

## Description

The LH1156AT High-Voltage Solid-State Relay is a single-pole, normally-open switch (1 Form A), which can replace mechanical relays in many applications. The relay features logic-level input control of isolated high-voltage switch outputs. The outputs are rated at 350 V and can handle loads up to 120 mA. Although the relay can switch both ac and dc loads, it is intended primarily for audio frequency or dc applications. Typical ON-Resistance is 30 Ω at 25 mA.

The LH1156AT Relay consists of a GaAlAs LED that optically couples control signals to a monolithic integrated circuit. Optical coupling provides 1500 Vrms of input/output isolation. The integrated circuit is a dielectrically isolated, high-voltage die comprised of photodiode arrays, switch control circuitry, and high-voltage DMOS transistor switches.

In operation the device is exceptionally linear up to 50 mA. Beyond 50 mA, the incremental resistance decreases, thereby minimizing internal power dissipation. Overload currents are clamped at 210 mA by internal current limiting. An extended clamp condition, which increases relay temperature, results in a reduction in clamp current, thereby further reducing internal power dissipation and preserving the relay's integrity. When properly protected, the relay will survive lightning test number 68-302. The relay is packaged in a 6-pin plastic DIP.

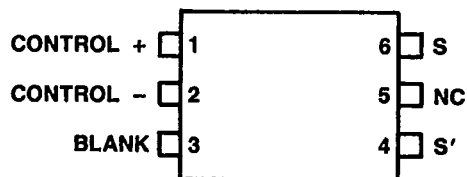
## Features

- Low ON-Resistance
- Clean, bounce-free switching
- 1500 Vrms input/output isolation
- dv/dt typically better than 500 V/μs
- High-surge capability
- Low power consumption
- Noise-free operation
- No electromagnetic interference
- Monolithic IC reliability

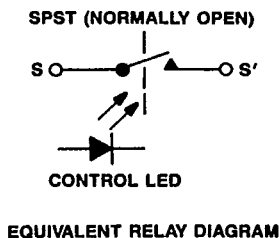
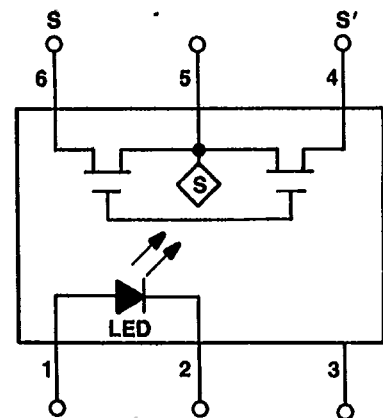
## Applications

- Telephone switchhook
- High-voltage testers
- Industrial controls
- Triac predriver
- Isolation switching

## Pin Diagram



## Functional Diagram



T-41-83

**Maximum Ratings**

At 25 °C

Stresses exceeding the values listed under Maximum Ratings may cause permanent damage to the device. This is an absolute stress rating only. Functional operation of the device at these or any other conditions in excess of those indicated in the operational sections of this data sheet is not implied. Exposure to maximum-rating conditions for extended periods of time may adversely affect device reliability.

Rating	Value	Unit
Ambient Operating Temperature Range	- 40 to + 85	°C
Storage Temperature Range	- 40 to + 100	°C
Pin Soldering Temperature (t = 15 seconds max.)	300	°C
Input/Output Voltage Isolation	1500	Vrms
LED Input Ratings:		
Continuous Forward Current	20	mA
Reverse Voltage	10	V
Output Operation:		
Operating Voltage	350	V
dc or Peak Load Current	120	mA

**Pin Descriptions**

Pin	Symbol	Name/Function
1 2	Control + Control -	These pins are the positive and negative inputs respectively to the input control LED. An appropriate amount of current through the LED will close the circuit path between S and S' (S Prime).
6 4	S S'	These pins are the outputs. The pin designated as S represents one side of a relay pole. The pin designated as S' is the complementary side of a relay pole. This relay pole is normally open unless sufficient control current is flowing.
3	Blank	This pin may be used as a tie-point for external components. Voltage on this pin should not exceed 300 V.
5	NC	This pin is connected to internal circuitry. It should <b>not</b> be used as a tie-point for external circuitry.

## Characteristics

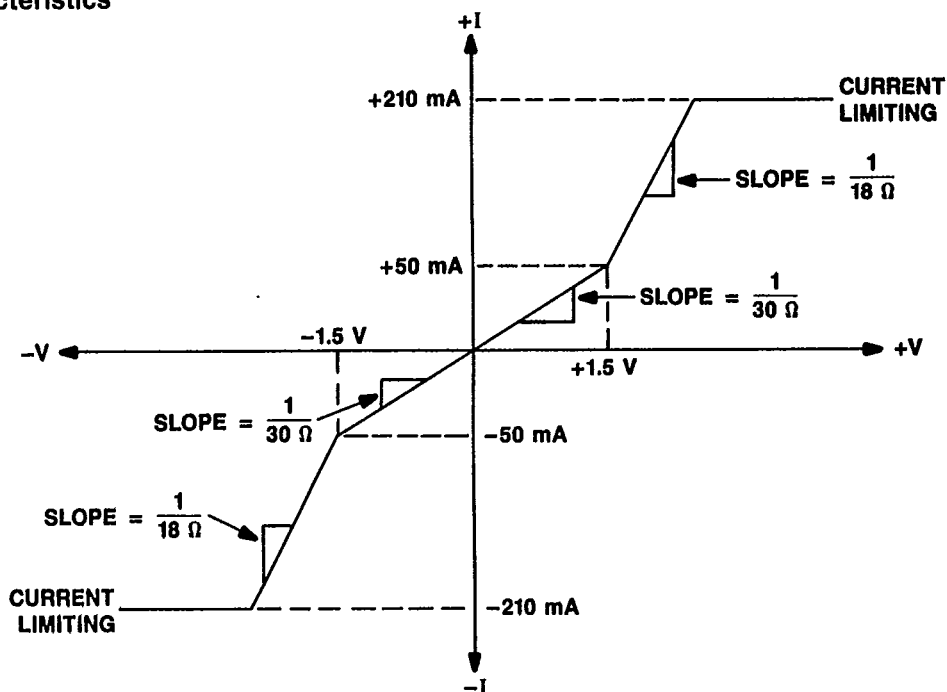


Figure 1. Typical ON Characteristics

## Electrical Characteristics

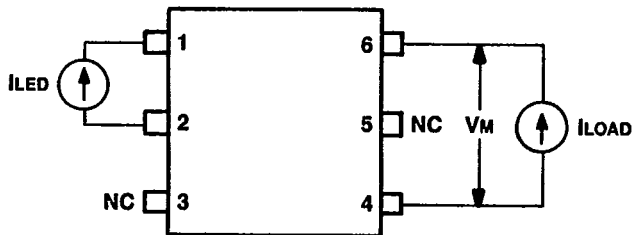
$T_A = 25\text{ }^\circ\text{C}$  unless otherwise specified.

Minimum and maximum values are testing requirements. Typical values are characteristics of the device and are the result of engineering evaluations. Typical values are for information purposes only and are not part of the testing requirements.

Characteristic	Test Conditions	Min	Typ	Max	Unit
LED Forward Current for Turn-On*	$I_{LOAD} = 120\text{ mA}, 25\text{ }^\circ\text{C}$	—	1.5	2.5	mA
	$I_{LOAD} = 95\text{ mA}, 70\text{ }^\circ\text{C}$	—	2.5	—	
LED ON Voltage @ 10 mA	—	1.15	1.30	1.45	V
ON-Resistance @ 25 mA (Figure 2)	—	20	30	50	$\Omega$
Breakdown Voltage @ 50 $\mu\text{A}$ (Figure 2)	—	350	380	—	V
Current Limit @ 7 V (Figure 3)	—	160	210	260	mA
Output Off-State Leakage Current (Figure 3)	100 V, $I_{LED} = 0\text{ }\mu\text{A}$	—	1.0	200	nA
	100 V, $I_{LED} = 200\text{ }\mu\text{A}$	—	0.1	2.0	$\mu\text{A}$
	300 V, $I_{LED} = 200\text{ }\mu\text{A}$	—	0.1	5.0	$\mu\text{A}$
Turn-On Time (Figure 4)	—	—	1.1	—	ms
Turn-Off Time (Figure 4)	—	—	0.9	—	
Feedthrough Capacitance, Pin 4 to 6 (4 V p-p, 1 kHz)	—	—	26	—	pF

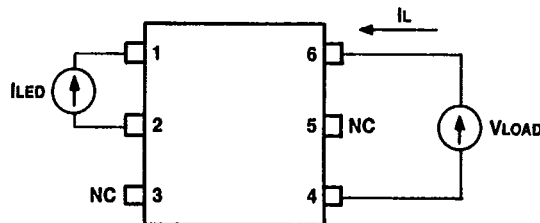
\* Proper operation requires a minimum of 6 mA LED current over the full operating temperature range.

## Test Circuits



I <sub>LED</sub>	I <sub>LOAD</sub>	Measure	Parameter
5.0 mA	±25 mA	±V <sub>M</sub>	ON-Resistance = $\frac{V_M}{25 \text{ mA}}$
0	±50 μA	±V <sub>M</sub>	Breakdown Voltage = V <sub>M</sub>

Figure 2. Test Circuit ON-Resistance and Breakdown Voltage



I <sub>LED</sub>	V <sub>LOAD</sub>	Measure	Parameter
200 μA	±300 V	I <sub>L</sub>	Leakage = I <sub>L</sub>
0, 200 μA	±100 V	I <sub>L</sub>	
5.0 mA	± 7 V	I <sub>L</sub>	Current Limit = I <sub>L</sub>

Figure 3. Test Circuit for Leakage and Current Limit

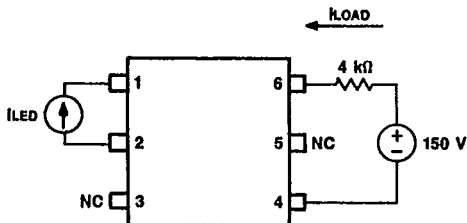


Figure 4. ton/toff Test Circuit and Waveform

## Applications

When the relay is used for telephone-loop applications, overvoltage protection is required. A recommended device is AT&T's LH1150-Type Integrated Secondary Protector. Another device for protection is a metal-oxide varistor (MOV) as shown in Figure 6. At worst-case fault current, the maximum MOV clamp voltage must be less than 350 V per relay output.

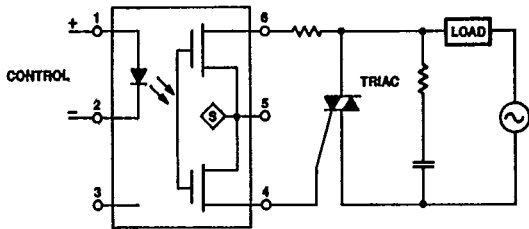


Figure 5. Triac Predriver

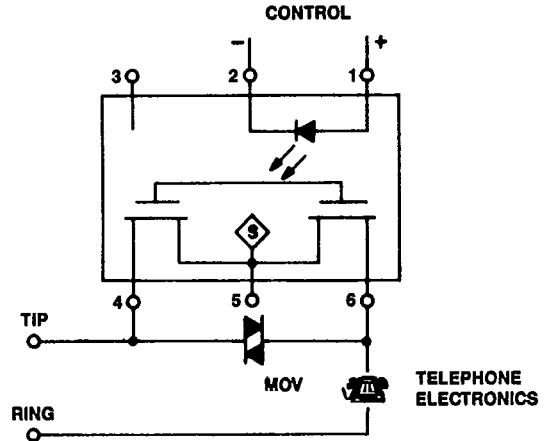
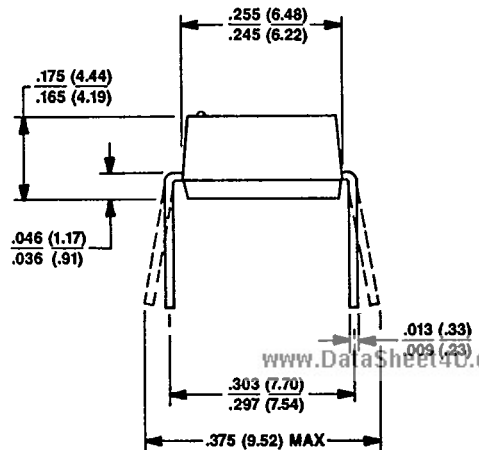
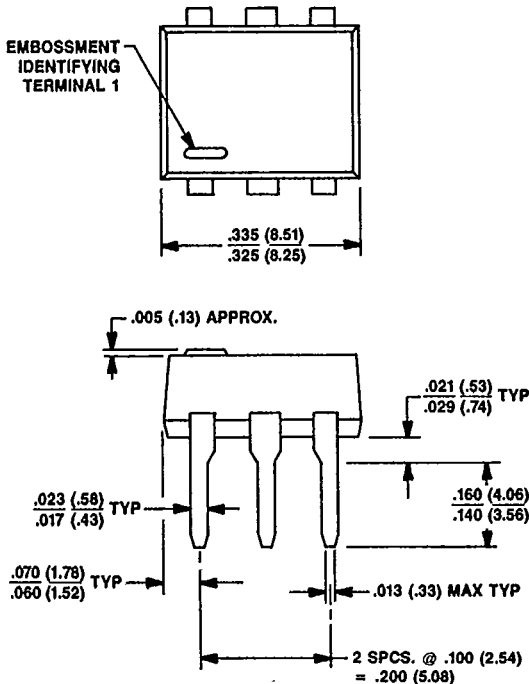


Figure 6. Telephone Switchhook

## Outline Drawings

### 6-Pin Plastic DIP

Dimensions are in inches and (millimeters).



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**Ordering Information**

<b>Device</b>	<b>Comcode</b>
LH1156AT	104436811

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