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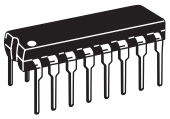
Freescale Semiconductor
Technical Data

MC145018
Rev. 4.1, 09/2006

Low-Power CMOS Ionization Smoke Detector IC with Interconnect and Temporal Horn Driver

MC145018

IONIZATION SMOKE DETECTOR IC WITH INTERCONNECT AND TEMPORAL HORN DRIVER



P SUFFIX
ED SUFFIX (PB-FREE)
PLASTIC DIP
CASE 648-08

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The MC145018, when used with an ionization chamber and a small number of external components, will detect smoke. When smoke is sensed, an alarm is sounded via an external piezoelectric transducer and internal drivers. This circuit is designed to operate in smoke detector systems that comply with UL217 and UL268 specifications.

Features

- Ionization Type with On-Chip FET Input Comparator
- Piezoelectric Horn Driver
- Guard Outputs on Both Sides of Detect Input
- Input-Protection Diodes on the Detect Input
- Low-Battery Trip Point, Internally Set, can be Altered Via External Resistor
- Detect Threshold, Internally Set, can be Altered Via External Resistor
- Pulse Testing for Low Battery Uses LED for Battery Loading
- Comparator Output for Detect
- Internal Reverse Battery Protection
- Strobe Output for External Trim Resistors
- I/O Pin Allows Up to 40 Units to be Connected for Common Signaling
- Supports NFPA 72, ANSi 53.41, and ISO 8201 Audible Emergency Evacuation Signals
- Power-On Reset Places IC in Standby Mode
- Pb-Free Packaging Designated by Suffix Code ED

ORDERING INFORMATION		
Device	**Case No.**	**Package**
MC145018P	648-08	Plastic Dip
MC145018ED		

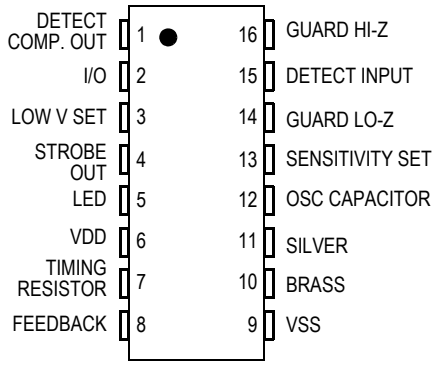


Figure 1. Pin Assignment

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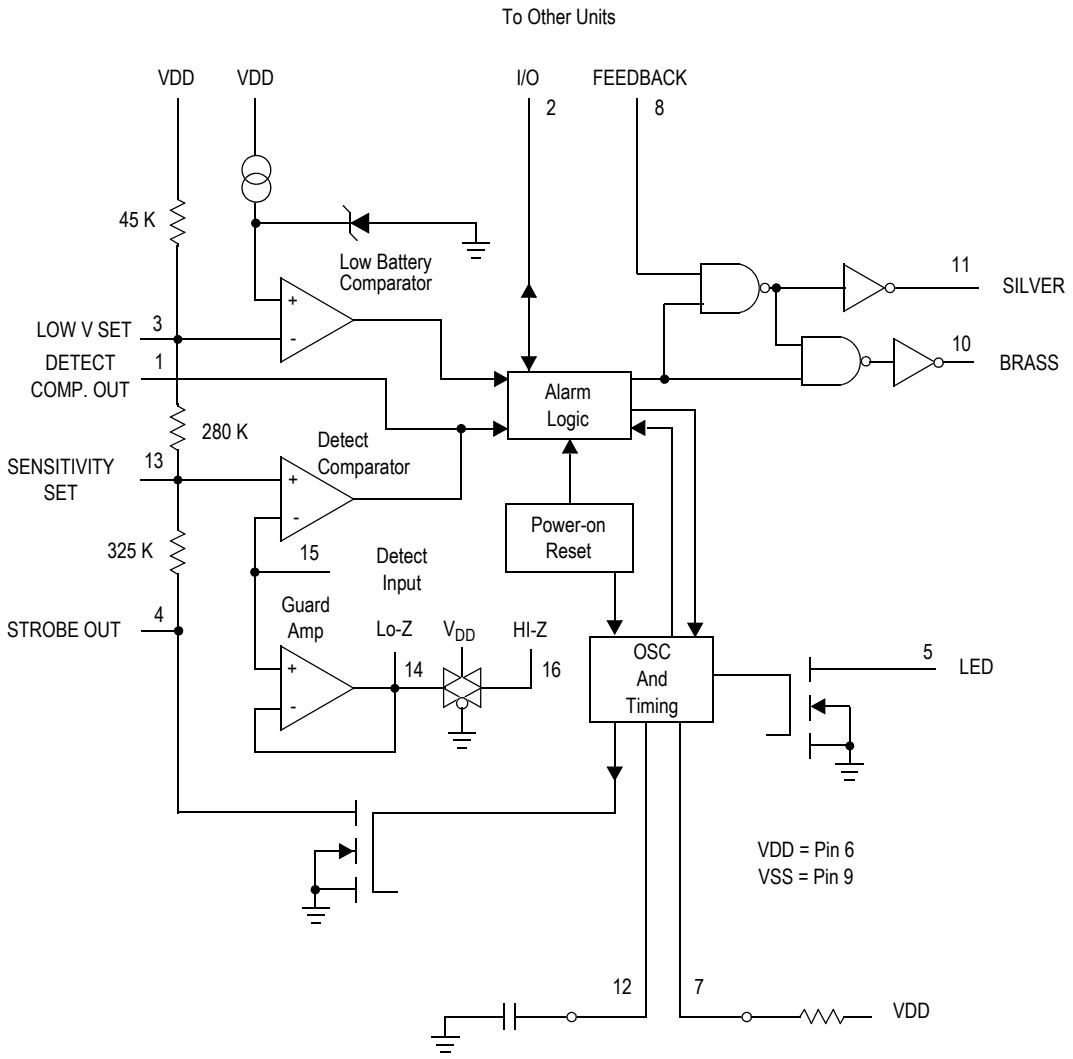


Figure 2. Block Diagram

Table 1. Maximum Ratings(1)
(Voltages referenced to V_{SS})

Rating	Symbol	Value	Unit
DC Supply Voltage	V_{DD}	–0.5 to + 15	V
Input Voltage, All Inputs Except Pin 8	V_{IN}	–0.25 to V_{DD} + 0.25	V
DC Current Drain per Input Pin, Except Pin 15 = 1 mA	I	10	mA
DC Current Drain per Output Pin	I	30	mA
Operating Temperature Range	T_A	–10 to + 60	°C
Storage Temperature Range	T_{STG}	–55 to + 125	°C
Reverse Battery Time	t_{RB}	5.0	s

1. Maximum Ratings are those values beyond which damage to the device may occur.
   This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields; however, it is advised that normal precautions be taken to avoid application of any voltage higher than maximum rated voltages to this high impedance circuit. For proper operation it is recommended that V_{in} and V_{out} be constrained to the range $V_{SS} \le (V_{in}$ or $V_{out}) \le V_{DD}$.

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Table 2. Recommended Operating Conditions

(Voltages referenced to V_{SS})

Parameter	Symbol	Value	Unit
Supply Voltage	V_{DD}	9.0	V
Timing Capacitor	—	0.1	µF
Timing Resistor	—	8.2	MΩ
Battery Load (Resistor or LED)	—	10	mA

Table 3. Electrical Characteristics

(Voltages referenced to V_{SS}, TA = 25°C)

Characteristic	Symbol	V_{DD} V_{DC}	Min	Typ(1)	Max	Unit
Operating Voltage	V_{DD}	—	6.0	—	12	V
Output Voltage Piezoelectric Horn Drivers (I_{OH} = –16 mA) Comparators (I_{OH} = –30 µA) Piezoelectric Horn Drivers (I_{OL} = + 16 mA) Comparators (I_{OL} = +30 µA)	V_{OH} V_{OL} 	 7.2 9.0 7.2 9.0	 6.3 8.5 — —	 — 8.8 — 0.1	 — — 0.9 0.5	V V
Output Voltage - LED Driver, I_{OL} = 10 mA	V_{OL}	7.2	—	—	3.0	V
Output Impedance, Active Guard Pin 14 Pin 16	 LO-Z HI-Z	 9.0 9.0	 — —	 — —	 10 1000	kΩ
Operating Current (R_{bias} = 8.2 MΩ)	I_{DD}	9.0 12.0	— —	5.0 —	9.0 12.0	µA
Input Current - Detect (40% R.H.)	I_{IN}	9.0	—	—	±1.0	pA
Input Current, Pin 8	I_{IN}	9.0	—	—	±0.1	µA
Input Current @ 50°C, Pin 15	I_{IN}	—	—	—	±6.0	pA
Internal Set Voltage Low Battery Sensitivity	 V_{LOW} V_{SET}	 9.0 —	 7.2 47	 — 50	 7.8 53	 V %V_{DD}
Hysteresis	V_{HYS}	9.0	75	100	150	mV
Offset Voltage (measured at V_{IN} = VDD/2) Active Guard Detect Comparator	V_{OS} 	 9.0 9.0	 — —	 — —	 ±100 ±50	mV
Input Voltage Range, Pin 8	V_{IN}	—	VSS –10	—	VDD + 10	V
Input Capacitance	C_{IN}	—	—	5.0	—	pF
Common Mode Voltage Range, Pin 15	V_{CM}	—	0.6	—	VDD –2	V
I/O Current, Pin 2 Input, V_{IH} = VDD –2 Output, V_{OH} = VDD –2	 I_{IH} I_{OH}	 — —	 25 –4.0	 — —	 100 —16	 µA mA

1. Data labelled “Typ" is not to be used for design purposes but is intended as an indication of the IC's potential performance.

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Table 4. Timing Parameters
($C = 0.1\ \mu F$, $R_{bias} = 8.2\ M\Omega$, $V_{DD} = 9.0\ V$, $T_A = 25°C$, See Figure 7)

Characteristics		Symbol	Min	Max	Units
Oscillator Period	No Smoke Smoke	t_{CI}	1.46 37.5	1.85 45.8	s ms
Oscillator Rise Time		t_R	10.1	12.3	ms
Horn Output (During Smoke)	On Time Off Time	PW_{ON} PW_{OFF}	450 450	550 550	ms ms
LED Output	Between Pulses On Time	t_{LED} PW_{ON}	35.0 10.1	44.5 12.3	s ms
Horn Output (During Low Battery)	On Time Between Pulses	t_{ON} t_{OFF}	10.1 35.0	12.3 44.5	ms s

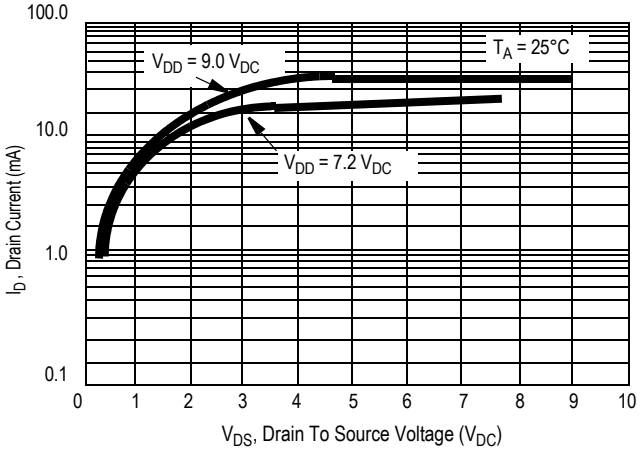


Figure 3. Typical LED Output I-V Characteristic

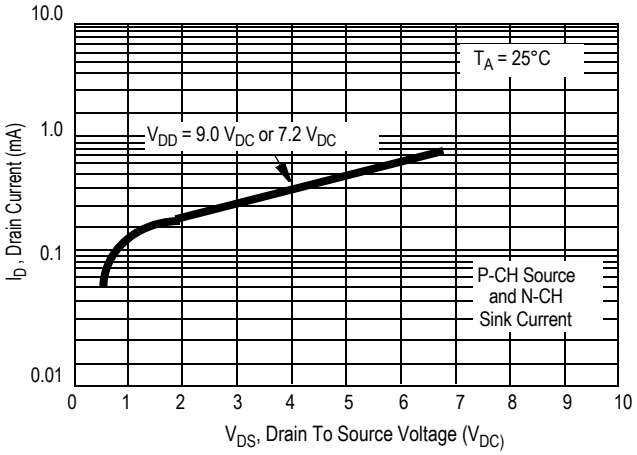


Figure 4. Typical Comparator Output I-V Characteristic

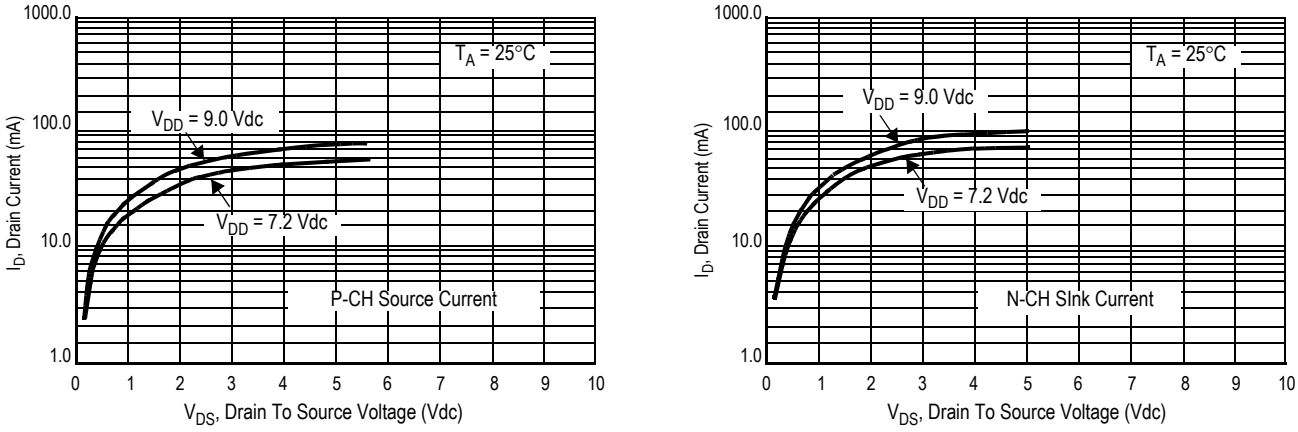


Figure 5. Typical P Horn Driver Output I-V Characteristic

DEVICE OPERATION

Timing

The internal oscillator of the MC145018 operates with a period of 1.65 seconds during no-smoke conditions. Each 1.65 seconds, internal power is applied to the entire IC and a check is made for smoke, except during LED pulse, Low Battery Alarm Chirp, or Horn Modulation (in smoke). Every 24 clock cycles a check is made for low battery by comparing V_{DD} to an internal zener voltage. Since very small currents are used in the oscillator, the oscillator capacitor should be of a low leakage type.

Detect Circuitry

If smoke is detected, the oscillator period becomes 41.67 ms and the piezoelectric horn oscillator circuit is

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enabled. The horn output is modulated 500 ms on, 500 ms off. During the off time, smoke is again checked and will inhibit further horn output if no smoke is sensed. During local smoke conditions the low battery alarm is inhibited, but the LED pulses at a 1.0 Hz rate. In remote smoke, the LED is inhibited as well.

An active guard is provided on both pins adjacent to the detect input. The voltage at these pins will be within 100 mV of the input signal. 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 op amp is not power strobed and thus gives constant protection from surface leakage currents. Pin 15 (the Detect input) has internal diode protection against static damage.

Interconnect

The I/O (Pin 2), in combination with V_{SS}, is used to interconnect up to 40 remote units for common signaling. A Local Smoke condition activates a current limited output driver, thereby signaling Remote Smoke to interconnected units. A small current sink improves noise immunity during non-smoke conditions. Remote units at lower voltages do not draw excessive current from a sending unit at a higher voltage. The I/O is disabled for three oscillator cycles after power up, to eliminate false alarming of remote units when the battery is changed.

Sensitivity/Low Battery Thresholds

Both the sensitivity threshold and the low battery voltage levels are set internally by a common voltage divider (see Figure 2) connected between VDD and VSS. These voltages can be altered by external resistors connected from pins 3 or 13 to either VDD or VSS. There will be a slight interaction here due to the common voltage divider network. The sensitivity threshold can also be set by adjusting the smoke chamber ionization source.

Test Mode

Since the internal op amps and comparators are power strobed, adjustments for sensitivity or low battery level could be difficult and/or time-consuming. By forcing Pin 12 to V_{SS}, the power strobing is bypassed and the output, Pin 1, constantly shows smoke/no smoke. Pin 1 = VDD for smoke. In this mode and during the 10 ms power strobe, chip current rises to approximately 50 μA.

LED Pulse

The 9-volt battery level is checked every 40 seconds during the LED pulse. The battery is loaded via a 10 mA pulse for 11.6 ms. If the LED is not used, it should be replaced with an equivalent resistor such that the battery loading remains at 10 mA.

Hysteresis

When smoke is detected, the resistor/divider network that sets sensitivity is altered to increase sensitivity. This yields approximately 100 mV of hysteresis and reduces false triggering.

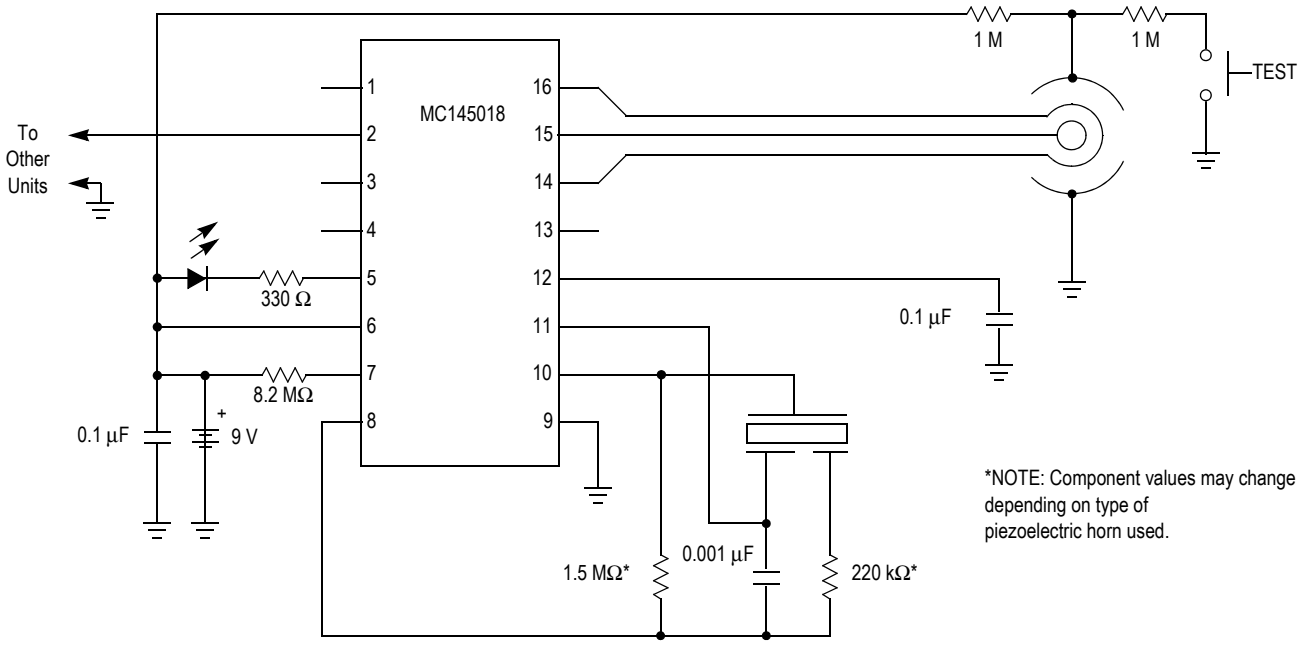


Figure 6. Typical Application as Ionization Smoke Detector

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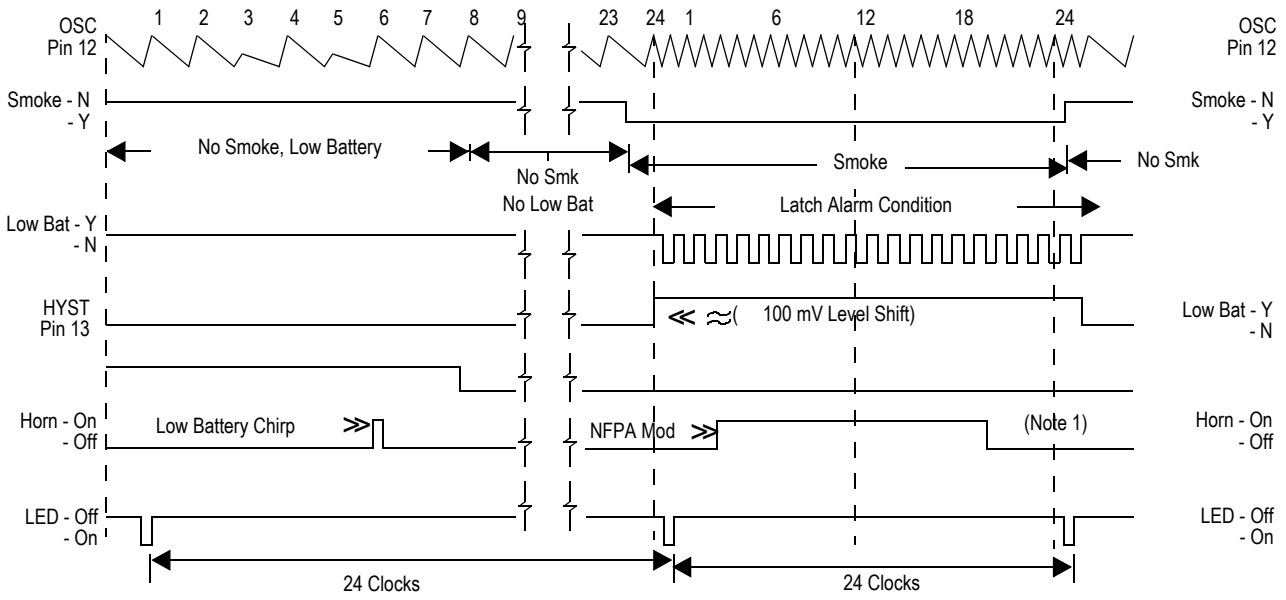


Figure 7. MC145017 Timing Diagram

NOTE:

1. Horn modulation is self-completing. When going from smoke to no smoke, the alarm condition will terminate only when horn is off.
   Comparators are strobed once per cycle (1.65 sec for no smoke, 40 msec for smoke).
   For timing under remote conditions, refer to MC14468 data sheet.

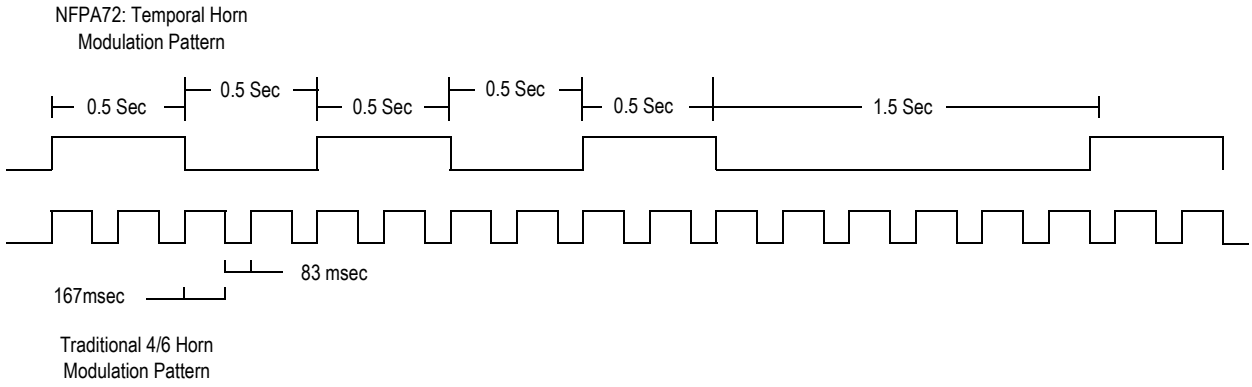
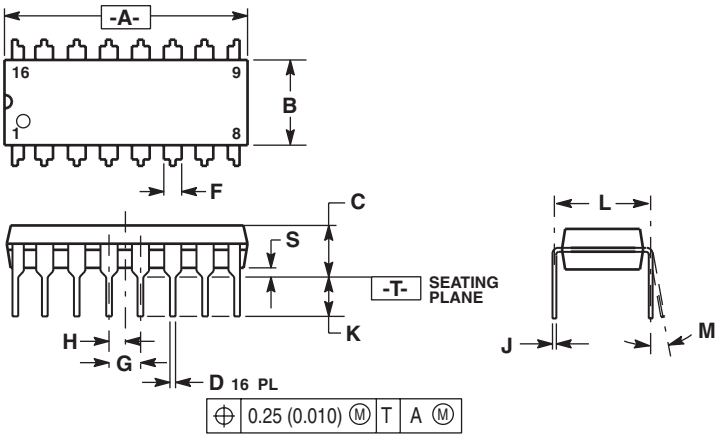


Figure 8. Horn Modulation

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PACKAGE DIMENSIONS



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.740	0.770	18.80	19.55
B	0.250	0.270	6.35	6.85
C	0.145	0.175	3.69	4.44
D	0.015	0.021	0.39	0.53
F	0.040	0.70	1.02	1.77
G	0.100 BSC		2.54 BSC	
H	0.050 BSC		1.27 BSC	
J	0.008	0.015	0.21	0.38
K	0.110	0.130	2.80	3.30
L	0.295	0.305	7.50	7.74
M	0	10	0	10
S	0.020	0.040	0.51	1.01

STYLE 1:
PIN 1. CATHODE
2. CATHODE
3. CATHODE
4. CATHODE
5. CATHODE
6. CATHODE
7. CATHODE
8. CATHODE
9. ANODE
10. ANODE
11. ANODE
12. ANODE
13. ANODE
14. ANODE
15. ANODE
16. ANODE

STYLE 2:
PIN 1. COMMON DRAIN
2. COMMON DRAIN
3. COMMON DRAIN
4. COMMON DRAIN
5. COMMON DRAIN
6. COMMON DRAIN
7. COMMON DRAIN
8. COMMON DRAIN
9. GATE
10. SOURCE
11. GATE
12. SOURCE
13. GATE
14. SOURCE
15. GATE
16. SOURCE

CASE 648-08
ISSUE R
16-LEAD PLASTIC DIP

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