SIEMENS

# High Voltage Solid State Relays General Information

## FEATURES

- 3750 Vrms or 5300 Vrms I/O isolation
- Current-limit protection built-in
- Linear ac/dc operation
- High-reliability monolithic receptor
- Extremely low leakage current (pA)
- High contact off-impedance (GΩ)
- Low power consumption (1 mW—12 mW)
- Very low switch offset (typically 0.1 μV)
- Logic compatible
- Clean, bounce-free switching
- Built-in 1 Form C break-before-make
- High surge capability
- Insensitive to dv/dt
- Surface mountable
- Compatible with UL1459 and FCC 68.302
- UL recognized
- CSA certified
- BABT certificate of recognition to BS6301

## BENEFITS

- Long life
- Maintenance free
- Current-limit SSRs can sustain repeated faults without damage
- Minimizes drive circuitry
- Noiseless
- Immune to shock
- Immune to environmental hazards such as salt, dirt, and humidity
- No arcing
- No mounting restrictions
- Preapproved for DAA applications
- High reliability
- Easily configured in series or in parallel for increased voltage or current

## DESCRIPTION

Siemens Solid State Relays (SSRs) are miniature, optically-coupled relays with high-voltage MOSFET outputs. The relays are capable of switching ac or dc loads from as little as nanovolts to hundreds of volts. Likewise, the relays can switch currents in the range of nanoamps to hundreds of milliamps. The MOSFET switches are ideal for small signal switching and are primarily suited for dc or audio frequency applications.

Siemens offers integrated current limiting on many of its relays. If load current through the relay exceeds the rated value, the relay clamps the current at a predefined value. If the excessive load current persists, the limiting circuit has a foldback feature to minimize relay power dissipation. The current-limit circuit has a multitude of uses. It can be used in telephony to clamp excessive currents emanating from lightning strikes and/or power-main crosses or in instrumentation and industrial application to squelch transients from reactive loads. The current-limit circuit also provides short-circuit protection in power-feed applications.

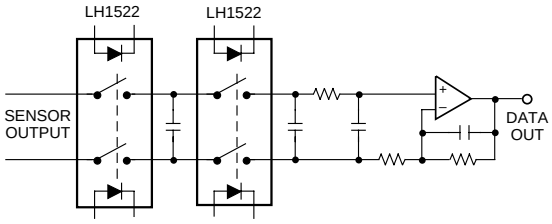
The SSRs feature a monolithic output die that minimizes wire bonds and permits easy integration of high-performance circuits such as current limiting in normally-open switches. The output die contains all the necessary circuitry to perform a relay function, including the photodiode receptor array, turn-on and turn-off control circuitry, and the MOSFET switches. The optically-coupled input is controlled by a highly efficient GaAlAs infrared LED.

Siemens SSRs are available in a 6- or 8-pin through-hole DIP or in gull-wing surface-mount packages. Some parts are also offered in 8- or 18-pin small-outline packages (SOPs). The SOPs are size and height compatible with PCMCIA Type 2 cards. A 0.4 mm distance through insulation spacing is also available on “H” suffix coded parts. Refer to the Parts Coding section for a more in-depth description of these parts.

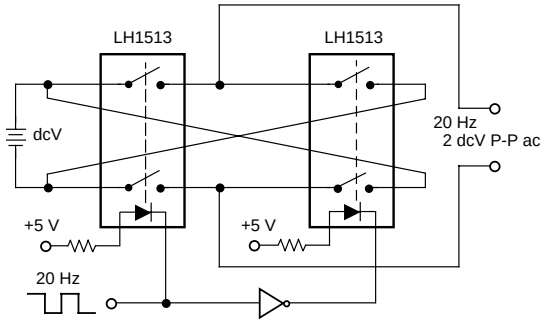
## Typical Applications

- ac Switch
- Telephone
- Heater Control
- Light Control
- Switching Systems
- Voltmeters
- Test Equipment
- Modems
- Programmable Controllers
- FAX
- Data Acquisition Systems
- Security Equipment
- Electric Meters
- Ring Relay

| Application | Flying Capacitor |
|---|---|
| Function | Flying Capacitor Switch |
| Equipment | Data Acquisition Systems |
| | Multiplexers |
| | Scanners |



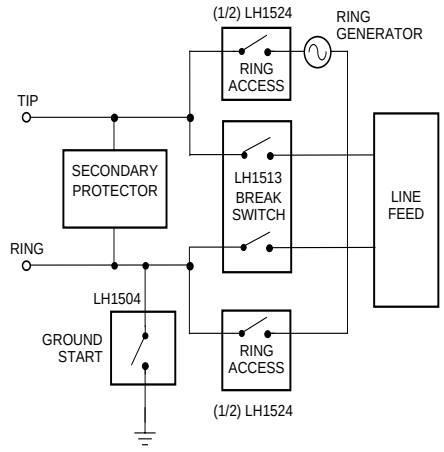

| Application | Ring Generators |
|---|---|
| Function | Square Wave Generator |
| Equipment | PBX |
| | Central Office Equipment |
| | Ring Generator |



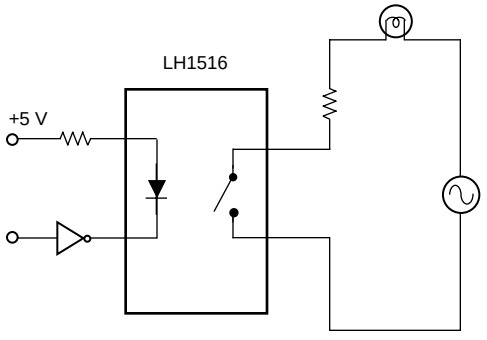

## Typical Applications (continued)

- Service Equipment
- E&M Signaling
- Multiplexers
- Scanners
- Motor Controls
- Output Modules
- Thermostats
- Answering Machines
- Battery Switch
- Board Testers
- Gas Pumps
- Appliances

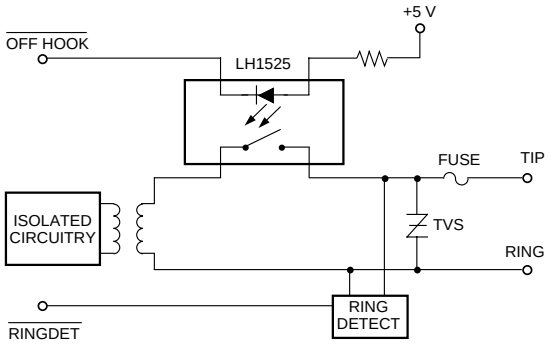
| Application | Telephone Line Interface/SLIC |
|---|---|
| Function | Ring Relay |
| | Break Switch |
| | Ground Start |
| | Test Access |
| | E&M Signalling |
| Equipment | Subscriber Line Interface Circuits |
| | PBX |
| | Switching Systems |
| | Test/Service Equipment |



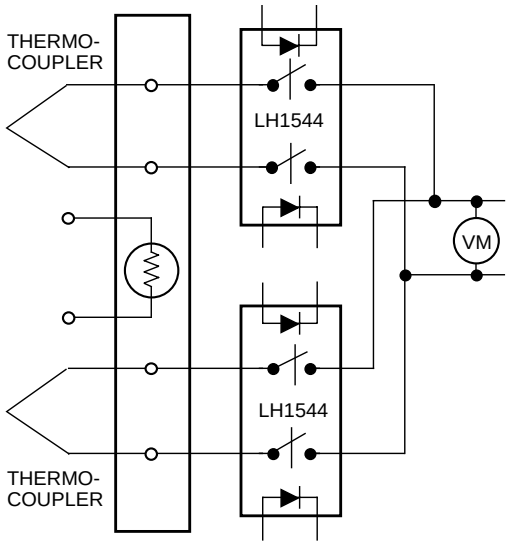

| Application | Lamp, Light, Indicator Control |
|---|---|
| Function | ac Switch |
| Equipment | Programmable Controllers |
| | Thermostats |
| | Control Panels |
| | Industrial Controls |



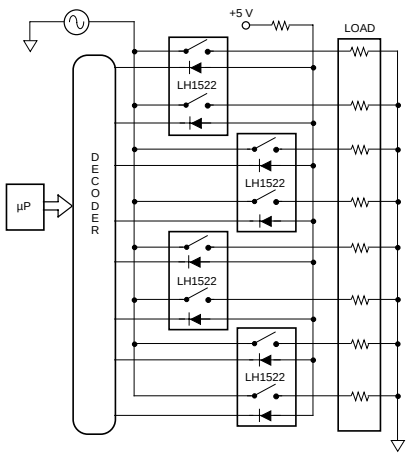
| | |
|---|---|
| Application | Data Access Arrangement (DAA) |
| Function | Current-Limited Switchhook Control |
| Equipment | Modems |
| | Security Equipment |
| | Answering Machines |
| | Telephones |
| | FAX |



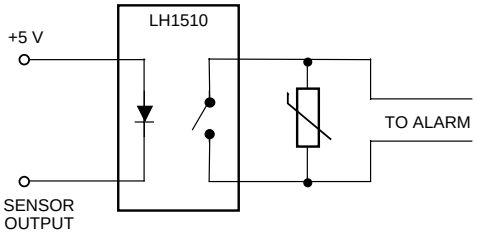

| | |
|---|---|
| Application | Thermocouple Switching |
| Function | Thermocouple Matrix Control |
| Equipment | Scanners |
| | Data Acquisition Systems |
| | Programmable Controllers |



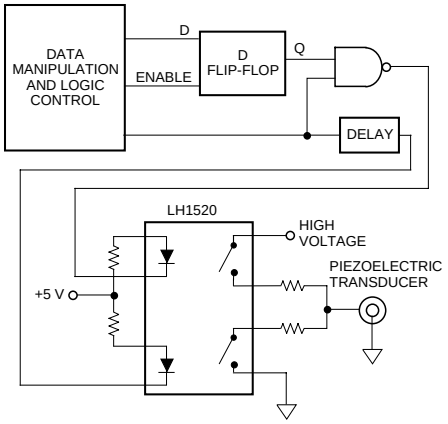

| | |
|---|---|
| Application | Multiplexer |
| Function | Analog Signal Multiplexer |
| | Analog Input Module |
| Equipment | Instrumentation |
| | Voltmeters |
| | Test Equipment |
| | Board Testers |
| | Scanners |
| | Data Acquisition Systems |



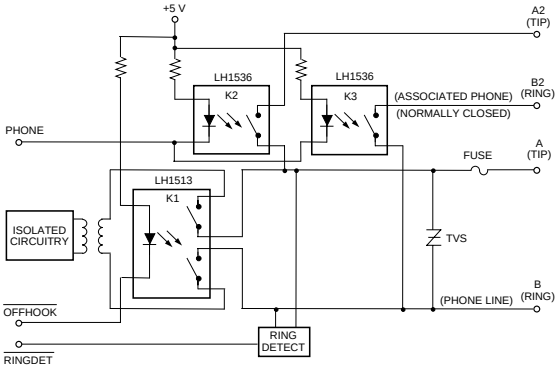

| | |
|---|---|
| Application | Alarm Switch |
| Function | Glass Break Indicator |
| | Fire, Smoke Detector |
| Equipment | Security Systems |
| | Fire/Smoke Alarms |



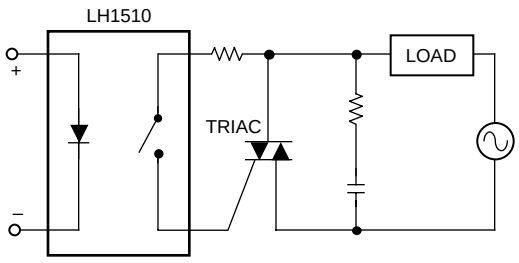
| | |
|---|---|
| Application | Print Head Driver |
| Function | Current-Limited Drivers |
| | Piezoelectric Transducer |
| | High-Voltage Print Head |
| Equipment | Ink Jet Printers |
| | Display Drivers |
| | Thermal Printers |



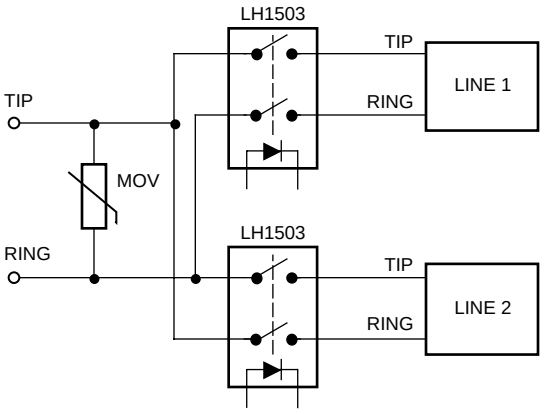

| | |
|---|---|
| Application | Talk/Data Switch |
| Function | On/Off-hook Control |
| Equipment | Modems |
| | FAX |



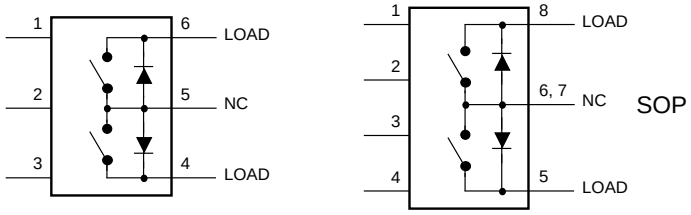
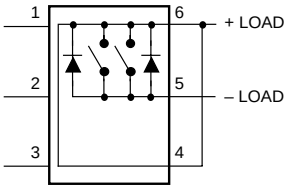
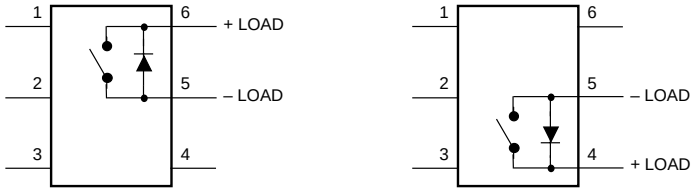
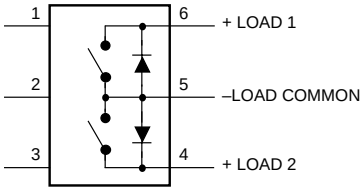

| | |
|---|---|
| Application | Motor, Light, Heat, Solenoid Control |
| Function | Triac Predriver |
| Equipment | Industrial Controls |
| | Programmable Controllers |
| | Factory Automation Equipment |
| | Appliances |




| | |
|---|---|
| Application | Two-Line PSTN Interface |
| Function | On/Off-hook Control |
| Equipment | Telephone Equipment |
| | Test/Service Equipment |



## Wiring Diagrams

| | | |
|---|---|---|
| ac/dc OUTPUT CONFIGURATIONS | SINGLE LOAD |  |
| | TWO LOADS |  |
| dc OUTPUT CONFIGURATIONS | SINGLE LOAD<br>— REDUCED RON<br>— INCREASED LOAD CURRENT<br>— REDUNDANCY |  |
| | SINGLE LOAD |  |
| | TWO LOADS |  |

**Absolute Maximum Ratings $T_A$=25°C**

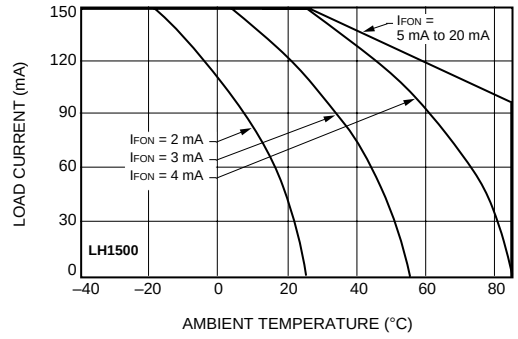
Stresses in excess of the Absolute Maximum Ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of this document. Exposure to Absolute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

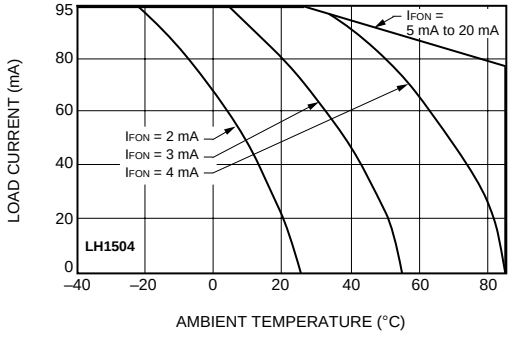
| Parameter | Symbol | Test Conditions | LH1500 | LH1504 | LH1510 | LH1516 | Units |
|---|---|---|---|---|---|---|---|
| Ambient Operating Temperature range | $T_A$ | — | –40 to +85 | | | | °C |
| Storage Temperature Range | $T_{stg}$ | — | –40 to +150 | | | | |
| Pin Soldering Temperature | $T_S$ | t=10 s max | 260 | | | | |
| Input/Output Isolation Voltage* | $V_{ISO}$ | — | 3750 | | | | Vrms |
| LED Continuous Forward Current | $I_F$ | — | 50 | | | | mA |
| LED Reverse Voltage | $V_R$ | $I_R \leq 10\ \mu A$ | 8 | | | | V |
| dc or Peak ac Load Voltage | $V_L$ | $I_L \leq 50\ \mu A$ | 350 | 400 | 200 | 400 | |
| Continuous dc Load Current<br>Bidirectional Operation<br>Unidirectional Operation | $I_L$ | — | <br>150<br>250 | <br>95<br>— | <br>200<br>350 | <br>240<br>450 | mA |
| Peak Load Current | $I_P$ | t=100 ms (single shot) | † | † | † | † | mA |
| Output Power Dissipation (continuous) | $P_{DISS}$ | — | 600 | 550 | | 600 | mW |

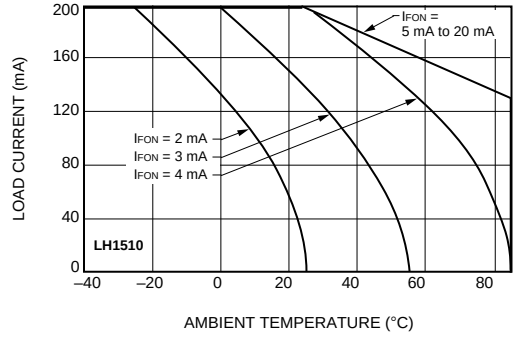
* 5300 Vrms input/output isolation voltage available on some products. Consult factory.

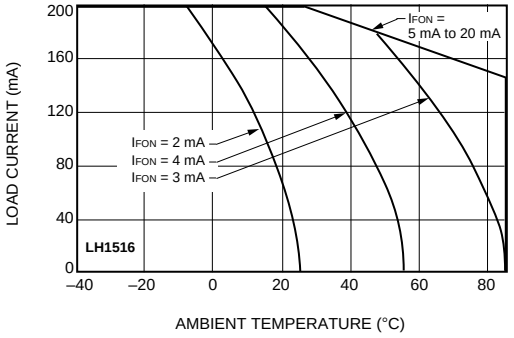
† Refer to Current Limit Performance Application Note 58 for a discussion on relay operation during transient currents.

**Recommended Operating Conditions**



**Electrical Characteristics** $T_A$=25°C

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.

| | Parameter | Symbol | Test Conditions | Values | LH1500 | LH1504 | LH1510 | LH1516 | Units |
|---|---|---|---|---|---|---|---|---|---|
| INPUT | LED Forward Current for Switch Turn-on | $I_{Fon}$ | $I_L$=100 mA t=10 ms | Min | — | — | — | — | mA |
| | | | | Typ | 1.0 | 0.5 | 1.0 | 0.9 | mA |
| | | | | Max | 2.0 | 2.0 | 2.0 | 2.0 | mA |
| | LED Forward Current for Switch Turn-off | $I_{Foff}$ | | Min | 0.2 | 0.1 | 0.2 | 0.2 | mA |
| | | | | Typ | 0.9 | 0.4 | 0.9 | 0.8 | mA |
| | | | | Max | — | — | — | — | mA |
| | | | $V_L$ | ± | 300 | 350 | 150 | 350 | V |
| | LED Forward Voltage | $V_F$ | $I_F$=10 mA | Min | 1.15 | 1.15 | 1.15 | 1.15 | V |
| | | | | Typ | 1.26 | 1.26 | 1.26 | 1.26 | V |
| | | | | Max | 1.45 | 1.45 | 1.45 | 1.45 | V |
| OUTPUT | ON-resistance ac/dc Pin 4 (±) to 6 (±) dc Pin 4, 6 (+) to 5 (±) | $R_{ON}$ | $I_F$=5 mA $I_L$=50 mA | Min | 12 | 12* | 6 | 5 | Ω |
| | | | | Typ | 20 | 23* | 10 | 7 | Ω |
| | | | | Max | 25 | 34* | 15 | 10 | Ω |
| | | | $I_F$=5 mA $I_L$=100 mA | Min | 3.00 | — | 1.50 | 1.25 | Ω |
| | | | | Typ | 5.00 | — | 2.50 | 2.00 | Ω |
| | | | | Max | 6.25 | — | 3.75 | 2.50 | Ω |
| | OFF-resistance | $R_{OFF}$ | $I_F$=0 mA $V_L$=±100 V | Min | 0.5 | 0.5 | 0.5 | 0.5 | GΩ |
| | | | | Typ | 5000 | 5000 | 5000 | 2500 | GΩ |
| | | | | Max | — | — | — | — | GΩ |
| | ON-state Voltage | — | $I_L$=1 mA | Min | — | 1.2 | — | — | V |
| | | | | Typ | — | 1.4 | — | — | V |
| | | | | Max | — | 1.8 | — | — | V |
| | | | $I_L$=90 mA t=10 ms | Min | — | 3.0 | — | — | V |
| | | | | Typ | — | 3.6 | — | — | V |
| | | | | Max | — | 5.0 | — | — | V |
| | Current Limit ac/dc Pin 4 (±) to 6 (±) dc Pin 4, 6 (+) to 5 (±) | $I_{LMT}$ | $I_F$=5 mA t=5 ms | Min | 230 | 150 | 300 | 290 | mA |
| | | | | Typ | 270 | 210 | 360 | 400 | mA |
| | | | | Max | 370 | 270 | 450 | 550 | mA |
| | | | $V_L$ | ± | 6 | 11 | 5 | 5 | V |
| | | | $I_F$=5 mA, $V_L$=4 V t=5 ms | Min | — | — | 600 | — | mA |
| | | | | Typ | — | — | 720 | — | mA |
| | | | | Max | — | — | 920 | — | mA |
| | Off-state Leakage Current | — | $I_F$=0 mA $V_L$=±100 V | Min | — | — | | — | nA |
| | | | | Typ | 0.02 | 0.02 | 0.02 | 0.04 | nA |
| | | | | Max | 200 | 200 | 200 | 200 | nA |
| | | | $I_F$=0 mA | Min | — | — | — | — | µA |
| | | | | Typ | — | — | — | — | µA |
| | | | | Max | 1.0 | 1.0 | 1.0 | 1.0 | µA |
| | | | $V_L$ | ± | 350 | 400 | 200 | 400 | V |
| | Output Capacitance Pin 4 to 6 | — | $I_F$=0 mA $V_L$=1 V | Min | — | — | — | — | pF |
| | | | | Typ | 55 | 2.5 | 60 | 150 | pF |
| | | | | Max | — | — | — | — | pF |
| | | | $I_F$=0 mA $V_L$=50 V | Min | — | — | — | — | pF |
| | | | | Typ | 10 | 2 | 15 | 30 | pF |
| | | | | Max | — | — | — | — | pF |
| | Switch Offset | — | $I_F$=5 mA | Min | — | — | — | — | µV |
| | | | | Typ | 0.15 | — | 0.15 | 0.1 | µV |
| | | | | Max | — | — | — | — | µV |
| TRANSFER | Input/Output Capacitance | $C_{ISO}$ | $V_{ISO}$=1 V | Min | — | — | — | — | pF |
| | | | | Typ | 0.8 | 0.8 | 0.8 | 0.8 | pF |
| | | | | Max | — | — | — | — | pF |
| | Turn-on Time | $t_{on}$ | $I_F$=5 mA $I_L$=50 mA | Min | — | — | — | — | ms |
| | | | | Typ | 1.2 | 1.6 | 1.0† | 1.1† | ms |
| | | | | Max | 2.0 | 5.0 | 2.0† | 3.0† | ms |
| | Turn-off Time | $t_{off}$ | $I_F$=5 mA $I_L$=50 mA | Min | — | — | — | — | ms |
| | | | | Typ | 0.5 | 2.0 | 0.7† | 0.8† | ms |
| | | | | Max | 2.0 | 5.0 | 2.0† | 3.0† | ms |

* $R_{ON}$=V (50 mA) – V (20 mA)/30 mA, †$I_F$=10 mA.

**Absolute Maximum Ratings** $T_A$=25°C

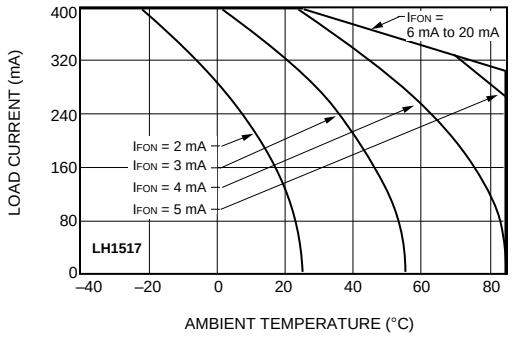
Stresses in excess of the Absolute Maximum Ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of this document. Exposure to Absolute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

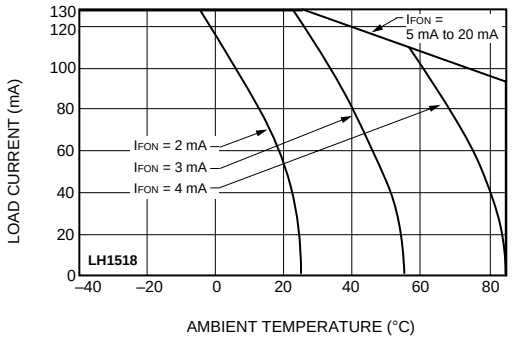
| Parameter | Symbol | Test Conditions | LH1517 | LH1518 | LH1519 | Units |
|---|---|---|---|---|---|---|
| Ambient Operating Temperature range | $T_A$ | — | –40 to +85 | | | °C |
| Storage Temperature Range | $T_{stg}$ | | –40 to +150 | | | |
| Pin Soldering Temperature | $T_S$ | t=10 s max | 260 | | | |
| Input/Output Isolation Voltage* | $V_{ISO}$ | — | 3750 | | | Vrms |
| LED Continuous Forward Current | $I_F$ | | 50 | | | mA |
| LED Reverse Voltage | $V_R$ | $I_R \le 10\ \mu A$ | 8 | | | V |
| dc or Peak ac Load Voltage | $V_L$ | $I_L \le 50\ \mu A$ | 150 | 250 | | |
| Continuous dc Load Current<br>Bidirectional Operation<br>Unidirectional Operation | $I_L$ | — | <br>400<br>800 | <br>155<br>300 | <br>240<br>450 | mA |
| Peak Load Current | $I_P$ | t=100 ms (single shot) | 1200 | † | † | |
| Output Power Dissipation (continuous) | $P_{DISS}$ | — | 600 | 550 | | mW |

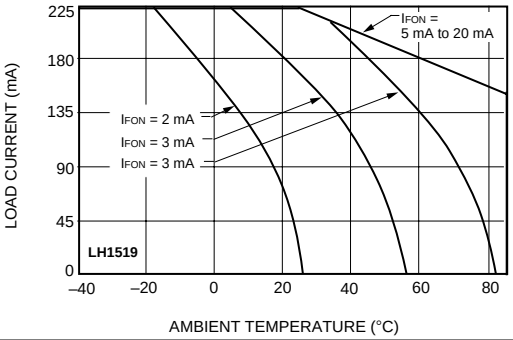
* 5300 Vrms input/output isolation voltage available on some products. Consult factory.

† Refer to Current-Limit Performance Application Note for a discussion on relay operation during transient currents.

**Recommended Operating Conditions**



**Electrical Characteristics** $T_A$=25°C
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.

| | Parameter | Symbol | Test Conditions | Values | LH1517 | LH1518 | LH1519 | Units |
|---|---|---|---|---|---|---|---|---|
| INPUT | LED Forward Current for Switch Turn-on | $I_{Fon}$ | $I_L$=100 mA t=10 ms | Min | — | — | — | mA |
| | | | | Typ | 0.9 | 0.8 | 0.9 | mA |
| | | | | Max | 2.0 | 2.0 | 2.0 | mA |
| | LED Forward Current for Switch Turn-off | $I_{Foff}$ | | Min | 0.2 | 0.2 | 0.2 | mA |
| | | | | Typ | 0.8 | 0.7 | 0.8 | mA |
| | | | | Max | — | — | — | mA |
| | | | $V_L$ | ± | 100 | 200 | 200 | V |
| | LED Forward Voltage | $V_F$ | $I_F$=10 mA | Min | 1.15 | 1.15 | 1.15 | V |
| | | | | Typ | 1.26 | 1.26 | 1.26 | V |
| | | | | Max | 1.45 | 1.45 | 1.45 | V |
| OUTPUT | ON-resistance ac/dc Pin 4 (±) to 6 (±) dc Pin 4, 6 (+) to 5 (±) | $R_{ON}$ | $I_F$=5 mA $I_L$=50 mA | Min | 1 | 10 | 3 | Ω |
| | | | | Typ | 2 | 15 | 6 | Ω |
| | | | | Max | 3 | 20 | 10 | Ω |
| | | | $I_F$=5 mA $I_L$=100 mA | Min | 0.25 | 2.50 | 0.75 | Ω |
| | | | | Typ | 0.50 | 3.75 | 1.50 | Ω |
| | | | | Max | 0.85 | 5.00 | 2.50 | Ω |
| | OFF-resistance | $R_{OFF}$ | $I_F$=0 mA $V_L$=±100 V | Min | 0.5 | 0.5 | 0.5 | GΩ |
| | | | | Typ | 2500 | 5000 | 2500 | GΩ |
| | | | | Max | — | — | — | GΩ |
| | ON-state Voltage | — | $I_L$=1 mA | Min | — | — | — | V |
| | | | | Typ | — | — | — | V |
| | | | | Max | — | — | — | V |
| | | | $I_L$=90 mA t=10 ms | Min | — | — | — | V |
| | | | | Typ | — | — | — | V |
| | | | | Max | — | — | — | V |
| | Current Limit ac/dc Pin 4 (±) to 6 (±) dc Pin 4, 6 (+) to 5 (±) | $I_{LMT}$ | $I_F$=5 mA t=5 ms | Min | — | 170 | 330 | mA |
| | | | | Typ | — | 200 | 450 | mA |
| | | | | Max | — | 280 | 550 | mA |
| | | | VL | ± | — | 6 | 4 | V |
| | | | $I_F$=5 mA, $V_L$=4 V t=5 ms | Min | — | — | — | mA |
| | | | | Typ | — | — | — | mA |
| | | | | Max | — | — | — | mA |
| | Off-state Leakage Current | — | $I_F$=0 mA $V_L$=±100 V | Min | — | — | — | nA |
| | | | | Typ | 0.04 | 0.02 | 0.04 | nA |
| | | | | Max | 200 | 200 | 200 | nA |
| | | | $I_F$=0 mA | Min | — | — | — | µA |
| | | | | Typ | — | — | — | µA |
| | | | | Max | 1.0 | 1.0 | 1.0 | µA |
| | | | $V_L$ | ± | 150 | 250 | | V |
| | Output Capacitance Pin 4 to 6 | — | $I_F$=0 mA $V_L$=1 V | Min | — | — | — | pF |
| | | | | Typ | 185 | 55 | 100 | pF |
| | | | | Max | — | — | — | pF |
| | | | $I_F$=0 mA $V_L$=50 V | Min | — | — | — | pF |
| | | | | Typ | 45 | 10 | 20 | pF |
| | | | | Max | — | — | — | pF |
| | Switch Offset | — | $I_F$=5 mA | Min | — | — | — | V |
| | | | | Typ | 0.1 | 0.15 | 0.1 | V |
| | | | | Max | — | — | — | V |
| TRANSFER | Input/Output Capacitance | $C_{ISO}$ | $V_{ISO}$=1 V | Min | — | — | — | pF |
| | | | | Typ | 0.8 | 0.8 | 0.8 | pF |
| | | | | Max | — | — | — | pF |
| | Turn-on Time | $t_{on}$ | $I_F$=5 mA $I_L$=50 mA | Min | — | — | — | ms |
| | | | | Typ | 1.7† | 1.4 | 2.0 | ms |
| | | | | Max | 3.0† | 3.0 | 3.0 | ms |
| | Turn-off Time | $t_{off}$ | $I_F$=5 mA $I_L$=50 mA | Min | — | — | — | |
| | | | | Typ | 1.3† | 0.7 | 0.9 | ms |
| | | | | Max | 3.0† | 3.0 | 3.0 | ms |

* $I_F$=1.5 mA
† $I_F$=10 mA
‡ $I_L$=25 mA

**Absolute Maximum Ratings** $T_A$=25°C

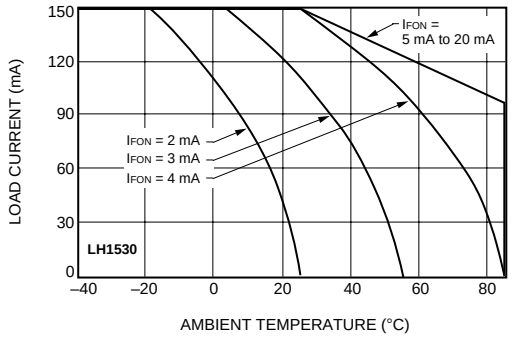
Stresses in excess of the Absolute Maximum Ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of this document. Exposure to Absolute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

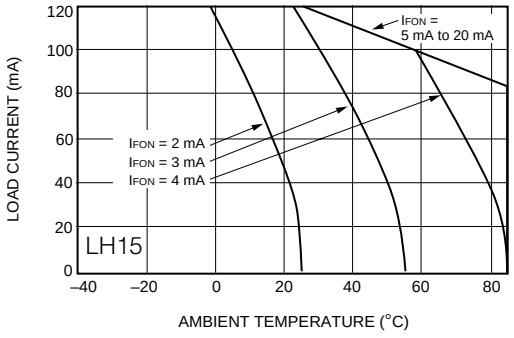
| Parameter | Symbol | Test Conditions | LH1530 | LH1535/ LH1540 | LH1541 | LH1550 | Units |
|---|---|---|---|---|---|---|---|
| Ambient Operating Temperature Range | $T_A$ | — | –40 to +85 | –40 to +85 | –40 to +85 | –40 to + 85 | °C |
| Storage Temperature Range | $T_{stg}$ | — | –40 to +150 | –40 to +150 | –40 to +150 | –40 to +150 | °C |
| Pin Soldering Temperature | $T_S$ | t=10 s max | 260 | 260 | 260 | 260 | °C |
| Input/Output Isolation Voltage* | $V_{ISO}$ | — | 3750 | 3750 | 3750 | 3750 | Vrms |
| LED Continuous Forward Current | $I_F$ | — | 50 | 50 | 50 | 50 | mA |
| LED Reverse Voltage | $V_R$ | $I_R \le 10\ \mu A$ | 8 | 8 | 8 | 5 | V |
| dc or Peak ac Load Voltage | $V_L$ | $I_L \le 50\ \mu A$ | 350 | 400/350 | 200 | 350 | V |
| Continuous dc Load Current<br>Bidirectional Operation<br>Unidirectional Operation | $I_L$ | — | <br>150<br>250 | <br>120<br>250 | <br>55<br>— | <br>100<br>— | <br>mA<br>mA |
| Peak Load Current | $I_P$ | t=100 ms (single shot) | 400 | † | 100 | † | mA |
| Output Power Dissipation (continuous) | $P_{DISS}$ | — | 550 | 550 | 550 | 550 | mW |

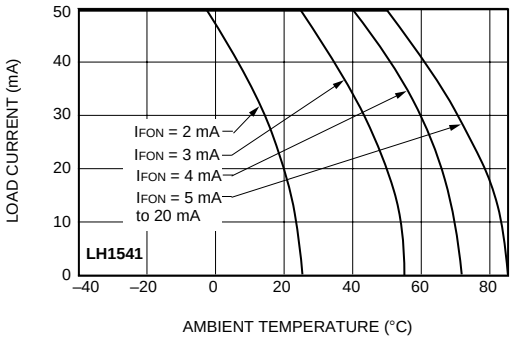
* 5300 Vrms input/output isolation voltage available on some products. Consult factory.

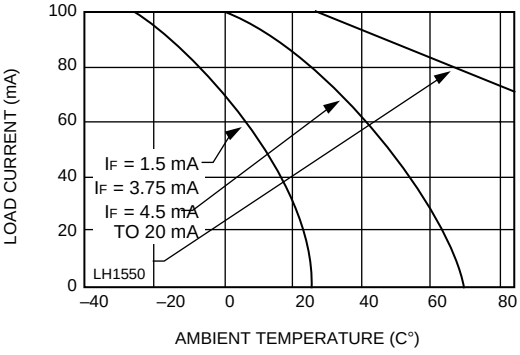
† Refer to Current-Limit Performance Application Note for a discussion on relay operation during transient currents

**Recommended Operating Conditions**



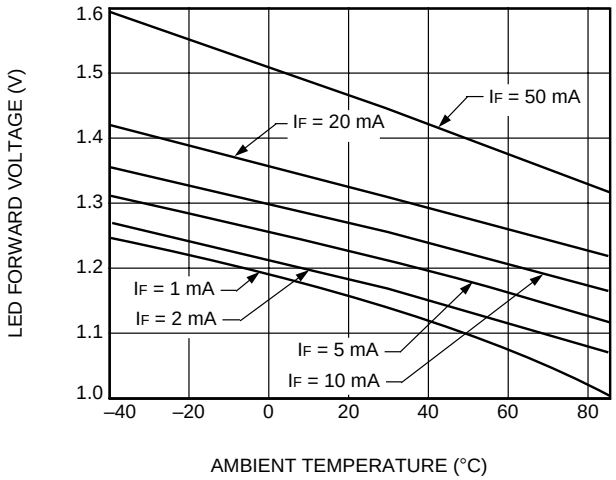



**Electrical Characteristics** $T_A$=25°C
Minimum and maximum values are testing requirements. Typical values are characteristics of the device and are the result of engineering evaluations. Typical values are for information purposes only and are not part of the testing requirements.

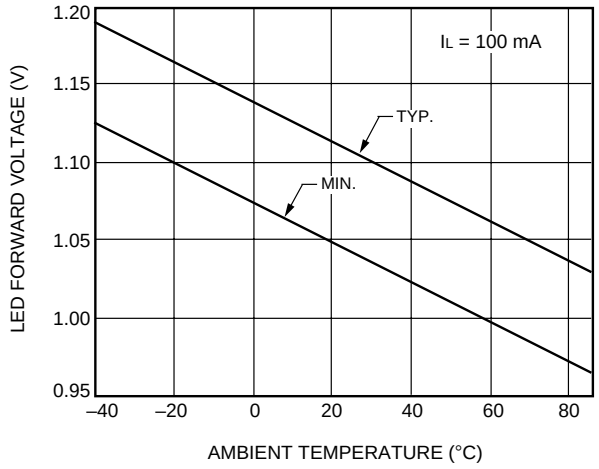
| | Parameter | Symbol | Test Conditions | Values | LH1530 | LH1535/ LH1540 | LH1541 | LH1550 | Units |
|---|---|---|---|---|---|---|---|---|---|
| INPUT | LED Forward Current for Switch Turn-on | $I_{Fon}$ | $I_L$=100 mA t=10 ms | Min | — | — | — | — | mA |
| | | | | Typ | 1.0 | 1.0 | 0.6 | 1.2 | mA |
| | | | | Max | 2.0 | 2.0 | 2.0 | 2.5 | mA |
| | LED Forward Current for Switch Turn-off | $I_{Foff}$ | | Min | 0.2 | 0.2 | 0.1 | 0.01 | mA |
| | | | | Typ | 0.9 | 0.9 | 0.5 | 1.100 | mA |
| | | | | Max | — | — | — | — | mA |
| | | | $V_L$ | ± | 300 | 350/300 | 150 | 300 | V |
| | LED Forward Voltage | $V_F$ | $I_F$=10 mA | Min | 1.15 | 1.15 | 1.10* | 1.10* | V |
| | | | | Typ | 1.26 | 1.26 | 1.19* | 1.19* | V |
| | | | | Max | 1.45 | 1.45 | 1.45* | 1.45* | V |
| OUTPUT | ON-resistance ac/dc Pin 4 (±) to 6 (±) dc Pin 4, 6 (+) to 5 (±) | $R_{ON}$ | $I_F$=5 mA $I_L$=50 mA | Min | 12 | 12 | 70 | 25‡ | Ω |
| | | | | Typ | 18 | 20 | 110 | 37‡ | Ω |
| | | | | Max | 25 | 25 | 160 | 50‡ | Ω |
| | | | $I_F$=5 mA $I_L$=100 mA | Min | 3.00 | 3.00 | — | — | Ω |
| | | | | Typ | 5.00 | 5.00 | — | — | Ω |
| | | | | Max | 6.25 | 6.25 | — | — | Ω |
| | OFF-resistance | $R_{OFF}$ | $I_F$=0 mA $V_L$=±100 V | Min | 0.5 | 0.5 | 0.5 | 0.5 | GΩ |
| | | | | Typ | 5000 | 5000 | 10000 | 5000 | GΩ |
| | | | | Max | — | — | — | — | GΩ |
| | ON-state Voltage | — | $I_L$=1 mA | Min | — | — | — | — | V |
| | | | | Typ | — | — | — | — | V |
| | | | | Max | — | — | — | — | V |
| | | | $I_L$=90 mA t=10 ms | Min | — | — | — | — | V |
| | | | | Typ | — | — | — | — | V |
| | | | | Max | — | — | — | — | V |
| | Current Limit ac/dc Pin 4 (±) to 6 (±) dc Pin 4, 6 (+) to 5 (±) | $I_{LMT}$ | $I_F$=5 mA t=5 ms | Min | — | 170 | — | 150 | mA |
| | | | | Typ | — | 210 | — | 200 | mA |
| | | | | Max | — | 250 | — | 270 | mA |
| | | | $V_L$ | ± | — | 6 | — | 13 | V |
| | | | $I_F$=5 mA, $V_L$=4 V t=5 ms | Min | — | — | — | — | mA |
| | | | | Typ | — | — | — | — | mA |
| | | | | Max | — | — | — | — | mA |
| | Off-state Leakage Current | — | $I_F$=0 mA $V_L$=±100 V | Min | — | — | — | — | nA |
| | | | | Typ | 0.1 | 0.32 | 0.4 | 0.3 | nA |
| | | | | Max | 200 | 200 | 200 | 200 | nA |
| | | | $I_F$=0 mA | Min | — | — | — | — | μA |
| | | | | Typ | — | — | — | — | μA |
| | | | | Max | 1.0 | 1.0 | 1.0 | 1.0 | μA |
| | | | $V_L$ | ± | 350 | 400/350 | 200 | 350 | V |
| | Output Capacitance Pin 4 to 6 | — | $I_F$=0 mA $V_L$=1 V | Min | — | — | — | — | pF |
| | | | | Typ | 55 | 55 | 4.8 | 40 | pF |
| | | | | Max | — | — | — | — | pF |
| | | | $I_F$=0 mA $V_L$ = 50 V | Min | — | — | — | — | pF |
| | | | | Typ | 10 | 10 | 3.6 | 8 | pF |
| | | | | Max | — | — | — | — | pF |
| | Switch Offset | — | $I_F$=5 mA | Min | — | — | — | — | V |
| | | | | Typ | 0.15 | 0.15 | 0.15 | 0.15 | V |
| | | | | Max | — | — | — | — | V |
| TRANSFER | Input/Output Capacitance | $C_{ISO}$ | $V_{ISO}$=1 V | Min | — | — | — | — | pF |
| | | | | Typ | 0.8 | 0.8 | 0.8 | 0.8 | pF |
| | | | | Max | — | — | — | — | pF |
| | Turn-on Time | $t_{on}$ | $I_F$=5 mA $I_L$=50 mA | Min | — | — | — | — | ms |
| | | | | Typ | 0.5† | 1.2 | 0.12 | 1.4 | ms |
| | | | | Max | 1.0† | 2.0 | 0.25 | 3.0 | ms |
| | Turn-off Time | $t_{off}$ | $I_F$=5 mA $I_L$=50 mA | Min | — | — | — | — | ms |
| | | | | Typ | 0.5† | 0.5 | 0.03 | 0.5 | ms |
| | | | | Max | 1† | 2.0 | 0.25 | 3.0 | ms |

* $I_F$=5 mA.
† $I_F$=10 mA.
‡ $I_L$=100 mA, t=10 ms

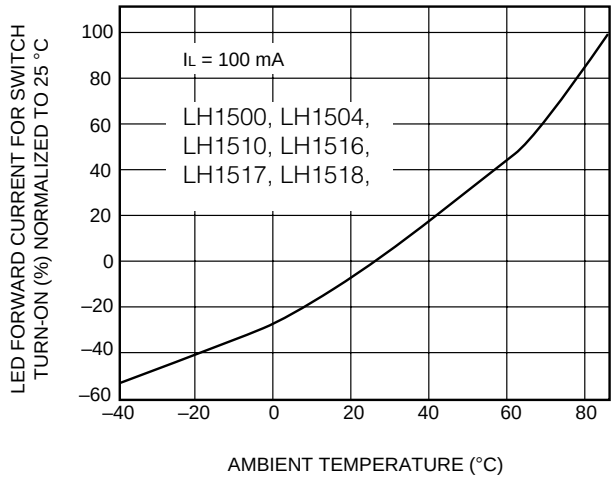
### A. LED Voltage vs. Temperature



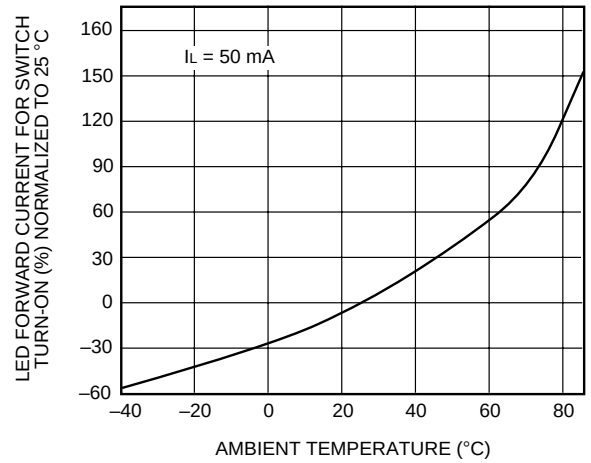

### B. LED Dropout Voltage vs. Temperature



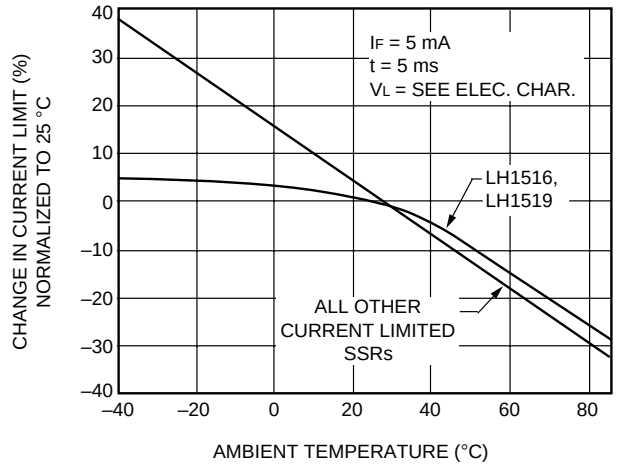

### C. LED Current for Switch Turn-On vs. Temperature



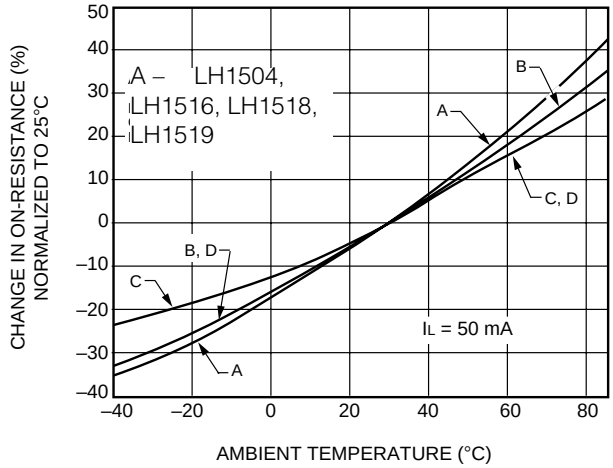

### D. LED Current for Switch Turn-On vs. Temperature (LH1541)



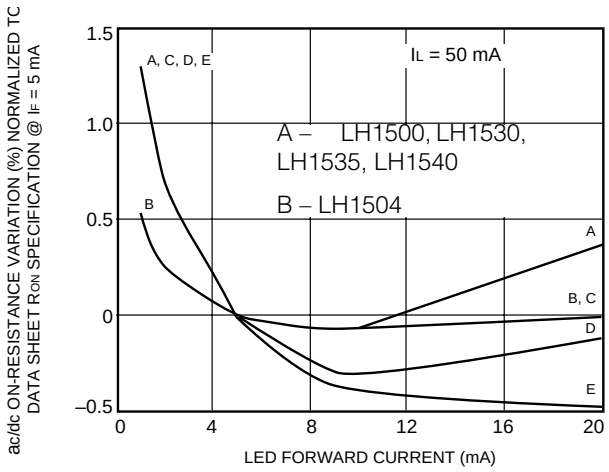

### E. Current Limit vs. Temperature



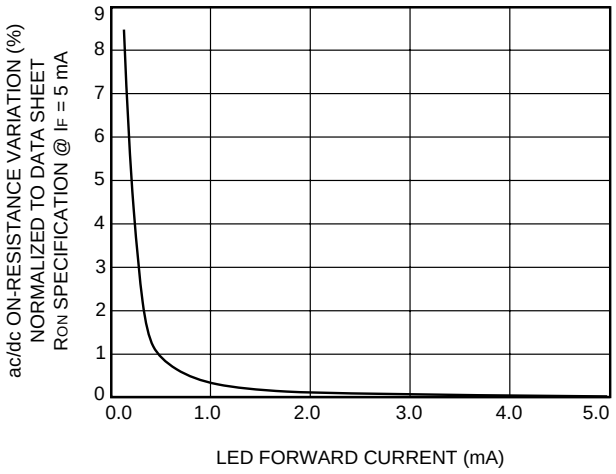

### F. ON-Resistance vs. Temperature



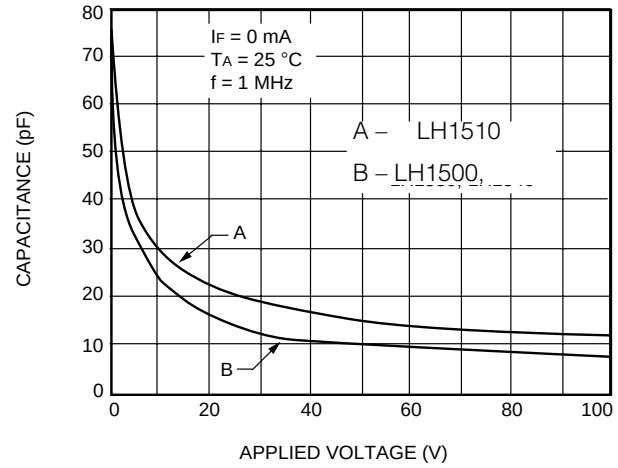
**A. Variation in ON-Resistance vs. LED Current**



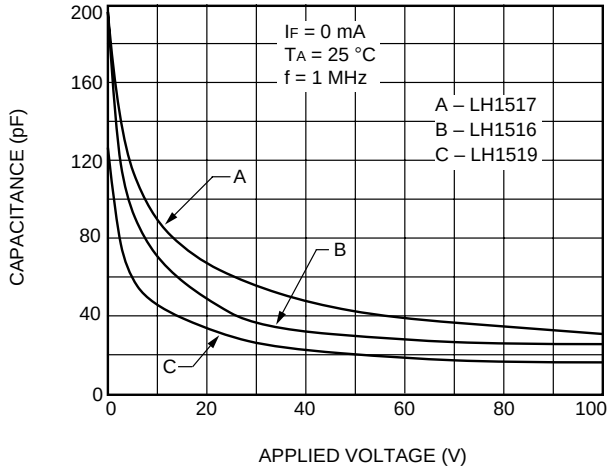

**B. Variation in ON-Resistance vs. LED Current (LH1525)**



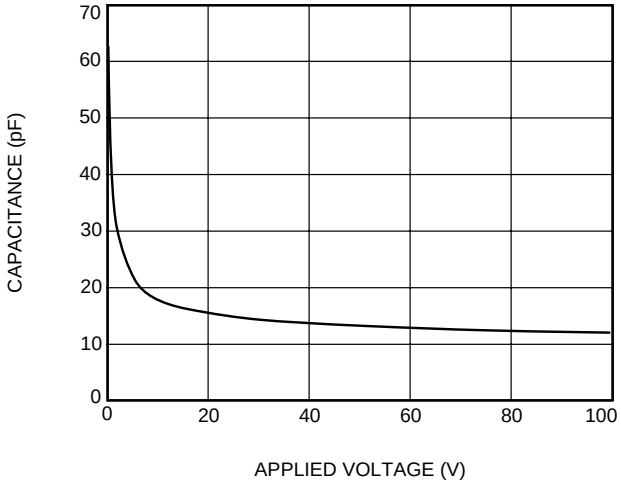

**C. Switch Capacitance vs. Applied Voltage**



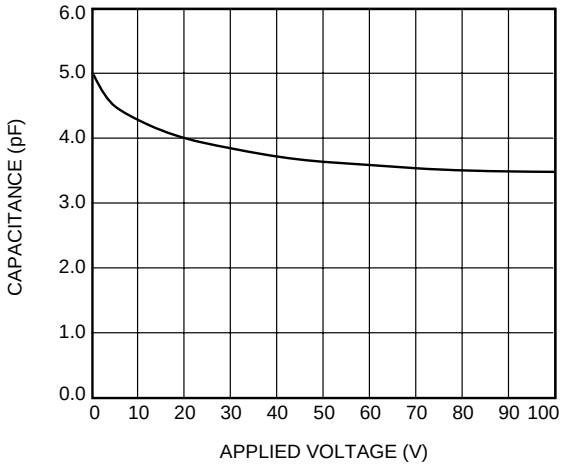

**D. Switch Capacitance vs. Applied Voltage**



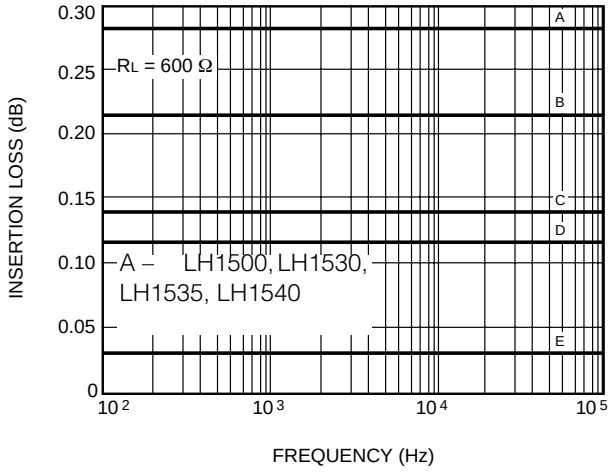

**E. Switch Capacitance vs. Applied Voltage (LH1525)**



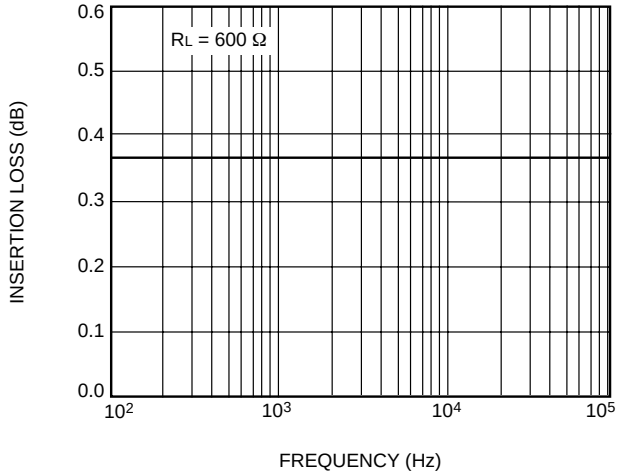

**F. Switch Capacitance vs. Applied Voltage (LH1541)**



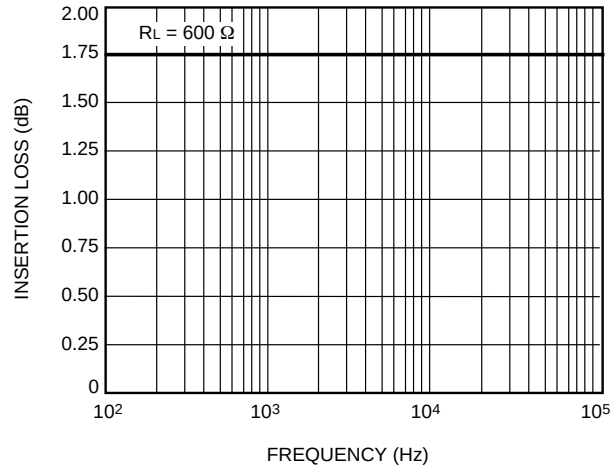
### A. Insertion Loss vs. Frequency



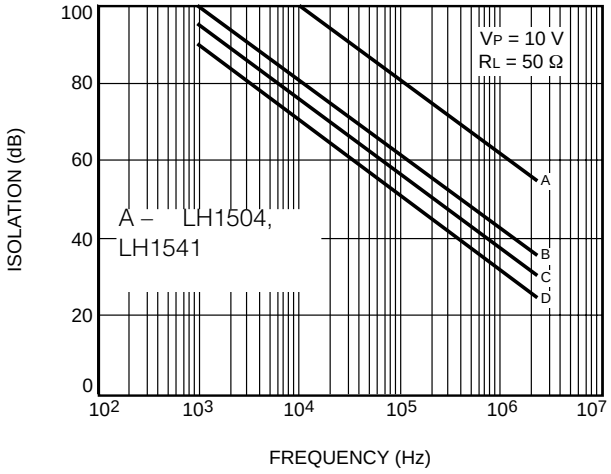

### B. Insertion Loss vs. Frequency (LH1525)



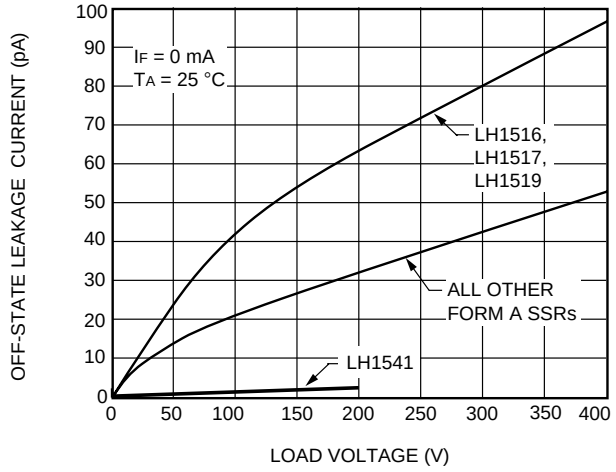

### C. Insertion Loss vs. Frequency (LH1541)



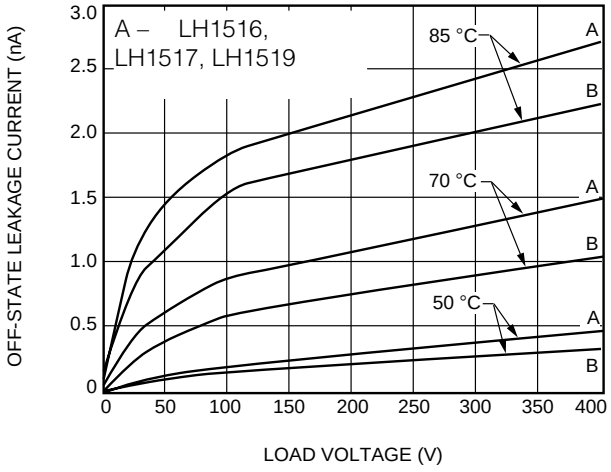

### D. Output Isolation



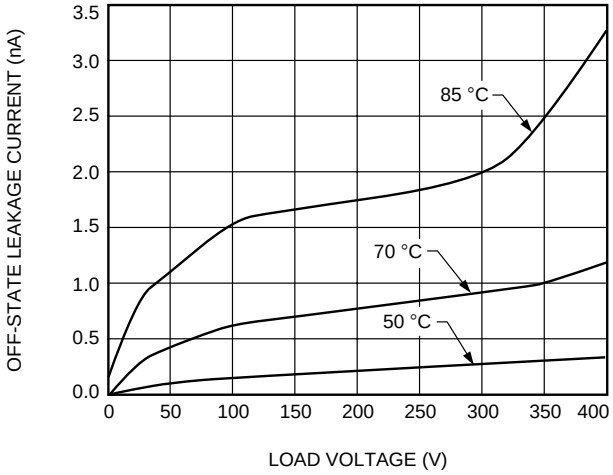

### E. Leakage Current vs. Applied Voltage



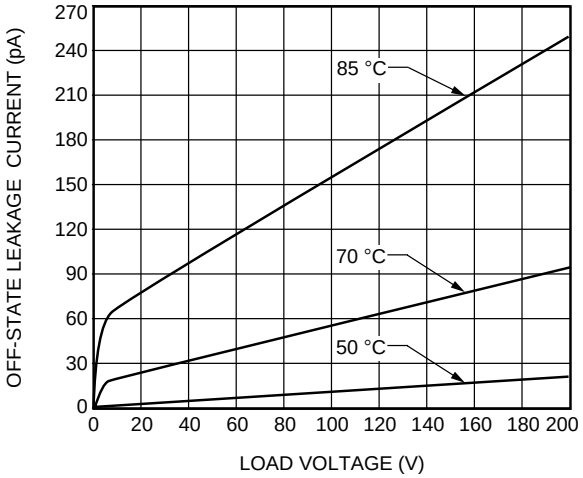

### F. Leakage Current vs. Applied Voltage at Elevated Temperatures



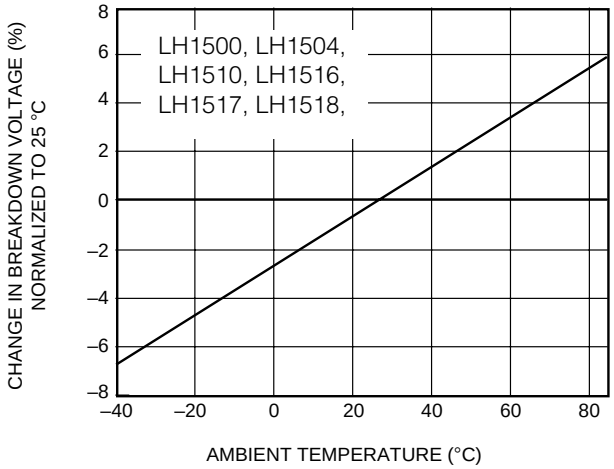
**A. Leakage Current vs. Applied Voltage at Elevated Temperatures (LH1525)**



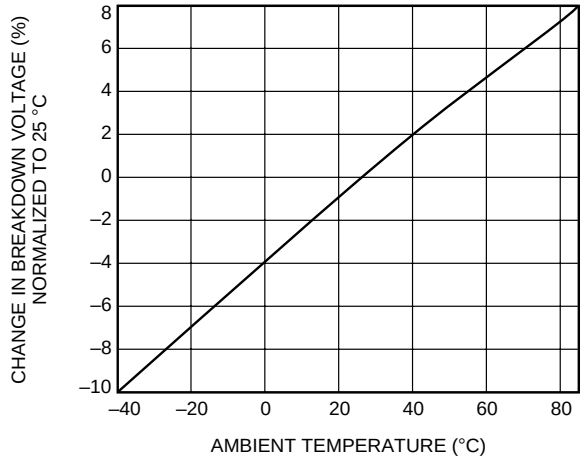

**B. Leakage Current vs. Applied Voltage at Elevated Temperatures (LH1541)**



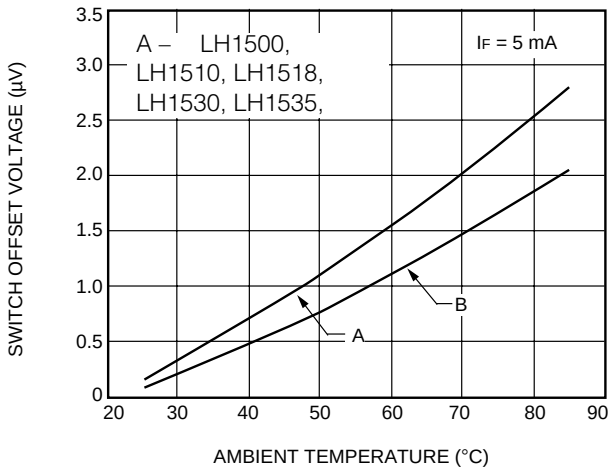

**C. Switch Breakdown Voltage vs. Temperature**



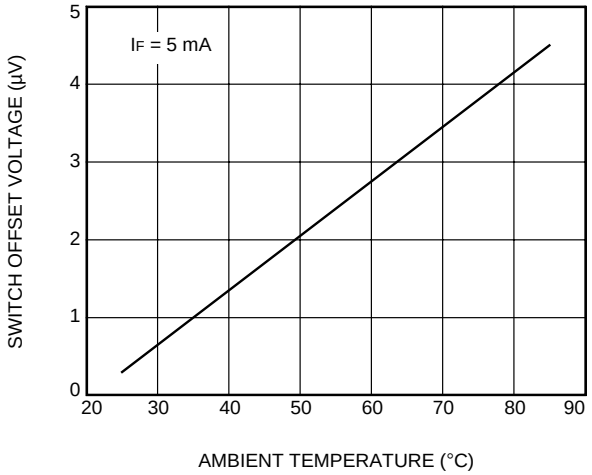

**D. Switch Breakdown Voltage vs. Temperature (LH1541)**



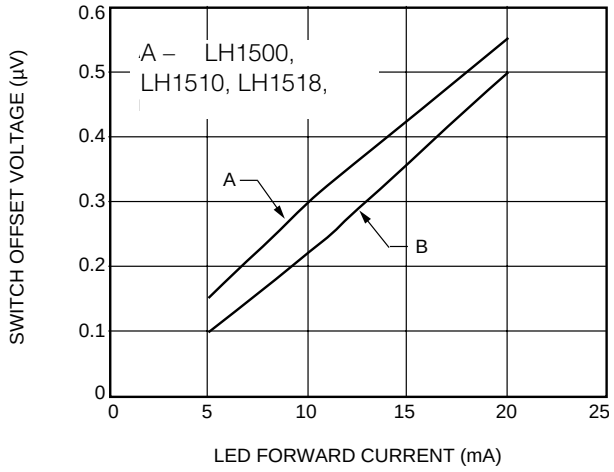

**E. Switch Offset Voltage vs. Temperature**



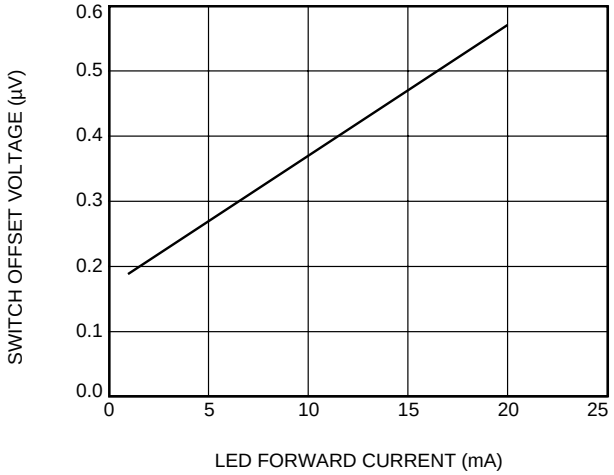

**F. Switch Offset Voltage vs. Temperature (LH1525)**



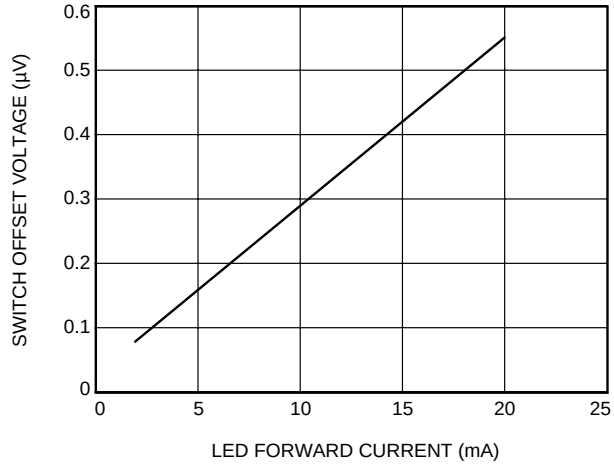
### A. Switch Offset Voltage vs. LED Current



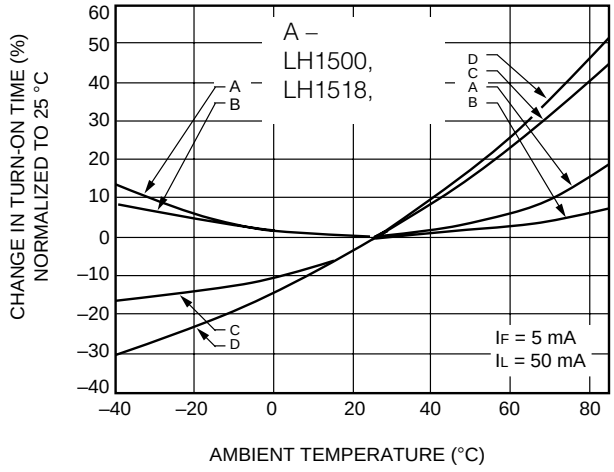

### B. Switch Offset Voltage vs. LED Current (LH1525)



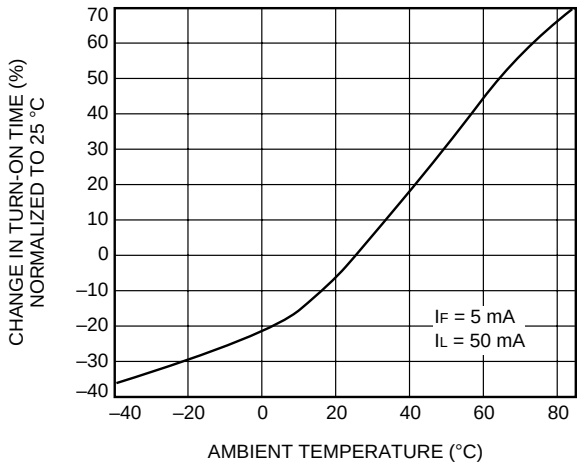

### C. Switch Offset Voltage vs. LED Current (LH1541)



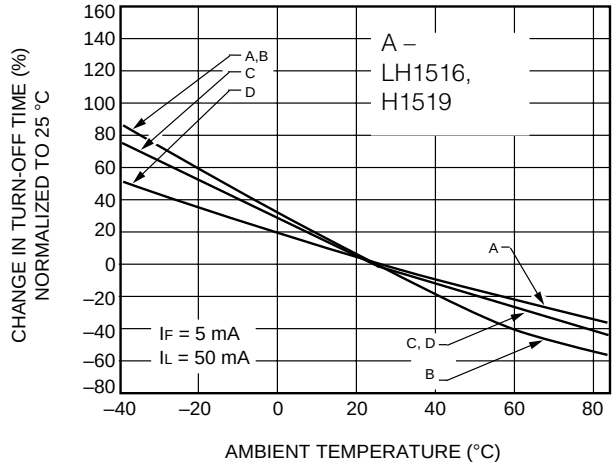

### D. Turn-On Time vs. Temperature



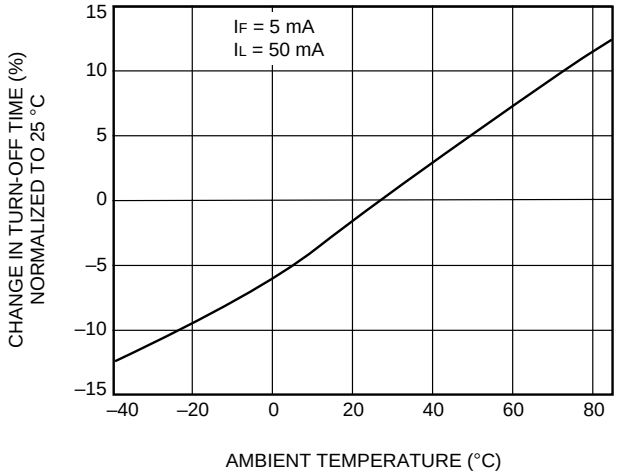

### E. Turn-On Time vs. Temperature (LH1541)



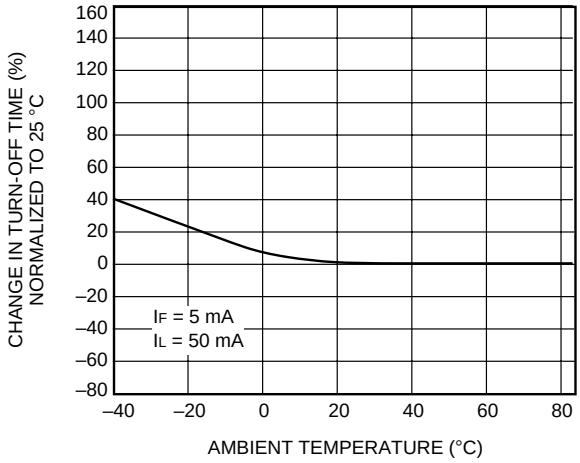

### F. Turn-Off Time vs. Temperature



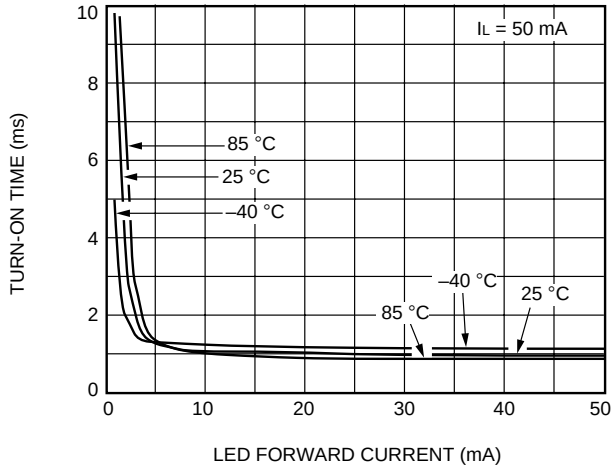
### A. Turn-Off Time vs. Temperature (LH1525)



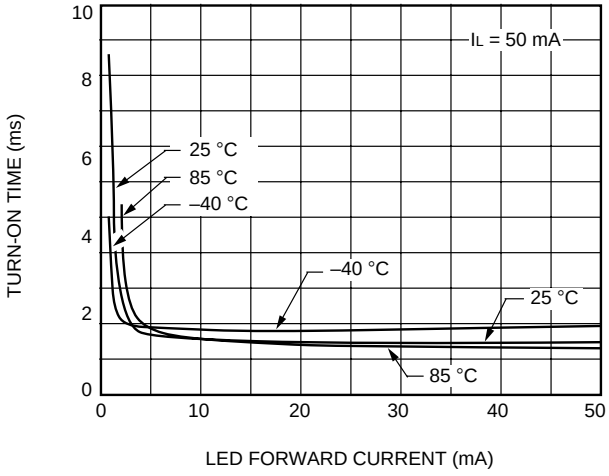

### B. Turn-Off Time vs. Temperature (LH1541)



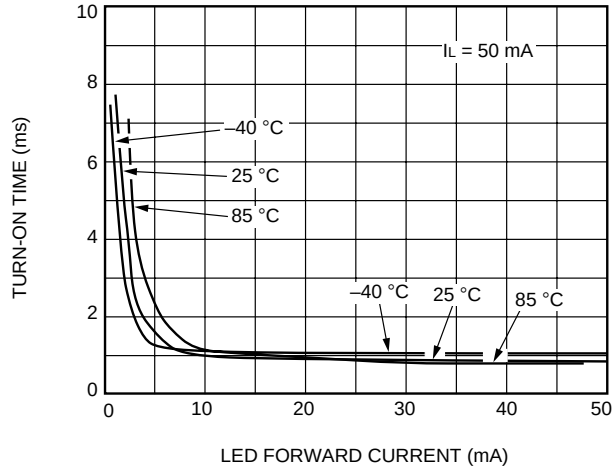

### C. Turn-On Time vs. LED Current (LH1500, LH1518, LH1540)



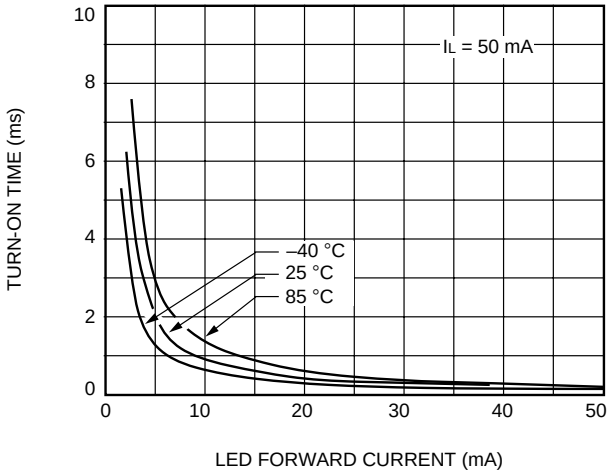

### D. Turn-On Time vs. LED Current (LH1504)



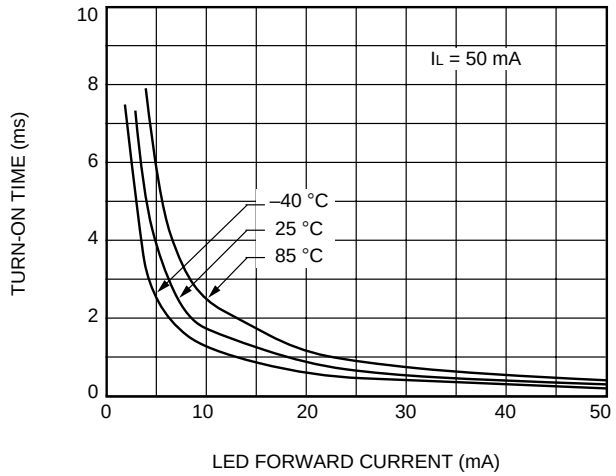

### E. Turn-On Time vs. LED Current (LH1510)



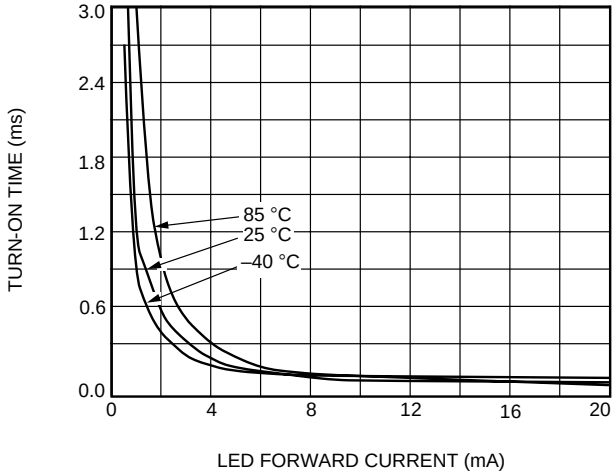

### F. Turn-On Time vs. LED Current (LH1516, LH1519)



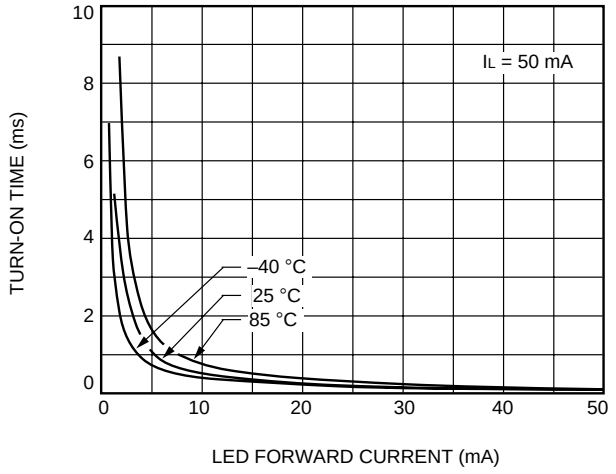
**A. Turn-On Time vs. LED Current (LH1517)**



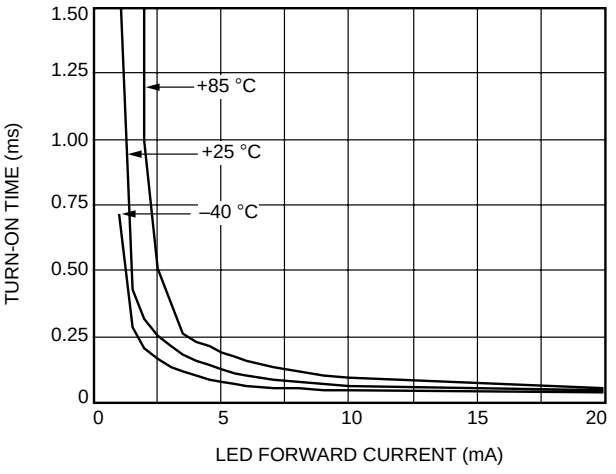

**B. Turn-On Time vs. LED Current (LH1525)**



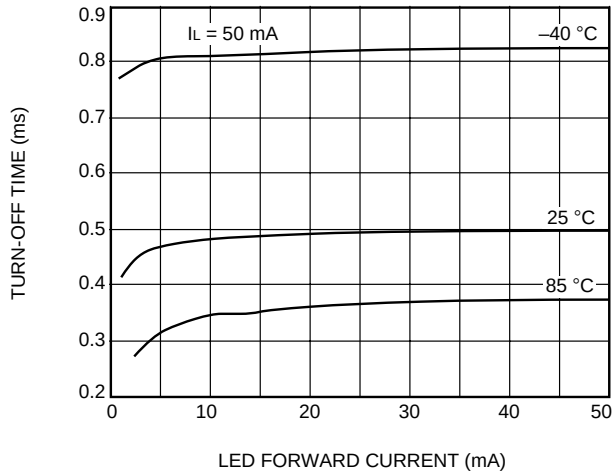

**C. Turn-On Time vs. LED Current (LH1530)**



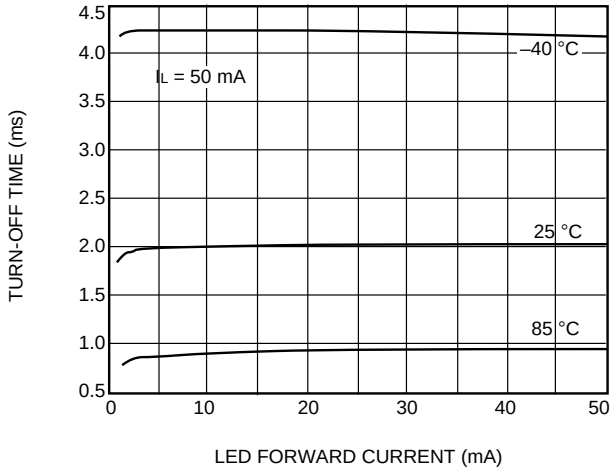

**D. Turn-On Time vs. LED Current (LH1541)**



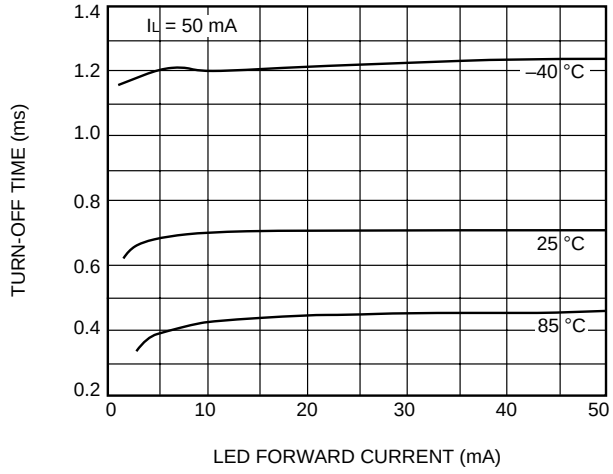

**E. Turn-Off Time vs. LED Current (LH1500, LH1530, LH1540)**



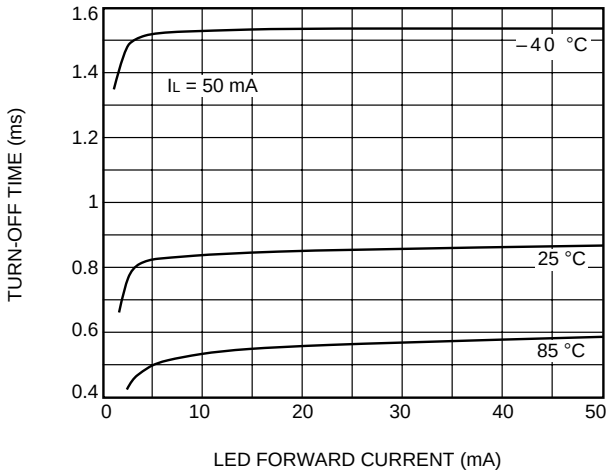

**F. Turn-Off Time vs. LED Current (LH1504)**



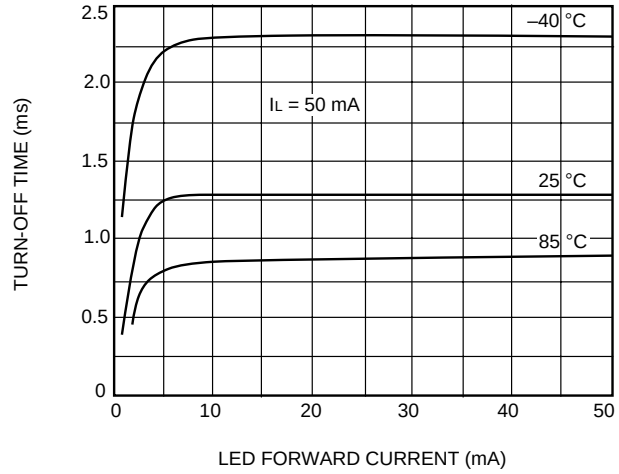
**A. Turn-Off Time vs. LED Current (LH1510, LH1518)**



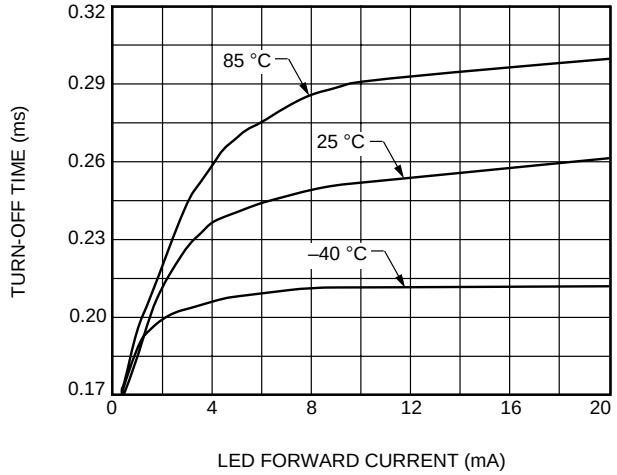

**B. Turn-Off Time vs. LED Current (LH1516, LH1519)**



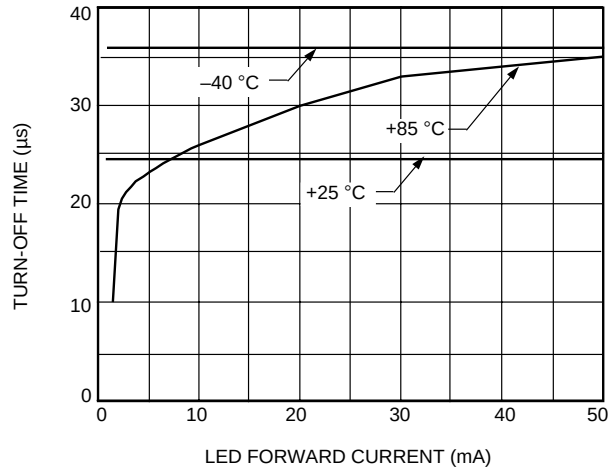

**C. Turn-Off Time vs. LED Current (LH1517)**




**D. Turn-Off Time vs. LED Current (LH1525)**

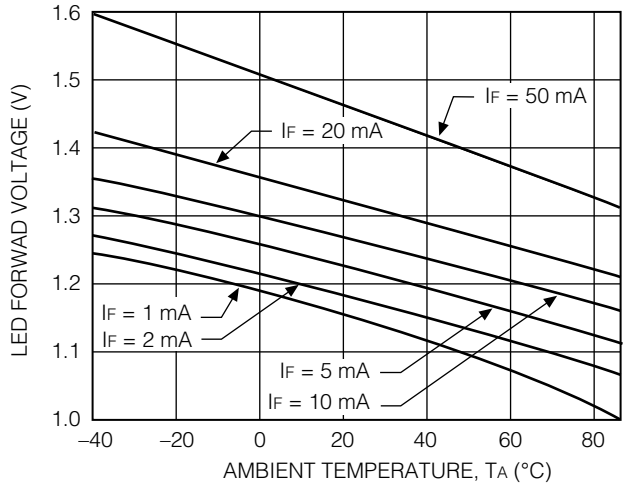



**E. Turn-Off Time vs. LED Current (LH1541)**

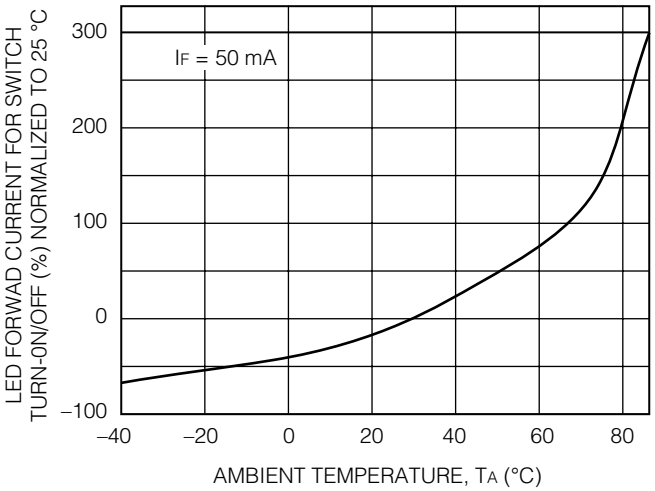


## Typical Performance Characteristics, LH1550

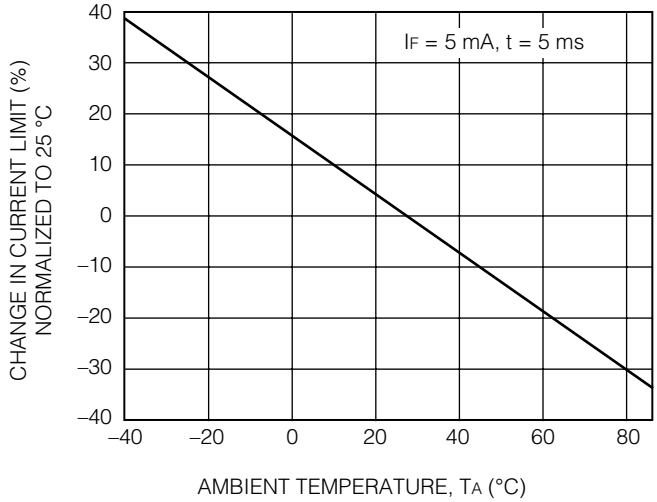
### A. LED Voltage vs. Temperature



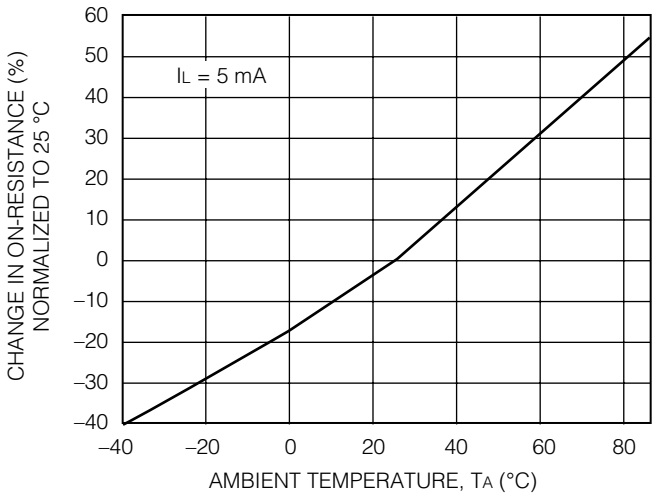

### B. LED Current for Switch Turn-On/Off vs. Temperature



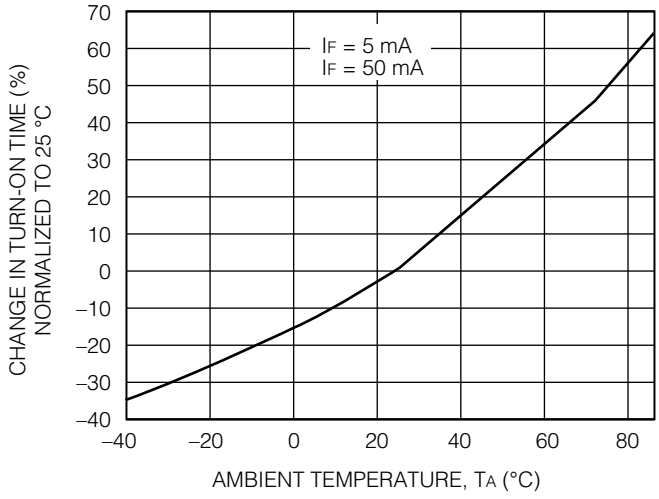

### C. Current Limit vs. Temperature




### D. ON-Resistance vs. Temperature




### E. Turn-Off Time vs. Temperature




### F. Turn-Off Time vs. Temperature