

TIMER CIRCUIT

The  $\mu$ PC1555 is a powerful integrated circuit. Adding a few external parts to it can turn it into various types of timing signal generators, such as monostable and astable multivibrators. It has trigger, threshold, and control pins. Inputting a signal to the reset pin can stop the circuit operation easily. In addition, the output can sink current as high as 200 mA (maximum). So, it can be used to drive relays and lamps.

TYPICAL CHARACTERISTICS

- Supply voltage : 4.5 to 16 V
- Circuit current ( $V_{CC} = 5\text{ V}$ ) : 3 mA
- Output current capacity : 200 mA
- Temperature stability : 0.005%/°C
- Rising and falling time : 100 ns

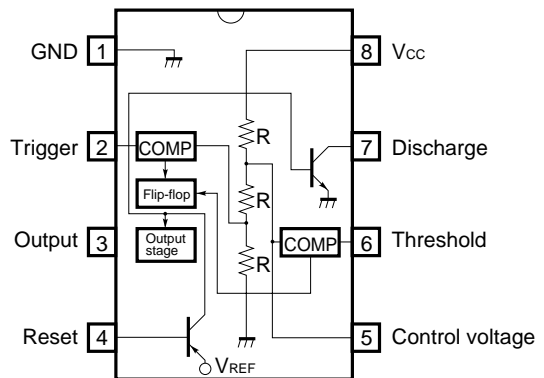
FEATURES

- Monostable and astable oscillation
- Interfacing directly with TTL-level signals
- Variable duty cycle

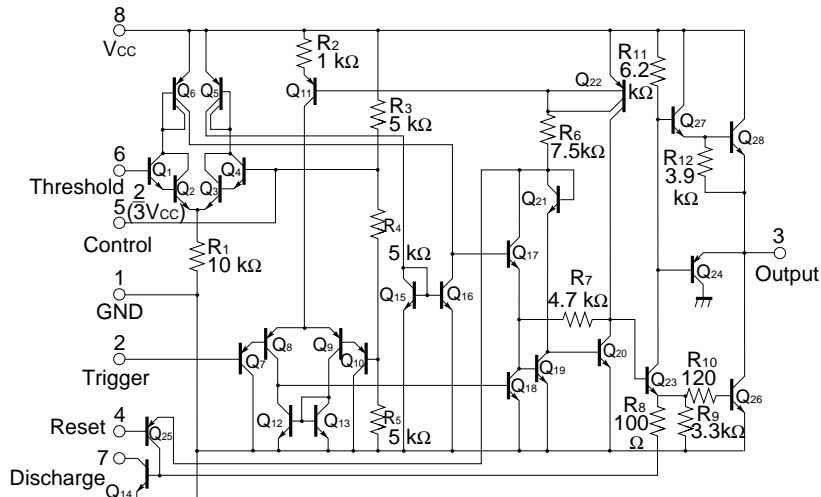
ORDERING INFORMATION

| Part number    | Package                     |
|----------------|-----------------------------|
| $\mu$ PC1555C  | 8-pin plastic DIP (300 mil) |
| $\mu$ PC1555G2 | 8-pin plastic SOP (225 mil) |

PIN CONFIGURATION (TOP VIEW)



EQUIVALENT CIRCUIT



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

| Parameter   | Symbol           | Rated value                   |                               | Unit |
|---|------------------|-------------------------------|-------------------------------|------|
|   |                  | μPC1555C                      | μPC1555G                      |      |
| Supply voltage  | V <sub>CC</sub>  | -0.3 to +18                   | -0.3 to +18                   | V    |
| Input voltage<br>(trigger, threshold, reset, control)                 | V <sub>IN</sub>  | -0.3 to V <sub>CC</sub> + 0.3 | -0.3 to V <sub>CC</sub> + 0.3 | V    |
| Applicable output voltage <sup>Note 4</sup><br>(output and discharge) | V <sub>O</sub>   | -0.3 to V <sub>CC</sub> + 0.3 | -0.3 to V <sub>CC</sub> + 0.3 | V    |
| Output current  | I <sub>O</sub>   | 200 <sup>Note 1</sup>         | 200 <sup>Note 1</sup>         | mA   |
| Power dissipation   | P <sub>T</sub>   | 600 <sup>Note 2</sup>         | 440 <sup>Note 3</sup>         | mW   |
| Operating temperature   | T <sub>A</sub>   | -20 to +80                    | -20 to +80                    | °C   |
| Storage temperature   | T <sub>stg</sub> | -55 to +125                   | -55 to +125                   | °C   |

**Notes 1.** Be sure to use the product within the Power dissipation.

**2.** For T<sub>A</sub> ≥ 25°C, the total loss is derated at T<sub>J MAX</sub> = 125°C and -6 mW/°C.  
(See the P<sub>T</sub>-T<sub>A</sub> characteristic curve.)

**3.** For T<sub>A</sub> ≥ 25°C, the total loss is derated at T<sub>J MAX</sub> = 125°C and -4.4 mW/°C.  
(See the P<sub>T</sub>-T<sub>A</sub> characteristic curve.)

**4.** This is an external voltage that can be applied to the output pin without deteriorating the quality of the product or causing damage to the product.

Be sure to use the product within the rated value under any conditions where coils are inserted or power is turned on or off. The output voltage that can be obtained during normal operation is within the output saturation voltage range.

**RECOMMENDED OPERATING CONDITIONS** (T<sub>A</sub> = 25°C)

| Parameter                                 | Symbol               | Conditions                  | MIN. | MAX.                  | Unit |
|---|----------------------|-----------------------------|------|-----------------------|------|
| Supply voltage                            | V <sub>CC</sub>      |                             | 4.5  | 16                    | V    |
| Oscillation frequency                     | f                    | V <sub>CC</sub> = 5 to 15 V | 0.1  | 100 k                 | Hz   |
| Output pulse width                        | t <sub>w (OUT)</sub> | V <sub>CC</sub> = 5 to 15 V | 10 μ | 10                    | Sec  |
| Input voltage (trigger, threshold)        | V <sub>IN</sub>      |                             | 0    | V <sub>CC</sub>       | V    |
| Input voltage <sup>Note 5</sup> (control) | V <sub>IN</sub>      |                             | 3.0  | V <sub>CC</sub> · 1.5 | V    |
| Reset voltage (high level)                | V <sub>reset H</sub> | V <sub>CC</sub> = 5 to 15 V | 1.0  | V <sub>CC</sub>       | V    |
| Reset voltage (low level)                 | V <sub>reset L</sub> | V <sub>CC</sub> = 5 to 15 V | 0    | 0.4                   | V    |

**Note 5.** This parameter defines the voltage that can be applied when a PWM mode application circuit is configured by applying an external voltage to the control pin. Usually, a capacitance of 0.01 μF is connected as shown in the application circuit.

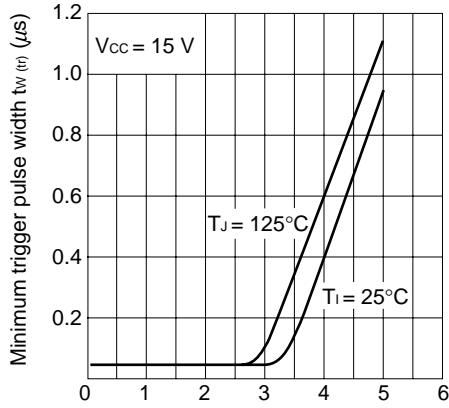
**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$ ,  $V_{CC} = 5$  to  $15$  V)

| Parameter                     | Symbol         | Conditions   | MIN.  | TYP.         | MAX. | Unit   |
|-------------------------------|----------------|--|-------|--------------|------|--------|
| Supply voltage                | $V_{CC}$       |  | 4.5   |              | 16   | V      |
| Supply current                | $I_{CC}$       | $V_{CC} = 5$ V, $R_L = \infty$ , $V_O = \text{"L"}$ Note 6   | 0     | 3            | 6    | mA     |
|                               |                | $V_{CC} = 15$ V, $R_L = \infty$ , $V_O = \text{"L"}$ Note 6  | 0     | 10           | 15   | mA     |
| Threshold voltage             | $V_{th}$       |  |       | $2/3 V_{CC}$ |      | V      |
| Threshold current             | $I_{th}$       | Note 7   | 0     | 0.1          | 0.25 | μA     |
| Trigger voltage               | $V_{tr}$       | $V_{CC} = 15$ V  |       | 5            |      | V      |
|                               |                | $V_{CC} = 5$ V   |       | 1.67         |      | V      |
| Trigger current               | $I_{tr}$       |  |       | 0.5          |      | μA     |
| Reset voltage                 | $V_{reset}$    | Note 8   | 0.4   | 0.7          | 1.0  | V      |
| Reset current                 | $I_{reset}$    |  |       | 0.1          |      | mA     |
| Control voltage               | $V_{cont}$     | $V_{CC} = 15$ V  | 9.0   | 10           | 11   | V      |
|                               |                | $V_{CC} = 5$ V   | 2.6   | 3.33         | 4    | V      |
| Output saturation voltage "L" | $V_{OL}$       | $V_{CC} = 15$ V, $I_{SINK} = 10$ mA                          | 0     | 0.1          | 0.25 | V      |
|                               |                | $V_{CC} = 15$ V, $I_{SINK} = 50$ mA                          | 0     | 0.4          | 0.75 | V      |
|                               |                | $V_{CC} = 15$ V, $I_{SINK} = 100$ mA                         | 0     | 2.0          | 2.5  | V      |
|                               |                | $V_{CC} = 15$ V, $I_{SINK} = 200$ mA                         |       | 2.5          |      | V      |
|                               |                | $V_{CC} = 5$ V, $I_{SINK} = 5$ mA                            | 0     | 0.1          | 0.35 | V      |
| Output saturation voltage "H" | $V_{OH}$       | $V_{CC} = 15$ V, $I_{SOURCE} = 200$ mA                       |       | 12.5         |      | V      |
|                               |                | $V_{CC} = 15$ V, $I_{SOURCE} = 100$ mA                       | 12.75 | 13.3         | 15.0 | V      |
|                               |                | $V_{CC} = 5$ V, $I_{SOURCE} = 100$ mA                        | 2.75  | 3.3          | 5.0  | V      |
| Propagation delay (L → H)     | $t_{PLH}$      |  |       | 200          |      | ns     |
| Propagation delay (H → L)     | $t_{PHL}$      |  |       | 200          |      | ns     |
| Minimum trigger pulse width   | $t_{W(tr)}$    | $V_{CC} = 15$ V, $V_{tr min.} = 2.5$ V                       |       | 25           |      | ns     |
| Minimum output pulse width    | $t_{W(OUT)}$   | $V_{CC} = 15$ V, $V_{tr min.} = 2.5$ V<br>$t_{W(tr)} = 3$ μs |       | 6            |      | μs     |
| Minimum reset pulse width     | $t_{W(reset)}$ | $V_{CC} = 15$ V, $V_{tr min.} = 0$ V                         |       | 900          |      | ns     |
| Timing error                  |                | Astable multivibrator  |       |              |      |        |
| Initial accuracy              |                | $R_A, R_B = 1$ to $100$ kΩ                                   |       | 1            |      | %      |
| Temperature drift             |                | $C = 0.1$ μF   |       | 50           |      | ppm/°C |
| Supply voltage drift          |                |  |       | 0.01         |      | %/V    |

- Notes 6.** When the output is "H", the circuit current decreases by approximately 1 mA (when  $V_{CC} = 5$  V).
- 7.** The maximum allowable value for  $R_A + R_B$  is determined for a supply voltage of 15 V. The maximum value is 20 MΩ.
- 8.** When the reset pin is driven to a low level, discharge  $T_rQ_{14}$  is turned on, stopping oscillation (the output state is undefined).

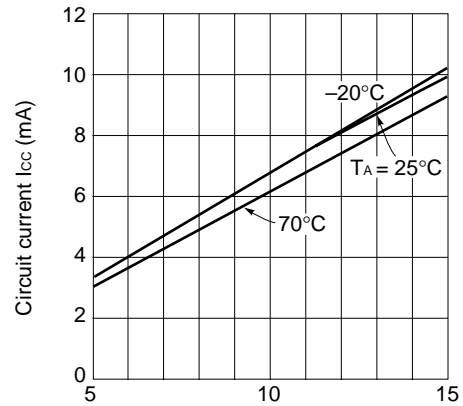
CHARACTERISTIC CURVES ( $T_A = 25^\circ\text{C}$ , TYP.)

Minimum trigger pulse width characteristic



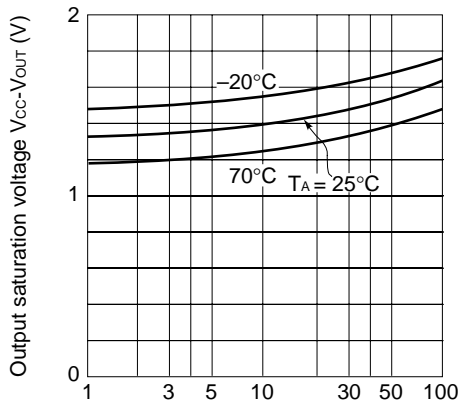
Minimum trigger pulse voltage  $V_{tr \min.}$  (V)

$I_{CC}$ - $V_{CC}$  characteristic



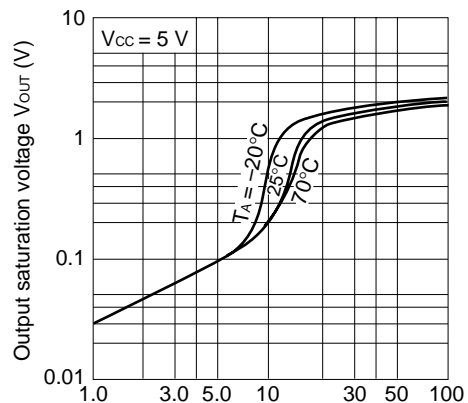
Supply voltage  $V_{CC}$  (V)

$I_{SOURCE}$ - $(V_{CC}-V_{OUT})$  characteristic



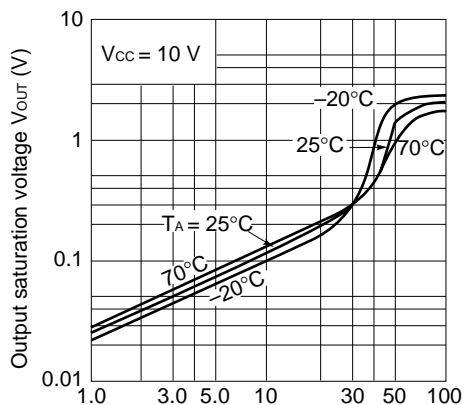
Output source current  $I_{SOURCE}$  (mA)

$I_{SINK}$ - $V_{OUT}$  characteristic



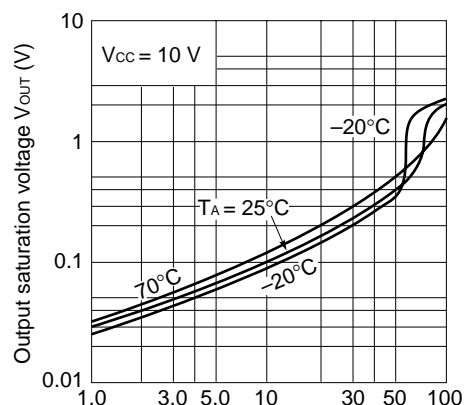
Output sink current  $I_{SINK}$  (mA)

$I_{SINK}$ - $V_{OUT}$  characteristic



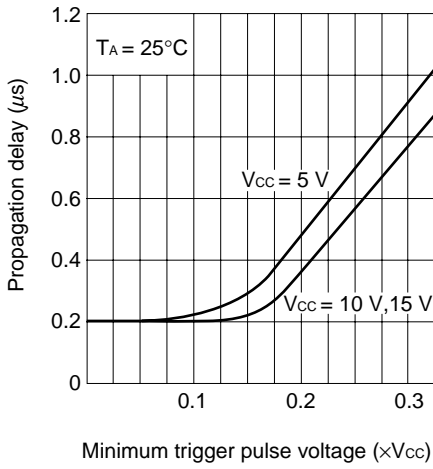
Output sink current  $I_{SINK}$  (mA)

$I_{SINK}$ - $V_{OUT}$  characteristic

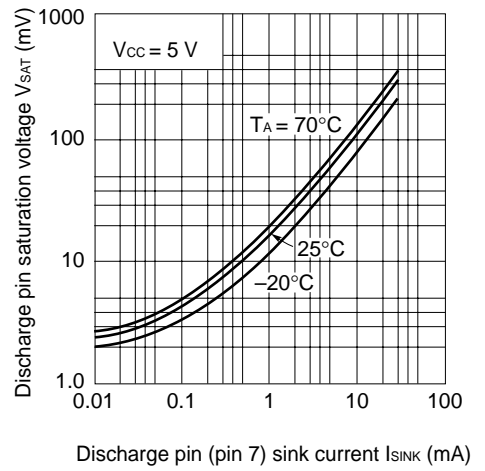


Output sink current  $I_{SINK}$  (mA)

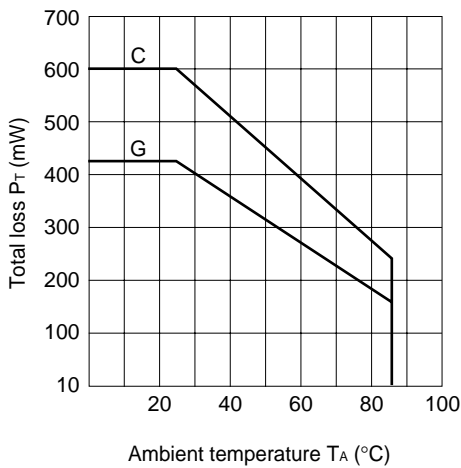
Propagation delay characteristic



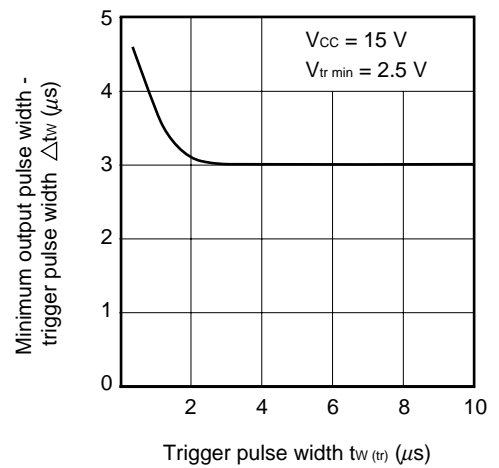
Discharge pin  $I_{SINK}$ - $V_{SAT}$  characteristic



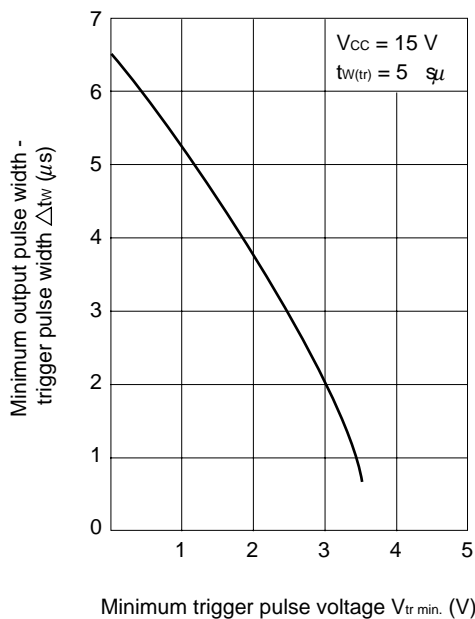
$P_T$ - $T_A$  characteristic



$\Delta t_w$ - $t_w$  ( $t_r$ ) characteristic



$\Delta t_w$ - $t_r$  min. characteristic



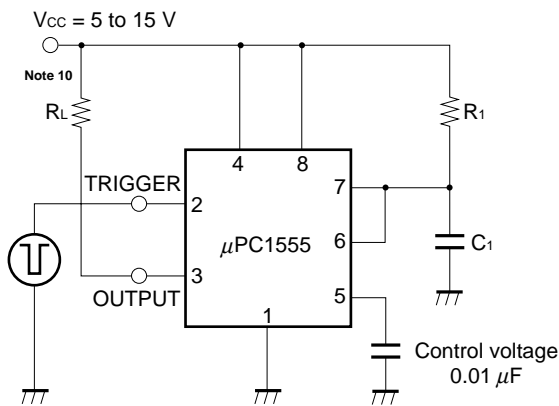
**PIN FUNCTIONS**

1. Trigger pin (pin 2) : Supplying one-third of  $V_{CC}$  to the trigger pin triggers the circuit, changing the output voltage from low to high.
2. Output pin (pin 3) : The maximum output current is 200 mA. Be careful not to exceed the total loss (see the  $P_T$ - $T_A$  characteristic curve).
3. Reset pin (pin 4) : Supplying 0.4 V or less to the reset pin stops the circuit operation (such as monostable or astable multivibrator operation).  
When not used, the reset pin should be clamped at 1 V to  $V_{CC}$ .
4. Control voltage (pin 5) : This voltage determines the threshold level of the comparator. It is set to two-thirds of  $V_{CC}$ . It is possible to configure a PWM (pulse width modulation) or PPM (pulse position modulation) mode application circuit by supplying a control voltage from the outside. When this pin is not in use, it should be bypassed using a capacitor of approximately 0.01  $\mu$ F for more stable circuit operation.
5. Threshold pin (pin 6) : The values of an external capacitor (C) and resistor (R) connected to this pin determine the width of the output pulse.
6. Discharge pin (pin 7) : This pin is used to discharge an external capacitor (if connected). It operates, when the internal flip-flop circuit is turned on, or a reset signal is applied.

APPLICATION CIRCUITS

(1) Monostable multivibrator

Fig. a Monostable Multivibrator Example



When the μPC1555 is configured as shown in Fig. a, it functions as a monostable multivibrator. Applying a voltage one-third as high as Vcc or less (trigger pulse<sup>Note 9</sup>) to pin 2 (trigger pin) drives the output to a high level. Under this condition, capacitor C<sub>1</sub> starts charging through resistor R<sub>1</sub>. When C<sub>1</sub> is charged up to two-thirds as high as Vcc, pin 6 (threshold pin) is turned on and inverted to a low level. At this point, C<sub>1</sub> starts discharging through pin 7. When a trigger pulse is applied to pin 2 again, the same operation is repeated. Fig. b shows this operation. A capacitor connected to pin 5 functions as a nose filter for the control voltage. If pin 4 (reset pin) is connected to 1 V or higher (for example, by being connected to Vcc), the circuit operation can be stopped by switching it from 2 V or higher to a GND level.

The output pulse width (delay) is determined theoretically by (see Fig. c):

$$t = 1.1 \cdot C_1 \cdot R_1$$

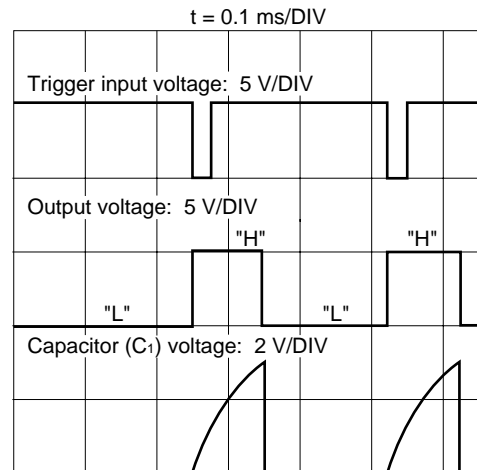
The value obtained by this equation is only an approximate value, however. If it is necessary to obtain an accurate output pulse width, determine R<sub>1</sub> and C<sub>1</sub> through actual measurement and confirmation; a trimmer should be used as required. Moreover, R<sub>1</sub> should be 300 Ω or higher.

**Notes 9.** Keep the trigger pulse width smaller than the output pulse width.

**10.** If the load is connected across the output and GND pins, a “staircase” occurs in the output waveform.

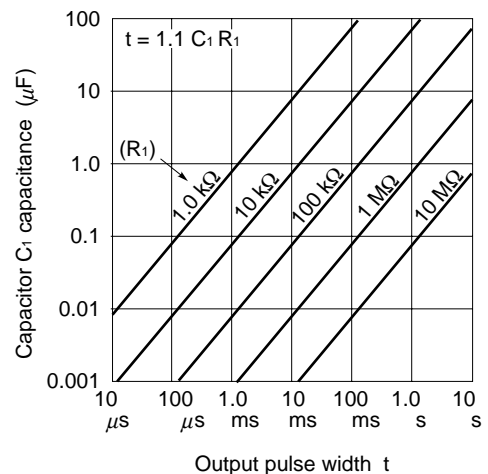
The application circuits and their parameters are for references only and are not intended for use in actual design-in's.

Fig. b Monostable Response Waveform



(R<sub>1</sub> = 9.1 kΩ, C<sub>1</sub> = 0.01 μF, R<sub>L</sub> = 1 kΩ)

Fig. c Interrelationships among Output Pulse Width, R<sub>1</sub>, and C<sub>1</sub> (approximate value obtained by calculation)



(2) Astable multivibrator example

Fig. d Astable Multivibrator Example

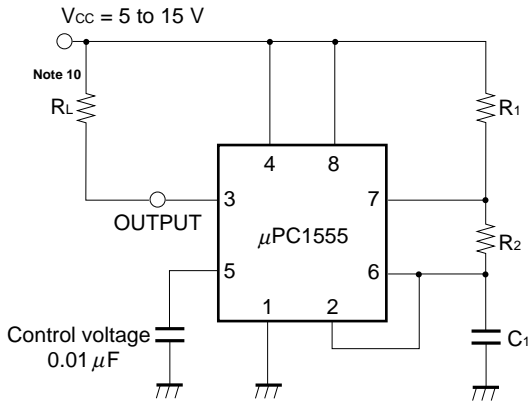
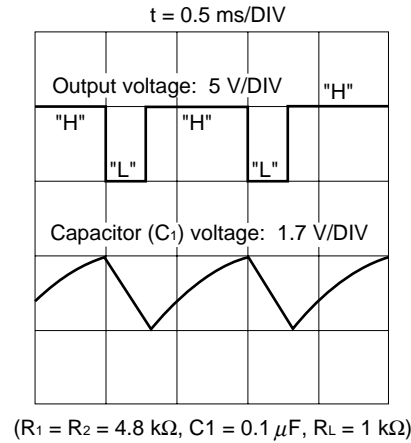
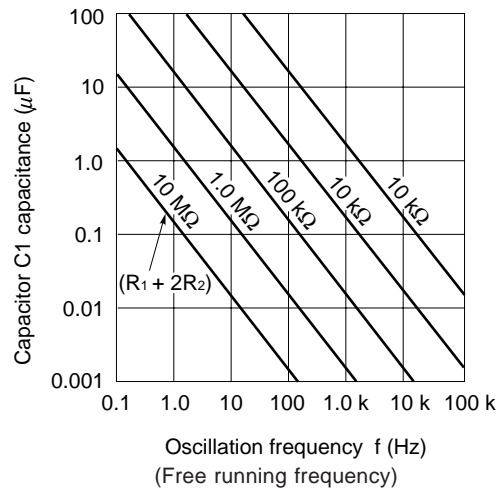


Fig. e Astable Multivibrator Response Waveform



When the μPC1555 is used in a circuit configuration shown in Fig. d, the circuit is triggered by itself to operate as an astable multivibrator, because pin 2 (trigger pin) and pin 6 (threshold pin) are connected to each other. When the output voltage is high, capacitor C<sub>1</sub> is charged through R<sub>1</sub> and R<sub>2</sub>. When C<sub>1</sub> is charged up to a voltage two-thirds as high as V<sub>cc</sub>, the threshold pin is turned on, and the output pin becomes low. At this point C<sub>1</sub> starts discharging through R<sub>2</sub>. When C<sub>1</sub> discharges, and the voltage across C<sub>1</sub> decreases to a voltage one-third as high as V<sub>cc</sub>, the trigger pin is turned on, and the output voltage becomes high, causing the charge current to flow into C<sub>1</sub> through R<sub>1</sub> and R<sub>2</sub> again. This operation is shown in Fig. e. Because C<sub>1</sub> repeats charging and discharging between one-third as high as V<sub>cc</sub> and two-thirds as high as V<sub>cc</sub>, the oscillation frequency is not affected by the supply voltage.

Fig. f Interrelationships among Oscillation Frequency, R<sub>1</sub>, R<sub>2</sub>, and C<sub>1</sub> (approximate value obtained by calculation)



Oscillation is represented theoretically using the following expressions.

When the output voltage is high, the charge time is :  $t_1 = 0.693 (R_1 + R_2) C_1$  ..... (1)

When the output voltage is low, the discharge time is :  $t_2 = 0.693 \cdot R_2 \cdot C_1$  ..... (2)

Adding expressions (1) and (2) determines period T :  $T = t_1 + t_2 = 0.693 (R_1 + 2R_2) C_1$  ..... (3)

Therefore, the oscillation frequency is

(see Fig. f for reference) :  $f = \frac{1}{T} = \frac{1.44}{(R_1 + 2R_2) C_1}$  ..... (4)

The duty cycle is determined by the equation (5)

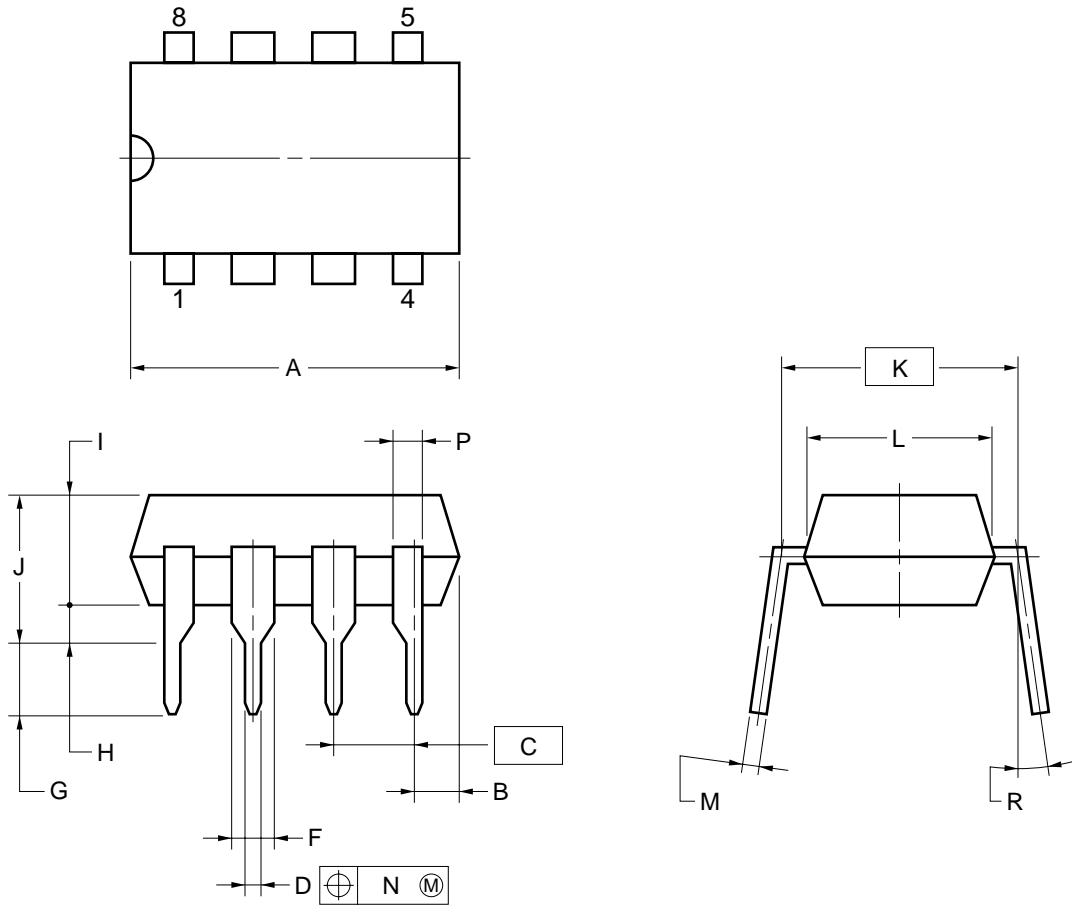
:  $D = \frac{R_2}{R_1 + 2R_2}$  ..... (5)

The values obtained this way are approximate values, however. If it is necessary to obtain an accurate oscillation frequency, determine R<sub>1</sub>, R<sub>2</sub>, and C<sub>1</sub> through actual measurement and confirmation; a trimmer should be used as required. Moreover, R<sub>1</sub> and R<sub>2</sub> should be 300 Ω or higher.

**Note 10.** If the load is connected across the output and GND pins, a “staircase” occurs in the output waveform.



8PIN PLASTIC DIP (300 mil)



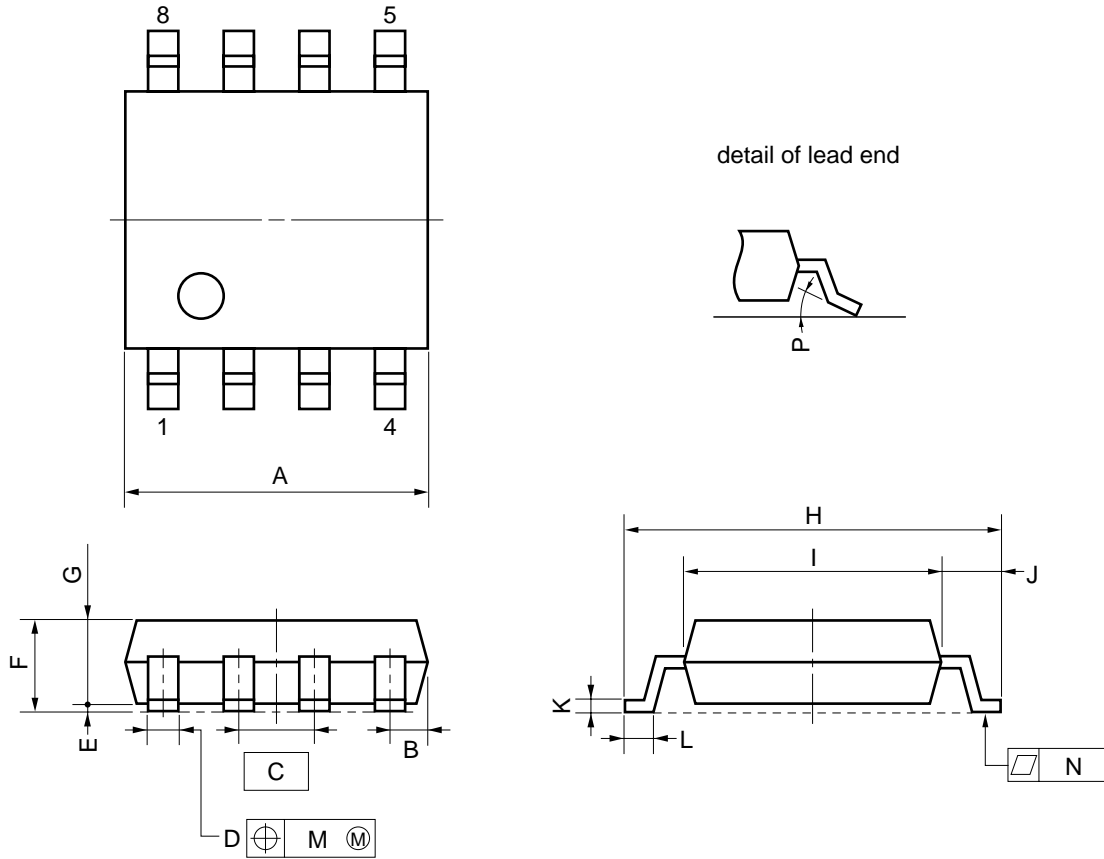
NOTES

- 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)



**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

**RECOMMENDED SOLDERING CONDITIONS**

The conditions listed below shall be met when soldering the μPC1555.

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

**Surface-Mount Devices**

For details of the recommended soldering conditions, refer to our document *SMD Surface Mount Technology Manual* (IEI-1207).

μPC1555G2

| Soldering process      | Soldering conditions   | Symbol  |
|------------------------|--|---------|
| Infrared reflow        | Peak package's surface temperature: 230°C<br>Reflow time: 30 seconds or less (at 210°C or more)<br>Maximum allowable number of reflow processes: 1<br>Exposure limit: None <b>Note</b> | IR30-00 |
| VPS                    | Peak package's surface temperature: 215°C<br>Reflow time: 40 seconds or less (at 200°C or more)<br>Maximum allowable number of reflow processes: 1<br>Exposure limit: None <b>Note</b> | VP15-00 |
| Wave soldering         | Temperature in the soldering vessel: 260°C or less<br>Soldering time: 10 seconds or less<br>Maximum allowable number of reflow processes: 1<br>Exposure limit: None <b>Note</b>        | WS60-00 |
| Partial heating method | Pin temperature: 300°C or less<br>Flow time: 10 seconds or less<br>Exposure limit: None <b>Note</b>  |         |

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

Storage conditions: Temperature of 25°C or less and maximum relative humidity of 65% or less

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

**Through-Hole Mount Devices**

μPC1555C

| Soldering process | Soldering conditions   |
|-------------------|--|
| Wave soldering    | Temperature in the soldering vessel: 260°C or less<br>Soldering time: 10 seconds or less |

**REFERENCE**

| Document name   | Document No. |
|---|--------------|
| NEC Semiconductor Device Reliability/Quality Control System | IEI-1212     |
| Quality Grade on NEC Semiconductor Devices                  | IEI-1209     |
| Semiconductor Device Mounting Technology Manual             | IEI-1207     |
| Semiconductor Device Package Manual                         | IEI-1213     |
| Guide to Quality Assurance for Semiconductor Devices        | MEI-1202     |
| Semiconductor Selection Guide                               | MF-1134      |

## [MEMO]

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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, customer 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 in "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 NEC Sales Representative in advance.

Anti-radioactive design is not implemented in this product.