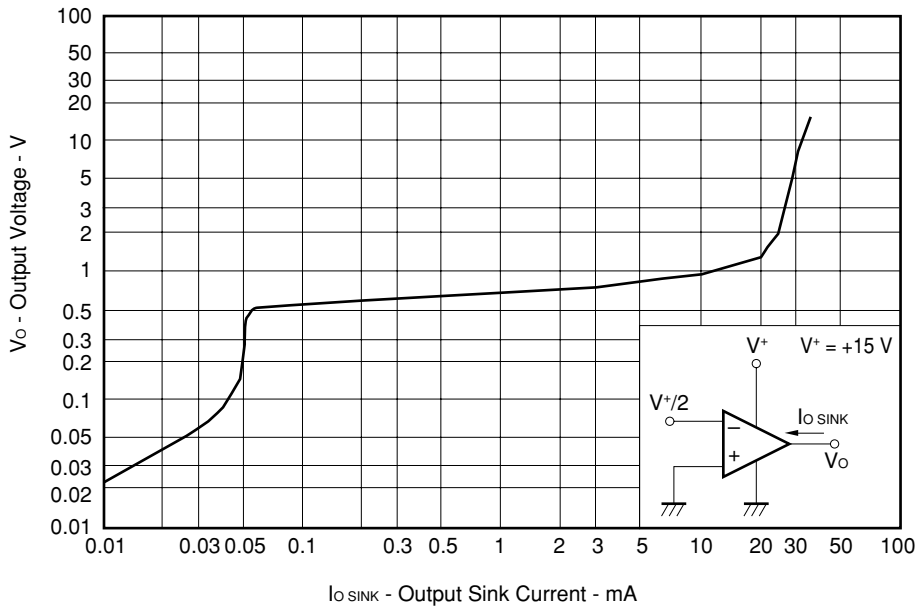




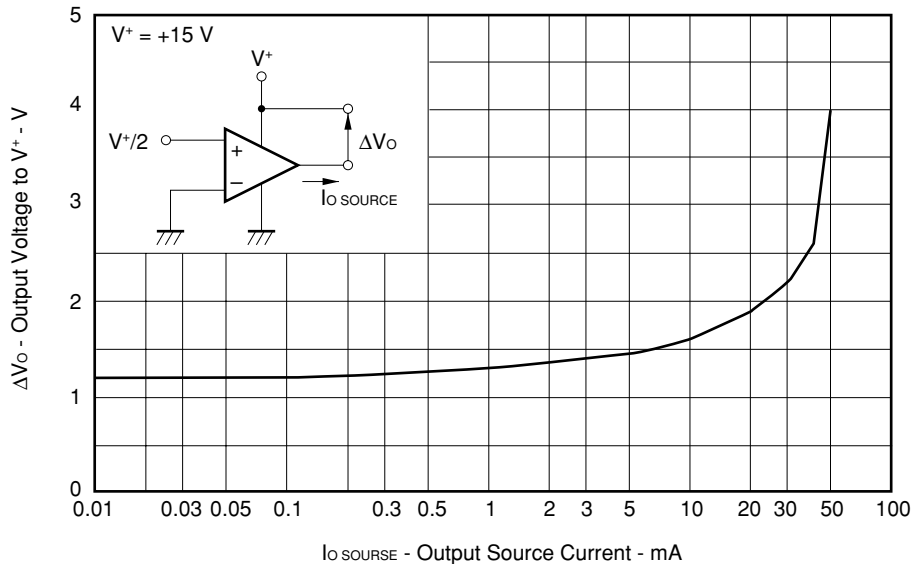
**SLEW RATE**



**OUTPUT SINK CURRENT LIMIT**



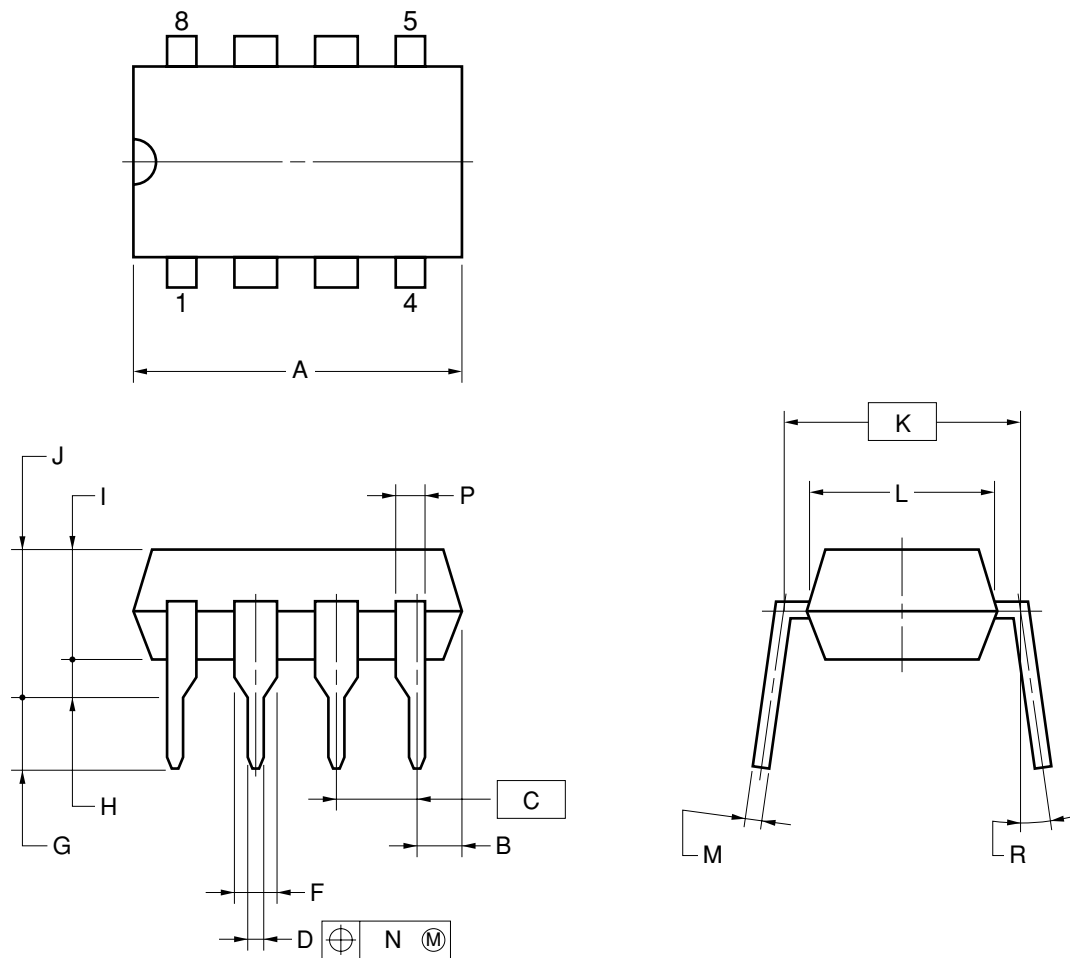
**OUTPUT SOURCE CURRENT LIMIT**





<R> PACKAGE DRAWINGS

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



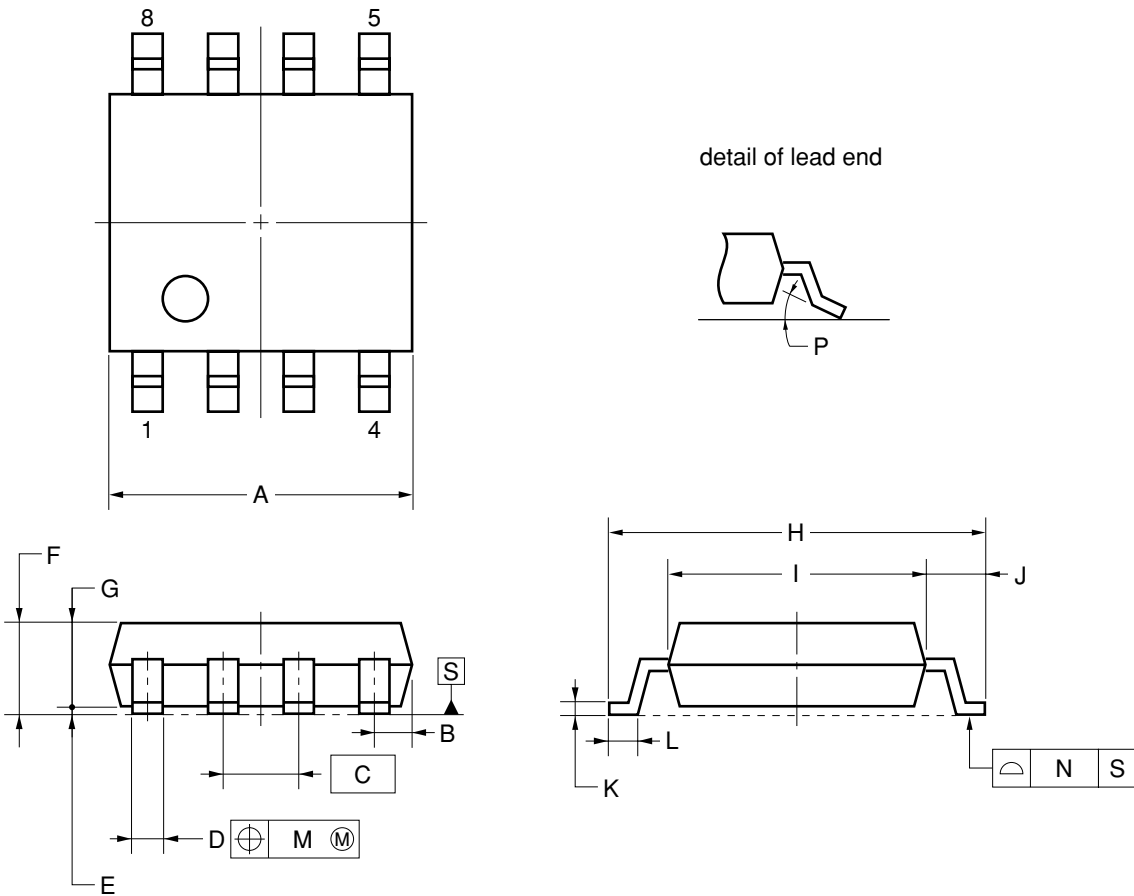
NOTES

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 <sup>+0.10</sup> <sub>-0.05</sub>
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 <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-6

<R> **RECOMMENDED SOLDERING CONDITIONS**

The μPC358 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**

**μPC358G2: 8-pin plastic SOP (5.72 mm (225))**

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 time.	IR35-00-3
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: 3 time.	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
Partial heating method	Pin temperature: 350 °C or below, Heat time: 3 seconds or less (Per each side of the device).	P350

**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.

**Types of Through-hole Device**

**μPC358C: 8-pin plastic DIP (7.62 mm (300))**

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	<a href="http://www.necel.com/pkg/en/mount/index.html">http://www.necel.com/pkg/en/mount/index.html</a>
NEC SEMICONDUCTOR DEVICE RELIABILITY/ QUALITY CONTROL SYSTEM - STANDARD LINEAR IC	IEI-1212

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