NEC

BIPOLAR ANALOG INTEGRATED CIRCUIT

μPC324

LOW POWER QUAD OPERATIONAL AMPLIFIER

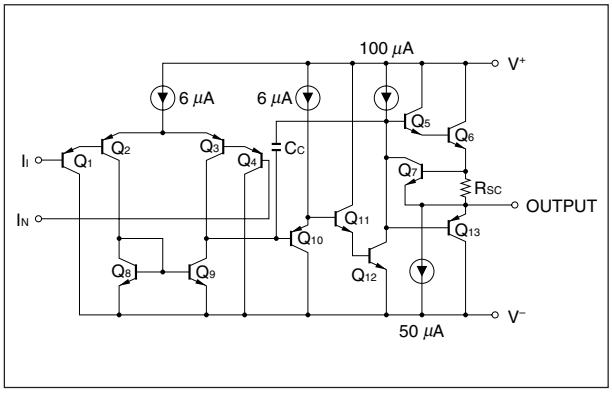
DESCRIPTION

The μPC324 is a quad 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 can also swing to ground in the linear mode.

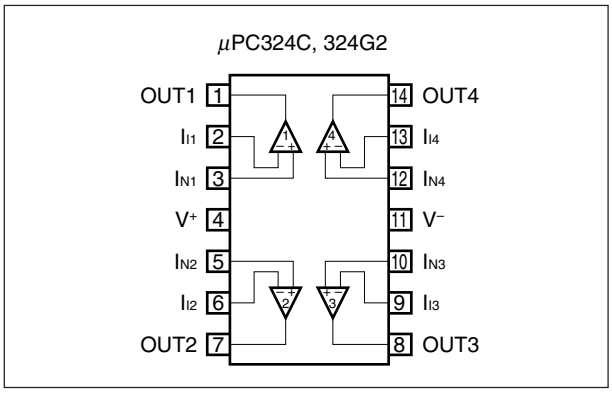
FEATURES

- Internal frequency compensation
- Wide output voltage swing V^- to V^+–1.5 V
- Common Mode input voltage range includes V^-
- Wide supply range
  - 3 V to 30 V (Single)
  - ±1.5 V to ±15 V (Split)
- Output short circuit protection

EQUIVALENT CIRCUIT (1/4 Circuit)



PIN CONFIGURATION (Top View)



★ ORDERING INFORMATION

Part Number	Package
μPC324C	14-pin plastic DIP (7.62 mm (300))
μPC324G2	14-pin plastic SOP (5.72 mm (225))
μPC324G2(5)	14-pin plastic SOP (5.72 mm (225))

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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 +32	V
Differential Input Voltage		V_{ID}	±32	V
Input Voltage **Note 2**		V_I	V^-–0.3 to V^-+32	V
Output Voltage **Note 3**		V_O	V^-–0.3 to V^++0.3	V
Power Dissipation	C Package **Note 4**	P_T	570	mW
	G2 Package **Note 5**		550	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 the both inputs are 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 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.

4. Thermal derating factor is –7.6 mW/°C when operating ambient temperature is higher than 50 °C.

5. Thermal derating factor is –5.5 mW/°C when operating ambient temperature is higher than 25 °C.

6. 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)	$V^{\pm}$	±1.5		±15	V
Supply Voltage (V^- = GND)	V^+	3		30	V

μPC324C, μPC324G2
ELECTRICAL CHARACTERISTICS (T_A = 25 °C, V^+ = 5 V, V^- = GND)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input Offset Voltage	V_{IO}	R_S = 0 Ω		±2	±7	mV
Input Offset Current	I_{IO}			±5	±50	nA
Input Bias Current **Note 7**	I_B			45	250	nA
Large Single Voltage Gain	A_V	R_L ≥ 2 kΩ	25	100		V/mV
★ Supply Current **Note 8**	I_{CC}	R_L = ∞, I_O = 0 A		1.0	2	mA
Common Mode Rejection Ratio	CMR		65	85		dB
Supply Voltage Rejection Ratio	SVR		65	100		dB
Output Voltage Swing	V_O	R_L = 2 kΩ (Connect to GND)	0		V^+ – 1.5	V
Common Mode Input Voltage Range	V_{ICM}		0		V^+ – 1.5	V
Output Current (SOURCE)	$I_{O\ SOURCE}$	V_{IN}^+ = +1 V, V_{IN}^- = 0 V	20	40		mA
Output Current (SINK)	$I_{O\ SINK}$	V_{IN}^- = +1 V, V_{IN}^+ = 0 V	10	20		mA
		V_{IN}^- = +1 V, V_{IN}^+ = 0 V, V_O = 200 mV	12	50		μA
Channel Separation		f = 1 kHz to 20 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.

★ **μPC324G2(5)**

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

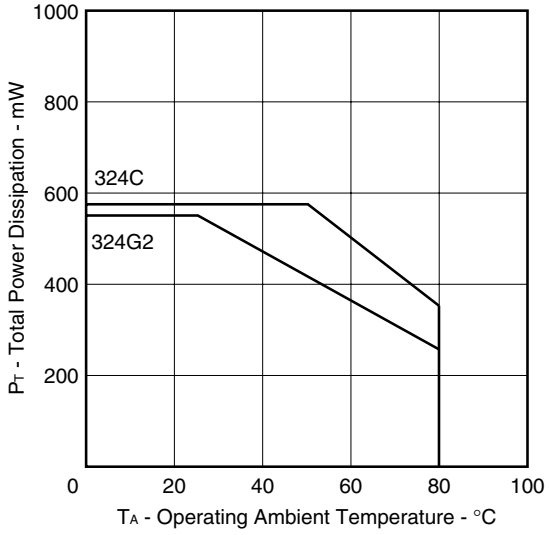
Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input Offset Voltage	V_{IO}	R_S = 0 Ω		±2	±3	mV
Input Offset Current	I_{IO}			±5	±50	nA
Input Bias Current **Note 7**	I_B			45	60	nA
Large Single Voltage Gain	A_V	$R_L \geq 2$ kΩ	50	100		V/mV
Supply Current **Note 8**	I_{CC}	$R_L = \infty$, I_O = 0 A		1.0	1.5	mA
Common Mode Rejection Ratio	CMR		65	85		dB
Supply Voltage Rejection Ratio	SVR		65	100		dB
Output Voltage Swing	V_O	R_L = 2 kΩ (Connect to GND)	0		$V^+ - 1.5$	V
Common Mode Input Voltage Range	V_{ICM}		0		$V^+ - 1.4$	V
Output Current (SOURCE)	$I_{O\ SOURCE}$	V_{IN}^+ = +1 V, V_{IN}^- = 0 V	30	40		mA
Output Current (SINK)	$I_{O\ SINK}$	V_{IN}^- = +1 V, V_{IN}^+ = 0 V	15	20		mA
		V_{IN}^- = +1 V, V_{IN}^+ = 0 V, V_O = 200 mV	30	50		μA
Channel Separation		f = 1 kHz to 20 kHz		120		dB

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

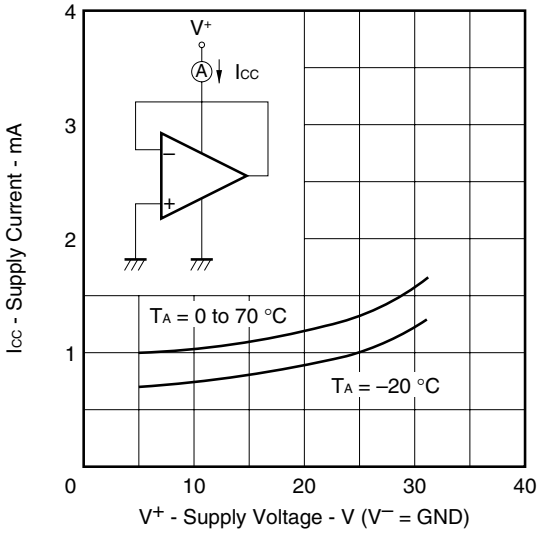
8. This current flows irrespective of the existence of use.

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

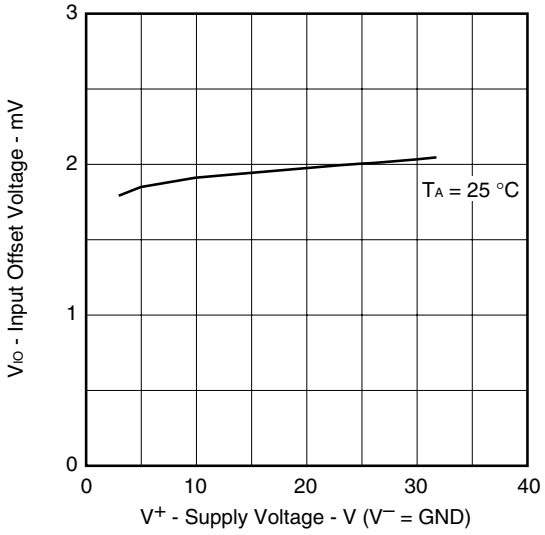
POWER DISSIPATION



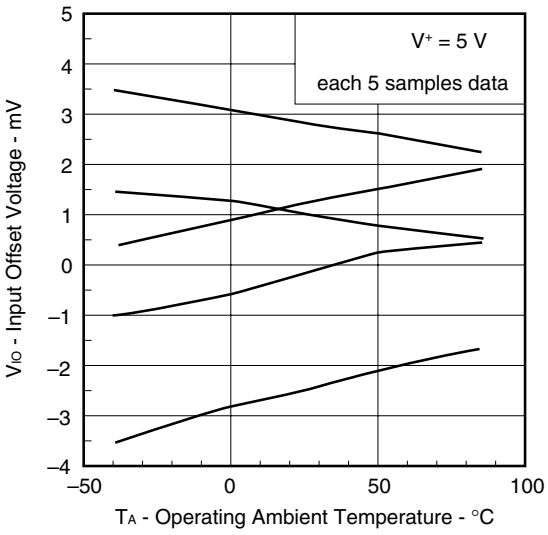
SUPPLY CURRENT



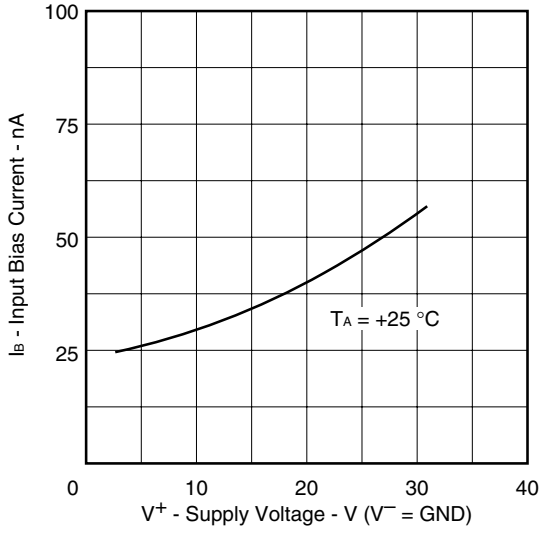
INPUT OFFSET VOLTAGE



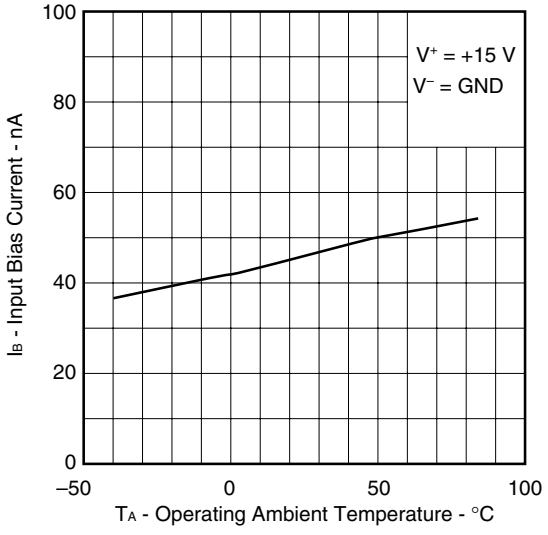
★ INPUT OFFSET VOLTAGE



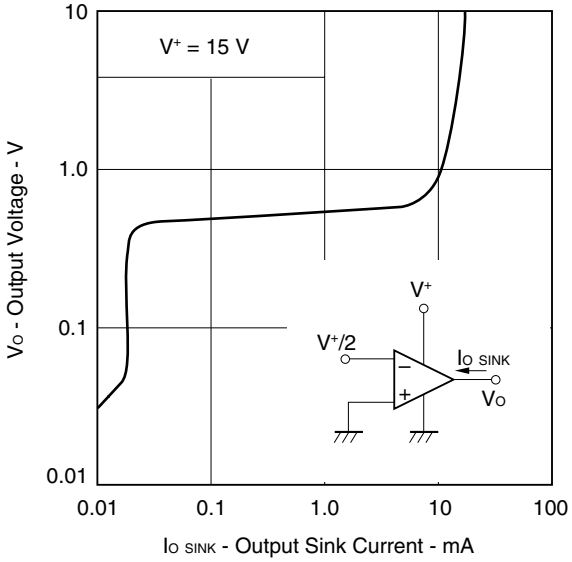
INPUT BIAS CURRENT



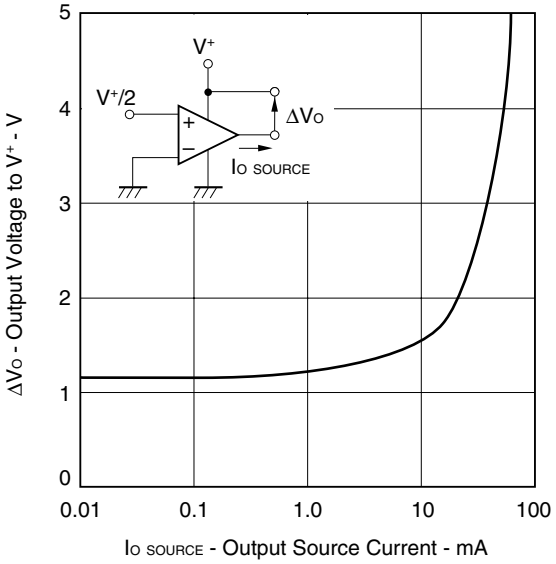
INPUT BIAS CURRENT



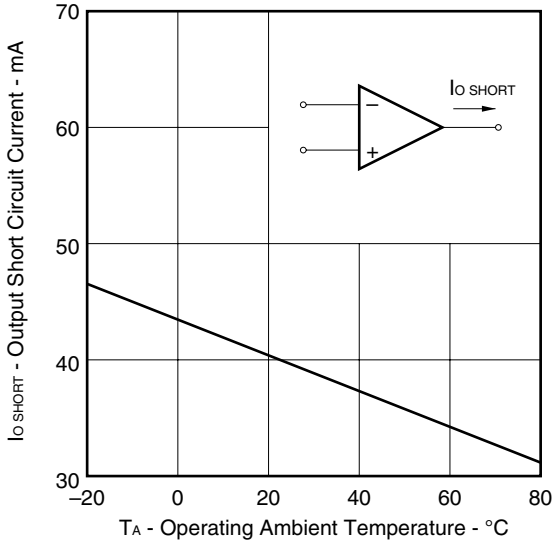
OUTPUT SINK CURRENT LIMIT



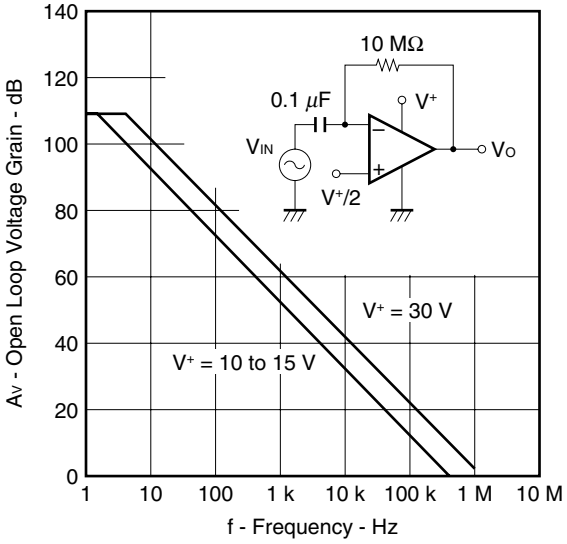
OUTPUT SOURCE CURRENT LIMIT



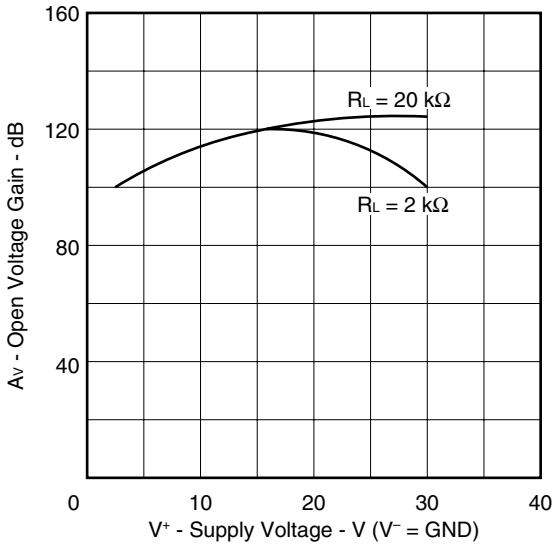
OUTPUT SHORT CIRCUIT CURRENT



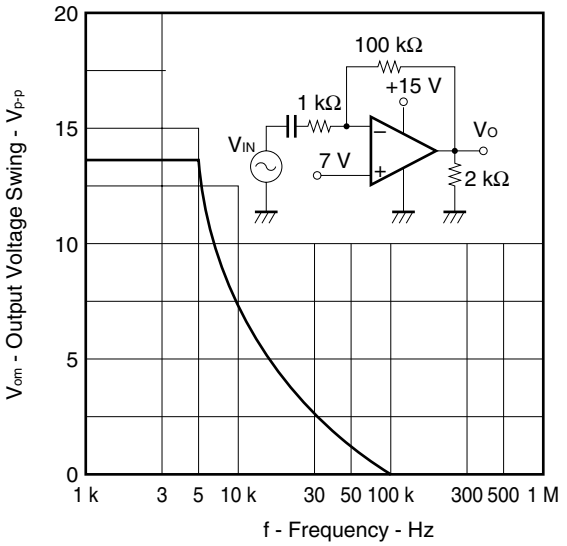
OPEN LOOP FREQUENCY RESPONSE



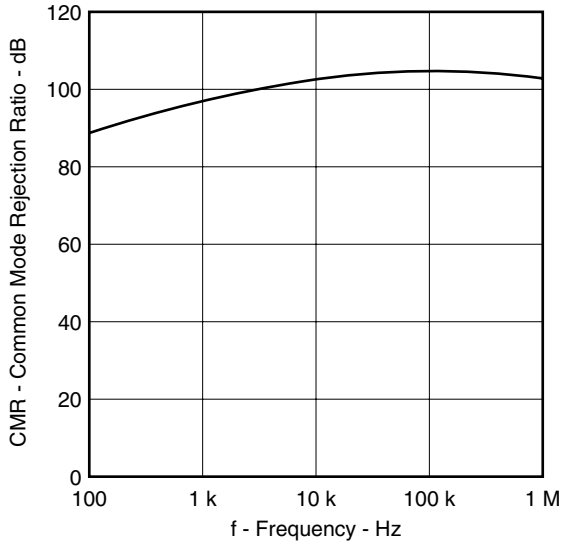
OPEN LOOP VOLTAGE GAIN



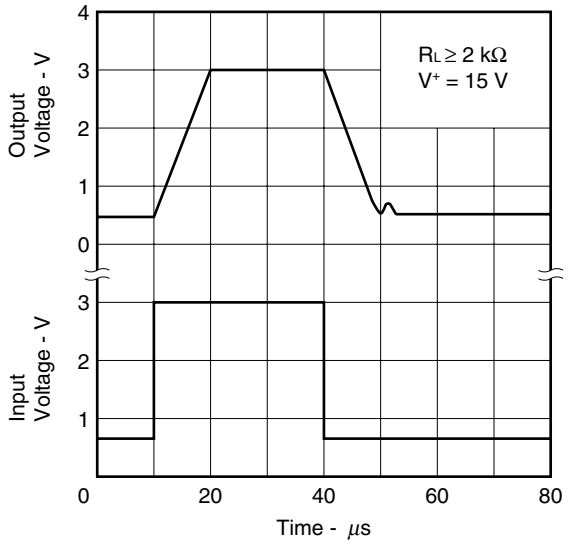
LARGE SIGNAL FREQUENCY RESPONSE



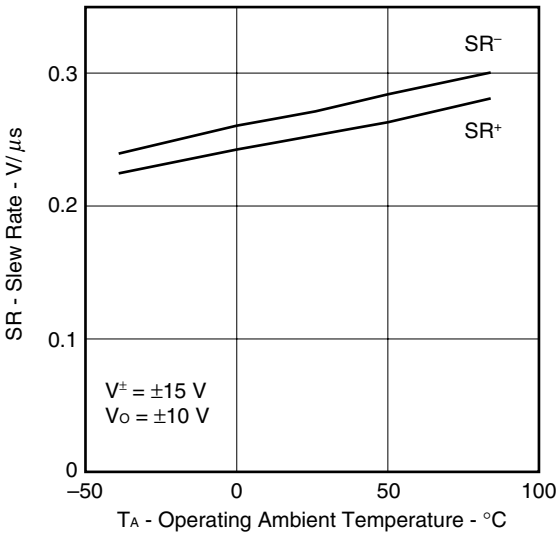
COMMON MODE REJECTION RATIO



VOLTAGE FOLLOWER PULSE RESPONSE

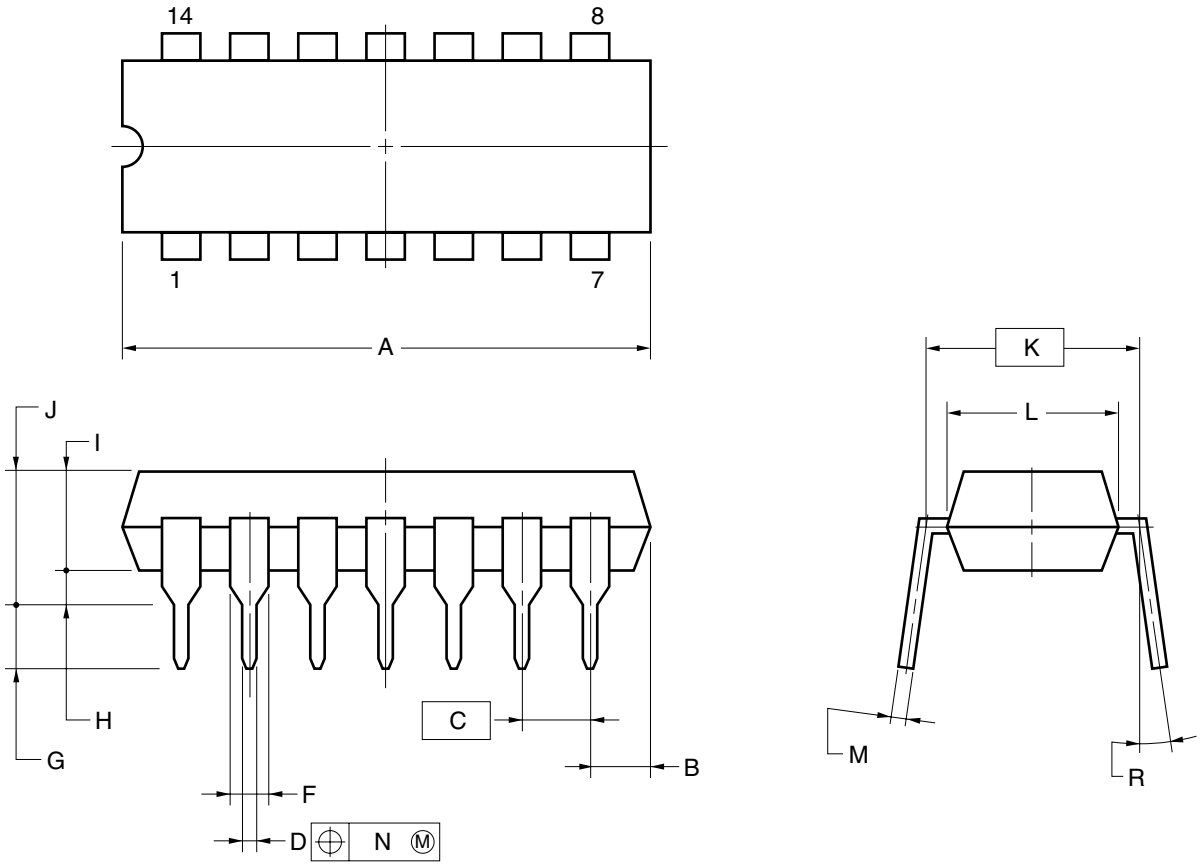


SLEW RATE



★ **PACKAGE DRAWINGS**

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



NOTES

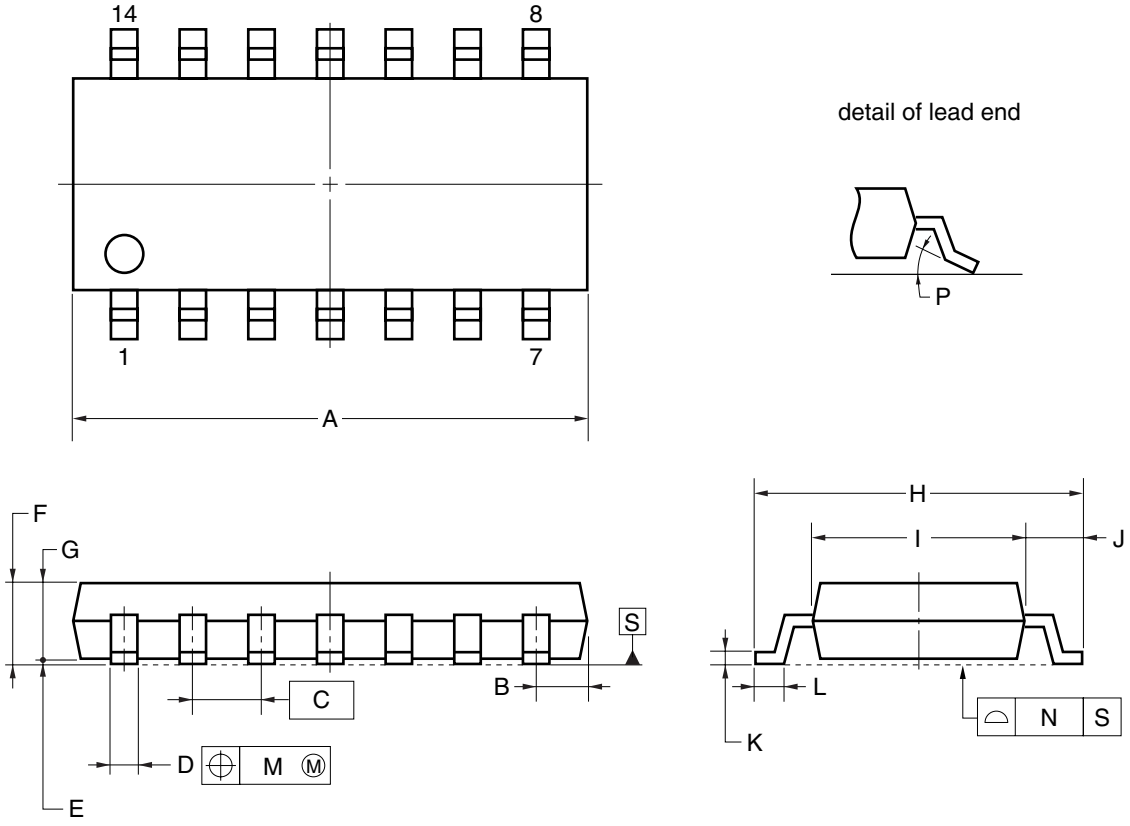
1. Each lead centerline is located within 0.25 mm of its true position (T.P.) at maximum material condition.

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

ITEM	MILLIMETERS
A	19.22±0.2
B	2.14 MAX.
C	2.54 (T.P.)
D	0.50±0.10
F	1.32±0.12
G	3.6±0.3
H	0.51 MIN.
I	3.55
J	4.3±0.2
K	7.62 (T.P.)
L	6.4±0.2
M	$0.25^{+0.10}_{-0.05}$
N	0.25
R	0~15°

P14C-100-300B1-3

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



NOTE

Each lead centerline is located within 0.1 mm of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS
A	10.2±0.26
B	1.42 MAX.
C	1.27 (T.P.)
D	$0.42^{+0.08}_{-0.07}$
E	0.1±0.1
F	$1.59^{+0.21}_{-0.2}$
G	1.49
H	6.5±0.2
I	4.4±0.1
J	1.1±0.16
K	$0.17^{+0.08}_{-0.07}$
L	0.6±0.2
M	0.1
N	0.10
P	$3^{\circ}{}^{+7^{\circ}}_{-3^{\circ}}$

S14GM-50-225B, C-6

★ RECOMMENDED SOLDERING CONDITIONS

The μPC324 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)

Surface mount device

μPC324G2: 14-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.

Through-hole device

μPC324C: 14-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	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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