

To our customers,

Old Company Name in Catalogs and Other Documents

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

April 1st, 2010
Renesas Electronics Corporation

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

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Phase-out/Discontinued

CMOS TIMER CIRCUIT

The μ PD5555 is a CMOS version of the μ PC617/1555 timer IC. Being a CMOS circuit, the μ PD5555 circuit requires only a little current, and outperforms the bipolar version in characteristics such as operating voltage, reset pin function, input current, and oscillation frequency. Moreover, its circuit configuration is highly immune to chattering, so it is best suited for applications such as a one-shot multivibrator and pulse generator.

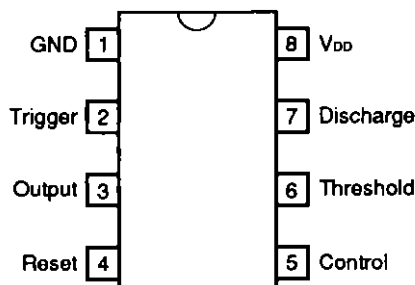
TYPICAL CHARACTERISTICS

- Recommended operating voltage : 3 to 16 V
- Circuit current : 115 μ A ($V_{DD} = 5$ V)
- Output saturation voltage : 0.14 V ($I_{SINK} = 3.2$ mA)

FEATURES

- Pin-compatible with the 556 type timer
- Requires only a small power supply bypass capacitance because of only a little switching noise occurring
0.047 μ F for $V_{DD} < 10$ V
0.1 μ F for $V_{DD} \geq 10$ V
- No interference occurs even if two or more units of this model are connected to the same power supply line.
- Setting the reset pin to a low level stops oscillation, thus clamping the output to a low level.
- Can drive both CMOS and TTL circuits.
- Sufficient provision to prevent electrostatic breakdown

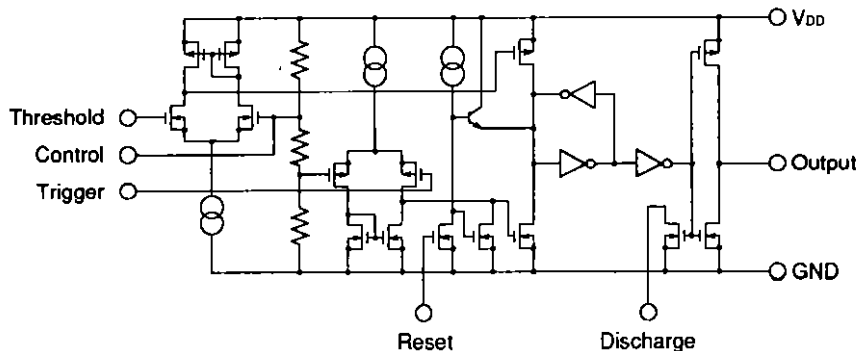
PIN CONFIGURATION



ORDERING INFORMATION

Part number	Package
μ PD5555C	8-pin plastic DIP (300 mil)
μ PD5555G	8-pin plastic SOP (225 mil)

EQUIVALENT CIRCUIT



ABSOLUTE MAXIMUM RATINGS (Ambient temperature $T_A = 25^\circ\text{C}$)

Parameter	Symbol	Rated value	Unit
Supply voltage	V_{DD}	-0.3 to +18	V
Input voltage (trigger, threshold, reset, control)	V_{IN}	$-0.3 \leq V_{IN} \leq V_{DD} + 0.3$	V
Output voltage (output and discharge) Note 4	V_o	$-0.3 \leq V_o \leq V_{DD} + 0.3$	V
Output current	I_o	100 Note 1	mA
Operating temperature range	T_A	-20 to +70	°C
Storage temperature range	T_{stg}	-55 to +125	°C
Power dissipation	(C package)	P_T	mW
	(G package)		
		350 Note 2	
		440 Note 3	

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

- 2.** The listed total loss applies when the ambient temperature is below 55°C. If the ambient temperature is 55°C or higher, the total loss should be derated at -5 mW/°C.
- 3.** The listed total loss applies when the ambient temperature is below 25°C. If the ambient temperature is 25°C or higher, the total loss should be derated at -4.4 mW/°C.
- 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 including power-on/-off transitions. The output voltage that can be obtained during normal operation is within the output saturation voltage range.

RECOMMENDED OPERATING CONDITIONS ($T_A = 25^\circ\text{C}$)

Parameter	Symbol	Conditions	MIN.	MAX.	Unit
Supply voltage	V_{DD}		3	16	V
Oscillation frequency	f	$V_{DD} = 3$ to 15 V	0.1	500 k	Hz
Output pulse width	$t_{W(OUT)}$	$V_{DD} = 3$ to 15 V	2 μ	10	Sec
Input voltage (trigger, threshold)	V_{IN}		0	V_{DD}	V
Input voltage Note 5 (control)	V_{IN}		2.0	$V_{DD} - 1$	V
Reset voltage (high level)	$V_{reset H}$	$V_{DD} = 3$ to 15 V	2.0	V_{DD}	V
Reset voltage (low level)	$V_{reset L}$	$V_{DD} = 3$ to 15 V	0	0.6	V
Output sink current	$I_{o SINK}$		0	3.2	mA
Output source current	$I_{o SOURCE}$		0	1	mA
Operating temperature range	T_A		-20	+70	°C

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°C, V_{DD} = +3 to +15 V, unless otherwise specified)

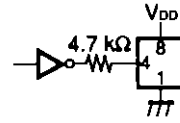
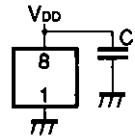
Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Supply current	I _{DD}	V _{DD} = 5 V	0	115	250	μA
		V _{DD} = 15 V	0	150	350	
Threshold voltage	V _{th}			2/3V _{DD}		V
Threshold current	I _{th}	V _{DD} = 15 V		50		pA
		V _{DD} = 5 V		10		
		V _{DD} = 3 V		1		
Trigger voltage	V _t			1/3V _{DD}		V
Trigger current	I _t	V _{DD} = 15 V		50		pA
		V _{DD} = 5 V		10		
		V _{DD} = 3 V		1		
Reset voltage (Voltage used to set the output to a low level)	V _{reset}	V _{DD} = 15 V	0.6	1.1	2.0	V
		V _{DD} = 3 V	0.6	1.1	2.0	
Reset current	I _{reset}	V _{RESET} = GND, V _{DD} = 15 V		100		pA
		V _{RESET} = GND, V _{DD} = 5 V		20		
		V _{RESET} = GND, V _{DD} = 3 V		2		
Output saturation voltage (low)	V _{OL}	V _{DD} = 15 V, I _{SINK} = 3.2 mA	0	0.06	0.4	V
		V _{DD} = 5 V, I _{SINK} = 3.2 mA	0	0.14	0.4	
Output saturation voltage (high)	V _{OH}	V _{DD} = 15 V, I _{SOURCE} = 1 mA	14.25	14.85	15.00	V
		V _{DD} = 5 V, I _{SOURCE} = 1 mA	4.0	4.7	5.0	
Output Rise time	t _{rise}	R _L = 10 MΩ, C _L = 7 pF, V _{DD} = 5 V		40		ns
Output Fall time	t _{fall}	R _L = 10 MΩ, C _L = 7 pF, V _{DD} = 5 V		40		ns
Maximum oscillation frequency	f _{MAX}	Astable vibration	500			kHz
Propagation delay	t _{pd}	Monostable multivibration Minimum trigger voltage = 0.1 · V _{DD}		350		ns
Minimum trigger pulse width	t _{w (tr)}	V _{DD} = 5 V Minimum trigger voltage = 0.1 · V _{DD}		160		ns
Minimum reset pulse width	t _{w (reset)}	V _{DD} = 5 V Reset voltage = 0.6 V		0.6		μs
Control voltage	V _{cont}			2/3V _{DD}		V
Timing error Initial accuracy		R ₁ , R ₂ = 1 k to 100 kΩ C = 0.1 μF V _{DD} = 5 to 15 V		2		%
Temperature drift				50		ppm/°C
Supply voltage drift				1		%/V

Notes 1. To prevent output switching pass-through current from causing noise on the power supply line, connect a bypass capacitor (having the capacitance listed below) to the V_{DD} pin (pin 8).

Capacitance: $C \geq 0.047 \mu\text{F}$ for $V_{DD} \leq 10 \text{ V}$

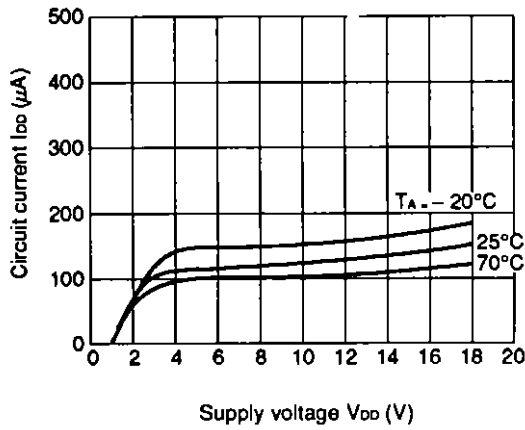
$C \geq 0.1 \mu\text{F}$ for $V_{DD} > 10 \text{ V}$

2. If a reset signal for this IC is supplied from an external digital device operating on a supply voltage other than the one to which this IC is connected, Connect a resistor of 4.7 kΩ or higher in series to the reset pin.

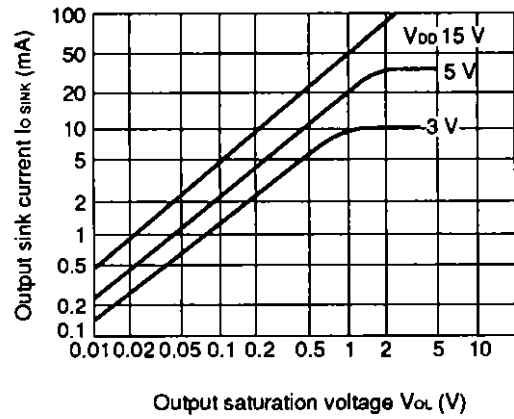


TYPICAL CHARACTERISTIC CURVES ($T_A = 25^\circ\text{C}$, TYP.)

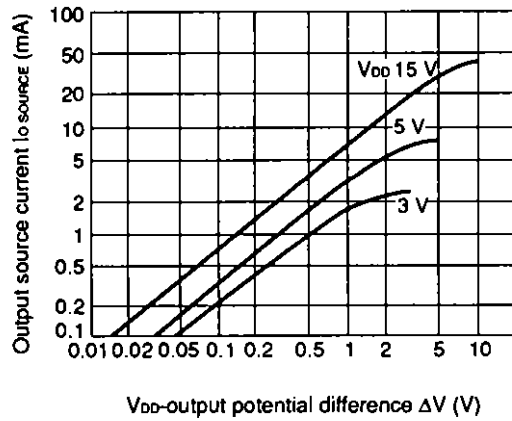
I_{DD} - V_{DD} characteristic



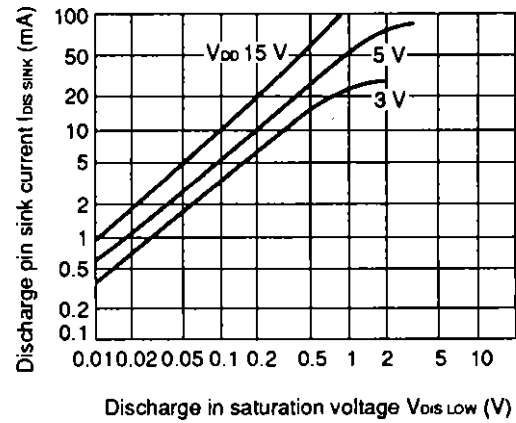
I_O SINK- V_{OL} characteristic



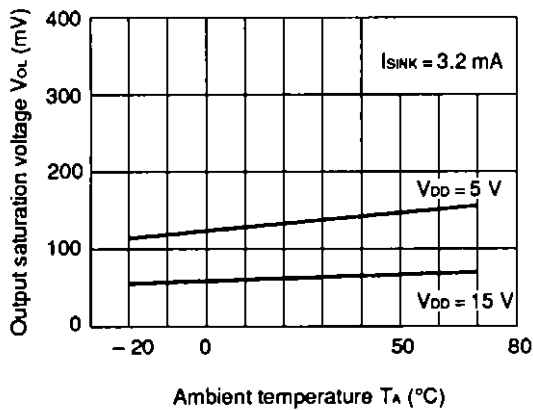
I_O SOURCE- ΔV characteristic



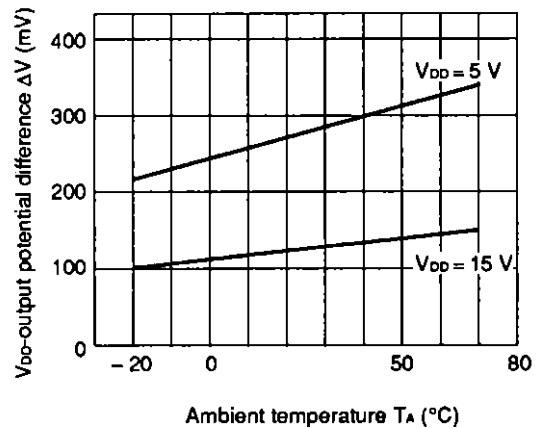
I_{DIS} SINK- V_{DIS} LOW characteristic



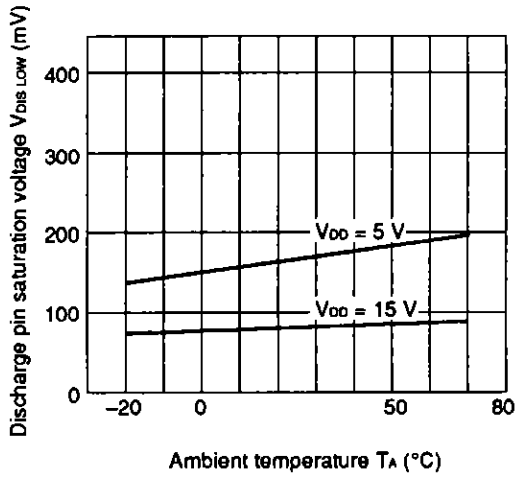
V_{OL} - T_A characteristic



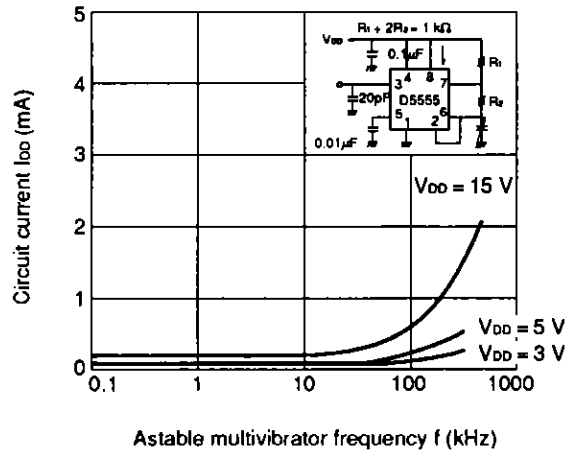
ΔV - T_A characteristic



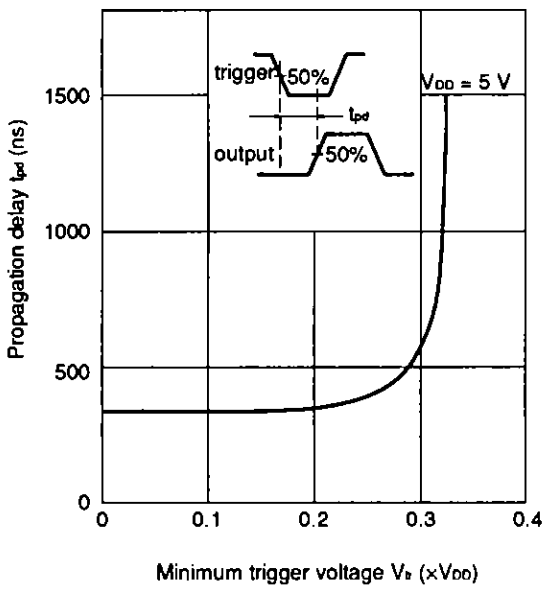
V_{DIS} low-T_A characteristic



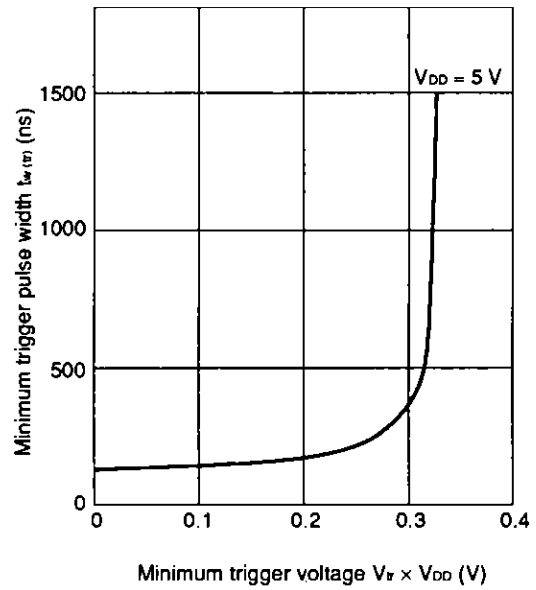
I_{DD}-f characteristic



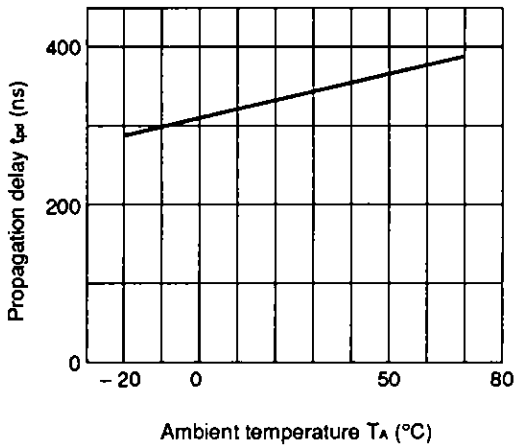
t_{pd}-V_{tr} characteristic



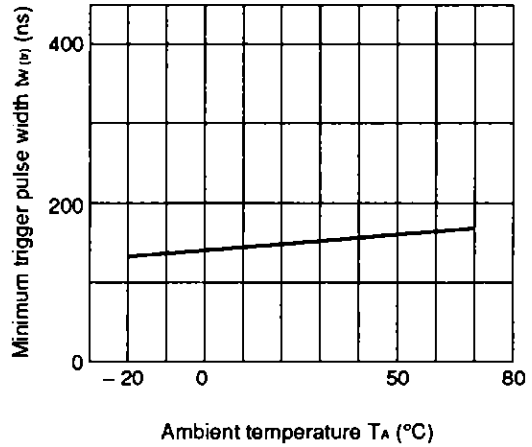
t_{w (tr)}-V_{tr} characteristic (monostable multivibrator)



t_{pd}-T_A characteristic



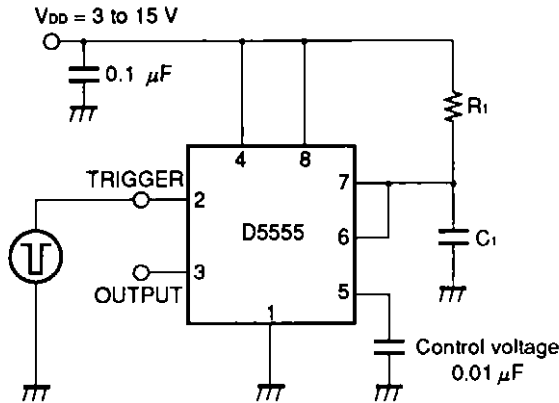
t_{w (tr)}-T_A characteristic



APPLICATION CIRCUITS

(1) Monostable multivibrator

Fig. a Monostable Multivibrator Example



When the μPD5555 is configured as shown in Fig. a, it functions as a monostable multivibrator. Applying a voltage one-third as high as V_{DD} or less (trigger pulse*) to pin 2 (trigger pin) drives the output to a high level. Under this condition, capacitor C_1 starts charging through resistor R_1 . When C_1 is charged up to two-thirds as high as V_{DD} , pin 6 (threshold pin) is turned on and inverted to a low level. At this point, C_1 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 2 V or higher (for example, by being connected to V_{DD}), 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_1 and C_1 through actual measurement and confirmation; a trimmer should be used as required. Moreover, R_1 should be 300 Ω or higher.

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

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

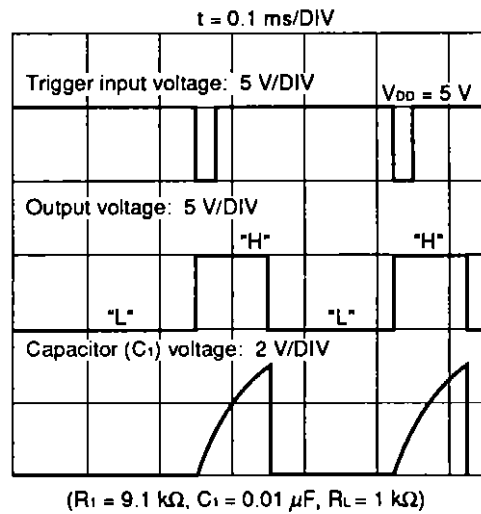
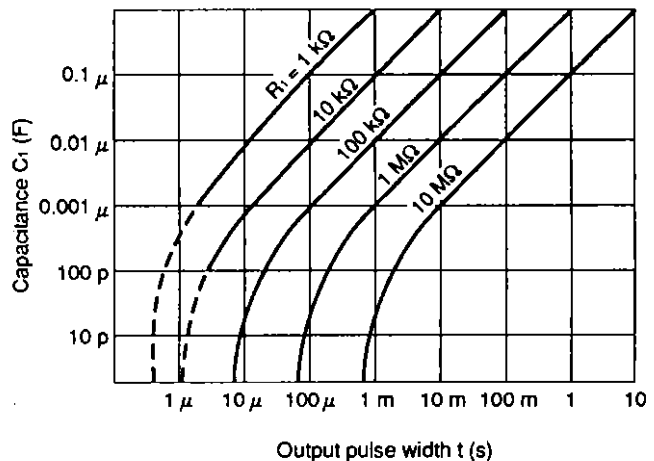


Fig. c Interrelationships among Output Pulse Width, R_1 , and C_1



(2) Astable multivibrator example

Fig. d Astable Multivibrator Example

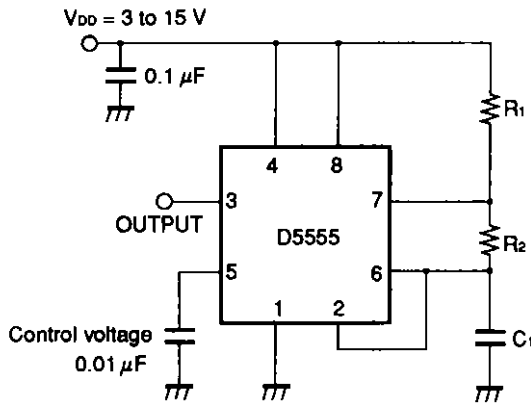
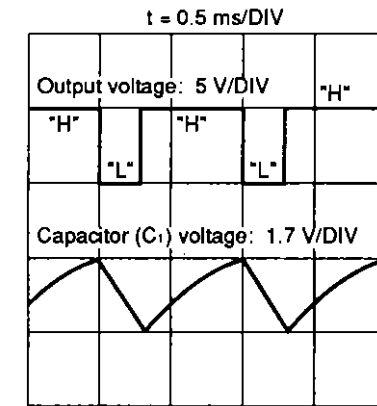


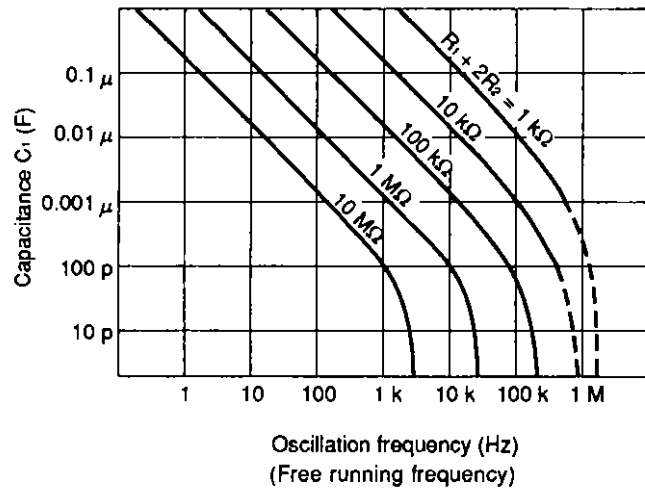
Fig. e Astable Multivibrator Response Waveform



(R₁ = R₂ = 4.8 kΩ, C₁ = 0.1 μF, R_L = 1 kΩ)

When the μPD5555 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 C₁ is charged through R₁ and R₂. When C₁ is charged up to a voltage two-thirds as high as V_{DD}, the threshold pin is turned on, and the output pin becomes low. At this point C₁ starts discharging through R₂. When C₁ discharges, and the voltage across C₁ decreases to a voltage one-third as high as V_{DD}, the trigger pin is turned on, and the output voltage becomes high, causing the charge current to flow into C₁ through R₁ and R₂ again. This operation is shown in Fig. e. Because C₁ repeats charging and discharging between one-third as high as V_{DD} and two-thirds as high as V_{DD}, the oscillation frequency is not affected by the supply voltage.

Fig. f Interrelationships among Oscillation frequency, R₁, R₂, and C₁



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)

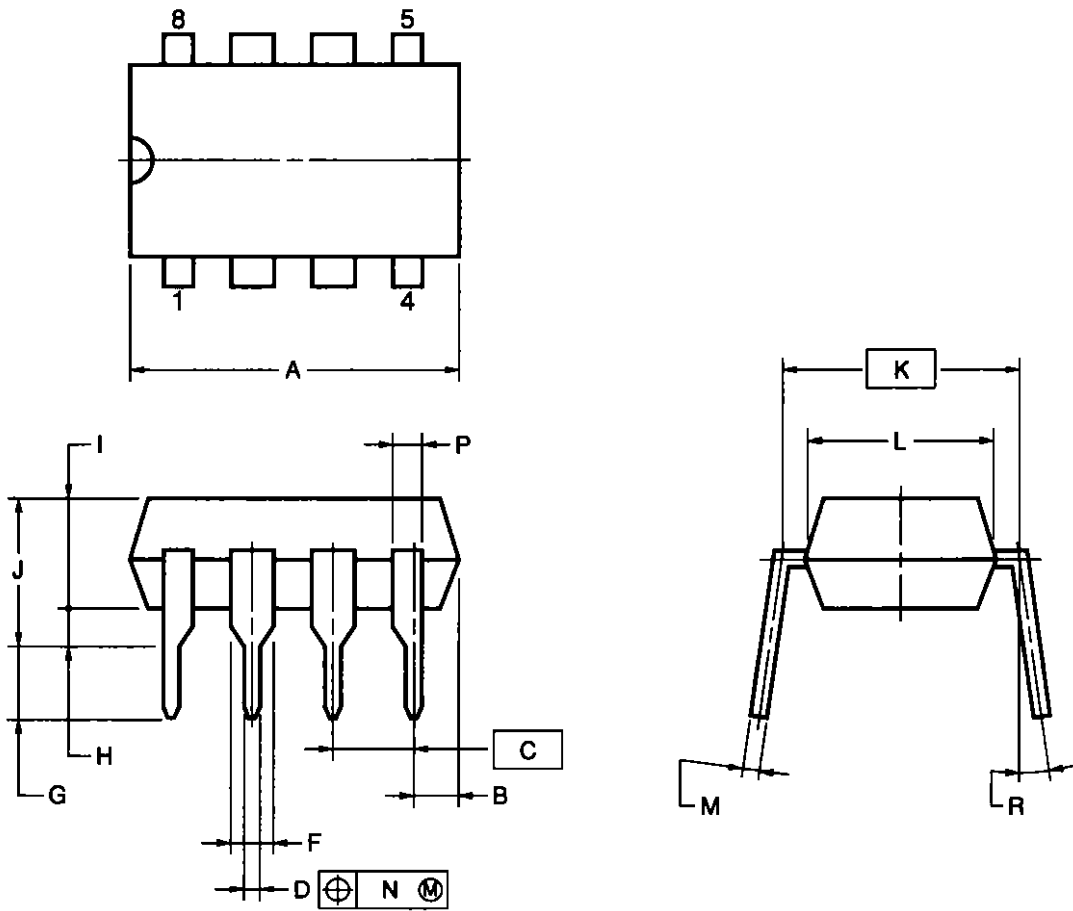
: $f = \frac{1}{T} = \frac{1.44}{(R_1 + 2R_2) C_1}$ (4)

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 R₁, R₂, and C₁ through actual measurement and confirmation; a trimmer should be used as required. Moreover, R₁ and R₂ should be 300 Ω or higher.

8PIN PLASTIC DIP (300 mil)



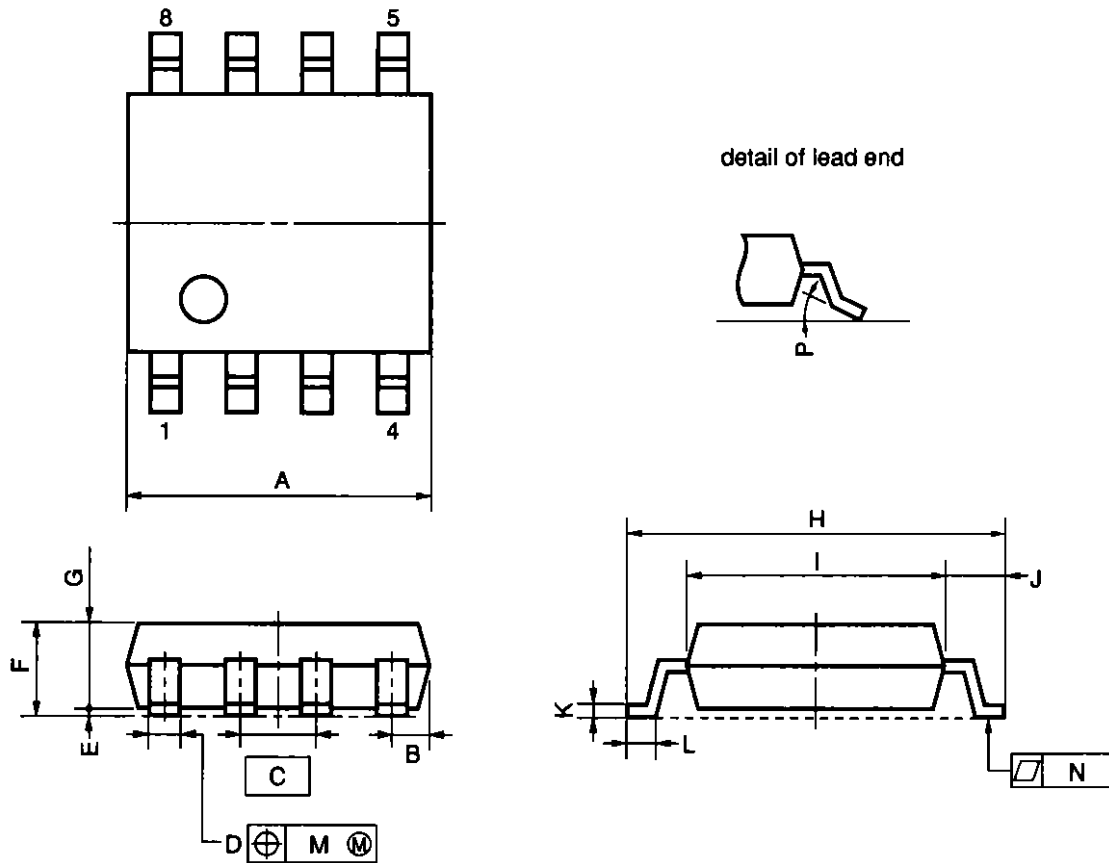
NOTES

- 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 ^{+0.004} _{-0.005}
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 ^{+0.10} _{-0.05}	0.010 ^{+0.004} _{-0.003}
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 ^{+0.10} _{-0.05}	0.016 ^{+0.004} _{-0.003}
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 ^{+0.10} _{-0.05}	0.006 ^{+0.004} _{-0.002}
L	0.6±0.2	0.024 ^{+0.008} _{-0.009}
M	0.12	0.005
N	0.10	0.004
P	3° ^{+7°} _{-3°}	3° ^{+7°} _{-3°}

S8GM-50-225B-4

RECOMMENDED SOLDERING CONDITIONS

The conditions listed below shall be met when soldering the μPD5555.

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).

μPD5555G

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

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

μPD5555C

Soldering process	Soldering conditions
Wave soldering	Temperature in the soldering vessel: 260°C or less 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

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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.