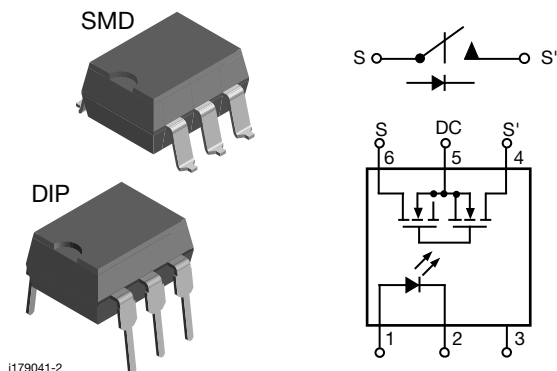




1 Form A Solid-State Relay



DESCRIPTION

The LH1525 relay are SPST normally open switches (1 form A) that can replace electromechanical relays in many applications. The relay requires a minimal amount of LED drive current to operate, making it ideal for battery powered and power consumption sensitive applications. The relay is constructed using a GaAlAs LED for actuation control and an integrated monolithic die for the switch output. The die, fabricated in a high-voltage dielectrically isolated technology, comprised of a photodiode array, switch-control circuitry, and MOSFET switches. In addition, the relay employs current-limiting circuitry, enabling it to pass lightning surge testing as per ANSI/TIA-968-B and other regulatory surge requirements when overvoltage protection is provided. The relay can be configured for AC/DC or DC-only operation.

FEATURES

- Extremely low operating current
- High speed operation
- Isolation test voltage 5300 V_{RMS}
- Current limit protection
- High surge capability
- DC only option
- Clean bounce free switching
- Low power consumption
- Surface mountable
- Material categorization: For definitions of compliance please see www.vishay.com/doc?99912



RoHS
COMPLIANT

APPLICATIONS

- General telecom switching
- Battery powered switch applications
- Industrial controls
- Programmable controllers
- Instrumentation

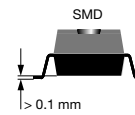
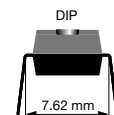
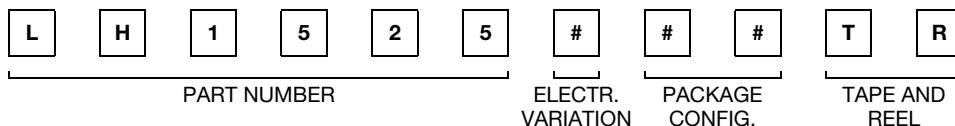
Note

- See "solid-state relays" (application note 56)

AGENCY APPROVALS

- UL1577 file no. E52744 system code H, double protection
- CSE certification 093751
- BSI no. 7979, BSI no. 7980
- FIMKO 25149

ORDERING INFORMATION



PACKAGE

SMD-6, tubes

LH1525AAB

SMD-6, tape and reel

LH1525AABTR

DIP-6, tubes

LH1525AT

**ABSOLUTE MAXIMUM RATINGS** ($T_{amb} = 25\text{ }^{\circ}\text{C}$, unless otherwise specified)

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
INPUT				
LED input ratings: continuous forward current		I_F	50	mA
LED input ratings: reverse voltage		V_R	8	V
OUTPUT				
Output operation (each channel): DC or peak AC load voltage	$I_L \leq 50\text{ }\mu\text{A}$	V_L	400	V
Continuous DC load current, bidirectional operation pin 4 to 6		I_L	125	mA
Continuous DC load current, unidirectional operation pins 4, 6 (+) to pin 5 (-)		I_L	250	mA
SSR				
Ambient operating temperature range		T_{amb}	- 40 to + 85	$^{\circ}\text{C}$
Storage temperature range		T_{stg}	- 40 to + 150	$^{\circ}\text{C}$
Pin soldering temperature ⁽¹⁾	$t = 10\text{ s max.}$	T_{sld}	260	$^{\circ}\text{C}$
Input to output isolation test voltage	$t = 1\text{ s}$	V_{ISO}	5300	V_{RMS}
Power dissipation		P_{diss}	550	mW

Notes

- Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of this document. Exposure to absolute maximum ratings for extended periods of the time can adversely affect reliability.

⁽¹⁾ Refer to reflow profile for soldering conditions for surface mounted devices (SMD). Refer to wave profile for soldering conditions for through hole devices (DIP).

ELECTRICAL CHARACTERISTICS ($T_{amb} = 25\text{ }^{\circ}\text{C}$, unless otherwise specified)

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
INPUT						
LED forward current, switch turn-on	$I_L = 100\text{ mA}$, $t = 10\text{ ms}$	I_{Fon}		0.33	0.5	mA
LED forward current, switch turn-off	$V_L = \pm 350\text{ V}$, $t = 100\text{ ms}$	I_{Foff}	0.001	0.23		mA
LED forward voltage	$I_F = 1.5\text{ mA}$	V_F	0.8	1.16	1.40	V
OUTPUT						
On-resistance, AC/DC, each pole	$I_F = 1.5\text{ mA}$, $I_L = \pm 50\text{ mA}$	R_{ON}	17	26	36	Ω
On-resistance, DC: pin 4, 6 (+) to 5 (-)	$I_F = 1.5\text{ mA}$, $I_L = 100\text{ mA}$	R_{ON}	4.25	7	8.25	Ω
Off-resistance	$I_F = 0\text{ mA}$, $V_L = \pm 100\text{ V}$	R_{OFF}		2000		$G\Omega$
Current limit AC ⁽¹⁾ : pin 4 ($\pm$) to 6 ($\pm$)	$I_F = 1.5\text{ mA}$, $t = 5\text{ ms}$, $V_L = 7\text{ V}$	I_{LMT}	170	185	270	mA
Off-state leakage current	$I_F = 0\text{ mA}$, $V_L = \pm 100\text{ V}$	I_O		0.67	200	nA
	$I_F = 0\text{ mA}$, $V_L = \pm 400\text{ V}$	I_O		0.096	1	μA
Output capacitance	$I_F = 0\text{ mA}$, $V_L = 1\text{ V}$	C_O		22		pF
	$I_F = 0\text{ mA}$, $V_L = 50\text{ V}$	C_O		6.42		pF
Switch offset	$I_F = 5\text{ mA}$	V_{OS}		0.2		μV
TRANSFER						
Capacitance (input to output)	$V_{ISO} = 1\text{ V}$	C_{IO}		0.75		pF

Notes

- 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 only and are not part of the testing requirements.

⁽¹⁾ No DC mode current limit available.

SWITCHING CHARACTERISTICS ($T_{amb} = 25\text{ }^{\circ}\text{C}$, unless otherwise specified)

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Turn-on time	$I_F = 1.5\text{ mA}$, $I_L = 50\text{ mA}$	t_{on}		1.25		ms
	$I_F = 5\text{ mA}$, $I_L = 50\text{ mA}$	t_{on}		0.22	1	ms
Turn-off time	$I_F = 1.5\text{ mA}$, $I_L = 50\text{ mA}$	t_{off}		0.6		ms
	$I_F = 5\text{ mA}$, $I_L = 50\text{ mA}$	t_{off}		1.1	1.5	ms

**SAFETY AND INSULATION RATINGS**

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Climatic classification	IEC 68 part 1		40/85/21	
Pollution degree	DIN VDE 0109		2	
Tracking resistance (comparative tracking index)	Insulation group IIIa	CTI	175	
Highest allowable overvoltage	Transient overvoltage	V_{IOTM}	8000	V_{peak}
Max. working insulation voltage	Recurring peak voltage	V_{IORM}	890	V_{peak}
Insulation resistance at 25 °C	$V_{IO} = 500\text{ V}$	R_{IS}	$\geq 10^{12}$	Ω
Insulation resistance at T_S		R_{IS}	$\geq 10^9$	Ω
Insulation resistance at 100 °C		R_{IS}	$\geq 10^{11}$	Ω
Partial discharge test voltage	Methode a, $V_{pd} = V_{IORM} \times 1.875$	V_{pd}	1669	V_{peak}
Safety limiting values - maximum values allowed in the event of a failure	Case temperature	T_{SI}	175	°C
	Input current	I_{SI}	300	mA
	Output power	P_{SO}	700	mW
Minimum external air gap (clearance)	Measured from input terminals to output terminals, shortest distance through air		≥ 7	mm
Minimum external tracking (creepage)	Measured from input terminals to output terminals, shortest distance path along body		≥ 7	mm
Insulation thickness			≥ 0.4	mm

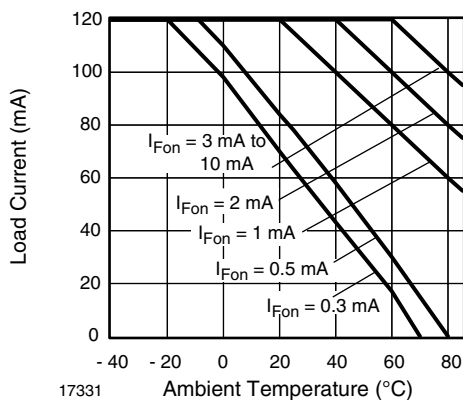
TYPICAL CHARACTERISTICS ($T_{amb} = 25\text{ °C}$, unless otherwise specified)

Fig. 1 - Recommended Operating Conditions

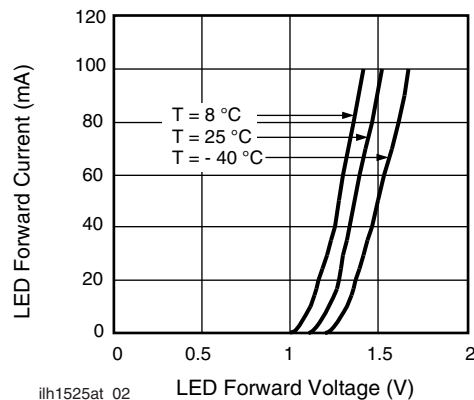


Fig. 3 - LED Forward Current vs. Forward Voltage

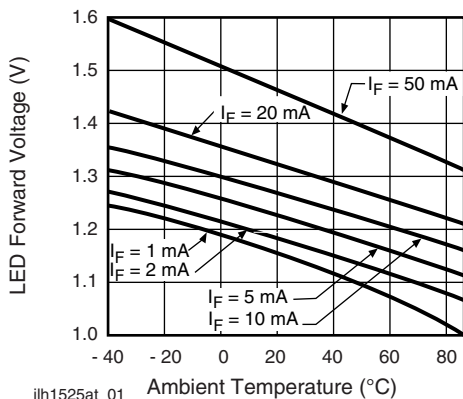


Fig. 2 - LED Voltage vs. Temperature

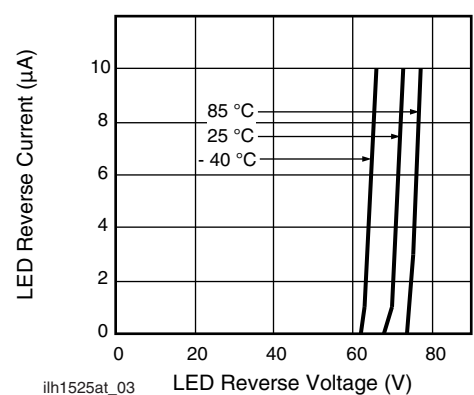


Fig. 4 - LED Reverse Current vs. LED Reverse Voltage

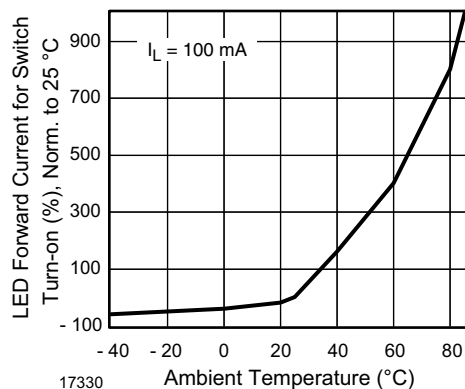


Fig. 5 - LED Current for Switch Turn-on vs. Temperature

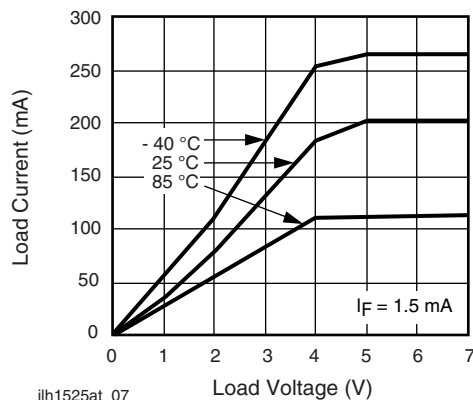


Fig. 8 - Load Current vs. Load Voltage

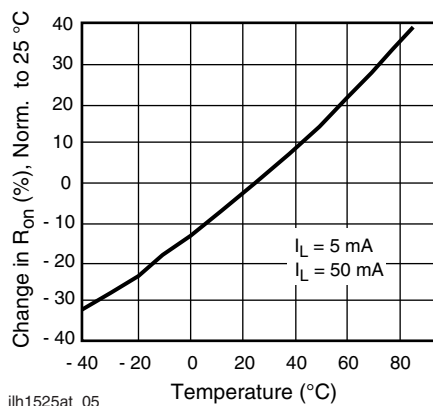


Fig. 6 - On-Resistance vs. Temperature

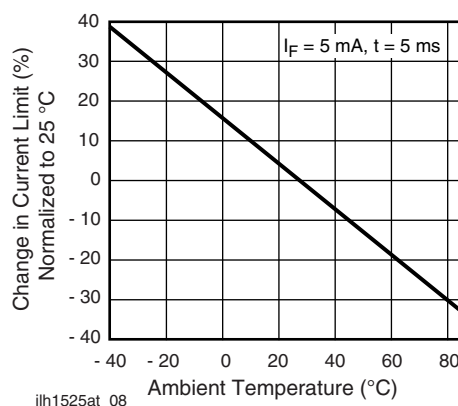


Fig. 9 - Current Limit vs. Temperature

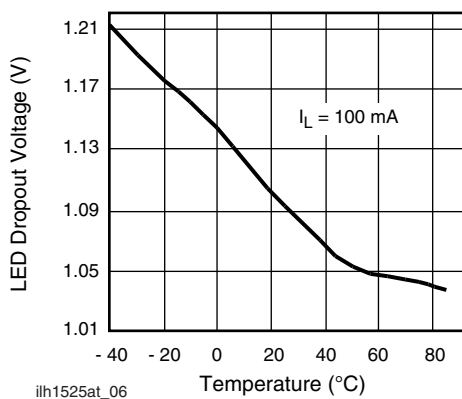


Fig. 7 - LED Dropout Voltage vs. Temperature

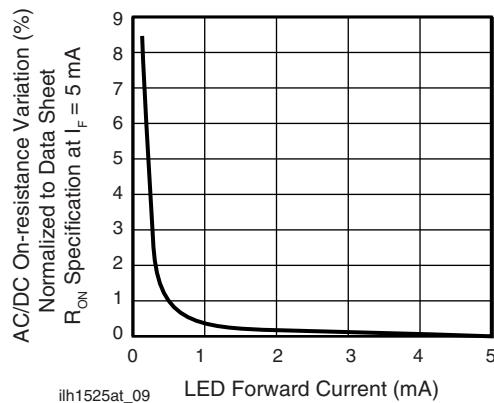


Fig. 10 - Variation in On-resistance vs. LED Current

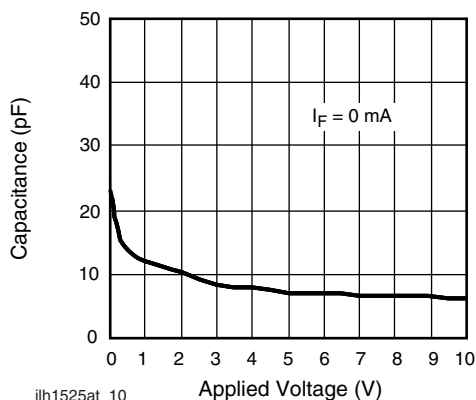


Fig. 11 - Switch Capacitance vs. Applied Voltage

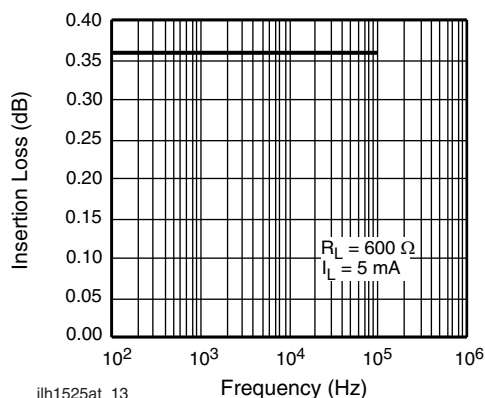


Fig. 14 - Insertion Loss vs. Frequency

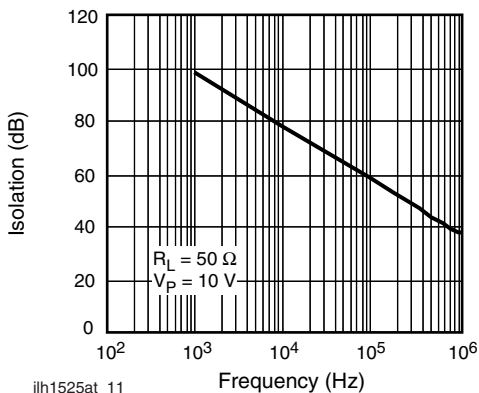


Fig. 12 - Output Isolation

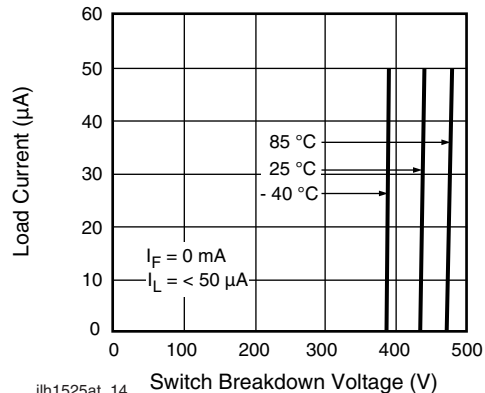


Fig. 15 - Switch Breakdown Voltage vs. Load Current

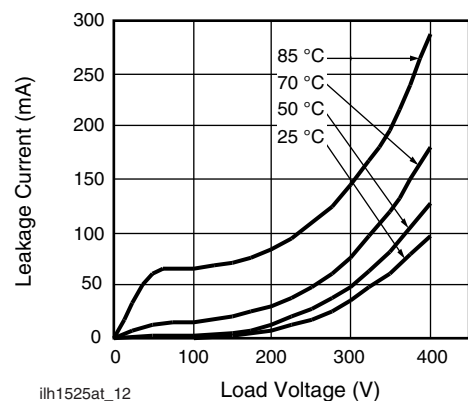


Fig. 13 - Leakage Current vs. Applied Voltage at Elevated Temperatures

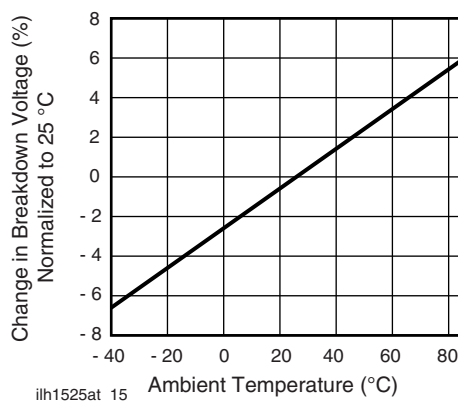


Fig. 16 - Switch Breakdown Voltage vs. Temperature

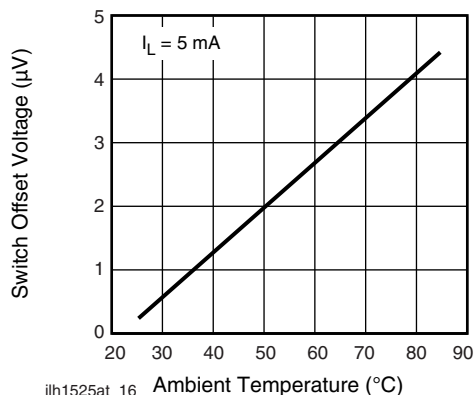


Fig. 17 - Switch Offset Voltage vs. Temperature

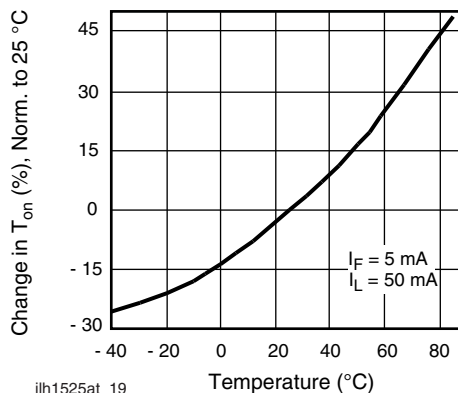


Fig. 20 - Turn-off Time vs. Temperature

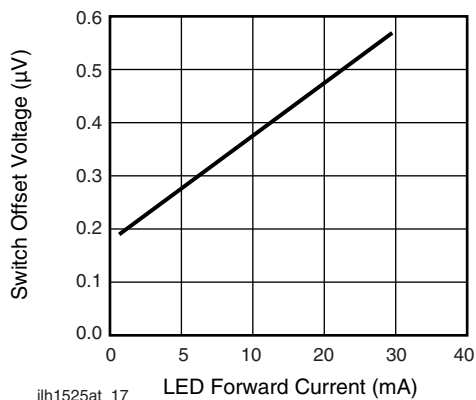


Fig. 18 - LED Offset Voltage vs. LED Current

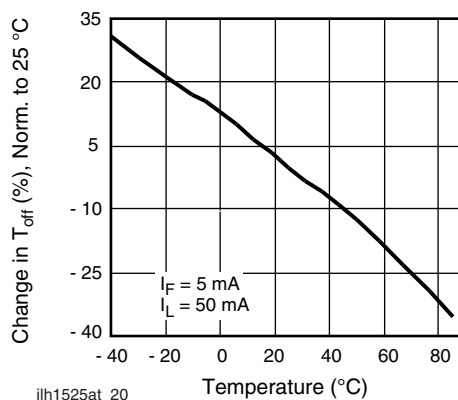


Fig. 21 - Turn-on Time vs. LED Temperature

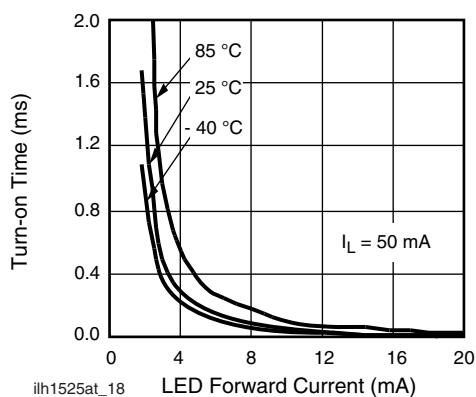


Fig. 19 - Turn-on Time vs. LED Current

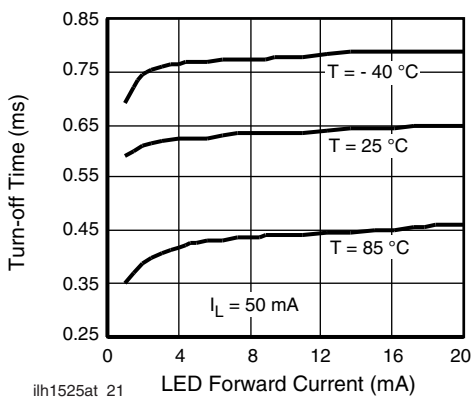


Fig. 22 - Turn-off Time vs. LED Current

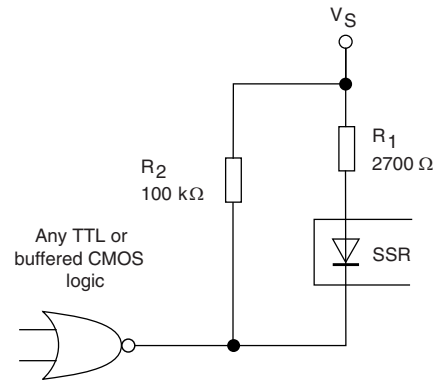
**APPLICATIONS****INPUT CONTROL**

The LH1525 low turn-on current SSR has highly sensitive photodetection circuits that will detect even the most minute currents flowing through the LED. Leakage current must be considered when designing a circuit to turn on and off these relays.

Figure 23 shows a typical logic circuit for providing LED drive current. R_1 is the input resistor that limits the amount of current flowing through the LED. For 5 V operation, a 2700 Ω resistor will limit the drive current to about 1.4 mA. Where high-speed actuation is desirable, use a lower value resistor for R_1 . An additional RC peaking circuit is not required with the LH1525 relay.

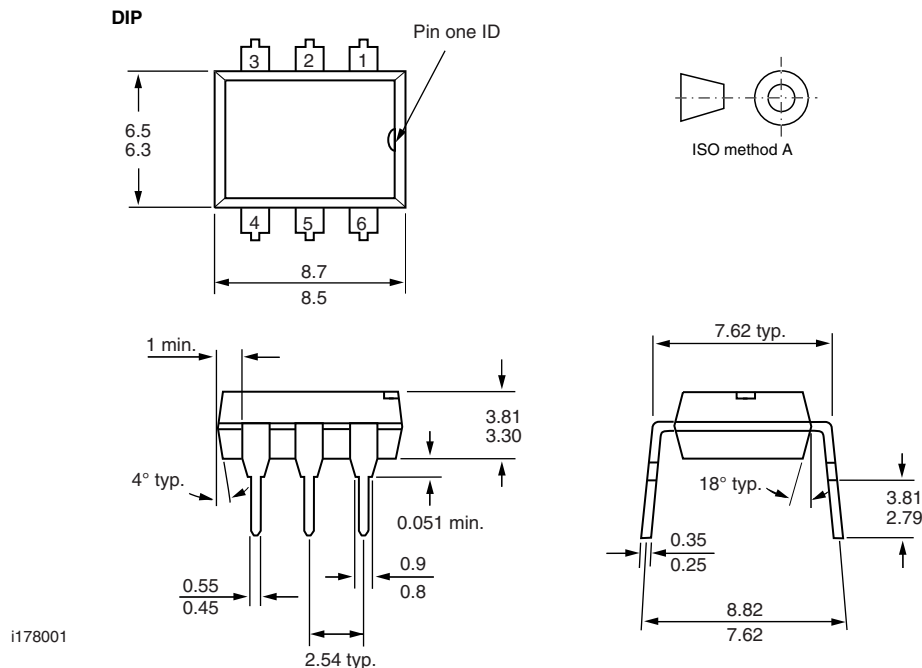
R_2 is an optional pull-up resistor which pulls the logic level high output (V_{OH}) up toward the V_S potential. The pull-up resistance is set at a high value to minimize the overall current drawn from the V_S . The primary purpose of this resistor is to keep the differential voltage across the LED below its turn-on threshold. LED dropout voltage is graphed vs. temperature in the typical performance characteristics section. When the logic gate is high, leakage current will flow through R_2 . R_2 will draw up to 8 mA before developing a voltage potential which may possibly turn on the LED.

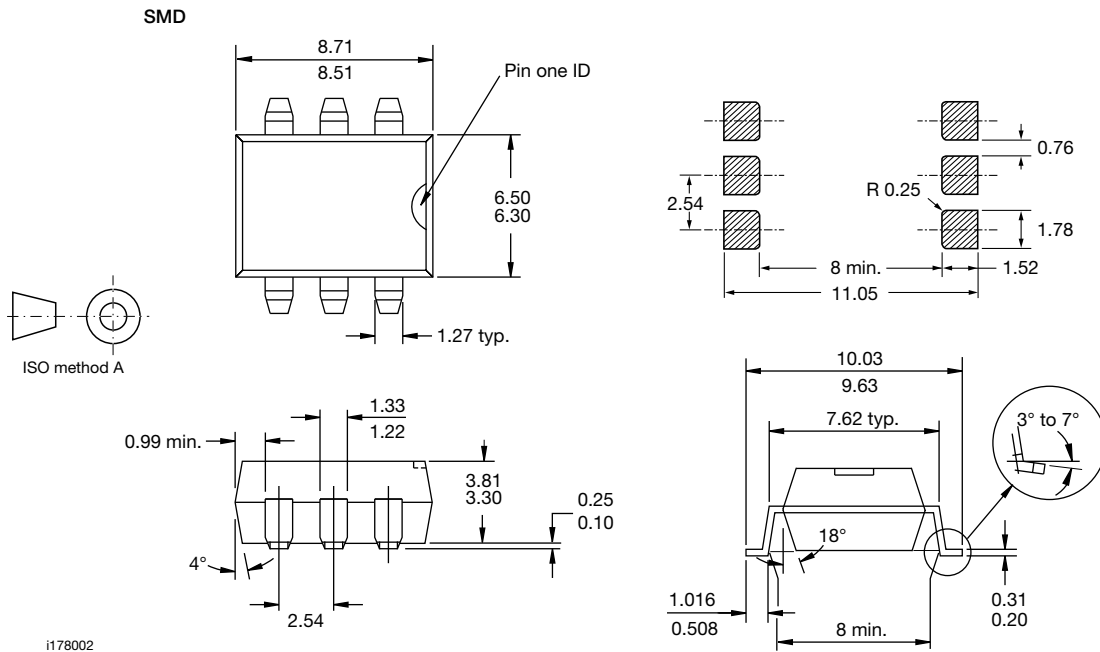
Each application should be evaluated, over the full operating temperature range to make sure that leakage current through the input control LED is kept to a value less than the minimum LED forward current for switch turn-off specification.



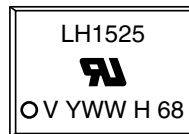
ilh1525at_22

Fig. 23 - Input Control Circuit

PACKAGE DIMENSIONS in millimeters



PACKAGE MARKING



Note

- Tape and reel suffix (TR) is not part of the package marking.



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