

## ■ Features

- Positive output type (totem pole output)
- Truth Table Guaranteed: VCC 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
- MSL class 1
- Regulatory Approvals
  - UL - UL1577
  - VDE - EN60747-5-5
  - CQC – GB4943.1-2011

## ■ Description

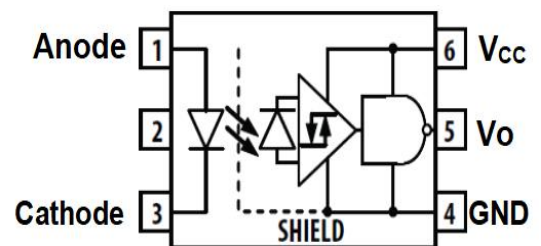
The MPH480 series fast speed photocoupler contains a LED and photo detector with built-in Schmitt trigger to provide logic-compatible waveforms, eliminating the need for additional wave shaping. The totem pole output eliminates the need for a pull up resistor and allows for direct drive Intelligent Power Module or gate drive.

Minimized propagation delay difference between devices makes these optocouplers excellent solutions for improving inverter efficiency through reduced switching dead time.

## ■ Applications

- IPM Interface Isolation
- Isolated IGBT/Power MOSFET gate drive
- Industrial Inverter
- AC and Brushless DC motor drives
- General Digital Isolation

## ■ Schematic





## MPH480 Series **IPM Photo Coupler**

### TURTH TABLE

LED	OUT
ON	High
OFF	Low

**Note:** A 0.1 $\mu$ F 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	
Total Package Power Dissipation	$P_T$	-	145	mW	
Supply Voltage	$V_{CC}$	0	35	V	
Output Voltage	$V_O$	-0.5	$V_{CC}$	V	
Output Collector Current	$I_O$	-	50	mA	
Isolation Voltage	Viso	5000	-	Vrms	
Operating Temperature	Topr	-40	110	$^{\circ}$ C	
Output IC Junction Temperature	$T_J$	-	125	$^{\circ}$ C	
Storage Temperature	Tstg	-55	125	$^{\circ}$ C	
Soldering Temperature	Tsol	-	260	$^{\circ}$ 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.

### RECOMMENDED OPERATION CONDITIONS

PARAMETER	SYMBOL	MIN.	MAX.	UNIT
Operating Temperature	$T_A$	-40	110	$^{\circ}$ C
Supply Voltage <sup>1</sup>	$V_{CC}$	4.5	30	V
Input Current(ON) <sup>2</sup>	$I_{F(ON)}$	1.6	5	mA
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.



# MPH480 Series

## IPM Photo Coupler

### ELECTRICAL OPTICAL CHARACTERISTICS

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITION	NOTE
INPUT CHARACTERISTICS							
Forward Voltage	$V_F$	1.6	2.0	2.4	V	$I_F=10\text{mA}$	
Input Forward Voltage Temperature Coefficient	$\Delta V_F / \Delta T$	-	-1.237	-	mV/°C	$I_F=10\text{mA}$	
Input Reverse Voltage	$BV_R$	5	-	-	V	$I_R=10\mu\text{A}$	
Input Threshold Current (Low to High)	$I_{FLH}$	-	0.25	1.5	mA	$V_{CC}=30\text{V}, V_O>5\text{V}$	
Input Threshold Voltage (High to Low)	$V_{FHL}$	0.8	-	-	V	$V_{CC}=30\text{V}, V_O<5\text{V}$	
Input Capacitance	$C_{IN}$	-	60	-	pF	$V_F=0, f=1\text{kHz}$	2
OUTPUT CHARACTERISTICS							
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	$I_{OH}$	-	-	-160	mA	$V_{CC}=5.5\text{V}, I_F=5\text{mA}, V_O=\text{GDN}$	1
				-200	mA	$V_{CC}=20\text{V}, I_F=5\text{mA}, V_O=\text{GDN}$	
Low Level Output Current	$I_{OL}$	160	-	-	mA	$V_O=V_{CC}=5.5\text{V}, V_F=0\text{V}$	1
		200	-	-	mA	$V_O=V_{CC}=20\text{V}, V_F=0\text{V}$	
High Level Output Voltage	$V_{OH}$	$V_{CC}-0.5$	$V_{CC}-0.04$	-	V	$I_{OL}=-6.5\text{mA}$	
Low Level Output Voltage	$V_{OL}$	-	0.09	0.5	V	$I_{OL}=6.5\text{mA}$	

Specified over recommended temperature ( $T_A = -40^\circ\text{C}$  to  $+110^\circ\text{C}$ ,  $+4.5\text{V} \leq V_{CC} \leq 30\text{V}$ ),  $I_{F(\text{ON})} = 1.6\text{mA}$  to  $5\text{mA}$ ,  $V_{F(\text{OFF})} = 0\text{V}$  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.



# MPH480 Series

## IPM Photo Coupler

SWITCHING SPECIFICATION							
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITION	NOTE
SWITCHING CHARACTERISTICS							
Propagation Delay Time to Output Low Level	$t_{PHL}$	-	110	220	ns	f=10kHz, Duty Cycle=50%, I <sub>F</sub> =2mA, V <sub>CC</sub> =30V	1
Propagation Delay Time to Output High Level	$t_{PLH}$	-	90	220	ns		1
Pulse Width Distortion	PWD	-	20	120	ns		2
Propagation Delay Difference Between Any Two Parts	PDD ( $t_{PHL}-t_{PLH}$ )	-200	-	+200	ns		3
Rise Time	$t_r$	-	6	-	ns		
Fall Time	$t_f$	-	7	-	ns		
Common Mode Transient Immunity at Logic High	CM <sub>H</sub>	20	-	-	kV/μs	I <sub>F</sub> =4mA, V <sub>CC</sub> =5V, T <sub>A</sub> =25°C, V <sub>CM</sub> =1.5kV	4
Common Mode Transient Immunity at Logic Low	CM <sub>L</sub>	20	-	-	kV/μs	I <sub>F</sub> =0mA, V <sub>CC</sub> =5V, T <sub>A</sub> =25°C, V <sub>CM</sub> =1.5kV	4

Over recommended operating conditions T<sub>A</sub> = -40° C to 105° C, V<sub>CC</sub> = +4.5 V to 30 V, I<sub>F(ON)</sub> = 1.6 mA to 5 mA, V<sub>F(OFF)</sub> = 0 V to 0.8 V, unless otherwise specified. All typicals at T<sub>A</sub> = 25°C.

**Note 1:** The t<sub>PLH</sub> 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<sub>PHL</sub> 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<sub>PHL</sub> - t<sub>PLH</sub>| for any given device.

**Note 3:** The difference of t<sub>PLH</sub> and t<sub>PHL</sub> between any two devices under the same test condition.

**Note 4:** CM<sub>H</sub> is the maximum slew rate of the common mode voltage that can be sustained with the output voltage in the logic high state, V<sub>O</sub> > 2.0 V. CM<sub>L</sub> is the maximum slew rate of the common mode voltage that can be sustained with the output voltage in the logic low state, V<sub>O</sub> < 0.8 V. Note: Equal value split resistors (R<sub>in</sub>/2) must be used at both ends of the LED.

## ISOLATION CHARACTERISTIC

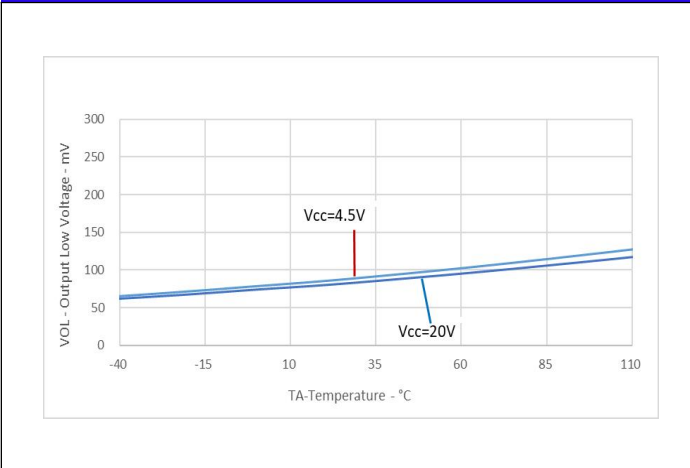
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITION	NOTE
Withstand Insulation Test Voltage	$V_{ISO}$	5000	-	-	V	$RH \leq 40 \sim 60\%$ , $t=1\text{min}, T_A=25^\circ\text{C}$	1,2
Input-Output Resistance	$R_{I-O}$	-	$10^{12}$	-	$\Omega$	$V_{I-O}=500\text{V DC}$	1

All Typical values at  $T_A = 25^\circ\text{C}$

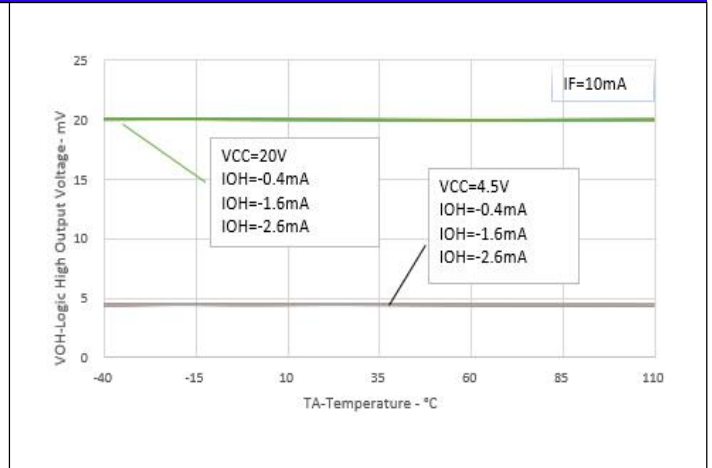
**Note 1:** Device is considered a two terminal device: pins 1, 2, 3 are shorted together and pins 4, 5, 6 are shorted together.

**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.

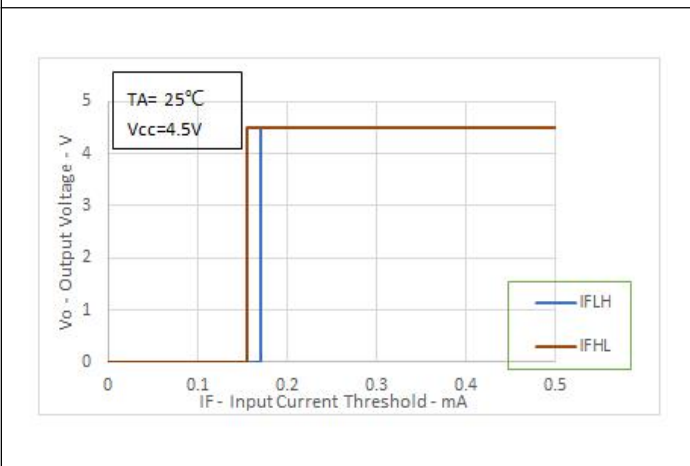
## TYPICAL PERFORMANCE CURVES & TEST CIRCUITS



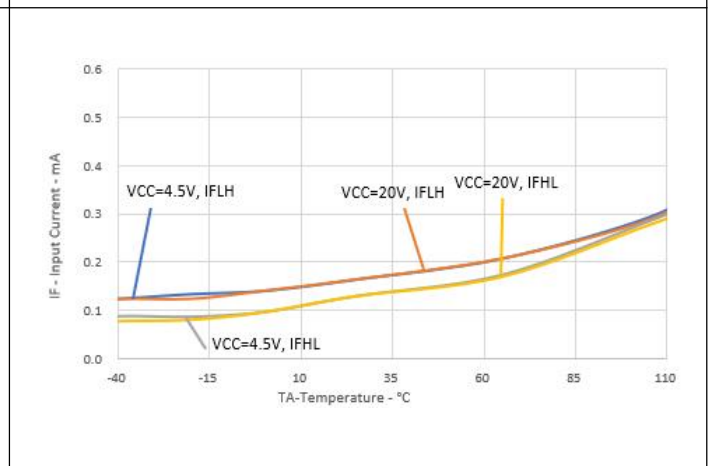
**Fig.1**  $V_{OL}$  vs. Temperature



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

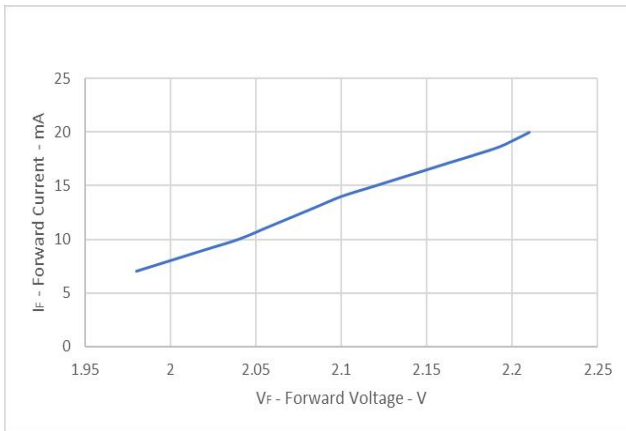


**Fig.3**  $I_{FLH}$  Hysteresis

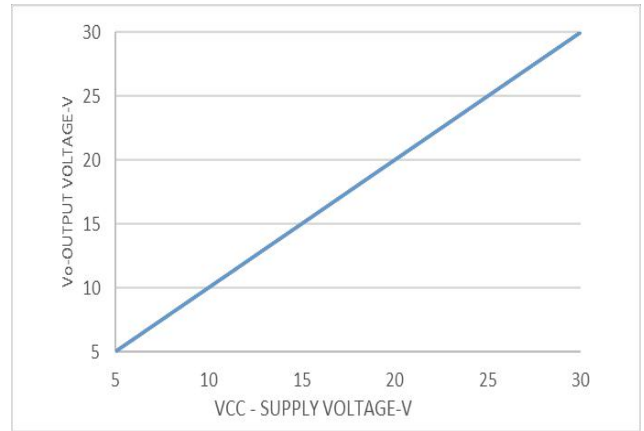


**Fig.4**  $I_{FLH}$  vs. Temperature

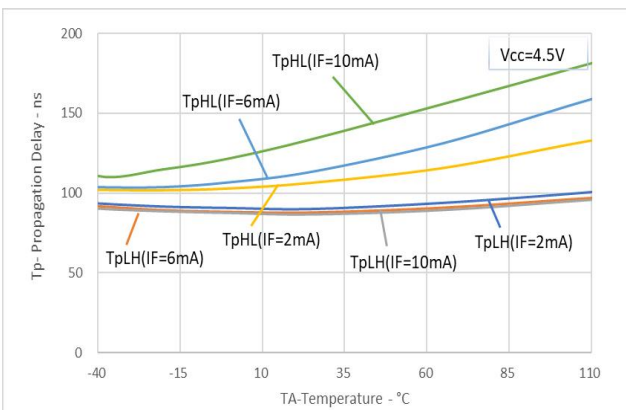
## CHARACTERISTIC CURVES



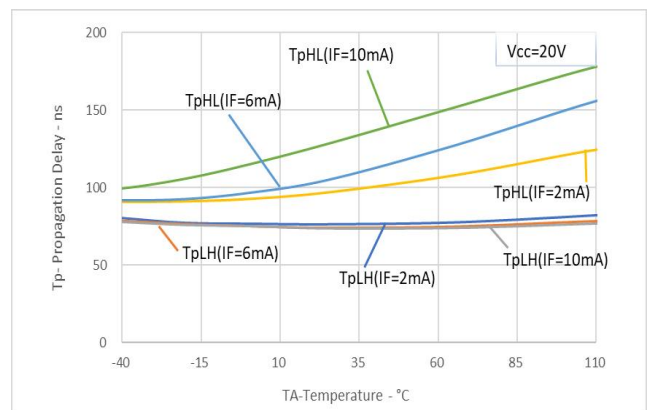
**Fig.5 Input Current vs. Voltage**



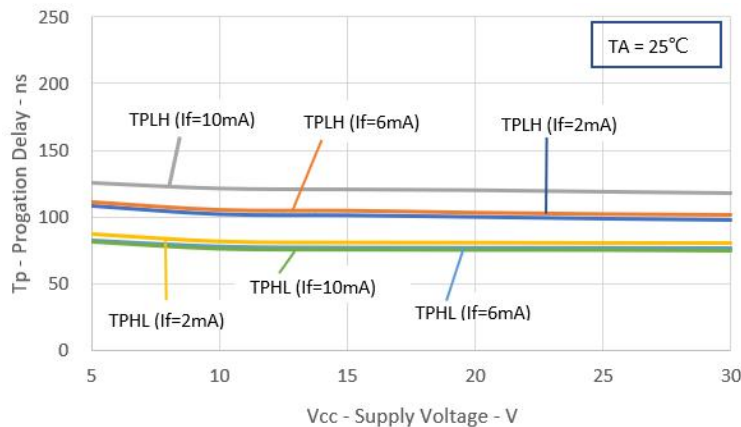
**Fig.6 Supply Voltage vs. Output Voltage**



**Fig.7 Propagation Delays vs. Temperature**



**Fig.8 Propagation Delays vs. Temperature**



**Fig.9 Propagation Delays vs. V<sub>CC</sub>**

## TEST CIRCUITS

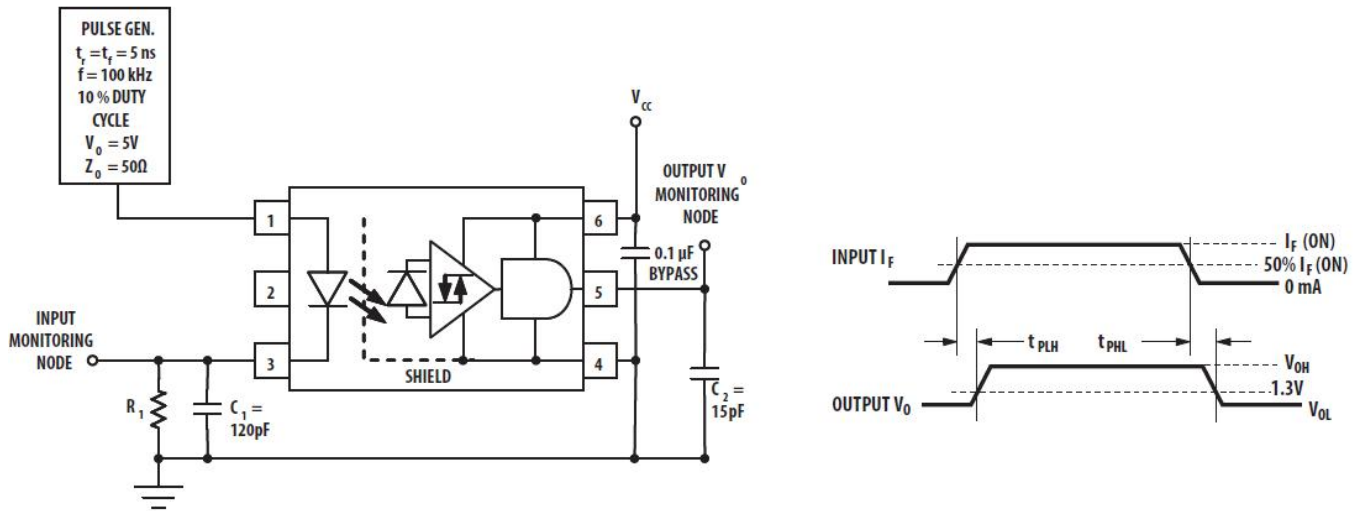


Fig.10 Test Circuit for  $t_{PLH}$ 、 $t_{PHL}$ 、 $t_r$  and  $t_f$

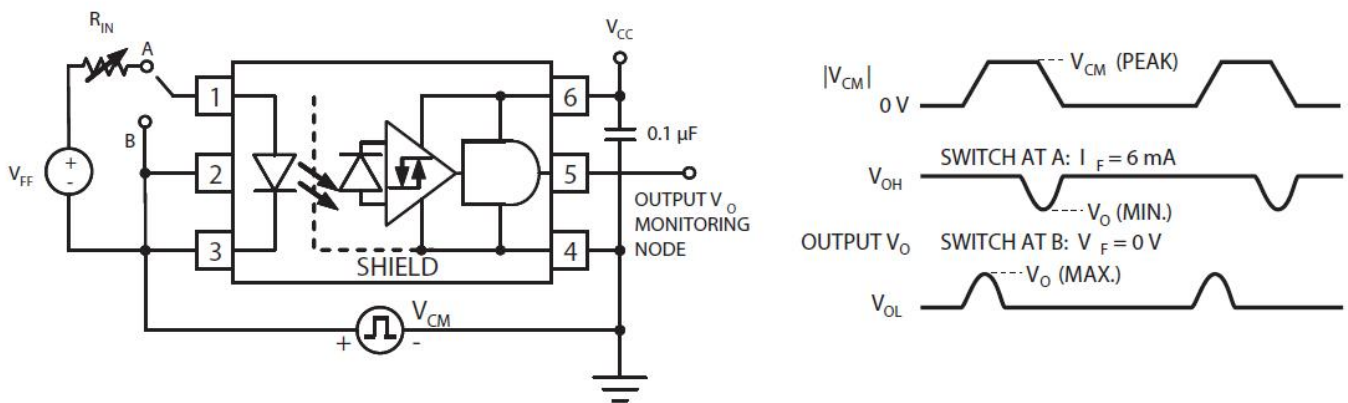
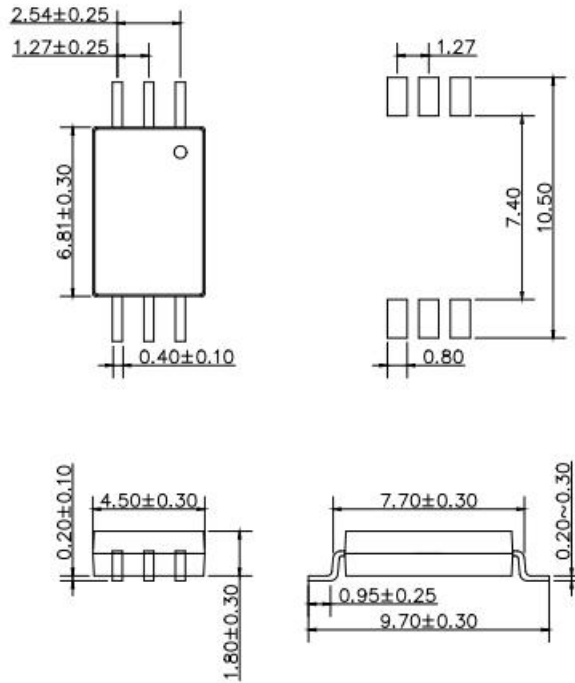


Fig.11 Common Mode Transient Immunity Test Circuit and Typical Waveforms

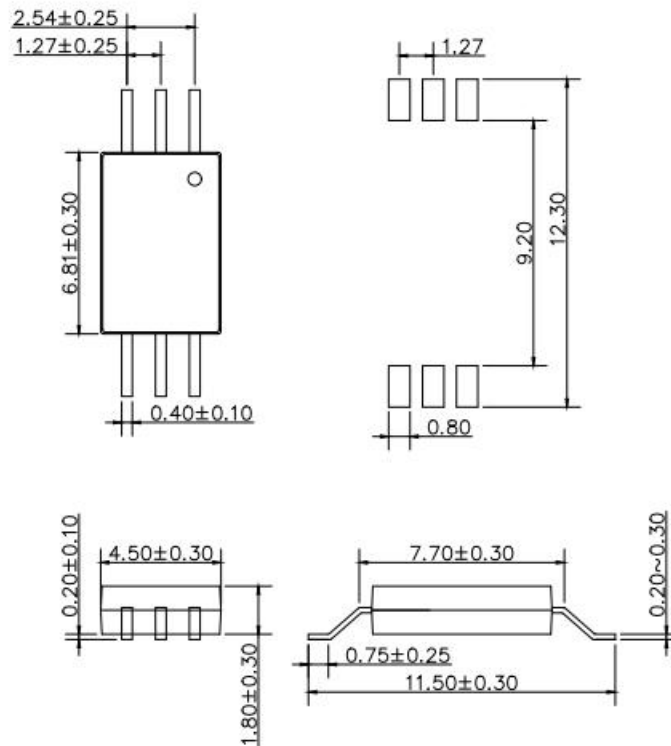
## PACKAGE DIMENSIONS (Dimensions in mm unless otherwise stated)

### Surface Mount Lead Forming

#### P type Dimension



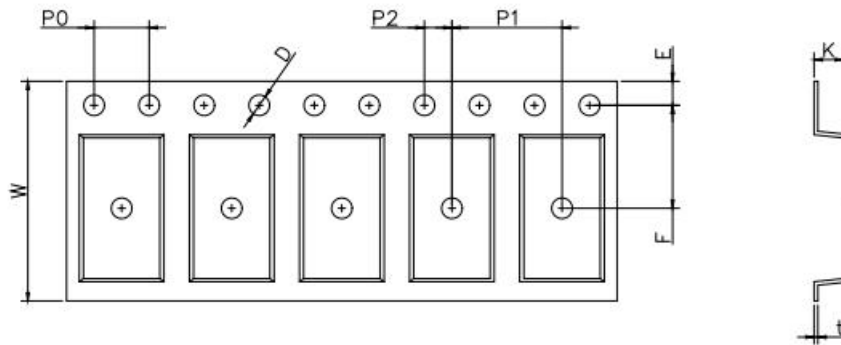
#### W type Dimension





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

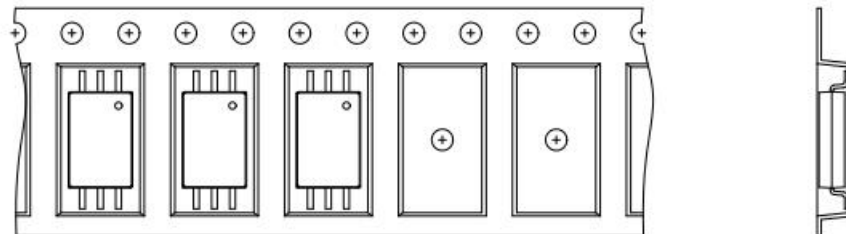
### Taping Dimensions



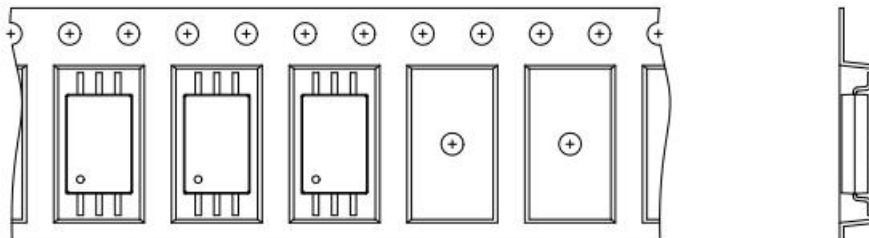
Dimension Symbol	D	E	F	P0	P1	P2	t	W	K
P type Dimension (mm)	1.5±0.1	1.75±0.1	7.5±0.1	4.0±0.1	8.0±0.1	2.0±0.1	0.3±0.1	16.0±0.3	2.15±0.1
W type Dimension (mm)	1.5±0.1	1.75±0.1	11.5±0.1	4.0±0.1	8.0±0.1	2.0±0.1	0.3±0.1	24.0±0.3	2.52±0.1

### Tape & Reel Packing Specifications

#### Option T1



#### Option T2



**ORDERING AND MARKING INFORMATION**

**MARKING INFORMATION**



**MP** : Company Abbr.  
**H** : High performance Photocoupler  
**480** : 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**

**MPH480(P/W)-VZ**

MP– Company Abbr.  
H – High performance Photocoupler  
480 – 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**

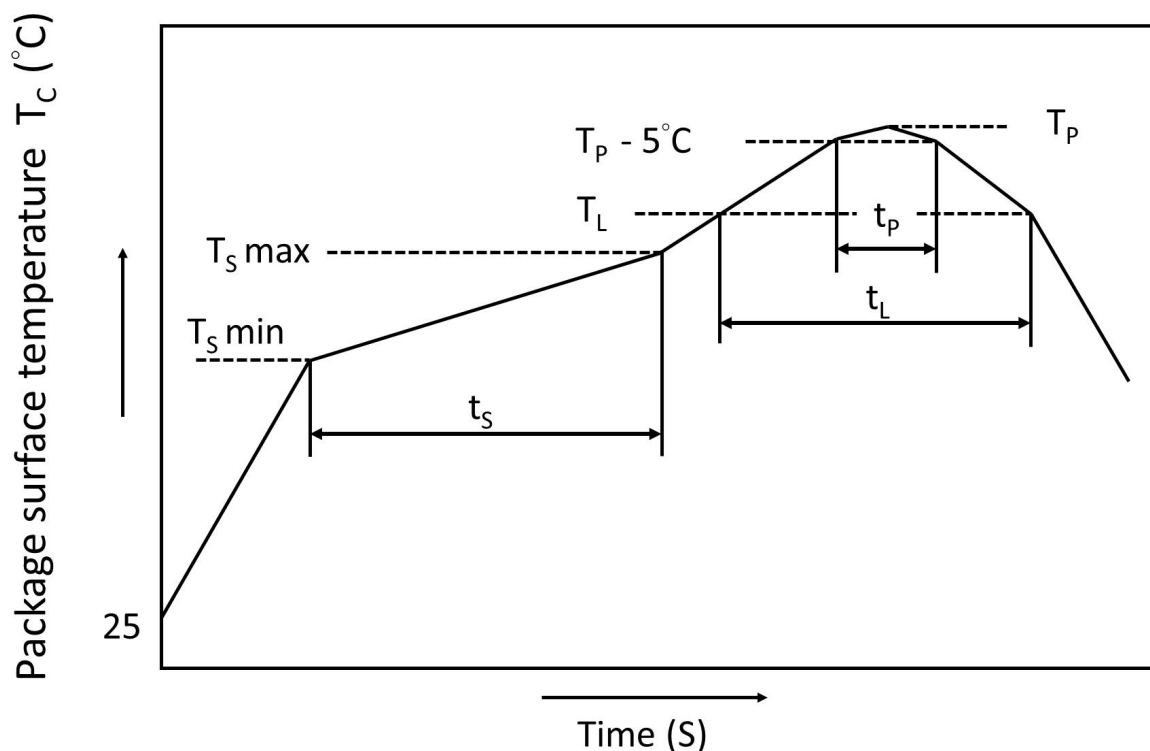
Option	Description	Quantity
P(T1)	Surface Mount Lead Forming – With Option 1 Taping	3000 Units/Reel
P(T2)	Surface Mount Lead Forming – With Option 2 Taping	3000 Units/Reel
W(T1)	Surface Mount Lead Forming – With Option 1 Taping	3000 Units/Reel
W(T2)	Surface Mount Lead Forming – With Option 2 Taping	3000 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	$^\circ\text{C}$
Preheat time	$t_s$	60	120	s
Ramp-up rate ( $T_L$ to $T_P$ )			3	$^\circ\text{C/s}$
Liquidus temperature	$T_L$	217		$^\circ\text{C}$
Time above $T_L$	$t_L$	60	100	s
Peak Temperature	$T_P$		260	$^\circ\text{C}$
Time during which $T_C$ is between ( $T_P - 5$ ) and $T_P$	$t_p$		20	s
Ramp-down rate			6	$^\circ\text{C/s}$



**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.
- 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.
- Immerge unit’s body in solder paste is not recommended.
- Discoloration might be occurred on the package surface after soldering, reflow or long-time use. It neither impacts the performance nor reliability.

**■ Revision History**

<b>Version</b>	<b>Date</b>	<b>Subjects (major changes since last revision)</b>
1.0	2022-07-22	Datasheet Complete