# MPCS-314 Series

***LSOP6, DC Input, 1.0A Gate Driver Optocoupler***

## Description

The MPCS-314 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 LED optically coupled to an integrated circuit with a power output stage. The 1.0A peak output current is capable of directly driving most IGBTs with ratings up to 1200 V/50 A. For IGBTs with higher ratings, the MPCS-314 series can be used to drive a discrete power stage which drives the IGBT gate.

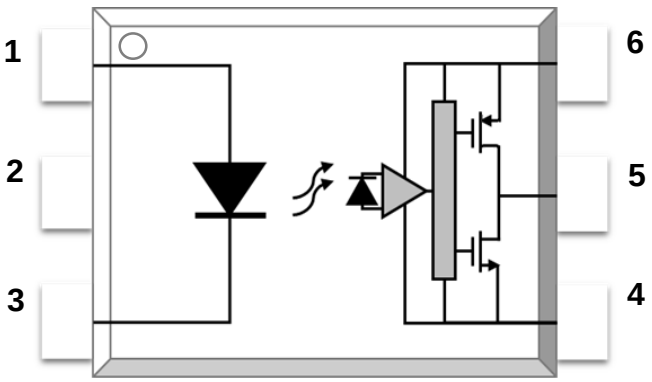
## Features

- 1.0 A maximum peak output current
- Rail-to-rail output voltage
- 110 ns maximum propagation delay
- Under Voltage Lock-Out protection (UVLO) with hysteresis
- Wide operating range: 10 to 30 Volts ($V_{CC}$)
- Guaranteed performance over temperature -40°C ~ +110°C.
- Regulatory Approvals
  - UL - UL1577
  - VDE - EN60747-5-5(VDE0884-5)
  - CQC – GB4943.1, GB8898

## Applications

- Isolated IGBT/Power MOSFET gate drive
- Industrial Inverter
- AC brushless and DC motor drives
- Induction Heating

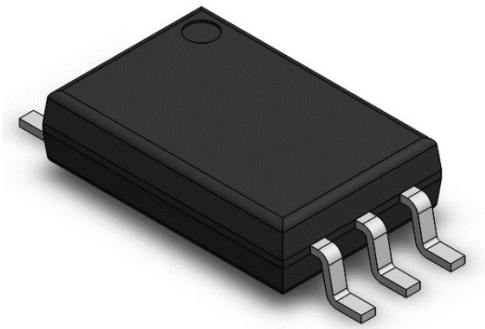
## SCHEMATIC

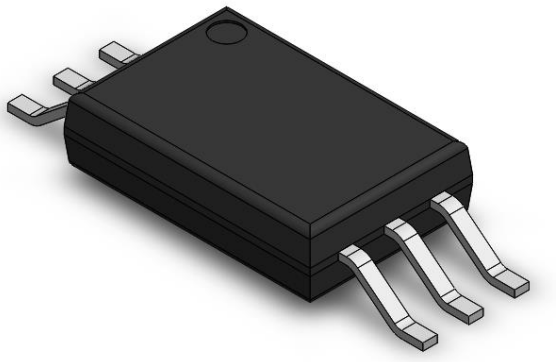



## PIN DEFINITION

| | |
|---|---|
| **1. Anode** | **6. $V_{CC}$** |
| **2. NC** | **5. $V_O$** |
| **3. Cathode** | **4. GND** |

## PACKAGE OUTLINE





## TRUTH TABLE

| LED | $V_{CC}$-$V_{SS}$ (Turn-ON, +ve going) | $V_{CC}$-$V_{SS}$ (Turn-OFF, -ve going) | VO |
|---|---|---|---|
| Off | 0V to 30V | 0V to 30V | Low |
| On | 0V to 6.9V | 0V to 5.9V | Low |
| On | 6.9V to 8.7V | 5.9V to 7.5V | Transition |
| On | 8.7V to 30V | 7.5V to 30V | High |

Note: A 0.1μF bypass capacitor must be connected between Pin 4 and 6.

## ABSOLUTE MAXIMUM RATINGS

| PARAMETER | SYMBOL | MIN. | MAX. | UNIT | NOTE |
|---|---|---|---|---|---|
| Storage Temperature | $T_{stg}$ | -55 | 125 | °C | - |
| Operating Temperature | $T_{opr}$ | -40 | 110 | °C | - |
| Output IC Junction Temperature | $T_J$ | - | 125 | °C | - |
| Total Output Supply Voltage | ($V_{CC}$ –$V_{SS}$) | 0 | 35 | V | - |
| Average Forward Input Current | $I_F$ | - | 20 | mA | - |
| Reverse Input Voltage | $V_R$ | - | 5 | V | - |
| “High” Peak Output Current | $I_{OH(PEAK)}$ | - | 1.0 | A | 1 |
| “Low” Peak Output Current | $I_{OL(PEAK)}$ | - | 1.0 | A | 1 |
| Output Voltage | $V_{O(PEAK)}$ | -0.5 | Vcc | V | - |
| Power Dissipation | $P_I$ | - | 45 | mW | - |
| Output IC Power Dissipation | $P_O$ | - | 250 | 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 1: Exponential waveform. Pulse width ≤ 10 μs, f ≤ 15 kHz

## RECOMMENDED OPERATION CONDITIONS

| PARAMETER | SYMBOL | MIN. | MAX. | UNIT |
|---|---|---|---|---|
| Operating Temperature | $T_A$ | -40 | 110 | °C |
| Supply Voltage | $V_{CC}$ | 10 | 30 | V |
| Input Current (ON) | $I_{F(ON)}$ | 5 | 16 | mA |
| Input Voltage (OFF) | $V_{F(OFF)}$ | -3.0 | 0.8 | V |

## ELECTRICAL OPTICAL CHARACTERISTICS

| PARAMETER | SYMBOL | MIN. | TYP. | MAX. | UNIT | TEST CONDITION | NOTE |
|---|---|---|---|---|---|---|---|
| INPUT CHARACTERISTICS | | | | | | | |
| Forward Voltage | $V_F$ | 1.6 | 1.9 | 2.4 | V | $I_F$= 10 mA | - |
| Input Forward Voltage Temperature Coefficient | $\Delta V_F / \Delta T$ | - | -1.237 | - | mV/°C | IF=10mA | - |
| Input Reverse Voltage | $BV_R$ | 5 | - | - | V | IR = 10μA | - |
| Input Threshold Current (Low to High) | $I_{FLH}$ | - | 0.6 | 2 | mA | $V_O$ > 5V, $I_O$ = 0A | - |
| Input Threshold Voltage (High to Low) | $V_{FHL}$ | 0.8 | - | - | V | VCC = 30 V, VO < 5V | - |
| Input Capacitance | $C_{IN}$ | - | 60 | - | pF | VF = 0, f = 1MHz | - |
| OUTPUT CHARACTERISTICS | | | | | | | |
| High Level Supply Current | $I_{CCH}$ | - | 1.55 | 3 | mA | $I_F$ = 10 mA, $V_{CC}$ = 30 V, $V_O$ = Open | - |
| Low Level Supply Current | $I_{CCL}$ | - | 1.92 | 3 | mA | $I_F$ = 0 mA, $V_{CC}$ = 30 V, $V_O$ = Open | - |
| High Level Output Voltage | $V_{OH}$ | 29.4 | 29.69 | - | V | $I_F$ = 10 mA, $I_O$ = -100 mA | 1,2 |
| Low Level Output Voltage | $V_{OL}$ | - | 0.17 | 0.4 | V | $I_F$ = 0 mA, $I_O$ = 100 mA | - |
| High Level Output Current | $I_{OH}$ | 1.0 | - | - | A | $I_F$ = 10 mA, $V_{CC}$ = 30V $V_O$ = $V_{CC}$ - 4 | 3 |
| Low Level Output Current | $I_{OL}$ | 1.0 | - | - | A | $I_F$ = 0 mA, $V_{CC}$ = 30V $V_O$ = $V_{SS}$ + 4 | 3 |
| Under Voltage Lockout Threshold | $V_{UVLO+}$ | 6.9 | 7.8 | 8.7 | V | $V_O$ > 5V, $I_F$ = 10 mA | - |
| | $V_{UVLO-}$ | 5.9 | 6.9 | 7.5 | V | $V_O$ < 5V, $I_F$ = 10 mA | - |

Note: All Typical values at $T_A$ = 25°C and $V_{CC}$ – $V_{SS}$ = 30 V, unless otherwise specified; all minimum and maximum specifications are at recommended operating condition.

Note 1: 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.

Note 2: Maximum pulse width = 1 ms.

Note 3: Maximum pulse width = 10 μs.

## SWITCHING SPECIFICATION

| PARAMETER | SYMBOL | MIN. | TYP. | MAX. | UNIT | TEST CONDITION | NOTE |
|---|---|---|---|---|---|---|---|
| SWITCHING CHARACTERISTICS | | | | | | | |
| Propagation Delay Time to Output Low Level | $t_{PHL}$ | - | 54 | 110 | ns | Rg = 47 Ω, Cg = 3 nF, f = 10kHz, Duty Cycle = 50%, $I_F$ = 10mA, $V_{CC}$ = 30V | - |
| Propagation Delay Time to Output High Level | $t_{PLH}$ | - | 69 | 110 | ns | | - |
| Pulse Width Distortion | $P_{WD}$ | - | 22 | 70 | ns | | - |
| Propagation Delay Difference Between Any Two Parts | $P_{DD}$ ($t_{PHL}$ - $t_{PLH}$) | -100 | - | +100 | ns | | - |
| Rise Time | $t_r$ | - | 35 | - | ns | | - |
| Fall Time | $t_f$ | - | 25 | - | ns | | - |
| Common Mode Transient Immunity at Logic High | $CM_H$ | 20 | 40 | - | kV/μs | $I_F$=7 to 16mA $V_{CC}$= 30V, $T_A$= 25 °C, $V_{CM}$= 1kV | 1,2 |
| Common Mode Transient Immunity at Logic Low | $CM_L$ | 20 | 40 | - | kV/μs | $I_F$=0mA $V_{CC}$= 30V, $T_A$= 25 °C, $V_{CM}$= 1kV | 1,3 |

Note: All Typical values at $T_A$ = 25°C and $V_{CC}$ – $V_{SS}$ = 30 V, unless otherwise specified; all minimum and maximum specifications are at recommended operating condition.

Note 1: Pin 2 needs to be connected to LED common.

Note 2: Common mode transient immunity in the high state is the maximum tolerable dVCM/dt of the common mode pulse, VCM, to assure that the output will remain in the high state (meaning VO > 10.0V).

Note 3: Common mode transient immunity in a low state is the maximum tolerable dVCM/dt of the common mode pulse, VCM, to assure that the output will remain in a low state (meaning VO < 1.0V).

## ISOLATION CHARACTERISTIC

| PARAMETER | SYMBOL | DEVICE | MIN. | TYP. | MAX. | UNIT | TEST CONDITION | NOTE |
|---|---|---|---|---|---|---|---|---|
| Withstand Insulation Test Voltage | $V_{ISO}$ | MPCS-314P | 5000 | - | - | V | RH ≤ 40%-60%, t = 1min, $T_A$ = 25 °C | 1,2 |
| | | MPCS-314W | | | | | | |
| Input-Output Resistance | $R_{I-O}$ | - | - | $10^{12}$ | - | Ω | $V_{I-O}$ = 500V DC | 1 |

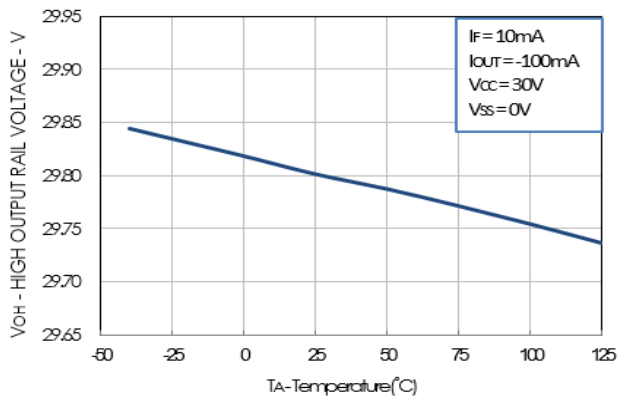
Note: All Typical values at $T_A$ = 25°C and $V_{CC}$ – $V_{SS}$ = 30 V, unless otherwise specified; all minimum and maximum specifications are at recommended operating condition.

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

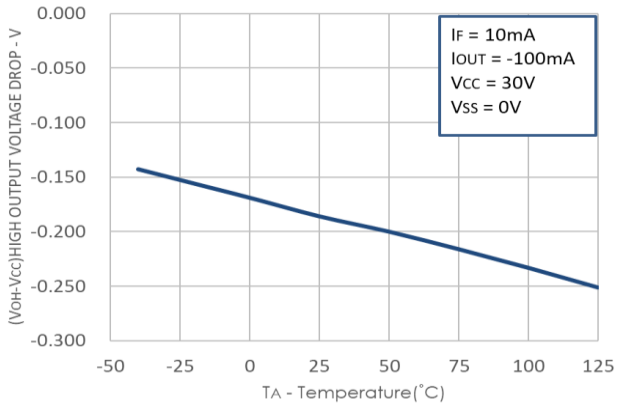
Note 2: According to UL1577, each photocoupler is tested by applying an insulation test voltage 6000VRMS for one second. This test is performed before the 100% production test for partial discharge.

## TYPICAL PERFORMANCE CURVES & TEST CIRCUITS

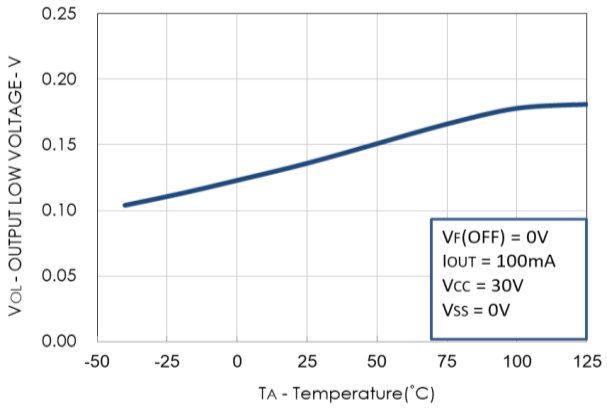
### Fig.1 High output rail voltage vs. Temperature



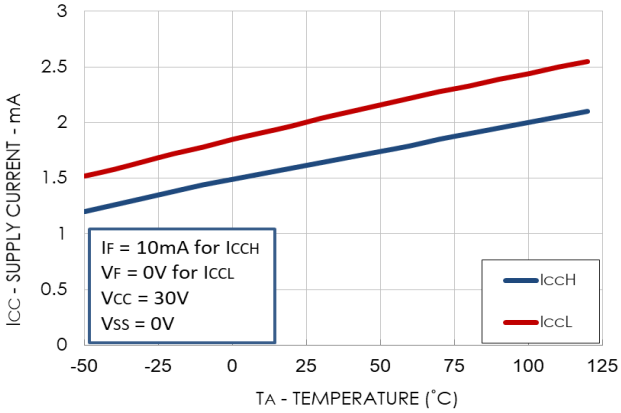

### Fig.2 $V_{OH}$ vs. Temperature



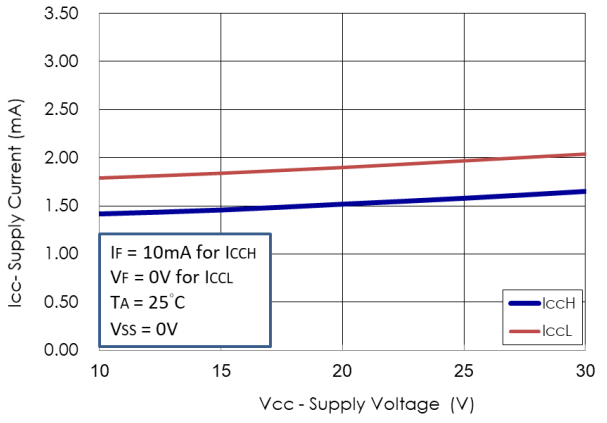

### Fig.3 $V_{OL}$ vs. Temperature




### Fig.4 $I_{CC}$ vs. Temperature




### Fig.5 $I_{CC}$ vs. $V_{CC}$




### Fig.6 $I_{FLH}$ vs. Hysteresis

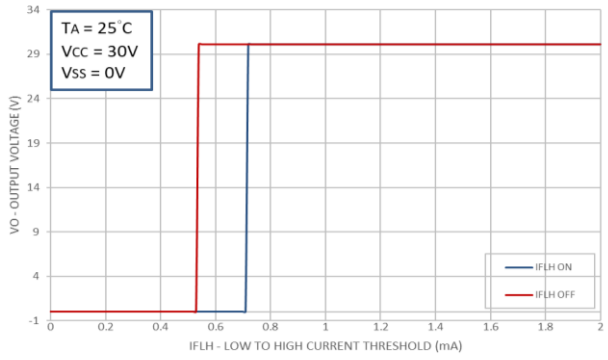


**Fig.7 $I_{FH}$ vs. Temperature**

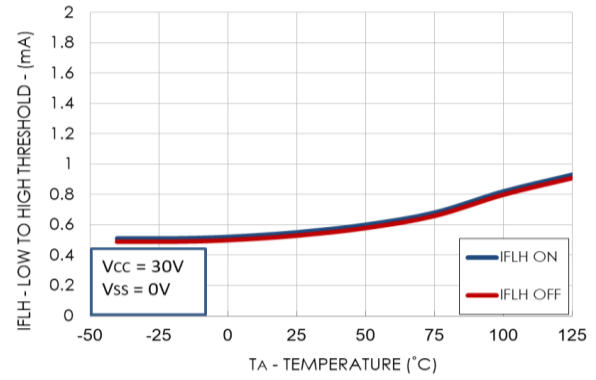



**Fig.8 Propagation Delays vs. $V_{CC}$**

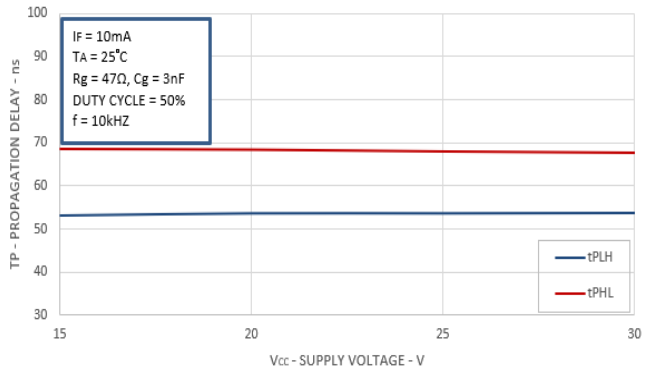



**Fig.9 Propagation Delays vs. $I_F$**

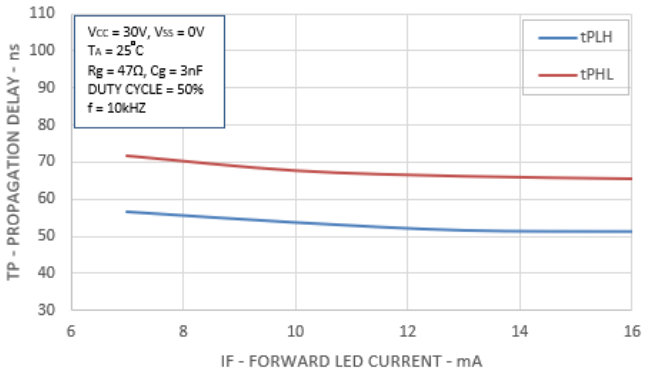



**Fig.10 Propagation Delays vs. Temperature**

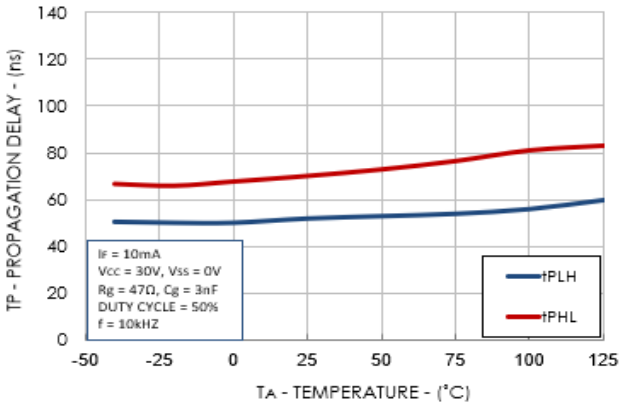



**Fig.11 Propagation Delays vs. Rg**

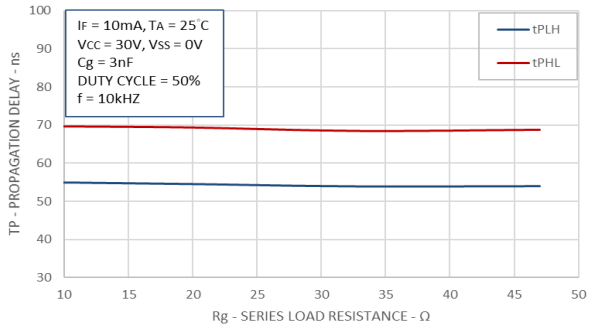



**Fig.12 Propagation Delays vs. Cg**

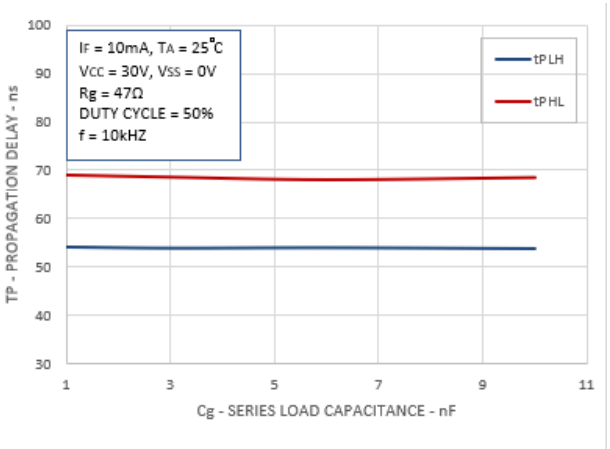


**Fig.13 Input Current vs. Forward Voltage**

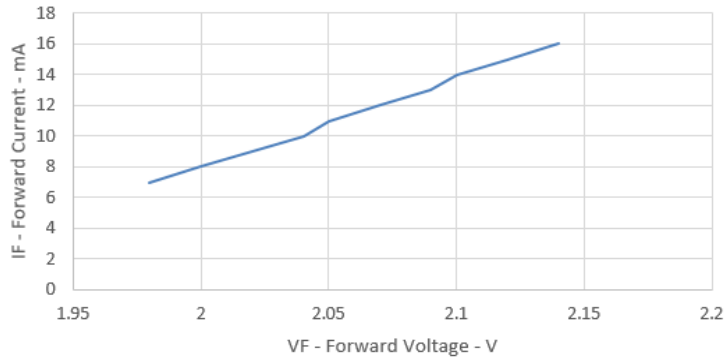



**Fig.14 $I_{OH}$ Test Circuit**

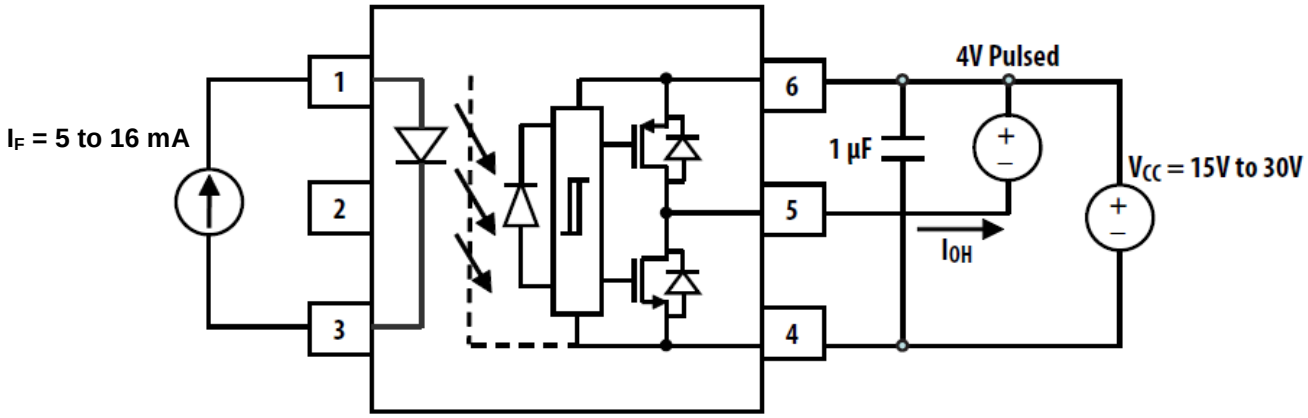



**Fig.15 $I_{OL}$ Test Circuit**

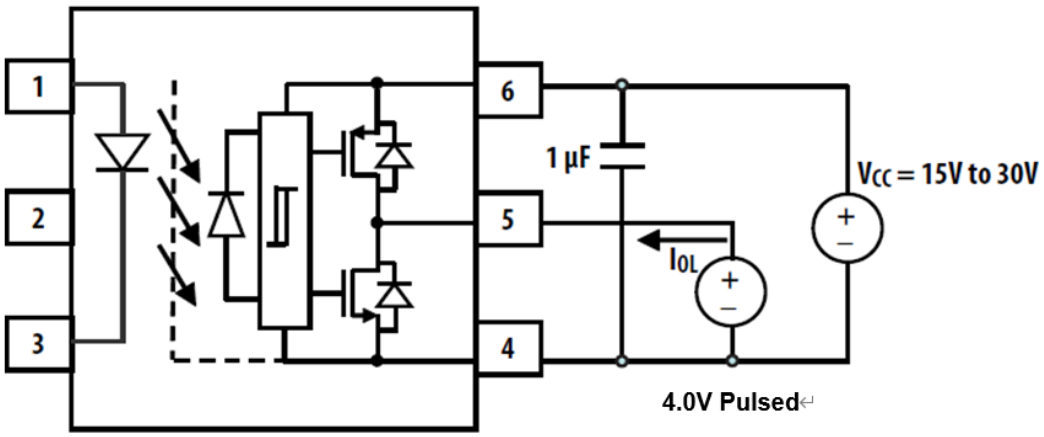


Fig.16 $V_{OH}$ Test Circuit

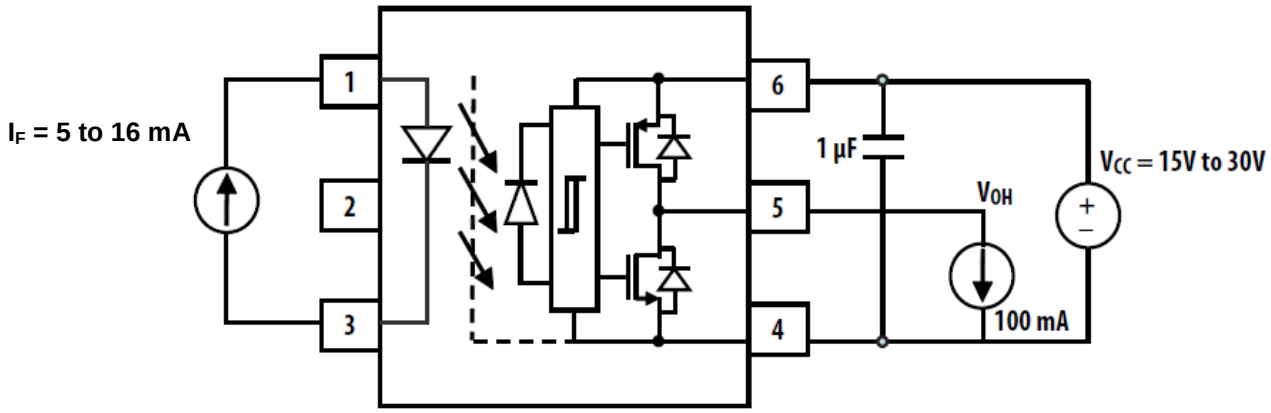



Fig.17 $V_{OL}$ Test Circuit

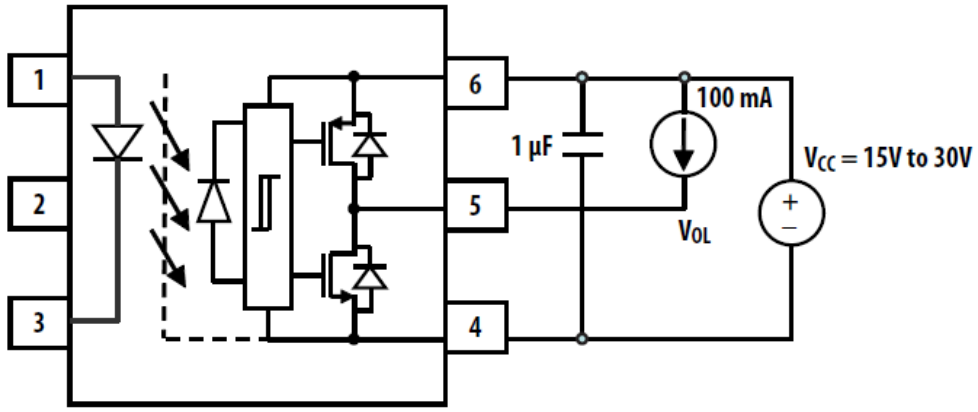



Fig.18 $I_{FLH}$ Test Circuit

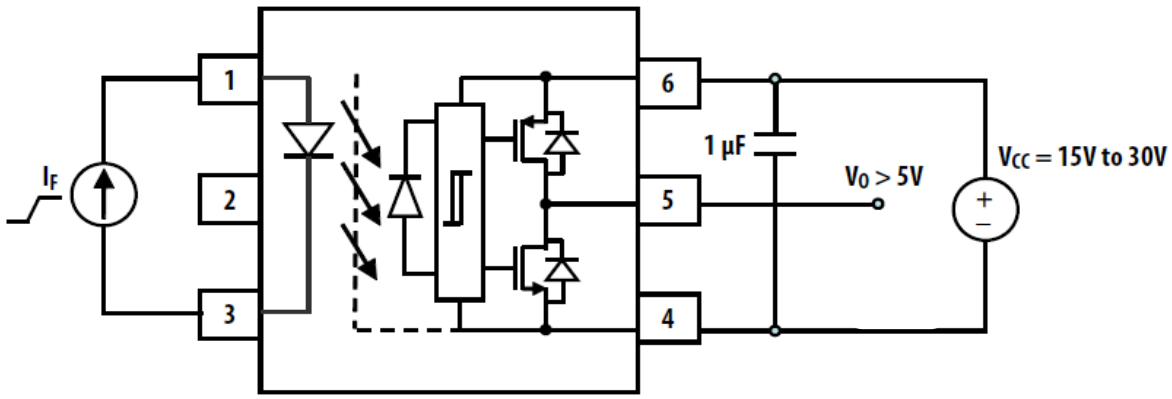


**Fig.19 $U_{VLO}$ Test Circuit**

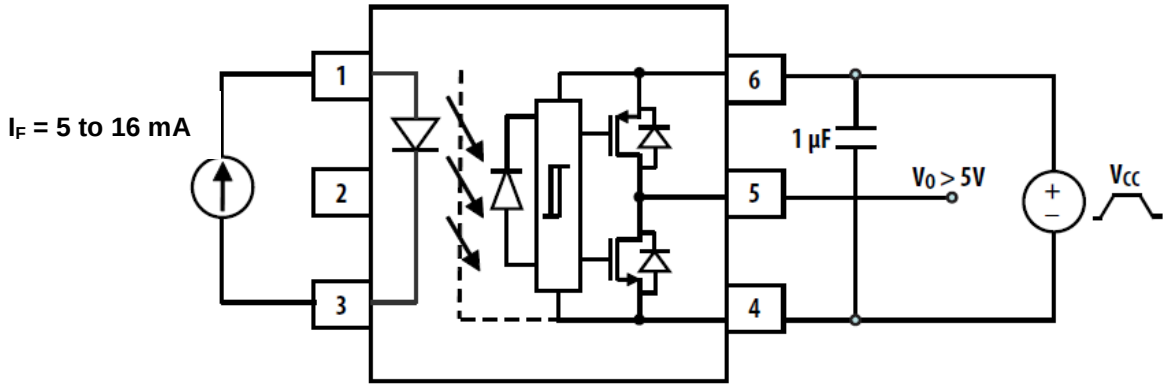



**Fig.20 $t_{PHL}$, $t_{PLH}$, $t_r$ and $t_f$ Test Circuit and Waveforms**

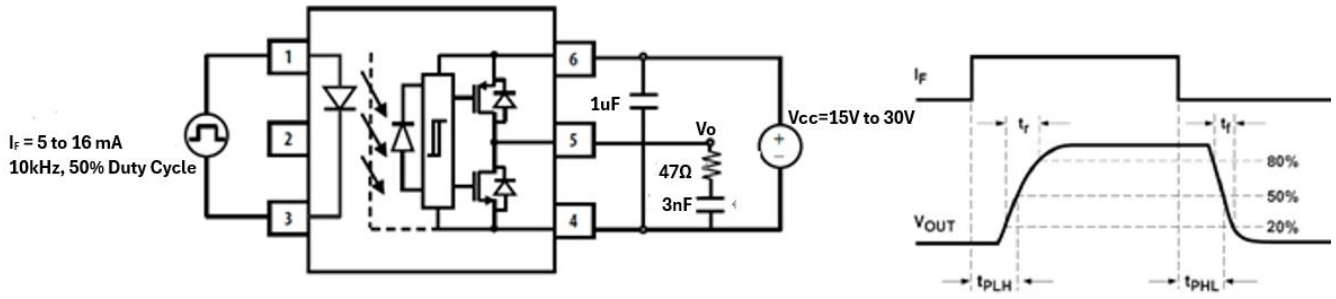
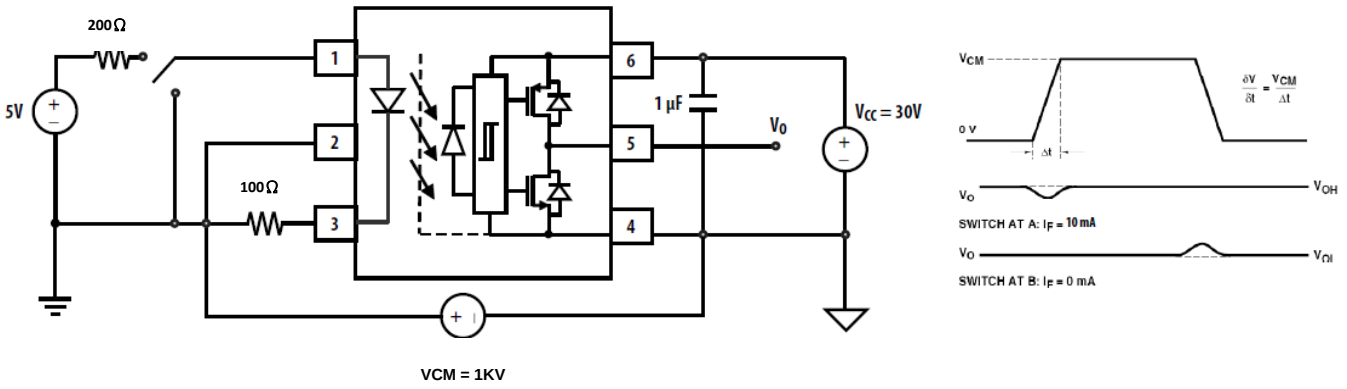
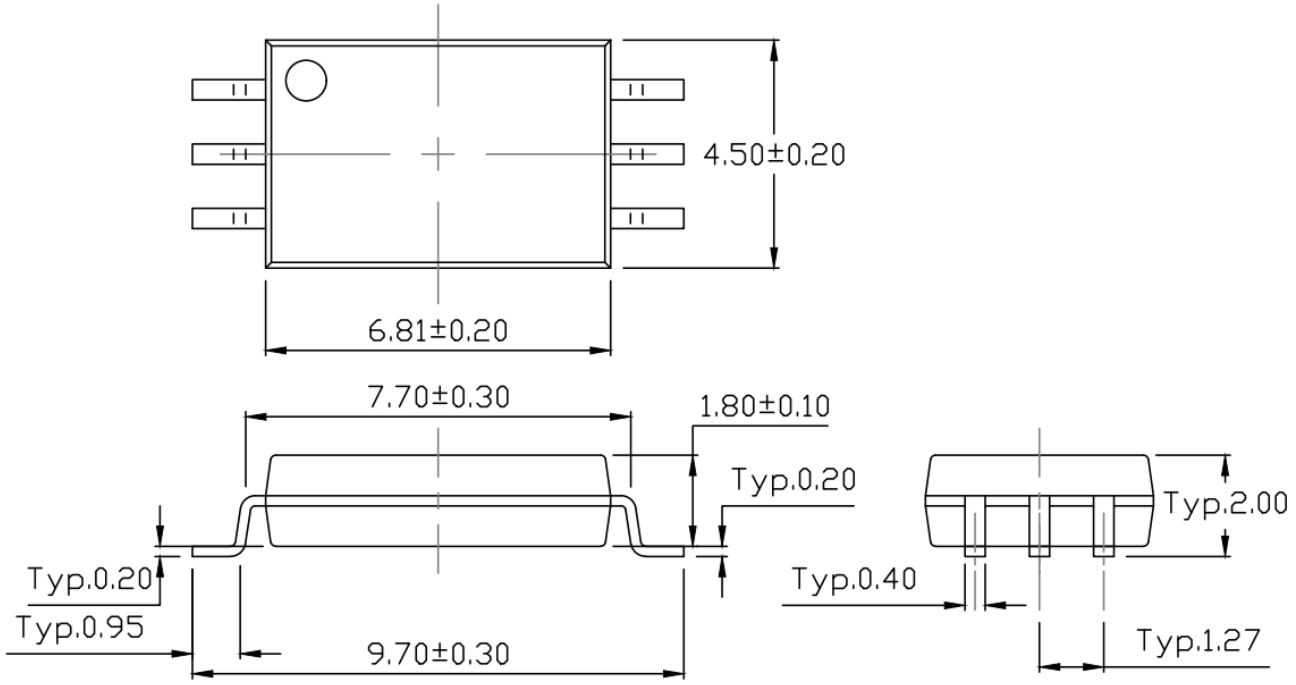



**Fig.21 CMR Test Circuit with Split Resistors Network and Waveforms**

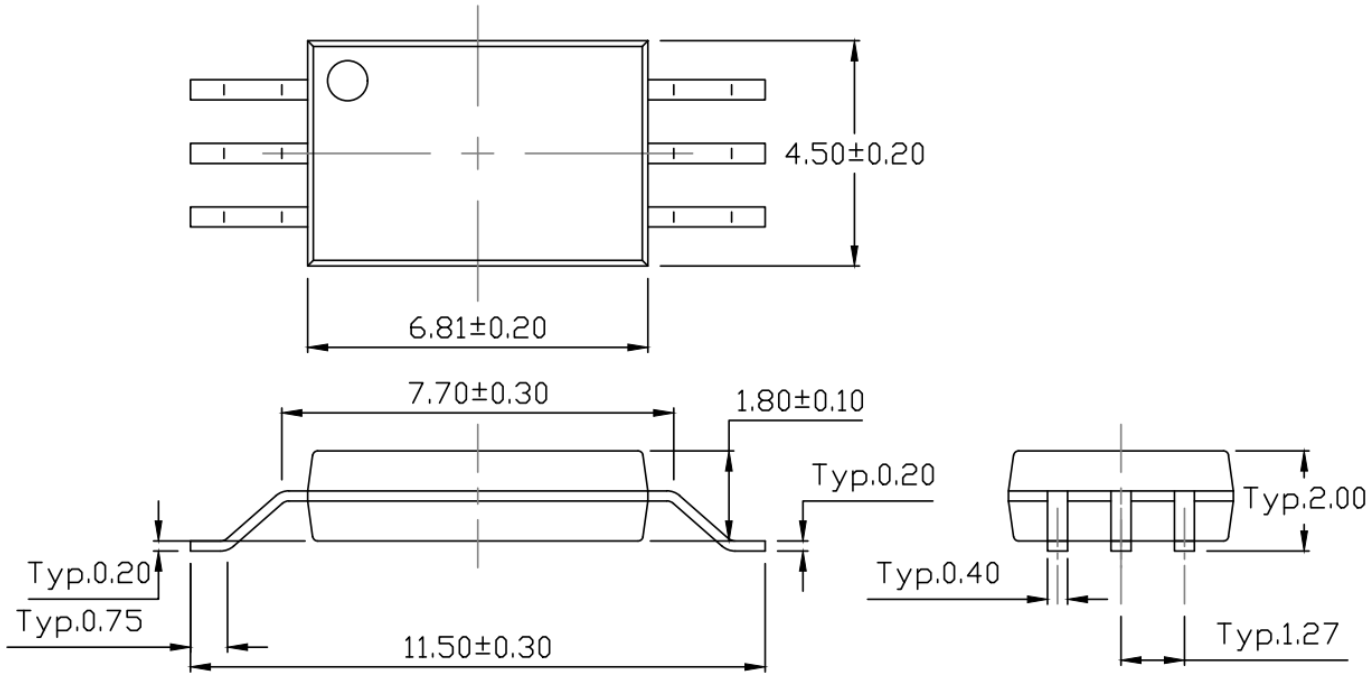


## PACKAGE DIMENSIONS (Dimensions in mm unless otherwise stated)

### Surface Mount Lead Forming (P Type)

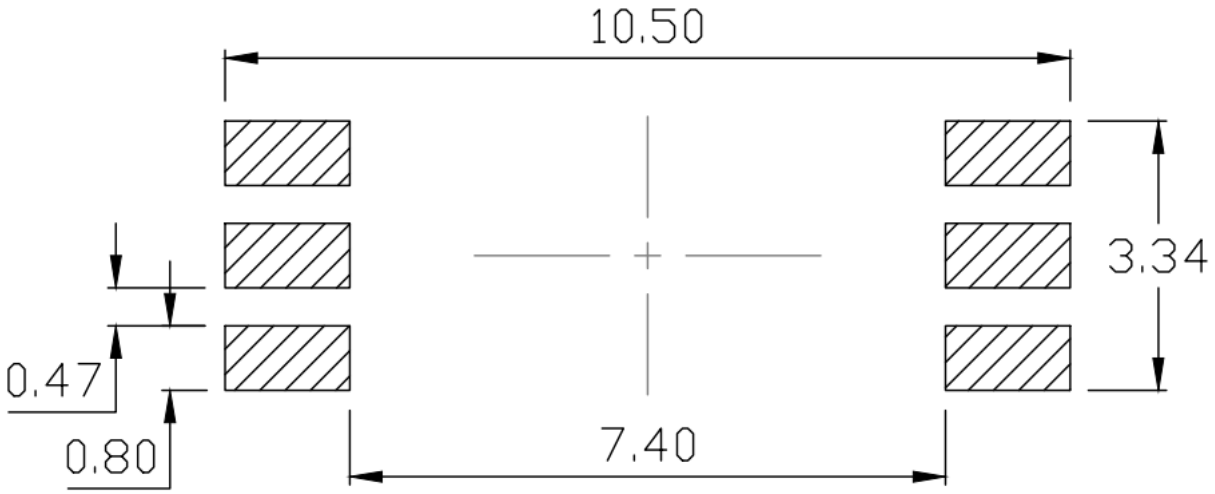



### Surface Mount (Gullwing) Lead Forming (W Type)

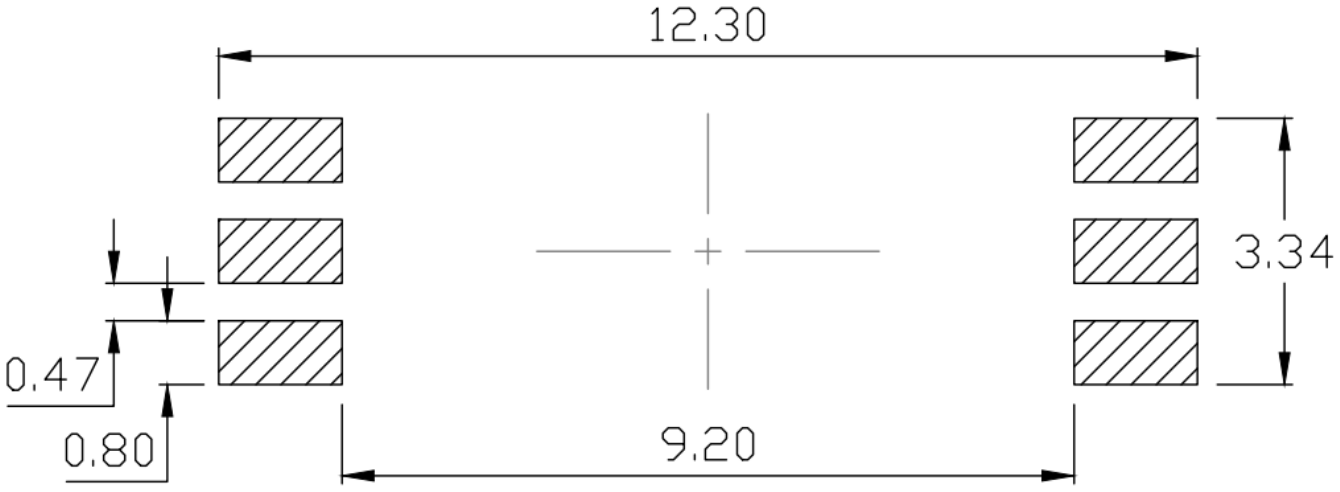


## RECOMMENDED SOLDER MASK (Dimensions in mm unless otherwise stated)

**Surface Mount Lead Forming (P Type)**

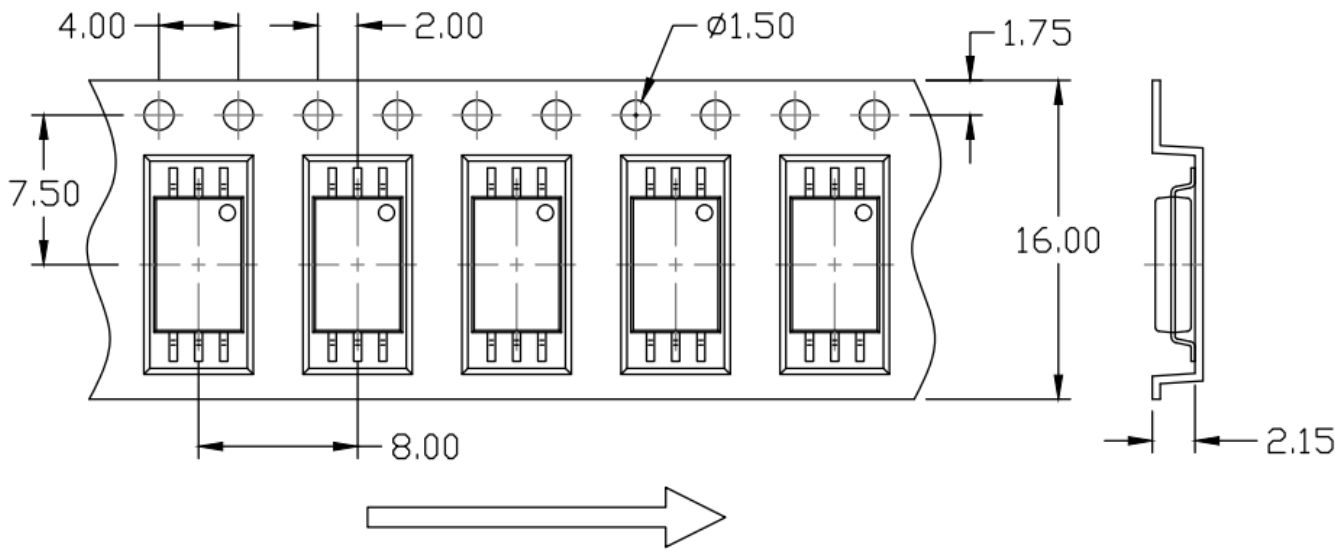



**Surface Mount (Gullwing) Lead Forming (W Type)**

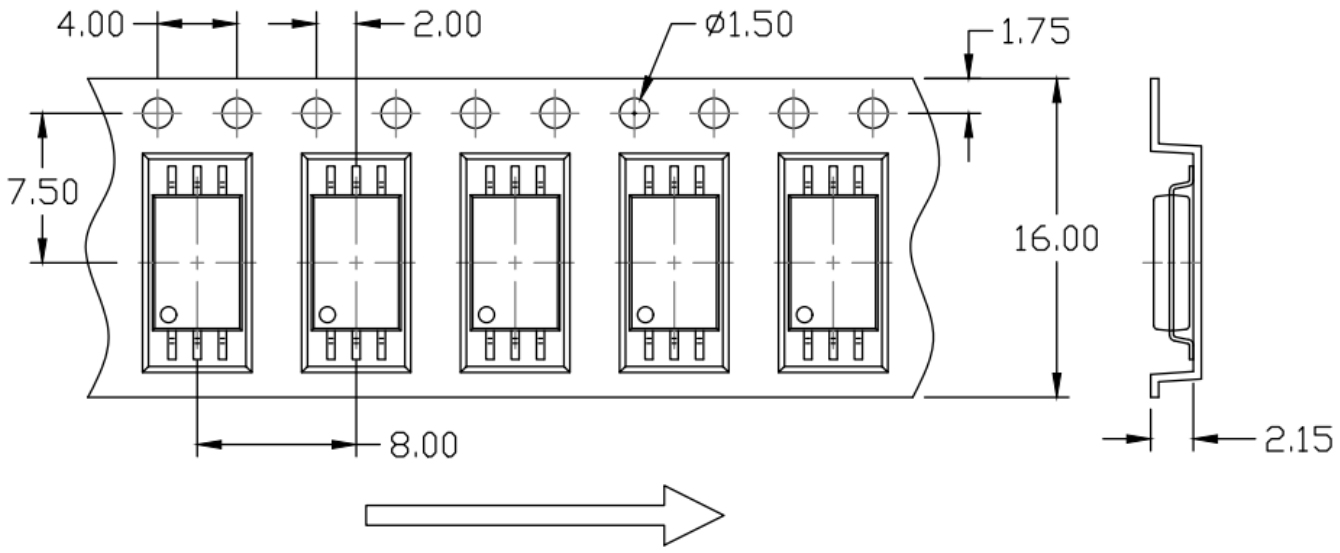


## CARRIER TAPE SPECIFICATIONS (Dimensions in mm unless otherwise stated)

**Surface Mount Lead Forming (P Type) Option T1**

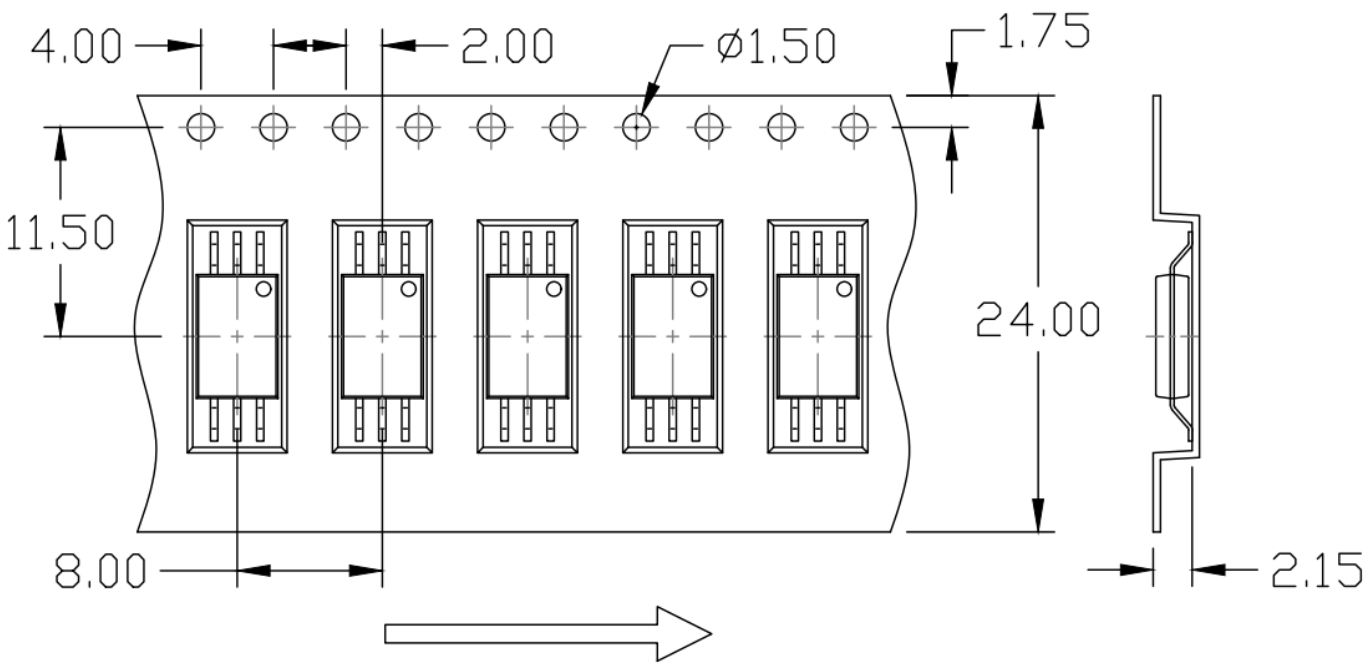



**Surface Mount Lead Forming (P Type) Option T2**

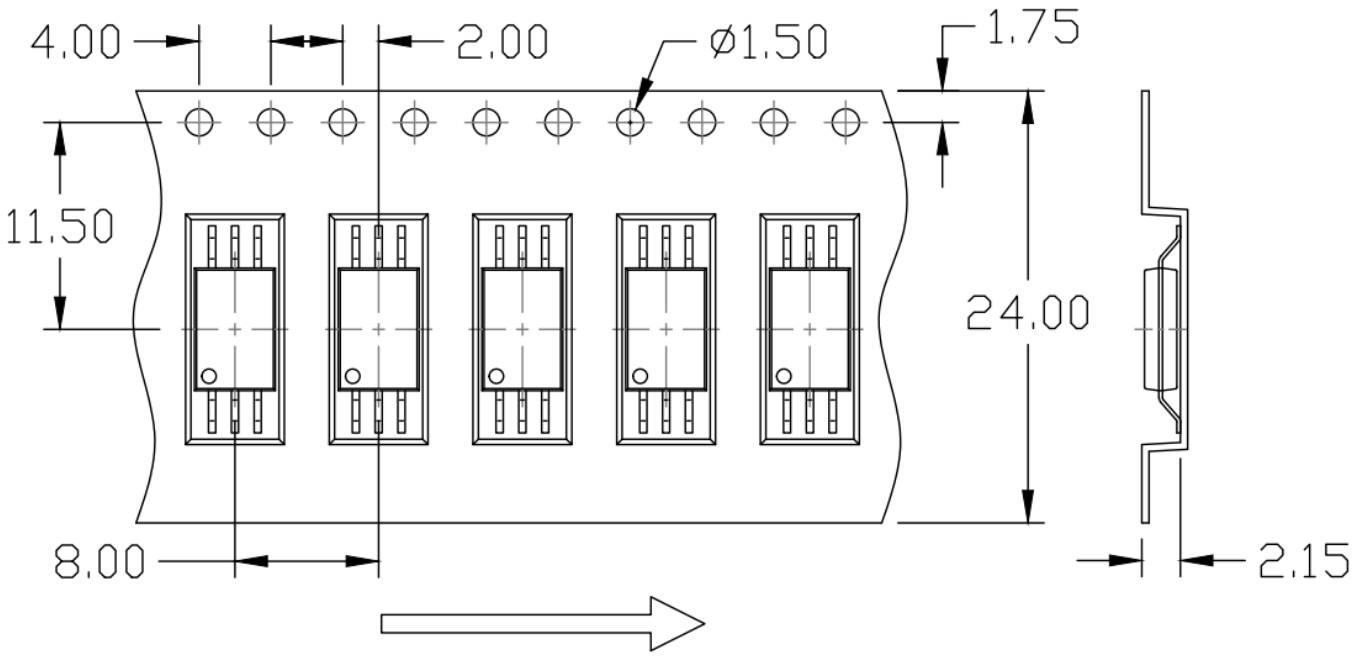


## CARRIER TAPE SPECIFICATIONS (Dimensions in mm unless otherwise stated)

**Surface Mount (Gullwing) Lead Forming (W Type) Option T1**

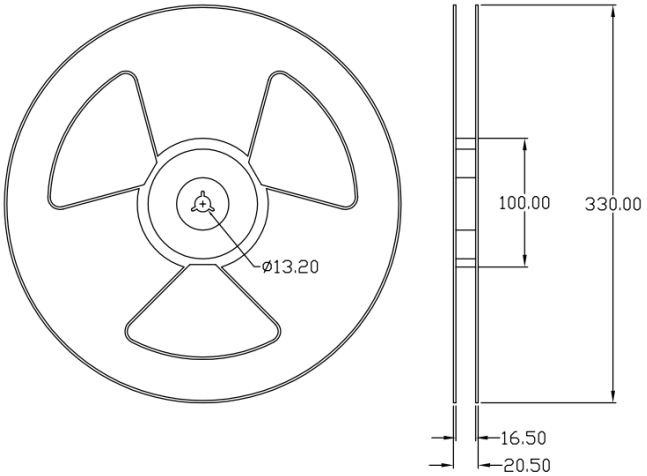



**Surface Mount (Gullwing) Lead Forming (W Type) Option T2**

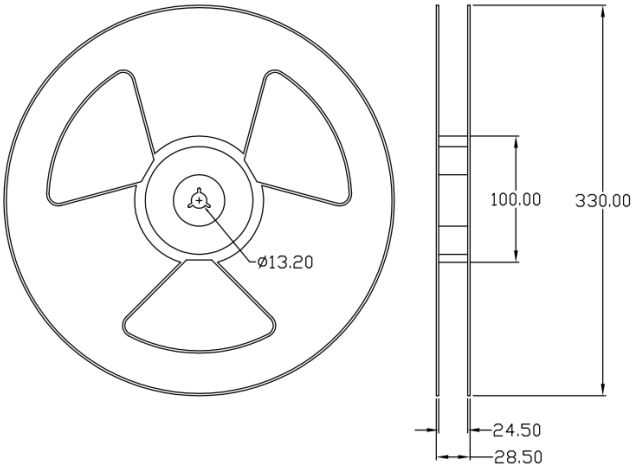


## REEL SPECIFICATIONS (Dimensions in mm unless otherwise stated)

### Surface Mount Lead Forming (P Type)

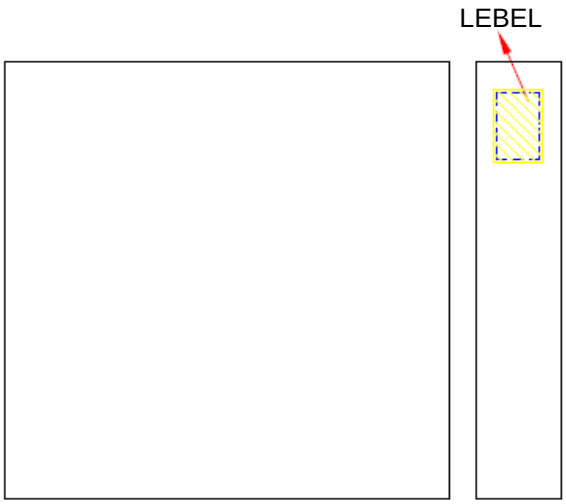



### Surface Mount (Gullwing) Lead Forming (W Type)



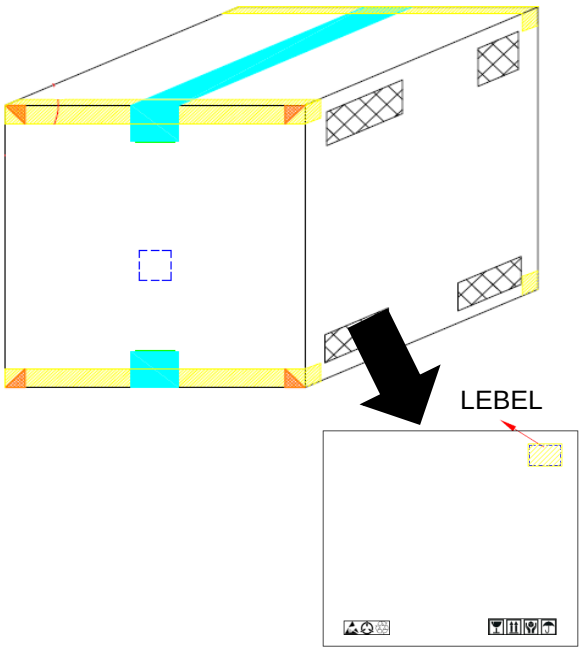

## BOX SPECIFICATIONS (Reel Type)

### INNER BOX




L x W x H = 36cm x 36cm x 6.9cm

### OUTER BOX




L x W x H = 45cm x 38cm x 38cm

## ORDERING AND MARKING INFORMATION

### MARKING INFORMATION

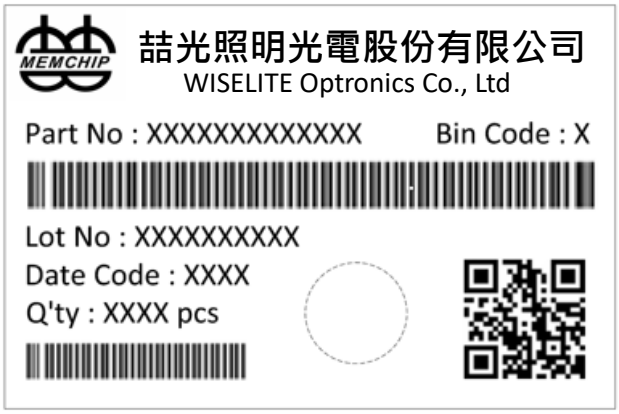

M : Company Abbr.
YY : Year date code
WW : 2-digit work week
314 : Part Number
T or H : Factory identification mark
V : VDE Identification(Option)

### ORDERING INFORMATION

**MPCS-314(P/W)-ZV**

MPC – Company Abbr.
S – Stack
314 – Part Number
P/W – Lead Form Option
(P-9mm Clearance or W-11mm Clearance)
Z – Tape and Reel Option (T1/T2)
V –VDE Option (V or None)

### LABEL INFORMATION

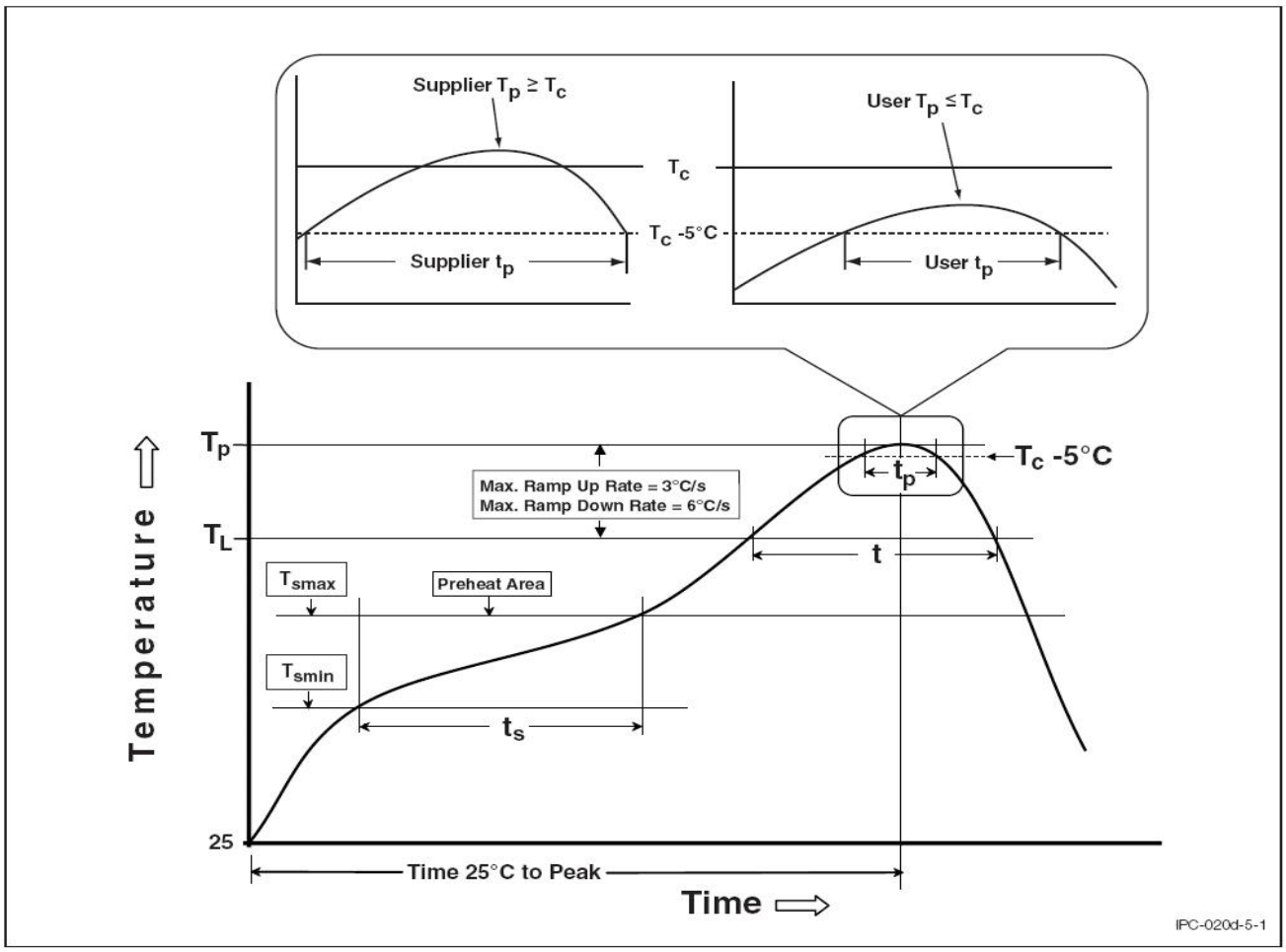



### PACKING QUANTITY

| Option | Quantity | Quantity – Inner box | Quantity – Outer box |
|---|---|---|---|
| Option P T1/T2 | 3000 Units/Reel | 3 Reels/Inner box | 5 Inner box/Outer box = 45k Units |
| Option W T1/T2 | 3000 Units/Reel | 2 Reels/Inner box | 5 Inner box/Outer box = 30k Units |

## REFLOW INFORMATION

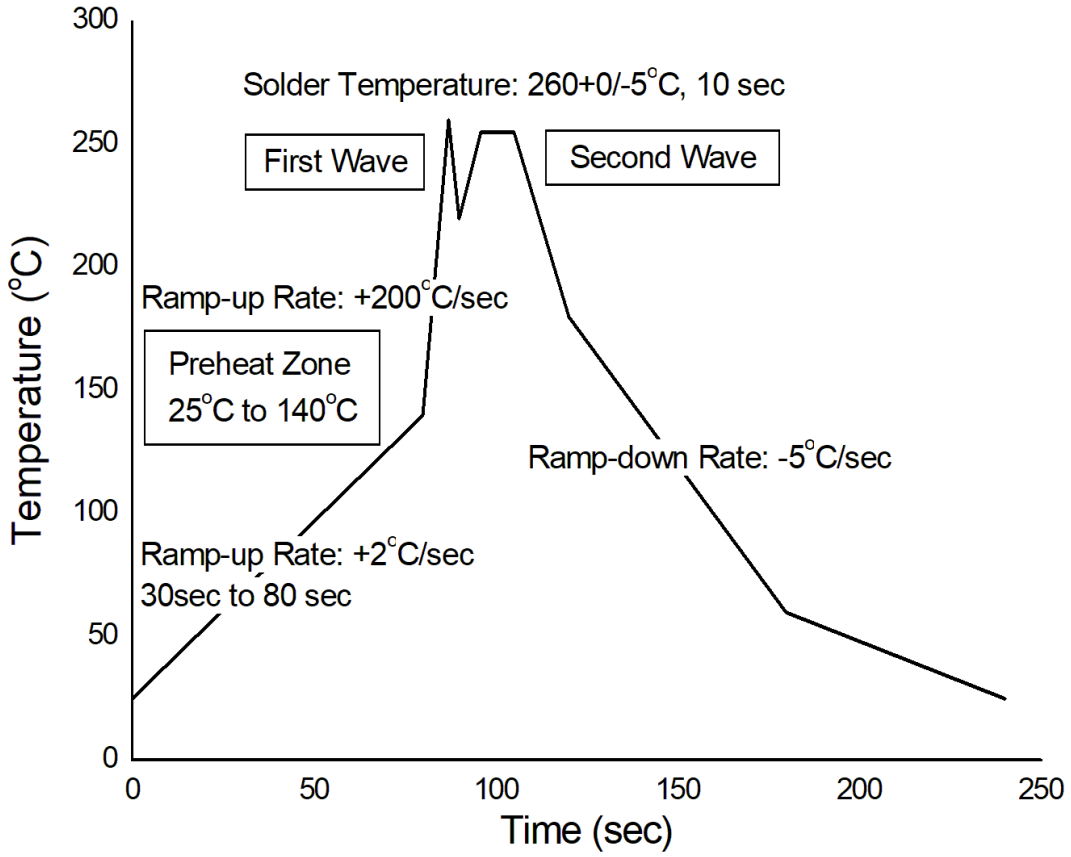
### REFLOW PROFILE




| Profile Feature | Sn-Pb Assembly Profile | Pb-Free Assembly Profile |
|---|---|---|
| Temperature Min. (Tsmin) | 100°C | 150°C |
| Temperature Max. (Tsmax) | 150°C | 200°C |
| Time (ts) from (Tsmin to Tsmax) | 60-120 seconds | 60-120 seconds |
| Ramp-up Rate (tL to tP) | 3°C/second max. | 3°C/second max. |
| Liquidous Temperature (TL) | 183°C | 217°C |
| Time (tL) Maintained Above (TL) | 60 – 150 seconds | 60 – 150 seconds |
| Peak Body Package Temperature | 235°C +0°C / -5°C | 260°C +0°C / -5°C |
| Time (tP) within 5°C of 260°C | 20 seconds | 30 seconds |
| Ramp-down Rate (TP to TL) | 6°C/second max | 6°C/second max |
| Time 25°C to Peak Temperature | 6 minutes max. | 8 minutes max. |

## TEMPERATURE PROFILE OF SOLDERING

### WAVE SOLDERING (JESD22-A111 COMPLIANT)




| HAND SOLDERING BY SOLDERING IRON | |
|---|---|
| Soldering Temperature | 380+0/-5°C |
| Soldering Time | 3 sec max. |
| One time soldering is recommended for all soldering method. | |
| Do not solder more than three times for IR reflow soldering. | |

## DISCLAIMER

- WISELITE is continually improving the quality, reliability, function and design. WISELITE reserves the right to make changes without further notices.
- The characteristic curves shown in this datasheet are representing typical performance which are not guaranteed.
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- This product is not intended to be used for military, aircraft, medical, life sustaining or lifesaving applications or any other application which can result in human injury or death.
- Please contact WISELITE sales agent for special application request.
- Immerge unit's body in solder paste is not recommended.
- Parameters provided in datasheets may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated in each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify WISELITE's terms and conditions of purchase, including but not limited to the warranty expressed therein.
- Discoloration might be occurred on the package surface after soldering, reflow or long-time use. It neither impacts the performance nor reliability.