# TDL314 Series

## 0.8A, Gate Driver Photo Coupler

## Description

The TDL314 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° C ~ +110°C.

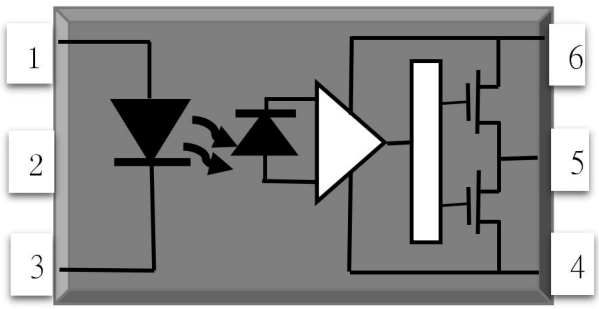
## Features

- 1.5 A maximum peak output current
- 0.8 A minimum 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.

## Applications

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

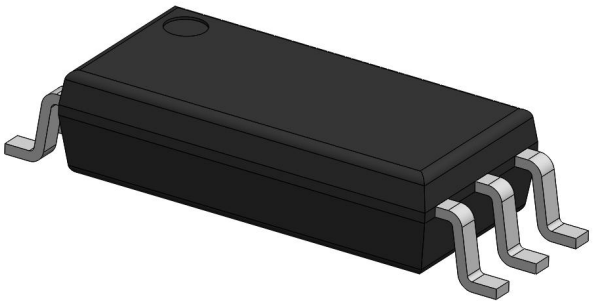
## SCHEMATIC




## PIN DEFINITION

| | |
|---|---|
| **1.Anode** | **6.$V_{CC}$** |
| **2.None** | **5.VO** |
| **3.Cathode** | **4.$V_{SS}$** |

## PACKAGE



| TRUTH 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 |
| Storage Temperature | $T_{stg}$ | -55 | 125 | °C | - |
| Operating Temperature | $T_{opr}$ | -40 | 100 | °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 | $I_{OH(PEAK)}$ | 0.8 | 1.5 | A | 1 |
| “Low” Peak Output Current | $I_{OL(PEAK)}$ | 0.8 | 1.5 | 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 kHRECOMMENDED 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 | $V_F$ | - | 1.38 | 1.8 | V | $I_F$= 10 mA | - |
| Reverse Current | $I_R$ | - | - | 10 | μA | $V_R$=5V | - |
| 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 | $V_{CC}$ = 30 V, $V_O$ < 5V | - |
| Input Capacitance | $C_{IN}$ | - | 60 | - | pF | $V_F$ = 0, f = 1MHz | - |
| OUTPUT CHARACTERISTICS | | | | | | | |
| High Level Supply Current | $I_{CCH}$ | - | 1.50 | 3 | mA | $I_F$ = 10 mA, $V_{CC}$ = 30 V, $V_O$ = Open, Rg = 30Ω, Cg = 3 nF | |
| Low Level Supply Current | $I_{CCL}$ | - | 1.50 | 3 | mA | $I_F$ = 0 mA, $V_{CC}$ = 30 V, $V_O$ = Open, Rg = 30Ω, Cg = 3 nF | |
| High Level Output Voltage | $V_{OH}$ | 29.4 | 29.69 | - | V | $I_F$ = 10 mA, $I_O$ = -100 mA | 2,3 |
| Low Level Output Voltage | $V_{OL}$ | - | 0.17 | 0.34 | V | $I_F$ = 0 mA, $I_O$ = 100 mA | |
| High Level Output Current | $I_{OH}$ | - | - | -0.8 | A | $I_F$ = 10 mA, $V_{CC}$ = 30V $V_O$ = $V_{CC}$ - 4 | 1 |
| Low Level Output Current | $I_{OL}$ | 0.8 | - | - | A | $I_F$ = 0 mA, $V_{CC}$ = 30V $V_O$ = $V_{SS}$ + 4 | 1 |
| Under Voltage Lockout Threshold | VUVLO+ | 6.9 | 7.8 | 8.7 | V | $V_O$ > 5V, $I_F$ = 10 mA | |
| | VUVLO- | 5.9 | 6.9 | 7.5 | V | $V_O$ < 5V, $I_F$ = 10 mA | |

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 VOH is measured with a dc load current. When driving capacitive loads, VOH will approach VCC as IOH 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 | $t_{PHL}$ | - | 140 | 500 | ns | Rg = 30Ω, Cg = 3 nF, f = 10kHz, Duty Cycle = 50%, $I_F$ = 10mA, $V_{CC}$ = 30V | - |
| Propagation Delay Time to Output High Level | $t_{PLH}$ | - | 150 | 500 | ns | | - |
| Pulse Width Distortion | PWD | - | 22 | 200 | ns | | - |
| Propagation Delay Difference Between Any Two Parts | PDD ($t_{PHL}$ - $t_{PLH}$) | -200 | - | +200 | ns | | - |
| Rise Time | $t_r$ | - | 50 | - | ns | | - |
| Fall Time | $t_f$ | - | 50 | - | ns | | - |
| Common Mode Transient Immunity at Logic High | $CM_H$ | ±20 | - | - | 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 | - | - | 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 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 | Symbo | Device | Min. | Typ. | Max. | Unit | Test Condition | Note |
| Withstand Insulation Test Voltage | VISO | - | 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 (leakage current less than 10uA). This test is performed before the 100% production test for partial discharge.

## CHARACTERISTIC CURVES

**Fig.1 Forward Current vs. Forward Voltage**

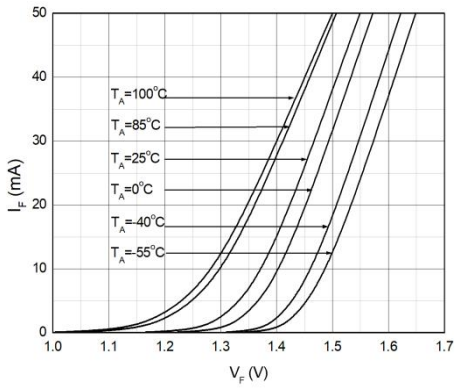



**Fig.2 Forward Voltage vs. Ambient Temperature**

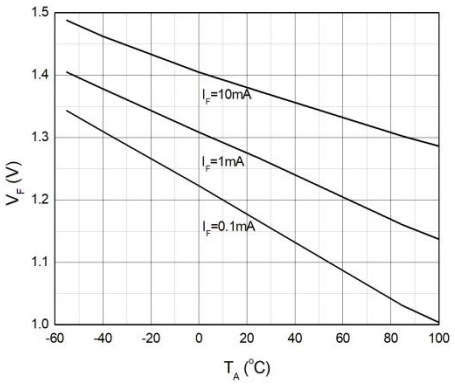



**Fig.3 Supply Current vs. Ambient Temperature**

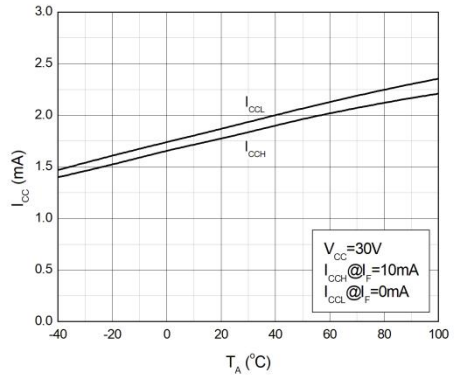



**Fig.4 Supply Current vs. Supply Voltage**

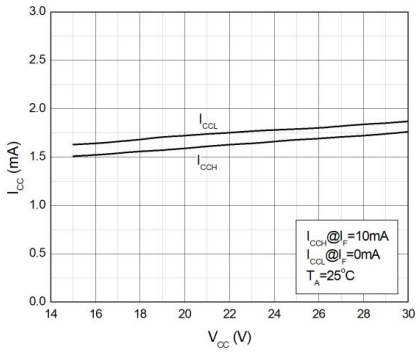



**Fig.5 High Level Output Voltage vs. High Level Output Current**

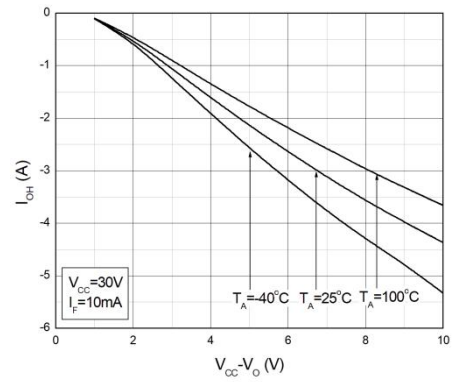
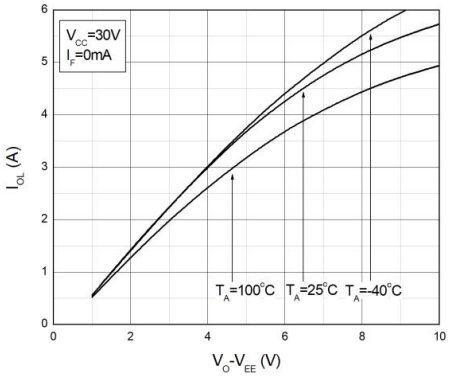



**Fig.6 Low Level Output Voltage vs. Low Level Output Current**



## CHARACTERISTIC CURVES

**Fig.7 High Level Output Voltage vs. Ambient Temperature**

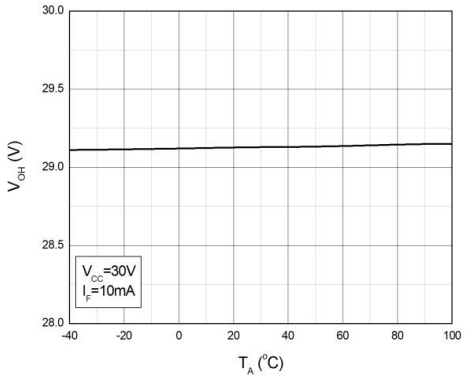



**Fig.8 Low Level Output Voltage vs. Ambient Temperature**

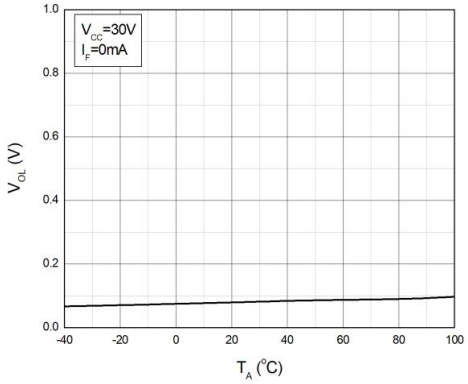



**Fig.9 Output Voltage vs. Forward Current**

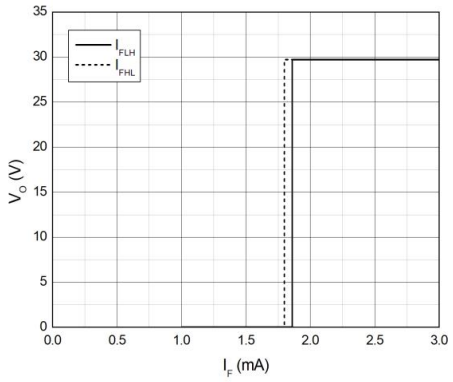



**Fig.10 Output Voltage vs. Supply Voltage**

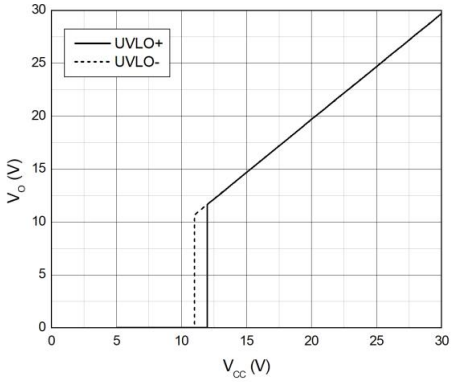



**Fig.11 Forward Current vs. Ambient Temperature**

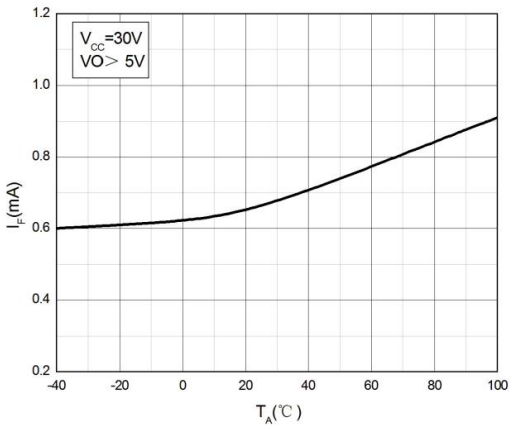
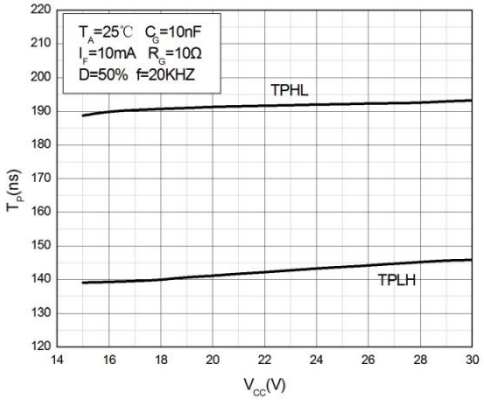



**Fig.12 Propagation Delay vs. Supply Voltage**



## CHARACTERISTIC CURVES

**Fig.13 Propagation Delay vs. Forward Current**

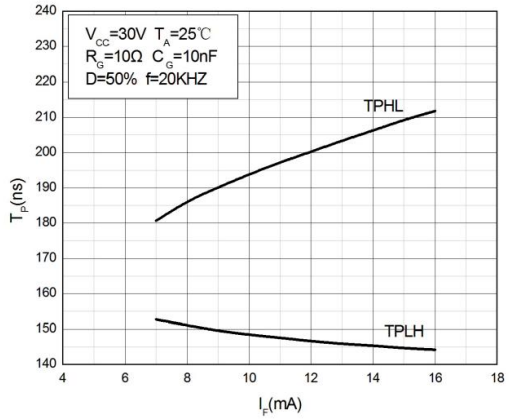



**Fig.14 Propagation Delay vs. Ambient Temperature**

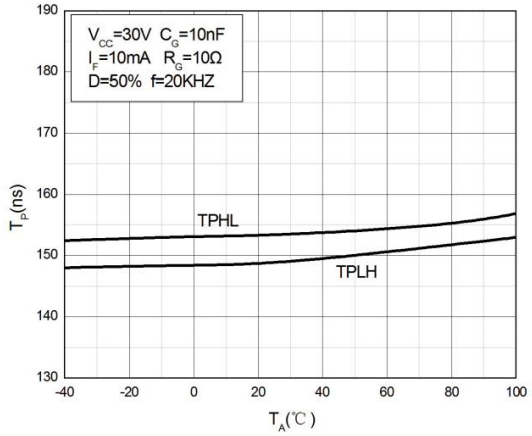



**Fig.15 Propagation Delay vs. Load Resistance**

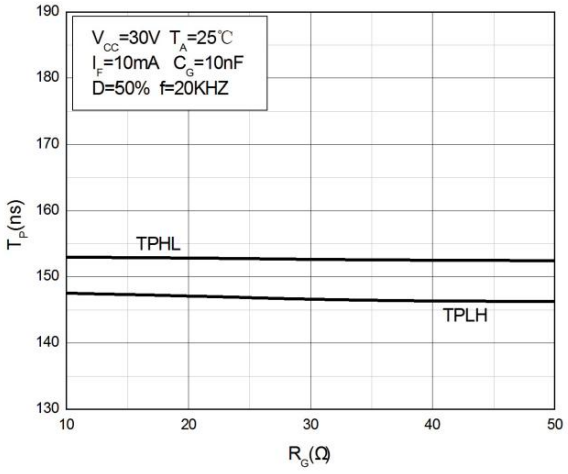
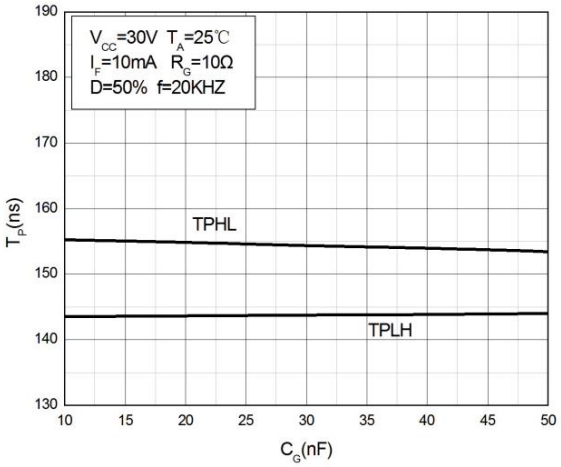
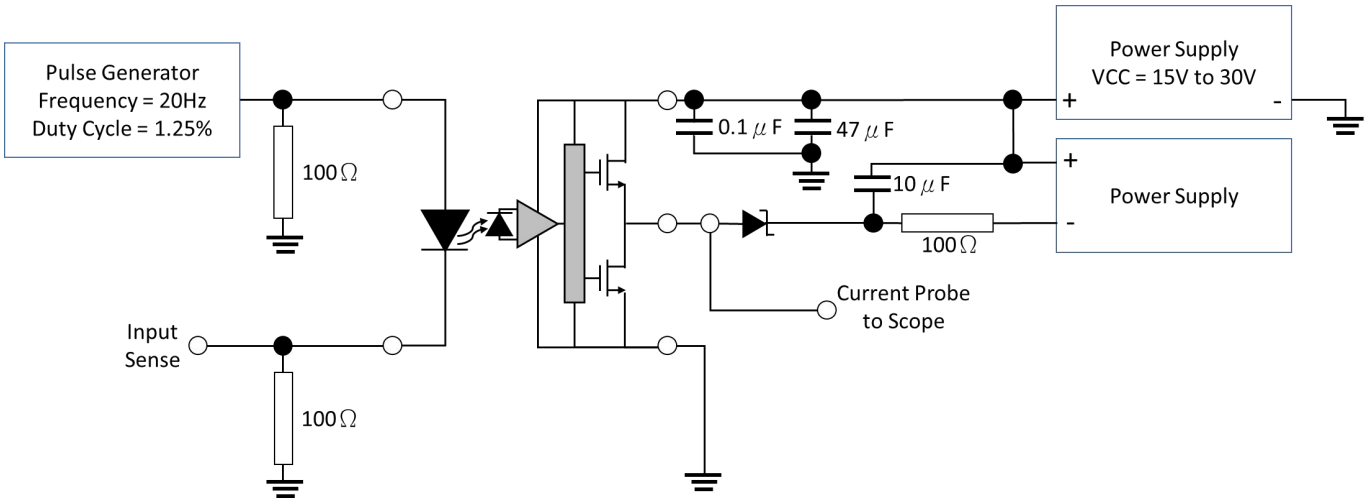



**Fig.16 Propagation Delay vs. Load Capacitance**

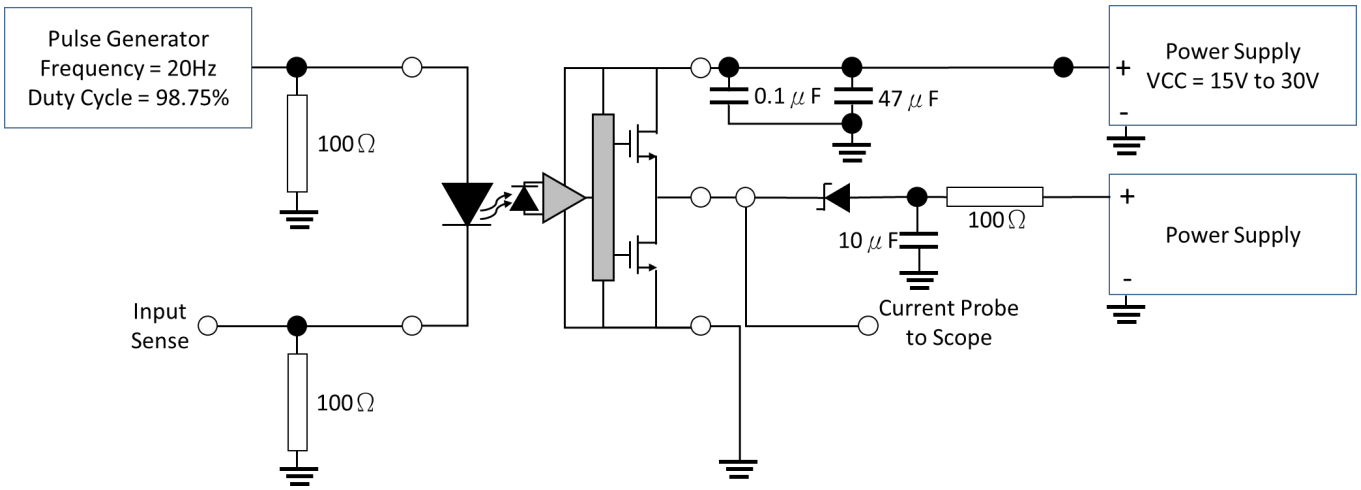


## TEST CIRCUITS

### Fig.17 Test Circuits for IOH




### Fig.18 Test Circuits for IOL



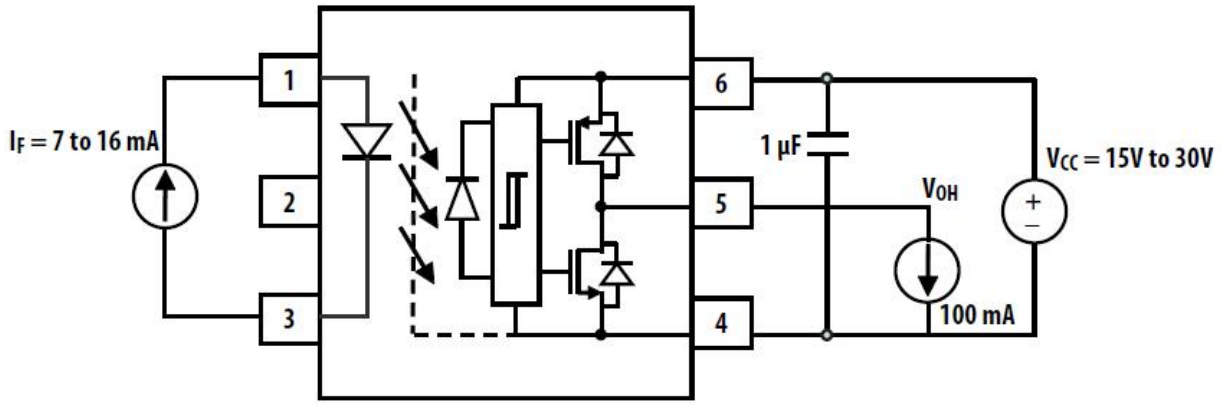



**Fig.19 $V_{OL}$ Test Circuit**

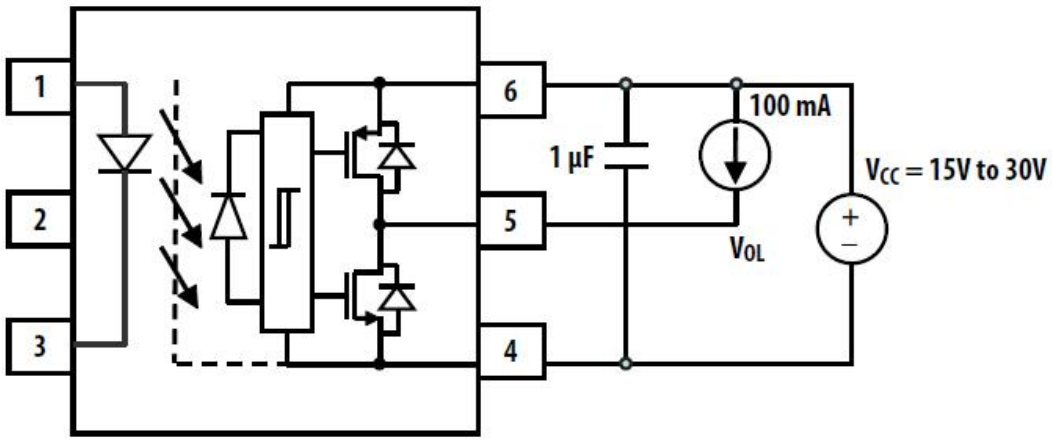



**Fig.20 $I_{FLH}$ Test Circuit**

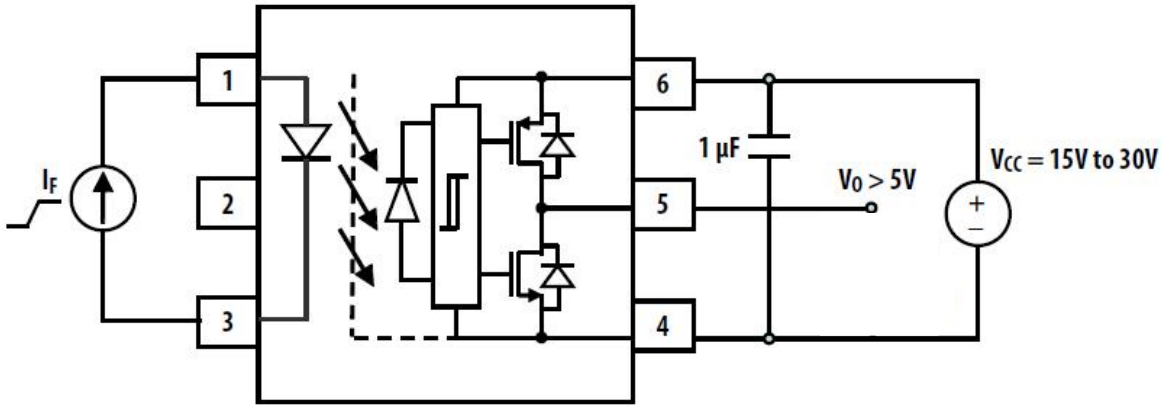


**Fig.21 UVLO Test Circuit**

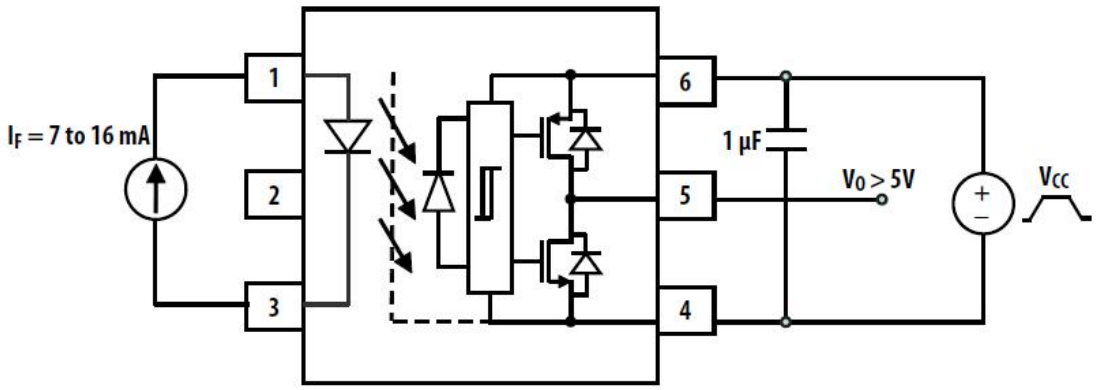



**Fig.22 tPHL, tPLH, tr and tf Test Circuit and Waveforms**

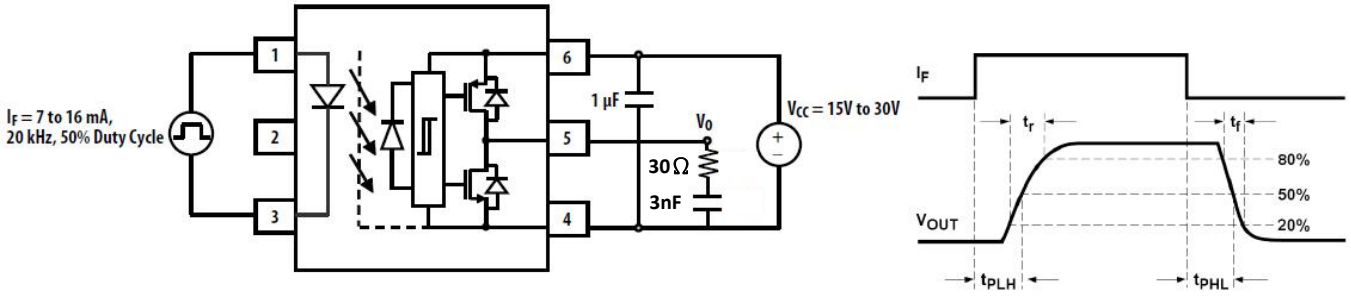
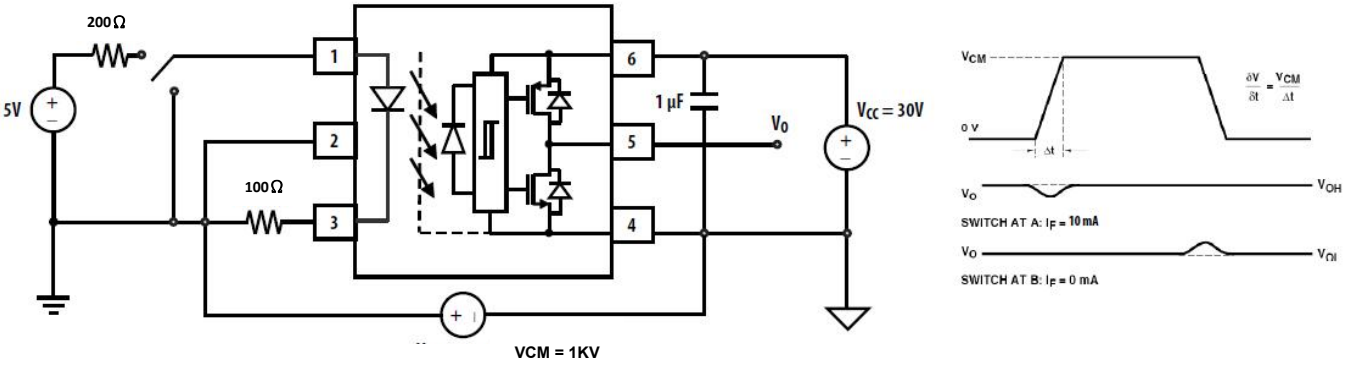
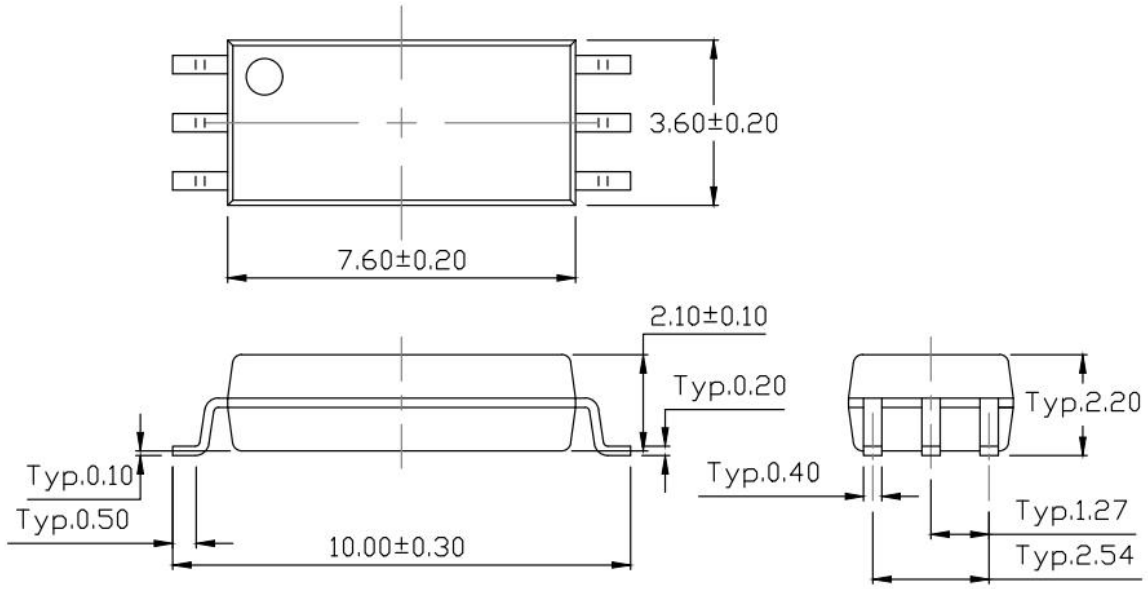



**Fig.23 CMR Test Circuit with Split Resistors Network and Waveforms**

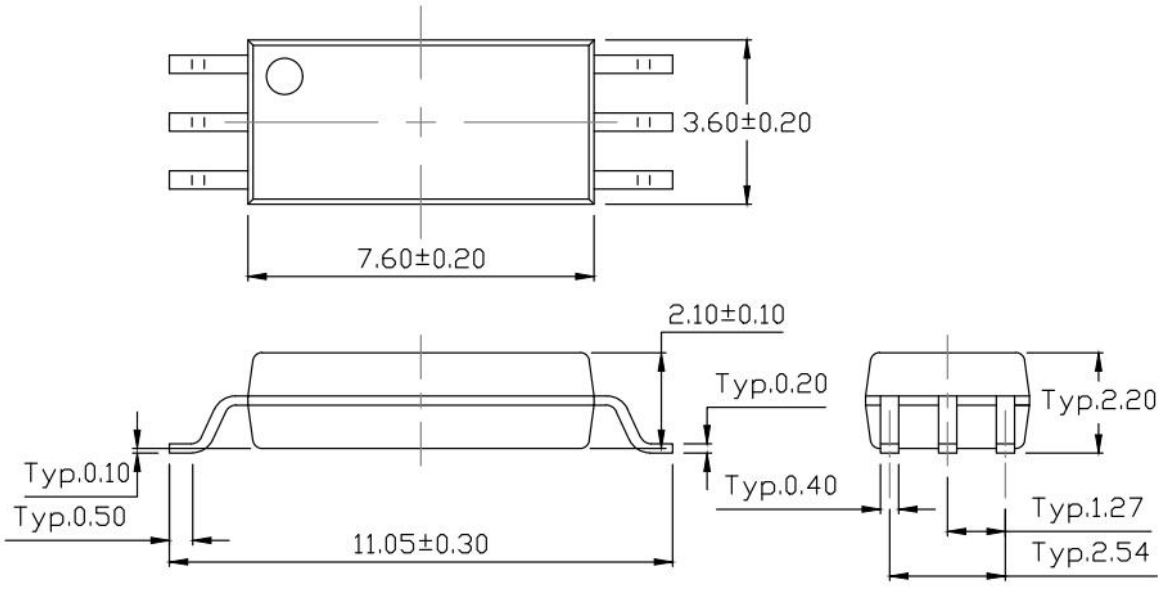


## PACKAGE DIMENSIONS (Dimensions in mm unless otherwise stated)

### Standard P Type

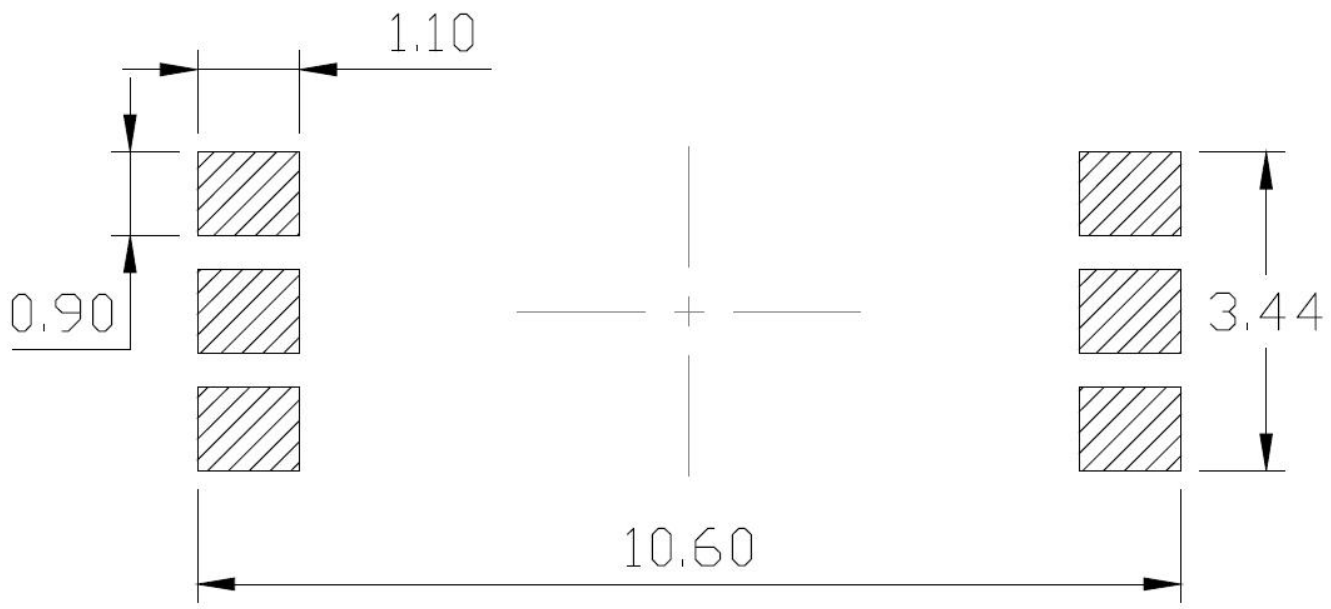



### Standard W Type

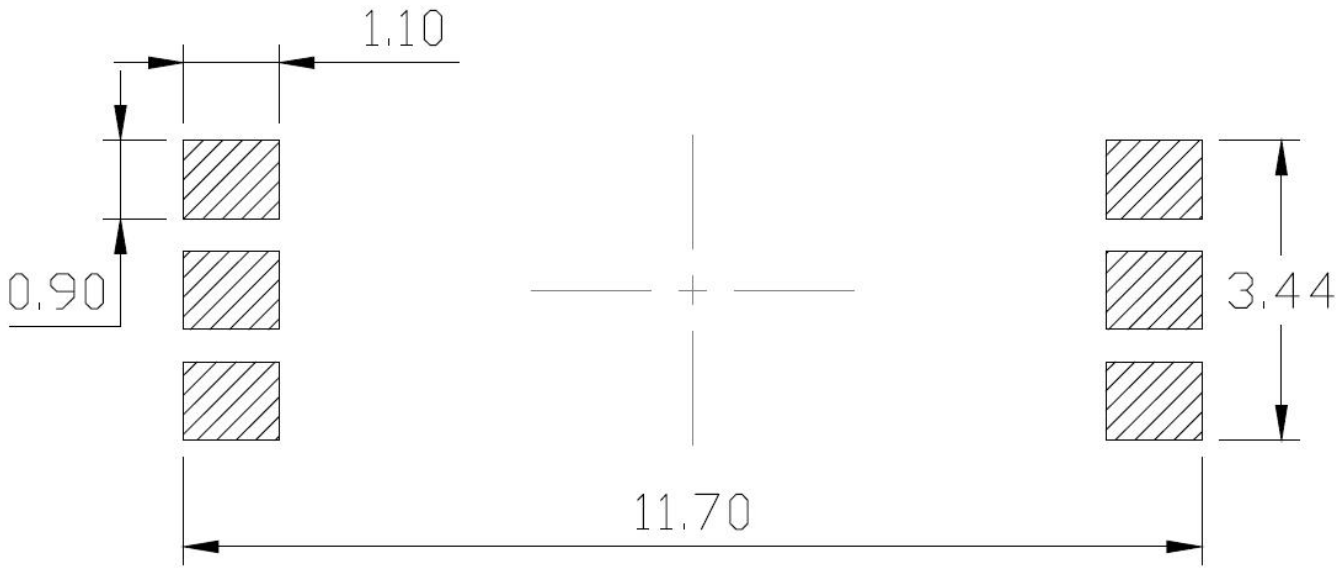


## RECOMMENDED SOLDER MASK (Dimensions in mm unless otherwise stated)

### Standard P Type

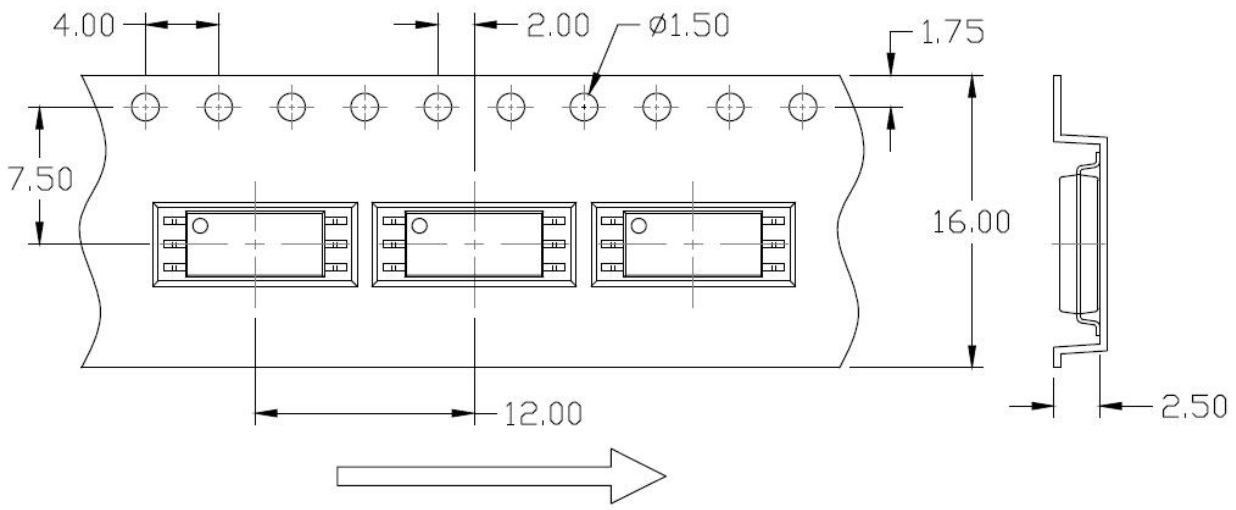



### Standard W Type

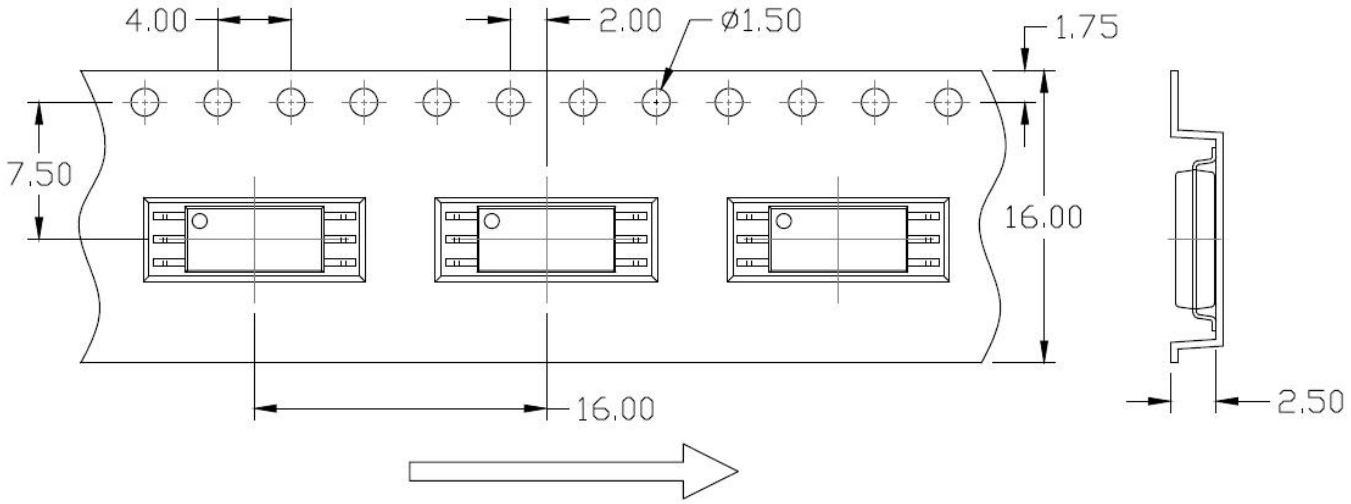


## CARRIER TAPE SPECIFICATIONS (Dimensions in mm unless otherwise stated)

### Standard P Type

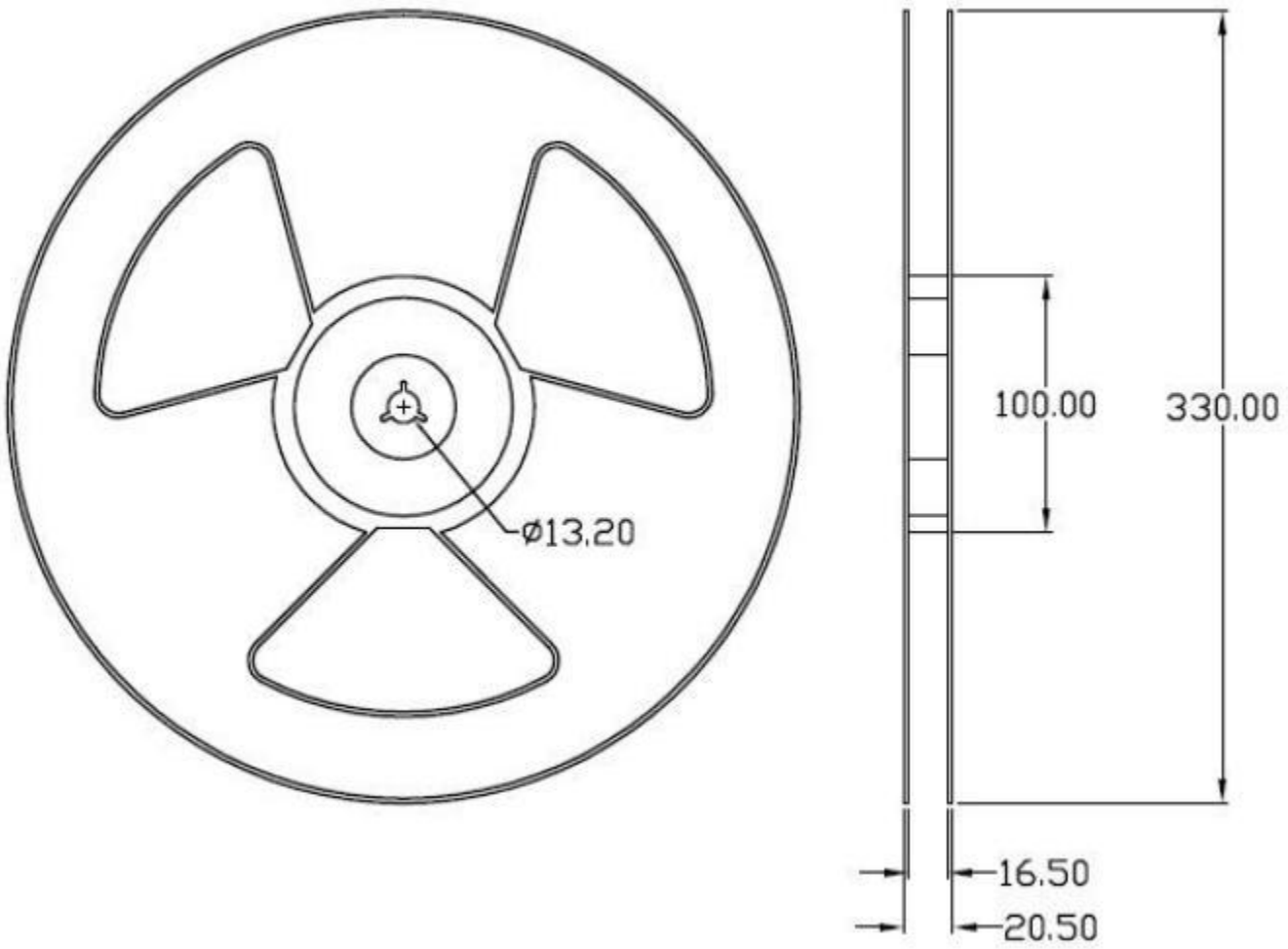



### Standard W Type



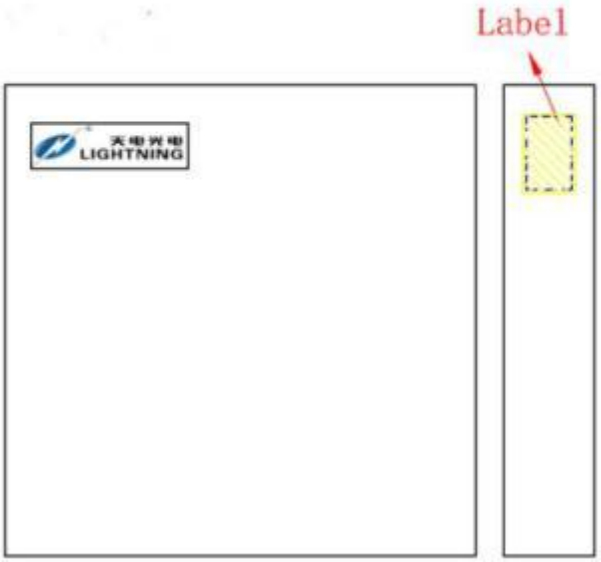
## REEL SPECIFICATIONS (Dimensions in mm unless otherwise stated)

**Option**



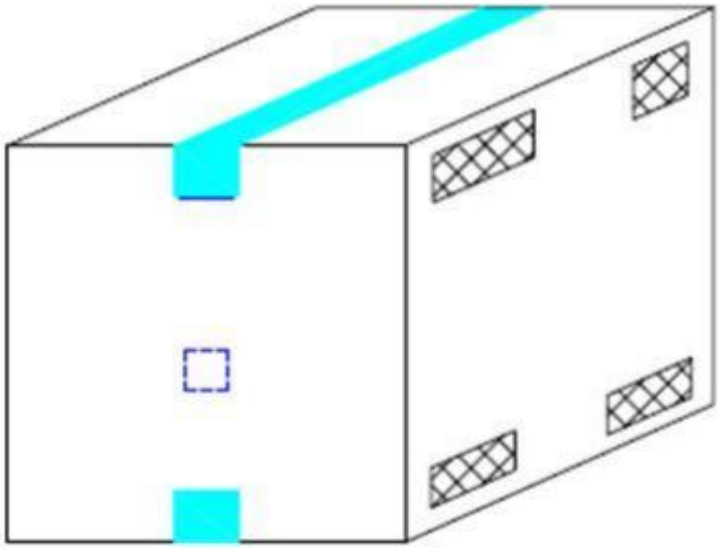
## BOX SPECIFICATIONS (Reel Type)

### Inner Box




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

### Outer Box



- L x W x H = 45cm x 3

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- The characteristic curves shown in this datasheet are representing typical performance which are not guaranteed.
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