

## PHOTOCOUPLER LTV-480 series

### LTV-480 series

### Positive Logic High CMR Intelligent Power Module and Gate Drive Interface Photocoupler

#### Description

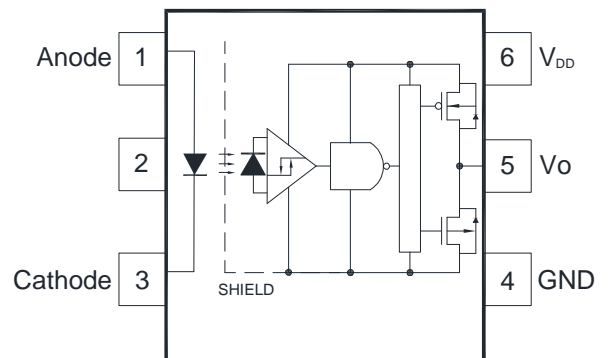
The LTV-480 series fast speed photocoupler contains a AlGaAs LED and photo detector with built-in Schmitt trigger to provide logic-compatible waveforms, eliminating the need for additional wave shaping. The totem pole output eliminates the need for a pull up resistor and allows for direct drive Intelligent Power Module or gate drive. Minimized propagation delay difference between devices makes these optocouplers excellent solutions for improving inverter efficiency through reduced switching dead time.

#### Features

- Positive output type (totem pole output)
- Truth Table Guaranteed:  $V_{CC}$  from 4.5V to 30V
- Performance Specified for Common IPM Applications Over Industrial Temperature Range.
- Short Maximum Propagation Delays
- Minimized Pulse Width Distortion (PWD)
- Very High Common Mode Rejection (CMR)
- Hysteresis
- Safety approval
  - UL 1577 recognized with 5000  $V_{RMS}$  for 1 minute for LTV-480P and LTV-480W
  - VDE DIN EN 60747-5-5 Approved  
 $V_{IORM} = 891V_{peak}$  for LTV-480P  
 $V_{IORM} = 1140V_{peak}$  for LTV-480W

#### Applications

- IPM Interface Isolation
- Isolated IGBT/MOSFET Gate Drive
- AC and Brushless DC Motor Drives
- Industrial Inverters
- General Digital Isolation



#### Specification

- Wide operating temperature range:  $-40^{\circ}C$  to  $105^{\circ}C$
- Maximum propagation delay  $t_{PLH} / t_{PHL} = 200/220$  ns
- Maximum Pulse Width Distortion (PWD) = 120 ns
- Propagation Delay Difference Min/Max =  $-210/210$  ns
- Wide Operating  $V_{CC}$  Range: 4.5 to 30Volts
- 20  $kV/\mu s$  minimum common mode rejection (CMR) at  $V_{CM} = 1500$  V

Truth Table

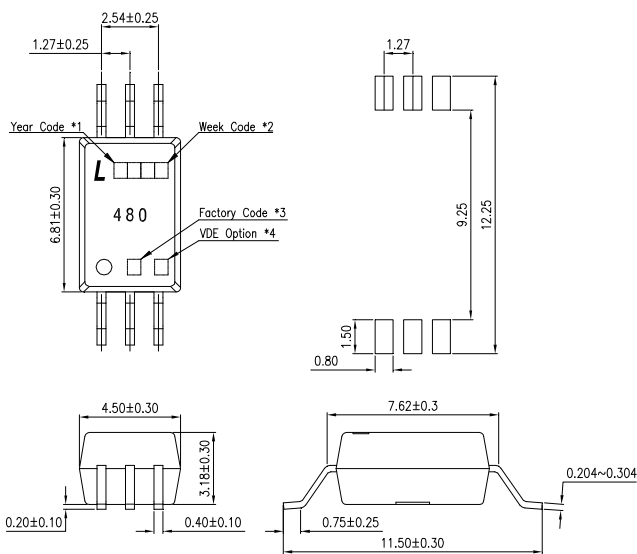
| LED | OUT |
|-----|-----|
| ON  | H   |
| OFF | L   |

A 0.1  $\mu F$  bypass Capacitor must be connected between Pin4 and Pin6

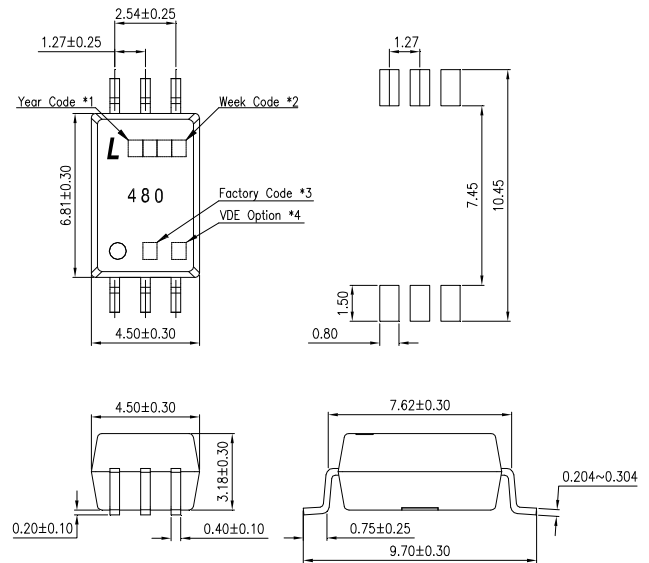
# PHOTOCOUPLER LTV-480 series

## 2. PACKAGE DIMENSIONS

### 2.1 LTV-480W



### 2.2 LTV-480P



#### Notes :

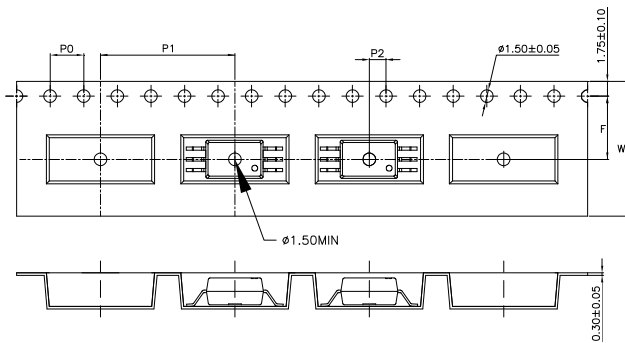
1. Year date code.
2. 2-digit work week.
3. Factory identification mark (Y : Thailand).
4. "4" or "V" for VDE option.

\* Dimensions are in Millimeters and (Inches).

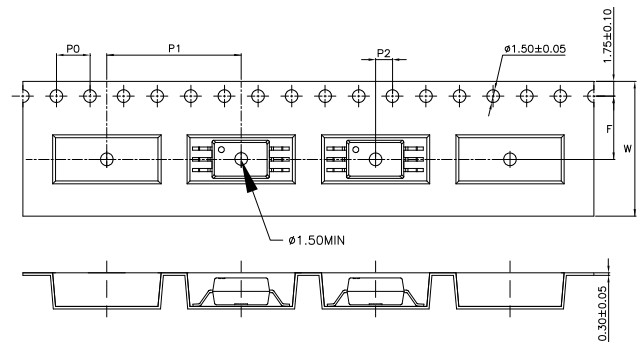
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## 3. TAPING DIMENSIONS

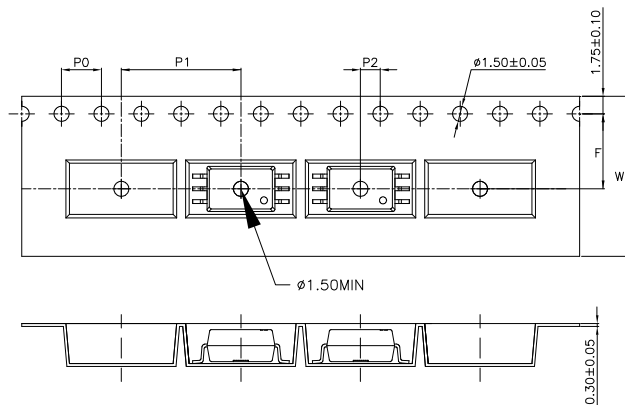
3.1 LTV-480W-TA



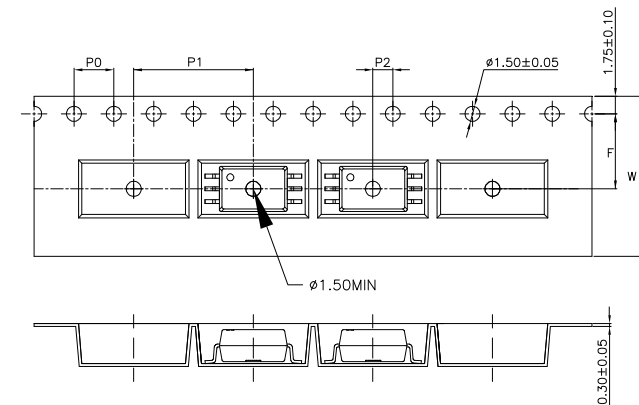
3.2 LTV-480W-TA1



3.3 LTV-480P-TA



3.4 LTV-480P-TA1



| Description                            | Symbol         | Dimension in mm (inch) |               |
|--|----------------|------------------------|---------------|
|  |                | For W type             | For P type    |
| Tape wide                              | W              | 16±0.3 (0.63)          | 16±0.3 (0.63) |
| Pitch of sprocket holes                | P <sub>0</sub> | 4±0.1 (0.16)           | 4±0.1 (0.16)  |
| Distance of compartment                | F              | 7.5±0.1 (0.3)          | 7.5±0.1 (0.3) |
|  | P <sub>2</sub> | 2±0.1 (0.079)          | 2±0.1 (0.079) |
| Distance of compartment to compartment | P <sub>1</sub> | 16±0.1 (0.63)          | 12±0.1 (0.47) |

### 3.5 Quantities Per Reel

| Package Type     | LTV-480 series |
|------------------|----------------|
| Quantities (pcs) | 1000           |

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### 4. RATING AND CHARACTERISTICS

#### 4.1 Absolute Maximum Ratings at Ta=25°C

|        | Parameter  | Symbol        | Rating     | Unit | Note |
|--------|--|---------------|------------|------|------|
| Input  | Average Forward Input Current                              | $I_F$         | 10         | mA   |      |
|        | Peak Transient Input Current<br>(<1us pulse width, 300pps) | $I_{F(tran)}$ | 1.0        | A    |      |
|        | Reverse Input Voltage                                      | $V_R$         | 5          | V    |      |
| Output | Output Collector Current                                   | $I_O$         | 50         | mA   |      |
|        | Output Collector Voltage                                   | $V_O$         | -0.5 ~ +35 | V    |      |
|        | Total Package Power Dissipation                            | $P_T$         | 145        | mW   |      |
|        | Supply Voltage   | $V_{CC}$      | 35         | V    |      |
|        | Operating Temperature                                      | $T_{opr}$     | -40 ~ +105 | °C   |      |
|        | Storage Temperature  | $T_{stg}$     | -55 ~ +125 | °C   |      |
|        | Lead Solder Temperature (10s)                              | $T_{sol}$     | 260        | °C   |      |

Note: A ceramic capacitor (0.1  $\mu$ 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.

#### 4.2 Recommended Operating Conditions

| Parameter                   | Symbol       | Min | Max | Unit | Note |
|-----------------------------|--------------|-----|-----|------|------|
| Operating Temperature       | $T_A$        | -40 | 105 | °C   |      |
| Supply Voltage              | $V_{CC}$     | 4.5 | 30  | V    | 1    |
| Forward Input Current (ON)  | $I_{F(ON)}$  | 1.6 | 5   | mA   | 2    |
| Forward Input Voltage (OFF) | $V_{F(OFF)}$ | -   | 0.8 | V    |      |

Note 1: Detector requires a  $V_{CC}$  of 4.5 V or higher for stable operation as output might be unstable if  $V_{CC}$  is lower than 4.5 V. Be sure to check the power ON/OFF operation other than the supply current.

Note 2: The initial switching threshold is 1.6 mA or less. It is recommended that 2.2 mA be used to permit at least a 20% LED degradation guard band.

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### 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           | 1.6  | V                          | $I_F = 5\text{mA}$   | 7      |      |
|                           | Input Forward Voltage Temperature Coefficient | $\Delta V_F / \Delta T$ |                  | -1.237         |      | $\text{mV}/^\circ\text{C}$ | $I_F = 5\text{mA}$   |        |      |
|                           | Input Reverse Voltage                         | $BV_R$                  | 5                |                |      | V                          | $I_R = 10\mu\text{A}$                                      |        |      |
|                           | Input Threshold Current (Low to High)         | $I_{FLH}$               |                  | 0.7            | 1.5  | mA                         |  | 5, 6   |      |
|                           | Input Threshold Voltage (High to Low)         | $V_{FHL}$               | 0.8              |                |      | V                          |  |        |      |
|                           | Input Capacitance                             | $C_{IN}$                |                  | 33             |      | pF                         | $f = 1\text{MHz}, V_F = 0\text{V}$                         |        | 2    |
| Output                    | High Level Supply Current                     | $I_{CCH}$               |                  |                | 3.0  | mA                         | $V_{CC} = 5.5\text{V}, I_F = 5\text{mA}, I_O = 0\text{mA}$ |        |      |
|                           |   |                         |                  | 1.9            | 3.0  | mA                         | $V_{CC} = 30\text{V}, I_F = 5\text{mA}, I_O = 0\text{mA}$  |        |      |
|                           | Low Level Supply Current                      | $I_{CCL}$               |                  |                | 3.0  | mA                         | $V_{CC} = 5.5\text{V}, V_F = 0\text{V}, I_O = 0\text{mA}$  |        |      |
|                           |   |                         |                  | 2.0            | 3.0  | mA                         | $V_{CC} = 30\text{V}, V_F = 0\text{V}, I_O = 0\text{mA}$   |        |      |
|                           | High level output current                     | $I_{OSH}$               |                  |                | -160 | mA                         | $V_{CC} = 5.5\text{V}, I_F = 5\text{mA}, V_O = \text{GND}$ |        | 1    |
|                           |   |                         |                  |                | -200 |                            | $V_{CC} = 20\text{V}, I_F = 5\text{mA}, V_O = \text{GND}$  |        |      |
|                           | Low level output current                      | $I_{OSL}$               | 160              |                |      | mA                         | $V_O = V_{CC} = 5.5\text{V}, V_F = 0\text{V}$              |        | 1    |
|                           |   |                         | 200              |                |      |                            | $V_O = V_{CC} = 20\text{V}, V_F = 0\text{V}$               |        |      |
| High level output voltage | $V_{OH}$                                      | $V_{CC} - 0.5$          | $V_{CC} - 0.025$ |                |      | V                          | $I_{OL} = -6.5\text{mA}$                                   | 4,8    |      |
| Low level output voltage  | $V_{OL}$                                      |                         | $V_{EE} + 0.015$ | $V_{EE} + 0.5$ |      | V                          | $I_{OL} = 6.5\text{mA}$                                    | 3      |      |

Specified over recommended temperature ( $T_A = -40^\circ\text{C}$  to  $+105^\circ\text{C}$ ,  $+4.5\text{V} \leq V_{CC} \leq 30\text{V}$ ),  $I_{F(ON)} = 1.6\text{mA}$  to  $5\text{mA}$ ,  $V_{F(OFF)} = 0\text{V}$  to  $0.8\text{V}$ , unless otherwise specified. All typicals at  $T_A = 25^\circ\text{C}$ .

Note 1: Duration of output short circuit time should not exceed 500  $\mu\text{s}$ .

Note 2: Input capacitance is measured between pin 1 and pin 3.

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### 5. SWITCHING SPECIFICATION

| Parameter  | Symbol    | Min. | Typ. | Max. | Unit              | Test Condition  | Figure          | Note |  |
|--|-----------|------|------|------|-------------------|---|-----------------|------|--|
| Propagation Delay Time to High Output Level                    | $t_{PHL}$ |      | 120  | 200  | ns                | $C_L = 100\text{pF}$ ,<br>$V_F = 0\text{V} \rightarrow I_{F(ON)} = 1.6\text{mA}$                          | 1, 9, 10,<br>11 | 1    |  |
| Propagation Delay Time to Low Output Level                     | $t_{PLH}$ |      | 130  | 220  |                   | $C_L = 100\text{pF}$ ,<br>$I_{F(ON)} = 1.6\text{mA} \rightarrow V_F = 0\text{V}$                          |                 | 1    |  |
| Pulse Width Distortion   | PWD       |      |      | 120  |                   | $C_L = 100\text{pF}$ ,  |                 | 2    |  |
| Propagation delay difference between any two parts or channels | PDD       | -210 |      | 210  |                   | $C_L = 100\text{pF}$ ,  |                 | 3    |  |
| Output Rise Time (10 to 90%)                                   | $T_r$     |      | 35   |      |                   |   |                 | 1    |  |
| Output Fall Time (90 to 10%)                                   | $T_f$     |      | 35   |      |                   |   |                 |      |  |
| Common mode transient immunity at high level output            | $ CM_H $  | 20   |      |      | kV/ $\mu\text{s}$ | $T_A = 25^\circ\text{C}$ ,<br>$I_F = 4.0\text{mA}$ ,<br>$V_{CM} = 1500\text{V}$ ,<br>$V_{CC} = 5\text{V}$ | 2               | 4    |  |
| Common mode transient immunity at low level output             | $ CM_L $  | 20   |      |      | kV/ $\mu\text{s}$ | $T_A = 25^\circ\text{C}$ ,<br>$V_F = 0\text{V}$ ,<br>$V_{CM} = 1500\text{V}$ ,<br>$V_{CC} = 5\text{V}$    |                 |      |  |

Over recommended operating conditions  $T_A = -40^\circ\text{C}$  to  $105^\circ\text{C}$ ,  $V_{CC} = +4.5\text{V}$  to  $30\text{V}$ ,  $I_{F(ON)} = 1.6\text{mA}$  to  $5\text{mA}$ ,  $V_{F(OFF)} = 0\text{V}$  to  $0.8\text{V}$ , unless otherwise specified. All typicals at  $T_A = 25^\circ\text{C}$ .

Note 1: The  $t_{PLH}$  propagation delay is measured from the 50% point on the leading edge of the input pulse to the 1.3 V point on the leading edge of the output pulse. The  $t_{PHL}$  propagation delay is measured from the 50% point on the trailing edge of the input pulse to the 1.3 V point on the trailing edge of the output pulse.

Note 2: Pulse Width Distortion (PWD) is defined as  $|t_{PHL} - t_{PLH}|$  for any given device.

Note 3: The difference of  $t_{PLH}$  and  $t_{PHL}$  between any two devices under the same test condition.

Note 4:  $CM_H$  is the maximum slew rate of the common mode voltage that can be sustained with the output voltage in the logic high state,  $V_O > 2.0\text{V}$ .  $CM_L$  is the maximum slew rate of the common mode voltage that can be sustained with the output voltage in the logic low state,  $V_O < 0.8\text{V}$ . Note: Equal value split resistors ( $R_{in}/2$ ) must be used at both ends of the LED.

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**6. ISOLATION CHARACTERISTIC**

| Parameter                         | Symbol    | Min. | Typ.      | Max. | Unit      | Test Condition   | Note |
|-----------------------------------|-----------|------|-----------|------|-----------|--|------|
| Withstand Insulation Test Voltage | $V_{ISO}$ | 5000 | —         | —    | $V_{RMS}$ | $RH \leq 50\%$ , $t = 1\text{min}$ ,<br>$T_A = 25^\circ\text{C}$ | 1, 2 |
| Input-Output Resistance           | $R_{I-O}$ | —    | $10^{12}$ | —    | $\Omega$  | $V_{I-O} = 500\text{V DC}$                                       | 1    |
| Input-Output Capacitance          | $C_{I-O}$ | —    | 1.0       | —    | p         | $f = 1\text{MHz}$ , $T_A = 25^\circ\text{C}$                     | 1    |

Specified over recommended temperature ( $T_A = -40^\circ\text{C}$  to  $+105^\circ\text{C}$ ) unless otherwise specified. Typical values applies to  $T_A = 25^\circ$

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

Note 2: In accordance with UL 1577, each optocoupler is proof tested by applying an insulation test voltage  $\geq 6000 V_{RMS}$  for one second (leakage detection current limit, I-I-O  $\leq 10 \mu\text{A}$ ). This test is performed before the 100% production test.

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## 7. TEST CIRCUIT

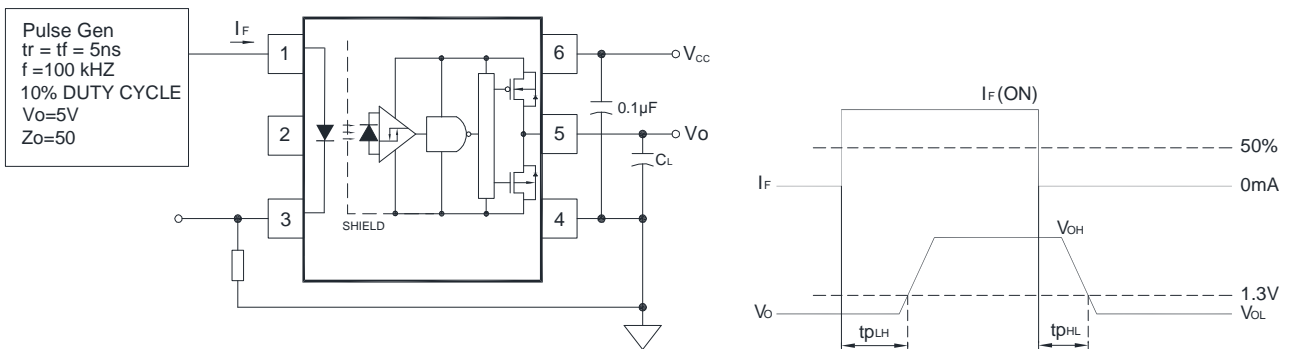
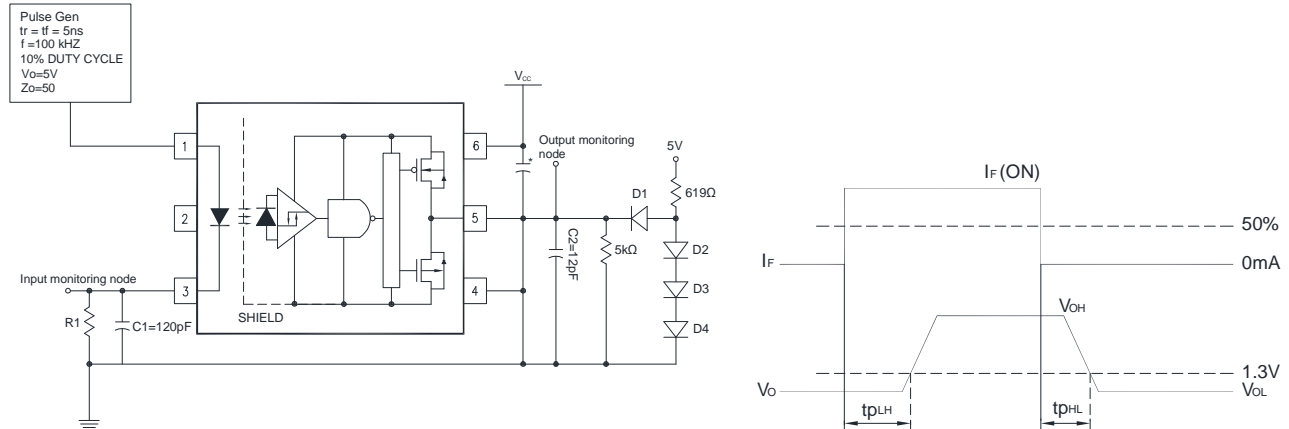


Figure 1 :  $t_r$ ,  $t_f$ ,  $t_{PLH}$  and  $t_{PHL}$  Test Circuit and Waveforms

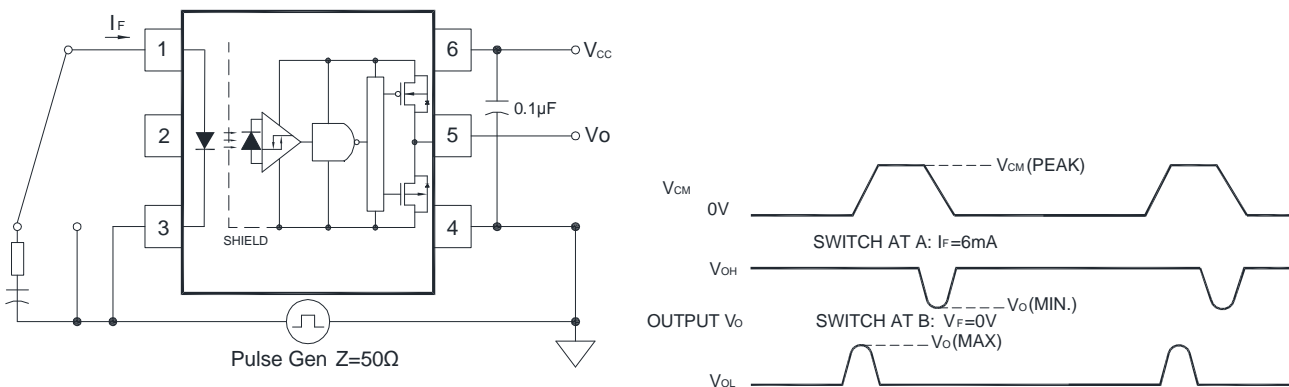


Figure 2 : CMR Test Circuit and Waveforms



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**8. TYPICAL PERFORMANCE CURVES**

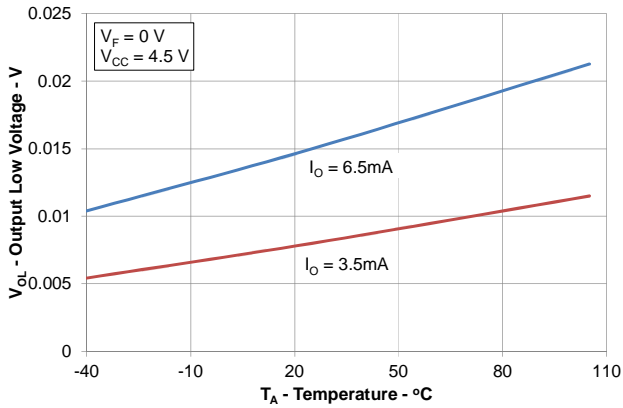


Figure 3: V<sub>OL</sub> vs. Temperature

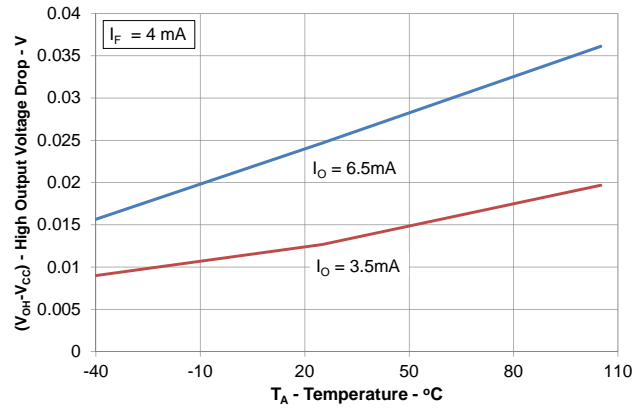


Figure 4: V<sub>OH</sub> - V<sub>CC</sub> vs. Temperature

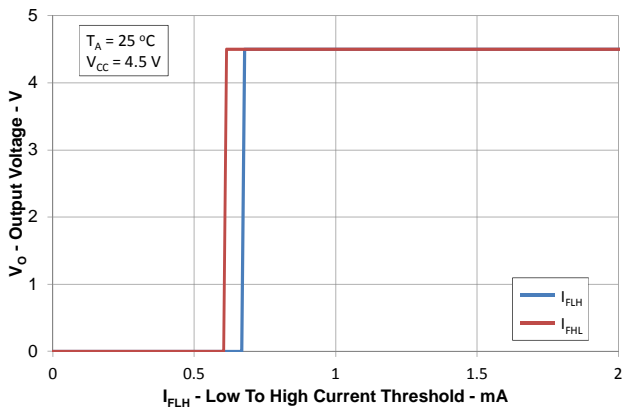


Figure 5: I<sub>FLH</sub> Hysteresis

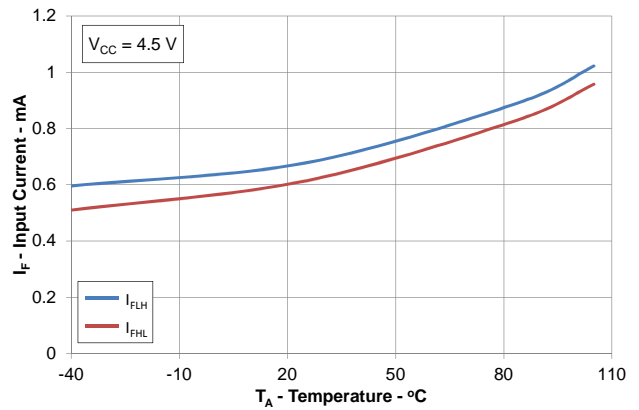


Figure 6: I<sub>FLH</sub> vs. Temperature

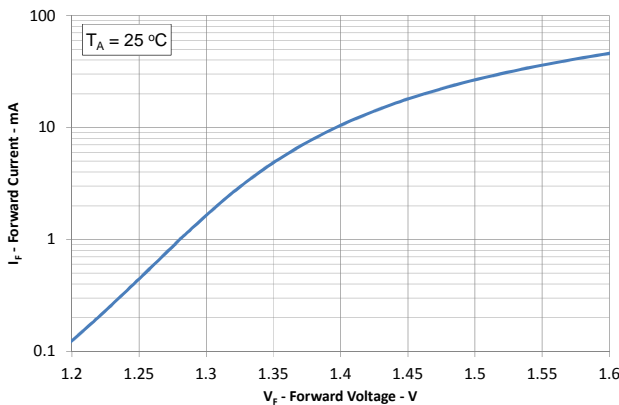


Figure 7: Input Current vs. Forward Voltage

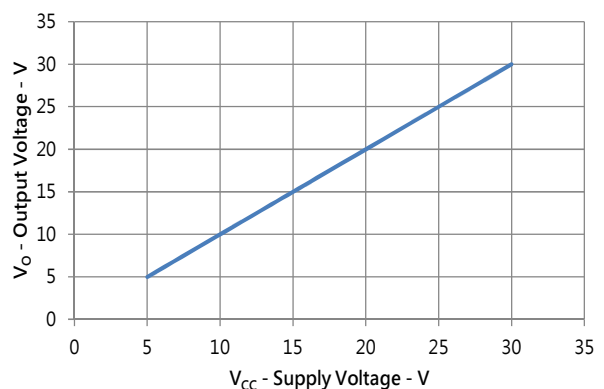


Figure 8: Input Current vs. Forward Voltage

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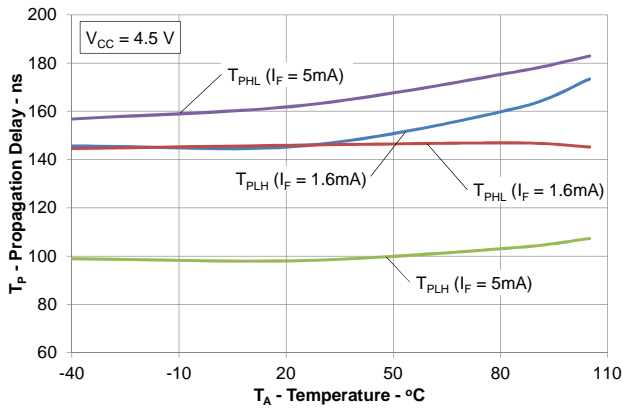


Figure 9: Propagation Delays vs. Temperature

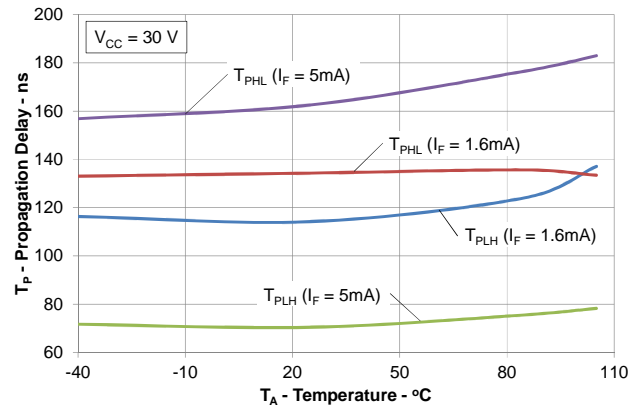


Figure 10: Propagation Delays vs. Temperature

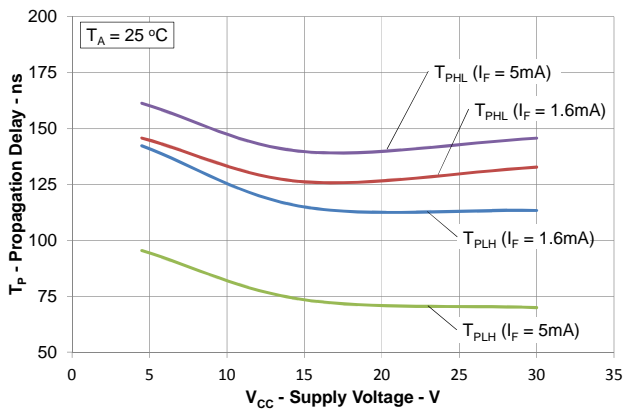


Figure 11: Propagation Delays vs.  $V_{CC}$

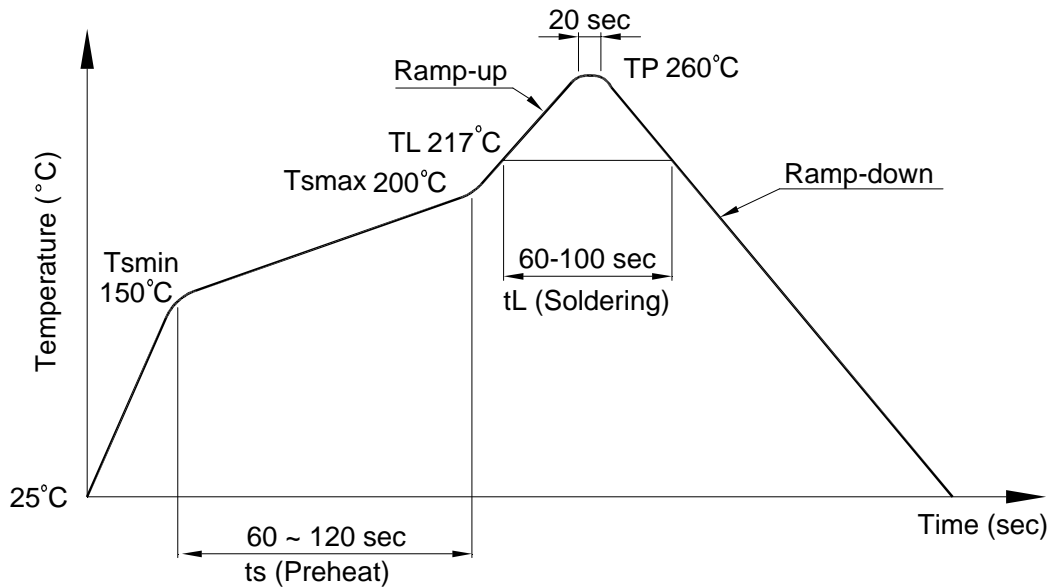
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**9. TEMPERATURE PROFILE OF SOLDERING**

**9.1 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 ~ 100sec    |
| Peak Temperature ( $T_P$ )       | 260°C          |
| Ramp-up rate                     | 3°C / sec max. |
| Ramp-down rate                   | 3~6°C / sec    |



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**9.2 Wave soldering (JEDEC22A111 compliant)**

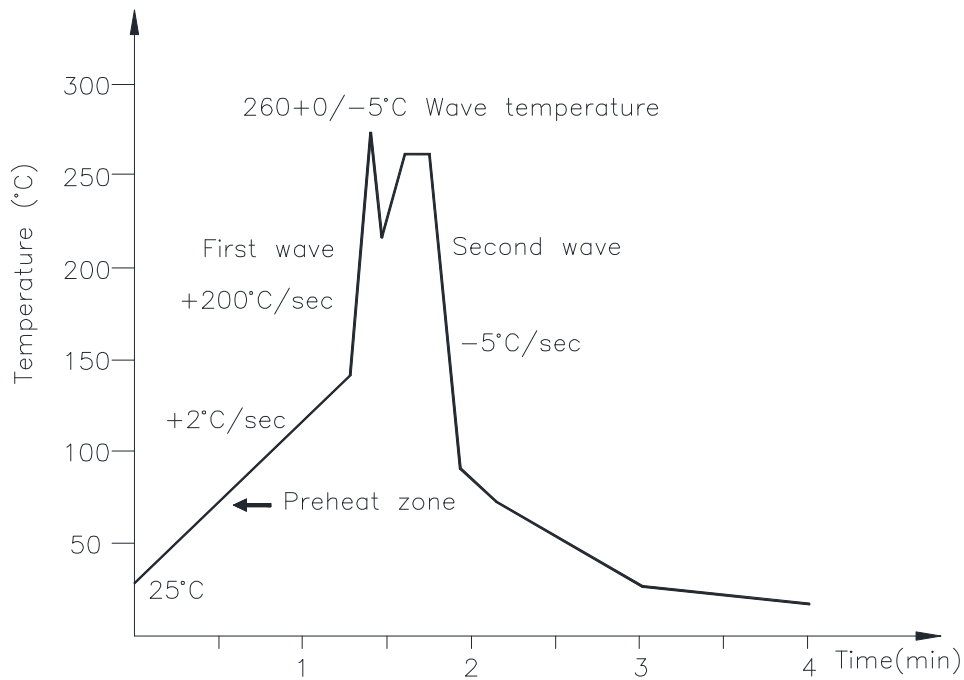
One time soldering is recommended within the condition of temperature.

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

Time: 10 sec.

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

Preheat time: 30 to 80 sec.



**9.3 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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**10. NAMING RULE**

| Part Number Options |
|---------------------|
| LTV-480P-TA         |
| LTV-480P-TA1        |
| LTV-480W-TA         |
| LTV-480W-TA1        |
| LTV480PTA-V         |
| LTV480PTA1-V        |
| LTV480WTA-V         |
| LTV480WTA1-V        |

| Definition of Suffix | Remark                                    |
|----------------------|---|
| "480"                | LiteOn model name                         |
| "P"                  | clearance distance 7mm typical            |
| "W"                  | clearance distance 8mm typical            |
| "TA"                 | Pin 1 location at lower right of the tape |
| "TA1"                | Pin 1 location at upper left of the tape  |
| "V"                  | VDE approved option                       |

**11. 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.
- Immerse unit's body in solder paste is not recommended.