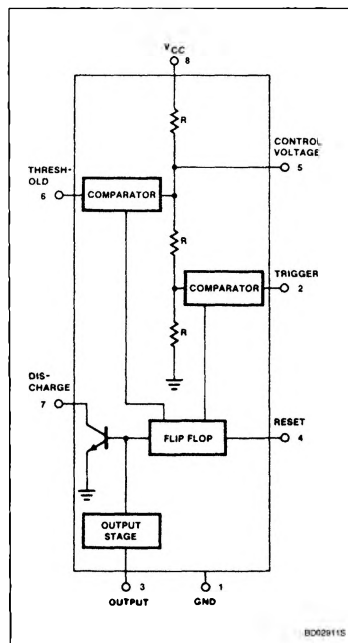


Linear Products

DESCRIPTION

The 555 monolithic timing circuit is a highly stable controller capable of producing accurate time delays, or oscillation. In the time delay mode of operation, the time is precisely controlled by one external resistor and capacitor. For a stable operation as an oscillator, the free running frequency and the duty cycle are both accurately controlled with two external resistors and one capacitor. The circuit may be triggered and reset on falling waveforms, and the output structure can source or sink up to 200mA.

BLOCK DIAGRAM



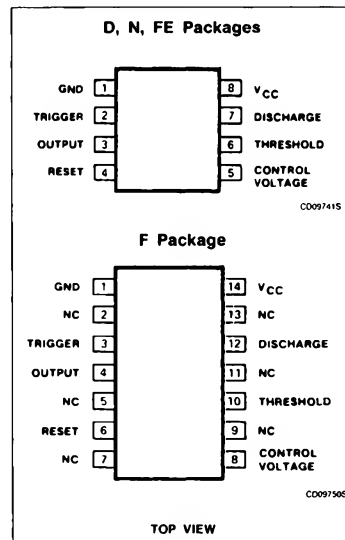
FEATURES

- Turn-off time less than $2\mu s$
- Max. operating frequency greater than 500kHz
- Timing from microseconds to hours
- Operates in both astable and monostable modes
- High output current
- Adjustable duty cycle
- TTL compatible
- Temperature stability of 0.005% per $^{\circ}C$

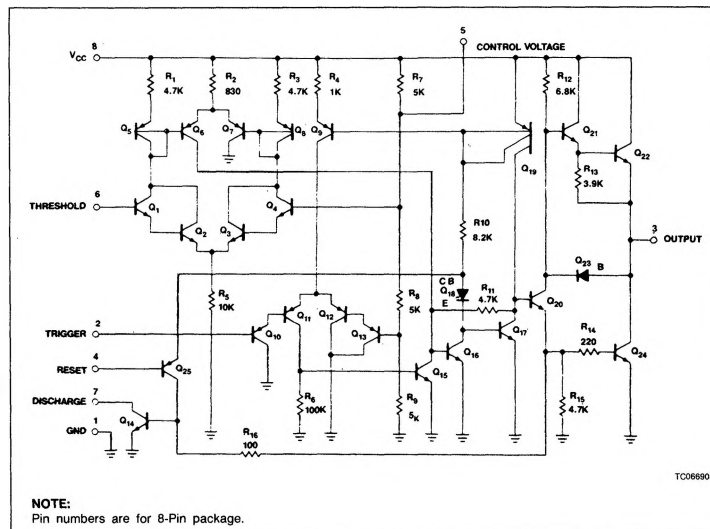
APPLICATIONS

- Precision timing
- Pulse generation
- Sequential timing
- Time delay generation
- Pulse width modulation
- Pulse position modulation
- Missing pulse detector

PIN CONFIGURATIONS



EQUIVALENT SCHEMATIC



Timer

NE/SA/SE555/SE555C

ORDERING INFORMATION

DESCRIPTION	TEMPERATURE RANGE	ORDER CODE
8-Pin Hermetic Cerdip	0 to +70°C	NE555FE
8-Pin Plastic SO	0 to +70°C	NE555D
8-Pin Plastic DIP	0 to +70°C	NE555N
8-Pin Plastic DIP	-40°C to +85°C	SA555N
8-Pin Plastic SO	-40°C to +85°C	SA555D
8-Pin Hermetic Cerdip	-55°C to +125°C	SE555CFE
8-Pin Plastic DIP	-55°C to +125°C	SE555CN
14-Pin Plastic DIP	-55°C to +125°C	SE555N
8-Pin Hermetic Cerdip	-55°C to +125°C	SE555FE
14-Pin Ceramic DIP	0 to +70°C	NE555F
14-Pin Ceramic DIP	-55°C to +125°C	SE555F
14-Pin Ceramic DIP	-55°C to +125°C	SE555CF

ABSOLUTE MAXIMUM RATINGS

SYMBOL	PARAMETER	RATING	UNIT
V_{CC}	Supply voltage		
	SE555	+ 18	V
	NE555, SE555C, SA555	+ 16	V
P_D	Maximum allowable power dissipation ¹	600	mW
T_A	Operating ambient temperature range		
	NE555	0 to +70	°C
	SA555	-40 to +85	°C
	SE555, SE555C	-55 to +125	°C
T_{STG}	Storage temperature range	-65 to +150	°C
T_{SOLD}	Lead soldering temperature (10sec max)	+300	°C

NOTE:

1. The junction temperature must be kept below 125°C for the D package and below 150°C for the FE, N and F packages. At ambient temperatures above 25°C, where this limit would be derated by the following factors:

- D package 160 °C/W
- FE package 150 °C/W
- N package 100 °C/W
- F package 105 °C/W

Timer

NE/SA/SE555/SE555C

DC AND AC ELECTRICAL CHARACTERISTICS $T_A = 25^\circ\text{C}$, $V_{CC} = +5\text{V}$ to $+15$ unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS	SE555			NE555/SE555C			UNIT
			Min	Typ	Max	Min	Typ	Max	
V_{CC}	Supply voltage		4.5		18	4.5		16	V
I_{CC}	Supply current (low state) ¹	$V_{CC} = 5\text{V}$, $R_L = \infty$ $V_{CC} = 15\text{V}$, $R_L = \infty$		3 10	5 12		3 10	6 15	mA mA
t_M $\Delta t_M/\Delta T$ $\Delta t_M/\Delta V_S$	Timing error (monostable) Initial accuracy ² Drift with temperature Drift with supply voltage	$R_A = 2\text{k}\Omega$ to $100\text{k}\Omega$ $C = 0.1\mu\text{F}$		0.5 30 0.05	2.0 100 0.2		1.0 50 0.1	3.0 150 0.5	% ppm/ $^\circ\text{C}$ %/V
t_A $\Delta t_A/\Delta T$ $\Delta t_A/\Delta V_S$	Timing error (astable) Initial accuracy ² Drift with temperature Drift with supply voltage	$R_A, R_B = 1\text{k}\Omega$ to $100\text{k}\Omega$ $C = 0.1\mu\text{F}$ $V_{CC} = 15\text{V}$		4 0.15	6 500 0.6		5 0.3	13 500 1	% ppm/ $^\circ\text{C}$ %/V
V_C	Control voltage level	$V_{CC} = 15\text{V}$ $V_{CC} = 5\text{V}$	9.6 2.9	10.0 3.33	10.4 3.8	9.0 2.6	10.0 3.33	11.0 4.0	V V
V_{TH}	Threshold voltage	$V_{CC} = 15\text{V}$ $V_{CC} = 5\text{V}$	9.4 2.7	10.0 3.33	10.6 4.0	8.8 2.4	10.0 3.33	11.2 4.2	V V
I_{TH}	Threshold current ³			0.1	0.25		0.1	0.25	μA
V_{TRIG}	Trigger voltage	$V_{CC} = 15\text{V}$ $V_{CC} = 5\text{V}$	4.8 1.45	5.0 1.67	5.2 1.9	4.5 1.1	5.0 1.67	5.6 2.2	V V
I_{TRIG}	Trigger current	$V_{TRIG} = 0\text{V}$		0.5	0.9		0.5	2.0	μA
V_{RESET}	Reset voltage ⁴		0.3		1.0	0.3		1.0	V
I_{RESET}	Reset current Reset current	$V_{RESET} = 0.4\text{V}$ $V_{RESET} = 0\text{V}$		0.1 0.4	0.4 1.0		0.1 0.4	0.4 1.5	mA mA
V_{OL}	Output voltage (low)	$V_{CC} = 15\text{V}$ $I_{SINK} = 10\text{mA}$ $I_{SINK} = 50\text{mA}$ $I_{SINK} = 100\text{mA}$ $I_{SINK} = 200\text{mA}$ $V_{CC} = 5\text{V}$ $I_{SINK} = 8\text{mA}$ $I_{SINK} = 5\text{mA}$		0.1 0.4 2.0 2.5 0.1 0.05	0.15 0.5 2.2 2.5 0.25 0.2		0.1 0.4 2.0 2.5 0.3 0.25	0.25 0.75 2.5 V 0.4 0.35	V V V V V V
V_{OH}	Output voltage (high)	$V_{CC} = 15\text{V}$ $I_{SOURCE} = 200\text{mA}$ $I_{SOURCE} = 100\text{mA}$ $V_{CC} = 5\text{V}$ $I_{SOURCE} = 100\text{mA}$	13.0 3.0	12.5 13.3 3.3		12.75 2.75	12.5 13.3 3.3		V V V
t_{OFF}	Turn-off time ⁵	$V_{RESET} = V_{CC}$		0.5	2.0		0.5	2.0	μs
t_R	Rise time of output			100	200		100	300	ns
t_F	Fall time of output			100	200		100	300	ns
	Discharge leakage current			20	100		20	100	ns

NOTES:

1. Supply current when output high typically 1mA less.

2. Tested at $V_{CC} = 5\text{V}$ and $V_{CC} = 15\text{V}$.3. This will determine the max value of $R_A + R_B$, for 15V operation, the max total $R = 10\text{M}\Omega$, and for 5V operation, the max. total $R = 3.4\text{M}\Omega$.

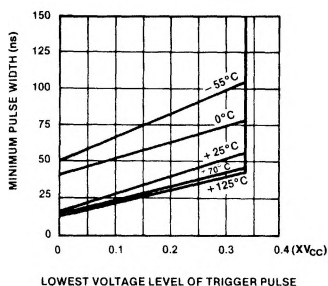
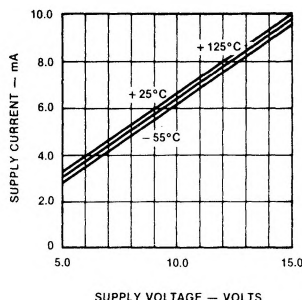
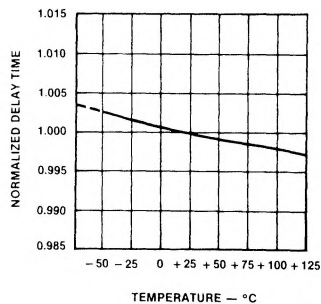
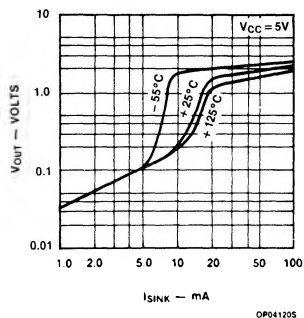
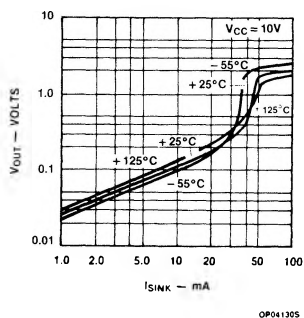
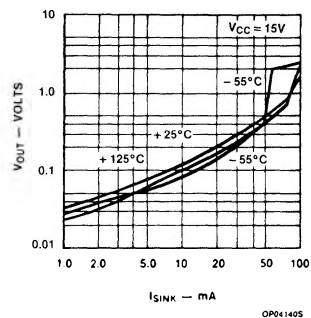
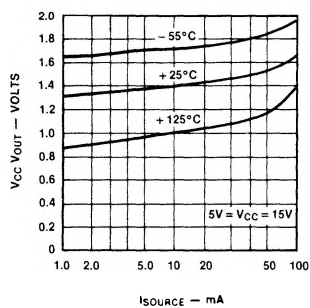
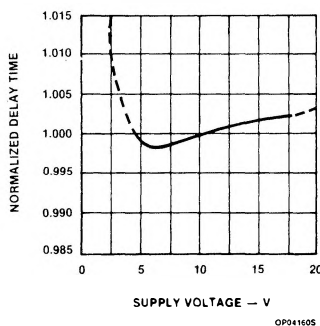
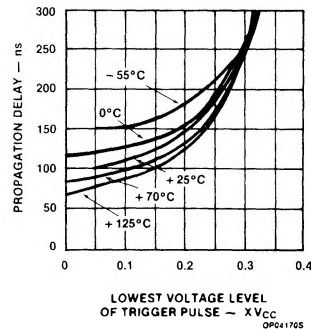
4. Specified with trigger input high.

5. Time measured from a positive going input pulse from 0 to $0.8 \times V_{CC}$ into the threshold to the drop from high to low of the output. Trigger is tied to threshold.

Timer

NE/SA/SE555/SE555C

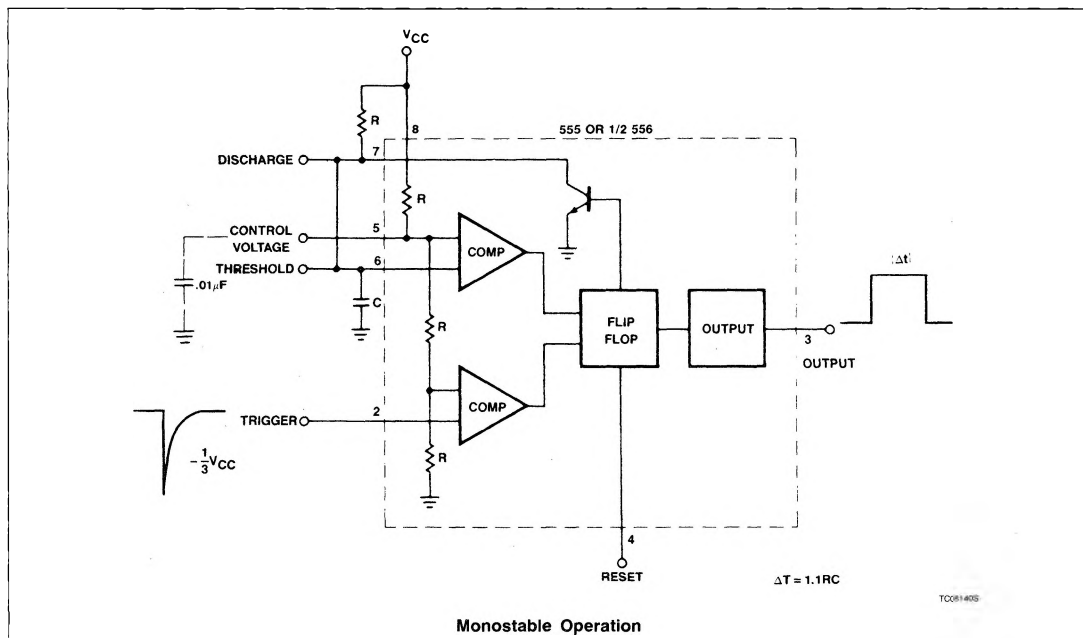
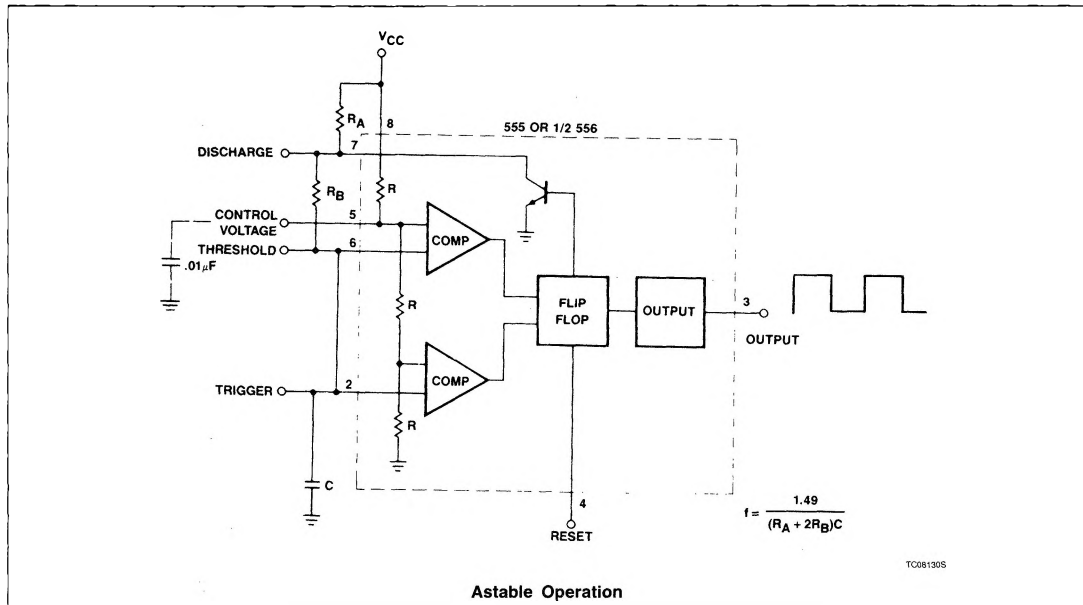
TYPICAL PERFORMANCE CHARACTERISTICS

Minimum Pulse Width
Required for TriggeringSupply Current vs
Supply VoltageDelay Time vs
TemperatureLow Output Voltage vs
Output Sink CurrentLow Output Voltage vs
Output Sink CurrentLow Output Voltage vs
Output Sink CurrentHigh Output Voltage Drop vs
Output Source CurrentDelay Time vs
Supply VoltagePropagation Delay vs
Voltage Level of Trigger Pulse

Timer

NE/SA/SE555/SE555C

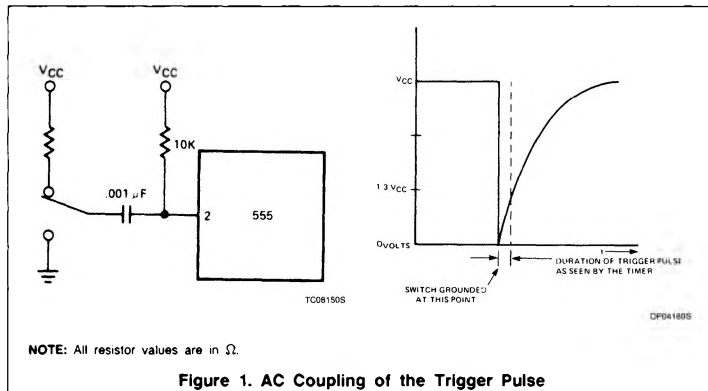
TYPICAL APPLICATIONS



Timer

NE/SA/SE555/SE555C

TYPICAL APPLICATIONS



Trigger Pulse Width Requirements and Time Delays

Due to the nature of the trigger circuitry, the timer will trigger on the negative going edge of the input pulse. For the device to time out properly, it is necessary that the trigger voltage level be returned to some voltage greater than one third of the supply before the time out period. This can be achieved by making either the trigger pulse sufficiently short or by

AC coupling into the trigger. By AC coupling the trigger, see Figure 1, a short negative going pulse is achieved when the trigger signal goes to ground. AC coupling is most frequently used in conjunction with a switch or a signal that goes to ground which initiates the timing cycle. Should the trigger be held low, without AC coupling, for a longer duration than the timing cycle the output will remain in a high state for the duration of the

low trigger signal, without regard to the threshold comparator state. This is due to the predominance of Q_{15} on the base of Q_{16} , controlling the state of the bistable flip-flop. When the trigger signal then returns to a high level, the output will fall immediately. Thus, the output signal will follow the trigger signal in this case.

Another consideration is the "turn-off time". This is the measurement of the amount of time required after the threshold reaches $2/3 V_{CC}$ to turn the output low. To explain further, Q_1 at the threshold input turns on after reaching $2/3 V_{CC}$, which then turns on Q_5 , which turns on Q_6 . Current from Q_6 turns on Q_{16} which turns Q_{17} off. This allows current from Q_{19} to turn on Q_{20} and Q_{24} to give an output low. These steps cause the $2\mu s$ max. delay as stated in the data sheet.

Also, a delay comparable to the turn-off time is the trigger release time. When the trigger is low, Q_{10} is on and turns on Q_{11} which turns on Q_{15} . Q_{15} turns off Q_{16} and allows Q_{17} to turn on. This turns off current to Q_{20} and Q_{24} , which results in output high. When the trigger is released, Q_{10} and Q_{11} shut off, Q_{15} turns off, Q_{16} turns on and the circuit then follows the same path and time delay explained as "turn off time". This trigger release time is very important in designing the trigger pulse width so as not to interfere with the output signal as explained previously.