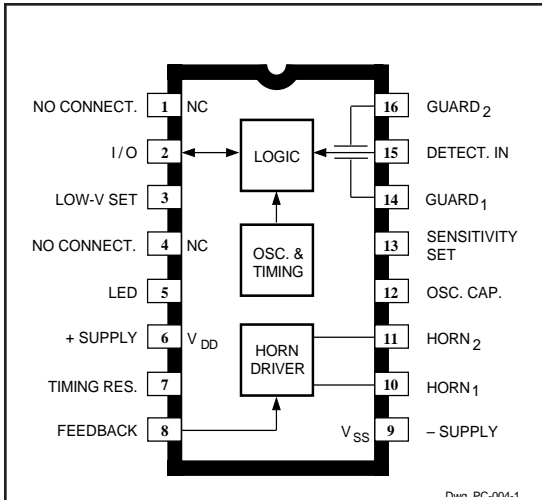


# 5354

## SMOKE DETECTOR WITH INTERCONNECT



### ABSOLUTE MAXIMUM RATINGS (Voltages are referenced to V<sub>SS</sub>)

Supply Voltage Range, V <sub>DD</sub> .....	<b>-0.5 V to +15 V</b>
Reverse Battery (10.5 V) .....	<b>20 s</b>
Input Voltage Range, V <sub>IN</sub> .....	<b>-0.3 V to V<sub>DD</sub> + 0.3 V</b>
Input Current, I <sub>IN</sub> .....	<b>10 mA</b>
Operating Temperature Range, T <sub>A</sub> .....	<b>0°C to +50°C</b>
Storage Temperature Range, T <sub>S</sub> .....	<b>-55°C to +125°C</b>

*CAUTION: CMOS devices have input static protection but are susceptible to damage when exposed to extremely high static electrical charges.*

The A5354CA 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 A5354CA 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. Similar devices, with an internal timer to allow for a period of reduced sensitivity ("hush"), are available as the A5348CA.

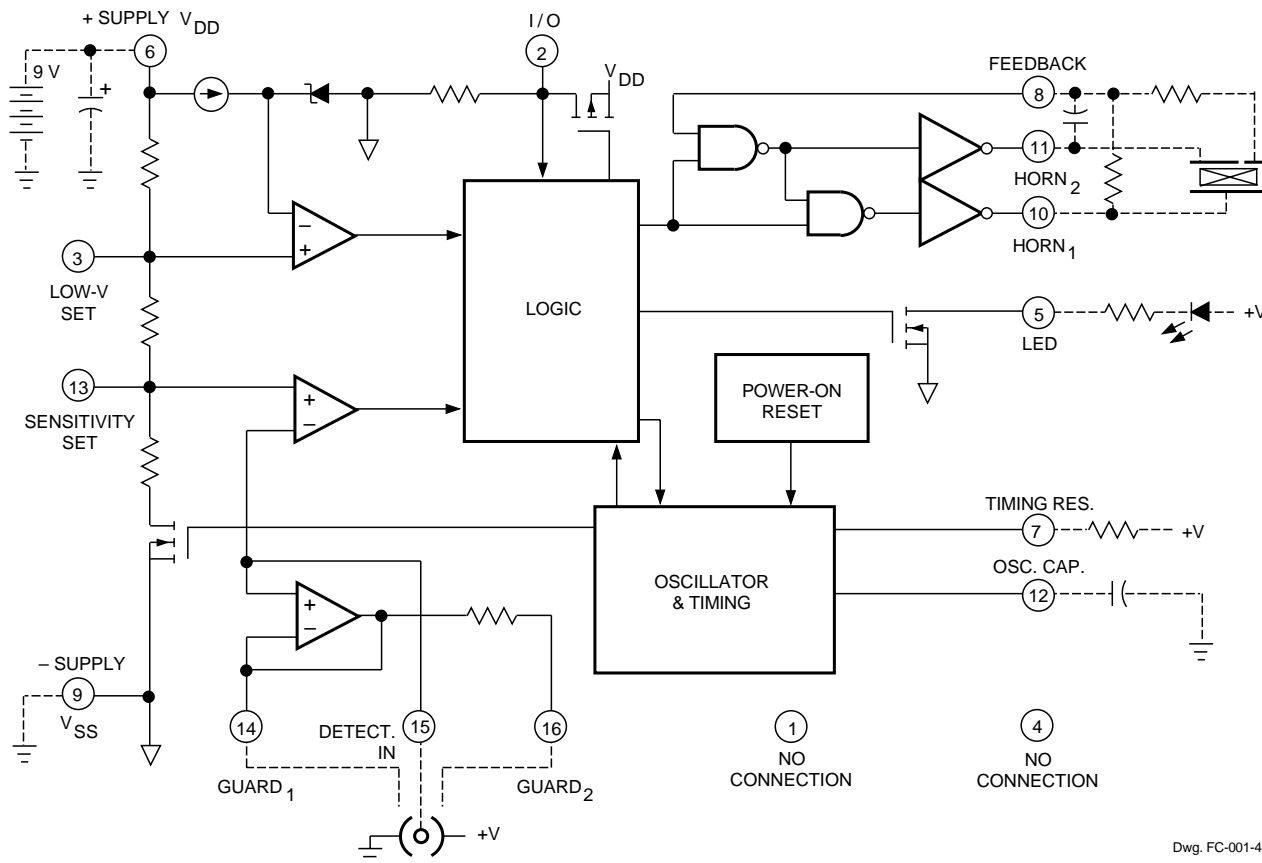
### FEATURES

- 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
- Built-In Hysteresis Reduces False Triggering

Always order by complete part number: **A5354CA** .

# 5354 SMOKE DETECTOR with INTERCONNECT

## FUNCTIONAL BLOCK DIAGRAM AND TYPICAL APPLICATION



# 5354

## ***SMOKE DETECTOR***

### ***with INTERCONNECT***

**ELECTRICAL CHARACTERISTICS** at  $T_A = +25^\circ\text{C}$ ,  $V_{DD} = 9.0\text{ V}$ ,  $V_{SS} = 0\text{ V}$ ,  $C_{12} = 0.1\ \mu\text{F}$ ,  $R_7 = 8.2\ \text{M}\Omega$  (unless otherwise noted).

Characteristic	Test Pin	Test Conditions	Limits			
			Min.	Typ.	Max.	Units
Supply Voltage Range	6	Operating	6.0	9.0	12	V
Detector Input Current	15	0 to 40% RH, $V_{IN} = 0$ to 9.0 V	—	—	$\pm 1.0$	pA
Input Offset Voltage	14-15	Active Guard	—	—	$\pm 100$	mV
	16-15	Active Guard	—	—	$\pm 100$	mV
	15-13	Detect Comparator	—	—	$\pm 50$	mV
Hysteresis	13	No Alarm to Alarm	90	130	170	mV
Common Mode Range	14-15	Guard Amplifier	2.0	—	$V_{DD} - 0.5$	V
	13-15	Smoke Comparator	0.5	—	$V_{DD} - 2.0$	V
Active Guard Impedance	14	to $V_{SS}$	—	10	—	k $\Omega$
	16	to $V_{SS}$	—	500	—	k $\Omega$
Oscillator Period	12	No Alarm	1.34	1.67	2.00	s
		Alarm	32	40	48	ms
Oscillator Pulse Width	12		8.0	10	12	ms
Low Voltage Threshold	6	$T_A = 0^\circ\text{C}$ to $50^\circ\text{C}$	7.2	—	7.8	V
Sensitivity Adjust Voltage	13	$V_{13}/V_{DD}$ , pin 13 open circuit	48.5	50	51.5	%
Horn Output Voltage	10-11	$I_{OUT} = 16\ \text{mA}$ , $V_{DD} = 9.0\ \text{V}$	—	0.1	0.5	V
		$I_{OUT} = 16\ \text{mA}$ , $V_{DD} = 7.2\ \text{V}$	—	—	0.9	V
		$I_{OUT} = -16\ \text{mA}$ , $V_{DD} = 9.0\ \text{V}$	8.5	8.8	—	V
		$I_{OUT} = -16\ \text{mA}$ , $V_{DD} = 7.2\ \text{V}$	6.3	—	—	V
Horn Output ON Time	10-11	Alarm	120	160	208	ms
		Low Battery	8.0	10	12	ms
Horn Output OFF Time	10-11	Alarm	60	80	104	ms
		Low Battery	32	40	48	s
LED Output ON Current	5	$V_{DD} = 7.2\ \text{V}$ , $V_{OUT} = 1.0\ \text{V}$	10	—	—	mA
LED Output ON Time	5		8.0	10	12	ms
LED Output OFF Time	5	No Alarm, In Standby	32	40	48	s

Continued next page . . .

NOTE 1: Negative current is defined as coming out of (sourcing) the specified device pin.

NOTE 2: Alarm (Smoke) Condition is defined as  $V_{15} < V_{13}$ ; No Alarm (No Smoke) Condition as  $V_{15} > V_{13}$ .

# 5354

## SMOKE DETECTOR

### with INTERCONNECT

#### ELECTRICAL CHARACTERISTICS continued

Characteristic	Test Pin	Test Conditions	Limits			
			Min.	Typ.	Max.	Units
I/O Current	2	No Alarm, $V_{I/O} = V_{DD} - 2.0\text{ V}$	25	—	60	$\mu\text{A}$
		Alarm, $V_{I/O} = V_{DD} - 2.0\text{ V}$	-7.5	—	—	$\text{mA}$
I/O Alarm Voltage	2	External "Alarm" In	3.0	—	—	V
I/O Delay	2	"Alarm" Out	—	3.0	—	s
Supply Current	6	$V_{DD} = 9.0\text{ V}$ , No Alarm, No Loads	—	5.0	9.0	$\mu\text{A}$
		$V_{DD} = 12\text{ V}$ , No Alarm, No Loads	—	—	12	$\mu\text{A}$

NOTE 1: Negative current is defined as coming out of (sourcing) the specified device pin.

NOTE 2: Alarm (Smoke) Condition is defined as  $V_{15} < V_{13}$ ; No Alarm (No Smoke) Condition as  $V_{15} > V_{13}$ .

#### CIRCUIT DESCRIPTION

The A5354CA 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 seconds during no-smoke conditions. Every 1.67 seconds, internal power is applied to the entire circuit and a check is made for smoke. Every 24 clock cycles (40 seconds), 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 at pin 12 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 sensitivity set voltage (pin 13) by typically 130 mV with no external connections to pins 3 or 13. This provides hysteresis and reduces false triggering. An active guard is provided on both pins adjacent to the detector input (pin 15). The voltage at pins 14 and 16 will be within 100 mV of the

input. 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 typically 160 ms ON, 80 ms OFF. During the OFF time, smoke is again checked and will inhibit further alarm output if smoke is not sensed. During smoke conditions the low battery alarm is inhibited and the LED is driven at a 1 Hz rate.

**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 between pin 13 and  $V_{DD}$ , or between pin 13 and  $V_{SS}$ .

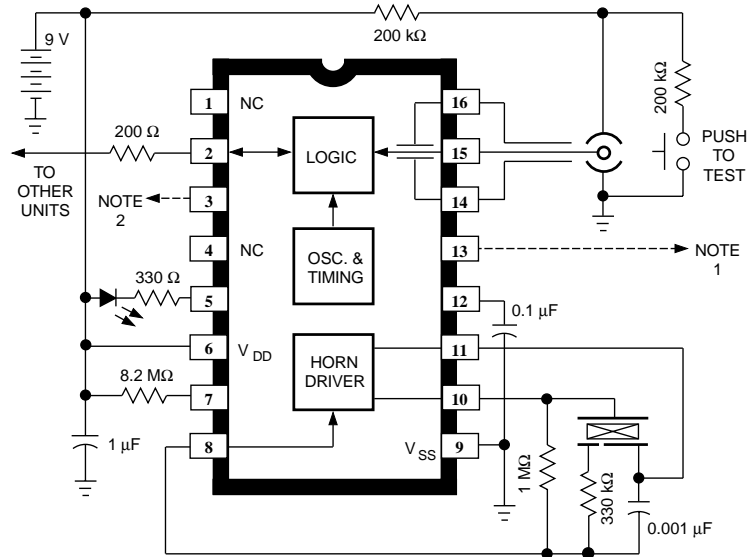
**Low Battery.** The low battery threshold is set internally by a voltage divider connected between  $V_{DD}$  and  $V_{SS}$ . The threshold can be increased by connecting a resistor between pin 3 and  $V_{DD}$ . The threshold can be decreased by connecting a resistor between pin 3 and  $V_{SS}$ . The battery voltage level is checked every 40 seconds during the 10 mA, 10 ms LED pulse. If an LED is not used, it should be replaced with an equivalent resistor (typically 500  $\Omega$  to 1000  $\Omega$ ) such that the battery loading remains at 10 mA.

# 5354 SMOKE DETECTOR with INTERCONNECT

## TYPICAL APPLICATION

**I/O.** A connection is provided at pin 2 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 second delay. The LED is suppressed when an alarm is signaled from an interconnected unit.

**Testing.** On power up, all internal counters are reset. Internal test circuitry allows for low battery check by holding pins 8 and 12 low during power up, then reducing  $V_{DD}$  and monitoring HORN<sub>1</sub> (pin 10). All functional tests can be accelerated by driving pin 12 with a 2 kHz square wave. The 10 ms strobe period must be maintained for proper operation of the comparator circuitry.

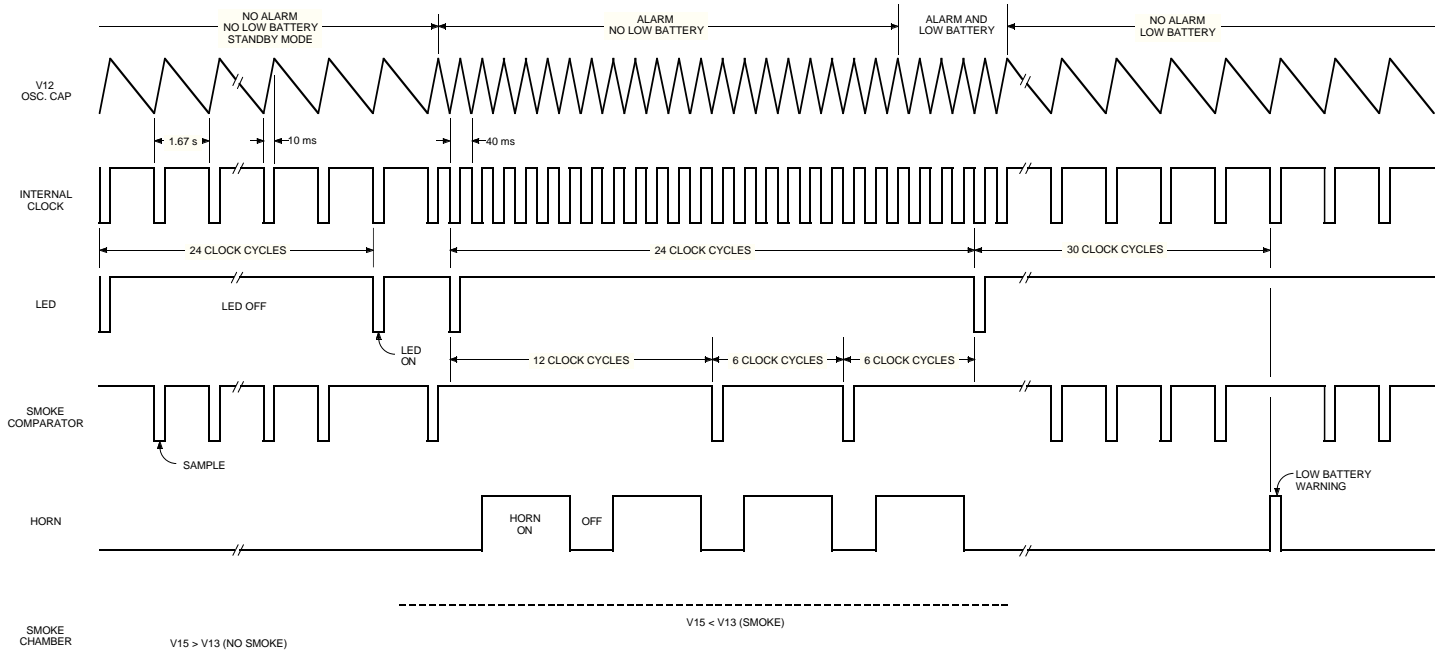


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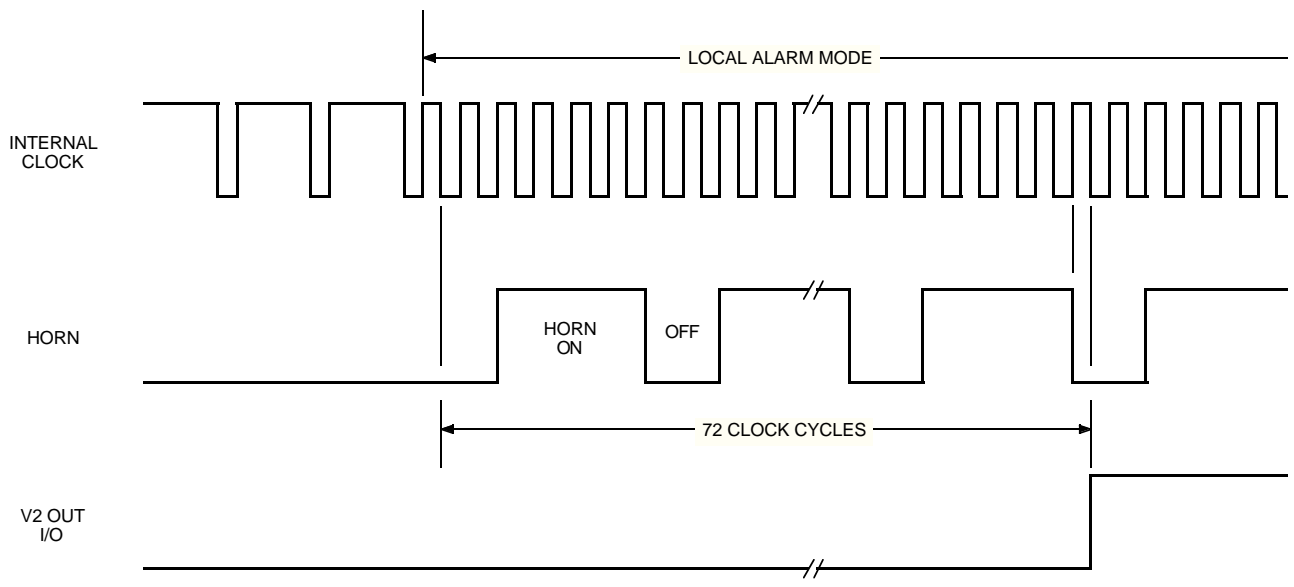
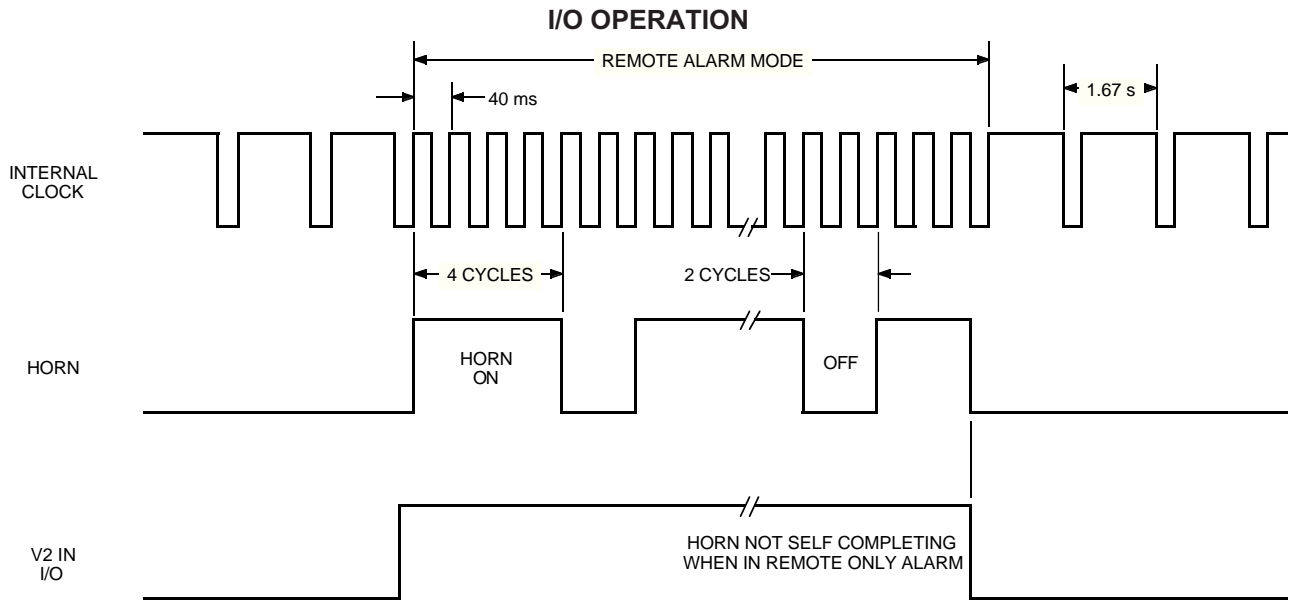
NOTE 1: An external resistor divider is used to adjust sensitivity for the particular smoke chamber.

NOTE 2: A resistor to ground or  $V_{DD}$  may be added to this pin to modify low battery voltage threshold.

## TIMING DIAGRAMS IN TYPICAL APPLICATION



**5354**  
**SMOKE DETECTOR**  
*with INTERCONNECT*



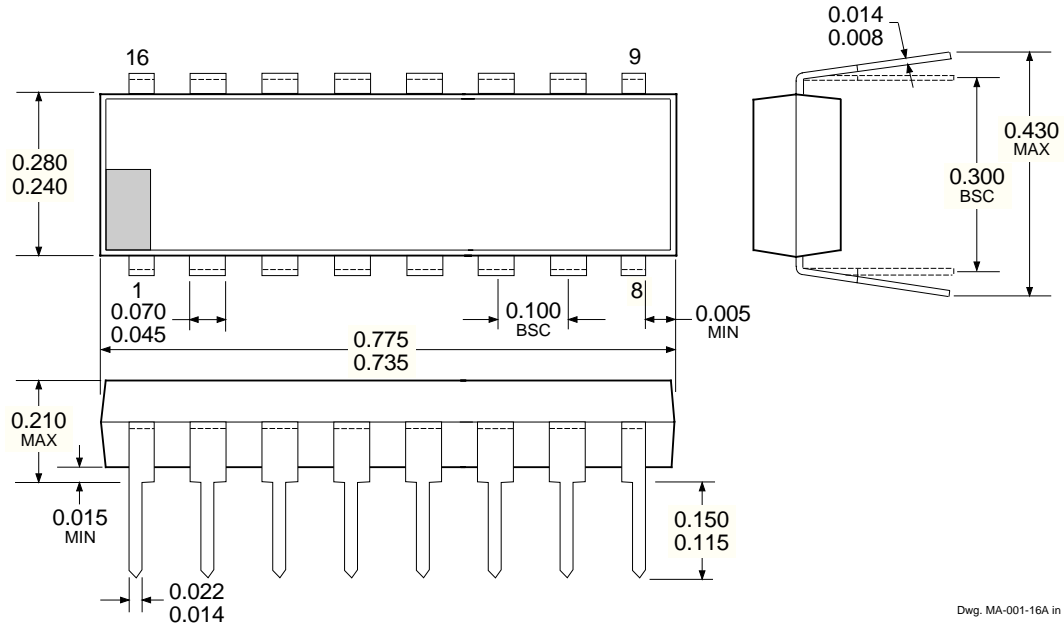
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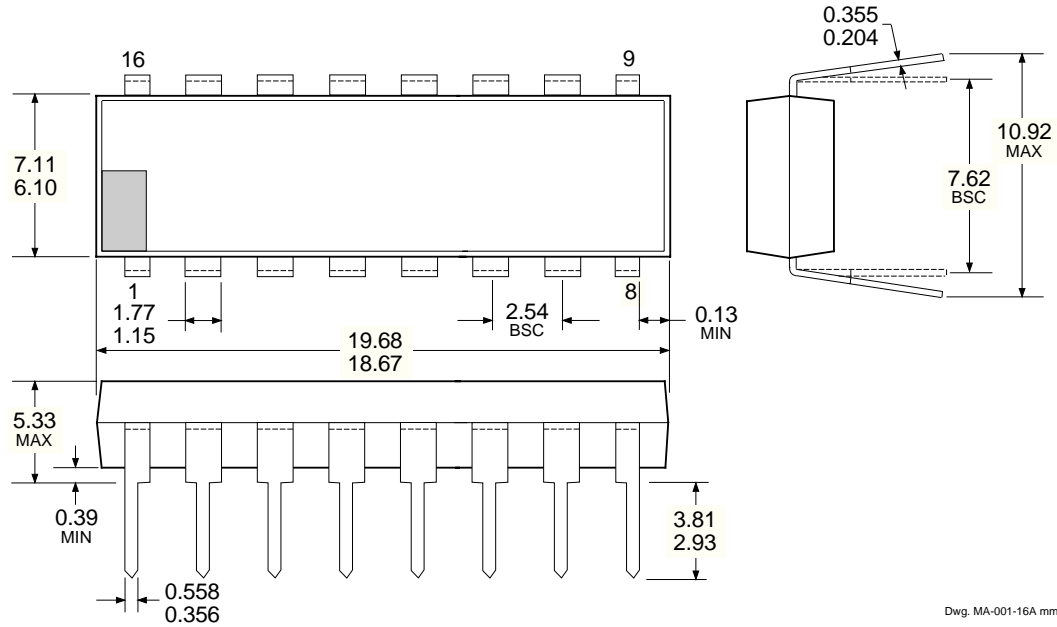
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 Worcester, Massachusetts 01615-0036 (508) 853-5000

**5354**  
**SMOKE DETECTOR**  
*with INTERCONNECT*

**Dimensions in Inches**  
 (controlling dimensions)



**Dimensions in Millimeters**  
 (for reference only)



- NOTES:
1. Lead thickness is measured at seating plane or below.
  2. Lead spacing tolerance is non-cumulative.
  3. Exact body and lead configuration at vendor's option within limits shown.

**5354**  
**SMOKE DETECTOR**  
**with INTERCONNECT**

**SAFETY & SECURITY ICs**  
**SELECTION GUIDE**

<b>Part Number</b>	<b>Function</b>
A3054KU/SU	Multiplexed Two-Wire Hall-Effect Sensor
A5347CA	Ionization-Type Smoke Detector with Interconnect and Timer
A5348CA	Ionization-Type Smoke Detector with Interconnect, Timer, and Reverse-Battery Protection
A5349CA	Ionization-Type Smoke Detector with Interconnect and Timer for AC Line Operation
A5354CA	Ionization-Type Smoke Detector with Interconnect and Reverse-Battery Protection
A5355CA	Ionization-Type Smoke Detector with Interconnect and Reverse-Battery Protection
A5358CA	Photoelectric-Type Smoke Detector with Interconnect and Timer

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