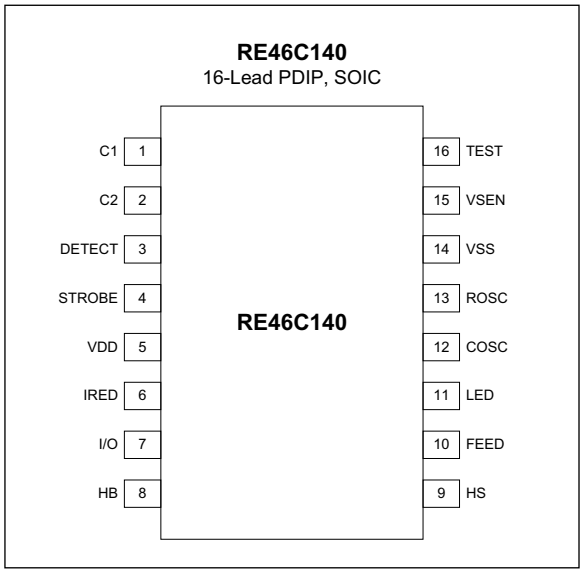
# RE46C140

## CMOS Photoelectric Smoke Detector ASIC with Interconnect and Timer Mode

### Features

- Internal Power On Reset (POR)
- Low Quiescent Current Consumption
- Electrostatic Discharge (ESD) Protection (HBM) on all Pins
- Interconnect up to 40 Detectors
- 10 Minute Timer for Sensitivity Control
- Temporal Horn Pattern
- Internal Low Battery and Chamber Test
- Available in RoHS Compliant Lead-Free Packaging
- Packaging:
  - 300 mil. 16-Lead PDIP
  - 3.90 mm 16-Lead SOIC
  - 7.50 mm 16-Lead SOIC
- Compatible with Allegro MicroSystems™ A5366

### Pin Configuration




### General Description

RE46C140 is a low power CMOS photoelectric smoke detector integrated circuit (IC). Together with a few external components, this circuit provides all the required features for a photoelectric smoke detector.

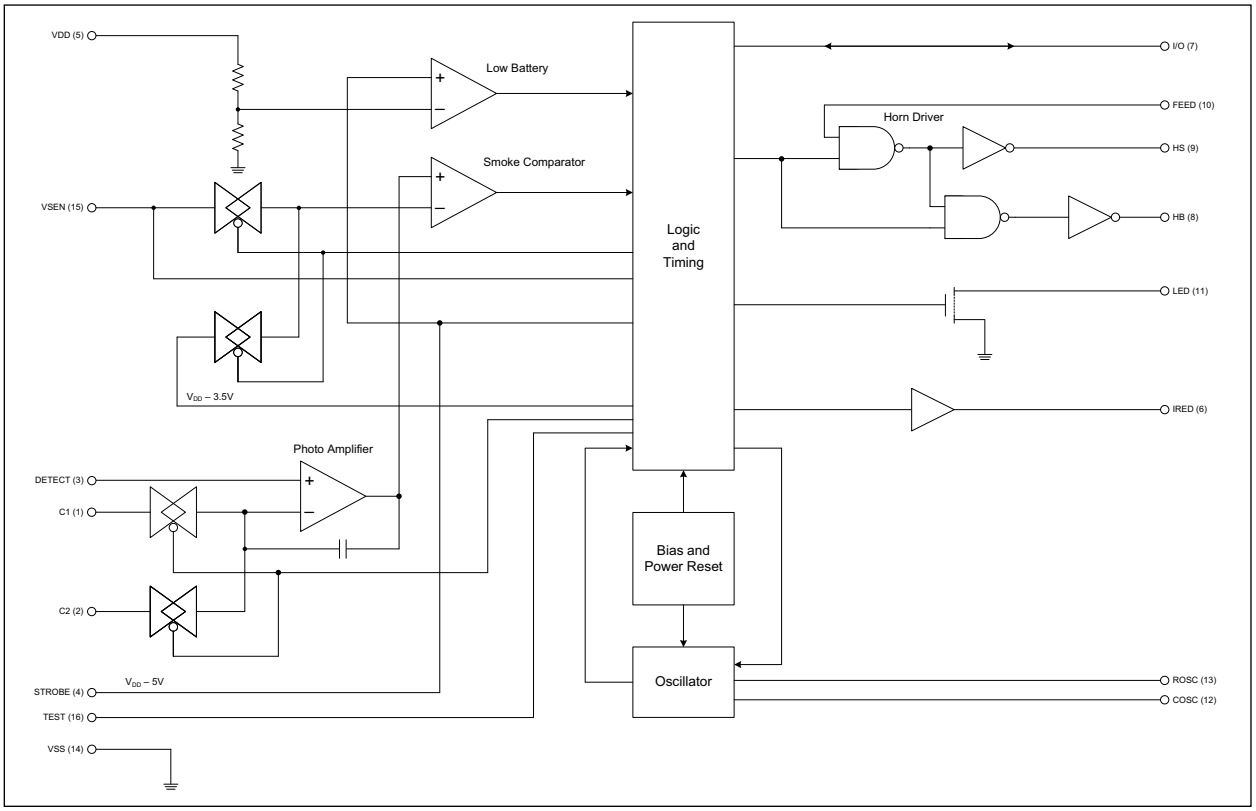
The design of RE46C140 includes a gain selectable photo amplifier used with an infrared emitter/detector pair. An internal oscillator strobes power to the smoke detector circuitry for 100 µs every 10 seconds to keep standby current to a minimum. If smoke is sensed, the detection rate increases to verify the alarm condition. A high gain mode is available for push button chamber testing.

While in standby, RE46C140 checks for low battery condition and chamber integrity every 43 seconds. The temporal horn pattern supports the NFPA 72 emergency evacuation signal.

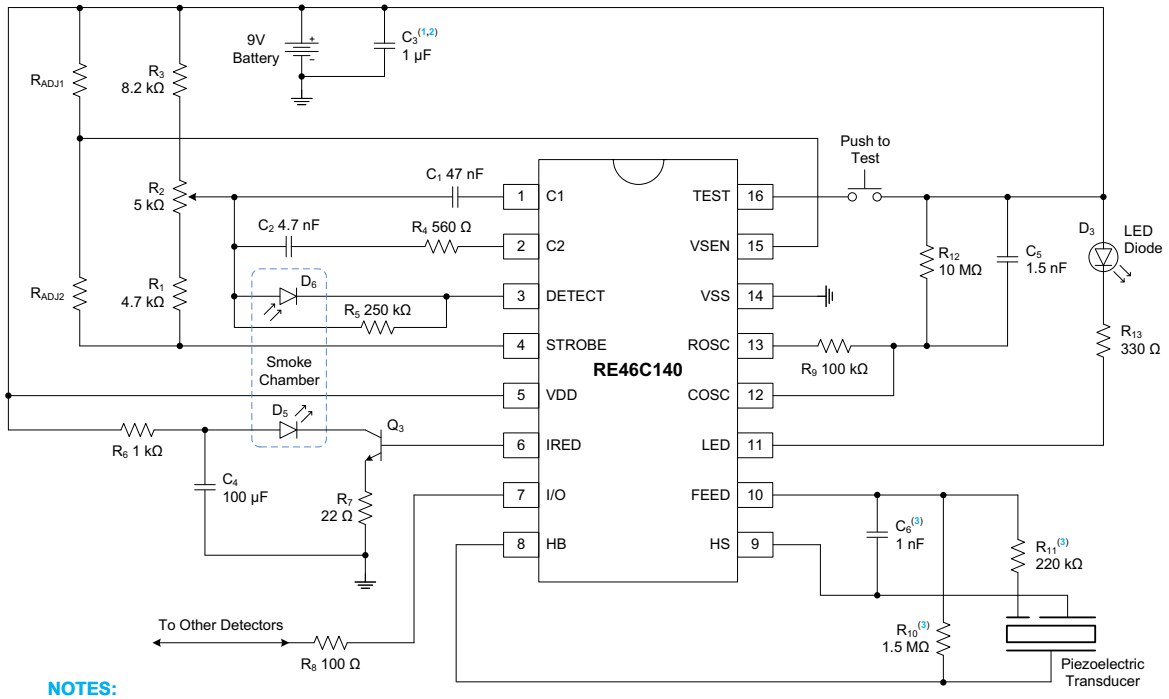
The interconnect pin (I/O) enables the connection of multiple detectors so that when one smoke detector alarms, all units sound together.

An internal 10 minute timer allows the use of a separate button for reduced sensitivity mode.

## Functional Block Diagram



## Typical Application




**NOTES:**

1. $C_3$ must be placed as close as possible to the RE46C140 power pins.
2. $C_3$ is typical for an alkaline battery. For a carbon battery, replace $C_3$ with a resistor ≥ 4.7 µF.
3. $R_{10}$, $R_{11}$ and $C_6$ are typical values and can be adjusted to maximize sound pressure.

# 1.0 ELECTRICAL CHARACTERISTICS

## 1.1 Absolute Maximum Ratings†

Supply Voltage ($V_{DD}$) . . . . . 15V
Input Voltage Range except FEED and I/O ($V_{IN}$) . . . . . -0.3V to $V_{DD}$ + 0.3V
FEED Input Voltage Range ($V_{INFD}$) . . . . . -10V to + 22V
I/O Input Voltage Range ($V_{IO1}$) . . . . . -0.3V to 17V
Input Current except FEED ($I_{IN}$) . . . . . 10 mA
Operating Temperature ($T_A$) . . . . . -25°C to +75°C
Storage Temperature ($T_{STG}$) . . . . . -55°C to +125°C
Maximum Junction Temperature ($T_J$) . . . . . +150°C

**† Notices:**

**1:** Stresses above those listed under “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°C to +75°C and $V_{DD}$ = 9V. **Note 1**, **Note 2**

| Parameter | Symbol | Pin | Min. | Typical | Max. | Units | Conditions |
|---|---|---|---|---|---|---|---|
| **Power Supply** | | | | | | | |
| Supply Voltage | $V_{DD}$ | VDD | 6 | — | 12 | V | Operating |
| Supply Current | $I_{DD1}$ | VDD | — | 4 | 6 | µA | **Typical Application**, COSC = $V_{SS}$, LED Off |
| | $I_{DD2}$ | VDD | — | 5.5 | 8 | µA | **Typical Application**, $V_{DD}$= 12V, COSC = $V_{SS}$, |
| | $I_{DD3}$ | VDD | — | — | 2 | mA | **Typical Application**, STROBE On, IRED Off, $V_{DD}$= 12V |
| | $I_{DD4}$ | VDD | — | — | 3 | mA | **Typical Application**, STROBE On, IRED On, $V_{DD}$= 12V, **Note 3** |
| Input Voltage High | $V_{IH1}$ | FEED | 6.2 | 4.5 | — | V | |
| | $V_{IH2}$ | I/O | 3.2 | — | — | V | No Local Alarm, I/O as input |
| | $V_{IH3}$ | VSEN | 1.6 | — | — | V | |
| | $V_{IH4}$ | TEST | 8.5 | — | — | V | |

**Note 1:** Typical values are for design information only and are not guaranteed by design.

**2:** Limits over the specified temperature range are not production tested and are based on characterization data.

**3:** Does not include Q3 emitter current.

**4:** Not production tested.

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

| **DC Electrical Characteristics:** Unless otherwise specified, all parameters apply at $T_A$ = -25°C to +75°C and $V_{DD}$ = 9V. **Note 1**, **Note 2** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Parameter** | **Symbol** | **Pin** | **Min.** | **Typical** | **Max.** | **Units** | **Conditions** |
| **Power Supply (continued)** | | | | | | | |
| Input Voltage Low | $V_{IL1}$ | FEED | — | 4.5 | 2.7 | V | — |
| | $V_{IL2}$ | I/O | — | — | 1.5 | V | No Local Alarm, I/O as input |
| | $V_{IL3}$ | VSEN | — | — | 0.5 | V | — |
| | $V_{IL4}$ | TEST | — | — | 7 | V | — |
| Input Leakage Low | $I_{IL1}$ | C1, C2, DETECT | — | — | -100 | nA | $V_{DD}$ = COSC = 12V, STROBE Active |
| | $I_{IL2}$ | FEED, COSC | — | — | -100 | nA | $V_{DD}$ = 12V, $V_{IN}$ = $V_{SS}$ |
| | $I_{IL3}$ | VSEN, TEST | — | — | -1 | µA | |
| | $I_{LFD}$ | FEED | — | — | -50 | µA | FEED = -10V |
| Input Leakage High | $I_{IH1}$ | C1, C2 | — | — | 100 | nA | $V_{DD}$ = COSC = 12V, STROBE Active |
| | $I_{IH2}$ | DETECT, FEED, COSC | — | — | 100 | nA | $V_{DD}$ = 12V, $V_{IN}$ = $V_{DD}$ |
| | $I_{HFD}$ | FEED | — | — | 50 | µA | FEED = 22V |
| Input Pull Down Current | $I_{PD1}$ | TEST | 0.25 | — | 10 | µA | $V_{IN}$ = $V_{DD}$ |
| | $I_{PD2}$ | VSEN | 0.1 | 0.25 | 0.5 | µA | |
| | $I_{PDIO1}$ | I/O | 20 | — | 80 | µA | |
| | $I_{PDIO2}$ | I/O | — | — | 140 | µA | $V_{IN}$ = 17V, $V_{DD}$ = 12V |
| Output Off Leakage Low | $I_{OZL1}$ | LED, ROSC | — | — | -1 | µA | Output Off, Output = $V_{SS}$ |
| Output Off Leakage High | $I_{OZH1}$ | LED, ROSC | — | — | 1 | µA | Output Off, Output = $V_{DD}$ |
| Output Voltage Low | $V_{OL1}$ | HB, HS | — | — | 1 | V | $I_{OL}$ = 16 mA, $V_{DD}$ = 6.5V |
| | $V_{OL2}$ | ROSC | — | 0.5 | — | V | $I_{OL}$ = 5 mA, $V_{DD}$ = 6.5V |
| | $V_{OL3}$ | LED | — | — | 0.6 | V | $I_{OL}$ = 10 mA, $V_{DD}$ = 6.5V |
| Output Voltage High | $V_{OH1}$ | HB, HS | 5.5 | — | — | V | $I_{OH}$ = -16 mA, $V_{DD}$ = 6.5V |

**Note 1:** Typical values are for design information only and are not guaranteed by design.

**2:** Limits over the specified temperature range are not production tested and are based on characterization data.

**3:** Does not include Q3 emitter current.

**4:** Not production tested.

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

**DC Electrical Characteristics:** Unless otherwise specified, all parameters apply at $T_A$ = -25°C to +75°C and $V_{DD}$ = 9V. **Note 1**, **Note 2**

| Parameter | Symbol | Pin | Min. | Typical | Max. | Units | Conditions |
|---|---|---|---|---|---|---|---|
| **Power Supply (continued)** | | | | | | | |
| Output Current | $I_{IOH1}$ | I/O | -4 | — | -16 | mA | Alarm, $V_{IO}$ = 0V or $V_{IO} = V_{DD} – 2V$ |
| | $I_{IODMP}$ | I/O | 5 | | — | mA | At the conclusion of Local Alarm or Test, $V_{IO}$ = 1V |
| Low Battery Voltage | $V_{LB}$ | VDD | 6.9 | 7.2 | 7.5 | V | — |
| Offset Voltage | $V_{STOFF}$ | STROBE | $V_{DD} – 0.1$ | — | — | V | STROBE Off, $V_{DD}$ = 12V, $I_{OUT}$ = -1 µA |
| | $V_{STON}$ | STROBE | $V_{DD} – 5.25$ | $V_{DD} – 5$ | $V_{DD} – 4.75$ | V | STROBE On, $V_{DD}$ = 9V, $I_{OUT}$ = 100 to 500 µA |
| | $V_{IREDOFF}$ | IRED | — | — | 0.1 | V | IRED Off, $V_{DD}$ = 12V, $I_{OUT}$ = 1 µA |
| | $V_{IREDON}$ | IRED | 2.85 | 3.1 | 3.35 | V | IRED On, $V_{DD}$ = 9V, $I_{OUT}$ = 0 to -6 mA, $T_A$ = +25°C |
| Common Mode Voltage | $V_{CM1}$ | C1, C2, DETECT | 0.5 | — | $V_{DD} – 2$ | V | Local Smoke, Push to Test or Chamber Test, **Note 4** |
| Smoke Comparator Reference | $V_{REF}$ | — | $V_{DD} – 3.7$ | — | $V_{DD} – 3.3$ | V | Internal Reference, **Note 4** |
| Temperature Coefficient | $TC_{ST}$ | STROBE | — | 0.01 | — | %/°C | $V_{DD}$ = 6V to 12V, STROBE Output Voltage |
| | $TC_{IRED}$ | LED | — | 0.3 | — | %/°C | $V_{DD}$ = 6V to 12V, IRED Output Voltage |
| Line Regulation | $\Delta V_{STON}$ | STROBE, VDD | — | -50 | — | dB | Active, $V_{DD}$ = 6V to 12V |
| | $\Delta V_{IREDON}$ | VDD, IRED | — | -30 | — | dB | |

**Note 1:** Typical values are for design information only and are not guaranteed by design.

**2:** Limits over the specified temperature range are not production tested and are based on characterization data.

**3:** Does not include Q3 emitter current.

**4:** Not production tested.

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

**AC Electrical Characteristics:** Unless otherwise specified, all parameters apply at $T_A$ = -25°C to +75°C, $V_{DD}$ = 9V, $V_{SS}$ = 0V. Component values from Typical Application, $R_9$ = 100 kΩ, $R_{12}$ = 10 MΩ and $C_5$ = 1.5 nF, unless otherwise noted. **Note 1**, **Note 2**, **Note 3**

| Parameter | Symbol | Pin | Min. | Typical | Max. | Units | Conditions |
|---|---|---|---|---|---|---|---|
| **Oscillator Time Base** | | | | | | | |
| Oscillator Period | $t_{POSC}$ | COSC | 9.4 | 10.5 | 11.5 | ms | No Alarm Condition |
| **STROBE, LED and IRED Indication** | | | | | | | |
| STROBE and LED On Time | $t_{ON1}$ | STROBE, LED | 9.4 | 10.5 | 11.5 | ms | Operating |
| LED Period | $t_{PLED1}$ | LED | 39 | 43 | 47 | s | Standby, No Alarm |
| | $t_{PLED2}$ | LED | 0.45 | 0.5 | 0.55 | s | Local Alarm Condition |
| | $t_{PLED3}$ | LED | 9.6 | 10.75 | 11.8 | s | Timer Mode, No Local Alarm |
| | $t_{PLED4}$ | LED | LED IS OFF | | | | Remote Alarm Only |
| STROBE and IRED Pulse Period | $t_{PER1}$ | STROBE, IRED | 9.6 | 10.75 | 11.8 | s | Standby, No Alarm |
| | $t_{PER1A}$ | STROBE, IRED | 1.8 | 2 | 2.2 | s | Standby, After 1 Valid Smoke Sample |
| | $t_{PER1B}$ | STROBE, IRED | 0.9 | 1 | 1.1 | s | Standby, After 2 Consecutive Valid Smoke Samples |
| | $t_{PER2}$ | STROBE, IRED | 0.9 | 1 | 1.1 | s | In Local Alarm (Requires 3 Consecutive Valid Smoke Samples) |
| | $t_{PER3}$ | STROBE, IRED | 7.2 | 8 | 8.9 | s | In Remote Alarm |
| | $t_{PER4}$ | STROBE, IRED | 0.3 | 0.336 | 0.37 | s | Push Button Test |
| | $t_{PER5}$ | STROBE, IRED | 38.9 | — | 47.1 | s | Chamber Test or Low Battery Test, No Alarms |
| IRED On Time | $t_{ON2}$ | IRED | 94 | 104 | 115 | µs | Operating |
| **Horn Indication** | | | | | | | |
| Horn On Time | $t_{HON1}$ | HB, HS | 450 | 500 | 550 | ms | Operating, Alarm Condition, **Note 4** |
| | $t_{HON2}$ | HB, HS | 9.5 | 10.5 | 11.5 | ms | Low Battery or Failed Smoke Chamber Test, No Alarm |
| Horn Off Time | $t_{HOFF1}$ | HB, HS | 450 | 500 | 550 | ms | Operating, Alarm Condition, **Note 4** |
| | $t_{HOFF2}$ | HB, HS | 1.35 | 1.5 | 1.65 | s | |
| | $t_{HOFF3}$ | HB, HS | 39 | 43 | 47 | s | Low Battery or Failed Smoke Chamber Test, No Alarm |

**Note 1:** $t_{POSC}$ and $t_{ON2}$ are 100% production tested. All other timings are guaranteed by functional design.

**2:** Typical values are for design information only and are not guaranteed by design.

**3:** Limits over the specified temperature range are not production tested and are based on characterization data.

**4:** See timing diagram for Temporal Horn Pattern in Figure 3-1.

**5:** During Timer Mode, the LED period is 10.5 seconds. It returns to 43 seconds once Timer Mode concludes.

### TABLE 1-2: AC ELECTRICAL SPECIFICATIONS (CONTINUED)

**AC Electrical Characteristics:** Unless otherwise specified, all parameters apply at $T_A$ = -25°C to +75°C, $V_{DD}$ = 9V, $V_{SS}$ = 0V. Component values from Typical Application, $R_9$ = 100 kΩ, $R_{12}$ = 10 MΩ and $C_5$ = 1.5 nF, unless otherwise noted. **Note 1**, **Note 2**, **Note 3**

| Parameter | Symbol | Pin | Min. | Typical | Max. | Units | Conditions |
|---|---|---|---|---|---|---|---|
| **I/O** | | | | | | | |
| I/O Charge Dump Duration | $t_{IODMP}$ | I/O | 0.9 | — | 1.46 | s | At the conclusion of Local Alarm or Test Alarm |
| I/O Delay | $t_{IODLY1}$ | I/O | — | 0 | — | s | From the start of Local Alarm to I/O Active |
| I/O Filter | $t_{IOFILT}$ | I/O | — | — | 0.6 | s | I/O pulse width guaranteed to be filtered. I/O as input, No Local Alarm |
| Remote Alarm Delay | $t_{IODLY2}$ | I/O | 1.05 | — | 2 | s | No Local Alarm, from I/O active to Horn Active |
| Timer Period | $t_{TPER}$ | — | 8 | 10 | 12 | min | No Alarm Condition, **Note 5** |

**Note 1:** $t_{POSC}$ and $t_{ON2}$ are 100% production tested. All other timings are guaranteed by functional design.

**2:** Typical values are for design information only and are not guaranteed by design.

**3:** Limits over the specified temperature range are not production tested and are based on characterization data.

**4:** See timing diagram for Temporal Horn Pattern in Figure 3-1.

**5:** During Timer Mode, the LED period is 10.5 seconds. It returns to 43 seconds once Timer Mode concludes.

### TABLE 1-3: TEMPERATURE CHARACTERISTICS

**DC Electrical Characteristics:** Unless otherwise specified, all parameters apply at $V_{DD}$ = 9V and $V_{SS}$ = 0V (typical application).

| Parameter | Symbol | Min. | Typical | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| **Temperature Ranges** | | | | | | |
| Specified Temperature Range | $T_A$ | -25 | — | +75 | °C | — |
| Operating Temperature Range | $T_{OP}$ | -25 | — | +75 | °C | — |
| Storage Temperature Range | $T_{STG}$ | -55 | — | +125 | °C | — |
| **Thermal Package Resistances** | | | | | | |
| Thermal Resistance, 16-Lead PDIP | $\theta_{JA}$ | — | 70 | — | °C/W | — |
| Thermal Resistance, 16-Lead SOIC (150 mil.) | $\theta_{JA}$ | — | 86.1 | — | °C/W | — |
| Thermal Resistance, 16-Lead SOIC (300 mil.) | $\theta_{JA}$ | — | 80 | — | °C/W | — |

## 2.0 PIN DESCRIPTION

Table 2-1 describes the pins of RE46C140.

**TABLE 2-1: RE46C140 PIN FUNCTION**

| Pin Number | Symbol | Description |
|---|---|---|
| 1 | C1 | Connect a capacitor to this pin to set the photo amplifier gain (high) for the push button and chamber sensitivity tests. The size of the capacitor depends on the chamber background reflections. A = 1 + ($C_1$/10), where $C_1$ is measured in pF. The photo amplifier gain must be less than 10,000. |
| 2 | C2 | Connect a capacitor to this pin to set the photo amplifier gain (normal) during standby. The size of the capacitor depends on the required smoke sensitivity. A = 1 + ($C_2$/10), where C2 is measured in pF. |
| 3 | DETECT | Positive input of the photo amplifier. This pin usually connects to the cathode of an external photo diode operated at zero bias. |
| 4 | STROBE | Regulated output voltage of $V_{DD}$ – 5V. The voltage is active during smoke tests. Provides bias for the photo amp circuitry as shown in Application Drawing. |
| 5 | VDD | Connects to the positive power supply. |
| 6 | IRED | IRED Driver Pin. It provides a regulated pulsed output voltage pre-driver for the infrared emitter. This pin usually drives the base of an NPN transistor. |
| 7 | I/O | Interconnect Pin. Use this bidirectional pin to connect multiple detectors in a single system. If one unit goes into alarm, the I/O pin is driven high causing all the interconnected detectors to alarm. This pin has an internal pull-down device. |
| 8 | HB | Horn Brass, Inverted Output. This pin connects to the metal electrode of a piezoelectric transducer. |
| 9 | HS | Horn Silver Output. This pin is a complementary output to the HB pin and connects to the ceramic electrode of the piezoelectric transducer. |
| 10 | FEED | Feedback Pin. It connects to the feedback electrode through a current limiting resistor. If not used, ensure the FEED pin connects to $V_{DD}$ or $V_{SS}$. |
| 11 | LED | LED Driver Pin. Open-drain NMOS output used to drive a visible LED. |
| 12 | COSC | Connect a capacitor with a parallel resistor to this pin to set the internal clock low time. This value is approximately the clock period. |
| 13 | ROSC | Connect a capacitor between this pin and the COSC pin to set the internal clock high time. This also sets the IRED pulse width (100 to 200 µs). |
| 14 | VSS | This pin connects to the negative power supply. |
| 15 | VSEN | During Timer mode, use this pin to set an external smoke comparator reference. |
| 16 | TEST | Use this pin to enter two Test modes or Timer mode. It has an internal pull-down device. |

# 3.0 DEVICE DESCRIPTION

## 3.1 Introduction

RE46C140 is a low power CMOS photoelectric 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 connected to the ROSC and COSC pins as indicated in the **Typical Application** diagram, the internal oscillator period is nominally $t_{POSC}$ = 10 ms. Usually, the analog circuitry is powered down to minimize standby current (4 µA at 9V, typical value).

The detection circuitry (normal gain) is powered up for 10 ms every 10 seconds. Before this 10 ms period ends, the IRED pulse activates for 100 µs. At the end of this 10 ms period, but not after, the photo amplifier is compared to an internal reference to determine its status and then latched. If a smoke condition is detected, the time until the next detection decreases and additional checks are made. Three consecutive smoke detections cause the RE46C140 device to alarm and its horn circuit and interconnect activate.

Every 40 seconds, the status of the battery voltage is checked and latched at the end of the LED pulse.

Every 10 seconds, the photo chamber samples using normal gain (capacitor $C_2$). Additionally, once every 40 seconds, the photo chamber activates using high gain mode (capacitor $C_1$) and RE46C140 checks the photo chamber by amplifying background reflections. If the low battery check or the photo chamber test fails, the horn chirps for 10 ms once every 40 seconds.

The oscillator period ($t_{POSC}$) is determined by the values of the $R_9$ and $R_{12}$ resistors and the $C_5$ capacitor, as shown in the **Typical Application** diagram:

$R_9$ = 100 kΩ, $R_{12}$ = 10 MΩ and $C_5$ = 1.5 nF

The oscillator period is calculated using Equation 3-1.

**EQUATION 3-1:**

$$t_{POSC} = t_R + t_F$$

$$t_R = 0.6931 \times R_{12} \times C_5$$

$$t_F = 0.6931 \times R_9 \times C_5$$

Where:

$t_{POSC}$ = Oscillator Period (ms)

## 3.3 Smoke Detection Circuitry

A comparator takes the value of the photo amplifier output and compares it to an internal reference voltage. If RE46C140 detects three consecutive smoke conditions, the device enters local alarm and the horn activates. During a local alarm, the $C_2$ gain is internally increased by ~ 10% to provide alarm hysteresis.

## 3.4 Push-to-Test

When one internal clock cycle passes after the TEST pin activates ($V_{IH}$), the smoke detection rate increases from once very 10 seconds to once every 330 ms. In Push-to-Test mode, RE46C140 selects the high gain capacitor ($C_1$) and then uses background reflections to simulate a smoke condition. After the required consecutive detections, the device will go into a local alarm condition.

When one internal clock cycle passes after the TEST pin deactivates ($V_{IL}$), RE46C140 selects the normal gain capacitor ($C_2$). The detection rate continues at once every 330 ms until RE46C140 detects three consecutive no-smoke conditions. After this, the device returns to standby timing.

## 3.5 LED Pulse

The LED pulses on for 10 ms every 43 seconds while in standby.

During a local alarm or push-to-test alarm, the LED pulses on every 0.5 seconds. However, during a remote alarm, the LED does not activate.

In Timer mode, the LED pulses on for 10 ms every 10 seconds.

## 3.6 Interconnect

Use the I/O pin to interconnect multiple detectors into a single system. If one unit enters local alarm, the I/O pin is driven high through a constant current source and all other connected detectors enter remote alarm and sound together.

Short-circuiting the I/O pin to ground does not cause excessive current. The I/O pin is ignored when the device is in local alarm.

The I/O pin includes a NMOS discharge device that activates for one second after any local alarm ends. This NMOS device quickly discharges any capacitors associated with the interconnect line.

When RE46C140 detects a remote active high signal, the device enters remote alarm and the horn activates. The internal protection circuitry allow the signaling unit to have a higher supply voltage than the signaled units without drawing excessive current.

The interconnect input (I/O pin) has a 670 ms nominal digital filter. This allows to interconnect other types of alarm devices, such as carbon monoxide detectors, that have a pulsed interconnect signal.

## 3.7 Low Battery and Chamber Test

In standby, an internal voltage reference is compared to the voltage divided $V_{DD}$ power supply. Low battery status is latched when the LED pulse ends. The horn chirps for 10 ms every 43 seconds until the low battery condition is no longer present.

In standby, a photo chamber test is also performed every 40 seconds by switching from the normal gain capacitor $C_2$ to the high gain capacitor $C_1$. RE46C140 then tries to sense the background reflections of the photo chamber. Two consecutive failed chamber tests trigger the horn to chirp for 10 ms every 43 seconds.

The low battery chirp occurs immediately before the LED pulse, while the failed chamber test chirp sounds 20 seconds later.

**Note:** Low battery and chamber tests are not performed when RE46C140 is in local or remote alarm.

## 3.8 Timer Mode

To enter the 10 minute Timer mode, the following conditions must be met:

- Resistors $R_{ADJ1}$ and $R_{ADJ2}$ are connected to RE46C140 as shown in the **Typical Application** diagram.
- A high-to-low transition occurs on the TEST pin.

In Timer mode, RE46C140 switches the smoke comparator voltage reference from the internal $V_{DD}$ – 3.5V reference to the voltage present on the VSEN pin. This enables the smoke sensitivity to be changed for the duration of the 10 minute timer.

Chamber tests can be performed in Timer mode.

**Note:** If the VSEN pin remains unconnected or it connects to $V_{SS}$, Timer mode is no longer accessible.

## 3.9 Diagnostic Mode

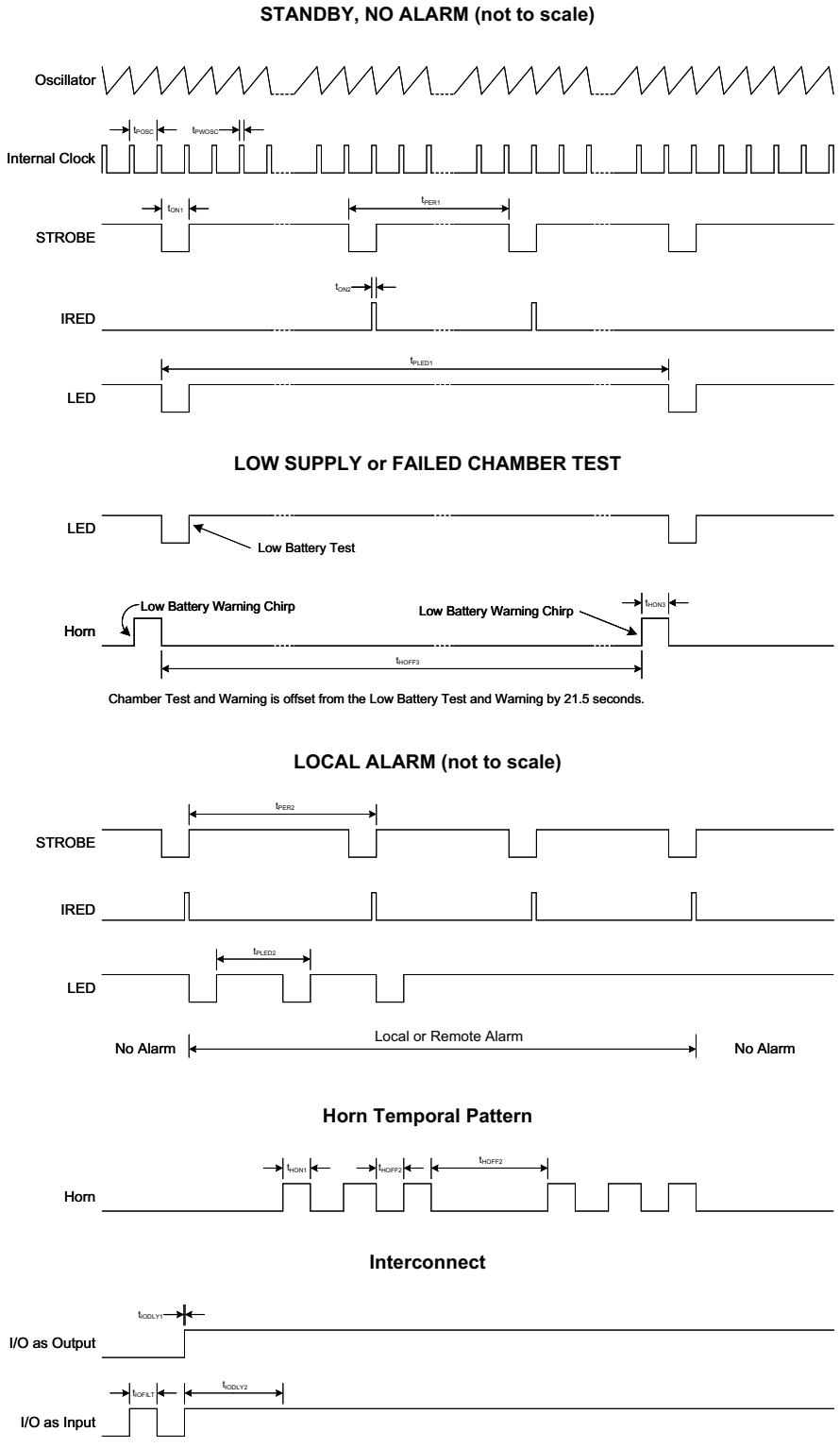
Besides the usual function of the TEST pin, a special Diagnostic mode is available for the calibration and testing of the smoke detector.

To enable Diagnostic mode, pull the TEST pin below $V_{SS}$ and source ~ 300 µA out of the pin for one clock cycle.

In Diagnostic mode, some pin functions are redefined, as shown in Table 3-1. Additionally, in this mode, the strobe is always active and the IRED pulses at a clock rate of 10.5 ms (nominal value).

**TABLE 3-1: DIAGNOSTIC MODE – REDEFINED PIN FUNCTIONS**

| Pin Name | Pin Number | Redefined Function |
|---|---|---|
| I/O | 7 | Disabled as output. Pulling the I/O pin high directs the photo amplifier output to the C1 or C2 pin, depending if the VSEN pin is pulled high or low. Amplification occurs while the IRED is active. |
| VSEN | 15 | if the I/O pin is pulled high, the VSEN pin controls what the gain capacitor is used. If the VSEN pin is pulled low, then the normal gain capacitor ($C_2$) is selected and the photo amplifier output is directed to the C1 pin. If the VSEN pin is pulled high, then the high gain capacitor ($C_1$) is selected the photo amplifier output is directed to the C2 pin. |
| FEED | 10 | If the VSEN pin is pulled low, then pulling the FEED pin high enables hysteresis, leading to a nominal 10% gain increase in normal gain mode. |
| COSC | 12 | The COSC pin can be driven by an external clock. |
| HB | 8 | The HB pin becomes output for the smoke integrator. A high level output indicates that an alarm condition was detected. |
| LED | 11 | The LED pin is used as a low battery indicator. When $V_{DD}$ is above the low battery threshold, the open-drain NMOS turns off. When $V_{DD}$ falls below the threshold, the NMOS turns on. |




**NOTES:**
**1.** Smoke is not sampled when the horn is active. Thus, the horn cycle is self-completing during a local alarm, but not during a remote alarm.
**2.** The Low Battery warning chirp is suppressed when a local or remote alarm is active.
**3.** I/O Dump is active only during a local alarm and inactive if the alarm is external.

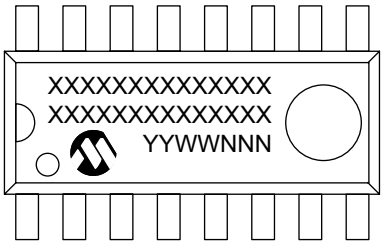
**FIGURE 3-1:** *RE46C140 Timing Diagrams.*

## 4.0 PACKAGING INFORMATION

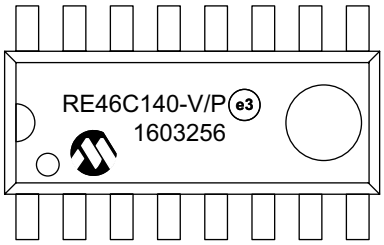
### 4.1 Package Marking Information

RE46C140

16-Lead PDIP, 300 mil. Body




Example:

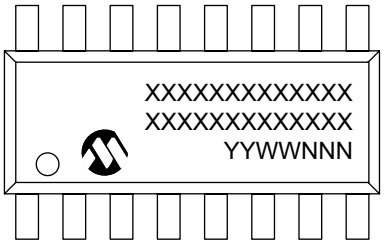



| | | |
|---|---|---|
| **Legend:** | XX...X | Customer-specific information |
| | Y | Year code (last digit of calendar year) |
| | YY | Year code (last 2 digits of calendar year) |
| | WW | Week code (week of January 1 is week ‘01’) |
| | NNN | Alphanumeric traceability code |
| | (e3) | Pb-free JEDEC 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. |

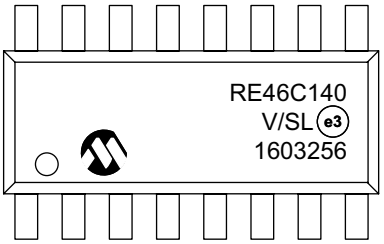
**Note**: In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information.

RE46C140

16-Lead SOIC, 3.90 mm Body

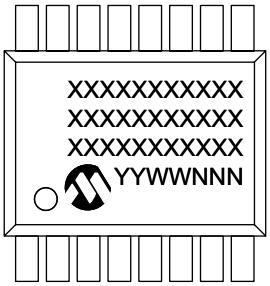



Example:

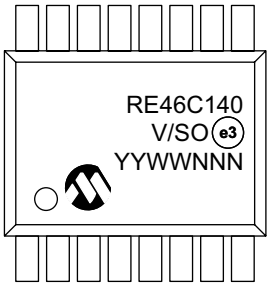



RE46C140

16-Lead SOIC, 7.50 mm Body




Example:



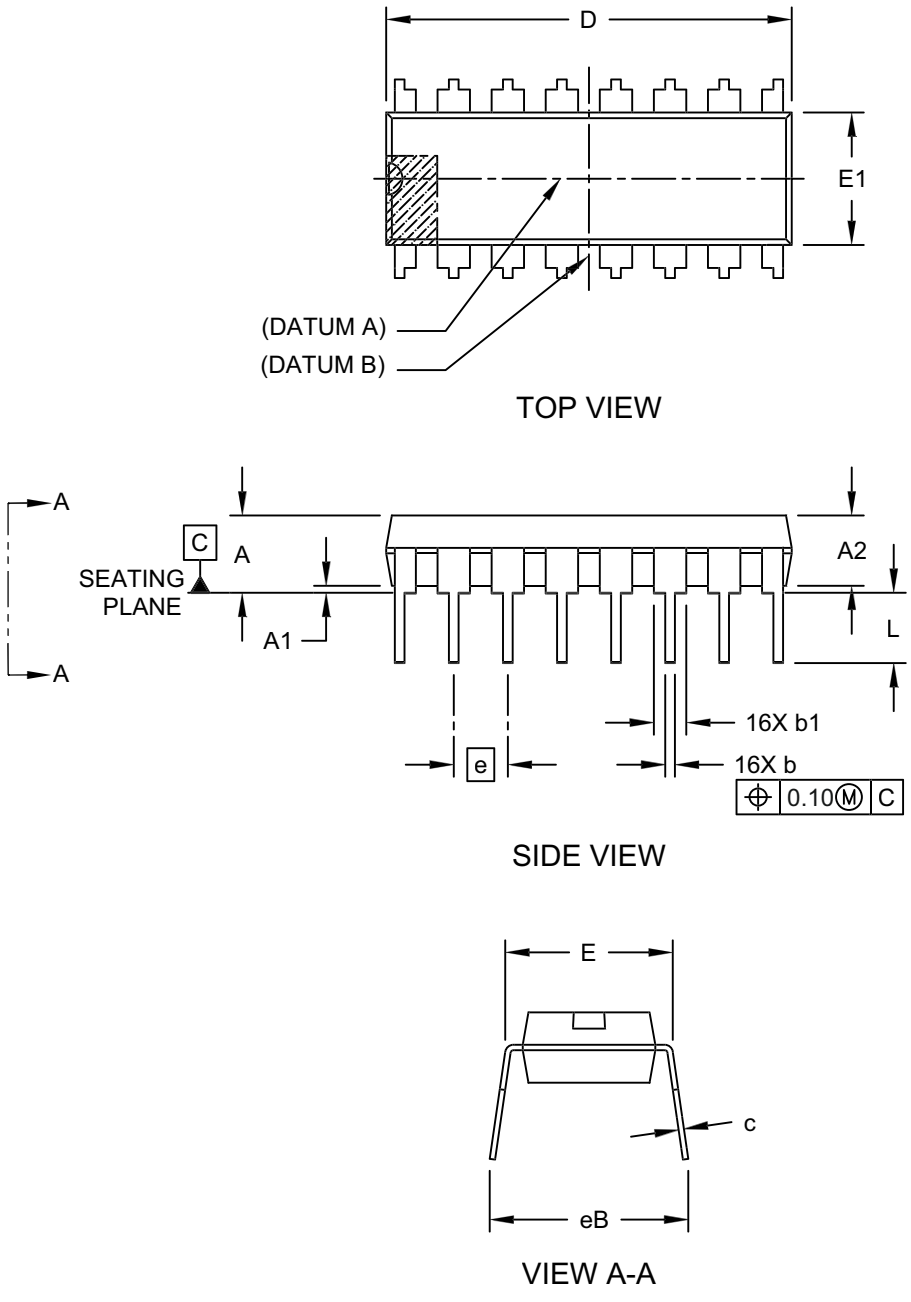

| | | |
|---|---|---|
| **Legend:** | XX...X | Customer-specific information |
| | Y | Year code (last digit of calendar year) |
| | YY | Year code (last 2 digits of calendar year) |
| | WW | Week code (week of January 1 is week ‘01’) |
| | NNN | Alphanumeric traceability code |
| | (e3) | Pb-free JEDEC 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.

## 4.2 Package Drawings

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

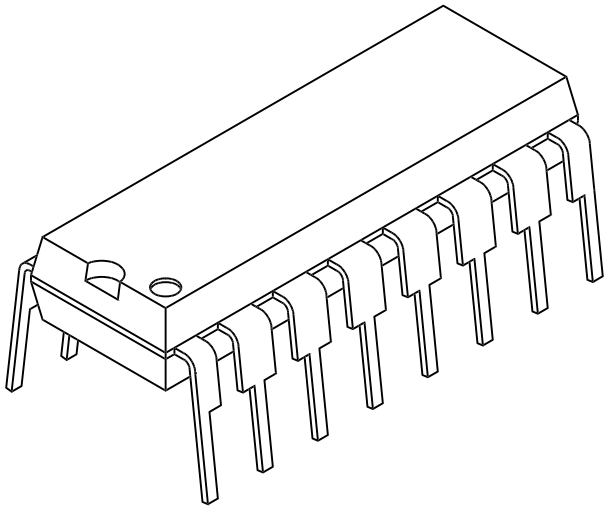
**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging




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:

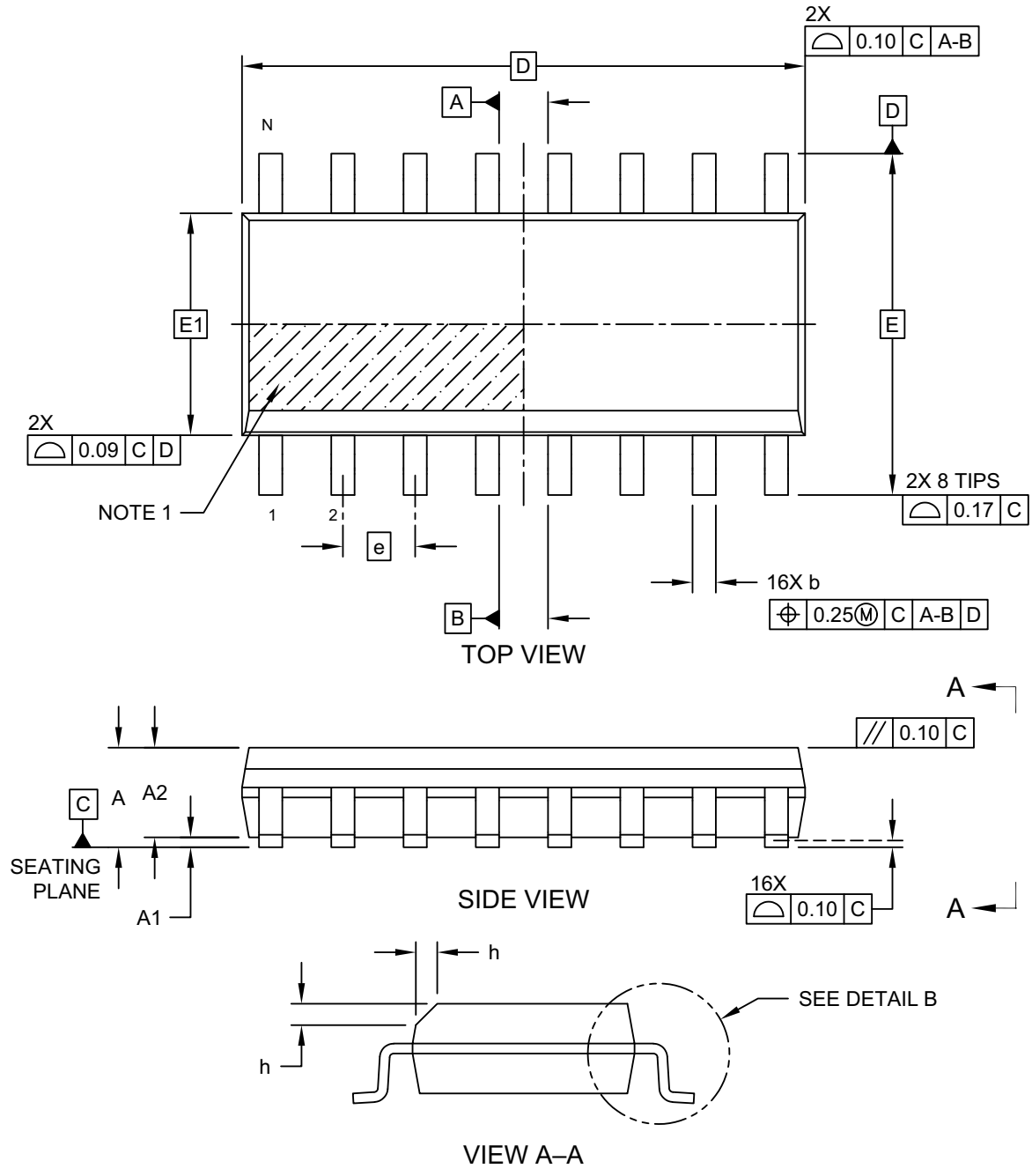
1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. § Significant Characteristic
3. Dimensions D and E do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .005" per side.
4. Dimensioning and tolerancing per ASME Y14.5M

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

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

### 16-Lead Plastic Small Outline (SL) - Narrow, 3.90 mm Body [SOIC]

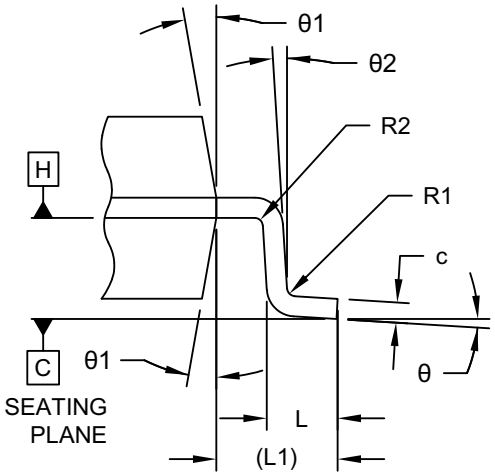
**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



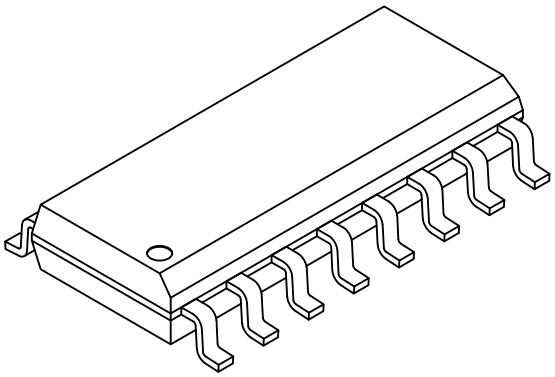

Microchip Technology Drawing C04-108-SL Rev E Sheet 1 of 2

## 16-Lead Plastic Small Outline (SL) - Narrow, 3.90 mm Body [SOIC]

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




DETAIL B



| Units | | MILLIMETERS | | |
|---|---|---|---|---|
| Dimension Limits | | MIN | NOM | MAX |
| Number of Terminals | N | | 16 | |
| Pitch | e | | 1.27 BSC | |
| Overall Height | A | - | - | 1.75 |
| Standoff § | A1 | 0.10 | - | 0.25 |
| Molded Package Thickness | A2 | 1.25 | - | – |
| Overall Length | D | | 9.90 BSC | |
| Overall Width | E | | 6.00 BSC | |
| Molded Package Width | E1 | | 3.90 BSC | |
| Terminal Width | b | 0.31 | - | 0.51 |
| Terminal Thickness | c | 0.10 | - | 0.25 |
| Corner Chamfer | h | 0.25 | - | 0.50 |
| Terminal Length | L | 0.40 | - | 1.27 |
| Footprint | L1 | | 1.04 REF | |
| Lead Bend Radius | R1 | 0.07 | - | - |
| Lead Bend Radius | R2 | 0.07 | - | - |
| Foot Angle | θ | 0° | - | 8° |
| Mold Draft Angle | θ1 | 0° | - | 15° |
| Lead Angle | θ2 | 0° | - | - |

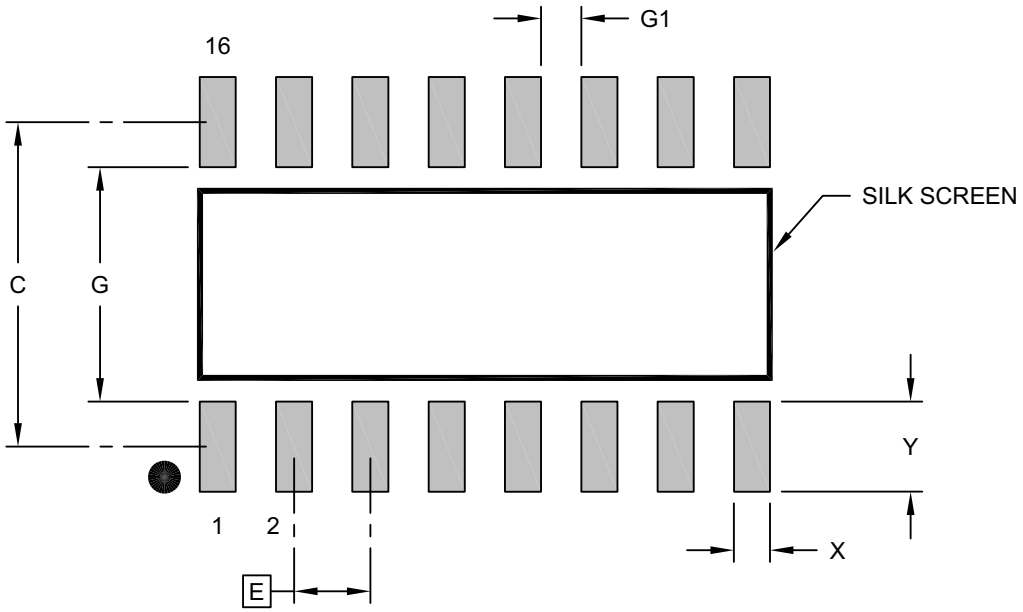
Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. § Significant Characteristic
3. Dimension D does not include mold flash, protrusions or gate burrs, which shall not exceed 0.15 mm per end. Dimension E1 does not include interlead flash or protrusion, which shall not exceed 0.25 mm per side.
4. Dimensioning and tolerancing per ASME Y14.5M
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.
   REF: Reference Dimension, usually without tolerance, for information purposes only.
5. Datums A & B to be determined at Datum H.

Microchip Technology Drawing C04-108-SL Rev E Sheet 2 of 2

## 16-Lead Plastic Small Outline (SL) - Narrow, 3.90 mm Body [SOIC]

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




RECOMMENDED LAND PATTERN

| Units | | MILLIMETERS | | |
|---|---|---|---|---|
| Dimension Limits | | MIN | NOM | MAX |
| Contact Pitch | E | 1.27 BSC | | |
| Contact Pad Spacing | C | | 5.40 | |
| Contact Pad Width (X16) | X | | | 0.60 |
| Contact Pad Length (X16) | Y | | | 1.50 |
| Contact Pad to Contact Pad (X8) | G | 3.90 | | |
| Contact Pad to Contact Pad (X14) | G1 | 0.67 | | |

Notes:

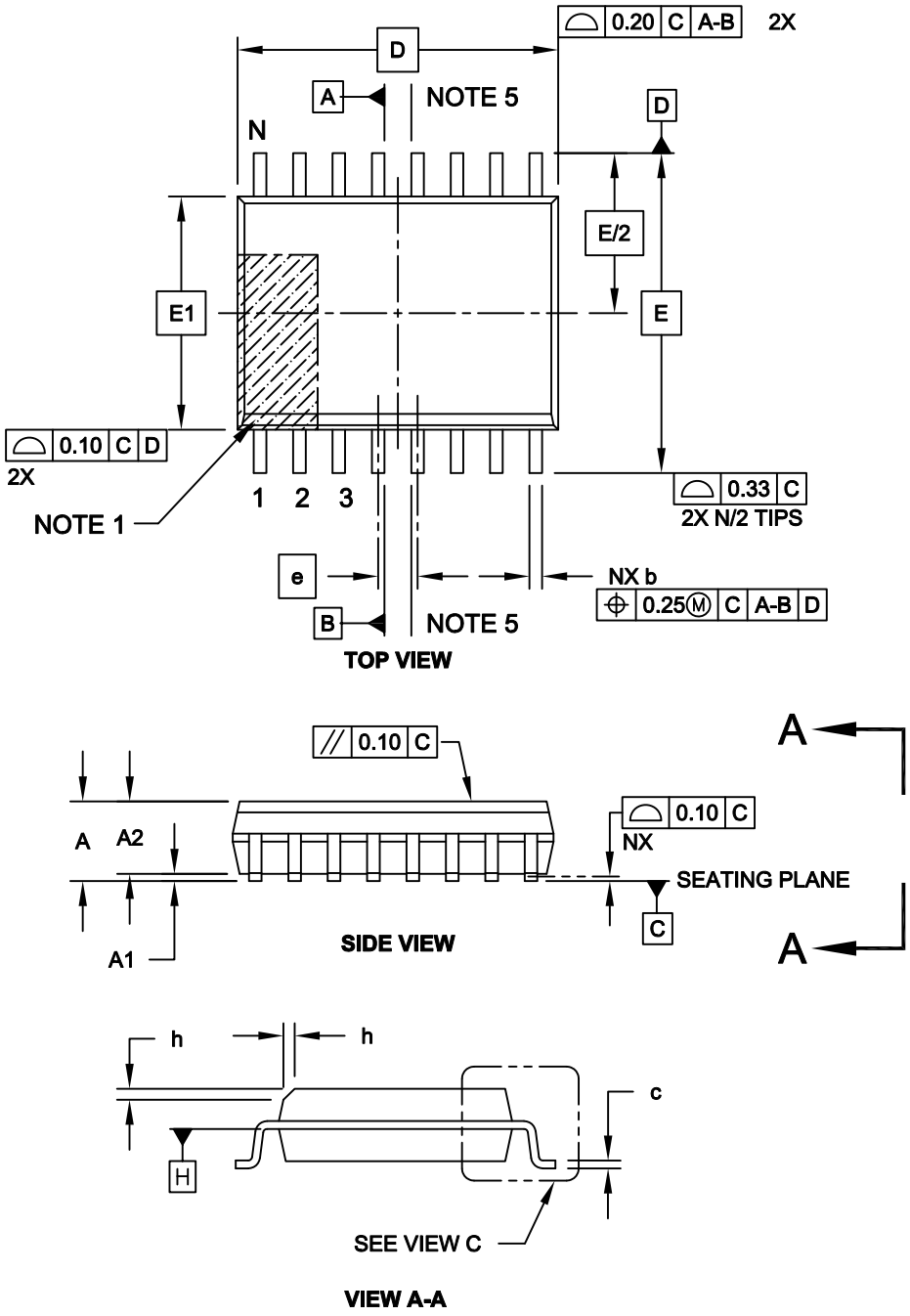
1. Dimensioning and tolerancing per ASME Y14.5M

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

Microchip Technology Drawing C04-2108-SL Rev E

### 16-Lead Plastic Small Outline (SO) - Wide, 7.50 mm Body [SOIC]

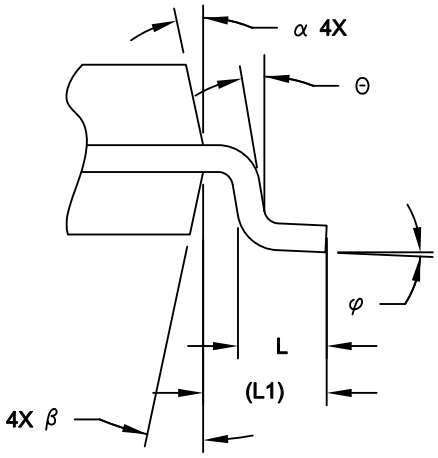
**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



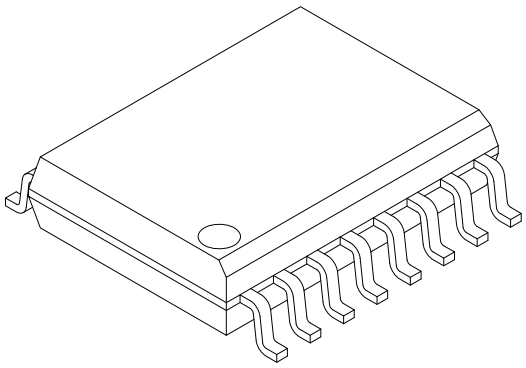

Microchip Technology Drawing C04-102C Sheet 1 of 2

## 16-Lead Plastic Small Outline (SO) - Wide, 7.50 mm Body [SOIC]

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




VIEW C



| Units | | MILLIMETERS | | |
|---|---|---|---|---|
| Dimension Limits | | MIN | NOM | MAX |
| Number of Pins | N | | 16 | |
| Pitch | e | | 1.27 BSC | |
| Overall Height | A | - | - | 2.65 |
| Molded Package Thickness | A2 | 2.05 | - | - |
| Standoff § | A1 | 0.10 | - | 0.30 |
| Overall Width | E | | 10.30 BSC | |
| Molded Package Width | E1 | | 7.50 BSC | |
| Overall Length | D | | 10.30 BSC | |
| Chamfer (Optional) | h | 0.25 | - | 0.75 |
| Foot Length | L | 0.40 | - | 1.27 |
| Footprint | L1 | | 1.40 REF | |
| Lead Angle | Θ | 0° | - | - |
| Foot Angle | φ | 0° | - | 8° |
| Lead Thickness | c | 0.20 | - | 0.33 |
| Lead Width | b | 0.31 | - | 0.51 |
| Mold Draft Angle Top | α | 5° | - | 15° |
| Mold Draft Angle Bottom | β | 5° | - | 15° |

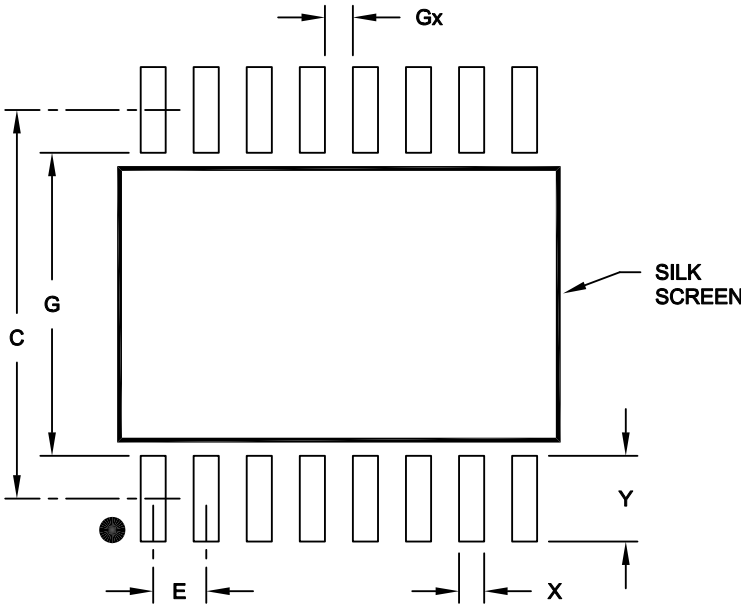
**Notes:**

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. § Significant Characteristic
3. Dimension D does not include mold flash, protrusions or gate burrs, which shall not exceed 0.15 mm per end. Dimension E1 does not include interlead flash or protrusion, which shall not exceed 0.25 mm per side.
4. Dimensioning and tolerancing per ASME Y14.5M
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.
   REF: Reference Dimension, usually without tolerance, for information purposes only.
5. Datums A & B to be determined at Datum H.

Microchip Technology Drawing C04-102C Sheet 2 of 2

### 16-Lead Plastic Small Outline (SO) - Wide, 7.50 mm Body [SOIC]

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




RECOMMENDED LAND PATTERN

| Units | | MILLIMETERS | | |
|---|---|---|---|---|
| Dimension Limits | | MIN | NOM | MAX |
| Contact Pitch | E | | 1.27 BSC | |
| Contact Pad Spacing | C | | 9.30 | |
| Contact Pad Width | X | | | 0.60 |
| Contact Pad Length | Y | | | 2.05 |
| Distance Between Pads | Gx | 0.67 | | |
| Distance Between Pads | G | 7.25 | | |

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

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

Microchip Technology Drawing No. C04-2102A

# APPENDIX A: REVISION HISTORY

## Revision C (August 2025)

- Removed mentions of Underwriters Laboratory Specifications UL217 and UL268.
- Updated Functional Block Diagram and Typical Application.
- Fixed issues with footnotes for Table 1-1 and Table 1-2. Also set I/O information apart in its own subsection within Table 1-2.
- Added **Section 2.0, "Pin Description"**.
- Updated **Section 3.0, "Device Description"**.
- Updated Figure 3-1.
- Updated **Section 3.4**.
- 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.

## PRODUCT IDENTIFICATION SYSTEM

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

| PART NO. | XX | XX | X | X |
|---|---|---|---|---|
| Device | Package | Number of Pins | Tape and Reel Option[1] | Lead Free |

| | | |
|---|---|---|
| **Device:** | RE46C140 | = CMOS Photoelectric Smoke Detector ASIC |
| **Package:** | E | = Plastic Dual In-line (P), 300 mil. Body (PDIP) |
| | S | = Plastic Small Outline (SL), 3.90 mm Body (SOIC) |
| | SW | = Plastic Small Outline (SO), 7.50 mm Body (SOIC) |
| **Number of Pins:** | 16 | = 16-Lead |
| **Tape and Reel Option:** | Blank | = Standard Packaging (Tube) |
| | T | = Tape and Reel[1] |
| **Lead Free:** | F | = Lead (Pb) Free Packaging |

**Note 1:** Tape and Reel identifier only appears in the catalog part number description. This identifier is used for ordering purposes and is not printed on the device package. Check with your Microchip Sales Office for package availability with the Tape and Reel option.

**Examples:**

a) RE46C140E16F = CMOS Photoelectric Smoke Detector ASIC, Plastic Dual In-Line, 300 mil. Body PDIP, 16-Lead, Lead (Pb) Free

b) RE46C140S16F = CMOS Photoelectric Smoke Detector ASIC, Plastic Small Outline, 3.90 mm Body SOIC 16-Lead, Lead (Pb) Free

c) RE46C140S16TF = CMOS Photoelectric Smoke Detector ASIC, Plastic Small Outline, 3.90 mm Body SOIC 16-Lead, Tape and Reel, Lead (Pb) Free

d) RE46C140SW16F = CMOS Photoelectric Smoke Detector ASIC, Plastic Small Outline, 7.50 mm Body SOIC, 16-Lead, Lead (Pb) Free

e) RE46C140SW16TF = CMOS Photoelectric Smoke Detector ASIC, Plastic Small Outline, 7.50 mm Body SOIC, 16-Lead, Tape and Reel, Lead (Pb) Free

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