MIC1555/1557 Evaluation Board

High-Speed BiCMOS Timer/Oscillator

Description

The MIC1555/1557 evaluation board is an assembled daughter board with both an MIC1555 IttyBitty™ timer/oscillator and MIC1557 IttyBitty™ oscillator. The evaluation board plugs into 14-pin DIP sockets and 0.1" solderless prototype boards.

The MIC1555 has separate threshold (upper limit) and trigger (lower limit) comparator inputs and may be used as an astable (oscillator) or monostable (one-shot).

The MIC1557 is used as a monostable (one-shot) only, has a chip select (CS), and usable output up to 5MHz.

In monostable mode, the output pulse width is precisely controlled by charging external timing capacitor C_T through resistor R_T connected to the output. Time delays may be accurately controlled from microseconds to hours.

In oscillator mode, OUT pumps external timing capacitor C_T through a resistor R_T connected to both TRG (trigger) and THR (threshold). The output is a nominal 50% duty-cycle, rail-to-rail output up to 5MHz.

Requirements

The evaluation board operates from 2.7V to 18Vdc with no external components. External RC timing elements may be added to tailor the pulse width or frequency.

Operation

Refer to the evaluation board schematic in Figure 1 and pcb orientation (below). *Circuit board* pin numbers and pin names are shown in bold or brackets. [1] is located next to "R1".

The MIC1555 (T10) OUT [7] remains low until input TR (trigger) [10] falls below 33% of the operating voltage V_S [4], causing OUT to switch to the positive rail, charging C4 through R4. When the voltage at Threshold pin TH [8,9] rises above 67% of V_S after approximately 110µs, OUT switches low.

Threshold has *precedence* over trigger, i.e., OUT is *low* whenever Threshold is *above* $⅔V_S$, reducing power consumption.

Timer Basics

Monostable (One-Shot)

A monostable produces a single pulse "one-shot" each time it is triggered. The pulse width is constant, while the time between pulses depends on the trigger input. One-shots are generally used to "stretch" incoming pulses of varying widths to a *minimum* width.

Pulse width is the time it takes to charge a capacitor from ground to the threshold's trip point ($⅔V_S$) after trigger goes *below* $⅓V_S$. Capacitor C_T (C4) is charged through resistor R_T (R4) connected to MIC1555 OUT [7]. Pulse width, when OUT is high, is approximately:

$$t = 1.1 \times R4 \times C4 = (1.1 \times 100pF \times 1M\Omega = 110\mu s)$$

Diode D1 allows C4 to quickly discharge when OUT is low, allowing the circuit to be retriggered within a few microseconds.

MIC1555 pulse width may be *reduced* by connecting an external resistor in parallel with R4 between TH [8,9] to OUT [7]. Pulse width may be *increased* by connecting an external capacitor in parallel with C4 between TH (threshold) [8,9] and GND [3,5,6 or 13].

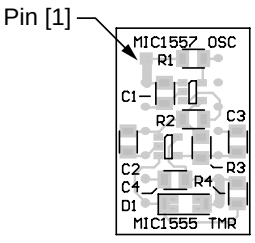
When power is applied, the MIC1555 may produce a single pulse.

If input TR (trigger) remains low longer than the OUT pulse width, short oscillations may be seen at OUT since TH has *precedence* over TR. These pulses occur as OUT goes *low* when TH rises above $⅔V_S$ and then goes high as soon as TH drops below $⅔V_S$ and trigger function is reasserted. By *AC coupling* the TR pin with a series capacitor and pull-up resistor (with an RC time constant less than the pulse width) will prevent these short oscillations. AC TR [11] has a 100k pull-up resistor and 0.01µF capacitor connected to TR [10] for <1ms retrigger. Place a capacitor in series with AC TR for faster response.

Rising-Edge Triggered Monostable

Figure 6 in the MIC1555/1557 data sheet shows how to obtain a low-going pulse from a rising edge input.

PCB Assembly Orientation



MIC1555/1557 Evaluation Board
(14-Pin Daughter Board—Top View)

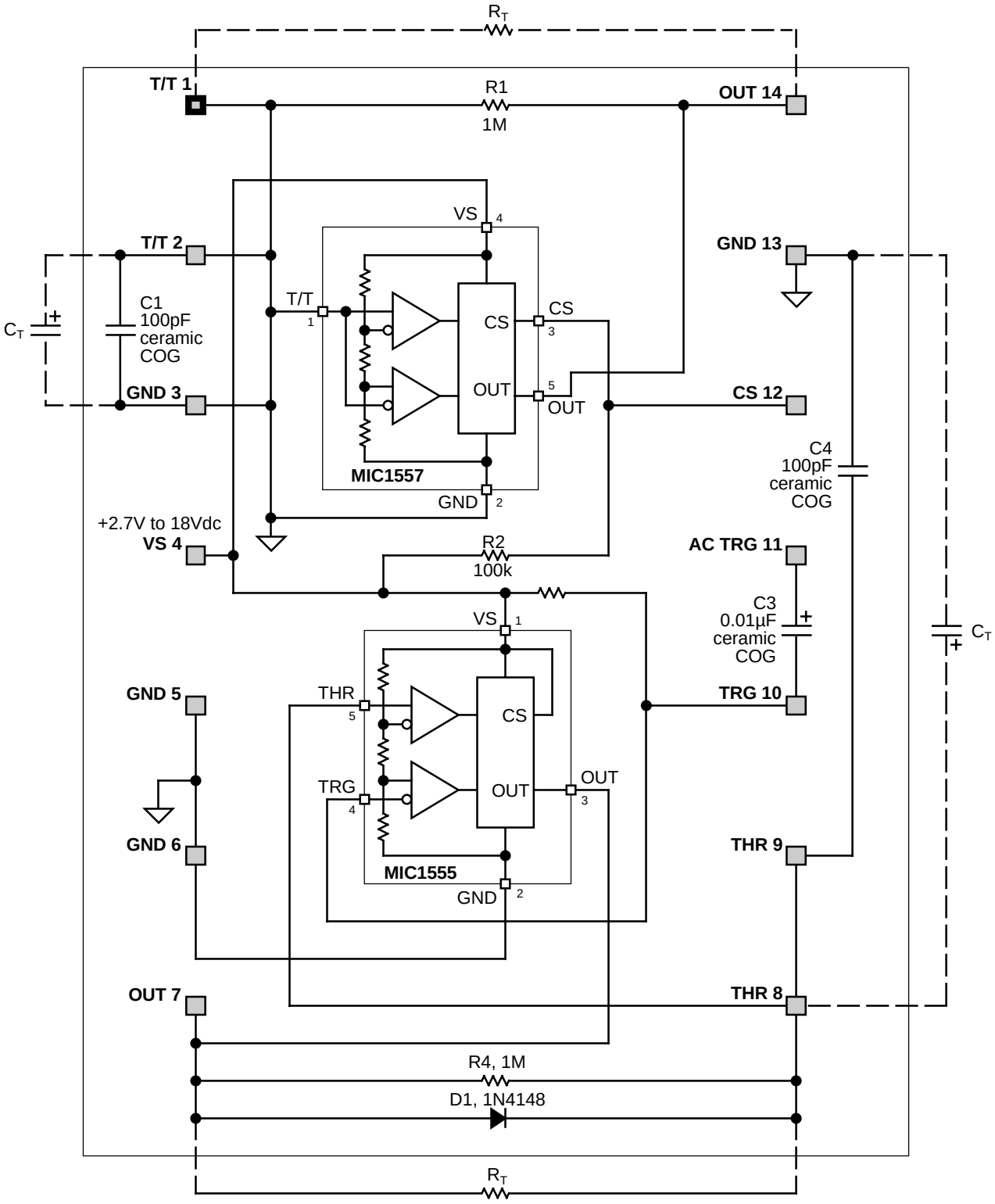


Figure 1. MIC1555/1557 Evaluation Board

Long Time Delays

Timing resistors larger than 1MΩ or capacitors greater than 10µF are not recommended due to component leakage current inaccuracies. Time delays greater than 10 seconds are more accurately produced by dividing the output of an oscillator by a chain of flip-flop counter stages. To produce an accurate one-hour delay, for example, divide a 4.55Hz MIC1557 oscillator by 16,384 (4000_{hex}, 2^{14}) with a *CD4020* CMOS divider. 4.55Hz may be generated with a 1µF C_T and approximately a 156kΩ variable R_T.

Astable (Oscillator)

The MIC1557 (T11) is optimized for astable operation, with a CS (chip select/reset) input for low power (<1µA) shutdown. The MIC1555 (T10) is optimized for monostable operation, but may be used as an astable by connecting TR [10] to TH [8,9]. MIC1557 is enabled when CS [12] is high.

Oscillator frequency depends on the RC time constant, and is approximately:

$$f = \frac{1}{1.4 \times R_T \times C_T} = (7kHz)$$

when R1 is connected from OUT [14] to T/T [1,2]. The frequency may be *increased* by connecting an external resistor in parallel with R1 from T/T [1,2] to OUT [14], or *decreased* by connecting an external capacitor in parallel with C1 between T/T [1,2] to GND [3,5,6 or 13].

The *first* half-cycle of an astable, after power-on or CS enable, is lengthened to:

$$1.1 \times R_T \times C_T = (110\mu s)$$

the same as the pulse-width of a one-shot—since C_T is charging from *ground* instead of ⅓V_S trigger trip.

Accuracy

The two comparators in MIC1555/1557 use an internal resistor ratio voltage divider to set threshold and trigger trip points to approximately ⅔ and ⅓ of V_S, ± 2% respectively. Since the charge and discharge rates of an RC circuit are dependent on the applied voltage, timing remains proportionally constant if the operating voltage varies.

Above 1MHz (<1µs), timing and duty cycle are affected by operating voltage, the values and Q of R_T and C_T and board layout. See the chart in the data sheet. A minimum R_T of 1kΩ and a minimum C_T of 68pF are recommended for consistent operation. If two diodes are used to adjust duty cycle, their forward voltage decreases with temperature, changing the frequency slightly.

Duty Cycle

Comparator trip points and similar output charge and discharge currents produce a nominal 50% ±2% astable duty-cycle. If a duty cycle other than 50% is desired, a low-power fast-signal diode (1N4148 or 1N914) may be connected in series with the timing resistor (R_A), and a second resistor (R_B), in series with an opposite facing diode, must be connected in parallel with R_A and its diode, as shown in the MIC1555/1557 data sheet Figure 2. The cycle time is then made up of two components: charge time:

$$t_A = 0.7 \times R_A \times C_T$$

and discharge time:

$$t_B = 0.7 \times R_B \times C_T$$

The frequency is the *reciprocal of the sum* of the two times:

$$f = \frac{1}{t_A + t_B}$$

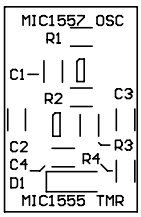
Sequencing

MIC1555 OUT [7] may be directly connected to MIC1557 CS [12] to produce a triggered tone burst. Likewise, MIC1557 OUT [14] may be connected to MIC1555 AC TR [11] to produce a train of constant width pulses.

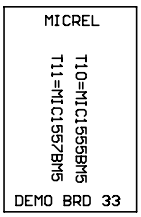
Precautions

- OUT is not protected against ESD damage. The usual precautions for working with CMOS parts are required.
- If OUT is heavily loaded, less energy is available for charging or discharging the RC network, so pulse-width may increase with load.
- Inductive loads on OUT may cause latch-up, unless a diode clamp is used to prevent negative excursions.
- Surface-mount components are very sensitive to over-temperature during mounting and may shift value.
- CS must not be left floating (the evaluation board has a 100k pull-up resistor). CS must be above ⅔V_S for reliable operation.
- Device power dissipation may be exceeded at high V_S and low-resistance output loads.
- The astable MIC1557 (T11) is not designed for monostable operation, as the TH and TR pins are connected together as T/T [1,2].
- For operation above 1MHz, use fast recovery diodes (<200ns) to adjust duty-cycle.
- Reversed polarity power supply connections may destroy the device.

Printed Circit Layout



Top Silk Screen



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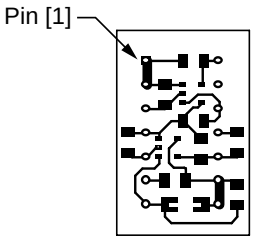

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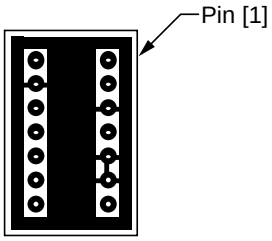

Bottom Layer

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