555

556

Timers

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TIMER 555

LINEAR INTEGRATED CIRCUITS

DESCRIPTION

The NE/SE 555 monolithic timing circuit is a highly stable controller capable of producing accurate time delays, or oscillation. Additional terminals are provided for triggering or resetting if desired. 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 or drive TTL circuits.

FEATURES

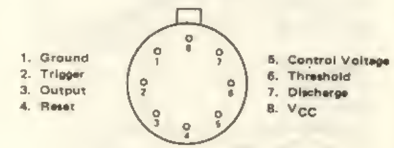
- TIMING THROUGH NINE DECADES
- OPERATES IN BOTH ASTABLE AND MONOSTABLE MODES
- ADJUSTABLE DUTY CYCLE
- HIGH CURRENT OUTPUT CAN SOURCE OR SINK 200mA
- OUTPUT CAN DRIVE TTL
- TEMPERATURE STABILITY OF 0.05% PER °C
- NORMALLY ON AND NORMALLY OFF OUTPUT

APPLICATIONS

PRECISION TIMING
PULSE GENERATION
SEQUENTIAL TIMING
TIME DELAY GENERATION
PULSE WIDTH MODULATION
PULSE POSITION MODULATION
MISSING PULSE DETECTOR

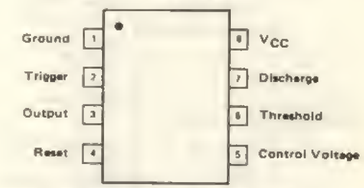
PIN CONFIGURATIONS (Top View)

T PACKAGE



ORDER PART NOS SE555T/NE555T

V PACKAGE

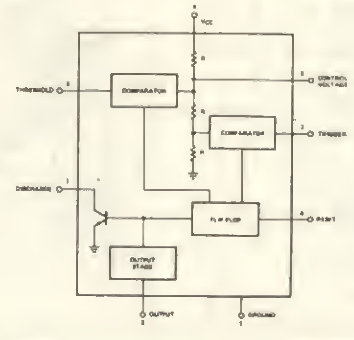


ORDER PART NOS. SE555V/NE555V

ABSOLUTE MAXIMUM RATINGS

Supply Voltage	+18V
Power Dissipation	600 mW
Operating Temperature Range	
NE555	0°C to +70°C
SE555	−55°C to +125°C
Storage Temperature Range	−65°C to +150°C
Lead Temperature (Soldering, 60 seconds)	+300°C

BLOCK DIAGRAM



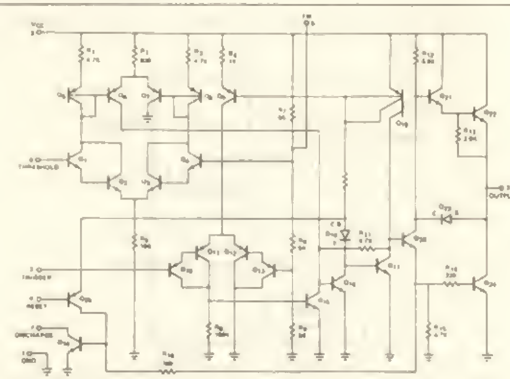
ELECTRICAL CHARACTERISTICS T_A = 25°C, V_{CC} = +5V to +15 unless otherwise specified

PARAMETER	TEST CONDITIONS	SE 555			NE 555			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
Supply Voltage		4.5		18	4.5		16	V
Supply Current	V_{CC} = 5V R_L = ∞		3	5		3	6	mA
	V_{CC} = 15V R_L = ∞		10	12		10	15	mA
	Low State, Note 1							
Timing Error	R_A, = 1KΩ to 100KΩ							
Initial Accuracy	C = 0.1 μF Note 2		0.5	2		1		%
Drift with Temperature	see Fig. 1a V_{CC} = 15V		30	100		50		ppm/°C
Drift with Supply Voltage			0.05	0.2		0.1		%/Volt
Threshold Voltage			2/3			2/3		X V_{CC}
Trigger Voltage	V_{CC} = 15V	4.8	5	5.2		5		V
	V_{CC} = 5V	1.45	1.67	1.9		1.67		V
Trigger Current			0.5			0.5		μA
Reset Voltage		0.4	0.7	1.0	0.4	0.7	1.0	V
Reset Current			0.1			0.1		mA
Threshold Current	Note 3		0.1	.25		0.1	.25	μA
Control Voltage Level	V_{CC} = 15V	9.6	10	10.4	9.0	10	11	V
	V_{CC} = 5V	2.9	3.33	3.8	2.6	3.33	4	V
Output Voltage Drop (low)	V_{CC} = 15V							
	I_{SINK} = 10mA		0.1	0.15		0.1	.25	V
	I_{SINK} = 50mA		0.4	0.5		0.4	.75	V
	I_{SINK} = 100mA		2.0	2.2		2.0	2.5	V
	I_{SINK} = 200mA		2.5			2.5		
	V_{CC} = 5V							
	I_{SINK} = 8mA		0.1	0.25				V
	I_{SINK} = 5mA					.25	.35	
Output Voltage Drop (high)								
	I_{SOURCE} = 200mA		12.5			12.5		
	V_{CC} = 15V							
	I_{SOURCE} = 100mA							
	V_{CC} = 15V	13.0	13.3		12.75	13.3		V
	V_{CC} = 5V	3.0	3.3		2.75	3.3		V
Rise Time of Output			100			100		nsec
Fall Time of Output			100			100		nsec

NOTES

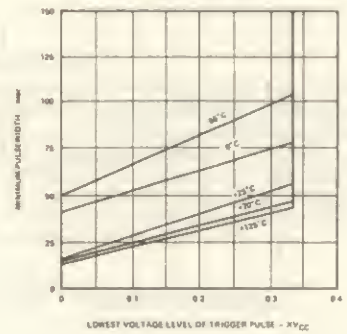
1. Supply Current when output high typically 1mA less.
2. Tested at V_{CC} = 5V and V_{CC} = 15V
3. This will determine the maximum value of $R_A + R_B$. For 15V operation, the max total R = 20 megohm.

EQUIVALENT CIRCUIT (Shown for One Side Only)

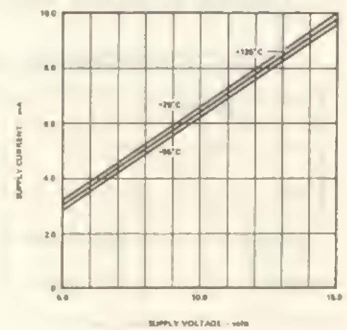


TYPICAL CHARACTERISTICS

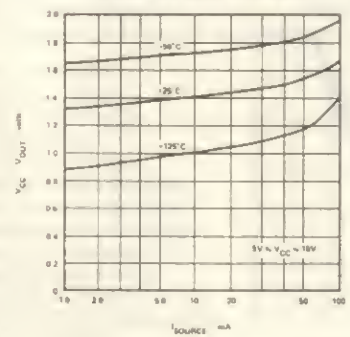
MINIMUM PULSE WIDTH REQUIRED FOR TRIGGERING



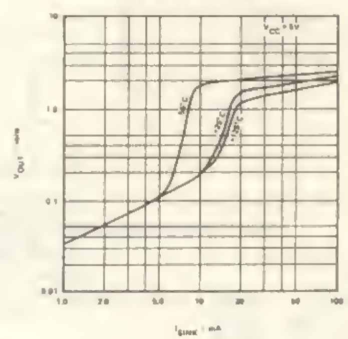
SUPPLY CURRENT vs SUPPLY VOLTAGE



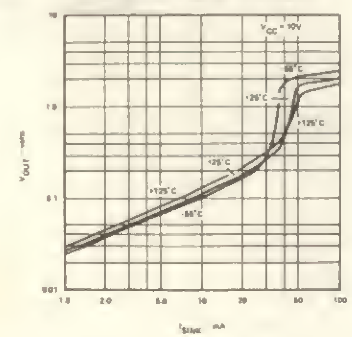
LOW OUTPUT VOLTAGE vs OUTPUT SINK CURRENT



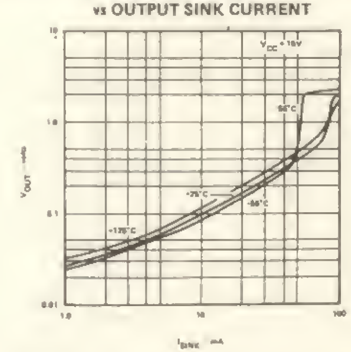
HIGH OUTPUT VOLTAGE vs OUTPUT SOURCE CURRENT



LOW OUTPUT VOLTAGE vs OUTPUT SINK CURRENT

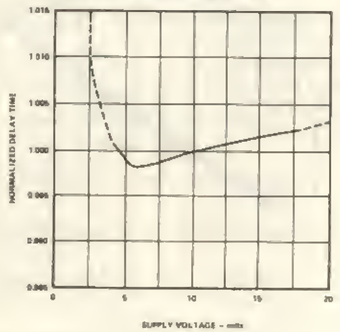


LOW OUTPUT VOLTAGE vs OUTPUT SINK CURRENT

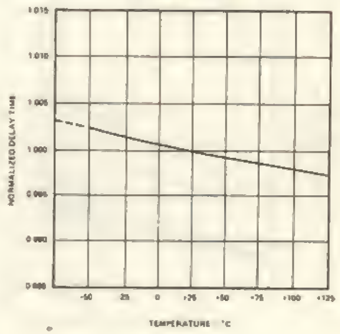


TYPICAL CHARACTERISTICS (Cont'd)

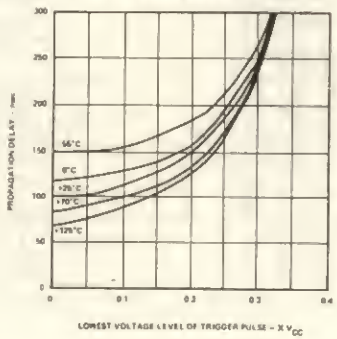
DELAY TIME vs SUPPLY VOLTAGE



DELAY TIME vs TEMPERATURE



PROPAGATION DELAY vs VOLTAGE LEVEL OF TRIGGER PULSE



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DUAL TIMER 556

LINEAR INTEGRATED CIRCUITS

DESCRIPTION

The NE/SE556 Dual Monolithic timing circuit is a highly stable controller capable of producing accurate time delays or oscillation. The 556 is a dual 555. Timing is provided by an external resistor and capacitor for each timing function. The two timers operate independently of each other sharing only V_{CC} and ground. The circuits may be triggered and reset on falling waveforms. The output structures may sink or source 150mA.

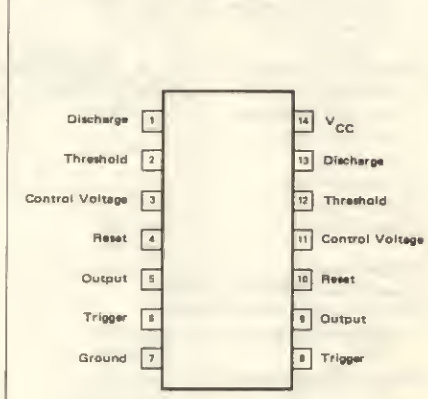
FEATURES

- TIMING THROUGH NINE DECADES
- REPLACES TWO 555 TIMERS
- OPERATES IN BOTH ASTABLE, MONOSTABLE, TIME DELAY MODES
- HIGH OUTPUT CURRENT
- ADJUSTABLE DUTY CYCLE
- TTL COMPATIBLE
- TEMPERATURE STABILITY OF 0.05% PER °C

APPLICATIONS

PRECISION TIMING
SEQUENTIAL TIMING
PULSE SHAPING
PULSE GENERATOR
MISSING PULSE DETECTOR
TONE BURST GENERATOR
PULSE WIDTH MODULATION
TIME DELAY GENERATOR
FREQUENCY DIVISION
INDUSTRIAL CONTROLS
PULSE POSITION MODULATION
APPLIANCE TIMING
TRAFFIC LIGHT CONTROL
TOUCH TONE ENCODER

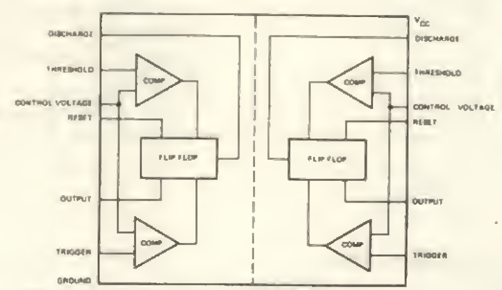
PIN CONFIGURATION (Top View)



ABSOLUTE MAXIMUM RATINGS

Supply Voltage		+18V
Power Dissipation		600mW
Operating Temperature Range	NE556	0°C to +70°C
	SE556	-55°C to +125°C
	SE556C	-55°C to +125°C
Storage Temperature Range		-65°C to +150°C
Lead Temperature (Soldering, 60 sec)		+300°C

BLOCK DIAGRAM

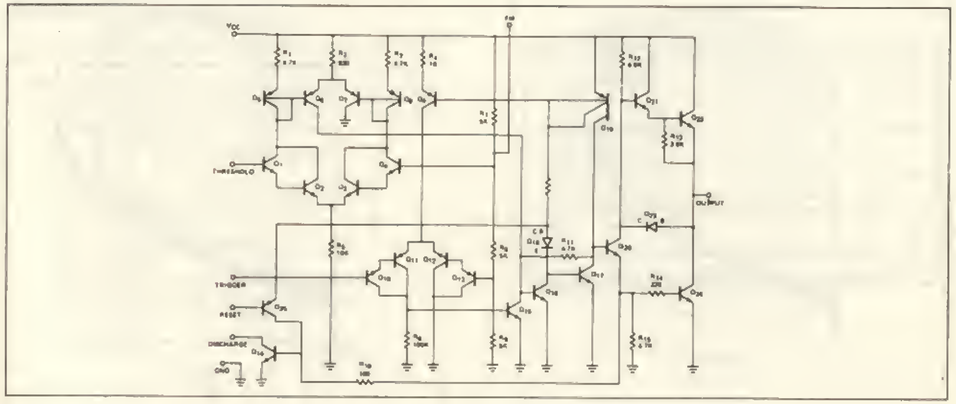


ELECTRICAL CHARACTERISTICS T_A = 25°C, V_{CC} = +5V to +15 unless otherwise specified

PARAMETER	TEST CONDITIONS	SE 556			NE 556			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
Supply Voltage		4.5		18	4.5		16	V
Supply Current	V_{CC} = 5V R_L = ∞		3	5		3	6	mA
	V_{CC} = 15V R_L = ∞		10	11		10	14	mA
	Low State, Note 1							
Timing Error (Monostable)	R_A = 2KΩ to 100KΩ							
Initial Accuracy	C = 0.1μF Note 2		0.5	1.5		0.75		%
Drift with Temperature	V_{CC} = 15V		30	100		50		ppm/°C
Drift with Supply Voltage			0.05	0.2		0.1		%/Volt
Timing Error (Astable)	R_A, R_B = 2KΩ to 100KΩ							
Initial Accuracy	C = 0.1μF Note 2		1.5			2.25		%
Drift with Temperature	V_{CC} = 15V		90			150		ppm/°C
Drift with Supply Voltage			0.15			0.3		%/Volt
Threshold Voltage			2/3			2/3		X V_{CC}
Threshold Current	Note 3		30	100		30	100	nA
Trigger Voltage	V_{CC} = 15V	4.8	5	5.2		5		V
	V_{CC} = 5V	1.45	1.67	1.9		1.67		V
Trigger Current			0.5			0.5		μA
Reset Voltage		0.4	0.7	1.0	0.4	0.7	1.0	V
Reset Current			0.1			0.1		mA
Control Voltage Level	V_{CC} = 15V	9.6	10	10.4	9.0	10	11	V
	V_{CC} = 5V	2.9	3.33	3.8	2.6	3.33	4	V
Output Voltage Drop (low)	V_{CC} = 15V							
	I_{SINK} = 10mA		0.1	0.15		0.1	.25	V
	I_{SINK} = 50mA		0.4	0.5		0.4	.75	V
	I_{SINK} = 100mA		2.0	2.25		2.0	2.75	V
	I_{SINK} = 200mA		2.5			2.5		
	V_{CC} = 5V							
	I_{SINK} = 8mA		0.1	0.25				V
	I_{SINK} = 5mA					.25	.35	
Output Voltage Drop (high)								
	I_{SOURCE} = 200mA		12.5			12.5		
	V_{CC} = 15V							
	I_{SOURCE} = 100mA							
	V_{CC} = 15V	13.0	13.3		12.75	13.3		V
	V_{CC} = 5V	3.0	3.3		2.75	3.3		V
Rise Time of Output			100			100		nsec
Fall Time of Output			100			100		nsec
Discharge Leakage Current			20	100		20	100	nA
Matching Characteristics (Note 4)								
Initial Timing Accuracy			0.05	0.1		0.1	0.2	%
Timing Drift with Temperature			±10			±10		ppm/°C
Drift with Supply Voltage			0.1	0.2		0.2	0.5	%/Volt

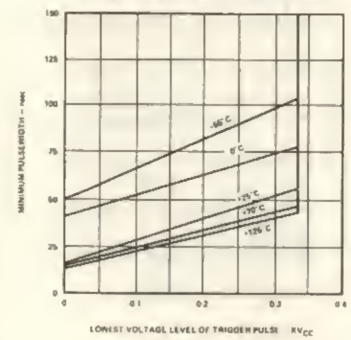
NOTES
1. Supply current when output is high is typically 1.0ma less.
2. Tested at V_{CC} = 5V and V_{CC} = 15V.
3. This will determine the maximum value of $R_A + R_B$ for 15V operation. The maximum total R = 20 meg-ohms.
4. Matching characteristics refer to the difference between performance characteristics of each timer section.

EQUIVALENT CIRCUIT (Shown for One Side Only)

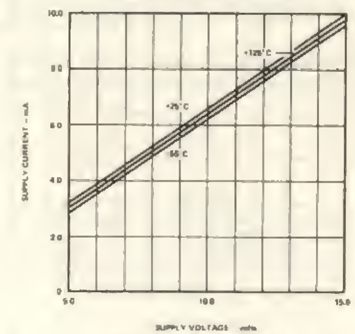


TYPICAL CHARACTERISTICS

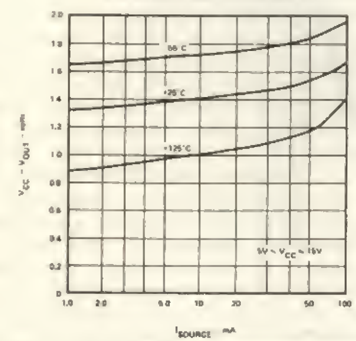
MINIMUM PULSE WIDTH
REQUIRED FOR TRIGGERING



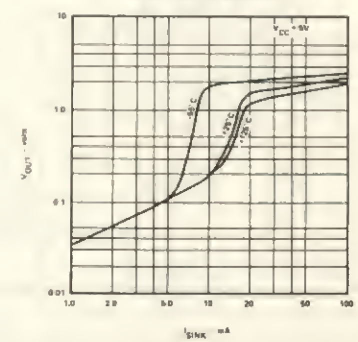
SUPPLY CURRENT
vs SUPPLY VOLTAGE



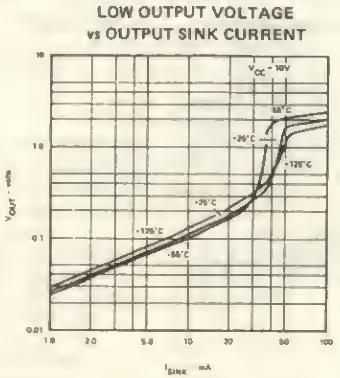
LOW OUTPUT VOLTAGE
vs OUTPUT SINK CURRENT

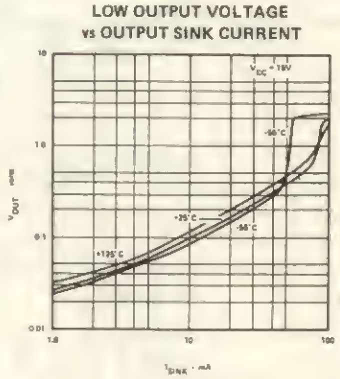


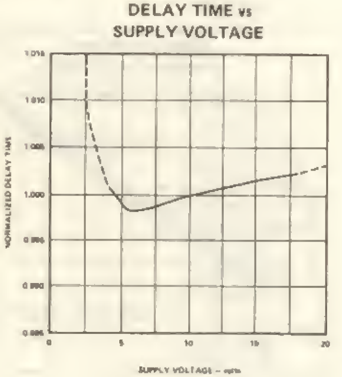
HIGH OUTPUT VOLTAGE
vs OUTPUT
SOURCE CURRENT

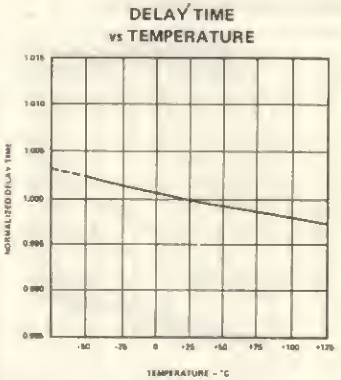


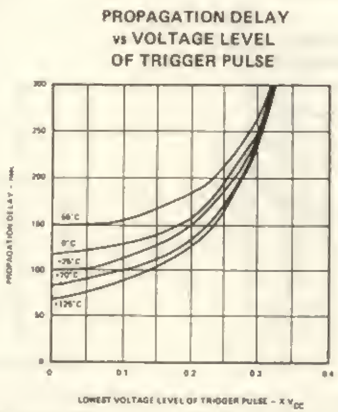
TYPICAL CHARACTERISTICS (Cont'd)











APPLICATIONS INFORMATION

MONOSTABLE OPERATION

In this mode of operation, the timer functions as a one-shot. Referring to Figure 1a the external capacitor is initially held discharged by a transistor inside the timer.

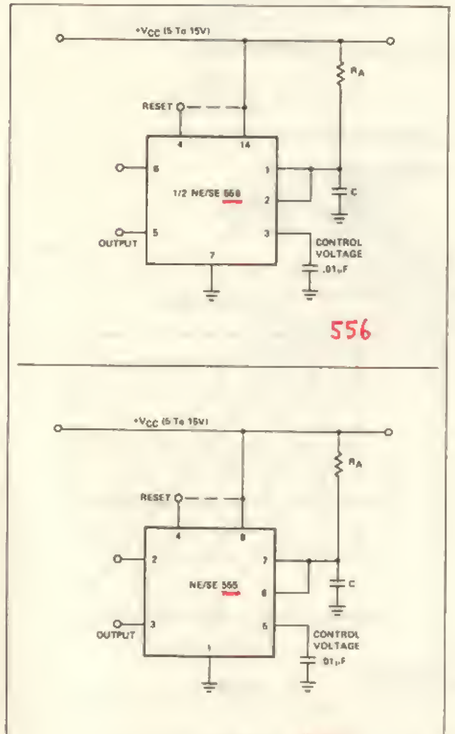


FIGURE 1a.

Upon application of a negative trigger pulse to pin 2, the flip-flop is set which releases the short circuit across the external capacitor and drives the output high. The voltage across the capacitor, now, increases exponentially with the time constant $\tau = R_AC$. When the voltage across the capacitor equals 2/3 V_{CC}, the comparator resets the flip-flop which in turn discharges the capacitor rapidly and drives the output to its low state. Figure 1b shows the actual waveforms generated in this mode of operation.

The circuit triggers on a negative going input signal when the level reaches 1/3 V_{CC}. Once triggered, the circuit will remain in this state until the set time is elapsed, even if it is triggered again during this interval. The time that the output is in the high state is given by $t = 1.1\ R_AC$ and can easily be determined by Figure 1c. Notice that since the charge rate, and the threshold level of the comparator are both directly proportional to supply voltage, the timing

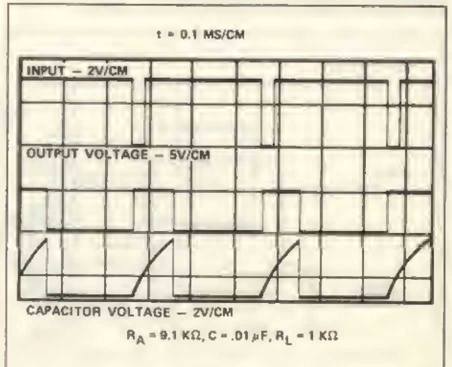


FIGURE 1b.

interval is independent of supply. Applying a negative pulse simultaneously to the reset terminal (pin 4) and the trigger terminal (pin 2) during the timing cycle discharges the external capacitor and causes the cycle to start over again. The timing cycle will now commence on the positive edge of the reset pulse. During the time the reset pulse is applied, the output is driven to its low state.

When the reset function is not in use, it is recommended that it be connected to V_{CC} to avoid any possibility of false triggering.

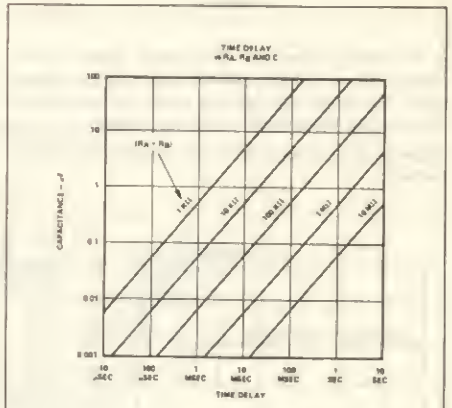


FIGURE 1c.

ASTABLE OPERATION

If the circuit is connected as shown in Figure 2a (pins 2 and 6 connected) it will trigger itself and free run as a multivibrator. The external capacitor charges through R_A and R_B and discharges through R_B only. Thus the duty cycle may be precisely set by the ratio of these two resistors.

APPLICATIONS INFORMATION (Cont'd)

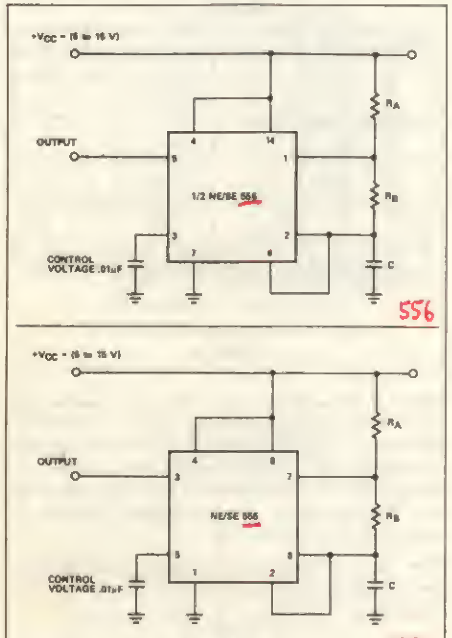


FIGURE 2a.

In this mode of operation, the capacitor charges and discharges between 1/3 V_{CC} and 2/3 V_{CC}. As in the triggered mode, the charge and discharge times, and therefore the frequency are independent of the supply voltage.

Figure 2b shows actual waveforms generated in this mode of operation.

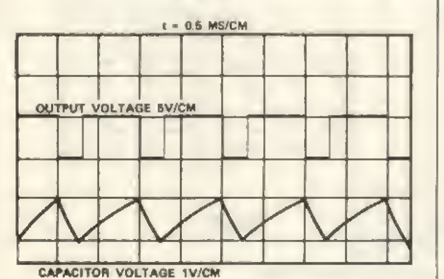


FIGURE 2b.

The charge time (output high) is given by:

$$t_1 = 0.693\,(R_A + R_B)\,C$$

and the discharge time (output low) by:

$$t_2 = 0.693\,(R_B)\,C$$

Thus the total period is given by:

$$T = t_1 + t_2 = 0.693\,(R_A + 2R_B)\,C$$

The frequency of oscillation is then:

$$f = \frac{1}{T} = \frac{1.44}{(R_A + 2R_B)\,C}$$

and may be easily found by Figure 2c.

The duty cycle is given by:

$$D = \frac{R_B}{R_A + 2R_B}$$

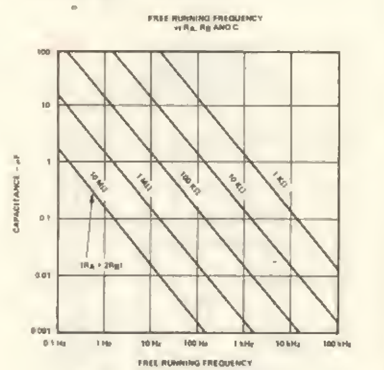
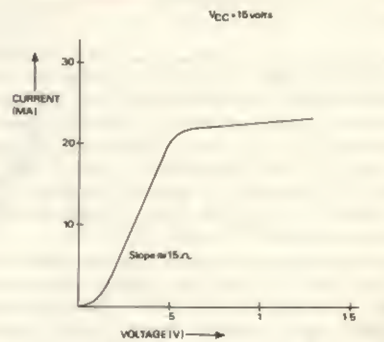
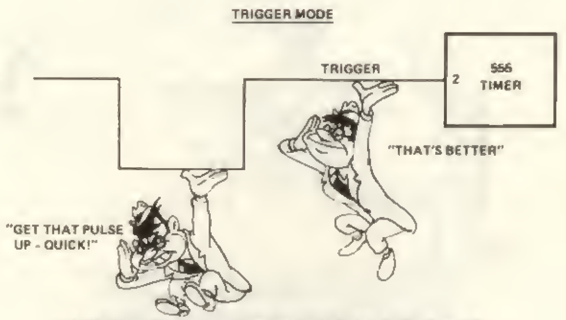


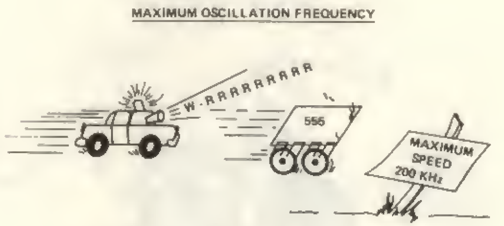
FIGURE 2c.



The discharge transistor characteristic shown above indicates how the device is power limiting when large values of charging capacitor are used. Thus, in the case of 15v supply rail, the capacitor discharge current is typically limited to 25 milliamps.

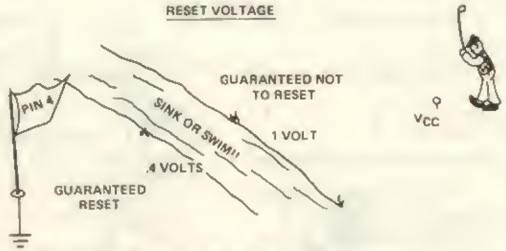


THE DEVICE TRIGGERS ON THE NEGATIVE GOING EDGE OF A LOW GOING PULSE. THE TRIGGER PULSE MUST BE OF SHORTER DURATION THAN THE "RC" TIME INTERVAL. IF THE TRIGGER IS HELD LOW, THE OUTPUT WILL STAY HIGH UNTIL TRIGGER IS DRIVEN HIGH AGAIN.



THE 555 TIMER IS CAPABLE OF OSCILLATING AT UP TO 300 KHz. HOWEVER, FOR TEMPERATURE STABILITY THE LIMIT SHOULD BE AROUND 200 KHz.

RESET VOLTAGE



THE RESET ACTS AS AN INHIBIT. WHEN THE RESET (PIN 4) IS ABOVE 1 VOLT THE DEVICE IS FREE TO FUNCTION. IF THE RESET IS TAKEN BELOW .4 VOLTS, THE OUTPUT IS FORCED LOW. WHEN THE RESET IS RELEASED, THE OUT PUT WILL STILL REMAIN LOW UNTIL A TRIGGER PULSE IS APPLIED.

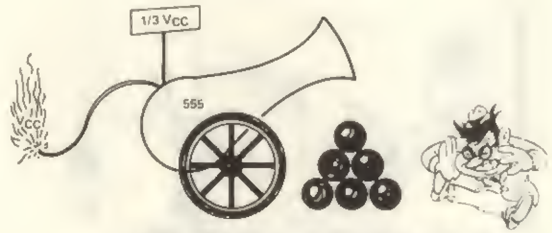
INITIAL ACCURACY

THE INITIAL ACCURACY IS THE TIMING REPEATABILITY FROM DEVICE TO DEVICE AND ALSO THE SAME DEVICE TODAY, TOMORROW AND 3 YEARS FROM NOW, WITH THE SAME "RC" NETWORK AND SUPPLY VOLTAGE. TYPICALLY, THE NE555 HAS A 1% INITIAL ACCURACY.

THRESHOLD VOLTAGE

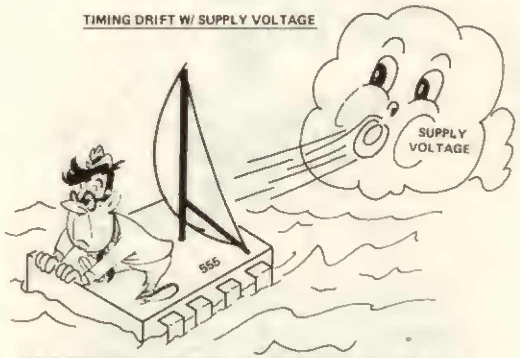
WHEN TRIGGERED, THE TIMER STARTS ITS TIMING CYCLE BY DRIVING THE OUTPUT, PIN 3, HIGH. SIMULTANEOUSLY, THE TIMING CAPACITOR STARTS CHARGING FROM ITS STEADY-STATE LEVEL AT GROUND. WHEN IT REACHES 2/3 V_{CC}, AN INTERNAL COMPARATOR IS TRIPPED, CAUSING THE CAPACITOR TO DISCHARGE TO GROUND. THIS DRIVES THE OUTPUT LOW, ENDING THE TIMING CYCLE.

TRIGGER VOLTAGE



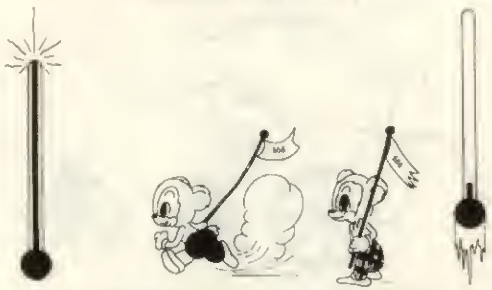
THE TRIGGER PULSE MUST DROP BELOW 1/3 OF THE SUPPLY VOLTAGE BEFORE THE TIMER TRIGGERS.

TIMING DRIFT W/ SUPPLY VOLTAGE



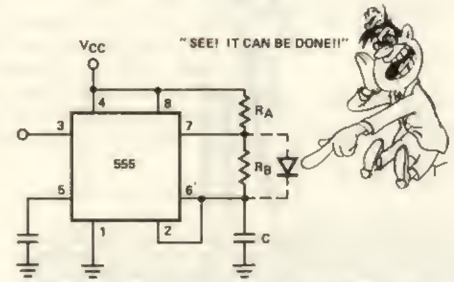
THE TIMING OF THE DEVICE WILL VARY SLIGHTLY WITH CHANGE IN SUPPLY VOLTAGE. THE TYPICAL TIMING DRIFT IS 0.1% PER VOLT.

TIMING DRIFT W/ TEMPERATURE



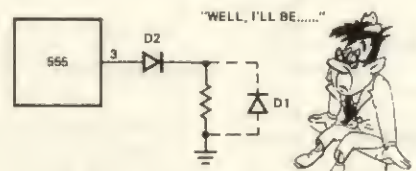
THE TIMER IN THE MONOSTABLE MODE HAS A TIMING DRIFT OF 50 PPM/°C TYPICAL. IN THE ASTABLE MODE, SINCE BOTH COMPARATORS OF THE DEVICE ARE USED, THE DRIFT IS SOMEWHAT GREATER. TYPICALLY 150 PPM/°C DRIFT.

DUTY CYCLE



THE DUTY CYCLE IS "ON TIME" EXPRESS IN TERMS OF TOTAL CYCLE TIME. THE DUTY CYCLE IS LIMITED, UNDER NORMAL CIRCUMSTANCES, TO 50%. HOWEVER, BY ADDING A DIODE A DUTY CYCLE OF LESS THAN 50% CAN BE ACHIEVED.

LATCH UP WHEN DRIVING AN INDUCTIVE LOAD



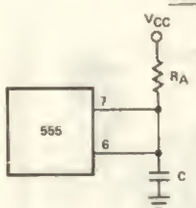
A NEGATIVE VOLTAGE AT PIN 3 CAN CAUSE A LATCH UP. THE SOLUTION IS TO ADD TWO DIODES AS SHOWN. THIS CIRCUIT PROHIBITS A NEGATIVE VOLTAGE FROM REACHING PIN 3.

CONTROL VOLTAGE

PIN 5, THE CONTROL VOLTAGE PIN, IS PRIMARILY USED FOR FILTERING WHEN DEVICE IS USED IN NOISY ENVIRONS. HOWEVER, BY IMPOSING A VOLTAGE AT THIS POINT, IT IS POSSIBLE TO VARY THE TIMING OF THE DEVICE INDEPENDENTLY OF THE "RC" NETWORK. THE CONTROL VOLTAGE MAY BE VARIED FROM 45% TO 90% OF V_{CC} IN THE MONOSTABLE MODE, AND FROM 1.7 VOLTS TO V_{CC} IN THE ASTABLE MODE.

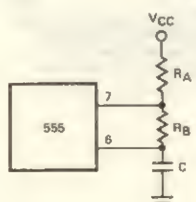
FORMULAS

MONOSTABLE TIMING



$T_{(OUTPUT\ HIGH)} = 1.1\ R_A C$

ASTABLE TIMING



$t_{1(OUTPUT\ HIGH)} = 0.693\ (R_A + R_B)C$

$t_{2(OUTPUT\ LOW)} = 0.693\ (R_B)C$

$T = t_1 + t_2$ (TOTAL PERIOD)

$$f = \frac{1}{T} = \frac{1.44}{(R_A + 2R_B)C}$$

$$D_{(DUTY\ CYCLE)} = \frac{R_B}{R_A + 2R_B}$$

HERE ARE SOME ADDITIONAL INGENIOUS APPLICATIONS DEVISED BY SIGNETICS ENGINEERS AND SOME OF OUR CUSTOMERS.

MISSING PULSE DETECTOR

Using the circuit of Figure 3a, the timing cycle is continuously reset by the input pulse train. A change in frequency, or a missing pulse, allows completion of the timing cycle which causes a change in the output level. For this application, the time delay should be set to be slightly longer than the normal time between pulses. Figure 3b shows the actual waveforms seen in this mode of operation.

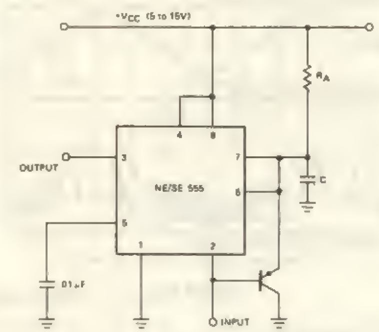
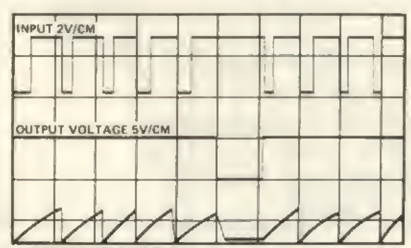


FIGURE 3a.

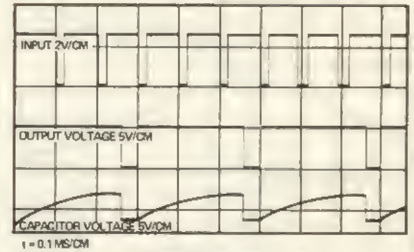


R_A = 1 KΩ, C = .09 μF

FIGURE 3b.

FREQUENCY DIVIDER

If the input frequency is known, the timer can easily be used as a frequency divider by adjusting the length of the timing cycle. Figure 4 shows the waveforms of the timer in Figure 1a when used as a divide by three circuit. This application makes use of the fact that this circuit cannot be retriggered during the timing cycle.



R_A = 1250Ω, C = .02 μF, R_L = 1 KΩ

FIGURE 4.

PULSE WIDTH MODULATION (PWM)

In this application, the timer is connected in the monostable mode as shown in Figure 5a. The circuit is triggered with a continuous pulse train and the threshold voltage is

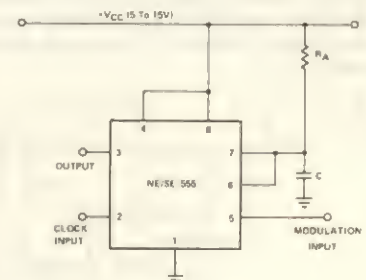


FIGURE 5a.

APPLICATIONS INFORMATION (Cont'd)

modulated by the signal applied to the control voltage terminal (pin 5). This has the effect of modulating the pulse width as the control voltage varies. Figure 5b shows the actual waveforms generated with this circuit.

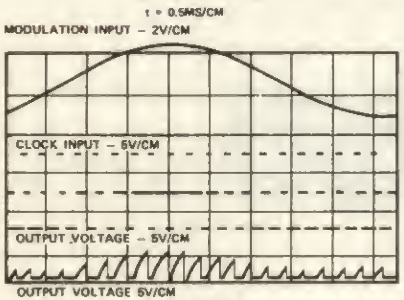


FIGURE 5b.

PULSE POSITION MODULATION (PPM)

This application uses the timer connected for astable (free-running) operation, Figure 6a, with a modulating signal again applied to the control voltage terminal. Now the pulse position varies with the modulating signal, since the threshold voltage and hence the time delay is varied. Figure 6b shows the waveforms generated for triangle wave modulation signal.

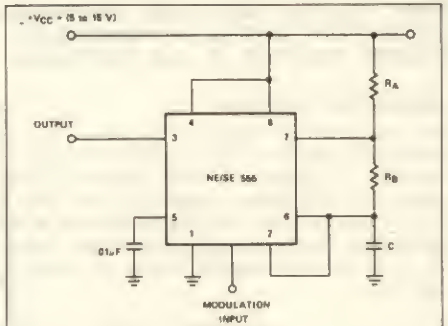
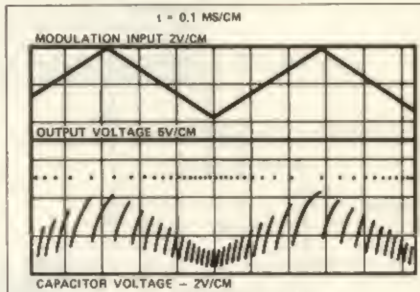


FIGURE 6a.



R_A = 3KΩ, R_B = 500Ω, C = .01 μF, R_L = 1KΩ

FIGURE 6b.

TEST SEQUENCER

Figure 7 shows several timers connected sequentially. The first timer is started by momentarily connecting pin 2 to ground, and runs for 10 msec. At the end of its timing cycle, it triggers the second circuit which runs for 50 msec. After this time, the third circuit is triggered. Note that the timing resistors and capacitors can be programmed digitally and that each circuit could easily trigger several other timers to start concurrent sequences.

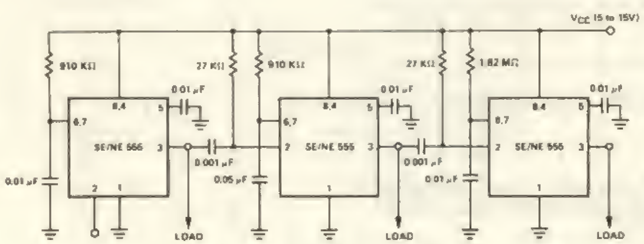


FIGURE 7.

APPLICATIONS INFORMATION

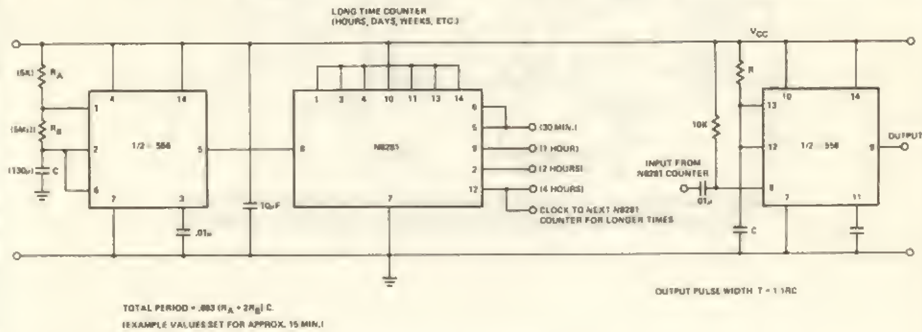
Each half of the 556 behaves like a separate 555 timer and as such all of the applications indicated in the Data Sheet for the 555 also are applicable to the 556.

LONG TIME DELAYS

In the 556 timer the timing is a function of the charging rate of the external capacitor. For long time delays expensive capacitors with extremely low leakage are required. The practicality of the components involved limits the time between pulses to something in the neighborhood of ten minutes.

To achieve longer time periods both halves may be connected in tandem with a "Divide-by" network in between the first timer section operates in an oscillatory mode with a period of $1/f_0$.

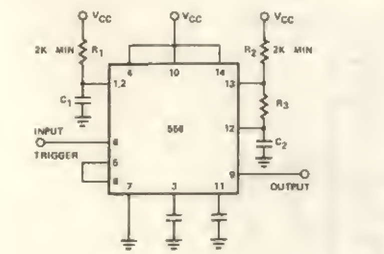
This signal is then applied to a "Divide-by-N" network to give an output with the period of N/f_0. This can then be used to trigger the second half of the 556. The total time delay is now a function of N and f_0.



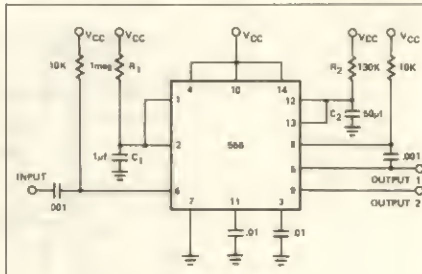
TONE BURST GENERATOR

The 556 Dual Timer makes an excellent Tone Burst Generator. The first half is connected as a one shot and the second half as an oscillator.

necting the output of the first half to the input of the second half via a .001μfd coupling capacitor sequential timing may be obtained. Delay t_1 is determined by the first half and t_2 by the second half delay.



TONE BURST GENERATOR



SEQUENTIAL TIMING

The pulse established by the one shot turns on the oscillator allowing a burst of pulses to be generated.

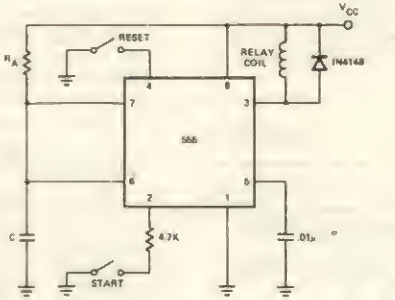
SEQUENTIAL TIMING

One feature of the Dual Timer is that by utilizing both halves it is possible to obtain sequential timing. By con-

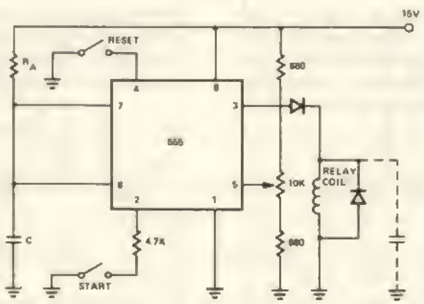
The first half of the timer is started by momentarily connecting pin 6 to ground. When it is timed out (determined by $1.1R_1C_1$) the second half begins. Its time duration is determined by $1.1R_2C_2$).

APPLICATIONS

SIMPLE TIME DELAY

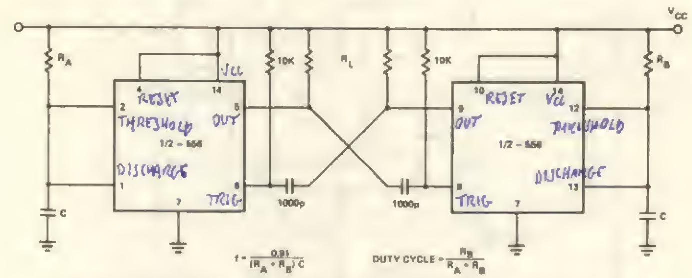


SIMPLE TIME DELAY



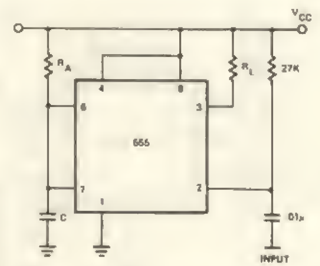
APPLICATIONS (Cont'd)

DUAL ASTABLE



THIS CIRCUIT MAINTAINS THE TEMPERATURE STABILITY OF THE MONOSTABLE MODE FOR ASTABLE OPERATION. IT ALSO ALLOWS A LOAD TO BE DRIVEN IN PUSH-PULL.

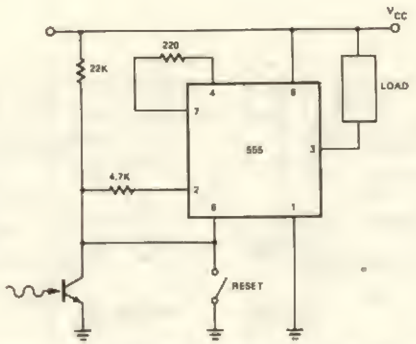
TOUCH CONTROL



THE 27K RESISTOR IS SUITABLE FOR INDUSTRIAL OR PUBLIC ENVIRONMENTS. WITH LOWER AMBIENT NOISE, A HIGHER VALUE OF RESISTOR MAY BE NECESSARY.

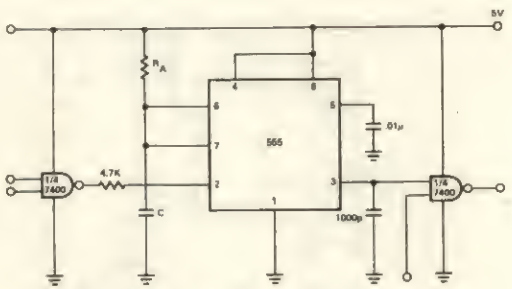
APPLICATIONS (Cont'd)

BURGLAR ALARM



INTERRUPTION OF INCIDENT LIGHT TO THE PHOTOTRANSISTOR CAUSES CURRENT TO FLOW THROUGH THE LOAD.

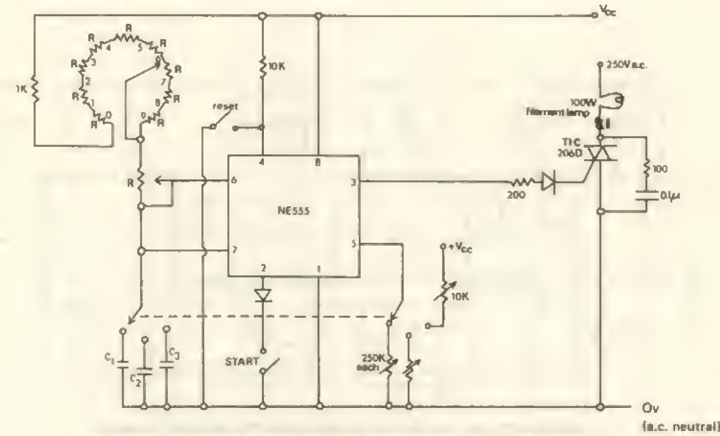
TTL MONOSTABLE



THIS CIRCUIT HAS SUPERIOR TIMING ACCURACY TO CONVENTIONAL TTL MONOSTABLES. THE 4.7K RESISTOR MAY BE REPLACED BY A DIODE, HAVING THE CATHODE TO THE GATE.

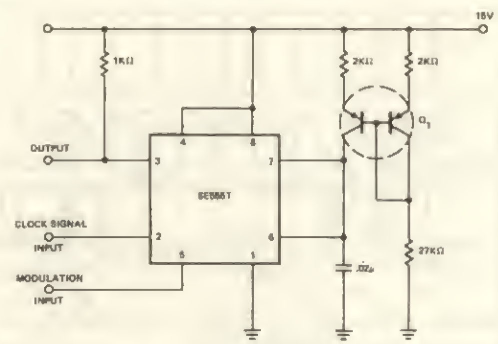
APPLICATIONS (Cont'd)

PHOTOGRAPHIC TIMER



THE SMALL INDUCTOR IN THE LOAD IS TO REDUCE VOLTAGE SPIKES AT SWITCH-ON. IT MAY BE OMITTED IF MAINS SPIKES CAN BE TOLERATED. TO REDUCE RADIATED NOISE FURTHER, THE TRIAC MAY BE DRIVEN FROM A GATED ZERO-CROSSING SWITCH.

LINEAR PULSE WIDTH MODULATOR

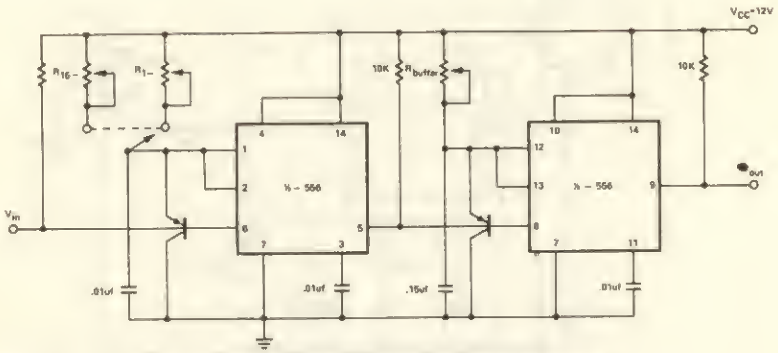


LINEARITY, ±0.2% over +4 to +12 volt input

THE 15V SUPPLY MUST BE WELL-REGULATED.

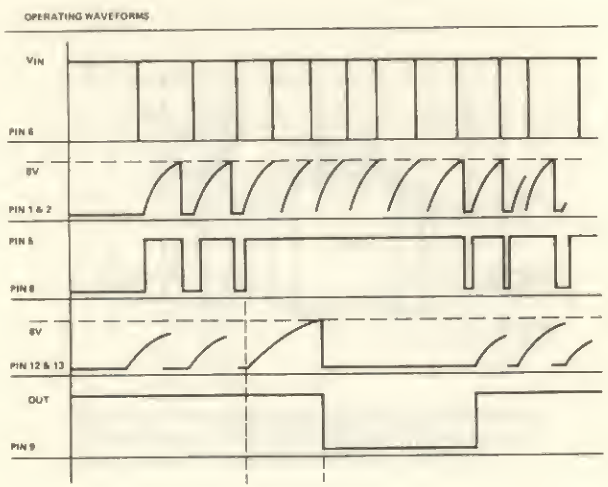
APPLICATIONS (Cont'd)

SPEED WARNING DEVICE

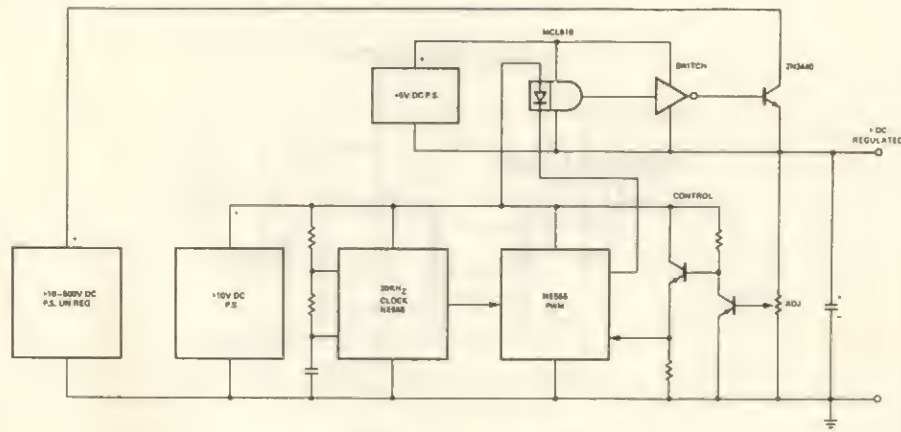


THE INPUT PULSE TRAIN IS DERIVED FROM A TRANSDUCER SENSING THE VEHICLE PROPELLOR SHAFT. THE OUTPUT OF THE SECOND TIMER GOES LOW WHEN A PRESET SPEED IS EXCEEDED.

OPERATING WAVEFORMS

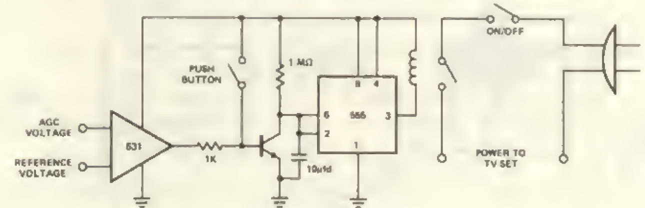


REMOTE CONTROLLED DC SWITCHING REGULATOR



APPLICATION—A PULSE WIDTH MODULATOR TO FEED DIGITAL PULSES INTO SWITCHING SECTION OF REGULAR PROPORTIONAL TO ERROR SIGNAL. ADJUST POT CAN BE REMOTELY POSITIONED.

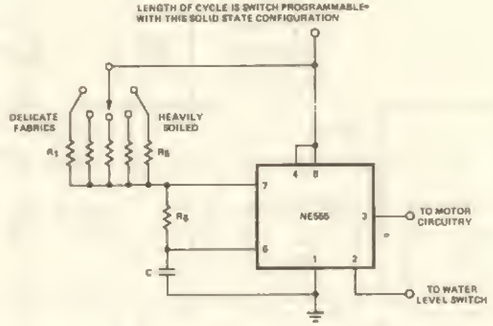
AUTOMATIC TURN OFF FOR TV SET



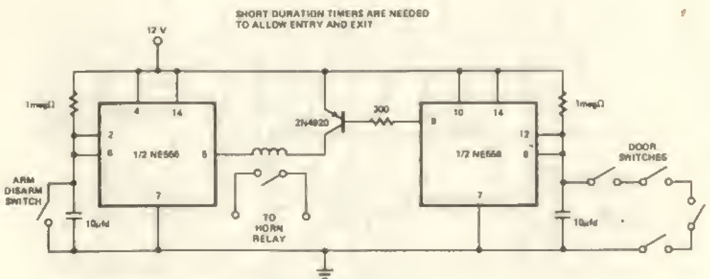
SET TURNS OFF SHORTLY AFTER TV STATION STOPS BROADCASTING

APPLICATIONS (Cont'd)

WASHER TIMER

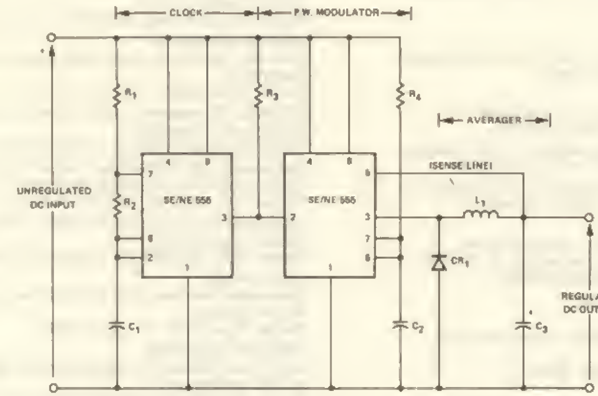


AUTO BURGLAR ALARM



APPLICATIONS (Cont'd)

SWITCHING STEP-DOWN REGULATOR



SCHEMATIC DIAGRAM OF DELAYED LIGHT TURN-OFF

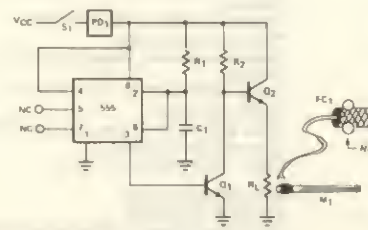
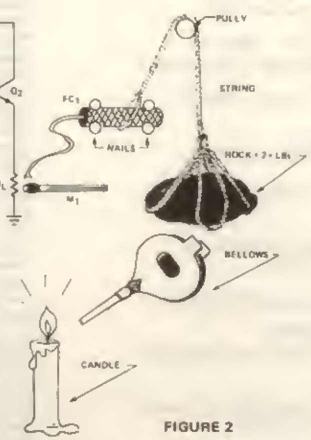


FIGURE 1



R_L = 5Ω 1/8W WIRE WOUND

DESIRED TIME CONSTANT DETERMINED BY VALUES OF R_1 & C_1

FIGURE 2

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