OPTOELECTRONICS

# Photocoupler

## Product Data Sheet

## LTV-3150-L Series

**Spec No.: DS70-2013-0037**

Effective Date: 04/19/2014

Revision: A

LITE-ON DCC

RELEASE

BNS-OD-FC001/A4


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# Photocouplers
# LTV-3150-L series

## 1. DESCRIPTION

The LTV-3150-L is a 1.0A Output Current Gate Drive Optocoupler, capable of driving most 1200V/50A IGBT/MOSFET. It is ideally suited for fast switching driving of power IGBT and MOSFETs used in motor control inverter applications, and high performance power system. It consists of a gallium aluminum arsenide (AlGaAs) light emitting diode optically coupled to an integrated circuit with a high-speed driver for push-pull MOSFET output stage.

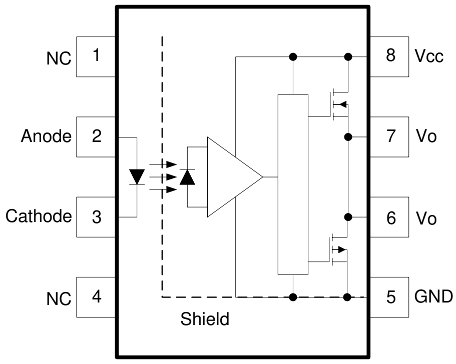
### 1.1 Features

- 1.0 A maximum peak output current
- 0.8 A minimum peak output current
- Rail-to-rail output voltage
- 400 ns maximum propagation delay
- 150 ns maximum propagation delay difference
- 15 kV/us minimum Common Mode Rejection (CMR) at $V_{CM}$ = 1500 V
- $I_{CC}$ = 3.0 mA maximum supply current
- Wide operating range: 10 to 30 Volts ($V_{CC}$)
- Guaranteed performance over temperature -40°C ~ +105°C.
- MSL Level 1
- Safety approval:
  - UL/ cUL Recognized 5000 $V_{RMS}$/1 min
  - IEC/EN/DIN EN 60747-5-5 $V_{IORM}$ = 630 $V_{peak}$

### 1.2 Applications

- IGBT/MOSFET gate drive
- Uninterruptible power supply (UPS)
- Industrial Inverter
- AC/Brushless DC motor drives

### Functional Diagram



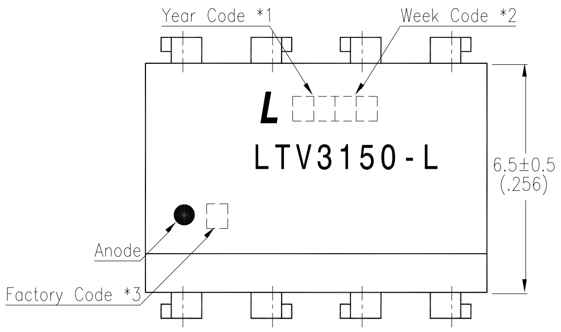

A 0.1µF bypass Capacitor must be connected between Pin 5 and 8. See note 11.

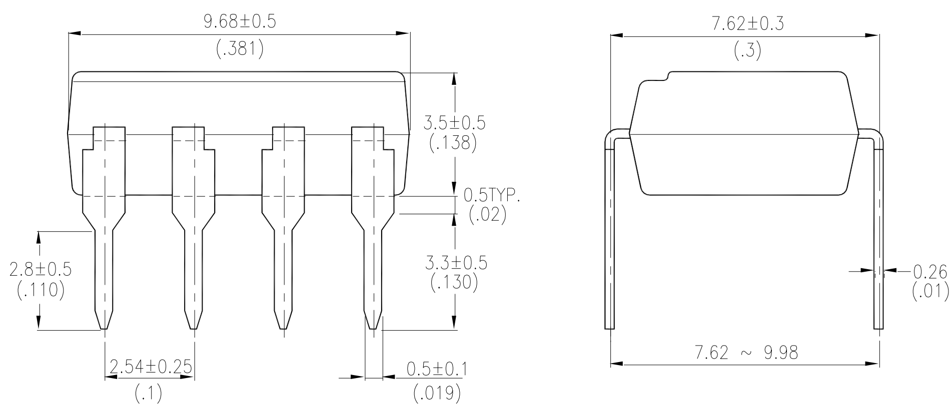
### Truth Table

| LED | High side | Low side | $V_O$ |
|---|---|---|---|
| OFF | OFF | ON | Low |
| ON | ON | OFF | High |

## 2. PACKAGE DIMENSIONS

### 2.1 LTV-3150-L




**Notes :**

*1. Year date code.

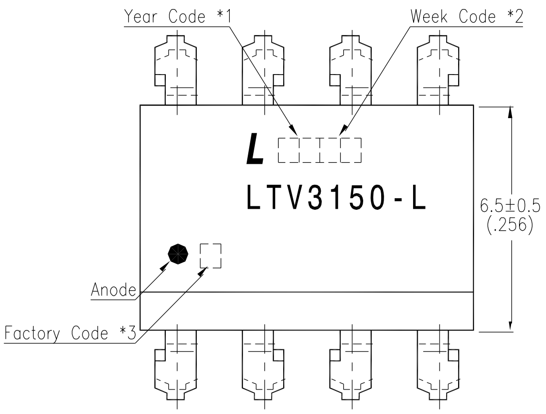
*2. 2-digit work week.

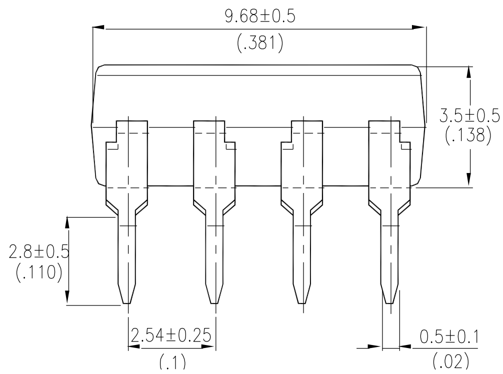
*3. Factory identification mark

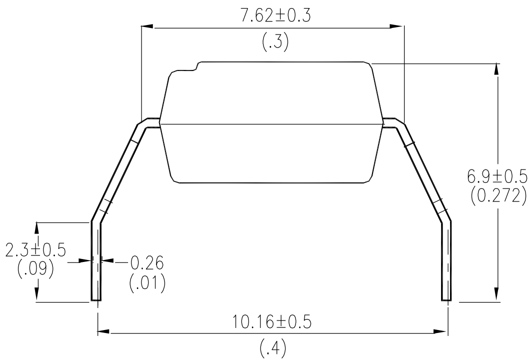
(Y : Thailand).

Dimensions are in Millimeters and (Inches).

## 2.2 LTV-3150M-L




### Notes

*1. Year date code.

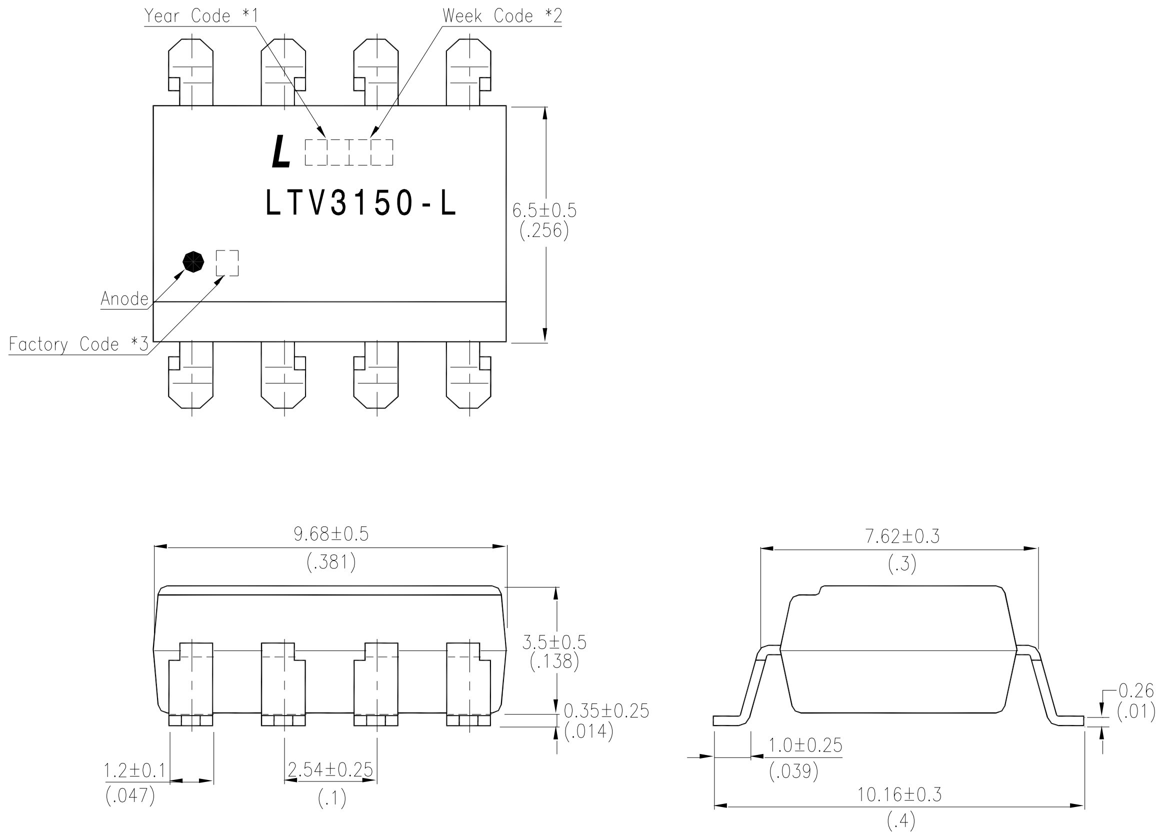
*2. 2-digit work week.

*3. Factory identification mark

(Y : Thailand).

Dimensions are in Millimeters and (Inches).

## 2.3 LTV-3150S-L




**Notes :**

*1. Year date code.

*2. 2-digit work week.

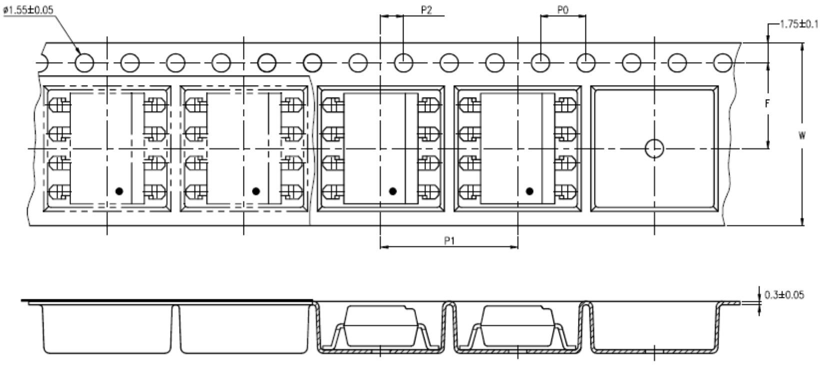
*3. Factory identification mark

(Y : Thailand).

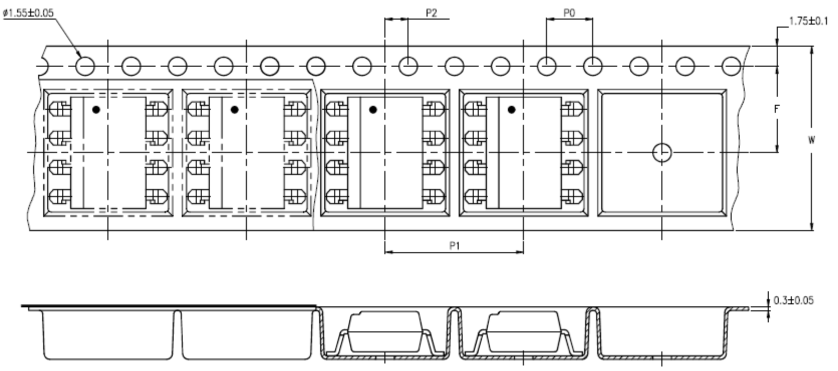
Dimensions are in Millimeters and (Inches).

# 3. TAPING DIMENSIONS

## 3.1 LTV-3150S-TA-L




## 3.2 LTV-3150S-TA1-L




| Description | Symbol | Dimension in mm (inch) |
|---|---|---|
| Tape wide | W | 16±0.3 (0.63) |
| Pitch of sprocket holes | $P_0$ | 4±0.1 (0.15) |
| Distance of compartment | F | 7.5±0.1 (0.295) |
| | $P_2$ | 2±0.1 (0.079) |
| Distance of compartment to compartment | $P_1$ | 12±0.1 (0.47) |

## 3.3 Quantities Per Reel

| Package Type | LTV-3150-L |
|---|---|
| Quantities (pcs) | 1000 |

# 4. RATING AND CHARACTERISTICS

## 4.1 Absolute Maximum Ratings

| Parameter | Symbol | Min | Max | Unit | Note |
|---|---|---|---|---|---|
| Storage Temperature | $T_{stg}$ | -55 | +125 | °C | |
| Operating Temperature | $T_{opr}$ | -40 | +105 | °C | |
| Output IC Junction Temperature | $T_J$ | | 125 | °C | |
| Isolation Voltage | $V_{iso}$ | 5000 | | $V_{RMS}$ | |
| Total Output Supply Voltage | $(V_{CC}-V_{EE})$ | 0 | 35 | V | |
| Average Forward Input Current | $I_F$ | | 25 | mA | |
| Reverse Input Voltage | $V_R$ | | 5 | V | |
| Peak Transient Input Current (<1 μs pulse width, 300 pps) | $I_{F(TRAN)}$ | | 1 | A | |
| "High" Peak Output Current | $I_{OH(PEAK)}$ | | 1.0 | A | 1 |
| "Low" Peak Output Current | $I_{OL(PEAK)}$ | | 1.0 | A | 1 |
| Input Current (Rise/Fall Time) | $t_{r(IN)}$ / $t_{f(IN)}$ | | 500 | ns | |
| Output Voltage | $V_{O(PEAK)}$ | -0.5 | $V_{CC}$ | V | |
| Power Dissipation | $P_I$ | | 40 | mW | |
| Output Power Dissipation | $P_O$ | | 250 | mW | |
| Total Power Dissipation | $P_T$ | | 295 | mW | |
| Lead Solder Temperature | $T_{sol}$ | | 260 | °C | |

Ambient temperature = 25°C, unless otherwise specified. Stresses exceeding the absolute maximum ratings can cause permanent damage to the device. Exposure to absolute maximum ratings for long periods of time can adversely affect reliability.

## 4.2 Recommended Operating Conditions

| Parameter | Symbol | Min | Max | Unit |
|---|---|---|---|---|
| Operating Temperature | $T_A$ | -40 | 105 | °C |
| Supply Voltage | $V_{CC}$ | 10 | 30 | V |
| Input Current (ON) | $I_{FL(ON)}$ | 7 | 16 | mA |
| Input Voltage (OFF) | $V_{F(OFF)}$ | -3.0 | 0.8 | V |

## 4.3 ELECTRICAL OPTICAL CHARACTERISTICS

| | Parameter | Symbol | Min. | Typ. | Max. | Unit | Test Condition | Figure | Note |
|---|---|---|---|---|---|---|---|---|---|
| Input | Input Forward Voltage | $V_F$ | 1.2 | 1.37 | 1.8 | V | $I_F$ = 10mA | 13 | |
| | Input Forward Voltage Temperature Coefficient | $\Delta V_F / \Delta T$ | — | -1.237 | — | mV/°C | $I_F$ = 10mA | | |
| | Input Reverse Voltage | $BV_R$ | 5 | — | — | V | $I_R$ = 10μA | | |
| | Input Threshold Current (Low to High) | $I_{FLH}$ | — | 1.4 | 5 | mA | $R_g$ = 10Ω, $C_g$ = 25nF, $V_O$ > 5V | 6, 7 ,18 | |
| | Input Threshold Voltage (High to Low) | $V_{FHL}$ | 0.8 | — | — | V | | | |
| | Input Capacitance | $C_{IN}$ | — | 33 | — | pF | f = 1 MHz, $V_F$ = 0 V | | |
| Output | High Level Supply Current | $I_{CCH}$ | — | 1.9 | 3.0 | mA | $R_g$ = 10Ω, $C_g$ = 25nF, $I_F$ = 10mA | 4, 5 | |
| | Low Level Supply Current | $I_{CCL}$ | — | 2.1 | 3.0 | mA | $R_g$ = 10Ω, $C_g$ = 25nF, $V_F$ = 0V | | |
| | High level output current | $I_{OH}$ | — | — | -0.6. | A | $V_O$ = ($V_{CC}$ – 2.5 V) | 16 | 1 |
| | | | — | -— | -1.0 | | $V_{CC}$ - $V_O$ ≤15V | | 2 |
| | Low level output current | $I_{OL}$ | 0.6 | — | — | A | $V_O$ = ($V_{CC}$ + 2.0 V) | 17 | 1 |
| | | | 1.0 | — | — | | $V_{CC}$ – $V_{EE}$ ≤15V | | 3 |
| | High level output voltage | $V_{OH}$ | $V_{CC}$ - 0.25 | $V_{CC}$ - 0.1 | | V | $I_F$ = 10mA, $I_O$ = -100mA | 1, 2, 14 | 4 |
| | Low level output voltage | $V_{OL}$ | | $V_{EE}$ + 0.1 | $V_{EE}$ + 0.25 | V | $I_F$ = 0mA, $I_O$ = 100mA | 3, 15 | |

All Typical values at $T_A$ = 25°C and $V_{CC} – V_{EE}$ = 30 V, unless otherwise specified; all minimum and maximum specifications are at recommended operating condition. (As page 6)

## 5. SWITCHING SPECIFICATION

<table>
<tr><th>Parameter</th><th>Symbol</th><th>Min.</th><th>Typ.</th><th>Max.</th><th>Unit</th><th>Test Condition</th><th>Figure</th><th>Note</th></tr>
<tr><td>Propagation Delay Time to High Output Level</td><td>$t_{PHL}$</td><td>100</td><td>242</td><td>400</td><td rowspan="6">ns</td><td rowspan="6">$R_g$ = 10Ω,<br>$C_g$ = 25nF,<br>f = 20 kHz,<br>Duty Cycle = 50%<br>$I_F$ = 7 to 16 mA,<br>$V_{CC}$ = 15 to 30V<br>$V_{EE}$ = ground</td><td rowspan="4">8, 9, 10, 11, 12, 19</td><td></td></tr>
<tr><td>Propagation Delay Time to Low Output Level</td><td>$t_{PLH}$</td><td>100</td><td>183</td><td>400</td><td></td></tr>
<tr><td>Pulse Width Distortion</td><td>PWD</td><td></td><td>-60</td><td>-120</td><td>10</td></tr>
<tr><td>Propagation delay difference between any two parts or channels</td><td>PDD</td><td>-150</td><td></td><td>150</td><td>7</td></tr>
<tr><td>Output Rise Time (20 to 80%)</td><td>Tr</td><td></td><td>42</td><td></td><td rowspan="2">19</td><td></td></tr>
<tr><td>Output Fall Time (80 to 20%)</td><td>Tf</td><td></td><td>50</td><td></td><td></td></tr>
<tr><td>Common mode transient immunity at high level output</td><td>|CMH|</td><td>15</td><td></td><td></td><td>kV/μs</td><td>$T_A$ = 25°C,<br>$I_F$ = 10 to 16 mA,<br>$V_{CM}$ = 1500 V,<br>$V_{CC}$ = 30 V</td><td rowspan="2">20</td><td>8</td></tr>
<tr><td>Common mode transient immunity at low level output</td><td>|CML|</td><td>15</td><td></td><td></td><td>kV/μs</td><td>$T_A$ = 25°C,<br>$V_F$ = 0 V,<br>$V_{CM}$ = 1500 V,<br>$V_{CC}$ = 30 V</td><td>9</td></tr>
</table>

All Typical values at $T_A$ = 25°C and $V_{CC} - V_{EE}$ = 30 V, unless otherwise specified; all minimum and maximum specifications are at recommended operating condition. (As page 6)

## 6. ISOLATION CHARACTERISTIC

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Test Condition | Note |
|---|---|---|---|---|---|---|---|
| Withstand Insulation Test Voltage | $V_{ISO}$ | 5000 | — | — | V | RH ≤ 50%, t = 1min, $T_A$ = 25°C | 5, 6 |
| Input-Output Resistance | $R_{I-O}$ | — | $6.5x10^{11}$ | — | Ω | $V_{I-O}$ = 500V DC | 5 |
| Input-Output Capacitance | $C_{I-O}$ | — | 1.0 | — | pF | f = 1MHz | |

All Typical values at $T_A$ = 25°C unless otherwise specified. All minimum and maximum specifications are at recommended operating condition. (As page 6)

**Notes**:

1) Maximum pulse width = 10μs, maximum duty cycle = 0.2%.
2) Output is sourced at -1.0A with a maximum pulse width = 10μs. $V_{CC}$-$V_O$ is measured to ensure 15 V or below.
3) Output is sourced at 1.0 A with a maximum pulse width = 10μs. $V_O$-$V_{EE}$ is measured to ensure 15 V or below.
4) In this test $V_{OH}$ is measured with a dc load current. When driving capacitive loads, $V_{OH}$ will approach $V_{CC}$ as $I_{OH}$ approaches zero amps.
5) Device is considered a two terminal device: pins 1, 2, 3 and 4 are shorted together and pins 5, 6, 7 and 8 are shorted together.
6) According to UL1577, each optocoupler is tested by applying an insulation test voltage 5250 $V_{RMS}$ for one second (leakage current less than 10uA). This test is performed before the 100% production test for partial discharge
7) The difference between $T_{PHL}$ and $T_{PLH}$ between any two LTV-3150-L parts under same test conditions.
8) Common mode transient immunity in high stage is the maximum tolerable negative $dV_{CM}/dt$ on the trailing edge of the common mode impulse signal, $V_{CM}$, to assure that the output will remain high.
9) Common mode transient immunity in low stage is the maximum tolerable positive $dV_{CM}/dt$ on the leading edge of the common mode impulse signal, $V_{CM}$, to assure that the output will remain low.
10) Pulse Width Distortion is defined as $T_{PHL}$ - $T_{PLH}$ for any given device.
11) At least a 0.1μF or bigger bypass capacitor must be connected/ closed across pin 8 and pin 5. Failure to provide the bypass may impair the switching property. Normally, it is recommended to place a 1μF multi-layer ceramic capacitor. To parallel one larger capacitor (>1μF) to optimize performance is better.

## 7. TYPICAL PERFORMANCE CURVES & TEST CIRCUITS

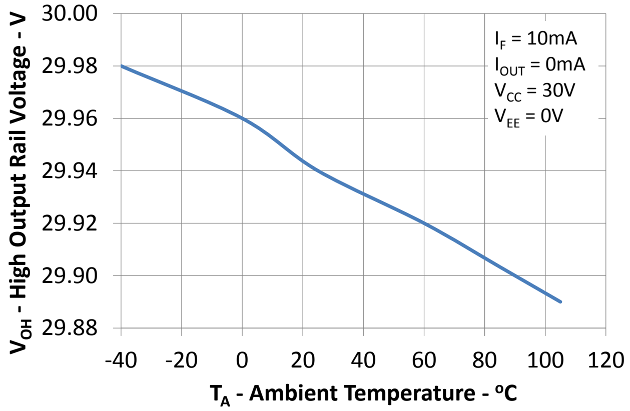



Figure 1: High output rail voltage vs. Temperature

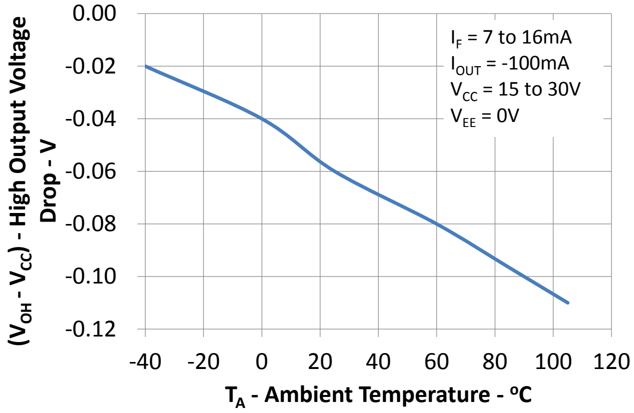



Figure 2: $V_{OH}$ vs. Temperature

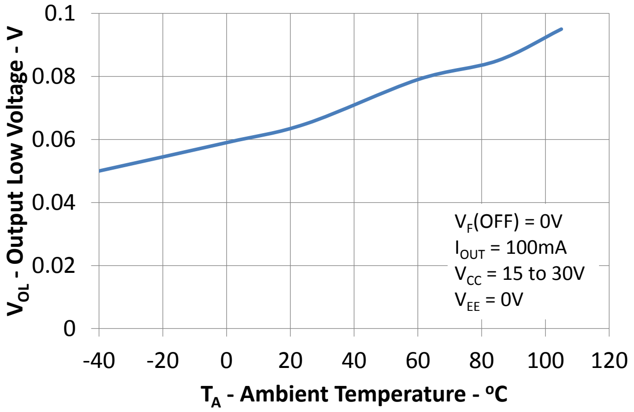



Figure 3: $V_{OL}$ vs. Temperature

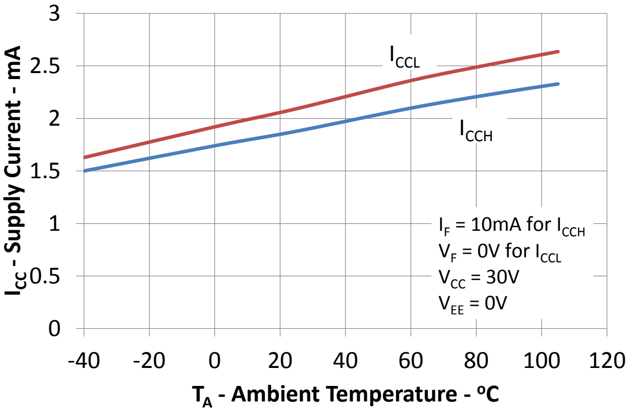



Figure 4: $I_{CC}$ vs. Temperature

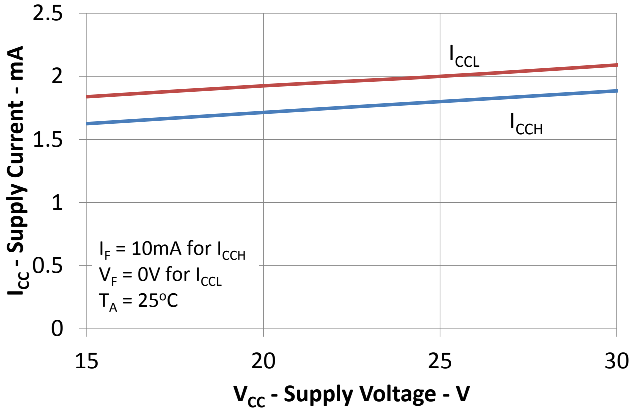



Figure 5: $I_{CC}$ vs. $V_{CC}$

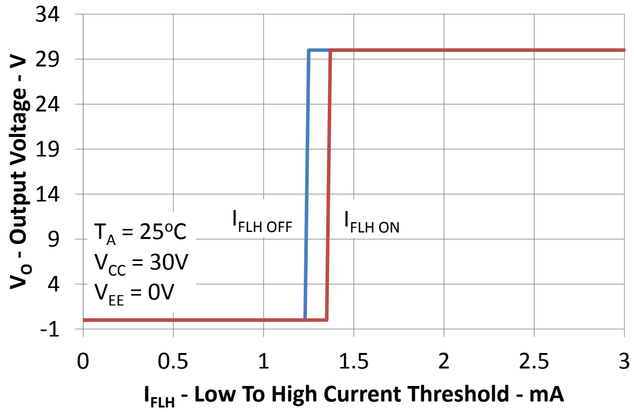



Figure 6: IFLH hysteresis

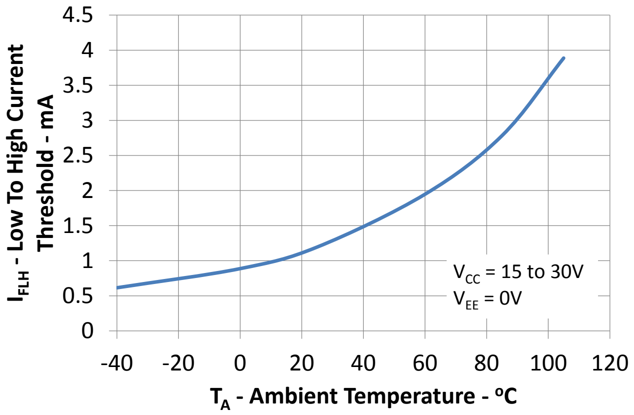



Figure 7: $I_{FLH}$ vs. Temperature

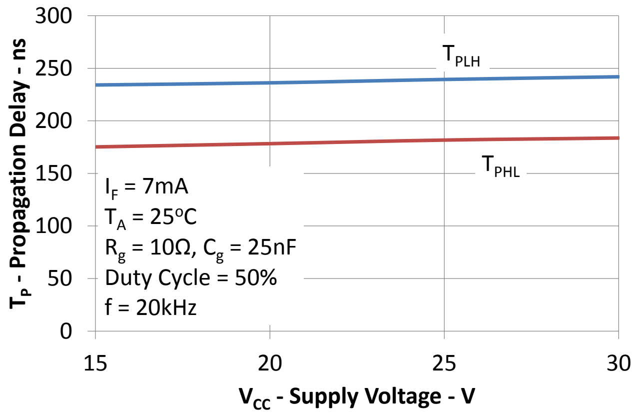



Figure 8: Propagation delays vs. $V_{CC}$

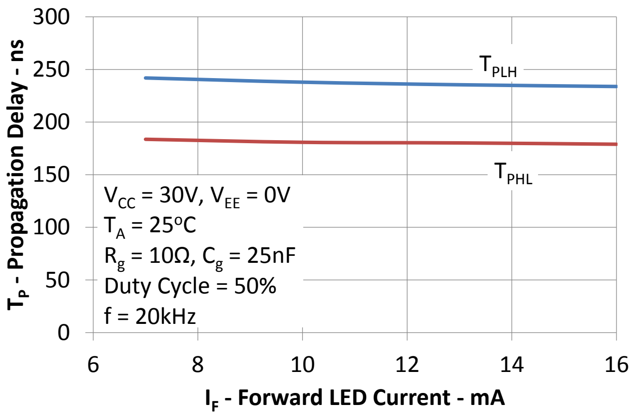



Figure 9: Propagation delays vs. $I_F$

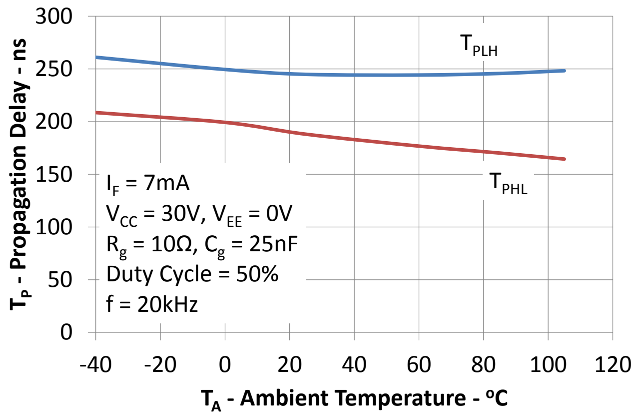



Figure 10: Propagation delays vs. Temperature

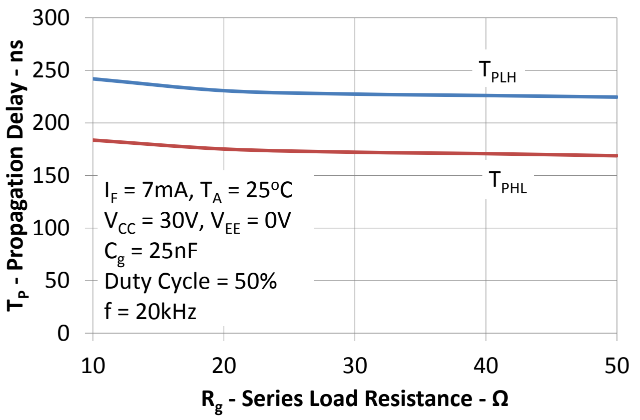



Figure 11: Propagation delays vs. $R_g$

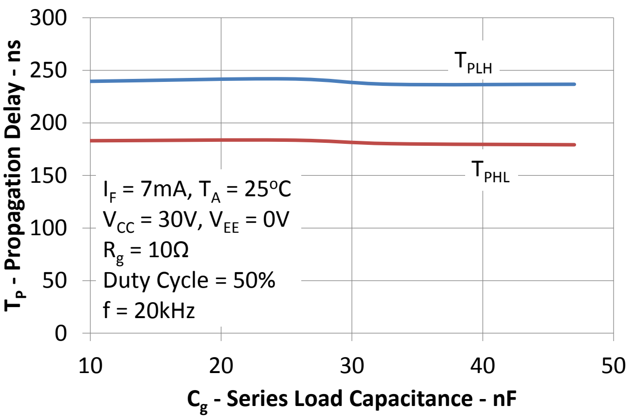



Figure 12: Propagation delays vs. $C_g$

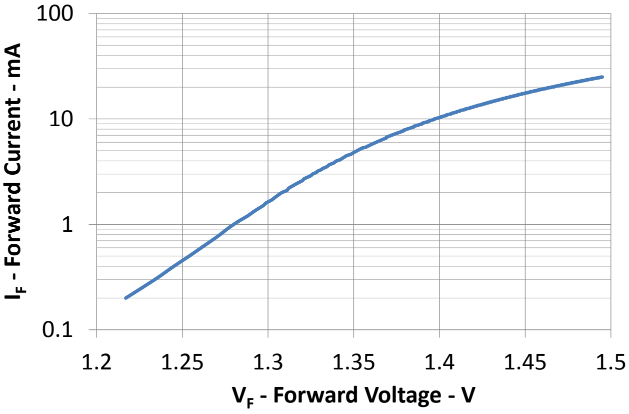



Figure 13: Input current vs. Forward voltage

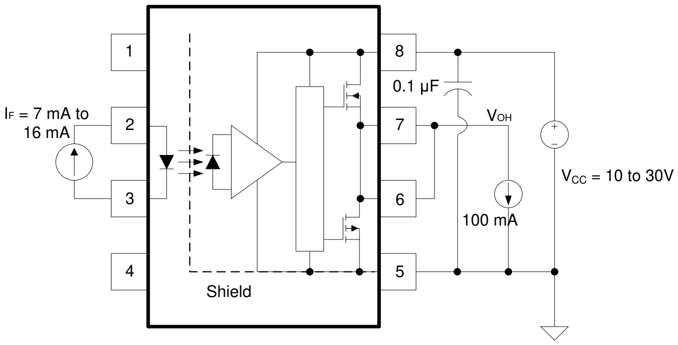



Figure 14 : VOH Test Circuit

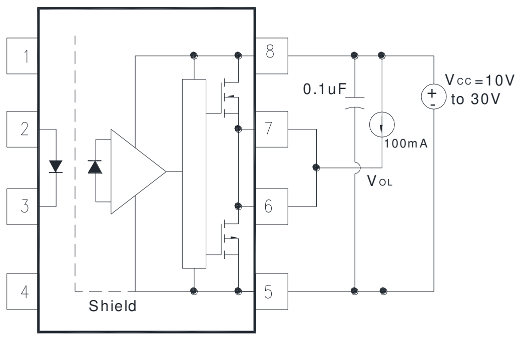



Figure 15 : VOL Test Circuit

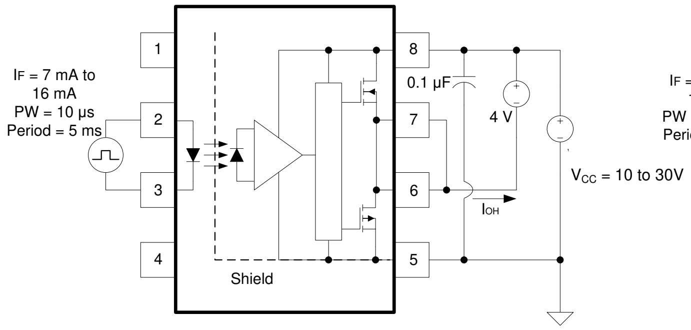



Figure 16 : IOH Test Circuit

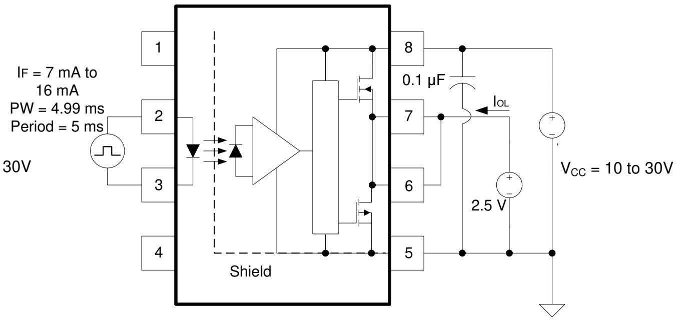



Figure 17 : IOL Test Circuit

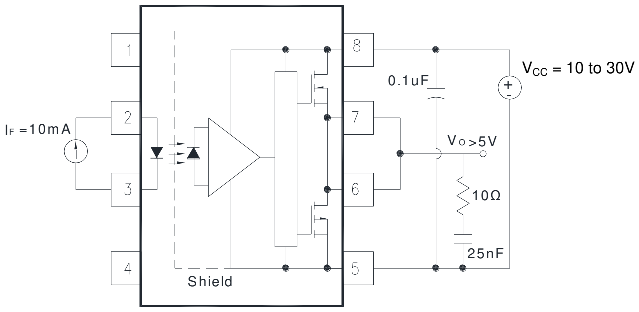



Figure 18 : $I_{FLH}$ Test Circuit

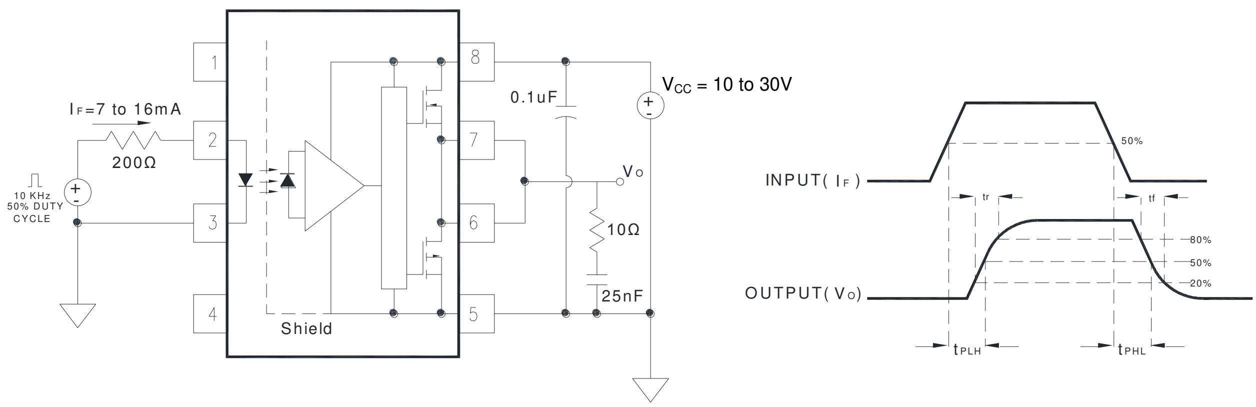



Figure 19 : $t_r$, $t_f$, $t_{PLH}$ and $t_{PHL}$ Test Circuit and Waveforms

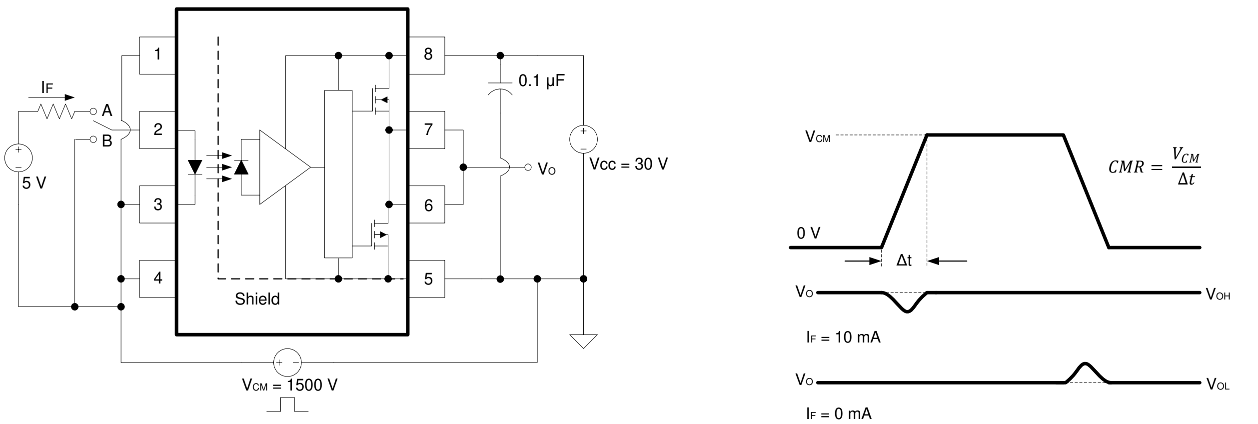


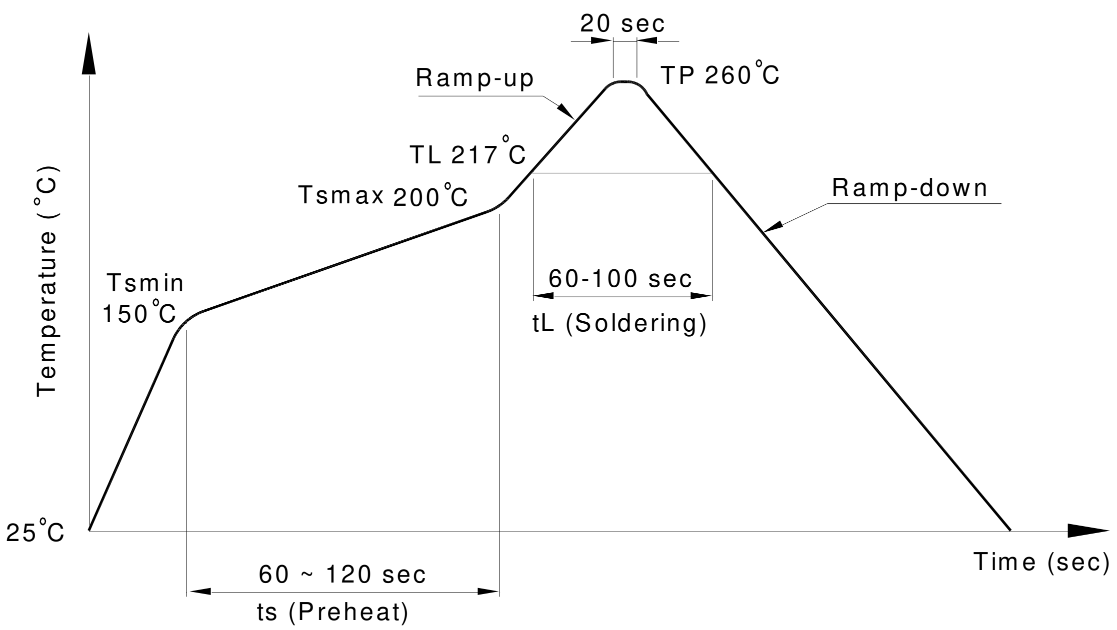

Figure 20 : CMR Test Circuit and Waveforms

# 8. TEMPERATURE PROFILE OF SOLDERING

## 8.1 IR Reflow soldering (JEDEC-STD-020C compliant)

One time soldering reflow is recommended within the condition of temperature and time profile shown below. Do not solder more than three times.

| Profile item | Conditions |
|---|---|
| Preheat | |
| - Temperature Min ($T_{Smin}$) | 150˚C |
| - Temperature Max ($T_{Smax}$) | 200˚C |
| - Time (min to max) (ts) | 90±30 sec |
| Soldering zone | |
| - Temperature ($T_L$) | 217˚C |
| - Time ($t_L$) | 60~100 sec |
| Peak Temperature ($T_P$) | 260˚C |
| Ramp-up rate | 3˚C / sec max. |
| Ramp-down rate | 3~6˚C / sec |



## 8.2 Wave soldering (JEDEC22A111 compliant)

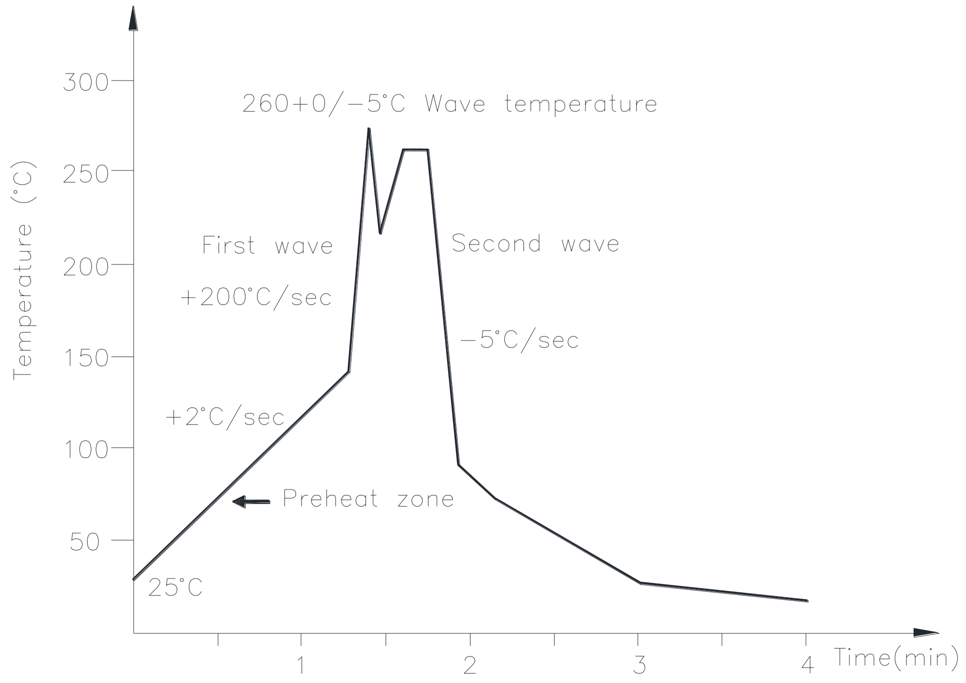
One time soldering is recommended within the condition of temperature.

Temperature: 260+0/-5°C

Time: 10 sec.

Preheat temperature:25 to 140°C

Preheat time: 30 to 80 sec.




## 8.3 Hand soldering by soldering iron

Allow single lead soldering in every single process. One time soldering is recommended.

Temperature: 380+0/-5°C

Time: 3 sec max.

## 9. ORDERING INFORMATION

| Parameter | Option | Minimum CMR | | Input-On Current (mA) | Remark |
|---|---|---|---|---|---|
| | | dV/dt (V/μs) | $V_{CM}$ (V) | | |
| LTV-3150-L | | 15,000 | 1500 | 10 | Single Channel, DIP-8 |
| | M | | | | Single Channel, Wide Lead Spacing |
| | S | | | | Single Channel, SMD-8 |