

## Photocoupler LTV-5341 series

### 3.0 Amp Output Current IGBT Gate Drive Photocoupler with Rail-to-Rail Output Voltage in Stretched LSO5

#### Description

The LTV-5341 series Photocoupler is ideally suited for driving power IGBTs and MOSFETs used in motor control inverter applications and inverters in power supply system. It contains an AlGaAs LED optically coupled to an integrated circuit with a power output stage. The Photocoupler operational parameters are guaranteed over the temperature range from  $-40^{\circ}\text{C} \sim +110^{\circ}\text{C}$ .

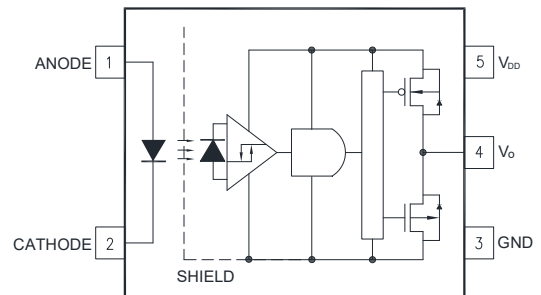
#### 1.1 Features

- 3.0 A maximum peak output current
- 2.5 A minimum peak output current
- Rail-to-rail output voltage
- 150 ns maximum propagation delay
- 100 ns maximum propagation delay difference
- Under Voltage Lock-Out protection (UVLO) with hysteresis
- 30 kV/us minimum Common Mode Rejection (CMR) at  $V_{CM} = 1000\text{ V}$
- Wide operating range: 15 to 30 Volts ( $V_{CC}$ )
- Guaranteed performance over temperature  $-40^{\circ}\text{C} \sim +110^{\circ}\text{C}$ .
- Safety approval:
  - UL1577
  - IEC/EN/DIN EN 60747-5-5

#### 1.2 Applications

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

#### Functional Diagram



A  $0.1\mu\text{F}$  bypass Capacitor must be connected between Pin 3 and 4.

#### Truth Table

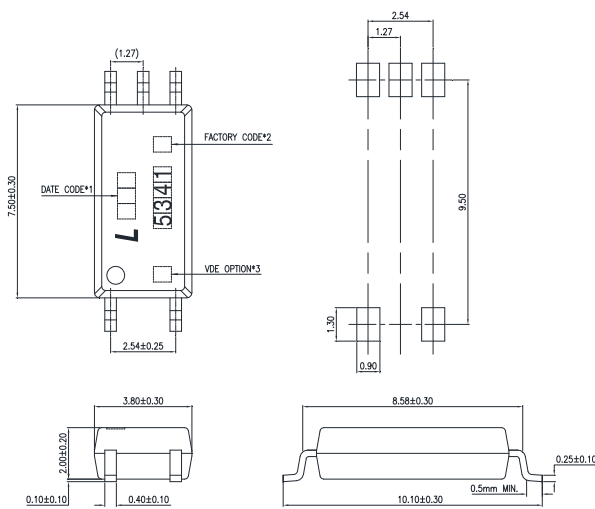
| LED | High side | Low side | $V_o$ |
|-----|-----------|----------|-------|
| OFF | OFF       | ON       | Low   |
| ON  | ON        | OFF      | High  |

Note: A  $1\mu\text{F}$  bypass capacitor must be connected between Pin 4 and 6.

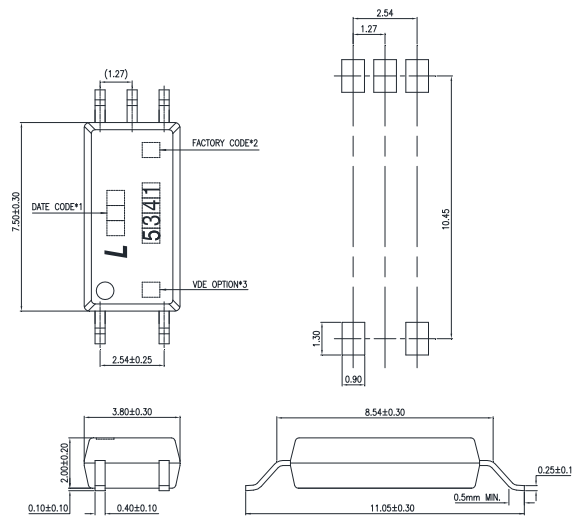
## Photocoupler LTV-5341 series

### 2. PACKAGE DIMENSIONS

#### 2.1 LTV-5341



#### 2.2 LTV-5341W



#### Notes :

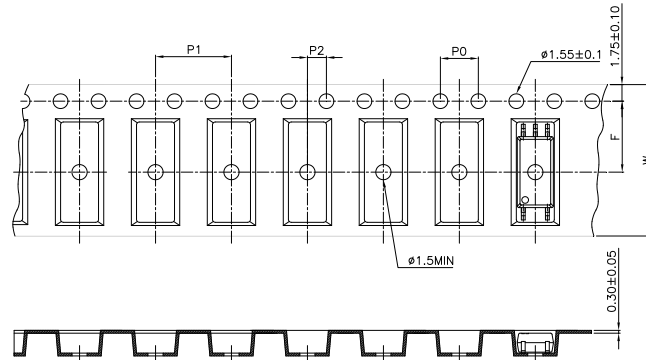
1. Year date code.
2. 2-digit work week.
3. Factory identification mark (X : Tianjin).
4. "4" or "V" for VDE option.

\* Dimensions are in Millimeters and (Inches).

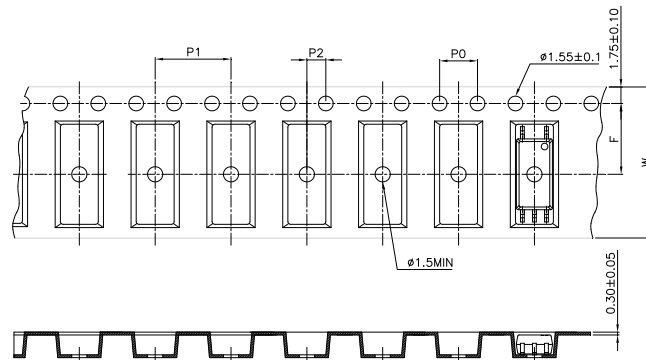
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### 3. TAPING DIMENSIONS

#### 3.1 LTV-5341-TP



#### 3.3 LTV-5341-TP1



| Description                            | Symbol         | Dimension in mm (inch) |
|--|----------------|------------------------|
| Tape wide                              | W              | 16±0.3 (0.47)          |
| Pitch of sprocket holes                | P <sub>0</sub> | 4±0.1 (0.15)           |
| Distance of compartment                | F              | 7.5±0.1 (0.217)        |
|  | P <sub>2</sub> | 2±0.1 (0.079)          |
| Distance of compartment to compartment | P <sub>1</sub> | 8±0.1 (0.315)          |

#### 3.5 Quantities Per Reel

| Package Type     | LTV-5341 series |
|------------------|-----------------|
| Quantities (pcs) | 3000            |



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### 4. IEC/EN/DIN EN 60747-5-5 Insulation Characteristics

| Description  | Symbol          | LTV-5341  | Unit       |
|--|-----------------|-----------|------------|
| Climatic Classification  | —               | 40/110/21 | —          |
| Pollution Degree (DIN VDE 0110/1.89)   | —               | 2         | —          |
| Maximum Working Insulation Voltage   | $V_{IORM}$      | 1230      | $V_{peak}$ |
| Input to Output Test Voltage, Method b*<br>$V_{IORM} \times 1.875 = V_{PR}$ , 100% Production Test with<br>$t_m = 1$ sec, Partial discharge < 5 pC | $V_{PR}$        | 2310      | $V_{peak}$ |
| Input to Output Test Voltage, Method a*<br>$V_{IORM} \times 1.6 = V_{PR}$ , Type and Sample Test, $t_m = 10$ sec,<br>Partial discharge < 5 pC      | $V_{PR}$        | 1970      | $V_{peak}$ |
| Highest Allowable Overvoltage<br>(Transient Overvoltage $t_{ini} = 60$ sec)  | $V_{IOTM}$      | 8000      | $V_{peak}$ |
| Case Temperature   | $T_S$           | 175       | °C         |
| Input Current  | $I_{S, INPUT}$  | 45        | mA         |
| Output Power   | $P_{S, OUTPUT}$ | 450       | mW         |
| Insulation Resistance at $T_S$ , $V_{IO} = 500$ V  | $R_S$           | $>10^9$   | $\Omega$   |

\* Refer to the optocoupler section of the Isolation and Control Components Designer's Catalog, under Product Safety Regulations section, (IEC/EN/DIN EN 60747-5-5) for a detailed description of Method a and Method b partial discharge test profiles.

Note: These optocouplers are suitable for "safe electrical isolation" only within the safety limit data. Maintenance of the safety data shall be ensured by means of protective circuits. Surface mount classification is Class A in accordance with CECC 00802.



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### 5. RATING AND CHARACTERISTICS

#### 5.1 Absolute Maximum Ratings

| Parameter                     | Symbol              | Min | Max      | Unit | Note |
|-------------------------------|---------------------|-----|----------|------|------|
| Storage Temperature           | $T_{stg}$           | -55 | +125     | °C   | —    |
| Operating Temperature         | $T_{opr}$           | -40 | +110     | °C   | —    |
| Total Output Supply Voltage   | $(V_{CC} - V_{EE})$ | 0   | 35       | V    | —    |
| Average Forward Input Current | $I_F$               | —   | 20       | mA   | —    |
| Peak Transient Input Current  | $I_{F(TRAN)}$       | —   | 1.0      | A    | 1    |
| “High” Peak Output Current    | $I_{OH(PEAK)}$      | —   | 3.0      | A    | 2    |
| “Low” Peak Output Current     | $I_{OL(PEAK)}$      | —   | 3.0      | A    |      |
| Output Voltage                | $V_{O(PEAK)}$       | —   | $V_{CC}$ | V    | —    |
| Input Power Dissipation       | $P_I$               | —   | 40       | mW   | —    |
| Output IC Power Dissipation   | $P_O$               | —   | 450      | mW   | —    |
| Lead Solder Temperature       | $T_{sol}$           | —   | 260      | °C   | —    |

Note: 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.

Note: A ceramic capacitor (1  $\mu$ F) should be connected between pin 6 and pin 4 to stabilize the operation of a high gain linear amplifier. Otherwise, this Photocoupler may not switch properly. The bypass capacitor should be placed within 1 cm of each pin.

Note 1: Pulse width (PW)  $\leq$  1  $\mu$ s, 300 pps

Note 2: Exponential waveform. Pulse width  $\leq$  0.3  $\mu$ s,  $f \leq$  15 kHz

#### 5.2 Recommended Operating Conditions

| Parameter                     | Symbol       | Min | Max  | Unit | Note |
|-------------------------------|--------------|-----|------|------|------|
| Supply Voltage                | $V_{CC}$     | 15  | 30   | V    |      |
| Input Current (ON)            | $I_{FL(ON)}$ | 3   | 10   | mA   | 1    |
| Input Voltage (OFF)           | $V_{F(OFF)}$ | 0   | 0.8  | V    |      |
| Peak Low-Level Output Current | $I_{OPH}$    | —   | -2.5 | A    |      |
| Peak Low-Level Output Current | $I_{OPL}$    | —   | 2.5  | A    |      |
| Operating Frequency           | $f$          | —   | 50   | kHz  |      |

Note 1: The rise and fall times of the input on-current should be less than 0.5  $\mu$ s

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### 5.3 ELECTRICAL OPTICAL CHARACTERISTICS

|                 | Parameter                                     | Symbol                  | Min.           | Typ.            | Max.           | Unit  | Test Condition   | Figure | Note |
|-----------------|---|-------------------------|----------------|-----------------|----------------|-------|--|--------|------|
| Input           | Input Forward Voltage                         | $V_F$                   | 1.4            | 1.6             | 1.8            | V     | $I_F = 10\text{mA}$  | 1      | —    |
|                 | Input Forward Voltage Temperature Coefficient | $\Delta V_F / \Delta T$ | —              | -2.0            | —              | mV/°C | $I_F = 10\text{mA}$  | —      | —    |
|                 | Input Threshold Current (Low to High)         | $I_{FLH}$               | —              | 0.8             | 2.5            | mA    | $V_{CC} = 15\text{-}30\text{ V}, V_O > 1\text{ V}$           | 4,16   | —    |
|                 | Input Threshold Voltage (High to Low)         | $V_{FHL}$               | 0.8            | —               | —              | V     | $V_{CC} = 15\text{-}30\text{ V}, V_O < 1\text{ V}$           | —      | —    |
|                 | Input Capacitance                             | $C_{IN}$                | —              | 33              | —              | pF    | $f = 1\text{ MHz}, V_F = 0\text{ V}$                         | —      | —    |
| Output          | High Level Supply Current                     | $I_{CCH}$               | —              | 1.6             | 3              | mA    | $I_F = 10\text{ mA}, V_{CC} = 30\text{V}, V_O = \text{Open}$ | 5,6    | —    |
|                 | Low Level Supply Current                      | $I_{CCL}$               | —              | 2.0             | 3              | mA    | $I_F = 0\text{ mA}, V_{CC} = 30\text{V}, V_O = \text{Open}$  |        | —    |
|                 | High level output current                     | $I_{OH}$                | —              | —               | -1.0           | A     | $V_O = (V_{CC} - 1.5\text{ V})$                              | 8,14   | 1    |
|                 |   |                         | —              | —               | -2.5           |       | $V_O = (V_{CC} - 4\text{ V})$                                |        | 2    |
|                 | Low level output current                      | $I_{OL}$                | 1.0            | —               | —              | A     | $V_O = (V_{EE} + 1.5\text{ V})$                              | 7,15   | 1    |
|                 |   |                         | 2.5            | —               | —              |       | $V_O = (V_{EE} + 4\text{ V})$                                |        | 2    |
|                 | High level output voltage                     | $V_{OH}$                | $V_{CC} - 0.3$ | $V_{CC} - 0.1$  | —              | V     | $I_F = 10\text{mA}, I_O = -100\text{mA}$                     | 6,12   | —    |
|                 | Low level output voltage                      | $V_{OL}$                | —              | $V_{EE} + 0.25$ | $V_{EE} + 0.4$ | V     | $I_F = 0\text{mA}, I_O = 100\text{mA}$                       | 5,13   | —    |
|                 | UVLO Threshold                                | $V_{UVLO+}$             | 11.0           | 12.5            | 13.5           | V     | $V_O > 5\text{V}, I_F = 10\text{ mA}$                        | 17     | —    |
|                 |   | $V_{UVLO-}$             | 9.5            | 11.1            | 12.0           | V     | $V_O < 5\text{V}, I_F = 10\text{ mA}$                        |        | —    |
| UVLO Hysteresis | $UVLO_{HYS}$                                  | —                       | 1.5            | —               | V              | —     | —  | —      |      |

All Typical values at  $T_A = 25^\circ\text{C}$  and  $V_{CC} - V_{EE} = 30\text{ V}$ , unless otherwise specified; all minimum and maximum specifications are at recommended operating condition. (Refer to 5.2)

Note 1: Maximum pulse width = 50  $\mu\text{s}$ .

Note 2: Maximum pulse width = 10  $\mu\text{s}$ .

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### 6. SWITCHING SPECIFICATION

| Parameter   | Symbol    | Min. | Typ. | Max. | Unit        | Test Condition   | Figure         | Note |
|---|-----------|------|------|------|-------------|--|----------------|------|
| Propagation Delay Time to High Output Level         | $t_{PLH}$ | 50   | 90   | 150  | ns          | $R_g = 20\Omega$ ,<br>$C_g = 10nF$ ,<br>$f = 25\text{ kHz}$ ,<br>Duty Cycle = 50%<br>$I_F = 3\text{ to }10\text{ mA}$ ,<br>$V_{CC} = 15\text{ to }30V$<br>$V_{EE} = \text{ground}$ | 9,10,11,<br>18 | —    |
| Propagation Delay Time to Low Output Level          | $t_{PHL}$ | 50   | 110  | 150  |             |  |                | —    |
| Pulse Width Distortion                              | PWD       | —    | —    | 50   |             |  |                | —    |
| Propagation delay skew                              | $t_{PSK}$ | -100 | —    | 100  |             |  | 3              |      |
| Output Rise Time (10 to 90%)                        | $T_r$     | —    | 10   | —    |             |  | 18             | —    |
| Output Fall Time (90 to 10%)                        | $T_f$     | —    | 10   | —    |             |  |                | —    |
| Common mode transient immunity at high level output | $ CM_H $  | 30   | —    | —    | kV/ $\mu$ s | $T_A = 25^\circ\text{C}$ ,<br>$I_F = 5\text{ mA}$ ,<br>$V_{CM} = 1000\text{ V}$ ,<br>$V_{CC} = 30\text{ V}$  | 19             | 1    |
| Common mode transient immunity at low level output  | $ CM_L $  | 30   | —    | —    | kV/ $\mu$ s | $T_A = 25^\circ\text{C}$ ,<br>$V_F = 0\text{ V}$ ,<br>$V_{CM} = 1000\text{ V}$ ,<br>$V_{CC} = 30\text{ V}$   |                | 2    |

All Typical values at  $T_A = 25^\circ\text{C}$  and  $V_{CC} - V_{EE} = 30\text{ V}$ , unless otherwise specified; all minimum and maximum specifications are at recommended operating condition. (Refer to 5.2)

Note 1:  $CM_H$  is the maximum rate of rise of the common mode voltage that can be sustained with the output voltage in the logic high state ( $V_O > 26\text{ V}$ ).

Note 2:  $CM_L$  is the maximum rate of fall of the common mode voltage that can be sustained with the output voltage in the logic low state ( $V_O < 1\text{ V}$ ).

Note 3: The difference between  $t_{PHL}$  and  $t_{PLH}$  between any two parts series parts under same test conditions.



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7. TYPICAL PERFORMANCE CURVES & TEST CIRCUITS

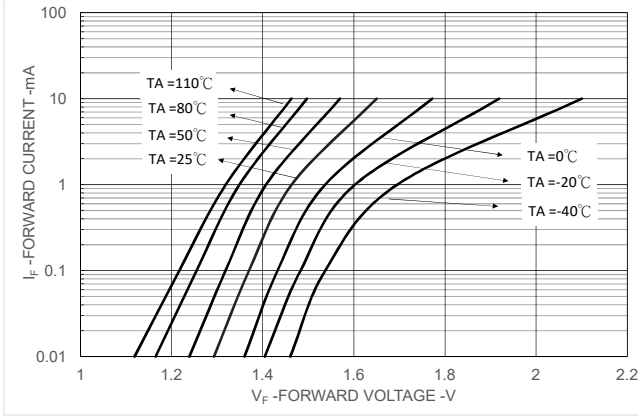


Figure 1.  $I_F$  vs.  $V_F$

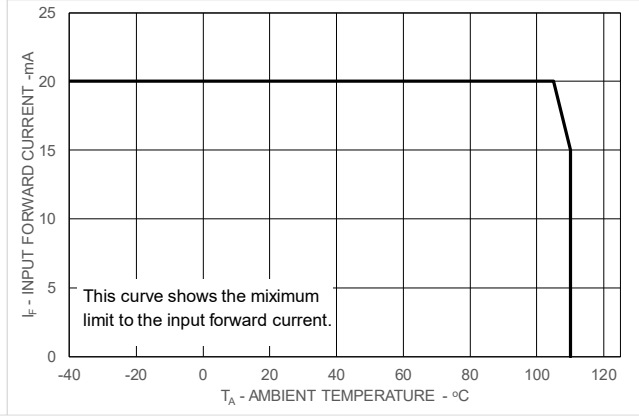


Figure 2.  $I_F$  vs. Temperature

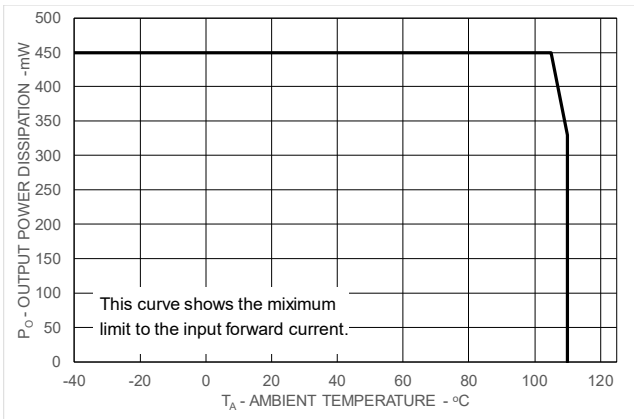


Figure 3.  $P_O$  vs. Temperature

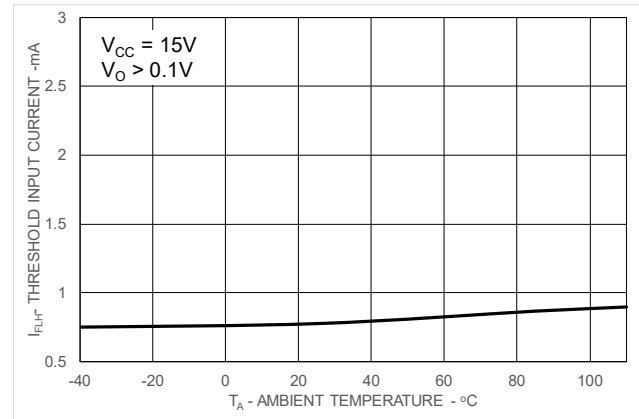


Figure 4.  $I_{FLH}$  vs. Temperature

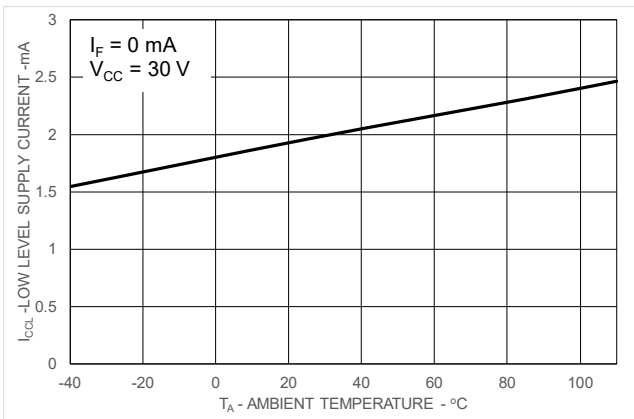


Figure 5.  $I_{CCL}$  vs. Temperature

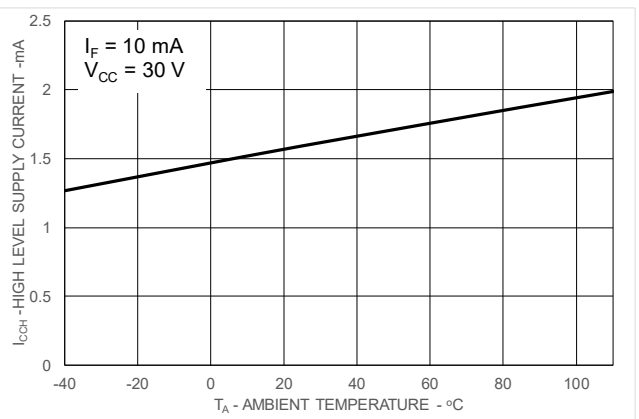


Figure 6.  $I_{CCH}$  vs. Temperature





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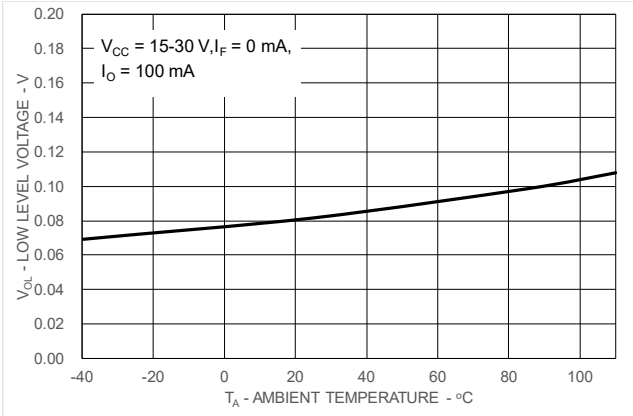


Figure 5. VOL vs. Temperature

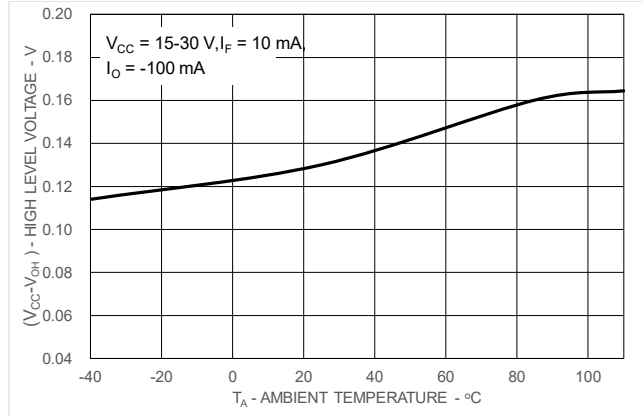


Figure 6. (VCC-VOH) vs. Temperature

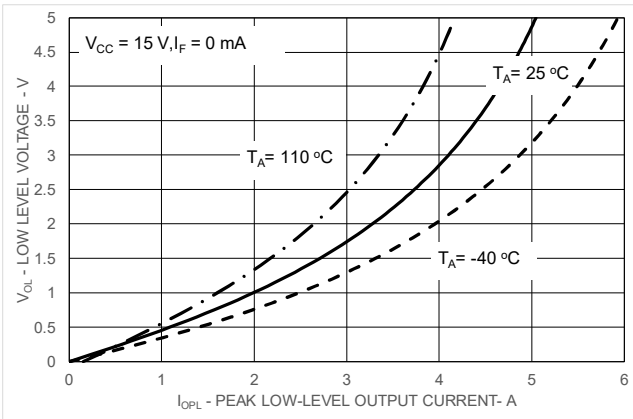


Figure 7. VOL vs. IOPL

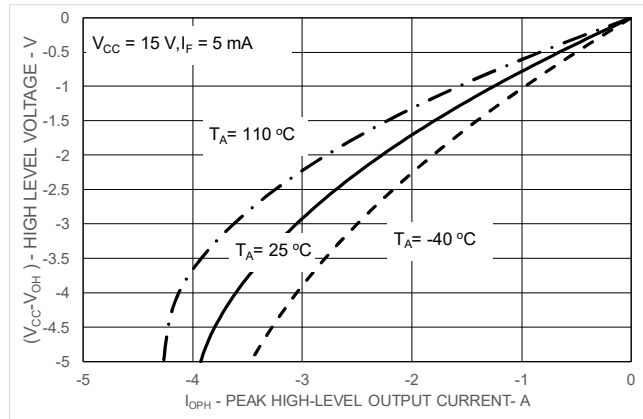


Figure 8. VOH vs. IOPH

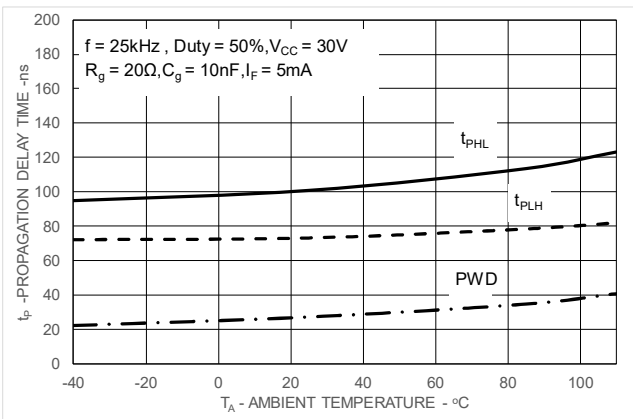


Figure 9. Propagation Delay Time vs. Temperature

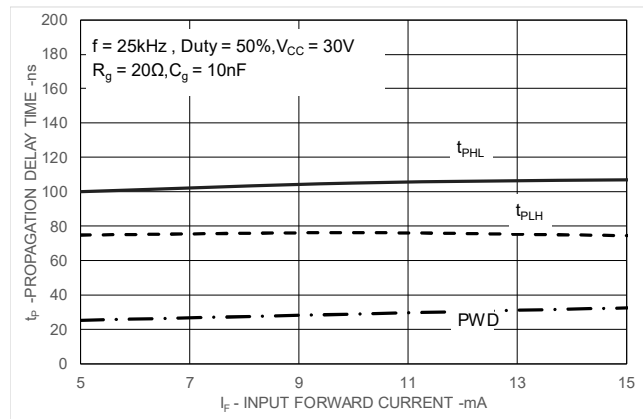


Figure 10. Propagation Delay Time vs. IF

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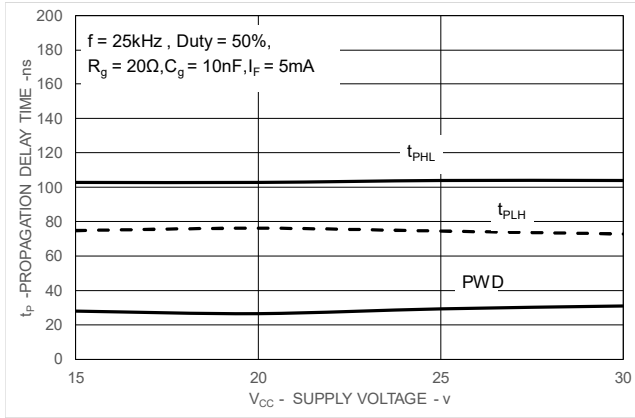


Figure 11. Propagation Delay Time vs. V<sub>cc</sub>

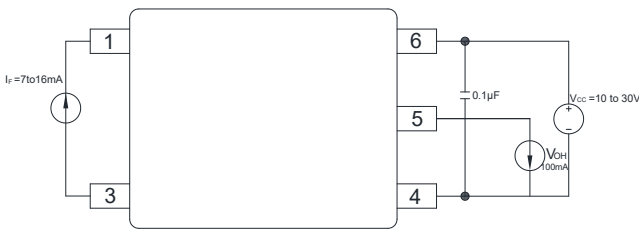


Figure 12 : V<sub>OH</sub> Test Circuit

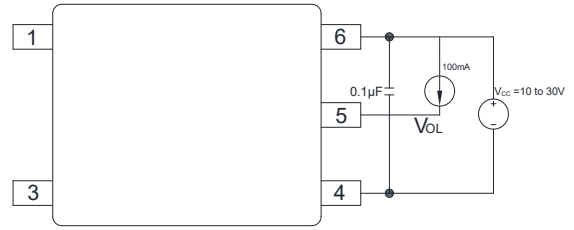


Figure 13 : V<sub>OL</sub> Test Circuit

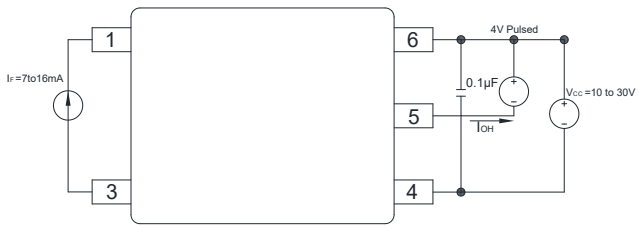


Figure 14 : I<sub>OH</sub> Test Circuit

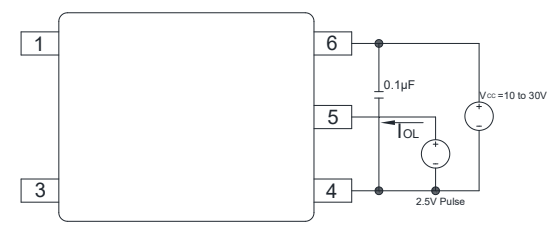


Figure 15 : I<sub>OL</sub> Test Circuit

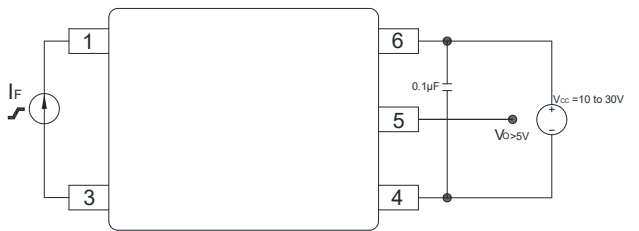


Figure 16 : I<sub>FLH</sub> Test Circuit

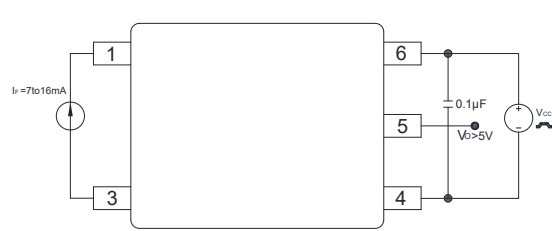


Figure 17 : U<sub>VLO</sub> Test Circuit

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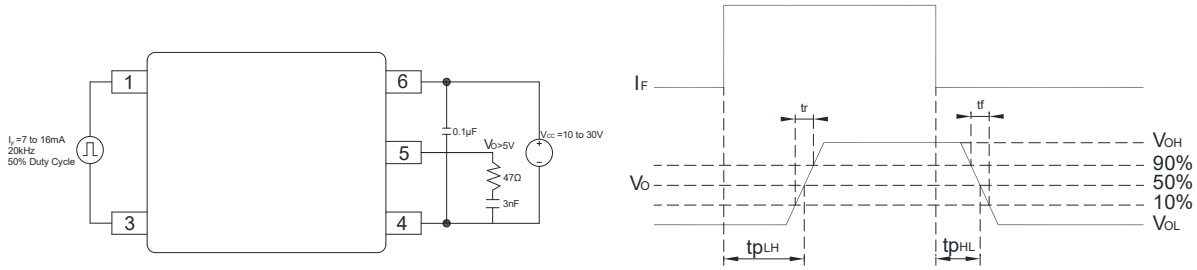


Figure 18 :  $t_r$ ,  $t_f$ ,  $t_{PLH}$  and  $t_{PHL}$  Test Circuit and Waveforms

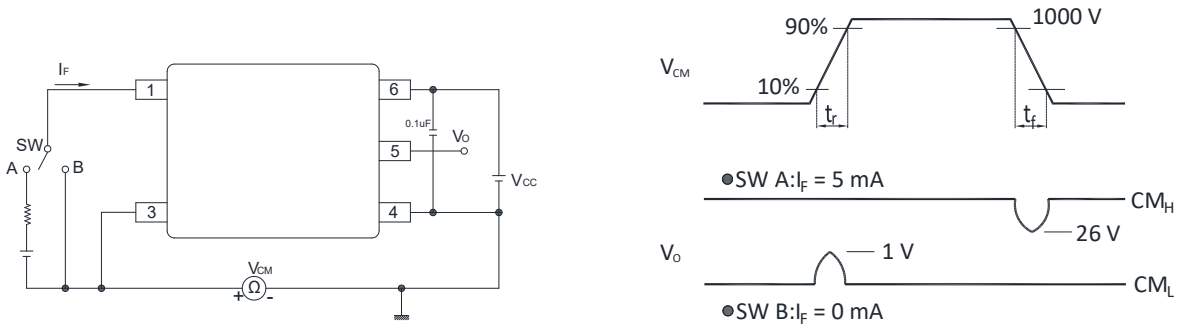


Figure 19 : CMR Test Circuit and Waveforms



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### 8. ISOLATION CHARACTERISTIC

| Parameter                   | Symbol    | Min. | Typ.      | Max. | Unit     | Test Condition               | Note |
|-----------------------------|-----------|------|-----------|------|----------|------------------------------|------|
| Withstand Insulation        | $V_{ISO}$ | 5000 | —         | —    | V        | $RH \leq 40\%-60\%$ ,        | 1, 2 |
| Input-Output<br>Resistance  | $R_{I-O}$ | —    | $10^{12}$ | —    | $\Omega$ | $V_{I-O} = 500V DC$          | 1    |
| Input-Output<br>Capacitance | $C_{I-O}$ | —    | 1         | —    | pF       | $f = 1MHz, T_A = 25^\circ C$ | 1    |

All Typical values at  $T_A = 25^\circ C$  unless otherwise specified. All minimum and maximum specifications are at recommended operating condition. (Refer to 5.2)

Note 1: Device is considered a two terminal device: pins 1, 2, 3 are shorted together and pins 4, 5, 6 are shorted together.

Note 2: According to UL1577, each photocoupler is tested by applying an insulation test voltage  $6000V_{RMS}$  for one second (leakage current less than  $10\mu A$ ). This test is performed before the 100% production test for partial discharge

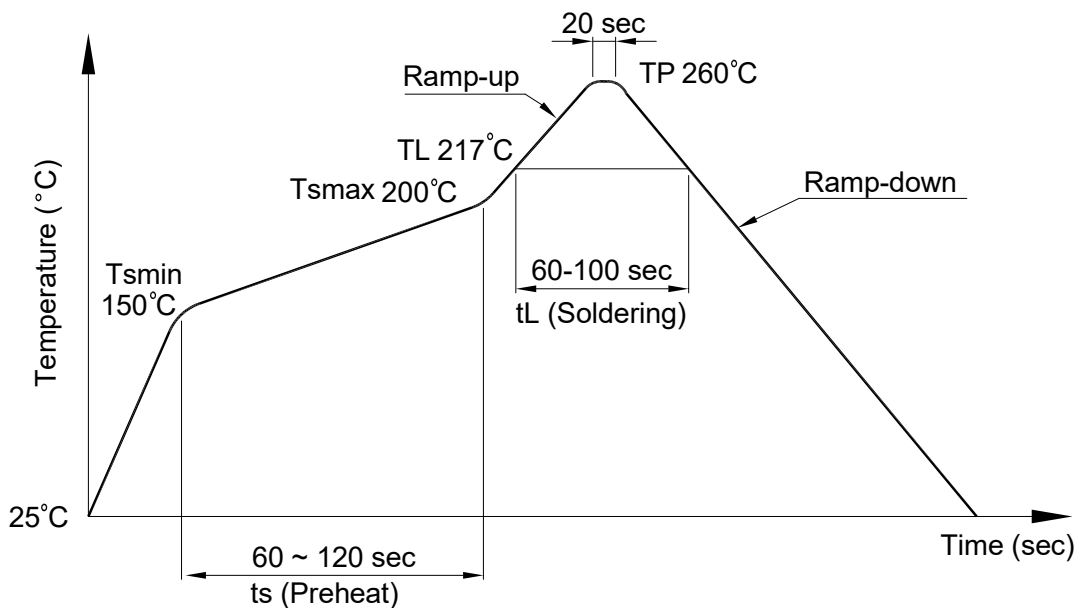
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### 8. TEMPERATURE PROFILE OF SOLDERING

#### 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) ( $t_s$ )    | 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    |



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### 8.2 Wave soldering (JEDEC22A111 compliant)

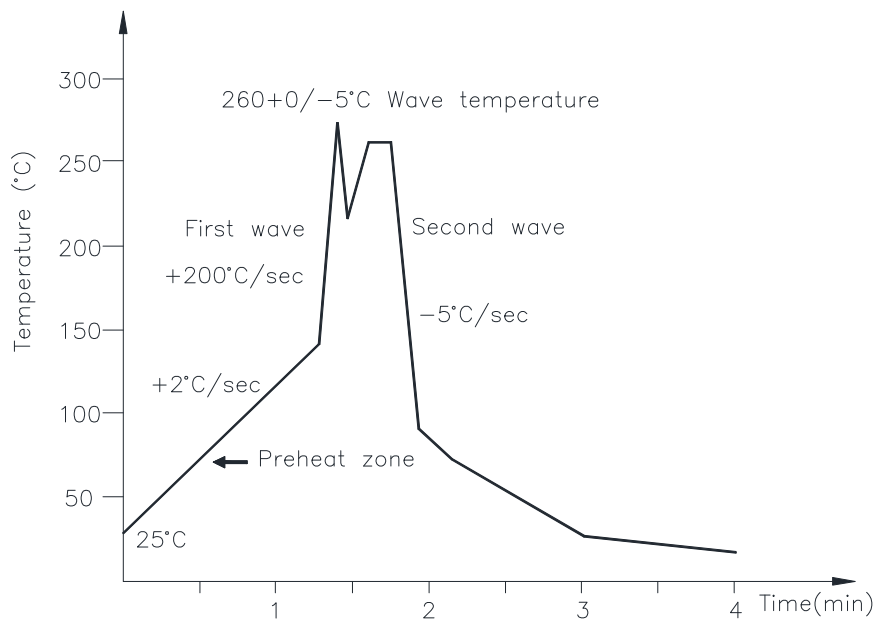
One time soldering is recommended within the condition of temperature.

Temperature:  $260+0/-5^{\circ}\text{C}$

Time: 10 sec.

Preheat temperature: 25 to  $140^{\circ}\text{C}$

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:  $380+0/-5^{\circ}\text{C}$

Time: 3 sec max.



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### 9. NAMING RULE

| Part Number | Lead Frame                   |                    | Suffix option |                         |                        |               | Quantity          |
|-------------|------------------------------|--------------------|---------------|-------------------------|------------------------|---------------|-------------------|
|             | Type                         | Clearance distance | Tape & Reel   | Pin 1 Location          | IEC/EN/DIN EN60747-5-5 | Customer Code |                   |
| LTV-5341    | Surface mount<br>S-loop type | Min. 8mm           | TP            | Lower right of the tape | -V                     | -             | 3000 pcs per reel |
| LTV-5341W   | Surface mount<br>W-loop type |                    | TP1           | Upper left of the tape  |                        |               |                   |

Example 1 : LTV-5341-TP1

Example 2 : LTV5341WTP1-V

\*Naming rule of VDE option : All "-" before -V be removed

### 10. Notes

- LiteOn is continually improving the quality, reliability, function or design and LiteOn reserves the right to make changes without further notices.
- The products shown in this publication are designed for the general use in electronic applications such as office automation equipment, communications devices, audio/visual equipment, electrical application and instrumentation.
- For equipment/devices where high reliability or safety is required, such as space applications, nuclear power control equipment, medical equipment, etc, please contact our sales representatives.
- When requiring a device for any "specific" application, please contact our sales in advice.
- If there are any questions about the contents of this publication, please contact us at your convenience.
- The contents described herein are subject to change without prior notice.
- Immerge unit's body in solder paste is not recommended.