

### DC to VHF WIDEBAND DIFFERENTIAL INPUT AND OUTPUT AMPLIFIER IC

#### DESCRIPTION

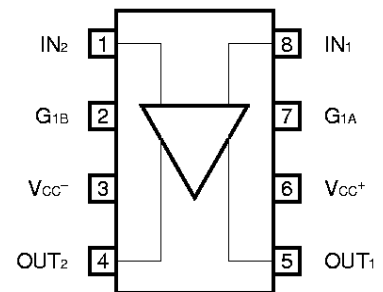
The  $\mu$ PC1663 is a differential input, differential output wideband amplifier IC that uses an high frequency ( $f_r = 6$  GHz) silicon bipolar process (called NESAT™). This process improves bandwidth phase characteristics, input noise voltage characteristics, and low power consumption when compared to conventional HF-band differential amplifier ICs.

These features make this device suitable as a wideband amplifier in high-definition TVs, high-resolution monitors, broadcasting satellite receivers, and video cameras, as a sense amplifier in high-density CCD and optical pick-up products, or as a pulse amplifier for optical data links.

#### FEATURES

- Bandwidth and typical gain
  - 120 MHz @  $A_{VOL} = 300$
  - 170 MHz @  $A_{VOL} = 100$
  - 700 MHz @  $A_{VOL} = 10$
- Phase delay  $-85$  deg. @  $A_{VOL} = 100, 100$  MHz
- Circuit Current 13mA
- Gain adjustable from 10 to 300 with external resistor
- No frequency compensation required (Small phase delay at 10 MHz or less)

#### CONNECTION DIAGRAM (Top View)

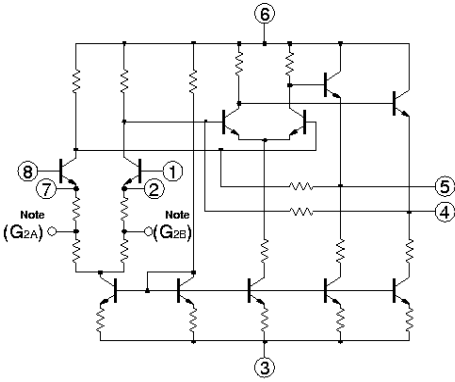


#### ORDERING INFORMATION

Part Number	Package	Markings	Supplying Form
$\mu$ PC1663C	8 pin plastic DIP (300 mil)	C1663C	Magazine case
$\mu$ PC1663G-E1	8 pin plastic SOP (225 mil)	1663	Embossed tape 12 mm wide. QTY 2500p/reel. Pin 1 is in tape pull-out direction.
$\mu$ PC1663GV-E1	8 pin plastic SSOP (175 mil)	1663	Embossed tape 8 mm wide. QTY 1000p/reel. Pin 1 is in tape pull-out direction.

**Caution: Electro-static sensitive devices**

PIN EXPLANATIONS

Pin No.	Pin Name	In dual bias unit: V	In single bias unit: V	Functions and applications	Internal equivalent circuit
8 1	IN1 IN2	Pin voltage 0	Apply voltage $V_{CC}/2$	Input pin	 <p>Internal circuit constants should be referred to application note.</p>
5 4	OUT1 OUT2	Pin voltage 0	Apply voltage $V_{CC}/2$	Output pin	
6	$V_{CC}^+$	G, GV $\pm 2$ to $\pm 6.5$	G, GV -0.3 to 14 C -0.3 to 16	Plus voltage supply pin. This pin should be connected with bypass capacitor to minimize AC impedance.	
2	$V_{CC}^-$	C $\pm 2$ to $\pm 7$	GND	Minus voltage supply pin. This pin should be connected with bypass capacitor to minimize AC impedance.	
7 2	$G_{1A}$ $G_{1B}$	—	—	Gain adjustment pin. External resistor from 0 to 10 kΩ can be inserted between pin 2 and 7 to determine gain value.	

**Note** μPC1664 which had  $G_{2A}$ ,  $G_{2B}$  of the other gain adjustment pins is discontinued.

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

PARAMETER	SYMBOL	μPC1663C	μPC1663G	μPC1663GV	UNIT
Supply Voltage	V <sub>CC</sub> <sup>±</sup>	±8	±7	±7	V
Power Dissipation	P <sub>D</sub>	500 (T <sub>A</sub> = +85 °C) <sup>Note</sup>	280 (T <sub>A</sub> = 75 °C) <sup>Note 1</sup>	200 <sup>Note 2</sup>	mW
Differential Input Voltage	V <sub>ID</sub>	±5	±5	±5	V
Input Voltage	V <sub>ICM</sub>	±6	±6	±6	V
Output Current	I <sub>O</sub>	35	35	35	mA
Operating Temperature Range	T <sub>A</sub>	-45 to +85	-45 to +75	-45 to +75	°C
Storage Temperature Range	T <sub>stg</sub>	-55 to +150	-55 to +150	-55 to +150	°C

**Note** Mounted on double sided copper clad 50 × 50 × 1.6 mm epoxy glass PWB

**RECOMMENDED OPERATING CONDITIONS**

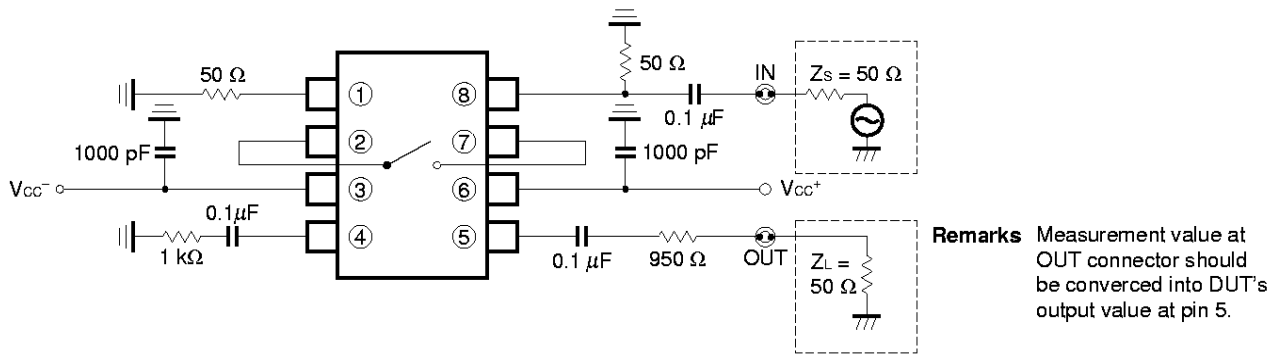
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V <sub>CC</sub> <sup>±</sup> (1663C)	±2	±6	±7	V
Supply Voltage	V <sub>CC</sub> <sup>±</sup> (1663G, 1663GV)	±2	±6	±6.5	V
Source Current	I <sub>O source</sub>			20	mA
Sink Current	I <sub>O sink</sub>			2.5	mA
Frequency Range	f <sub>opt</sub>	DC		200	MHz

**ELECTRICAL CHARACTERISTICS** ( $T_A = +25\text{ }^\circ\text{C}$ ,  $V_{CC}^{\pm} = \pm 6\text{ V}$ )

PARAMETER		SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Differential Voltage Gain	Gain 1	$A_{vd}$	<b>Note 1</b>	200	320	500	
	Gain 2		<b>Note 2</b>	8	10	12	
Bandwidth	Gain 1	BW	$R_S = 50\ \Omega$ (3 dB down point)	—	120	—	MHz
	Gain 2			—	700	—	
Rise Time	Gain 1	$t_r$	$R_S = 50\ \Omega$ , $V_{out} = 1\text{ V}_{P-P}$	—	2.9	—	ns
	Gain 2			—	2.7	—	
Propagation Delay	Gain 1	$t_{pd}$	$R_S = 50\ \Omega$ , $V_{out} = 1\text{ V}_{P-P}$	—	2	—	ns
	Gain 2			—	1.2	—	
Input Impedance	Gain 1	$R_{in}$		—	4.0	—	k $\Omega$
	Gain 2			50	180	—	
Input Capacitance		$C_{in}$		—	2	—	pF
Input Offset Current		$I_{io}$		—	0.4	5.0	$\mu\text{A}$
Input Bias Current		$I_b$		—	20	40	$\mu\text{A}$
Input Noise Voltage		$V_n$	$R_S = 50\ \Omega$ , 10 k to 10 MHz	—	3	—	$\mu\text{V}_{r.m.s.}$
Input Voltage Range		$V_I$		$\pm 1.0$	—	—	V
Common Mode Rejection Ratio	Gain 2	CMR	$V_{cm} = \pm 1\text{ V}$ , $f \leq 100\text{ kHz}$	53	94	—	dB
Supply Voltage Rejection Ratio		SVR	$\Delta V = \pm 0.5\text{ V}$	50	70	—	dB
Output Offset Voltage	Gain 1	$V_{O(off)}$	$V_{O(off)} =  \text{OUT}_1 - \text{OUT}_2 $	—	0.3	1.5	V
	Gain 2			—	0.1	1.0	
Output Common Mode Voltage		$V_{O(CM)}$		2.4	2.9	3.4	V
Output Voltage Swing		$V_{OP-P}$	Single-end	3.0	4.0	—	$V_{P-P}$
Output Sink Current		$I_{sink}$		2.5	3.6	—	mA
Power Supply Current		$I_{CC}$		—	13	20	mA

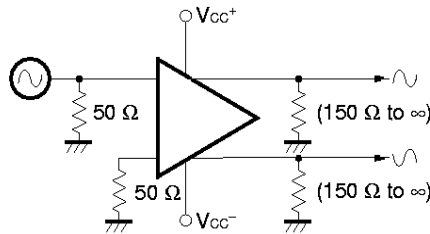
- Notes**
- Gain select pins  $G_{1A}$  and  $G_{1B}$  are connected.
  - All gain select pins are opened.

TEST CIRCUIT



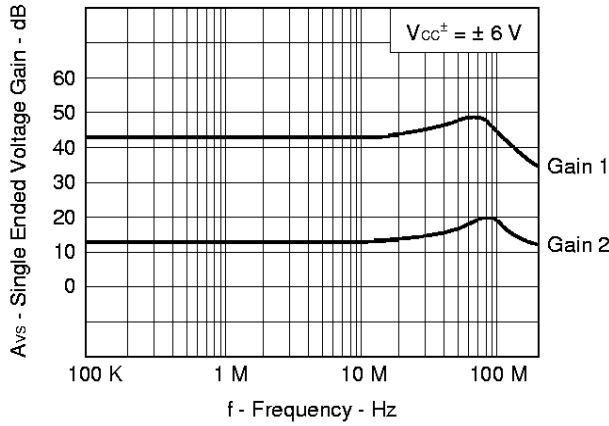
**Remarks** Definition and test circuit of each characteristic should be referred to application note 'Usage of μPC1663 (Document No. G12290E)'.

- Caution 1.** When gain between Gain 1 and Gain 2 is necessary, insert adjustment resistor (0 to 10 kΩ) between G<sub>1A</sub> and G<sub>1B</sub> to determine gain value.
- 2.** Due to high-frequency characteristics, the physical circuit layout is very critical. Supply voltage line bypass, double-sided printed-circuit board, and wide-area ground line layout are necessary for stable operation. Two signal resistors connected to both inputs and two load resistors connected to both outputs should be balanced for stable operation.

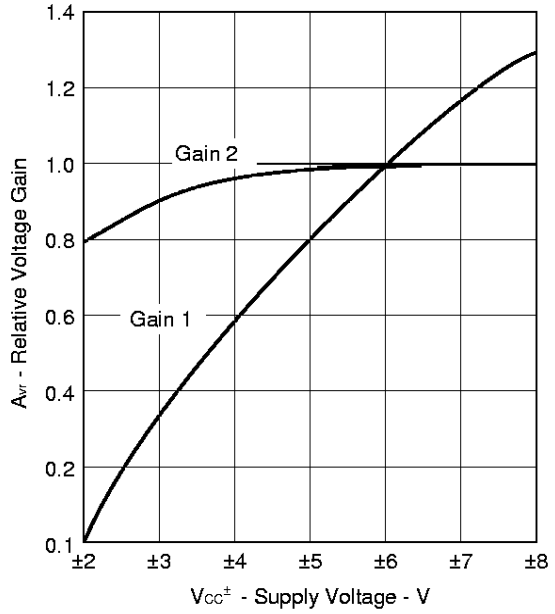


TYPICAL PERFORMANCE CHARACTERISTICS (Unless otherwise specified  $T_A = 25\text{ }^\circ\text{C}$ )

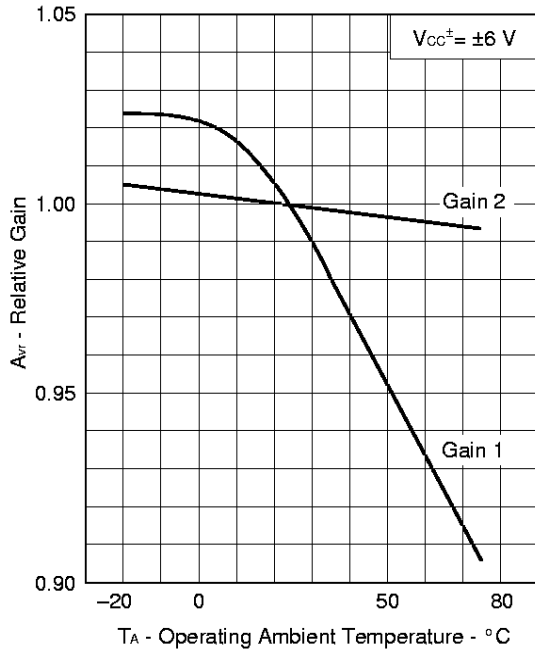
SINGLE ENDED VOLTAGE GAIN vs. FREQUENCY



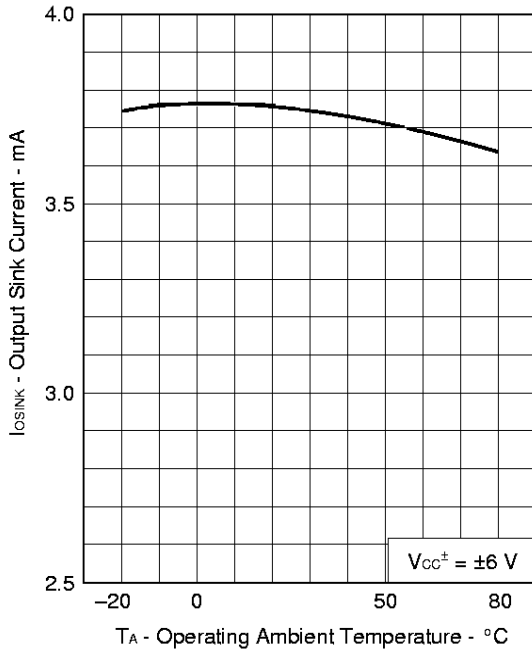
RELATIVE VOLTAGE GAIN vs. OPERATING AMBIENT TEMPERATURE



VOLTAGE GAIN

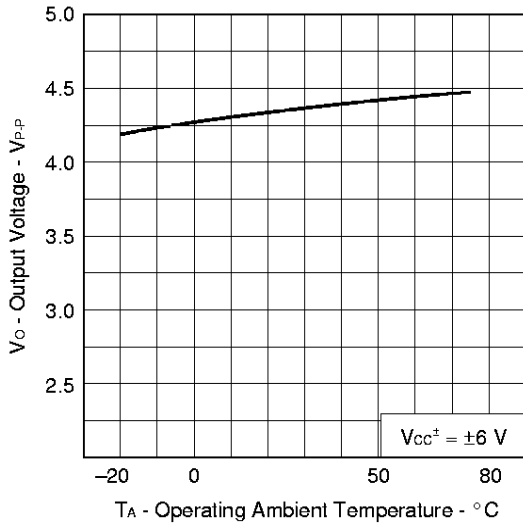


OUTPUT SINK CURRENT vs. OPERATING AMBIENT TEMPERATURE

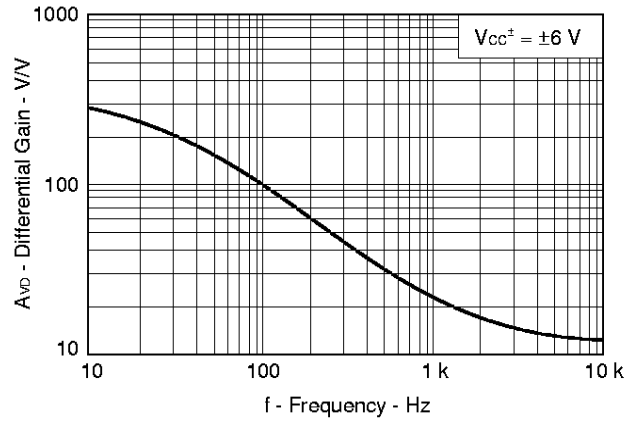


**Remarks** Relative voltage gains are described based on gains 1.00 at  $T_A = +25\text{ }^\circ\text{C}$ ,  $V_{CC}^{\pm} = \pm 6\text{ V}$

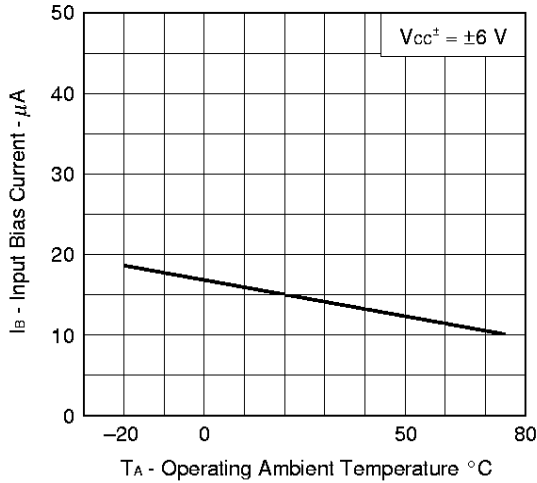
**SINGLE ENDED OUTPUT VOLTAGE SWING vs. OPERATING AMBIENT TEMPERATURE**



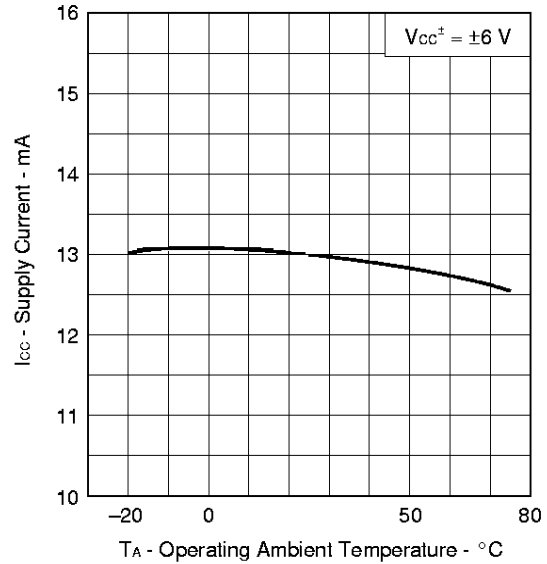
**DIFFERENTIAL VOLTAGE GAIN**



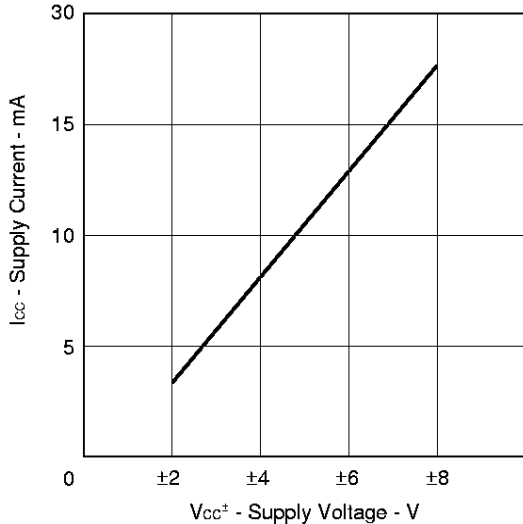
**INPUT BIAS CURRENT vs. OPERATING AMBIENT TEMPERATURE**



**SUPPLY CURRENT vs. OPERATING AMBIENT TEMPERATURE**



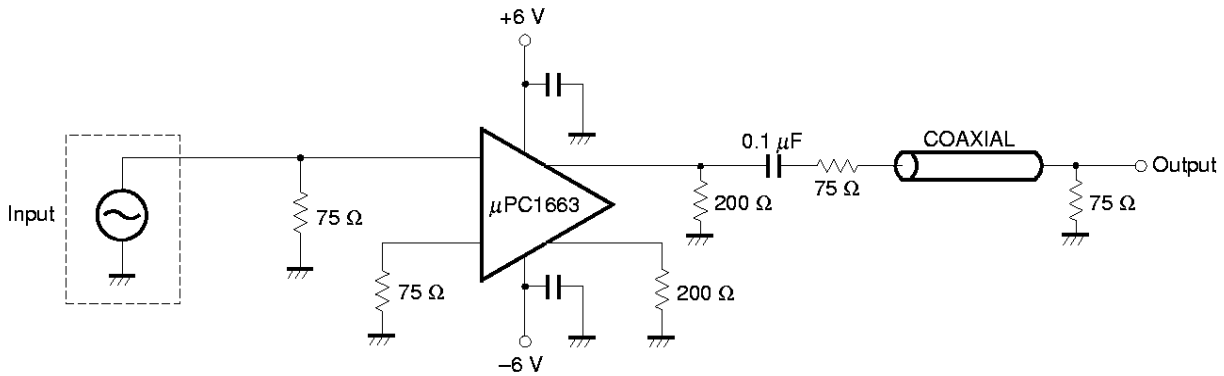
**SUPPLY CURRENT vs. SUPPLY VOLTAGE**



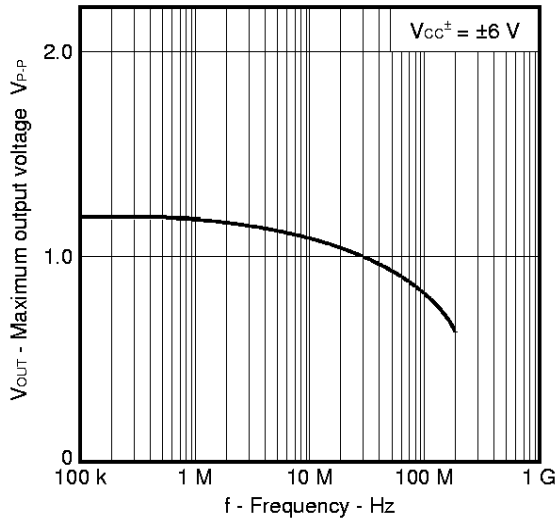
APPLICATION CIRCUIT EXAMPLES

EXAMPLE 1

Video Line Driver Circuit Example

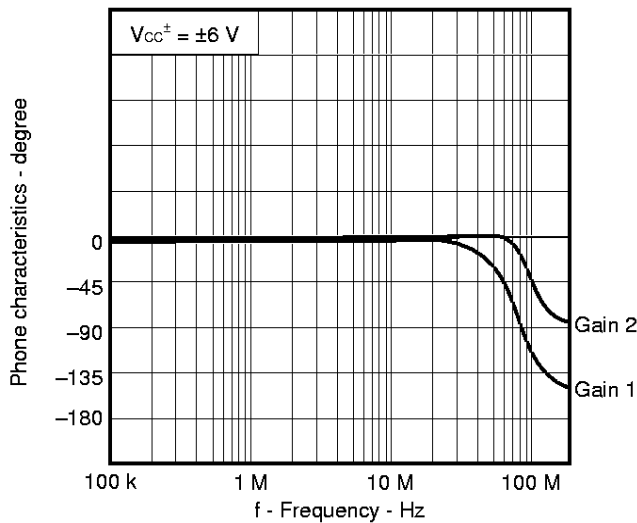


Maximum output voltage vs. Frequency (Video Line, Single Ended)



**Remark**  
Differential output voltage is double of single ended output voltage.

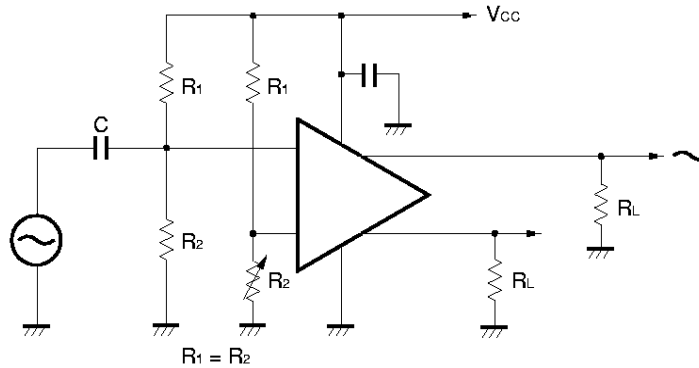
Phase Characteristics vs. Frequency





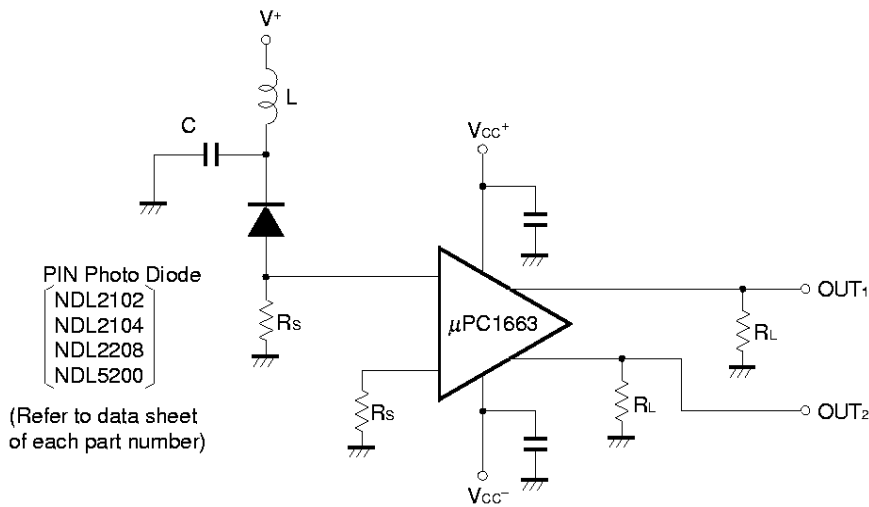
**EXAMPLE 2**

**V<sub>CC</sub> single supply application example (Outline)**



**EXAMPLE 3**

**Photo signal detector circuit example (Outline)**



**Caution** When signal source impedance for μPC1663 is critical, FET source follower buffer should be inserted between PIN Photo diode and μPC1663 input

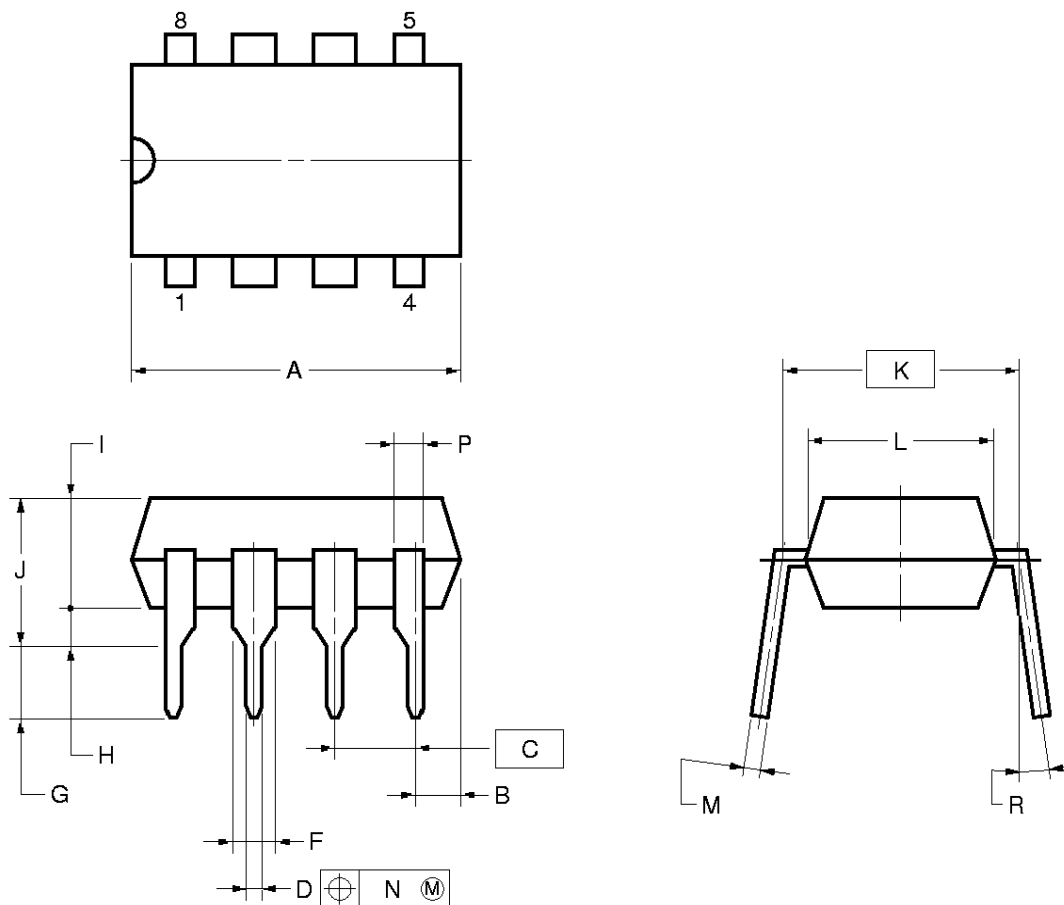
The application circuits and their parameters are for reference only and are not intended for use in actual design-ins.

Precautions for design in and detail application circuit examples should be referred to application note 'Usage to μPC1663 (Document No. G12290E)'.

PACKAGE DIMENSIONS (Unit: mm)

8PIN PLASTIC DIP (300 mil)

– μPC1663C–



NOTES

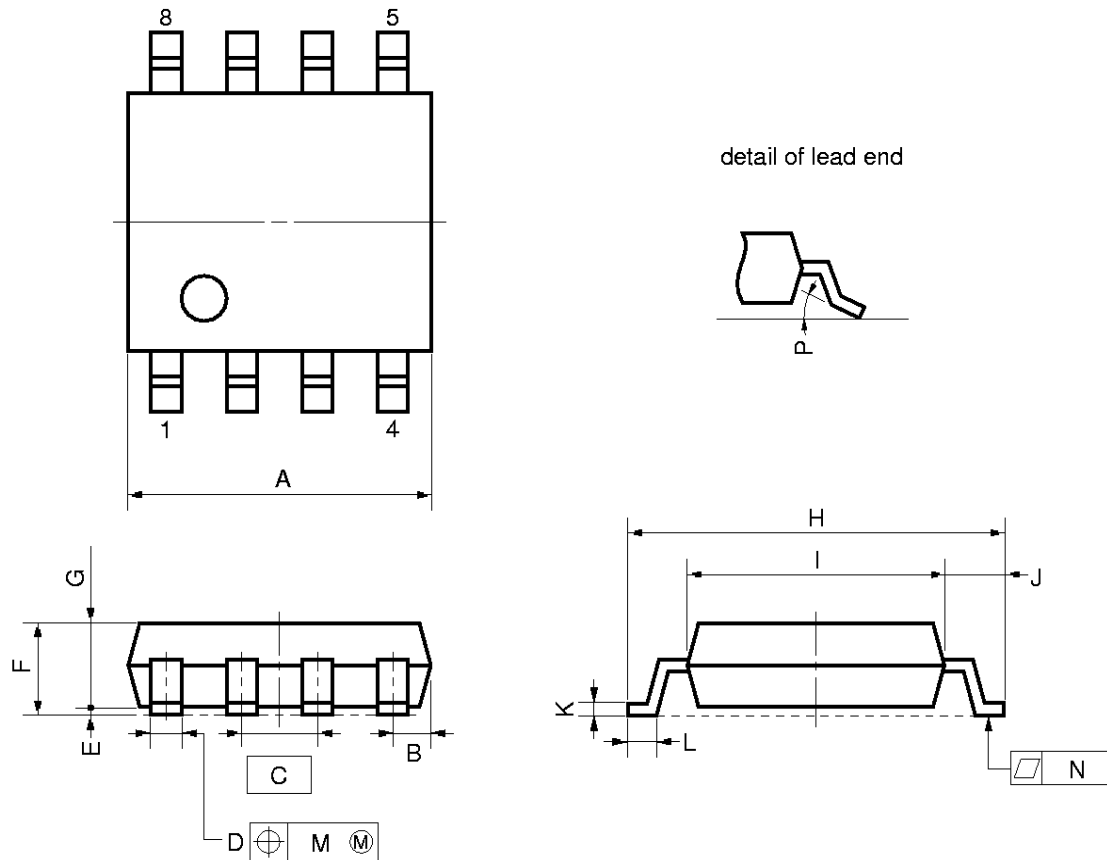
- 1) Each lead centerline is located within 0.25 mm (0.01 inch) of its true position (T.P.) at maximum material condition.
- 2) Item "K" to center of leads when formed parallel.

ITEM	MILLIMETERS	INCHES
A	10.16 MAX.	0.400 MAX.
B	1.27 MAX.	0.050 MAX.
C	2.54 (T.P.)	0.100 (T.P.)
D	0.50±0.10	0.020 <sup>+0.004</sup> <sub>-0.005</sub>
F	1.4 MIN.	0.055 MIN.
G	3.2±0.3	0.126±0.012
H	0.51 MIN.	0.020 MIN.
I	4.31 MAX.	0.170 MAX.
J	5.08 MAX.	0.200 MAX.
K	7.62 (T.P.)	0.300 (T.P.)
L	6.4	0.252
M	0.25 <sup>+0.10</sup> <sub>-0.05</sub>	0.010 <sup>+0.004</sup> <sub>-0.003</sub>
N	0.25	0.01
P	0.9 MIN.	0.035 MIN.
R	0~15°	0~15°

P8C-100-300B,C-1

8 PIN PLASTIC SOP (225 mil)

-μPC1663C-



NOTE

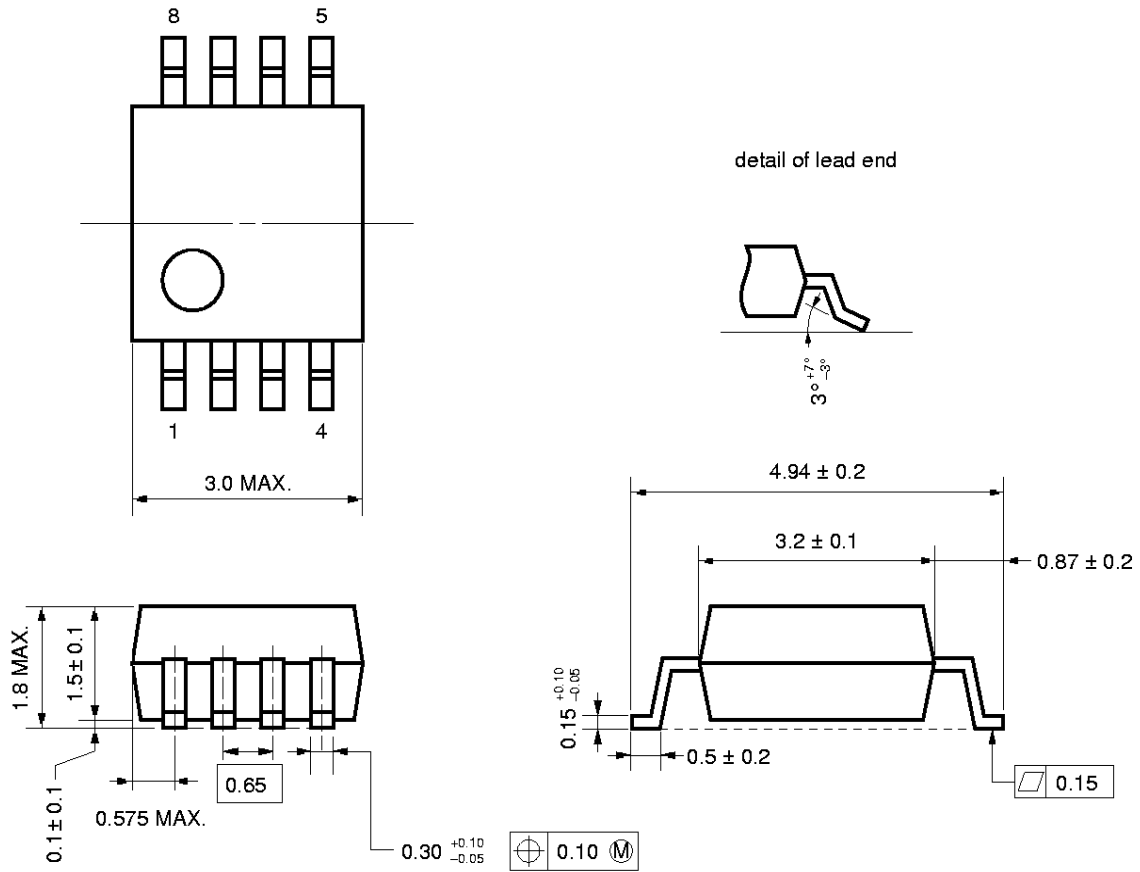
Each lead centerline is located within 0.12 mm (0.005 inch) of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS	INCHES
A	5.37 MAX.	0.212 MAX.
B	0.78 MAX.	0.031 MAX.
C	1.27 (T.P.)	0.050 (T.P.)
D	0.40 <sup>+0.10</sup> <sub>-0.05</sub>	0.016 <sup>+0.004</sup> <sub>-0.003</sub>
E	0.1±0.1	0.004±0.004
F	1.8 MAX.	0.071 MAX.
G	1.49	0.059
H	6.5±0.3	0.256±0.012
I	4.4	0.173
J	1.1	0.043
K	0.15 <sup>+0.10</sup> <sub>-0.05</sub>	0.006 <sup>+0.004</sup> <sub>-0.002</sub>
L	0.6±0.2	0.024 <sup>+0.008</sup> <sub>-0.009</sub>
M	0.12	0.005
N	0.10	0.004
P	3° <sup>+7°</sup> <sub>-3°</sub>	3° <sup>+7°</sup> <sub>-3°</sub>

S8GM-50-225B-4

8PIN PLASTIC DIP (175 mil)

-μPC1663GV-



**RECOMMENDED SOLDERING CONDITIONS**

The following conditions (see tables below) must be met when soldering this product.

Please consult with our sales offices in case other soldering process is used, or in case other soldering is done under different conditions.

**Surface Mount Types**

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

**μPC1663G, μPC1663GV**

Soldering method	Soldering conditions	Recommended condition symbol
Infrared ray reflow	Peak package's surface temperature : 235 °C or below, Reflow time: 30 seconds or below (210 °C or higher), Number of reflow process: 3, Exposure limit <sup>Note</sup> : None	IR35-00-3
VPS	Peak package's surface temperature : 215 °C or below, Reflow time: 40 seconds or below (200 °C or higher), Number of reflow process: 3, Exposure limit <sup>Note</sup> : None	VP15-00-3
Wave soldering	Solder temperature: 260 °C or below, Flow time: 10 seconds or below, Number of flow process: 1, Exposure limit <sup>Note</sup> : None	WS60-00-1
Partial heating method	Terminal temperature : 300 °C or below, Flow time: 3 seconds or below/pin, Exposure limit <sup>Note</sup> : None	

**Note** Exposure limit before soldering after dry-pack package is opened.

Storage conditions: 25 °C and relative humidity at 65 % or less.

**Caution** Do not apply more than a single process at once, except for "Partial heating method".

**Through Hole Mount Type**

**μPC1663C**

Soldering method	Soldering conditions	Recommended condition symbol
Wave soldering	Solder temperature: 260 °C or below, Flow time: 10 seconds or below	
Partial heating method	Pin temperature : 300 °C or below, Flow time: 3 seconds or below/pin, Exposure limit <sup>Note</sup> : None	

[MEMO]

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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.

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Anti-radioactive design is not implemented in this product.