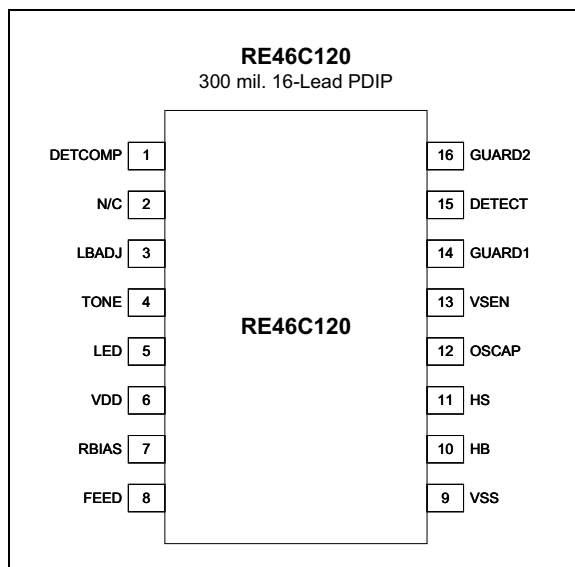


## CMOS Ionization Smoke Detector ASIC

### Features

- Guard Outputs for Ion Detector Input
- $\pm 0.75$  pA Detect Input Current
- Internal Reverse-battery Protection
- Internal Low-battery Detection
- Pin Selectable Horn Pattern
- Low Quiescent Current Consumption ( $< 6.5$   $\mu$ A)
- Electrostatic Discharge (ESD) Protection on all Pins
- Available in RoHS Compliant Lead-free Packaging
- Packaging:
  - 300 mil. 16-Lead PDIP
- Compatible with MC145017 and MC14467

### Pin Configuration



### General Description

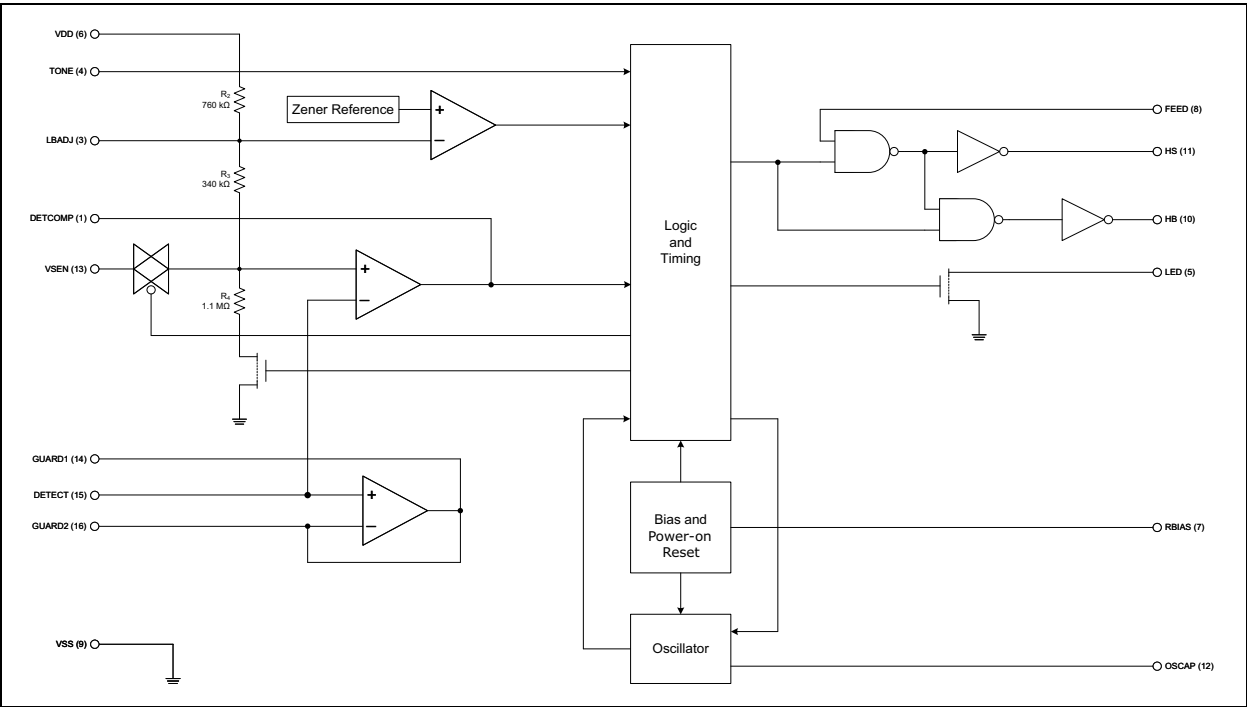
RE46C120 is a low-power CMOS ionization smoke detector integrated circuit (IC). Together with a few external components, this circuit provides all the required features for an ionization type smoke detector.

An internal oscillator strobes power to the smoke detector circuitry for 10.5 ms every 1.66s to keep standby current to a minimum. While in standby, RE46C120 performs a check for low-battery condition every 40 seconds. The TONE pin allows to select between a temporal horn pattern or a 2/3 duty cycle continuous tone. The temporal horn pattern supports the NFPA 72 emergency evacuation signal.

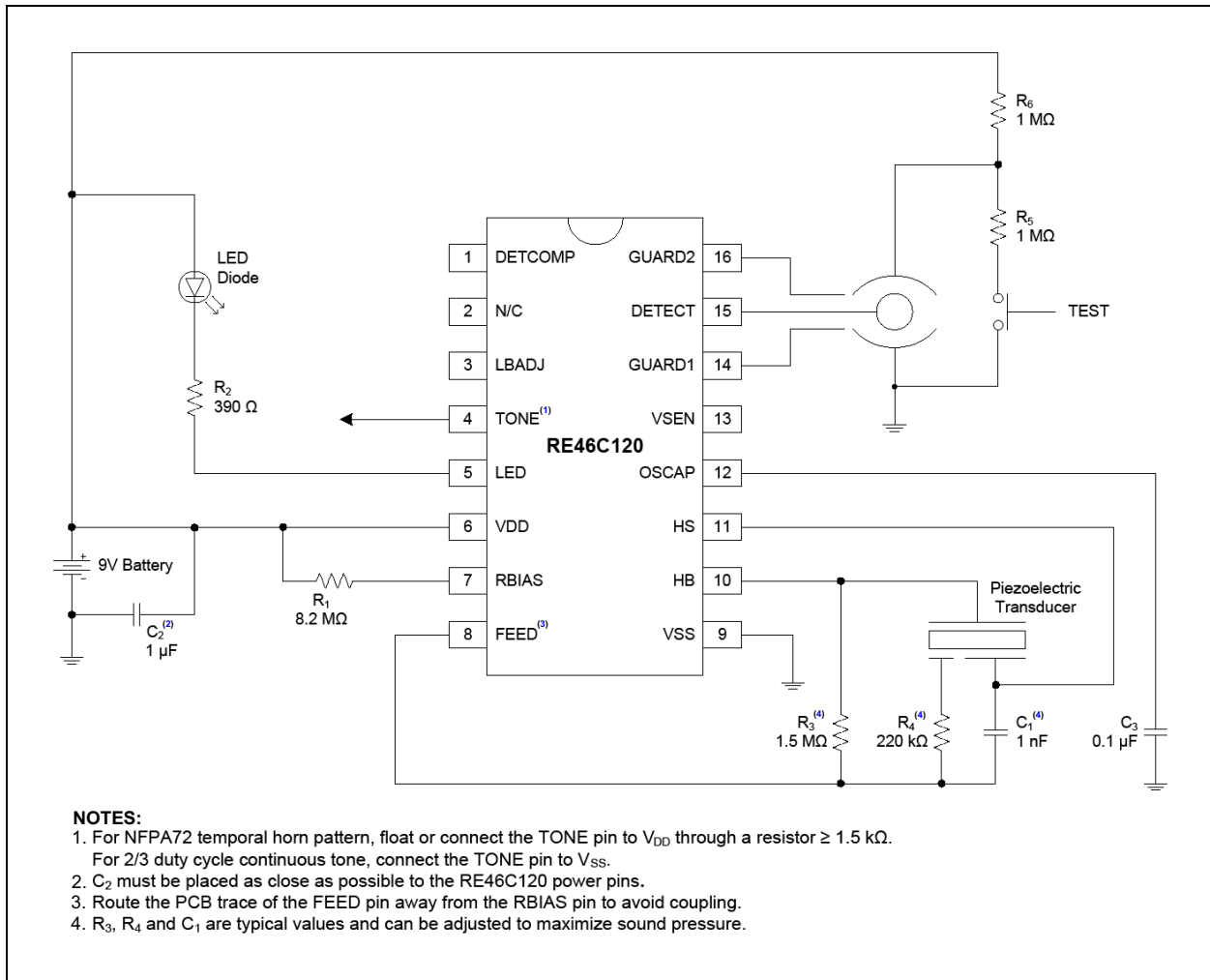
Although RE46C120 is designed for smoke detection using an ionization chamber, the device can be used in a variety of security applications.

# RE46C120

## Functional Block Diagram



## Typical Application



# RE46C120

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NOTES:

## 1.0 ELECTRICAL CHARACTERISTICS

### 1.1 Absolute Maximum Ratings†

Supply Voltage ( $V_{DD}$ )	15V
Input Voltage Range except FEED ( $V_{IN}$ )	-0.3V to $V_{DD} + 0.3V$
FEED Input Voltage Range ( $V_{INFD}$ )	-10V to +22V
Reverse-battery Time ( $t_{RB}$ )	5s
Input Current except FEED ( $I_{IN}$ )	10 mA
Operating Temperature ( $T_A$ )	-10°C to +60°C
Storage Temperature ( $T_{STG}$ )	-55°C to +125°C
Maximum Junction Temperature ( $T_J$ )	+150°C

#### † Notices:

- 1: Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these, or any other conditions above those indicated in the operation listings of this specification, is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.
- 2: Although this product uses CMOS technology with static protection, proper ESD prevention procedures must be used when handling this product. Damage can occur when exposed to extremely high static electric charge.

### 1.2 Electrical Specifications

**TABLE 1-1: DC ELECTRICAL SPECIFICATIONS**

DC Electrical Characteristics: Unless otherwise specified, all parameters apply at $T_A = +25^\circ\text{C}$ , $V_{DD} = 9\text{V}$ , $OSCAP = 0.1\ \mu\text{F}$ , $R_{BIAS} = 8.2\ \text{M}\Omega$ and $V_{SS} = 0\text{V}$ .							
Parameter	Symbol	Pin	Min.	Typical	Max.	Units	Conditions
<b>Power Supply</b>							
Supply Voltage	$V_{DD}$	VDD	6	—	12	V	Operating
Supply Current	$I_{DD1}$	VDD	—	4.5	6.5	$\mu\text{A}$	$OSCAP = 0.1\ \mu\text{F}$ , $R_{BIAS} = 8.2\ \text{M}\Omega$
	$I_{DD2}$	VDD	—	—	9	$\mu\text{A}$	$OSCAP = 0.1\ \mu\text{F}$ , $R_{BIAS} = 8.2\ \text{M}\Omega$ , $V_{DD} = 12\text{V}$
Input Voltage High	$V_{IH}$	TONE, FEED	6.2	4.5	—	V	—
Input Voltage Low	$V_{IL}$	TONE, FEED	—	4.5	2.7	V	—
Input Leakage Low	$I_{LDET1}$	DETECT	—	—	-0.75	$\mu\text{A}$	$V_{DD} = 9\text{V}$ , DETECT = $V_{SS}$ , 0-40% RH
	$I_{LDET2}$	DETECT	—	—	-1.5	$\mu\text{A}$	$V_{DD} = 9\text{V}$ , DETECT = $V_{SS}$ , 85% RH (Note 1)
	$I_{LTONE}$	TONE	-100	—	-450	nA	TONE = $V_{SS}$ , $R_{BIAS} = 8.2\ \text{M}\Omega$
	$I_{LFD}$	FEED	—	—	50	$\mu\text{A}$	FEED = -10V

- Note 1:** Sample test only  
**2:** Production tested at room temperature with guardbanded limits  
**3:** Not 100% production tested

# RE46C120

**TABLE 1-1: DC ELECTRICAL SPECIFICATIONS (CONTINUED)**

**DC Electrical Characteristics:** Unless otherwise specified, all parameters apply at  $T_A = +25^\circ\text{C}$ ,  $V_{DD} = 9\text{V}$ ,  $\text{OSCAP} = 0.1\ \mu\text{F}$ ,  $R_{BIAS} = 8.2\ \text{M}\Omega$  and  $V_{SS} = 0\text{V}$ .

Parameter	Symbol	Pin	Min.	Typical	Max.	Units	Conditions
Input Leakage High	$I_{HDET1}$	DETECT	—	—	0.75	pA	$V_{DD} = 9\text{V}$ , DETECT = $V_{DD}$ , 0-40% RH
	$I_{HDET2}$	DETECT	—	—	1.5	pA	$V_{DD} = 9\text{V}$ , DETECT = $V_{DD}$ , 85% RH (Note 1)
	$I_{HFD}$	FEED	—	—	50	$\mu\text{A}$	FEED = 22V
Output Off Leakage High	$I_{OHZ}$	LED	—	—	1	$\mu\text{A}$	LED Off
Output Voltage High	$V_{OH1}$	HB, HS	6.3	—	—	V	$I_{OH} = -16\ \text{mA}$ , $V_{DD} = 7.2\text{V}$
	$V_{OH2}$	DETCOMP	8.5	—	—	V	$I_{OH} = -30\ \mu\text{A}$
Output Voltage Low	$V_{OL1}$	HB, HS	—	—	0.9	V	$I_{OL} = 16\ \text{mA}$ , $V_{DD} = 7.2\text{V}$
	$V_{OL2}$	DETCOMP	—	—	0.5	V	$I_{OL} = 30\ \text{mA}$
	$V_{OL3}$	LED	—	—	3	V	$I_{OL} = 10\ \text{mA}$ , $V_{DD} = 7.2\text{V}$
Low-battery Voltage	$V_{LB}$	VDD	7.2	7.5	7.8	V	$T_A = -10^\circ\text{C}$ to $+60^\circ\text{C}$ (Note 2)
Internal Sensitivity Set Voltage	$V_{SET1}$	VSEN	47	50	53	% $V_{DD}$	—
	$V_{SET2}$	LBADJ	—	65.5	—	% $V_{DD}$	—
Offset Voltage	$V_{GOS1}$	GUARD1, DETECT	-50	—	50	mV	Guard Amplifier
	$V_{GOS2}$	DETECT, GUARD2	-50	—	50	mV	Guard Amplifier
	$V_{GOS3}$	VSEN, DETECT	-50	—	50	mV	Smoke Comparator
Common Mode Voltage	$V_{CM1}$	GUARD1, DETECT	2	—	$V_{DD} - 0.5$	V	Guard Amplifier (Note 3)
	$V_{CM2}$	VSEN, DETECT	0.5	—	$V_{DD} - 2$	V	Smoke Comparator (Note 3)
Common Mode Impedance	$Z_{OUT}$	GUARD1, GUARD2	—	10	—	k $\Omega$	Guard Amplifier Outputs (Note 3)
Hysteresis	$V_{HYS}$	VSEN	90	130	170	mV	No Alarm to Alarm Condition

**Note 1:** Sample test only

**2:** Production tested at room temperature with guardbanded limits

**3:** Not 100% production tested

**TABLE 1-2: AC ELECTRICAL SPECIFICATIONS**

<b>AC Electrical Characteristics:</b> Unless otherwise specified, all parameters apply at $T_A = +25^\circ\text{C}$ , $V_{DD} = 9\text{V}$ , $\text{OSCAP} = 0.1\ \mu\text{F}$ , $\text{RBIAS} = 8.2\ \text{M}\Omega$ and $V_{SS} = 0\text{V}$ . All timing except oscillator period ( $t_{\text{PER}}$ ) and oscillator pulse width ( $t_{\text{PW}}$ ) are guaranteed by functional tests.							
Parameter	Symbol	Pin	Min.	Typical	Max.	Units	Conditions
<b>Oscillator Time Base</b>							
Oscillator Period	$t_{\text{PER1}}$	OSCAP	1.34	1.67	2	s	No Alarm Condition
	$t_{\text{PER2}}$	OSCAP	37.5	41.5	45.8	ms	Alarm Condition
Oscillator Pulse Width	$t_{\text{PW}}$	LED	9.1	10.5	12.9	ms	Operating
<b>LED Indication</b>							
LED On Time	$t_{\text{LON}}$	LED	9.1	10.5	12.9	ms	Operating
LED Off Time	$t_{\text{LOF1}}$	LED	32	40	48	s	Standby, No Alarm
	$t_{\text{LOF2}}$	LED	0.9	1	1.1	s	Alarm Condition
<b>Horn Indication</b>							
Horn On Time	$t_{\text{HON1}}$	HB, HS	450	500	550	ms	Operating, Alarm Condition, $\text{TONE} = V_{DD}$ or Float ( <b>Note 1</b> )
	$t_{\text{HON2}}$	HB, HS	9.1	10.5	12.9	ms	Low Battery, No Alarm
	$t_{\text{HON3}}$	HB, HS	150	166	183	ms	Operating, Alarm Condition, $\text{TONE} = \text{Low}$
Horn Off Time	$t_{\text{HOF1}}$	HB, HS	450	500	550	ms	Operating, Alarm Condition, $\text{TONE} = V_{DD}$ or Float ( <b>Note 1</b> )
	$t_{\text{HOF2}}$	HB, HS	1.35	1.5	1.65	s	Operating, Alarm Condition, $\text{TONE} = V_{DD}$ or Float ( <b>Note 1</b> )
	$t_{\text{HOF3}}$	HB, HS	75	83	92	ms	Operating, Alarm Condition, $\text{TONE} = \text{Low}$
	$t_{\text{HOF4}}$	HB, HS	32	40	48	s	Low Battery, No Alarm

**Note 1:** See timing diagram for HFP72 Temporal Horn Pattern in [Figure 3-1](#).

**TABLE 1-3: TEMPERATURE CHARACTERISTICS**

<b>DC Electrical Characteristics:</b> Unless otherwise specified, all parameters apply at $V_{DD} = 9\text{V}$ and $V_{SS} = 0\text{V}$ (typical application).							
Parameter	Symbol	Min.	Typical	Max.	Units	Conditions	
<b>Temperature Ranges</b>							
Specified Temperature Range	$T_A$	-10	—	+60	$^\circ\text{C}$	—	
Operating Temperature Range	$T_A$	-10	—	+60	$^\circ\text{C}$	—	
Storage Temperature Range	$T_{\text{STG}}$	-55	—	+125	$^\circ\text{C}$	—	
<b>Thermal Package Resistances</b>							
Thermal Resistance, 16-Lead PDIP	$\theta_{JA}$	—	70	—	$^\circ\text{C/W}$	—	

# RE46C120

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NOTES:

## 2.0 PIN DESCRIPTION

Table 2-1 describes the pins of RE46C120.

**TABLE 2-1: RE46C120 PIN FUNCTION**

Pin Number	Symbol	Description
1	DETCOMP	Use this pin to check for smoke while holding the OSCAP pin low.
2	N/C	Not Connected.
3	LBADJ	Use this pin to modify the low-battery set point by connecting a resistor between the pin and $V_{DD}$ or $V_{SS}$ .
4	TONE	Horn Tone Select. This pin selects between the NFPA72 horn tone (pin driven high) or the 2/3 duty cycle continuous tone (pin driven low).
5	LED	LED Driver Pin. Open-drain NMOS output used to drive a visible LED.
6	VDD	This pin connects to the positive power supply.
7	RBIAS	Set the internal bias current by connecting a resistor between this pin and $V_{DD}$ .
8	FEED	This pin connects to the feedback electrode through a current limiting resistor. If not used, ensure this pin connects to $V_{DD}$ or $V_{SS}$ .
9	VSS	This pin connects to the negative power supply.
10	HB	Horn Brass, Inverted Output. This pin connects to the metal electrode of a piezoelectric transducer.
11	HS	Horn Silver Output. This pin is a complementary output to the HB pin and connects to the ceramic electrode of the piezoelectric transducer.
12	OSCAP	Set the oscillator period ( $t_{PER}$ ) by connecting a capacitor between this pin and $V_{SS}$ .
13	VSEN	Use this pin to set an external smoke comparator reference by connecting external resistors to $V_{DD}$ or $V_{SS}$ .
14	GUARD1	Guard amplifier output 1. This allows for measurement of the DETECT pin without loading the ionization chamber.
15	DETECT	This pin connects to the collector electrode of the ion smoke chamber.
16	GUARD2	Guard amplifier output 2. This allows for measurement of the DETECT pin without loading the ionization chamber.

# RE46C120

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NOTES:

## 3.0 DEVICE DESCRIPTION

### 3.1 Introduction

RE46C120 is a low-power CMOS ionization smoke detector integrated circuit (IC). Together with a few external components, this circuit provides all the required features for an ionization type smoke detector.

**Note:** All timing references are nominal values. Refer to [Table 1-1](#) and [Table 1-2](#) for limits.

### 3.2 Internal Timing

With external components as indicated in the [Typical Application](#) diagram, the oscillator period becomes  $t_{PER1} = 1.67$  seconds while in standby. The detection circuitry is powered up for 10.5 ms every 1.66s and the status of the smoke comparator is latched. Additionally, every 40 seconds, the LED driver is turned on for 10.5 ms and the status of the low-battery comparator is latched. The smoke comparator status is not checked during the low-battery test or low-battery horn warning chirp or when the horn is active due to an alarm condition.

If RE46C120 detects an alarm condition, the oscillator period increases to  $t_{PER2} = 41.5$  ms.

Due to the low currents used in the oscillator, ensure that the OSCAP pin connects to a low leakage type capacitor. Oscillator accuracy depends mainly on the tolerance of the bias resistor connected to the RBIAS pin and the oscillator capacitor connected to the OSCAP pin.

### 3.3 Smoke Detection Circuitry

The smoke comparator takes the value of the ionization chamber voltage and compares it to a voltage derived from a resistor divider across  $V_{DD}$ . This divider voltage is available externally on the VSEN pin. When smoke is detected, the divider voltage is internally increased by 130 mV nominal to provide hysteresis and make the detector less sensitive to false triggering.

Use the VSEN pin to modify the internal set point for the smoke comparator by connecting external resistors to  $V_{DD}$  or  $V_{SS}$ . Nominal values for the internal resistor divider are indicated on the [Functional Block Diagram](#). While these internal resistor values can vary up to  $\pm 20\%$ , the resistor matching is typically less than 2% on any single device. A transmission switch on the VSEN pin isolates the pin during low-battery tests to prevent the low-battery set point from being affected when using external resistors to modify the smoke sensitivity set point.

To reduce surface leakage, the guard amplifier and outputs are always active and within 50 mV of the DETECT pin voltage. The guard outputs also allow for the measurement of the DETECT input without loading the ionization chamber.

### 3.4 Low-Battery Detection

An internal Zener reference is compared to the voltage divided  $V_{DD}$  power supply. The battery is checked under load using the LED low-side driver output since a low-battery status is latched at the conclusion of the 10.5 ms LED pulse. Use the LBADJ pin to modify the low-battery set point by connecting a resistor between the pin and  $V_{DD}$  or  $V_{SS}$ .

**Note 1:** The internal resistor string is common to both LBADJ and VSEN pins. This results in some interaction between the two pins.

**2:** Modifying the low-battery set point can affect the smoke sensitivity setting.

### 3.5 LED Pulse

The LED pulses on for 10.5 ms every 40 seconds while in standby. When an alarm condition is detected, the LED pulses on for 10.5 ms every second.

### 3.6 Testing

At power-up, all internal registers are reset. By holding the OSCAP pin low at power-up, the internal power strobe becomes active. Use the DETCOMP pin to check for smoke.

While functional testing can be accelerated by driving the OSCAP pin with a 4 kHz square wave, maintain the 10.5 ms strobe period to ensure the proper operation of the analog circuitry. Refer to the timing diagrams in [Figure 3-1](#).

### 3.7 Horn Tone

Drive the TONE pin high or leave it floating to select the NFPA 72 horn tone. Drive the TONE pin low to select the 2/3 duty cycle continuous tone.

If the TONE pin is externally driven high, connect the pin to  $V_{DD}$  through a current limiting resistor of at least 1.5 k $\Omega$ .

### 3.8 Reverse Battery Protection

RE46C120 internally limits the current from  $V_{SS}$  to  $V_{DD}$  in the event of accidental polarity reversal. If an input is connected to  $V_{DD}$ , ensure that it is done using a resistor of at least 1.5 k $\Omega$  to limit the reverse current through this path.

# RE46C120

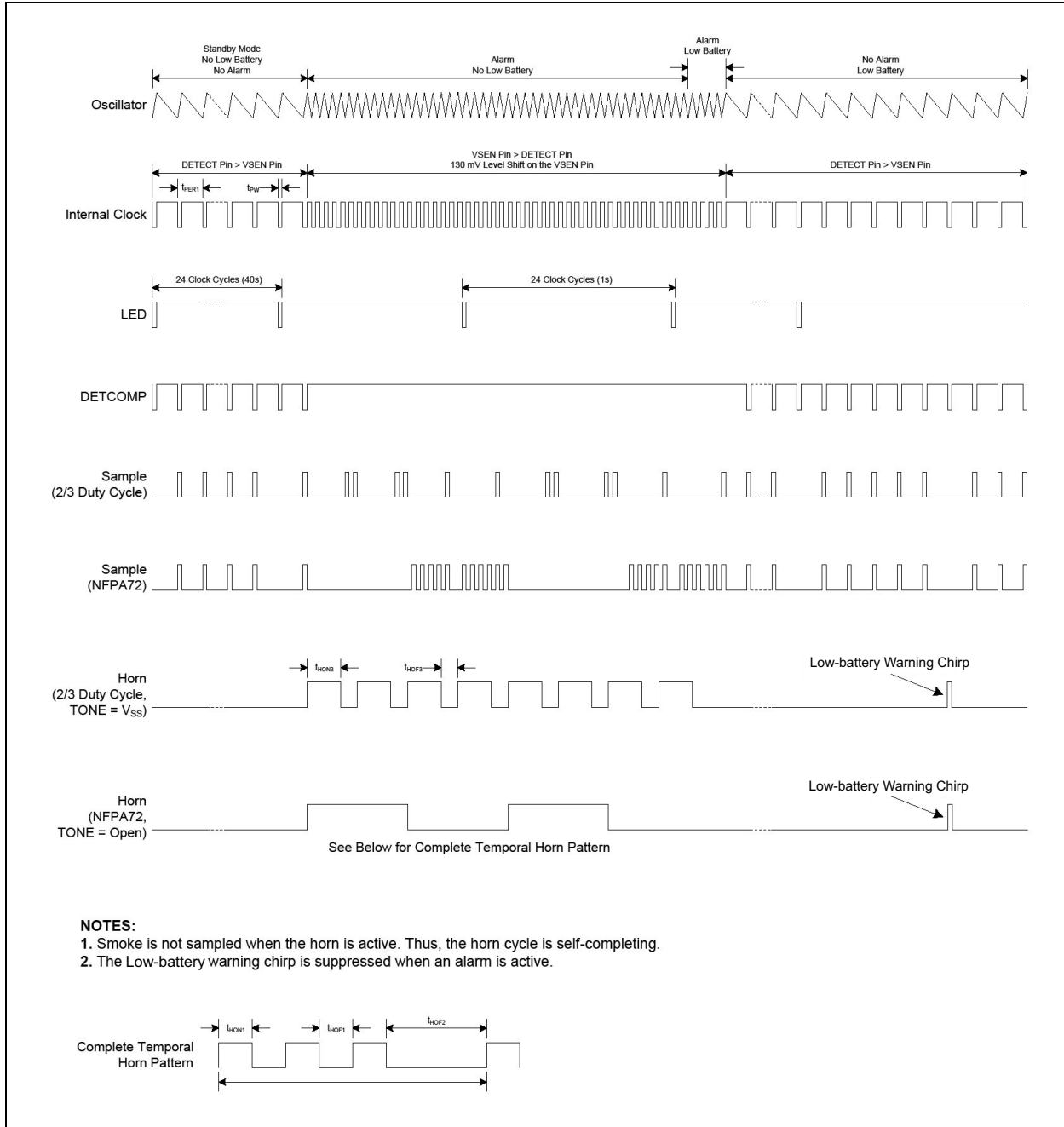
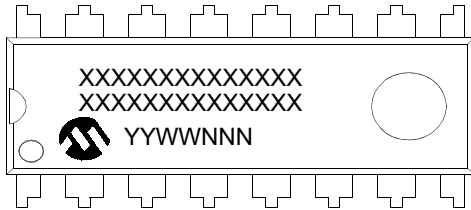


FIGURE 3-1: RE46C120 Timing Diagram.

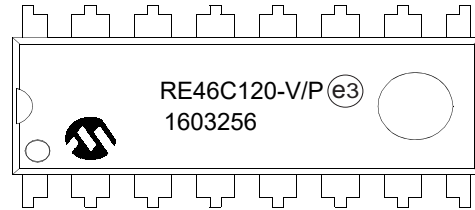
## 4.0 PACKAGING INFORMATION

### 4.1 Package Marking Information

16-Lead PDIP (300 mil.)



Example:



<b>Legend:</b>	XX...X	Customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week '01')
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free JEDEC designator (e3) can be found on the outer packaging for this package.

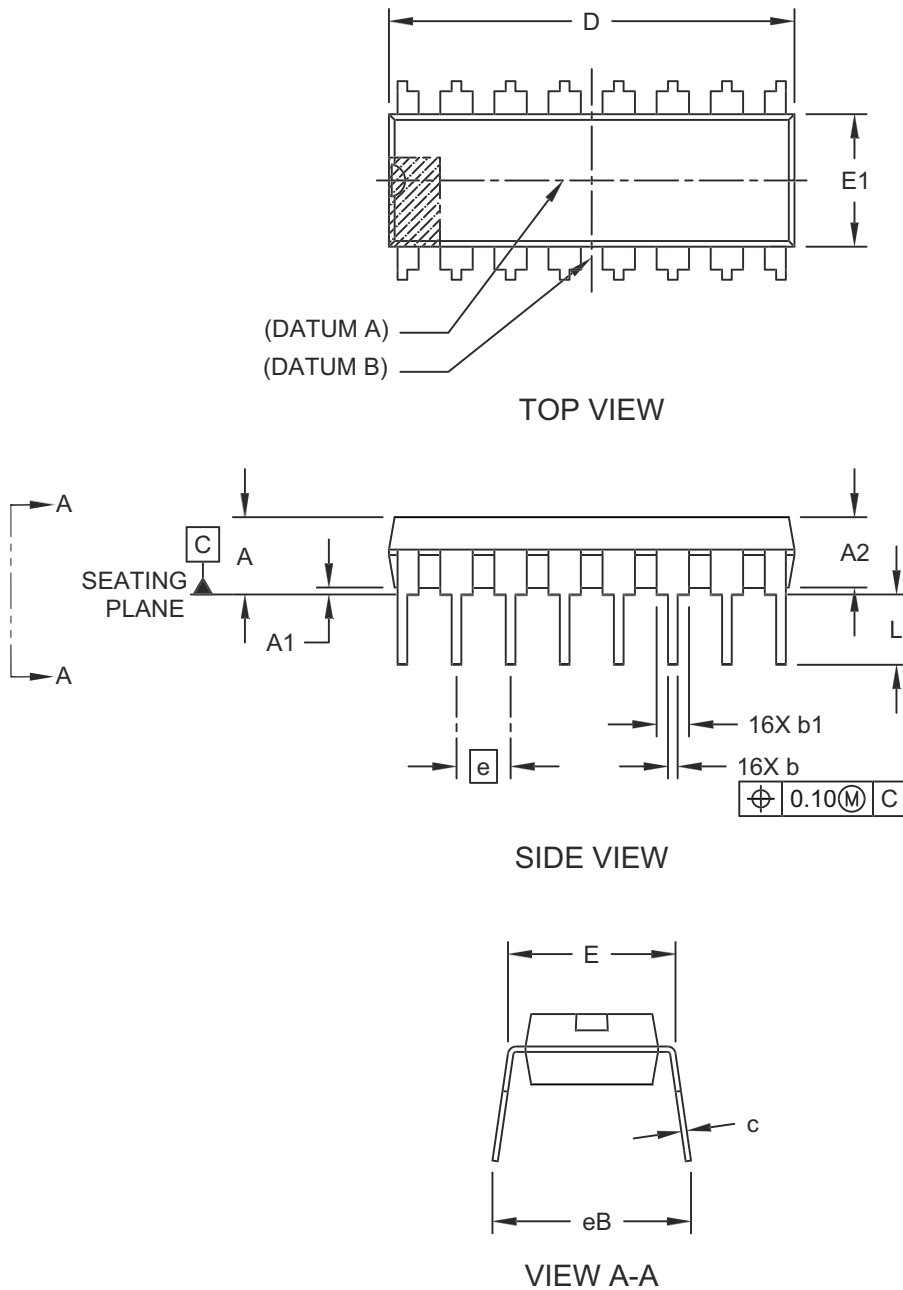
**Note:** In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information.

# RE46C120

## 4.2 Package Drawings

### 16-Lead Plastic Dual In-Line (P) - 300 mil Body [PDIP]

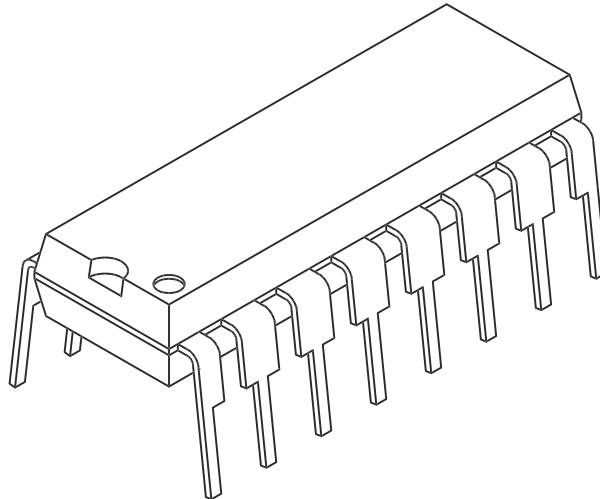
**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



Microchip Technology Drawing C04-00017 Rev C (P) Sheet 1 of 2

## 16-Lead Plastic Dual In-Line (P) - 300 mil Body [PDIP]

**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



		Units	INCHES		
Dimension Limits			MIN	NOM	MAX
Number of Pins	N		16		
Pitch	e		.100 BSC		
Top to Seating Plane	A	-	-	.210	
Molded Package Thickness	A2	.115	.130	.195	
Base to Seating Plane	A1	.015	-	-	
Shoulder to Shoulder Width	E	.290	.310	.325	
Molded Package Width	E1	.240	.250	.280	
Overall Length	D	.735	.750	.775	
Tip to Seating Plane	L	.115	.130	.150	
Lead Thickness	c	.008	.010	.015	
Upper Lead Width	b1	.045	.060	.070	
Lower Lead Width	b	.014	.018	.022	
Overall Row Spacing	§	eB	-	-	.430

**Notes:**

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. § Significant Characteristic
3. Dimensions D and E do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .005" per side.
4. Dimensioning and tolerancing per ASME Y14.5M

BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing C04-00017 Rev C (P) Sheet 2 of 2



## APPENDIX A: REVISION HISTORY

### Revision C (April 2025)

- Removed mentions of Underwriters Laboratory Specifications UL217 and UL268.
- Updated [Functional Block Diagram](#) and [Typical Application](#).
- Updated [Figure 3-1](#).
- Added [Section 2.0, "Pin Description"](#).
- Updated [Section 3.0, "Device Description"](#).
- Added [Section 4.0, "Packaging Information"](#).
- Added [Product Identification System](#) section.

### Revision B (June 2009)

- Undocumented changes.

### Revision A (May 2009)

- Initial release of this document.

NOTES:

## PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

<u>PART NO.</u>	<u>X</u>	<u>XX</u>	<u>X</u>
Device	Package	Number of Pins	Lead Free
<b>Device:</b>	RE46C120	= CMOS Ionization Smoke Detector ASIC	
<b>Package:</b>	E	= Plastic Dual In-Line (P), 300 mil. Body (PDIP)	
<b>Number of Pins:</b>	16	= 16-Lead	
<b>Lead Free:</b>	F	= Lead Free Packaging	

**Examples:**

a) RE46C120E16F = CMOS Ionization Smoke Detector ASIC, Plastic Dual In-Line PDIP, 16-Lead, Lead Free

# RE46C120

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NOTES:

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