ICM7555/ICM7556

High Reliability General Purpose Timer

GENERAL DESCRIPTION

The ICM7555/6 are CMOS RC timers providing significantly improved performance over the standard SE/NE555/6 and 355 timers, while at the same time being direct replacements for those devices in most applications. Improved parameters include low supply current, wide operating supply voltage range, low THRESHOLD, $\overline{\text{TRIGGER}}$ and $\overline{\text{RESET}}$ currents, no crowbarring of the supply current during output transitions, higher frequency performance and no requirement to decouple CONTROL VOLTAGE for stable operation.

Specifically, the ICM7555/6 are stable controllers capable of producing accurate time delays or frequencies. The ICM7556 is a dual ICM7555, with the two timers operating independently of each other, sharing only V+ and GND. In the one shot mode, the pulse width of each circuit is precisely controlled by one external resistor and capacitor. For astable operation as an oscillator, the free running frequency and the duty cycle are both accurately controlled by two external resistors and one capacitor. Unlike the regular bipolar 555/6 devices, the CONTROL VOLTAGE terminal need not be decoupled with a capacitor. The circuits are triggered and reset on falling (negative) waveforms, and the output inverter can source or sink currents large enough to drive TTL loads, or provide minimal offsets to drive CMOS loads.

ORDERING INFORMATION

Part Number	Temperature Range	Package
ICM7555MTV*	−55°C to +125°C	TO-99 Can
ICM7556MJD*	−55°C to +125°C	14 Lead CERDIP

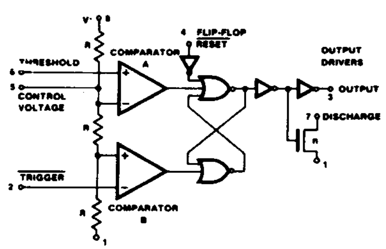
*Add /883B to part number if 883B processing is desired.

FEATURES

- **Exact Equivalent In Most Cases for SE/NE555/556 or TLC555/556**
- **Low Supply Current — 60μA Typ. (ICM7555) 120μA Typ. (ICM7556)**
- **Extremely Low Trigger, Threshold and Reset Currents — 20pA Typical**
- **High Speed Operation — 1MHz Typical**
- **Wide Operation Supply Voltage Range Guaranteed 2 to 18 Volts**
- **Normal Reset Function – No Crowbarring of Supply During Output Transition**
- **Can Be Used With Higher Impedance Timing Elements Than Regular 555/6 for Longer RC Time Constants**
- **Timing From Microseconds Through Hours**
- **Operates In Both Astable and Monostable Modes**
- **Adjustable Duty Cycle**
- **High Output Source/Sink Driver Can Drive TTL/CMOS**
- **Typical Temperature Stability of 0.005% Per °C at 25°C**
- **Outputs Have Very Low Offsets, HI and LO**

APPLICATIONS

- **Precision Timing**
- **Pulse Generation**
- **Sequential Timing**
- **Time Delay Generation**
- **Pulse Width Modulation**
- **Pulse Position Modulation**
- **Missing Pulse Detector**



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This Functional Diagram reduces the circuitry down to its simplest equivalent components. Tie down unused inputs. R = 100kΩ, ±20% typ.

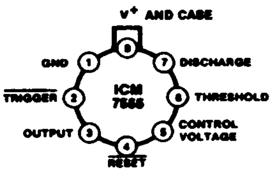
Figure 1: Functional Diagram

ABSOLUTE MAXIMUM RATINGS

Supply Voltage .... +18 Volts
Input Voltage: Trigger,
Control Voltage, Threshold, ... V+ +0.3V to V− −0.3V
Reset
Output Current 100mA
Power Dissipation[2] ICM7556 .... 300mW
ICM7555 .... 200mW
Storage Temperature .... −65°C to +150°C
Lead Temperature (Soldering, 10sec) .... +300°C
Operating Temperature Range[2]
ICM7555/6M .... −55°C to +125°C

NOTE: *Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions above those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.*

2



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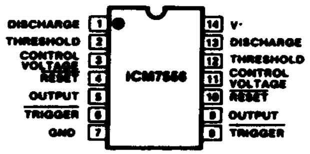
(OUTLINE DRAWING TV)



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(OUTLINE DRAWING JD)

Figure 2: Pin Configuration (Top View)

ICM7555/ICM7556

ICM7555
ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Conditions	ICM7555M $T_A = 25°C$			ICM7555M $-55°C \leq T_A \leq +125°C$			Units
			Min	Typ	Max	Min	Typ	Max	
$I+$	Static Supply Current	$V_{DD} = 5V$ $V_{DD} = 15V$		40 60	200 300			300 300	μA μA
	Monostable Timing Accuracy	$RA = 10k$, $C = 0.1\mu F$, $V_{DD} = 5V$		2		858		1161	% μs
	Drift with Temp*	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$		150 200 250			150 200 250		ppm/°C ppm/°C ppm/°C
	Drift with Supply*	$V_{DD} = 5$ to $15V$		0.5			0.5		%/V
	Astable Timing Accuracy	$RA = RB = 10k$, $C = 0.1\mu F$, $V_{DD} = 5V$		2		1717		2323	% μs
	Drift with Temp*	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$		150 200 250			150 200 250		ppm/°C ppm/°C ppm/°C
	Drift with Supply*	$V_{DD} = 5V$ to $15V$		0.5			0.5		%/V
V_{TH}	Threshold Voltage	$V_{DD} = 15V$	62	67	71	61		72	% V_{DD}
V_{TRIG}	Trigger Voltage	$V_{DD} = 15V$	28	32	36	27		37	% V_{DD}
I_{TRIG}	Trigger Current	$V_{DD} = 15V$			10			50	nA
I_{TH}	Threshold Current	$V_{DD} = 15V$			10			50	nA
V_{CV}	Control Voltage	$V_{DD} = 15V$	62	67	71	61		72	% V_{DD}
V_{RST}	Reset Voltage	$V_{DD} = 2$ to $15V$	0.4		1.0	0.2		1.2	V
I_{RST}	Reset Current	$V_{DD} = 15V$			10			50	nA
I_{DIS}	Discharge Leakage	$V_{DD} = 15V$			10			50	nA
V_{OL}	Output Voltage Drop	$V_{DD} = 15V$, $I_{sink} = 20mA$ $V_{DD} = 5V$, $I_{sink} = 3.2mA$		0.4 0.2	1.0 0.4			1.25 0.5	V V
V_{OH}	Output Voltage Drop	$V_{DD} = 15V$, $I_{source} = 0.8mA$ $V_{DD} = 5V$, $I_{source} = 0.8mA$	14.3 4.0	14.6 4.3		14.2 3.8			V V
V_{DIS}	Discharge Output Voltage Drop	$V_{DD} = 5V$, $I_{SINK} = 15mA$ $V_{DD} = 15V$, $I_{sink} = 15mA$		0.2	0.4			0.6 0.4	V V
$V+$	Supply Voltage	Functional Oper.	2.0		18.0	2.0		18.0	V
t_R	Output Rise Time*	$RL = 10M$, $CL = 10pF$, $V_{DD} = 5V$		75			75		ns
t_F	Output Fall Time*	$RL = 10M$, $CL = 10pF$, $V_{DD} = 5V$		75			75		ns
f_{MAX}	Oscillator Frequency*	$V_{DD} = 5V$, $RA = 470\Omega$, $RB = 270\Omega$ $C = 200pF$		1			1		MHz

*These parameters are based upon characterization data and are not tested.

2

ICM7556

ELECTRICAL CHARACTERISTICS

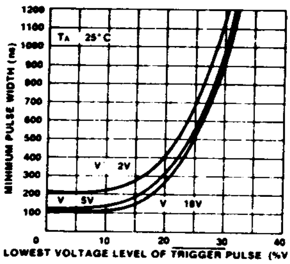
Symbol	Parameter	Test Conditions	ICM7556M $T_A = 25°C$ Min	Typ	Max	ICM7556M $-55°C \leq T_A \leq +125°C$ Min	Typ	Max	Units
I^+	Static Supply Current	$V_{DD} = 5V$ $V_{DD} = 15V$		80 120	400 600			600 600	μA μA
	Monostable Timing Accuracy	RA = 10k, C = 0.1μF, $V_{DD} = 5V$		2		858		1161	% μs
	Drift with Temp*	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$		150 200 250			150 200 250		ppm/°C ppm/°C ppm/°C
	Drift with Supply*	$V_{DD} = 5V$ to 15V		0.5			0.5		%/V
	Astable Timing Accuracy	RA = RB = 10k, C = 0.1μF, $V_{DD} = 5V$		2		1717		2323	% μs
	Drift with Temp*	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$		150 200 250			150 200 250		ppm/°C ppm/°C ppm/°C
	Drift with Supply*	$V_{DD} = 5V$ to 15V		0.5			0.5		% V
V_{TH}	Threshold Voltage	$V_{DD} = 15V$	62	67	71	61		72	% V_{DD}
V_{TRIG}	Trigger Voltage	$V_{DD} = 15V$	28	32	36	27		37	% V_{DD}
I_{TRIG}	Trigger Current	$V_{DD} = 15V$			10			50	nA
I_{TH}	Threshold Current	$V_{DD} = 15V$			10			50	nA
V_{CV}	Control Voltage	$V_{DD} = 15V$	62	67	71	61		72	% V_{DD}
V_{RST}	Reset Voltage	$V_{DD} = 2V$ to 15V	0.4		1.0	0.2		1.2	V
I_{RST}	Reset Current	$V_{DD} = 15V$			10			50	nA
I_{DIS}	Discharge Leakage	$V_{DD} = 15V$			10			50	nA
V_{OL}	Output Voltage Drop	$V_{DD} = 15V$, $I_{sink} = 20mA$ $V_{DD} = 5V$, $I_{sink} = 3.2mA$		0.4 0.2	1.0 0.4			1.25 0.5	V V
V_{OH}	Output Voltage Drop	$V_{DD} = 15V$, $I_{source} = 0.8mA$ $V_{DD} = 5V$, $I_{source} = 0.8mA$	14.3 4.0	14.6 4.3		14.2 3.8			V V
V_{DIS}	Discharge Output Voltage Drop	$V_{DD} = 5V$, $I_{sink} = 15mA$ $V_{DD} = 5V$, $I_{sink} = 15mA$		0.2	0.4			0.6 0.4	V V
V^+	Supply Voltage	Functional Oper.	2.0		18.0	2.0		18.0	V
t_R	Output Rise Time*	RL = 10M, CL = 10pF, $V_{DD} = 5V$		75			75		ns
t_F	Output Fall Time*	RL = 10M, CL = 10pF, $V_{DD} = 5V$		75			75		ns
f_{MAX}	Oscillator Frequency*	$V_{DD} = 5V$, RA = 470Ω, RB = 270Ω, C = 200pF		1			1		MHz

*These parameters are based upon characterization data and are not tested.

ICM7555/ICM7556

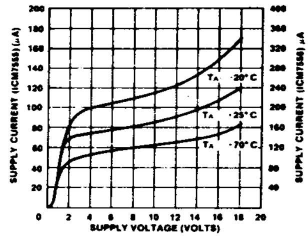
TYPICAL PERFORMANCE CHARACTERISTICS

MINIMUM PULSE WIDTH REQUIRED FOR TRIGGERING



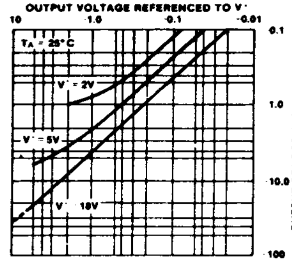
0117-4

SUPPLY CURRENT AS A FUNCTION OF SUPPLY VOLTAGE



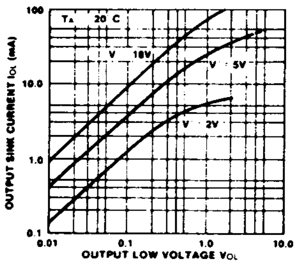
0117-5

OUTPUT SOURCE CURRENT AS A FUNCTION OF OUTPUT VOLTAGE



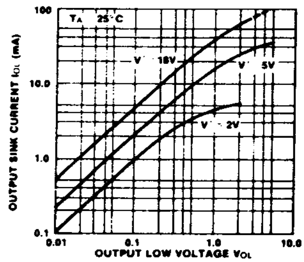
0117-6

OUTPUT SINK CURRENT AS A FUNCTION OF OUTPUT VOLTAGE



0117-7

OUTPUT SINK CURRENT AS A FUNCTION OF OUTPUT VOLTAGE



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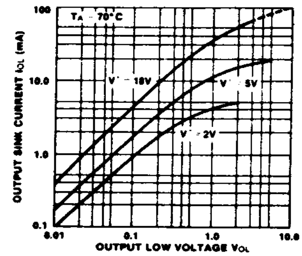
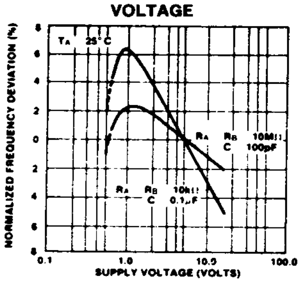
OUTPUT SINK CURRENT AS A FUNCTION OF OUTPUT VOLTAGE



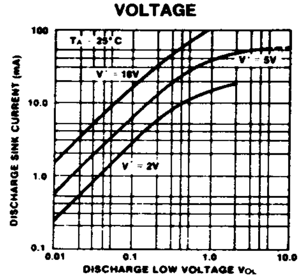
0117-9

NORMALIZED FREQUENCY STABILITY IN THE ASTABLE MODE AS A FUNCTION OF SUPPLY VOLTAGE



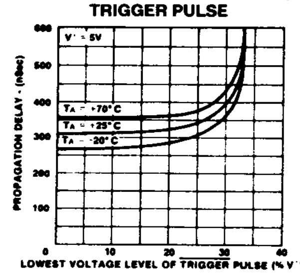
0117-10

DISCHARGE OUTPUT CURRENT AS A FUNCTION OF DISCHARGE OUTPUT VOLTAGE



0117-11

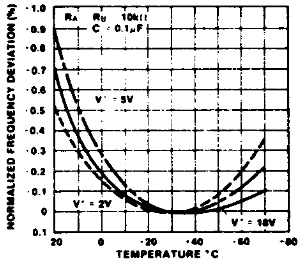
PROPAGATION DELAY AS A FUNCTION OF VOLTAGE LEVEL OF TRIGGER PULSE



0117-12

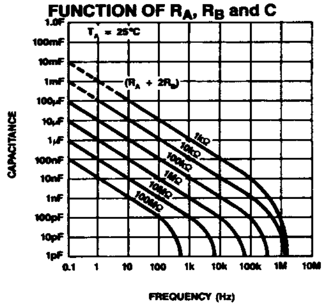
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

NORMALIZED FREQUENCY STABILITY IN THE ASTABLE MODE AS A FUNCTION OF TEMPERATURE



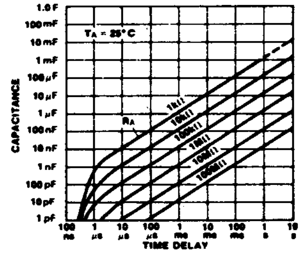
0117-13

FREE RUNNING FREQUENCY AS A FUNCTION OF R_A, R_B and C



0117-14

TIME DELAY IN THE MONOSTABLE MODE AS A FUNCTION OF R_A AND C



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APPLICATION NOTES

GENERAL

The ICM7555/6 devices are, in most instances, direct replacements for the NE/SE 555/6 devices. However, it is possible to effect economies in the external component count using the ICM7555/6. Because the bipolar 555/6 devices produce large crowbar currents in the output driver, it is necessary to decouple the power supply lines with a good capacitor close to the device. The 7555/6 devices produce no such transients. See Figure 3.

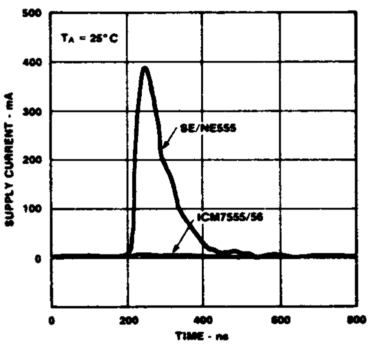

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Figure 3: Supply Current Transient Compared with a Standard Bipolar 555 During an Output Transition

The ICM7555/6 produces supply current spikes of only 2–3mA instead of 300–400mA and supply decoupling is normally not necessary. Secondly, in most instances, the CONTROL VOLTAGE decoupling capacitors are not required since the input impedance of the CMOS comparators on chip are very high. Thus, for many applications 2 capacitors can be saved using an ICM7555, and 3 capacitors with an ICM7556.

POWER SUPPLY CONSIDERATIONS

Although the supply current consumed by the ICM7555/6 devices is very low, the total system supply can be high unless the timing components are high impedance. Therefore, use high values for R and low values for C in Figures 4 and 5.

OUTPUT DRIVE CAPABILITY

The output driver consists of a CMOS inverter capable of driving most logic families including CMOS and TTL. As such, if driving CMOS, the output swing at all supply voltages will equal the supply voltage. At a supply voltage of 4.5 volts or more the ICM7555/6 will drive at least 2 standard TTL loads.

ASTABLE OPERATION

The circuit can be connected to trigger itself and free run as a multivibrator, see Figure 4. The output swings from rail to rail, and is a true 50% duty cycle square wave. (Trip points and output swings are symmetrical). Less than a 1% frequency variation is observed, over a voltage range of +5 to +15V.

$$f = \frac{1}{1.4\,RC}$$

The timer can also be connected as shown in Figure 4b. In this circuit, the frequency is:

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

The duty cycle is controlled by the values of R_A and R_B, by the equation:

$$D = (R_A + R_B)/(R_A + 2R_B)$$

MONOSTABLE OPERATION

In this mode of operation, the timer functions as a one-shot. Initially the external capacitor (C) is held discharged by a transistor inside the timer. Upon application of a negative $\overline{\text{TRIGGER}}$ pulse to pin 2, the internal 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 a time constant $t = R_AC$. When the voltage across the capacitor equals ⅔ V^+, the comparator resets the flip flop, which in turn discharges the capacitor rapidly and also drives the OUTPUT to its low state. $\overline{\text{TRIGGER}}$ must return to a high state before the OUTPUT can return to a low state.

$$t_{output} = -\ln(1/3)\,R_AC = 1.1\,R_AC$$

ICM7555/ICM7556

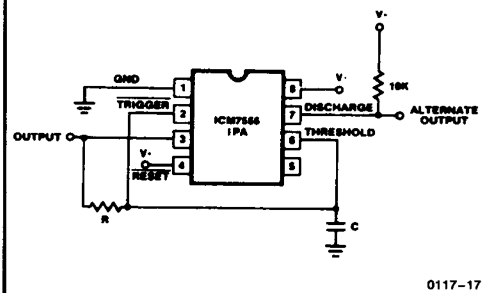

Figure 4a: Astable Operation

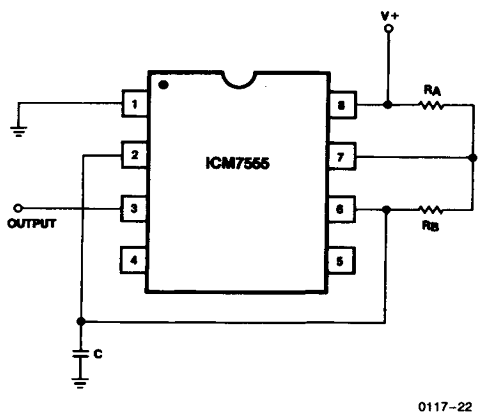

Figure 4b:

CONTROL VOLTAGE

The CONTROL VOLTAGE terminal permits the two trip voltages for the THRESHOLD and $\overline{\text{TRIGGER}}$ internal comparators to be controlled. This provides the possibility of oscillation frequency modulation in the astable mode or even inhibition of oscillation, depending on the applied voltage. In the monostable mode, delay times can be changed by varying the applied voltage to the CONTROL VOLTAGE pin.

$\overline{\text{RESET}}$

The $\overline{\text{RESET}}$ terminal is designed to have essentially the same trip voltage as the standard bipolar 555/6, i.e. 0.6 to 0.7 V. At all supply voltages it represents an extremely high input impedance. The mode of operation of the $\overline{\text{RESET}}$ function is, however, much improved over the standard bipolar 555/6 in that it controls only the internal flip flop, which in turn controls simultaneously the state of the OUTPUT and DISCHARGE pins. This avoids the multiple threshold problems sometimes encountered with slow falling edges in the bipolar devices.

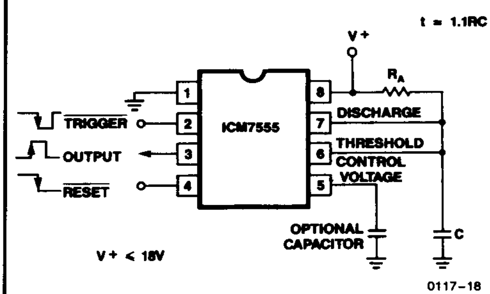

Figure 5: Monostable Operation

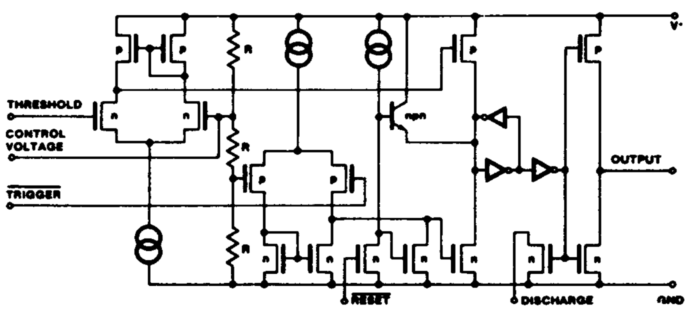

Figure 6: Equivalent Circuit

TRUTH TABLE

Threshold Voltage	$\overline{\text{Trigger}}$ Voltage	$\overline{\text{RESET}}$	Output	Discharge Switch
DON'T CARE	DON'T CARE	LOW	LOW	ON
$>2/3(V+)$	$>1/3(V+)$	HIGH	LOW	ON
$<2/3(V+)$	$>1/3(V+)$	HIGH	STABLE	STABLE
DON'T CARE	$<1/3(V+)$	HIGH	HIGH	OFF

NOTE: $\overline{\text{RESET}}$ will dominate all other inputs: $\overline{\text{TRIGGER}}$ will dominate over THRESHOLD.