Ionization Chamber Type Smoke Detector Circuit

Ordering Information

Device	Package	Order No.
SD3A	14 Pin Plastic	SD3AP

Features

- ☐ Capable of Directly Driving Piezoelectric Horn
- ☐ Multiple I/O Station Capability
- ☐ Low Battery Level Beep Alarm
- ☐ Continuous or Intermittent Alarm
- ☐ LowPower Consumption - 10μA Maximum
- ☐ High Noise Immunity CMOS Technology
- ☐ Meets UL217 Requirements
- ☐ Uses Economical Zinc Carbon 9V Battery
- ☐ No Voltage Detection Adjustment Necessary
- ☐ Optional Battery Impedance Check

Absolute Maximum Ratings

Storage Temperature Range	-55°C to +150°C
Operating Temperature	0°C to +50°C
Supply Voltage	+15.0V
Voltage on All Other Pins	-0.3V to V_{DD} + 0.3V
Power Dissipation	300mW
Relative Humidity Range	5% to 95%

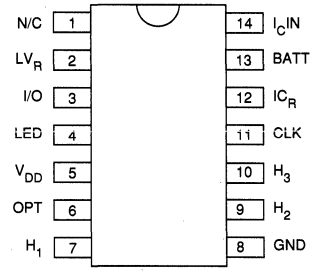
General Description

The SD3A is a CMOS integrated circuit designed for an ionization chamber type smoke detector that directly drives a piezoelectric horn. It satisfies UL217 requirements and is available in a 14-lead plastic DIP.

Designed and built for an efficient, low component count, smoke detector system, the SD3A has numerous features that allow increased alarm effectiveness and reduced false triggering. With an improved offset voltage and built-in hysteresis, this device requires less ion source and has increased sensitivity.

The horn output of this circuit can be a continuous or intermittent alarm. An optional LED indicator can be used to monitor the battery level. The SD3A operates on a single 9-volt alkaline or zinc carbon battery. It also may be used in multiple station connection applications.

Pin Configuration



top view

14-pin DIP

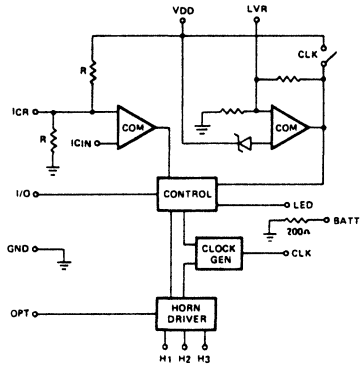
DC Electrical Characteristics

Parameter	Symbol	Min	Typ	Max	Units	Conditions
Operating Voltage	V_{DD}	6.0		10.0	V	
Supply Current	I_{DD}		7.0	10.0	µA	V_{DD} = 9.0V; LED not con't
Ionization Chamber Input Reference Voltage	V_{IR}	$1/2V_{DD}$ - 0.15	$1/2V_{DD}$	$1/2V_{DD}$ + 0.15	V	V_{IR} = floating
		0.5		V_{DD} - 3	V	V_{IR} tied to external resistor
Ionization Chamber Input Leakage Current	I_I			1.0	pA	Input Voltage = 9.0V
Ionization Chamber Input Offset Voltage	V_{OS}		50	150	mV	
Input/Output Alarm Trigger Voltage	$V_{I/O}$	3.0			V	
Input/Output Drive Current	$I_{I/O}$	-3.0	-5.0		mA	V_{DD} = 7.0V; V_{IO} = 6.0V
Operating Voltage Low Voltage Detection	V_{DD}	7.5	7.7	7.9	V	No Adjustment Necessary
Horn Current H2, H3	I_{HORN}	-25			mA	V_{DD} = 7.0V; V_{HORN} = 1.0V
				25	mA	V_{DD} = 7.0V; V_{HORN} = 5.0V
LED Current	I_{LED}	2	4		mA	V_{DD} = 8.0V
Clock Period	i_C	20	40	60	sec	C_L = 1µF; V_{DD} = 8.0V
Clock ON Time	t_{ON}	10	20	30	msec	C_L = 1µF; V_{DD} = 8.0V
LED Flash Period	t_{LED}	10		30	sec	C_L = 1µF; V_{DD} = 8.0V
Horn Pulse ON/OFF Time	t_{OSC}		0.5		sec	Intermittent Mode Only

Pin Definition

Label	SD3A Pin	Function
CLK	11	Clock oscillates with a nominal period of 40 sec when an external 1µF capacitor is connected to the clock lead.
IC_R	12	The Ionization Chamber Reference Input is connected to the other side of the Ionization Chamber comparator. It is set at 1/2 V_{DD} generated by an internal resistor network.
IC_{IN}	14	The Ionization Chamber Input has high input impedence and is connected to one side of the Ionization Chamber comparator.
I/O	3	Input/Output terminal can drive up to 20 units using a simple two wire bus.
LED	4	An optional Light Emitting Diode can be attached to this lead to monitor operation of the SD3A.
V_{DD}	5	Power Supply.
H_1	7	The Horn Driver Feedback Input is used for a piezoelectric horn feedback connection.
GND	8	Ground.
H_2	9	This horn driver output connects to the brass disc of the piezoelectric horn.
H_3	10	This horn driver output connects to the top electrode of the piezoelectric horn.
LV_R	2	For Low Voltage Detection Point Adjustment.
OPT	6	This pin controls the type of horn drive. When tied to V_{DD}, the horn output is continuous. When this pin is left open, the horn output is intermittent.
BATT	13	This lead is for battery Test.

Block Diagram



Operation

The SD3A is specifically designed to directly drive a piezoelectric horn. In this circuit the ionization chamber input (I_{CIN}) is connected to the first input of a voltage comparator which responds to a voltage drop by activating the horn. The other input of the voltage comparator is connected to an internal reference voltage preset at $V_{DD}/2$. This reference voltage can also be adjusted externally by a resistor or potentiometer tied to the ionization chamber reference input (I_{CR}). Adjustment of the bias voltage sets the sensitivity of the chamber to the smoke.

The horn output of this device can be connected to an electromechanical horn through an external resistor. The piezoelectric horn drive provides a feedback lead for resonance oscillation to boost the sound output level at a modulated tone to increase the horn effectiveness.

Low voltage is detected by the internal zener reference and voltage detection circuitry. This design allows either utilization of the preset low voltage detection level or external adjustment using a resistor tied to the low voltage reference (LV_R) lead of SD3A. The preset low battery voltage detection level is at 7.7 volts ± 2.0V. Several connection options are illustrated in Figures 1, 2 and 3.

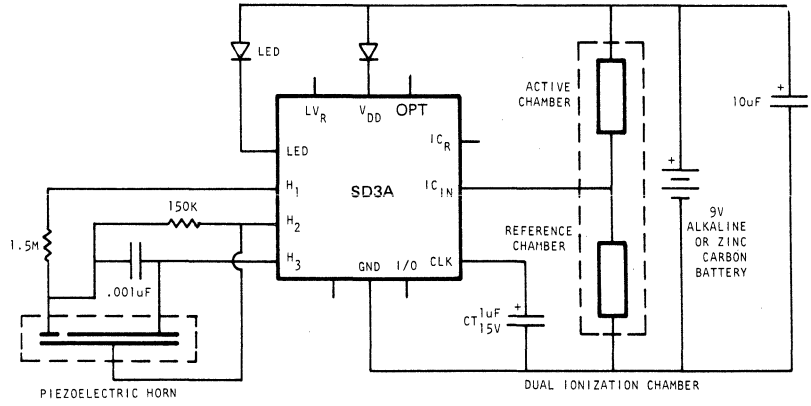


Figure 1. SD3A with a Daul Ionization Chamber and Piezoelectric Horn together with an LED as battery connection indicator.

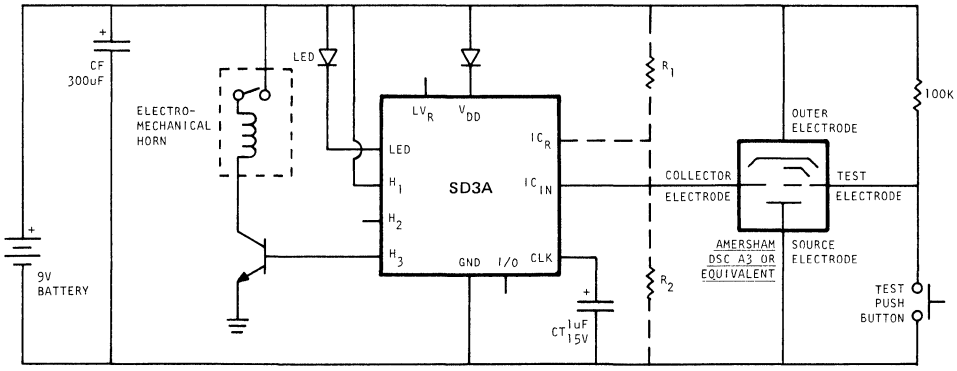


Figure 2. SD3A with an Amersham DSC A3 Concentric Chamber and an electromechanical Horn. Special features are optional R1/R2 resistor network for adjusting comparator trip voltage and built-in test electrode for in-circuit alarm test.

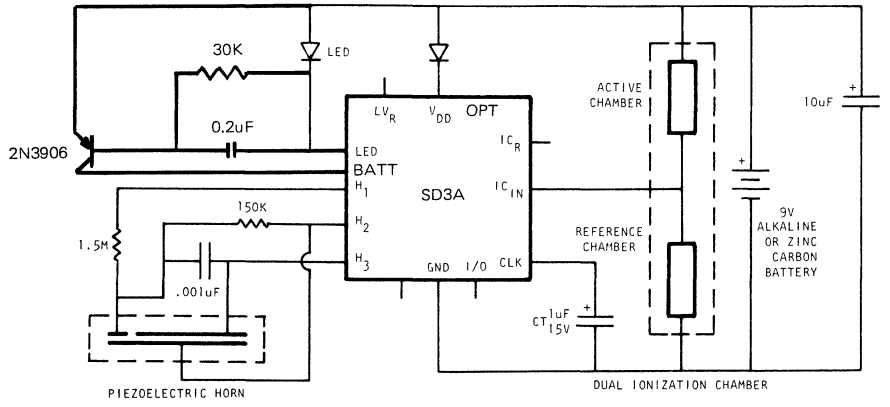


Figure 3. SD3A with a Dual Ion Chamber, Piezoelectric Horn, LED, Battery Impedance Check, and Intermittent Horn.

Multiple Station Connection

The SD3A can drive up to 20 units simultaneously. When any unit detects smoke, all the units are triggered. However, when only one unit gives a beep indicating low battery level, only that unit beeps. Multiple station connection of SD3A devices requires only a simple two-wire bus.