NA555S-13 Datasheet

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https://www.DiGi-Electronics.com
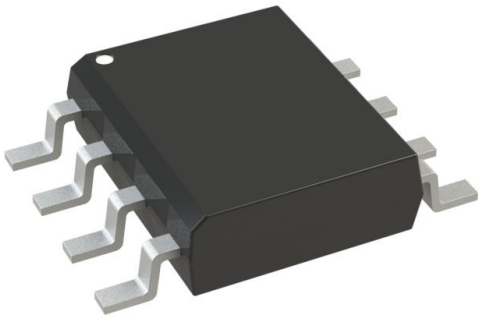
DiGi Electronics Part Number	NA555S-13-DG
Manufacturer	Diodes Incorporated
Manufacturer Product Number	NA555S-13
Description	IC OSC SINGLE TIMER 500KHZ 8SO
Detailed Description	555 Type, Timer/Oscillator (Single) IC 500kHz 8-SO

Purchase and inquiry

Manufacturer Product Number:	Manufacturer:
NA555S-13	Diodes Incorporated
Series:	Product Status:
-	Active
Type:	Count:
555 Type, Timer/Oscillator (Single)	-
Frequency:	Voltage - Supply:
500kHz	4.5V ~ 16V
Current - Supply:	Operating Temperature:
13 mA	-40°C ~ 105°C
Package / Case:	Supplier Device Package:
8-SOIC (0.154", 3.90mm Width)	8-SO
Mounting Type:	Base Product Number:
Surface Mount	NA555

Environmental & Export classification

RoHS Status:	Moisture Sensitivity Level (MSL):
ROHS3 Compliant	1 (Unlimited)
REACH Status:	ECCN:
REACH Unaffected	EAR99
HTSUS:	
8542.39.0001	

Lead-free Green

**NE555**

PRECISION TIMER

Description

These devices are precision timing circuits capable of producing accurate time delays or oscillation. In the time-delay or monostable mode of operation, the timed interval is controlled by a single external resistor and capacitor network. In the astable mode of operation, the frequency and duty cycle can be controlled independently with two external resistors and a single external capacitor.

The threshold and trigger levels normally are two-thirds and one-third, respectively, of V_{CC}. These levels can be altered by use of the control-voltage terminal. When the trigger input falls below the trigger level, the flip-flop is set, and the output goes high. If the trigger input is above the trigger level and the threshold input is above the threshold level, the flip-flop is reset and the output is low. The reset (RESET) input can override all other inputs and can be used to initiate a new timing cycle. When RESET goes low, the flip-flop is reset, and the output goes low. When the output is low, a low-impedance path is provided between discharge (DISCH) and ground.

The output circuit is capable of sinking or sourcing current up to 200mA. Operation is specified for supplies of 5V to 15V. With a 5-V supply, output levels are compatible with TTL inputs.
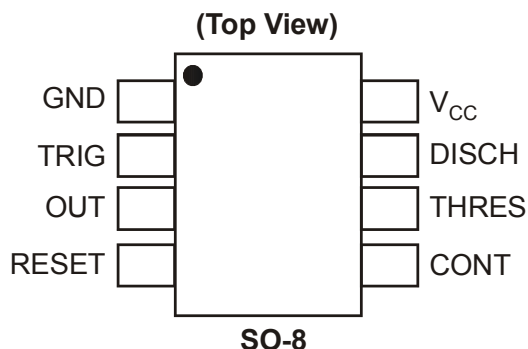
Features

- Timing from microseconds to hours
- Astable or monostable operation
- Adjustable duty cycle
- TTL compatible output can source or sink up to 200mA
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen- and Antimony-Free. "Green" Device (Note 3)**
- **For automotive applications requiring specific change control (i.e. parts qualified to AEC-Q100/101/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please contact us or your local Diodes representative.**
  https://www.diodes.com/quality/product-definitions/

Pin Assignments

(Top View)

GND	V_{CC}
TRIG	DISCH
OUT	THRES
RESET	CONT

SO-8

Notes:
1. No purposely added lead. FullyEU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3).compliant.
2. See https://www.diodes.com/quality/lead-free/ formore information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

NE555/SA555/NA555
Document number: DS35112 Rev. 5 - 2

1 of 14
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Pin Descriptions

Pin Name	Pin Number	Description
GND	1	Ground
TRIG	2	Trigger set 1/3V_{CC}
OUT	3	Timer output
RESET	4	Reset active low
CONT	5	External adjustment of internal threshold and trigger voltages
THRES	6	Threshold set to 2/3 V_{CC}
DISCH	7	Low impedance discharge path
V_{CC}	8	Chip supply voltage

Functional Block Diagram
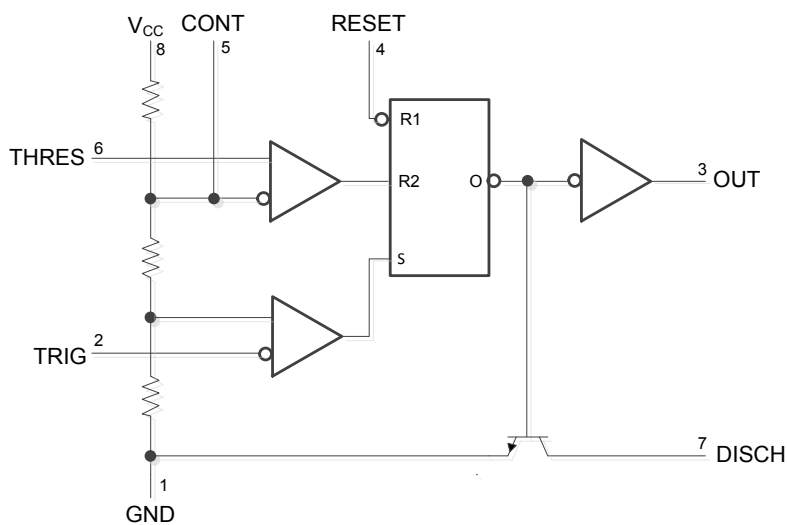
RESET can override TRIG, which can override THRESH

Functional Table

RESET	Nominal Trigger Voltage	Threshold Voltage	Output	Discharge Switch
Low	Irrelevant	Irrelevant	Low	On
High	<1/3V_{CC}	Irrelevant	High	Off
High	>1/3V_{CC}	>2/3V_{CC}	Low	On
High	>1/3V_{CC}	<2/3V_{CC}	As previously established	

NE555/SA555/NA555
Document number: DS35112 Rev. 5 - 2

2 of 14
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Absolute Maximum Ratings (Note 4) @ T_A = 25°C unless otherwise stated

Symbol	Parameter		Rating	Unit
V_{CC}	Supply voltage (Note 5)		18	V
V_I	Input voltage	CONT, RESET, THRES, TRIG	V_{CC}	V
I_O	Output current		±225	mA
θ_{JA}	Package thermal resistance Junction-to-Ambient (Note 6)		130	°C/W
θ_{JC}	Package thermal resistance Junction-to-Case (Note 7)		15	°C/W
T_J	Junction temperature		150	°C
T_{STG}	Storage temperature		-65 to 150	°C

Notes: 4. Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
5. All voltage values are with respect ground.
6. Maximum power dissipation is a function of T_J(max), θ_{JA}, and T_A. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(max) – T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can affect reliability.
7. Maximum power dissipation is a function of T_J(max), θ_{JC}, and T_A. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(max) – T_C)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can affect reliability.

Recommended Operating Conditions (T_A = 25°C)

Symbol	Parameter		Min	Max	Unit
V_{CC}	Supply voltage		4.5	16	V
V_I	Input voltage	CONT, RESET, THRES, TRIG	—	V_{CC}	V
I_O	Output current		—	±200	mA
T_A	Operating Ambient Temperature	NE555	0	70	°C
		SA555	-40	85	
		NA555	-40	105	

Electrical Characteristics (V_{CC} = 5V to 15V, T_A = 25°C unless otherwise stated)

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
V_{TH}	Threshold voltage level	V_{CC} = 15V	8.8	10	11.2	V
		V_{CC} = 5V	2.4	3.3	4.2	
I_{TH}	Threshold current (Note 8)	—	—	30	250	nA
V_{TR}	Trigger voltage level	V_{CC} = 15V	4.5	5	5.6	V
		V_{CC} = 5V	1.1	1.67	2.2	
I_{TR}	Trigger current	TRIG at 0V	—	0.5	2	µA
V_{RST}	RESET voltage level	—	0.3	0.7	1	V
I_{RST}	RESET current	RESET at V_{CC}	—	0.1	0.4	mA
		RESET at 0V	—	-0.4	-1.5	
I_{DIS}	DISCH switch off-state current	—	—	20	100	nA
V_{DIS}	DISCH saturation voltage with output low (Note 9)	V_{CC} = 15V, I_{DIS} = 15mA	—	180	480	mV
		V_{CC} = 5V, I_{DIS} = 4.5mA	—	80	200	
V_{CON}	CONT voltage (open circuit)	V_{CC} = 15V	9	10	11	V
		V_{CC} = 5V	2.6	3.3	4	

Notes: 8. This parameter influences the maximum value of the timing resistors R_A and R_B in the circuit of Figure 12. For example, when V_{CC} = 5 V, the maximum value is R = R_A + R_B ≈ 3.4MΩ, and for V_{CC} = 15 V, the maximum value is 10MΩ.
9. No protection against excessive pin 7 current is necessary providing package dissipation rating is not exceeded

NE555/SA555/NA555
Document number: DS35112 Rev. 5 - 2
3 of 14
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February 2021
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Electrical Characteristics (V$_{CC}$ = 5V to 15V, T$_A$ = 25°C unless otherwise stated)

Symbol	Parameter	Test conditions		Min	Typ.	Max	Unit
V$_{OL}$	Low level output voltage	V$_{CC}$ = 15V, I$_{OL}$ = 10mA		—	0.1	0.25	V
		V$_{CC}$ = 15V, I$_{OL}$ = 50mA		—	0.4	0.75	
		V$_{CC}$ = 15V, I$_{OL}$ = 100mA		—	2	2.5	
		V$_{CC}$ = 15V, I$_{OL}$ = 200mA		—	2.5	—	
		V$_{CC}$ = 5V, I$_{OL}$ = 5mA		—	0.1	0.35	
		V$_{CC}$ = 5V, I$_{OL}$ = 8mA		—	0.15	0.4	
V$_{OH}$	High level output voltage	V$_{CC}$ = 15V, I$_{OH}$ = -100mA		12.75	13.3	—	V
		V$_{CC}$ = 15V, I$_{OH}$ = -200mA		—	12.5	—	
		V$_{CC}$ = 5V, I$_{OH}$ = -100mA		2.75	3.3	—	
I$_{CC}$	Supply current	Output low, no load	V$_{CC}$ = 15V	—	10	15	mA
			V$_{CC}$ = 5V	—	3	6	
		Output high, no load	V$_{CC}$ = 15V	—	9	13	
			V$_{CC}$ = 5V	—	2	5	
T$_{ER}$	Initial error of timing interval (Note 10)	Each time, monostable (Note 11)	—	—	1	3	%
		Each time, astable (Note 12)		—	2.25	—	
T$_{TC}$	Temperature coefficient of timing interval	Each time, monostable (Note 11)	T$_A$ = full range	—	50	—	ppm/°C
		Each time, astable (Note 12)		—	150	—	
T$_{VCC}$	Supply voltage sensitivity of timing interval	Each time, monostable (Note 11)	—	—	0.1	0.5	%/V
		Each time, astable (Note 12)		—	0.3	—	
T$_{RI}$	Output pulse rise time	C$_L$ = 15pF		—	—	300	ns
T$_{FA}$	Output pulse fall time	C$_L$ = 15pF		—	—	300	ns

Notes: 10. Timing interval error is defined as the difference between the measured value and the average value of a random sample from each process run.
11. Values specified are for a device in a monostable circuit similar to Figure 9, with the following component values: R$_A$ = 2kΩ to 100kΩ, C = 0.1uF.
12. Values specified are for a device in an astable circuit similar to Figure 12, with the following component values: R$_A$ = 1kΩ to 100kΩ, C = 0.1uF.

NE555/SA555/NA555
Document number: DS35112 Rev. 5 - 2

4 of 14
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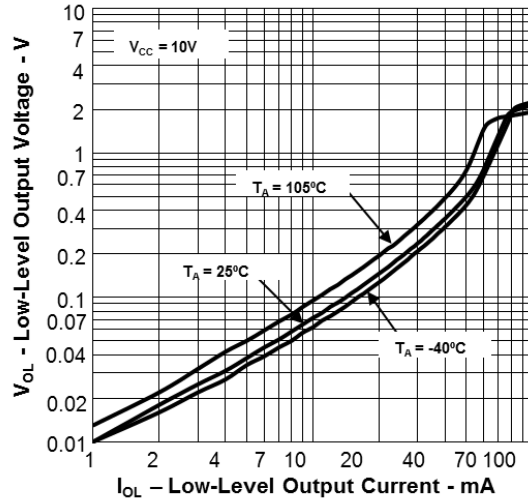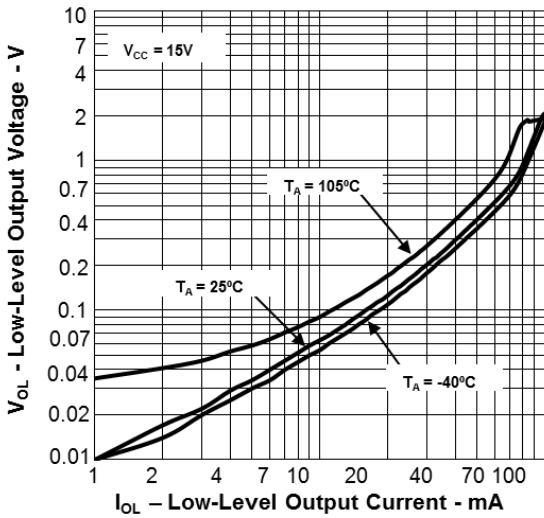
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Typical Performance Characteristics
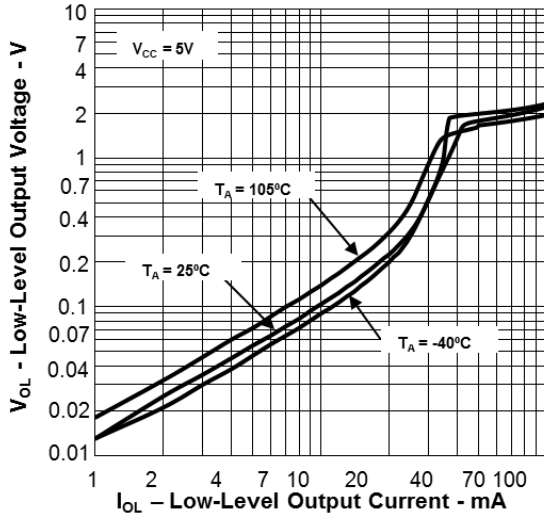
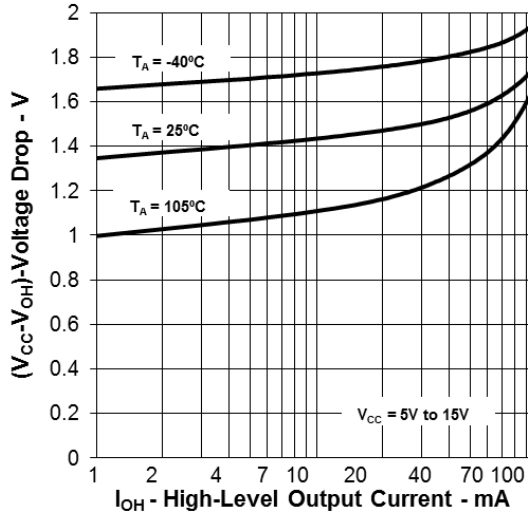**Low Level Output Voltage vs.
Low Level Output Current @ V$_{CC}$ = 5V**

**Low Level Output Voltage vs.
Low Level Output Current @ V$_{CC}$ = 10V**

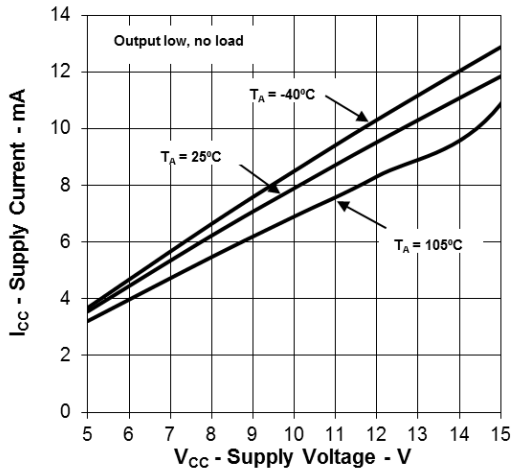**Low Level Output Voltage vs.
Low Level Output Current @ V$_{CC}$ = 15V**

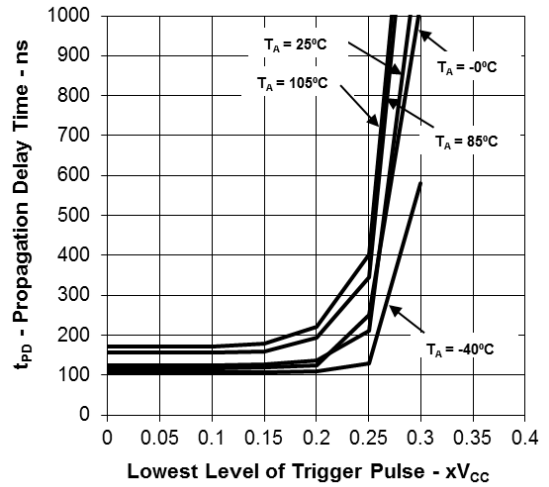**Drop Between Supply Voltage and Output vs.
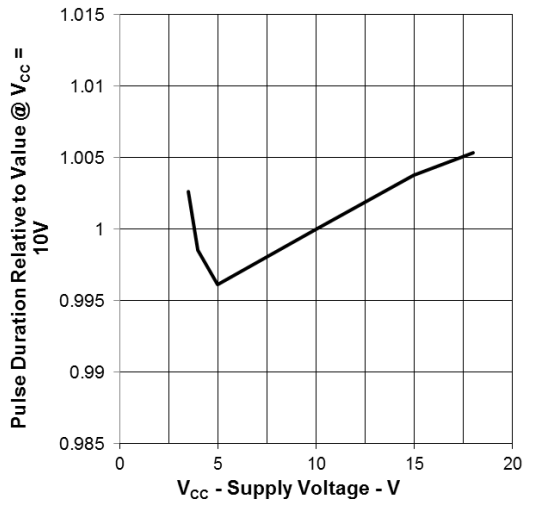High Level Output Current**

NE555/SA555/NA555
Document number: DS35112 Rev. 5 - 2

5 of 14
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February 2021
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Typical Performance Characteristics (cont.)

Supply Current vs. Supply Voltage

**Propagation Delay Time vs.
Lowest Voltage Level of Trigger Pulse**

**Normalized Output Pulse Duration
(Monostable Mode) vs. Supply Voltage**
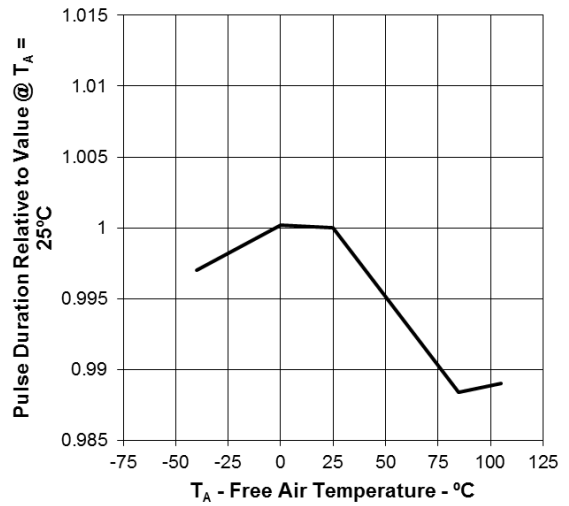
**Normalized Output Pulse Duration
(Monostable Mode) vs. Free-Air Temperature**

NE555/SA555/NA555
Document number: DS35112 Rev. 5 - 2

6 of 14
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Typical Applications Characteristics

Monostable Operation

For monostable operation, any of the '555 timers can be connected as shown in Figure 1. If the output is low, application of a negative-going pulse to the trigger (TRIG) sets the internal flip-flop and drives the output high. Capacitor C is then charged through R_A until the voltage across the capacitor reaches the threshold voltage of the threshold (THRES) input. If TRIG has returned to a high level, the output of the threshold comparator resets the internal flip-flop, drives the output low, and discharges C.
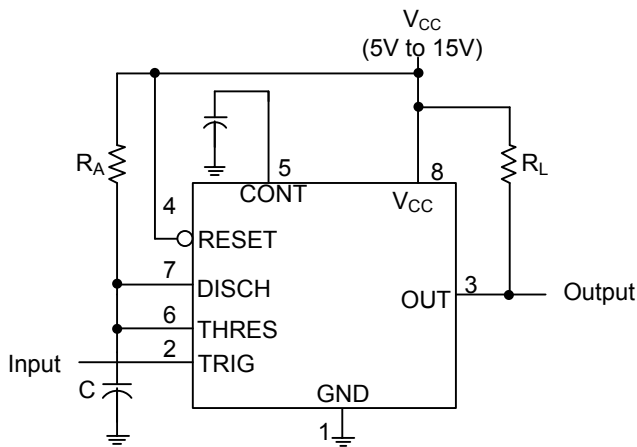
Fig. 1 Monostable operation

Monostable operation is initiated when TRIG voltage falls below the trigger threshold. Once initiated, the sequence ends only if TRIG is high for at least 10µs before the end of the timing interval. When the trigger is grounded, the comparator storage time can be as long as 10µs, which limits the minimum monostable pulse width to 10µs. Because of the threshold level and saturation voltage of Q1, the output pulse duration is approximately $t_W = 1.1 R_A C$. Figure 3 is a plot of the time constant for various values of R_A and C. The threshold levels and charge rates both are directly proportional to the supply voltage, V_{CC}. The timing interval is, therefore, independent of the supply voltage, so long as the supply voltage is constant during the time interval.

Applying a negative-going trigger pulse simultaneously to RESET and TRIG during the timing interval discharges C and reinitiates the cycle, commencing on the positive edge of the reset pulse. The output is held low as long as the reset pulse is low. To prevent false triggering, when RESET is not used, it should be connected to V_{CC}.
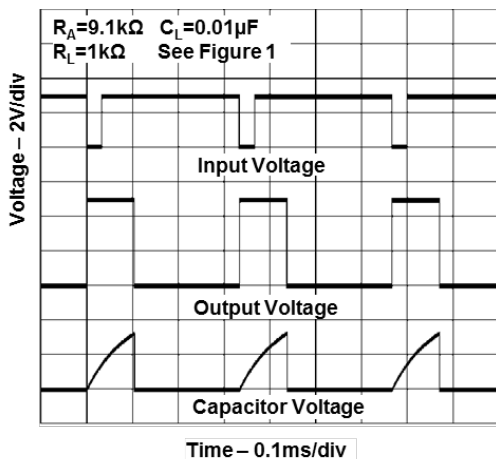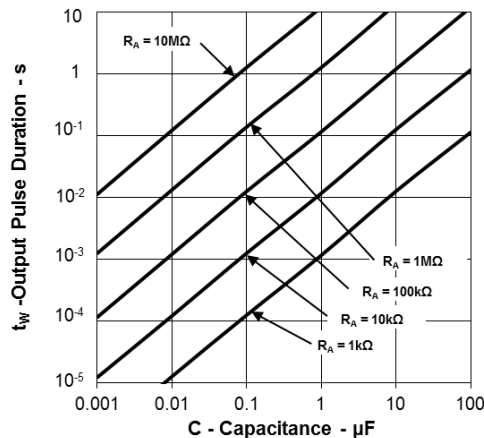

Fig. 2 Typical Monostable Waveforms

Fig. 3 Output Pulse Duration vs. Capacitance

NE555/SA555/NA555
Document number: DS35112 Rev. 5 - 2

7 of 14
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## Typical Applications Characteristics (cont.)

Astable Operation

As shown in Figure 4, adding a second resistor, R_B, to the circuit of Figure 1 and connecting the trigger input to the threshold input causes the timer to self-trigger and run as a multivibrator. The capacitor C charges through R_A and R_B and then discharges through R_B. Therefore, the duty cycle is controlled by the values of R_A and R_B.

This astable connection results in capacitor C charging and discharging between the threshold-voltage level ($\approx 0.67 V_{CC}$) and the trigger-voltage level ($\approx 0.33 V_{CC}$). As in the monostable circuit, charge and discharge times (and, therefore, the frequency and duty cycle) are independent of the supply voltage.
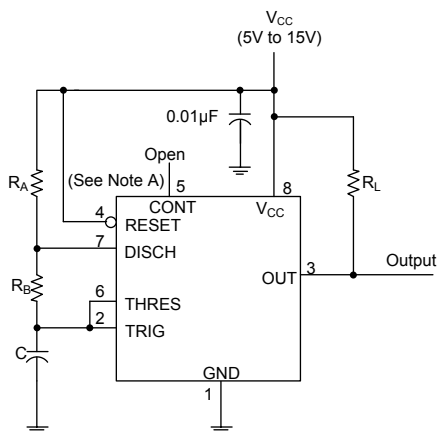
Decoupling CONT voltage to ground with a capacitor can improve operation. This should be evaluated for individual applications.

Fig. 4 Circuit for Astable Operation
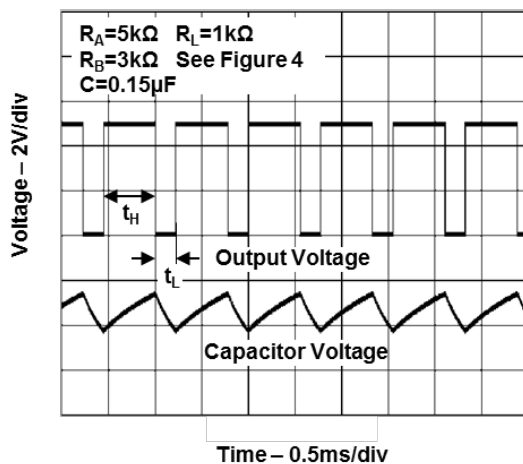
Fig. 5 Typical Astable Waveforms

Figure 5 shows typical waveforms generated during astable operation. The output high-level duration t_H and low-level duration t_L can be calculated as follows:

$t_H = 0.693(R_A + R_B)C$

$t_L = 0.693(R_B)C$

Other useful equations are:

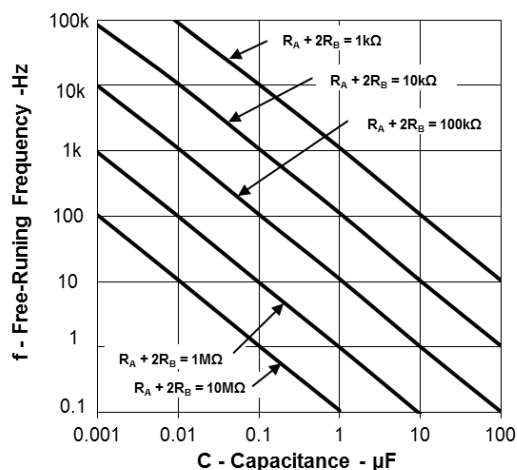period $= t_H + t_L = 0.693(R_A + 2R_B)C$

frequency $= 1.44/(R_A + 2R_B)C$

output driver duty cycle $= t_L/(t_H + t_L) = R_B/(R_A + 2R_B)$

output waveform duty cycle $= t_H/(t_H + t_L) = 1 - R_B/(R_A + 2R_B)$

low to high ratio $= t_L/t_H = R_B/(R_A + R_B)$

Fig. 6 Free Running Frequency

NE555/SA555/NA555
Document number: DS35112 Rev. 5 - 2

8 of 14
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## Typical Applications Characteristics (cont.)

Missing Pulse Detector

The circuit shown in Figure 7 can be used to detect a missing pulse or abnormally long spacing between consecutive pulses in a train of pulses. The timing interval of the monostable circuit is retriggered continuously by the input pulse train as long as the pulse spacing is less than the timing interval. A longer pulse spacing, missing pulse, or terminated pulse train permits the timing interval to be completed, thereby generating an output pulse as shown in Figure 8.
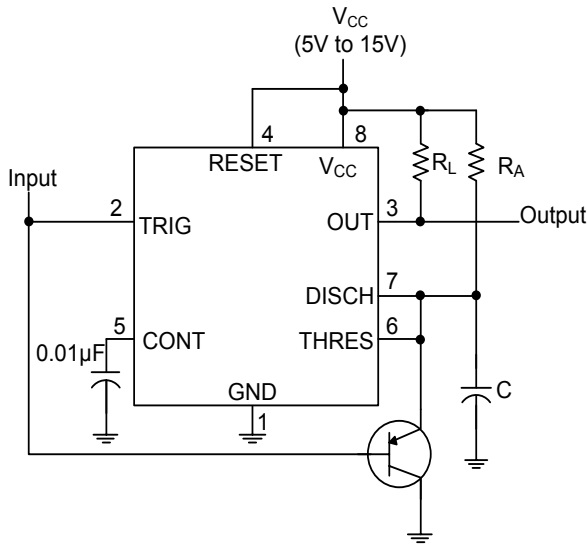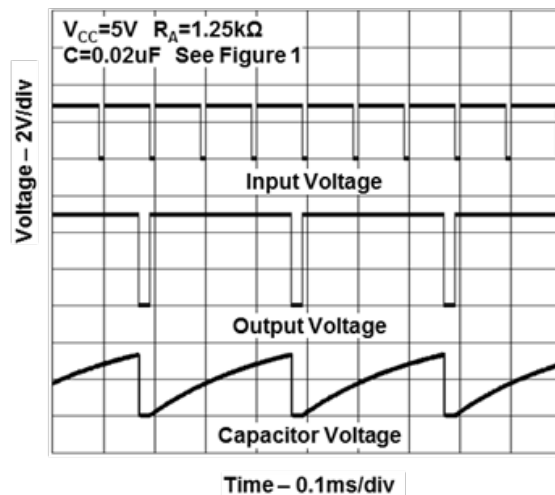

Fig. 7 Circuit for Missing Pulse Detector
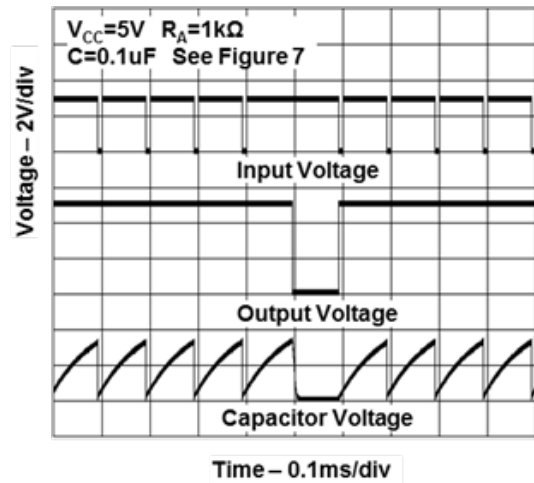
Fig. 8 Timing Waveforms for Missing Pulse Detector

Frequency Divider

By adjusting the length of the timing cycle, the basic circuit of Figure 1 can be made to operate as a frequency divider. Figure 9 shows a divide-by-three circuit that makes use of the fact that retriggering cannot occur during the timing cycle.


Fig. 9 Divide by Three Circuit Waveforms

NE555/SA555/NA555
Document number: DS35112 Rev. 5 - 2

9 of 14
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Typical Applications Characteristics (cont.)

Pulse Width Modulation

The operation of the timer can be modified by modulating the internal threshold and trigger voltages, which is accomplished by applying an external voltage (or current) to CONT. Figure 10 shows a circuit for pulse-width modulation. A continuous input pulse train triggers the monostable circuit, and a control signal modulates the threshold voltage. Figure 11 shows the resulting output pulse-width modulation. While a sine-wave modulation signal is shown, any wave shape could be used.
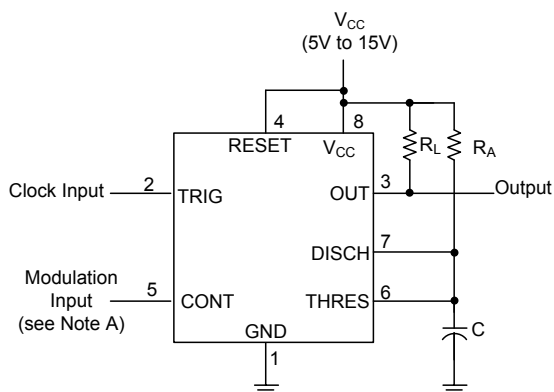
The modulating signal can be directly or capacitively coupled to CONT. For direct coupling, the effects of modulation source voltage and impedance on the bias of the timer should be considered.

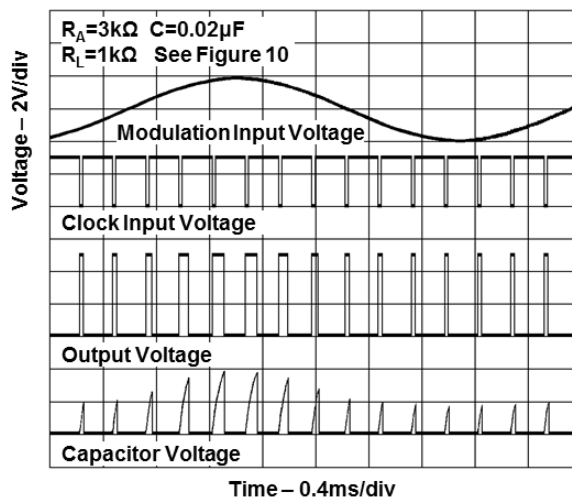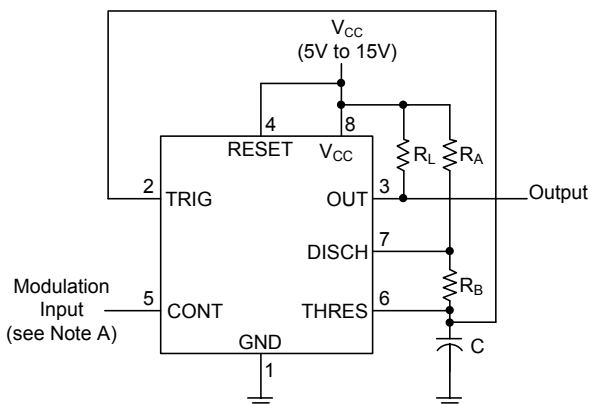**Fig. 10 Circuit for Pulse width modulation**

Fig. 11 Pulse width modulation timing diagrams

Pulse Position Modulation

As shown in Figure 12, any of these timers can be used as a pulse-position modulator. This application modulates the threshold voltage and, thereby, the time delay, of a free-running oscillator. Figure 13 shows a triangular-wave modulation signal for such a circuit; however, any wave shape could be used.

The modulating signal can be directly or capacitively coupled to CONT. For direct coupling, the effects of modulation source voltage and impedance on the bias of the timer should be considered.

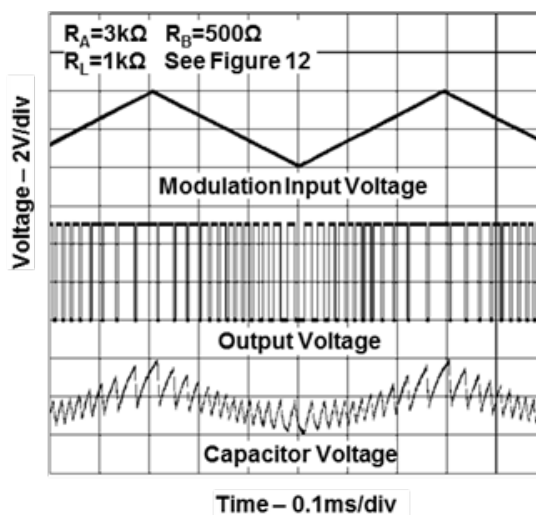**Fig. 12 Circuit for pulse position modulation**

Fig. 13 Pulse position modulation timing diagrams

NE555/SA555/NA555
Document number: DS35112 Rev. 5 - 2

10 of 14
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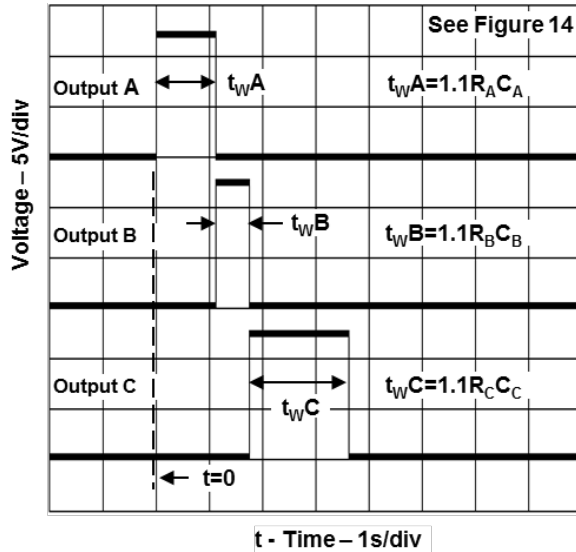## Typical Applications Characteristics (cont.)

Sequential Timer

Many applications, such as computers, require signals for initializing conditions during start-up. Other applications, such as test equipment, require activation of test signals in sequence. These timing circuits can be connected to provide such sequential control. The timers can be used in various combinations of astable or monostable circuit connections, with or without modulation, for extremely flexible waveform control. Figure 14 shows a sequencer circuit with possible applications in many systems, and Figure 15 shows the output waveforms.
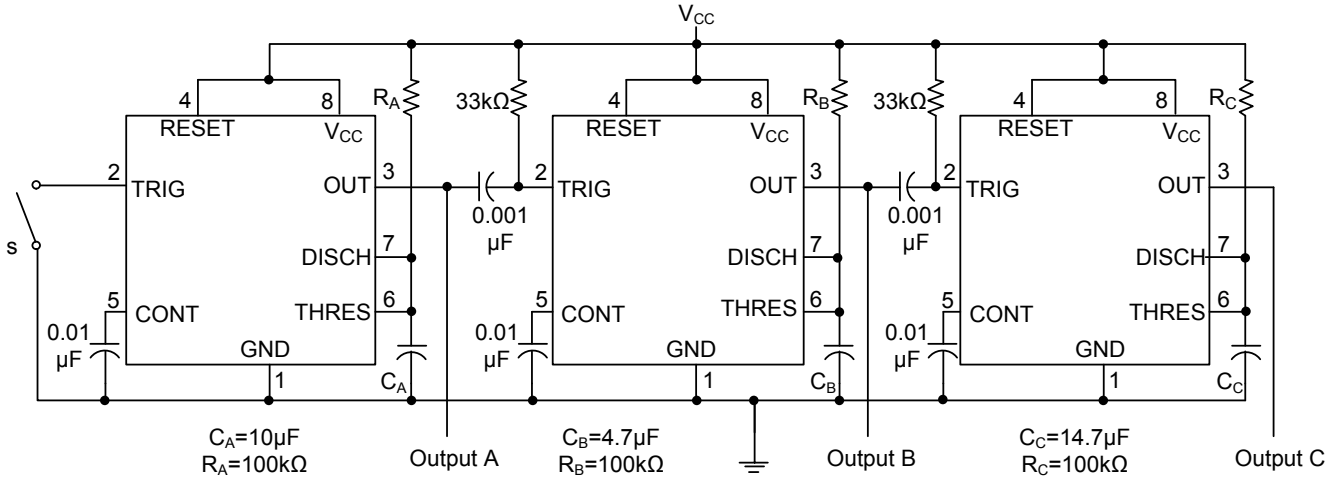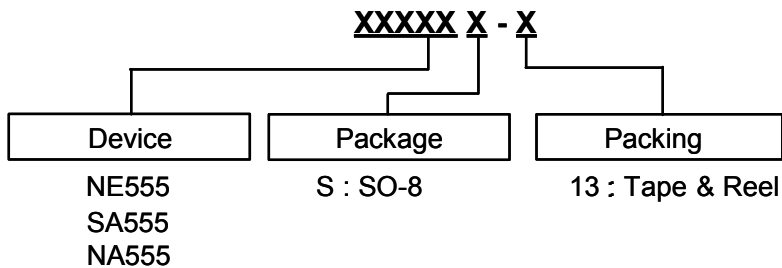

Note A: S closes momentarily at t=0.

Fig. 14 Circuit for Sequential Timer

Fig. 15 Sequential timer waveforms

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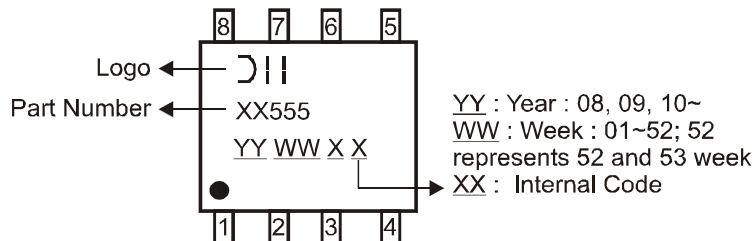Document number: DS35112 Rev. 5 - 2

11 of 14
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February 2021
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NE555

Ordering Information

XXXXX X - X

Device	Package	Packing
NE555	S : SO-8	13 : Tape & Reel
SA555		
NA555		

Device	Operating Temperature	Package Code	Packaging (Note 13)	13" Tape and Reel	
				Quantity	Part Number Suffix
NE555S-13	0 to 70°C	S	SO-8	2500/Tape & Reel	-13
SA555S-13	-40to 85°C	S	SO-8	2500/Tape & Reel	-13
NA555S-13	-40 to 105°C	S	SO-8	2500/Tape & Reel	-13

Notes: 13. For packaging details, go to our website at https://www.diodes.com/design/support/packaging/diodes-packaging/.

Marking Information

SO-8

Logo
Part Number → XX555
YY WW X X

YY : Year : 08, 09, 10~
WW : Week : 01~52; 52 represents 52 and 53 week
XX : Internal Code

NE555/SA555/NA555
Document number: DS35112 Rev. 5 - 2

12 of 14
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Package Outline Dimensions (All Dimensions in mm)

Please see http://www.diodes.com/package-outlines.html for the latest version.

SO-8
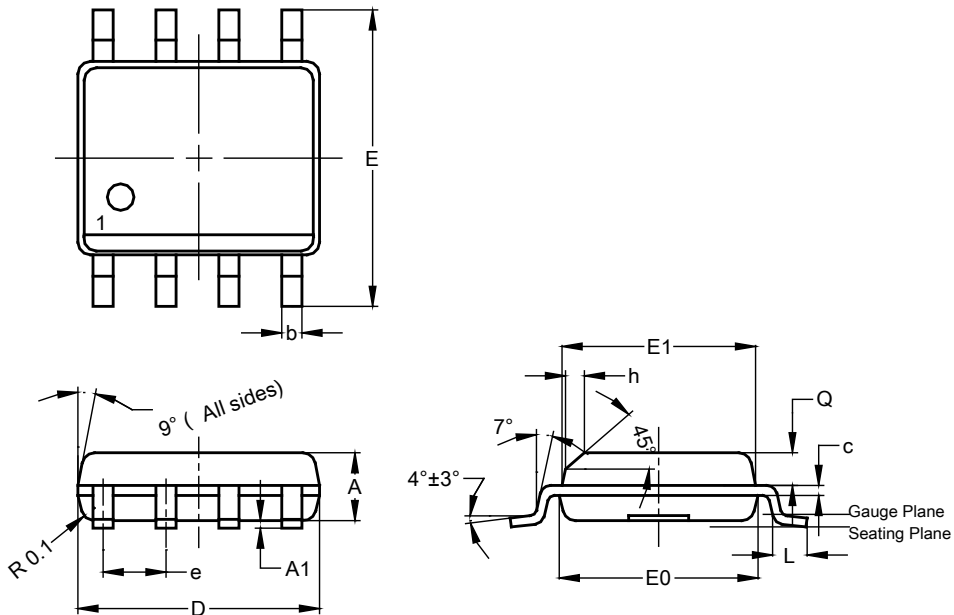
SO-8			
Dim	Min	Max	Typ
A	1.40	1.50	1.45
A1	0.10	0.20	0.15
b	0.30	0.50	0.40
c	0.15	0.25	0.20
D	4.85	4.95	4.90
E	5.90	6.10	6.00
E1	3.80	3.90	3.85
E0	3.85	3.95	3.90
e	--	--	1.27
h	-	--	0.35
L	0.62	0.82	0.72
Q	0.60	0.70	0.65
All Dimensions in mm			

Suggested Pad Layout

Please see http://www.diodes.com/package-outlines.html for the latest version.

SO-8
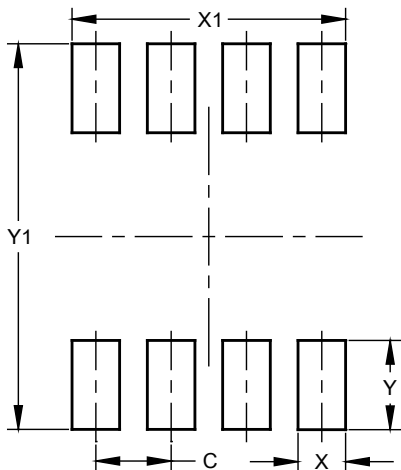
Dimensions	Value (in mm)
C	1.27
X	0.802
X1	4.612
Y	1.505
Y1	6.50

NE555/SA555/NA555
Document number: DS35112 Rev. 5 - 2

13 of 14
www.diodes.com

February 2021
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NE555

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Document number: DS35112 Rev. 5 - 2

14 of 14
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