# MPH-314 Series

## 1.0A, Gate Driver Photo Coupler

## Description

The MPH-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 Photocoupler operational parameters are guaranteed over the temperature range from -40° C ~ +110°C.

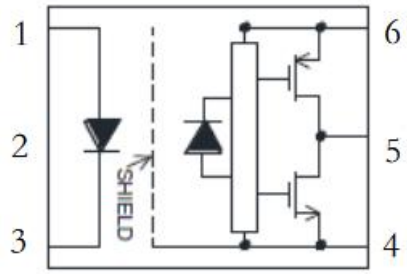
## Features

- 1.0 A maximum peak output current
- Rail-to-rail output voltage
- 110ns 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.
- MSL class 1
- Regulatory Approvals(Pending Approved)
  - UL - UL1577
  - VDE - EN60747-5-5
  - CQC – GB4943.1, GB8898

## Applications

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

## SCHEMATIC




## PIN DEFINITION

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

## PACKAGE OUTLINE

| TURTH TABLE | | | |
|---|---|---|---|
| LED | $V_{CC}$-$V_{SS}$ (Turn-ON, +ve going) | $V_{CC}$-$V_{SS}$ (Turn-OFF, -ve going) | $V_O$ |
| 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 |
| Average Forward Current | $I_F$ | - | 20 | mA | |
| Reverse Input Voltage | $V_R$ | - | 5 | V | |
| Input Power Dissipation | $P_I$ | - | 45 | mW | |
| Total Output Supply Voltage | ($V_{CC}$-$V_{SS}$) | 0 | 35 | V | |
| “High” Peak Output Current | $I_{OH(PEAK)}$ | - | 1.0 | A | 1 |
| “Low” Peak Output Current | $I_{OL(PEAK)}$ | - | 1.0 | A | |
| Output Voltage | $V_{O(PEAK)}$ | -0.5 | $V_{CC}$ | V | |
| Output Power Dissipation | $P_O$ | - | 250 | mW | |
| Isolation Voltage | Viso | 5000 | - | Vrms | |
| Operating Temperature | Topr | -40 | 110 | °C | |
| Output IC Junction Temperature | $T_J$ | - | 125 | °C | |
| Storage Temperature | Tstg | -55 | 125 | °C | |
| Soldering Temperature | Tsol | - | 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.

**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) | $I_{F(ON)}$ | 7 | 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 | $I_F$=10mA | |
| 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) | $I_{FLH}$ | - | 0.6 | 2 | mA | $V_O$>5V,$I_O$=0A | |
| Input Threshold Voltage (High to Low) | $V_{FHL}$ | 0.8 | - | - | V | $V_{CC}$=30V,$V_O$<5V | |
| Input Capacitance | Cin | - | 60 | - | pF | $V_F$=0, f=1kHz | |
| OUTPUT CHARACTERISTICS | | | | | | | |
| High Level Supply Current | $I_{CCH}$ | - | 1.55 | 3 | mA | $I_F$=10mA,$V_{CC}$=30V $V_O$=Open,Rg=30Ω Cg=3nF | |
| Low Level Supply Current | $I_{CCL}$ | - | 1.92 | 3 | mA | $I_F$=10mA,$V_{CC}$=30V $V_O$=Open,Rg=30Ω Cg=3nF | |
| High Level Output Voltage | $V_{OH}$ | 29.4 | 29.69 | - | V | $I_F$=10mA,$I_O$=-100mA | 2,3 |
| Low Level Output Voltage | $V_{OL}$ | - | 0.17 | 0.4 | V | $I_F$=0mA,$I_O$=100mA | |
| High Level Output Current | $I_{OH}$ | 1.0 | - | - | A | $I_F$=10mA,$V_{CC}$=30V $V_O$=$V_{CC}$-4 | 1 |
| Low Level Output Current | $I_{OL}$ | 1.0 | - | - | A | $I_F$=10mA,$V_{CC}$=30V $V_O$=$V_{SS}$+4 | 1 |
| Under Voltage Lockout Threshold | VUVLO+ | 6.9 | 7.8 | 8.7 | V | $V_O$>5V,$I_F$=10mA | |
| | VUVLO- | 5.9 | 6.9 | 7.5 | V | $V_O$<5V,$I_F$=10mA | |

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:** Maximum pulse width = 10 μs.

**Note 2:** 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 3:** Maximum pulse width = 1 ms.

| 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=47Ω, Cg=3nF, 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 | PWD | - | 22 | 70 | ns | | |
| Propagation Delay Difference Between Any Two Parts | PDD ($t_{PHL}$-$t_{PLH}$) | -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 to16mA, $V_{CC}$=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 |

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 $V_O$ > 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 $V_O$ < 1.0V).

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

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**

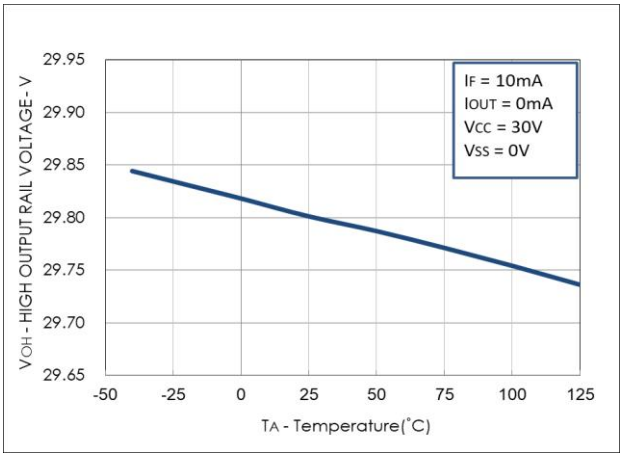



**Fig.2 VOH vs. Temperature**

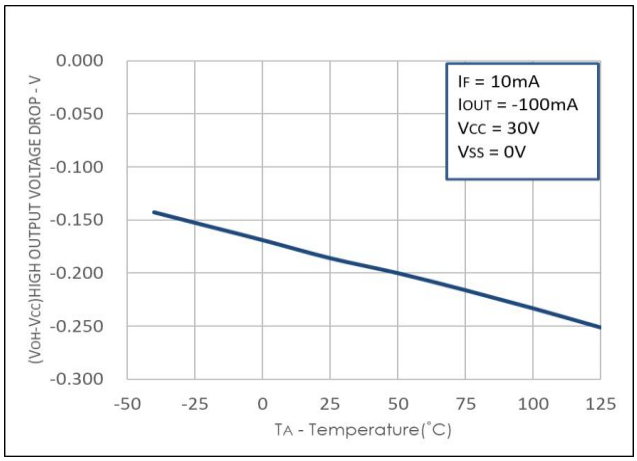



**Fig.3 VOL vs. Temperature**

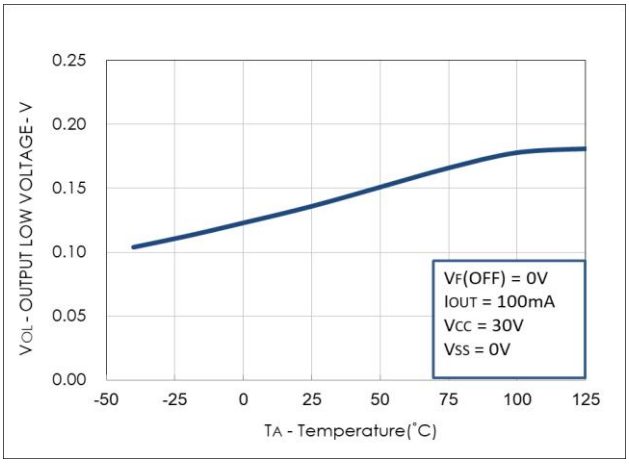



**Fig.4 ICC vs. Temperature**

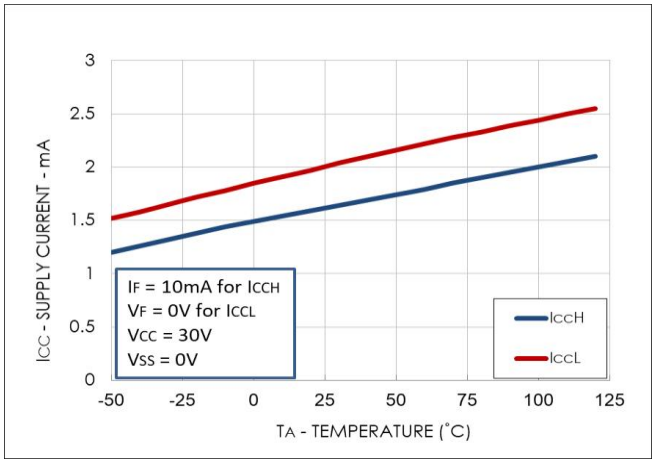



**Fig.5 ICC vs. VCC**

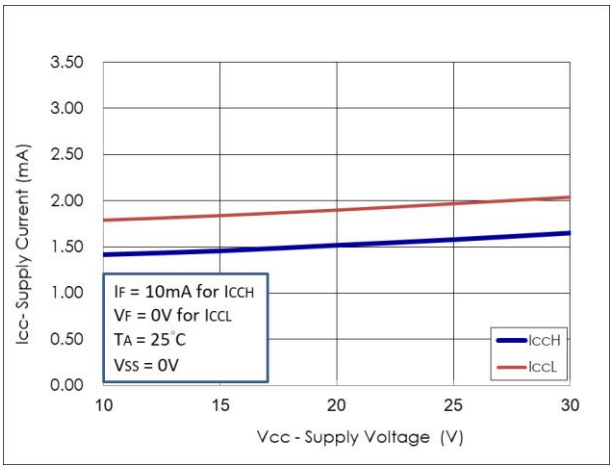
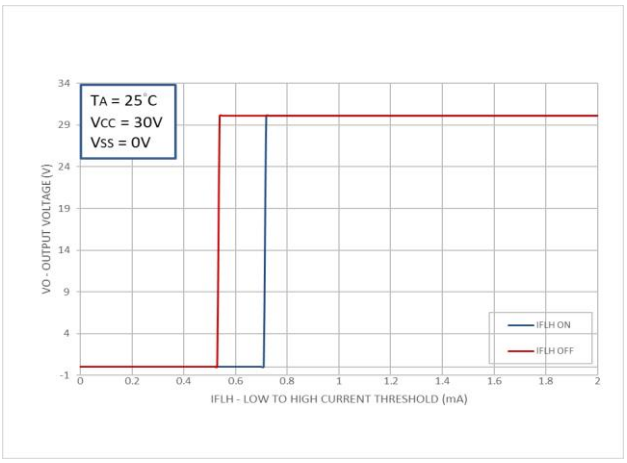
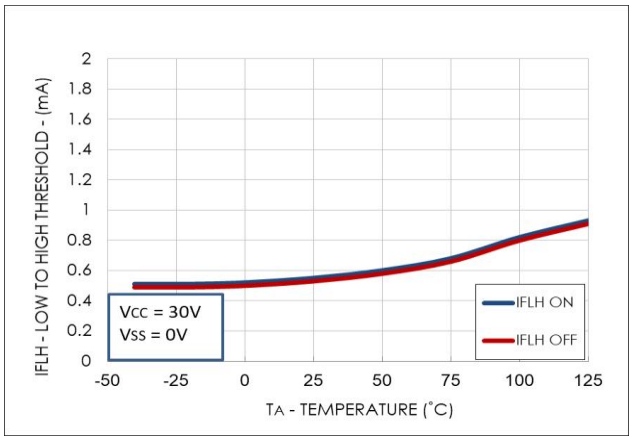



**Fig.6 FLH vs. Hysteresis**

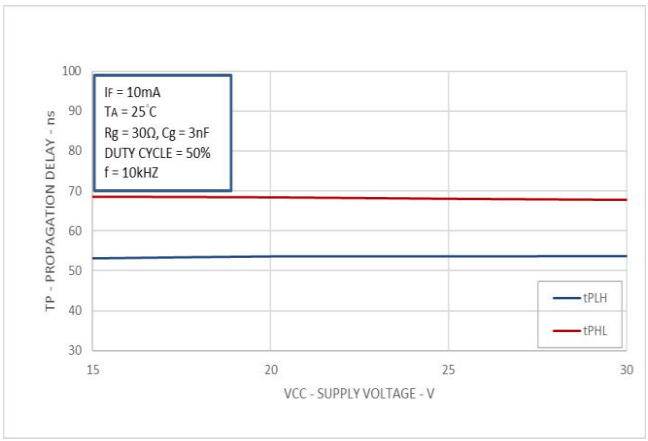


## CHARACTERISTIC CURVES

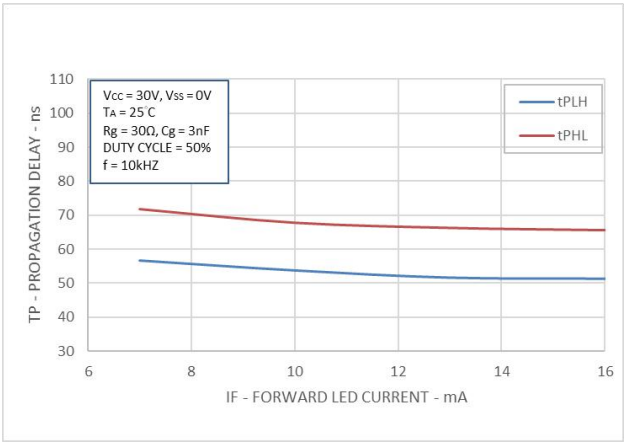
### Fig.7 IFH vs. Temperature



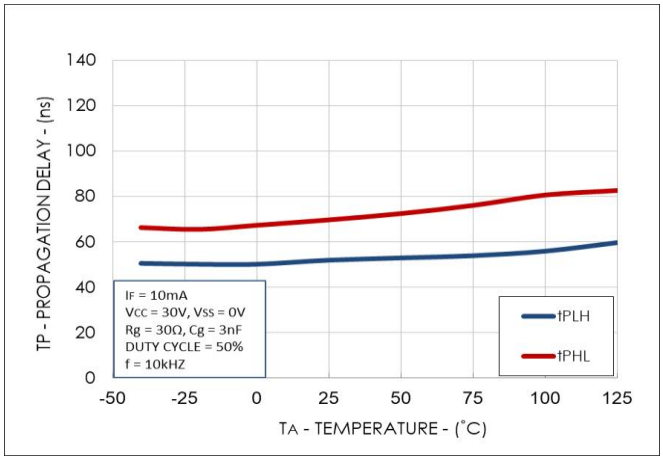

### Fig.8 Propagation Delays vs. VCC



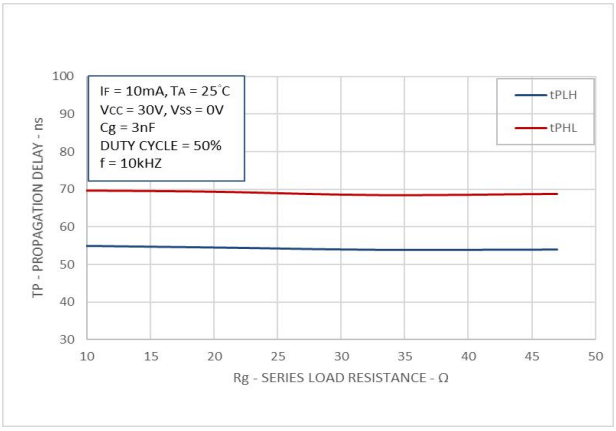

### Fig.9 Propagation Delays vs. IF




### Fig.10 Propagation Delays vs. Temperature




### Fig.11 Propagation Delays vs. Rg




### Fig.12 Propagation Delays vs. Cg

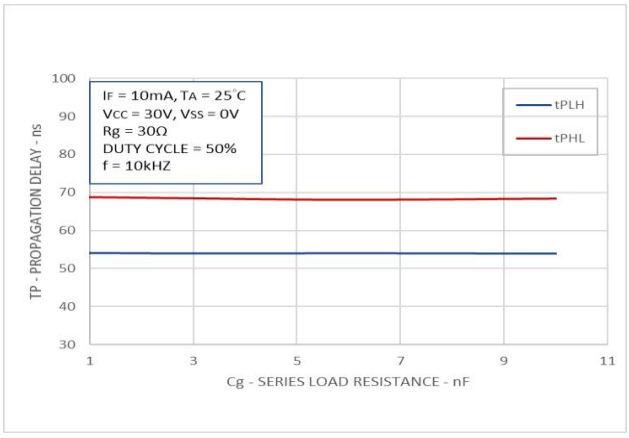


**Fig.13 Input Current vs. Forward Voltage**

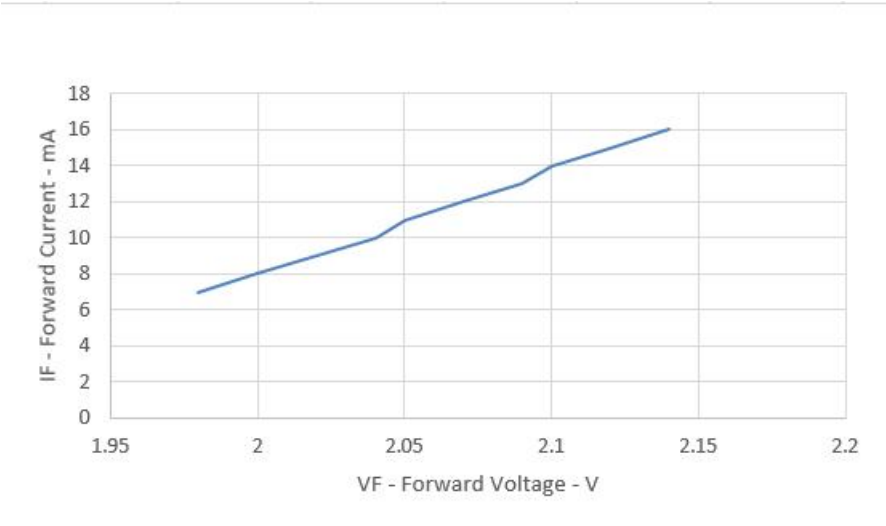



**Fig.14 IOH Test Circuit**

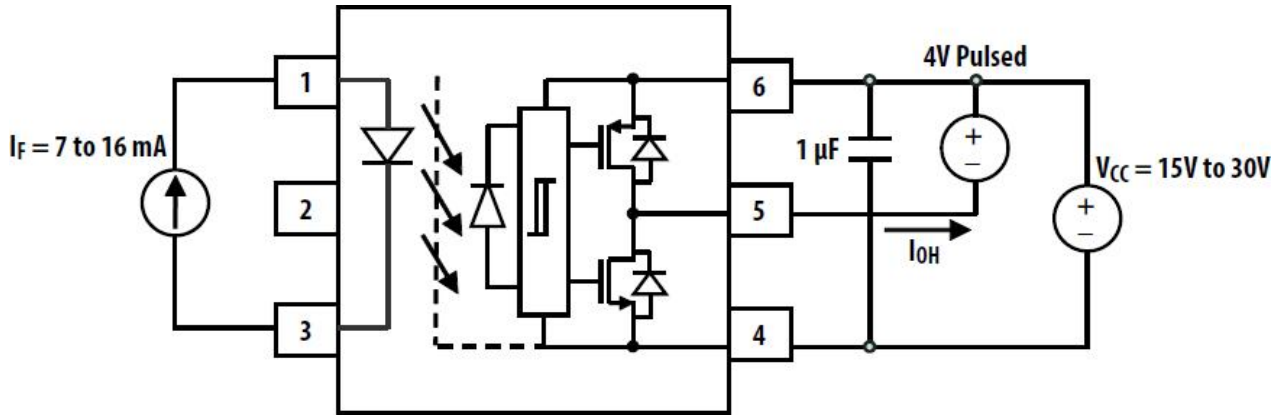



**Fig.15 IOL Test Circuit**

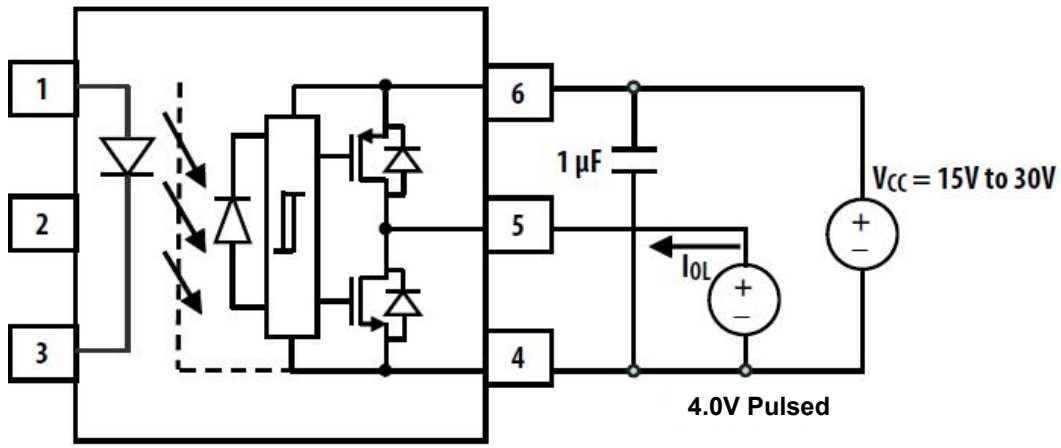


Fig.16 VOH Test Circuit

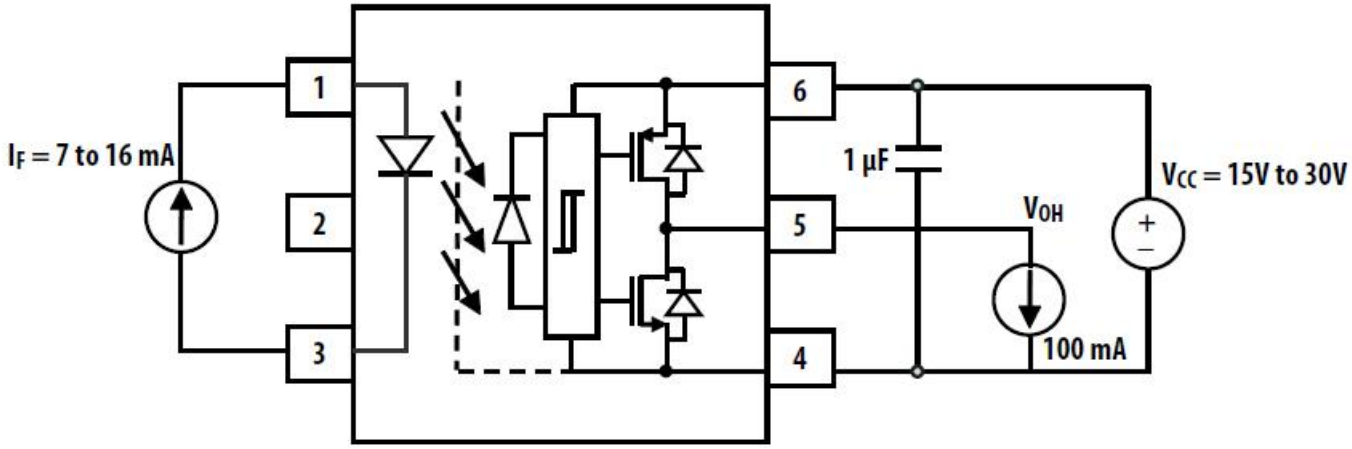



Fig.17 VOL Test Circuit

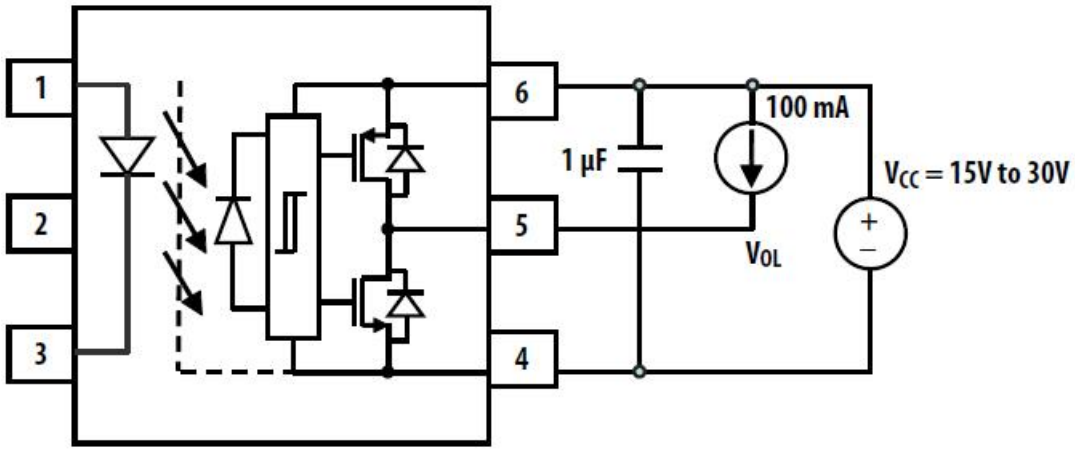



Fig.18 IFLH Test Circuit

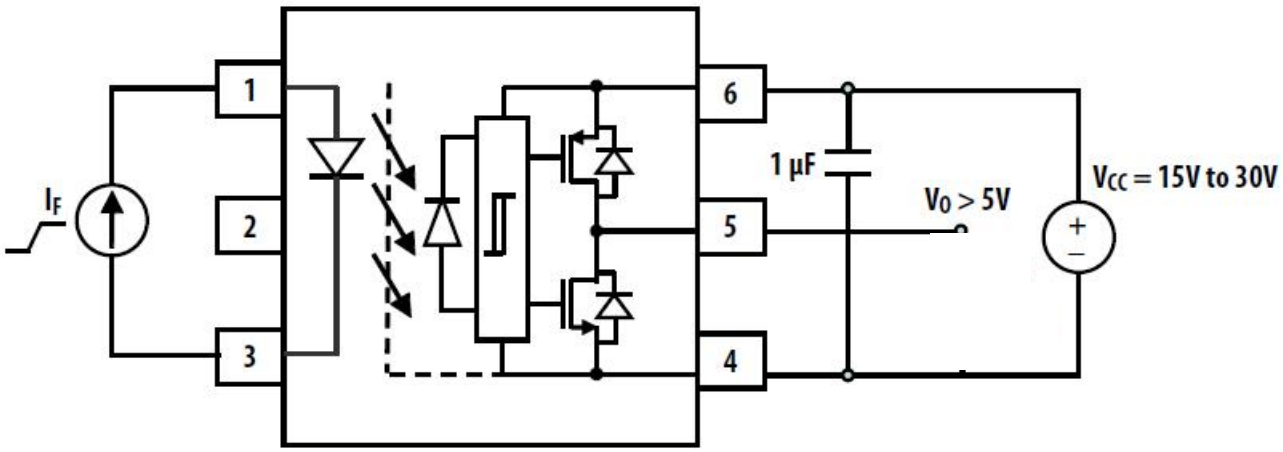


**Fig.19 UVLO Test Circuit**

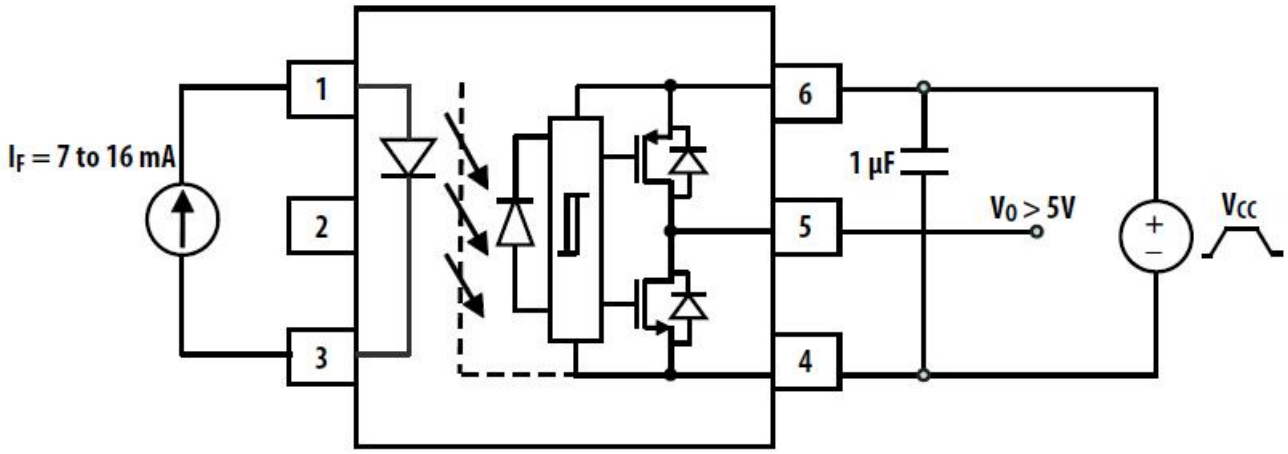



**Fig.20 tPHL, tPLH, tr and tf Test Circuit and Waveforms**

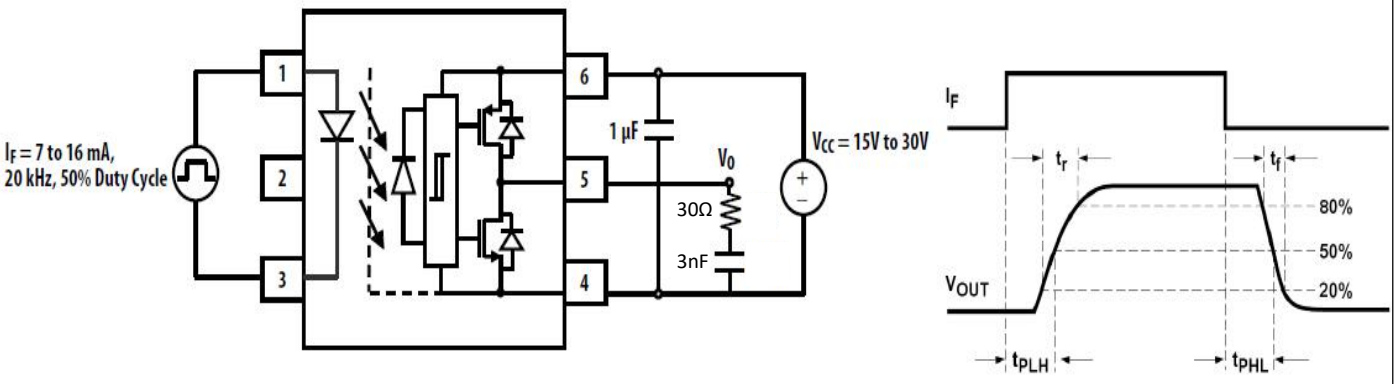
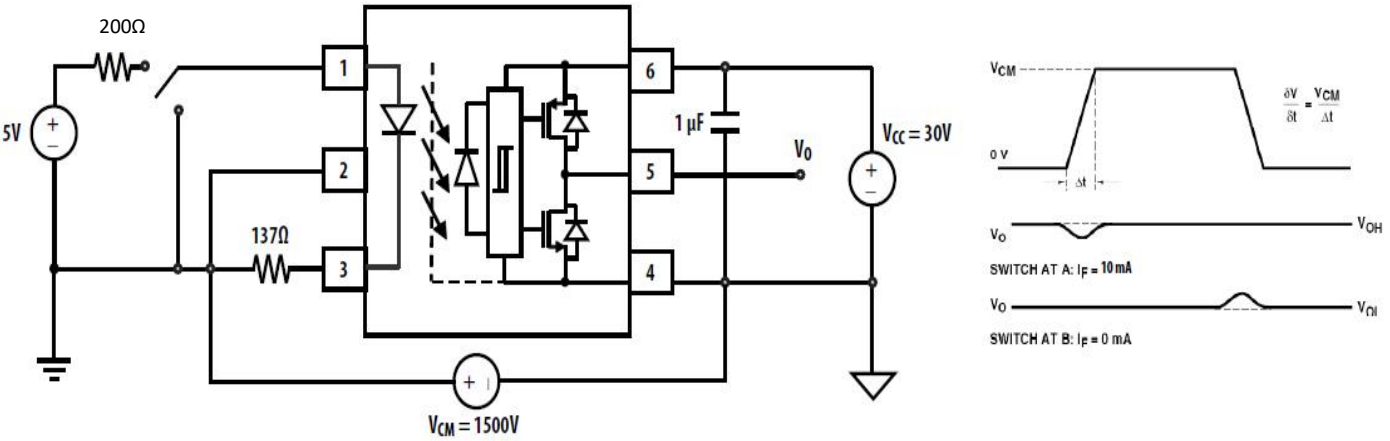


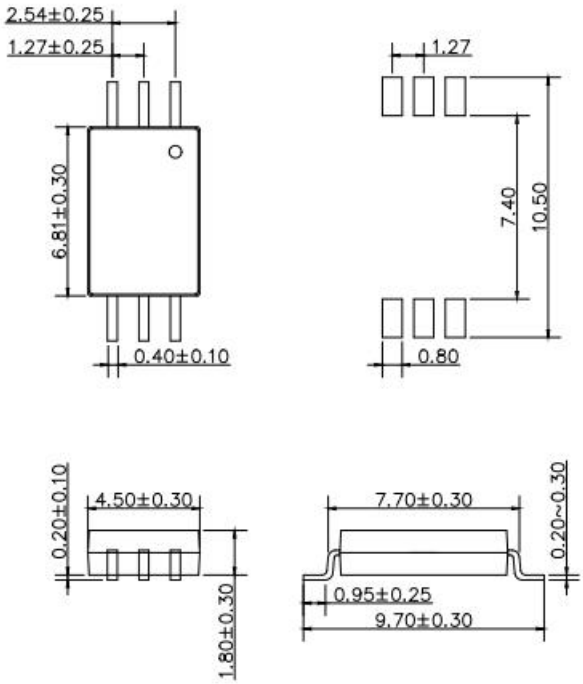

**Fig.21 CMR Test Circuit with Split Resistors Network and Waveforms**



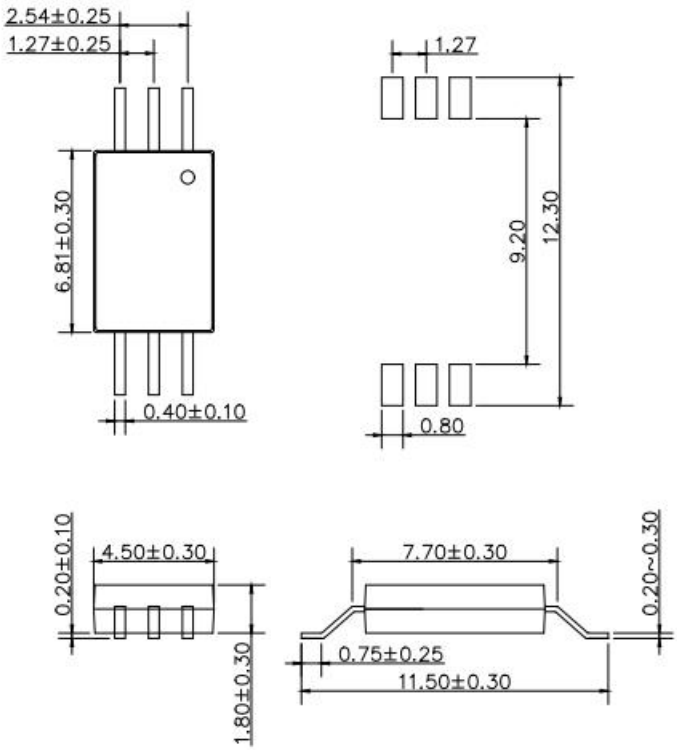
## PACKAGE DIMENSIONS (Dimensions in mm unless otherwise stated)

**Surface Mount Lead Forming**

### P type Dimension

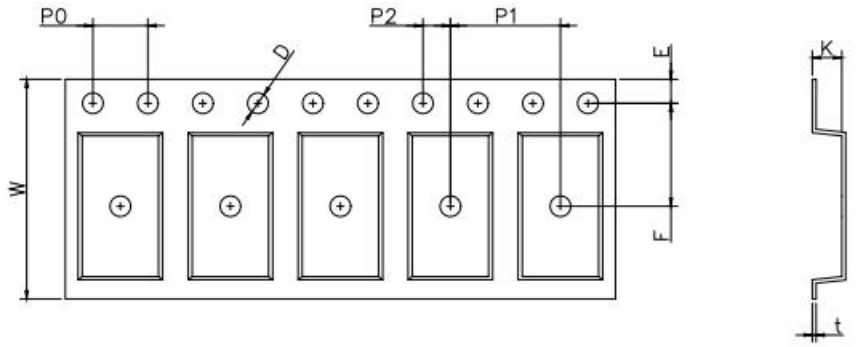



### W type Dimension



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

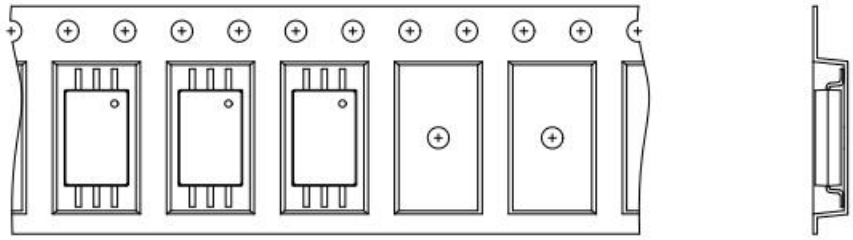
### Taping Dimensions



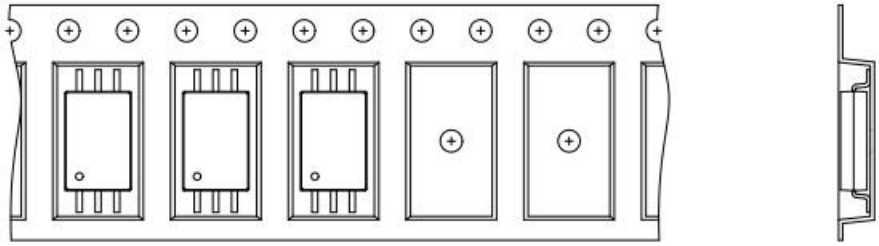

| Dimension Symbol | D | E | F | P0 | P1 | P2 | t | W | K |
|---|---|---|---|---|---|---|---|---|---|
| P type Dimension (mm) | 1.5±0.1 | 1.75±0.1 | 7.5±0.1 | 4.0±0.1 | 8.0±0.1 | 2.0±0.1 | 0.3±0.1 | 16.0±0.3 | 2.15±0.1 |
| W type Dimension (mm) | 1.5±0.1 | 1.75±0.1 | 11.5±0.1 | 4.0±0.1 | 8.0±0.1 | 2.0±0.1 | 0.3±0.1 | 24.0±0.3 | 2.52±0.1 |

### Tape & Reel Packing Specifications

Option T1



Option T2



## ORDERING AND MARKING INFORMATION

### MARKING INFORMATION


| | |
|---|---|
| **MP** | **: Company Abbr.** |
| **H** | **: High performance Photocoupler** |
| **314** | **: Part Number** |
| **P/W** | **: Lead Form Option** |
| **V** | **: VDE Identification(Option)** |
| **Y** | **: Year date code** |
| **H** | **: Factory identification mark** |
| **WW** | **: 2-digit work week** |

### ORDERING INFORMATION

# MPH-314(P/W)-VZ

MP– Company Abbr.

H – High performance Photocoupler

314 – Part Number

P/W – Lead Form Option(P-9mm Clearance or W-11mm Clearance)

V – VDE Option (V or None)

Z – Tape and Reel Option (T1/T2)

**Packing Quantity**

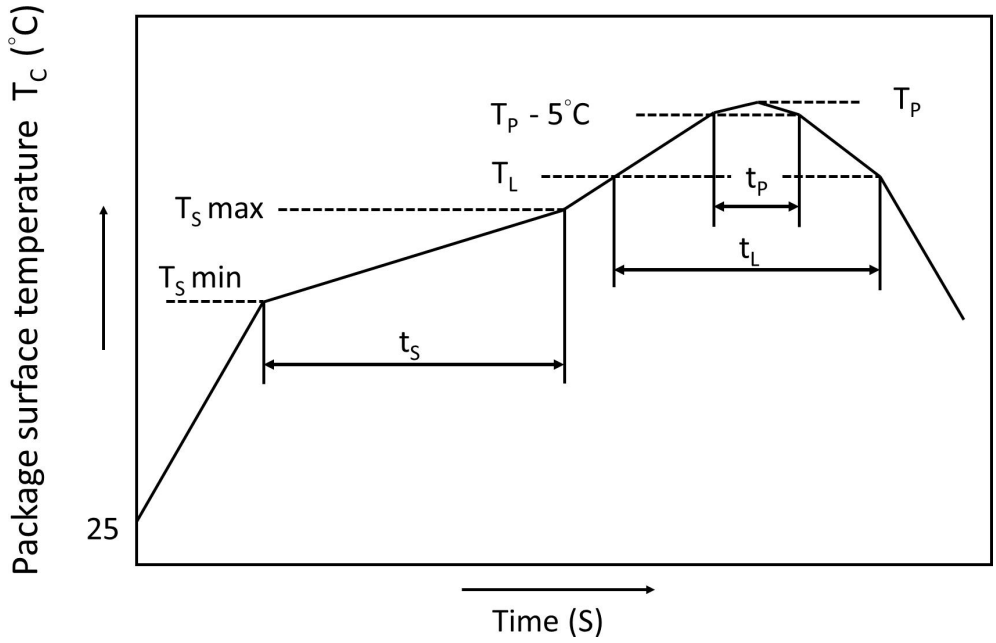
| Option | Description | Quantity |
|---|---|---|
| P(T1) | Surface Mount Lead Forming – With Option 1 Taping | 3000 Units/Reel |
| P(T2) | Surface Mount Lead Forming – With Option 2 Taping | 3000 Units/Reel |
| W(T1) | Surface Mount Lead Forming – With Option 1 Taping | 3000 Units/Reel |
| W(T2) | Surface Mount Lead Forming – With Option 2 Taping | 3000 Units/Reel |

## REFLOW INFORMATION

### REFLOW PROFILE

IR Reflow soldering

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




| | Symbol | Min. | Max. | Unit |
|---|---|---|---|---|
| Preheat temperature | $T_S$ | 150 | 200 | °C |
| Preheat time | $t_S$ | 60 | 120 | s |
| Ramp-up rate ($T_L$ to $T_P$) | | | 3 | °C/s |
| Liquidus temperature | $T_L$ | 217 | | °C |
| Time above $T_L$ | $t_L$ | 60 | 100 | s |
| Peak Temperature | $T_P$ | | 260 | °C |
| Time during which $T_C$ is between ($T_P$ - 5) and $T_P$ | $t_P$ | | 20 | s |
| Ramp-down rate | | | 6 | °C/s |

## DISCLAIMER

- Our company is continually improving the quality, reliability, function and design. Our company reserves the right to make changes without further notices.
- The characteristic curves shown in this datasheet are representing typical performance which are not guaranteed.
- Our company makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Our company disclaims (a) any and all liability arising out of the application or use of any product, (b) any and all liability, including without limitation special, consequential or incidental damages, and (c) any and all implied warranties, including warranties of fitness for particular
- 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 purpose, non-infringement and merchantability.
- This product is not intended to be used for military, aircraft, automotive, medical, life sustaining or lifesaving applications or any other application which can result in human injury or death.
- Please contact Our company 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 Our company'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.

## Revision History

| Version | Date | Applicant | Subjects (major changes since last revision) |
|---|---|---|---|
| 1.0 | 2022-07-21 | Lee | Datasheet Complete |
| | | | |