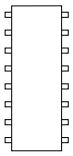
A5338

Smoke Detector with Interconnect and Timer

Package A, 16-lead DIP



Approximate Scale 1:1



Features

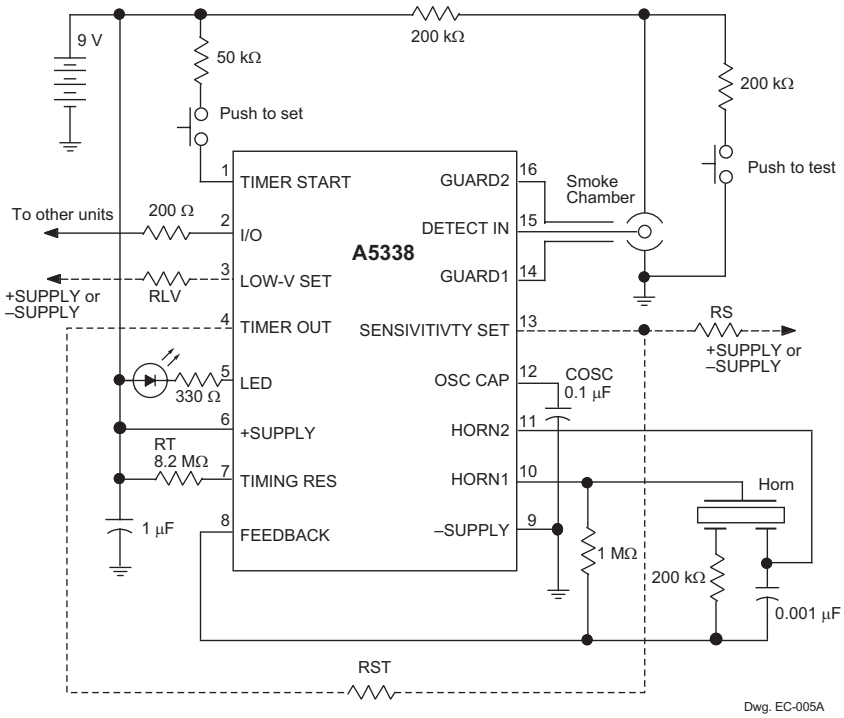
- Interconnect up to 125 detectors
- Piezoelectric horn driver
- Guard outputs for detector input
- Pulse testing for low battery
- Power-on reset
- Internal reverse battery protection
- Internal timer and control for reduced sensitivity
- Built-in hysteresis reduces false triggering

The A5338CA is a low-current, CMOS circuit providing all of the required features for an ionization-type smoke detector. A networking capability allows as many as 125 units to be interconnected so that if any unit senses smoke, all units will sound an alarm. In addition, special features are incorporated to facilitate alignment and test of the finished smoke detector. This device is designed to comply with Underwriters Laboratories Specification UL217.

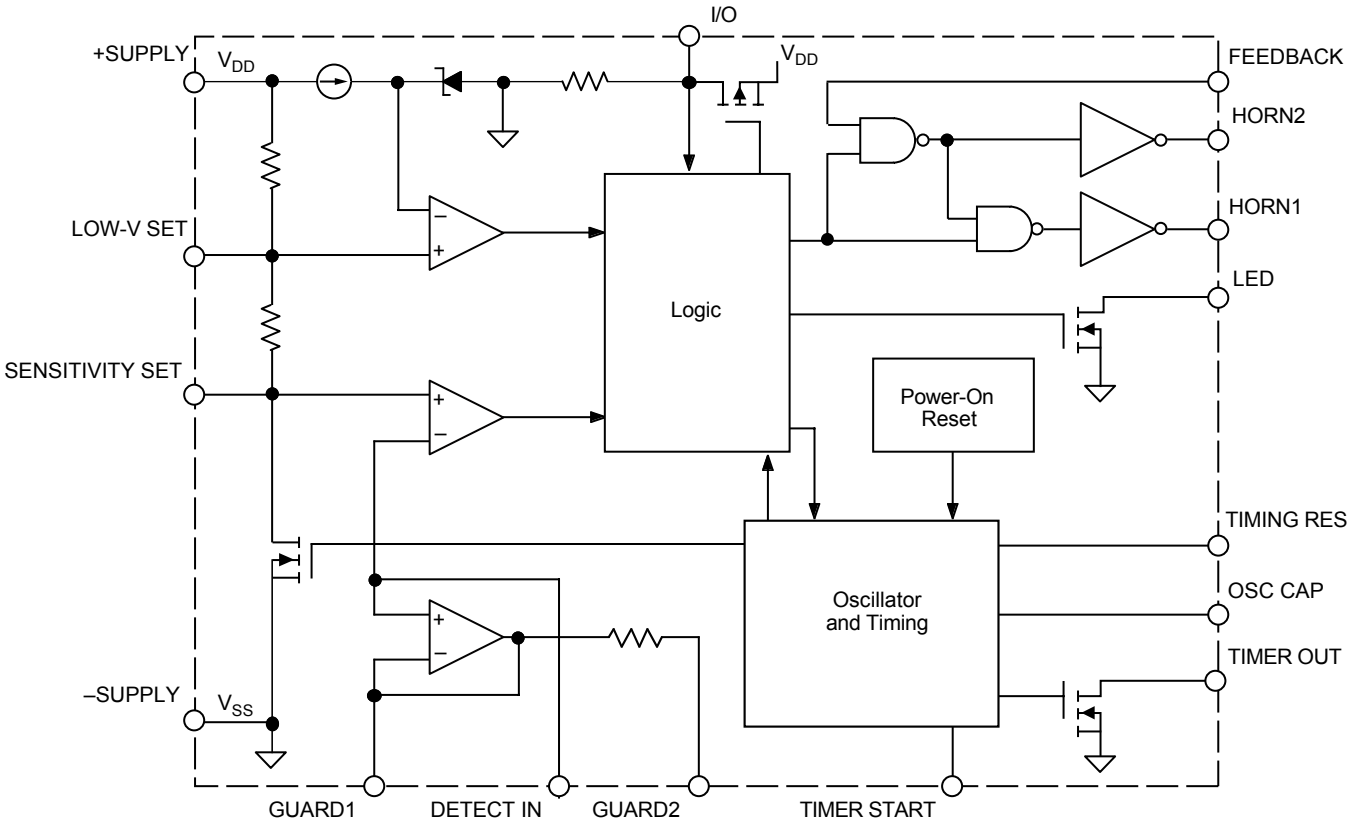
The internal oscillator and timing circuitry keeps standby power to a minimum by powering down the device for 1.66 seconds and sensing smoke for only 10 ms. Every 24 on/off cycles, a check is made for low battery condition. By substituting other types of sensors, or a switch for the ionization detector, this very-low power device can be used in numerous other battery-operated safety/security applications.

The A5338CA is supplied in a low-cost, 16-pin dual in-line plastic package. It is rated for continuous operation over the temperature range of 0°C to +50°C.

Typical Application



Functional Block Diagram



Selection Guide

Part Number	Package	Packing
A5338CA	16-pin DIP, 300 mil spacing	25 pieces per tube

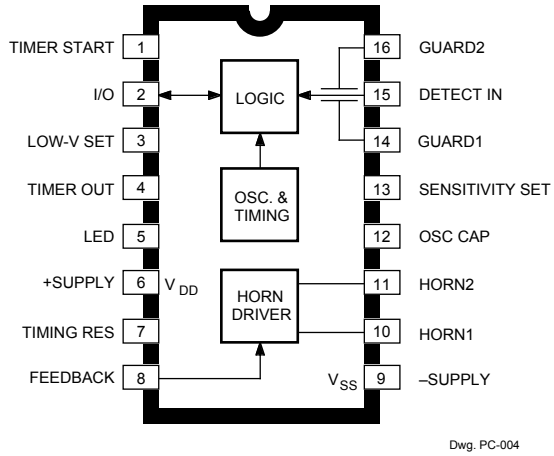
Absolute Maximum Ratings[1]

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Supply Voltage Range[2]	V_{DD}		–0.5	–	15	V
Reverse Battery	–	10.5 V	–	–	20	s
Logic Input Voltage Range[2]	V_I		–0.3		V_{DD} + 0.3	V
Logic Input Current	I_I		–	–	10	mA
Operating Temperature Range (C)	T_A		0	–	50	°C
Junction Temperature	T_J		–	–	150	°C
Storage Temperature Range	T_S		–55	–	125	°C

[1]CMOS devices have input static protection, but are susceptible to damage when exposed to extremely high static electrical charges.
[2]Voltages are references to V_{SS}.

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Pin-out Diagram



Dwg. PC-004

Terminal List Table

Number	Name	Function
1	TIMER START	Logic input for setting device mode.
2	I/O	Logic input/output, where multiple detectors can be connected.
3	LOW-V SET	Terminal for a resistor, RLV, to the –SUPPLY pin (V_{SS}) or to the +SUPPLY pin (V_{DD}), which may be added to modify the battery Low Voltage Threshold, V_{DDL}.
4	TIMER OUT	Terminal for a resistor, RST, to reduce sensitivity during Timer mode.
5	LED	LED output.
6	+SUPPLY	Device supply, V_{DD}.
7	TIMING RES	Terminal for timing resistor.
8	FEEDBACK	Feedback from horn external circuit.
9	–SUPPLY	Device supply, V_{SS}.
10	HORN1	Horn driver output 1.
11	HORN2	Horn driver output 2.
12	OSC CAP	Terminal for timing oscillator capacitor.
13	SENSITIVITY SET	Terminal for resistor, RS, to adjust sensitvity for a particular smoke chamber.
14	GUARD1	Terminal for smoke detector guard 1.
15	DETECT IN	Terminal for smoke detector input.
16	GUARD2	Terminal for smoke detector guard 2.

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ELECTRICAL CHARACTERISTICS[1] at T_A = 25°C, V_{DD} = 9.0 V, V_{SS} = 0 V, C_{OSC} = 0.1 µF, R_T = 8.2 MΩ, unless otherwise noted

Characteristic	Symbol	Test Pin	Test Conditions	Min.	Typ.	Max.	Units
Supply Voltage Range	V_{DD}	6	Operating	6.0	9.0	12	V
Supply Current	I_{DD}	6	V_{DD} = 9.0 V, no alarm, no loads	—	5.0	9.0	µA
			V_{DD} = 12 V, no alarm, no loads	—	—	12	µA
Detector Input Current[2]	I_S	15	0 to 40% RH, $V_{I(detect\ in)}$ = 0 to 9.0 V	–1.0	—	1.0	pA
Input Offset Voltage	V_{IO}	14-15	Active guard	–100	—	100	mV
		16-15	Active guard	–100	—	100	mV
		15-13	Smoke detect comparator	–50	—	50	mV
Hysteresis	V_{Ohys}	13	No alarm condition to alarm	90	130	170	mV
Common Mode Range	$V_{IC(guard)}$	14-15	Guard amplifier	2.0	—	V_{DD} - 0.5	V
	$V_{IC(det)}$	13-15	Smoke detect comparator	0.5	—	V_{DD} - 2.0	V
Active Guard Impedance	Z_{guard}	14	With reference to V_{SS}	—	10	—	Ω
		16	With reference to V_{SS}	—	500	—	Ω
Oscillator Period	t_{OSC}	12	No alarm	1.34	1.67	2.00	s
			Alarm	32	40	48	ms
Oscillator Pulse Width	$t_{w(osc)}$	4		8.0	10	12	ms
Timer Period	t_{timer}	4	After V_{TIMER_START} transition high-to-low (smoke detected)	5.0	6.5	8.0	min
Low Voltage Threshold	$V_{DD(th)}$	6	T_A = 0 to 50°C	7.2	—	7.8	V
Sensitivity Adjust Voltage	V_S	13	$V_{SENSITIVITY_SET}/V_{DD}$, SENSITIVITY SET pin open circuit	48.5	50	51.5	%
HORN*x* Output Voltage	$V_{O(horn)}$	10-11	$I_{O(horn)}$ = 16 mA, V_{DD} = 9.0 V	—	0.1	0.5	V
			$I_{O(horn)}$ = 16 mA, V_{DD} = 7.2 V	—	—	0.9	V
			$I_{O(horn)}$ = –16 mA, V_{DD} = 9.0 V	8.5	8.8	—	V
			$I_{O(horn)}$ = –16 mA, V_{DD} = 7.2 V	6.3	—	—	V
HORN*x* Output ON Time	$t_{on(horn)}$	10-11	Alarm	120	160	208	ms
			Low battery	8.0	10	12	ms
HORN*x* Output OFF Time	$t_{off(horn)}$	10-11	Alarm	60	80	104	ms
			Low Battery	32	40	48	s
TIMER START Logic Levels	$V_{IH(ts)}$	1		4.5	—	—	V
	$V_{IL(ts)}$	1		—	—	2.5	V
TIMER START Input Current	$I_{I(ts)}$	1	$V_{I(ts)}$ = 9.0 V	20	—	80	µA
TIMER OUT Output Current	$I_{O(to)}$	4	$V_{O(to)}$ = 0.5 V	500	—	—	µA
LED Output ON Current	I_{LED}	5	V_{DD} = 7.2 V, V_{LED} = 1.0 V	10	—	—	mA
LED Output ON Time	$t_{on(led)}$	5		8.0	10	12	ms
LED Output OFF Time	$t_{off(led)}$	5	No alarm; in Standby mode	32	40	48	s
			No alarm; in Timer mode after V_{TIMER_START} transition high-to-low	8.0	10	12	s
I/O Current[2]	$I_{(io)}$	2	No alarm, $V_{(IO)}$ = V_{DD} - 2.0 V	25	—	60	µA
			Alarm, $V_{(IO)}$ = V_{DD} - 2.0 V	-7.5	—	—	mA
			Charge dump, $V_{(io)}$ = 1.0 V	5.0	—	—	mA
I/O Charge Dump Duration	$t_{f(io)}$	2	After local alarm	1.33	1.66	1.99	s
I/O Alarm Voltage	$V_{I(io)}$	2	External alarm signal in	3.0	—	—	V
I/O Delay	$t_{d(io)}$	2	Alarm signal out	—	3.0	—	s

[1]Alarm (smoke detected) condition is defined as $V_{DETECT_IN} < V_{SENSITIVITY_SET}$; No-Alarm (no smoke detected) condition is defined as $V_{DETECT_IN} > V_{SENSITIVITY_SET}$.
[2]Negative current is defined as coming out of (sourcing) the specified device pin.

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Functional Description

The A5338 is a low-current CMOS circuit providing all of the required features for an ionization-type smoke detector.

Oscillator. An internal oscillator operates with a period of 1.67 s during no-smoke conditions. Every 1.67 s, internal power is applied to the entire circuit and a check is made for smoke. Every 24 oscillator cycles (40 s total), the LED is pulsed and a check is made for low battery by comparing V_{DD} to an internal reference. Because very low currents are used in the device, the oscillator capacitor, COSC, at the OSC CAP pin should be a low-leakage type (PTFE, polystyrene, or polypropylene).

Detector Circuitry. When smoke is detected, the resistor divider network that sets the sensitivity (smoke trip point) is altered to increase the voltage on the SENSITIVITY SET pin by 130 mV typical, when there are no external connections to the SENSITIVITY SET pin or LOW-V SET pin. This provides hysteresis and reduces false triggering. An active guard is provided on both GUARD*x* pins, adjacent to the DETECT IN detector input pin. The voltage at the GUARD*x* pins will be within 100 mV of DETECT IN. This will keep surface leakage currents to a minimum, and provide a method of measuring the input voltage without loading the ionization chamber. The active guard amplifier is not power-strobed and thus provides constant protection from surface leakage currents. The detector input has internal diode protection against static damage.

Alarm Circuitry. If smoke is detected, the oscillator period changes to 40 ms and the horn is enabled. The horn output is 160 ms ON, and 80 ms OFF, typical. During the OFF time, smoke is again checked and the circuit will inhibit further horn output if smoke is not sensed. During smoke conditions, the low-battery-warning is inhibited. The LED is driven at a 1 Hz rate, and will only turn ON while the horn outputs are in the OFF state.

Sensitivity Adjust. The detector sensitivity to smoke is set internally by a voltage divider connected between V_{DD} and V_{SS}. The sensitivity can be externally adjusted to the individual characteristics of the ionization chamber by connecting a resistor, RS, between the SENSITIVITY SET pin and +SUPPLY, or between SENSITIVITY SET pin and –SUPPLY.

Low Battery. The low-battery threshold is set internally by a voltage divider connected between V_{DD} and V_{SS}. The threshold can be increased by connecting a resistor, RLV, between the LOW-V SETpin and +SUPPLY. The threshold can be decreased by connecting RLV between LOW-V SETpin and –SUPPLY. The battery voltage level is checked every 40 s during the 10 mA, 10 ms LED pulse. If an LED is not used, it should be replaced with an equivalent resistor (typically 500 to 1000 Ω), such that the battery loading remains at 10 mA.

Timer. An internal timer is provided that can be used in various configurations to allow for a period of reduced smoke detector sensitivity, *Hush* mode. When a high-to-low transition occurs at the TIMER START pin, the internal timer is reset, Timer mode is enabled, and the circuit is reset to a no-alarm condition. During Hush mode, the LED will flash at a 10 s rate. If the level of smoke is increased such that the reduced sensitivity level is reached, the device will go into the alarm condition. The timer, however, will continue to completion of the nominal 6.5 minute period (232 oscillator cycles). If Timer mode is not used, the TIMER START pin should be tied low. While in Hush mode, the battery is checked. If a low-battery condition is detected, the low-battery warning chirp will be activated.

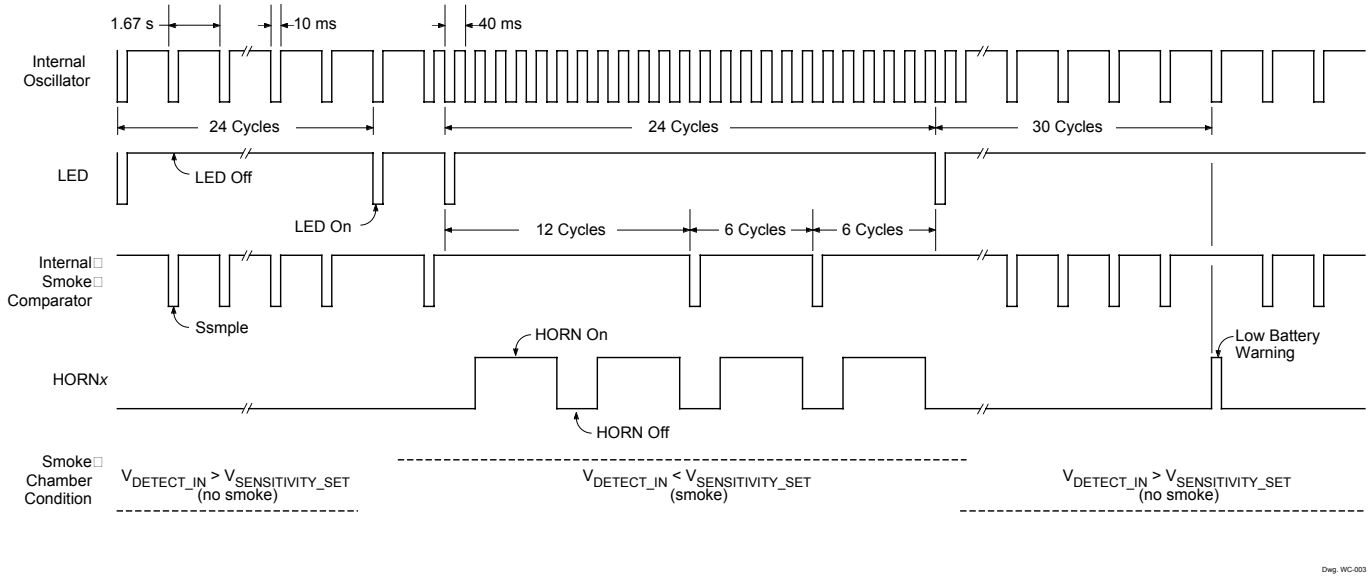
I/O. The I/O pin provides a terminal to allow multiple smoke detectors to be commoned. If any single unit detects smoke (I/O is driven high), all connected units will sound their associated horns after a nominal 3 s delay. The LED is suppressed when an alarm is signaled from another interconnected unit. An internal NMOS device acts as a charge dump to aid in applications involving a large (distributed) capacitance on the I/O pin. The charge dump is activated only on the removal of a local alarm.

Testing. On power-up, all internal counters are reset. Internal test circuitry allows for low-battery check by holding the FEEDBACK and OSC CAP pins low during power-up, then reducing V_{DD} and monitoring HORN1. All functional tests can be accelerated by driving OSC CAP with a 2 kHz square wave. The 10 ms strobe period must be maintained for proper operation of the comparator circuitry.

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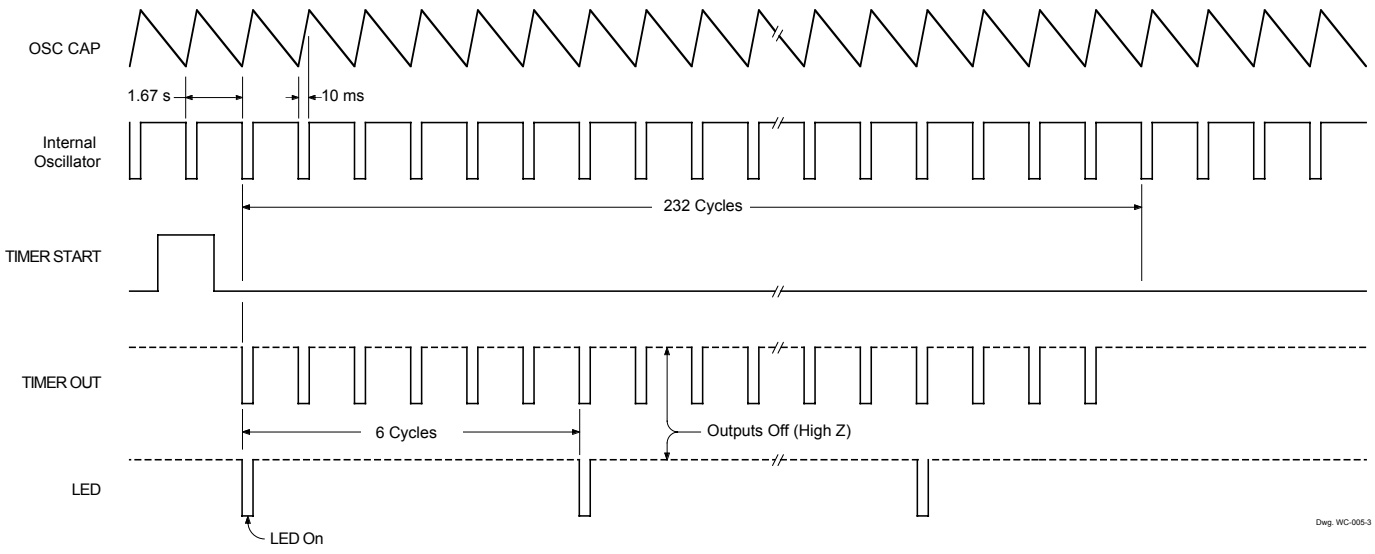
Timing Requirements: Nontimer Mode

(Circuit Shown in Typical Application)



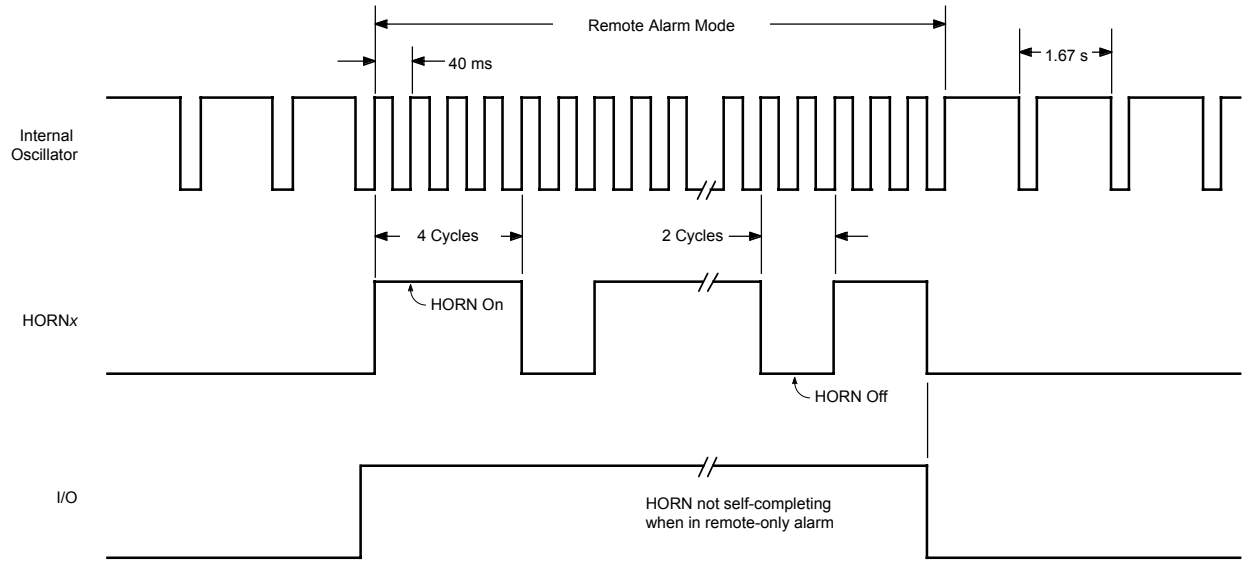
Timing Requirements: Timer Mode

(Circuit Shown in Typical Application)

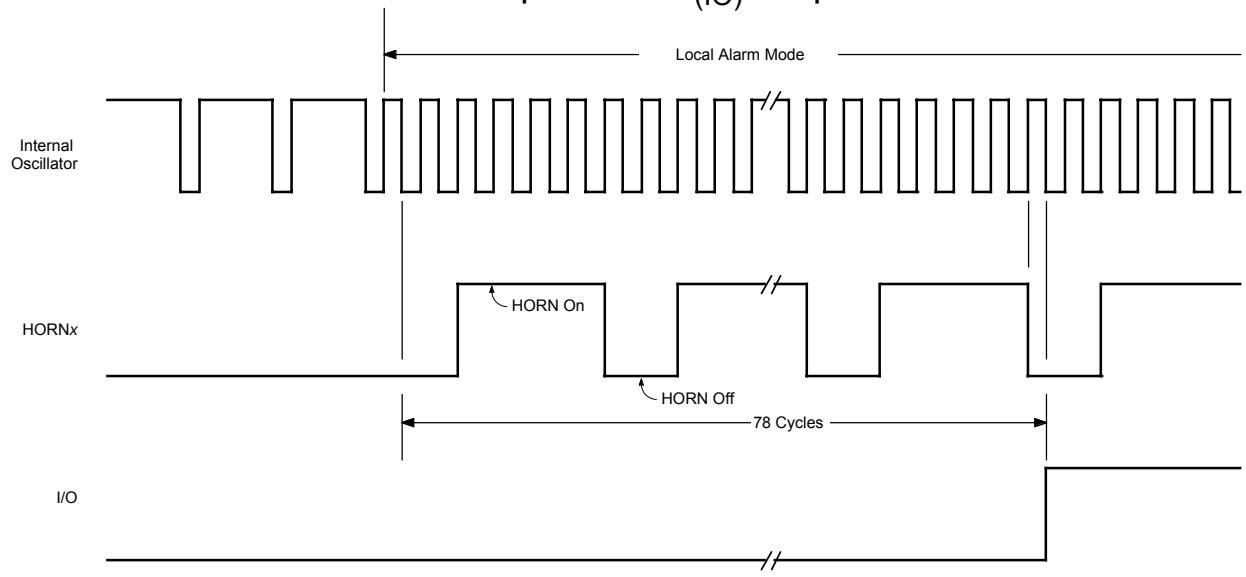


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I/O Operation: $V_{(IO)}$ Input



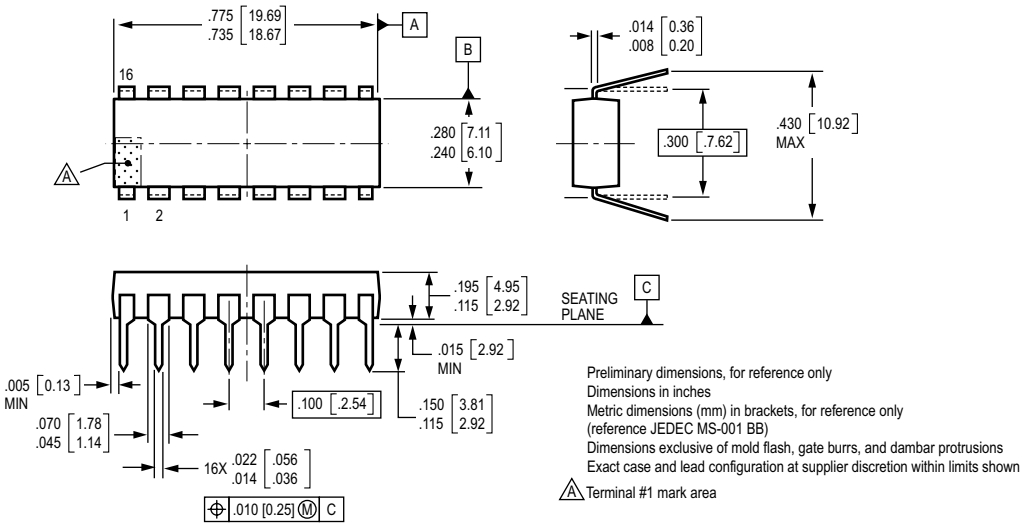
I/O Operation: $V_{(IO)}$ Output



Dwg. WC-004

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Package A, 16-pin DIP



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