MPH481 Series
IPM Photo Coupler

■ Features

- Inverted 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
- Available in Stretched SO-6 Package
- MSL class 1
- Regulatory Approvals
  - UL - UL1577
  - VDE - EN60747-5-5
  - CQC – GB4943.1-2011

■ Applications

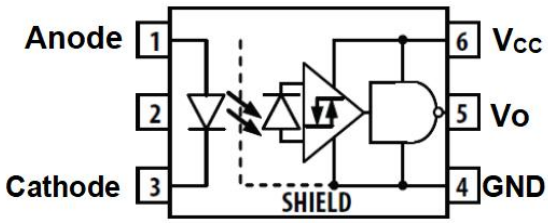
- IPM Interface Isolation
- Isolated IGBT/Power MOSFET gate drive
- Industrial Inverter
- AC and Brushless DC motor drives
- General Digital Isolation

■ Description

The MPH481 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.

■ Schematic



TURTH TABLE	
LED	OUT
ON	Low
OFF	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	
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	°C	
Output IC Junction Temperature	T_J	-	125	°C	
Storage Temperature	Tstg	-55	125	°C	
Soldering Temperature	Tsol	-	260	°C	

Note: A ceramic capacitor (0.1 μF) 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	°C
Supply Voltage[1]	V_{CC}	4.5	30	V
Input Current(ON)[2]	$I_{F(ON)}$	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.

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=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}	-	0.25	1.5	mA	V_{CC}=30V,V_O>5V	
Input Threshold Voltage (High to Low)	V_{FHL}	0.8	-	-	V	V_{CC}=30V,V_O<5V	
Input Capacitance	C_{IN}	-	60	-	pF	V_F=0, f=1kHz	2
OUTPUT CHARACTERISTICS							
High Level Supply Current	I_{CCH}	-	-	3.0	mA	V_{CC}=5.5V,V_F=0V,I_O=0mA	
		-	1.9	3.0	mA	V_{CC}=30V,V_F=0V,I_O=0mA	
Low Level Supply Current	I_{CCL}	-	-	3.0	mA	V_{CC}=5.5V,I_F=5mA,I_O=0mA	
		-	2.0	3.0	mA	V_{CC}=30V,I_F=5mA,I_O=0mA	
High Level Output Current	I_{OH}	-	-	-160	mA	V_{CC}=5.5V,V_F=0V,V_O=GND	1
				-200	mA	V_{CC}=20V,V_F=0V,V_O=GND	
Low Level Output Current	I_{OL}	160	-	-	mA	V_O=V_{CC}=5.5V,I_F=5mA	1
		200	-	-	mA	V_O=V_{CC}=20V,I_F=5mA	
High Level Output Voltage	V_{OH}	V_{CC}-0.5	V_{CC}-0.05	-	V	I_{OL}=-6.5mA	
Low Level Output Voltage	V_{OL}	-	0.09	0.5	V	I_{OL}=6.5mA	

Specified over recommended temperature (T_A = -40°C to +110°C, +4.5V ≤ V_{CC} ≤ 30V), $I_{F(ON)}$ = 1.6mA to 5mA, $V_{F(OFF)}$ = 0V to 0.8V, unless otherwise specified. All typicals at T_A = 25°C .

Note 1: Duration of output short circuit time should not exceed 500 μs.

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

SWITCHING SPECIFICATION							
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITION	NOTE
SWITCHING CHARACTERISTICS							
Propagation Delay Time to Output Low Level	t_{PHL}	-	90	220	ns	f=10kHz, Duty Cycle=50%, I_F=2mA, V_{CC}=30V	1
Propagation Delay Time to Output High Level	t_{PLH}	-	110	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_H	20	-	-	kV/μs	V_F=0V,V_{CC}=5V, T_A=25°C, V_{CM}=1.5kV	4
Common Mode Transient Immunity at Logic Low	CM_L	20	-	-	kV/μs	I_F=4mA,V_{CC}=5V, T_A=25°C, V_{CM}=1.5kV	4

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

Note 1: The tPLH 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 tPHL 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 |tPHL - tPLH | for any given device.

Note 3: The difference of tPLH and tPHL between any two devices under the same test condition.

Note 4: CMH 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 V. CML 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 V. Note: Equal value split resistors (Rin/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≤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

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

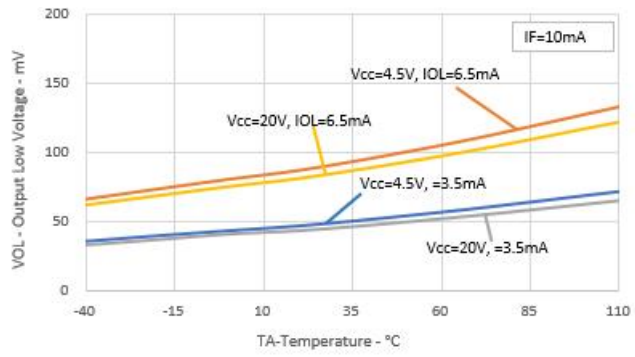


Fig.1 V_{OL} vs. Temperature

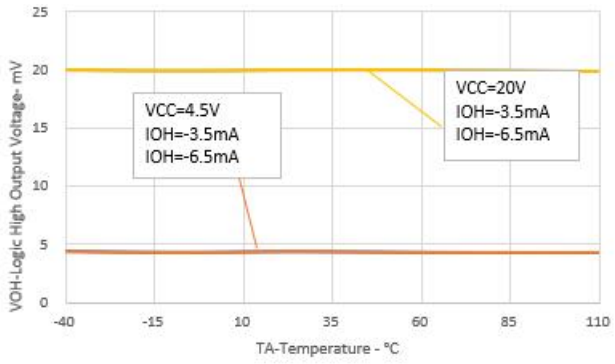


Fig.2 V_{OH} vs. Temperature

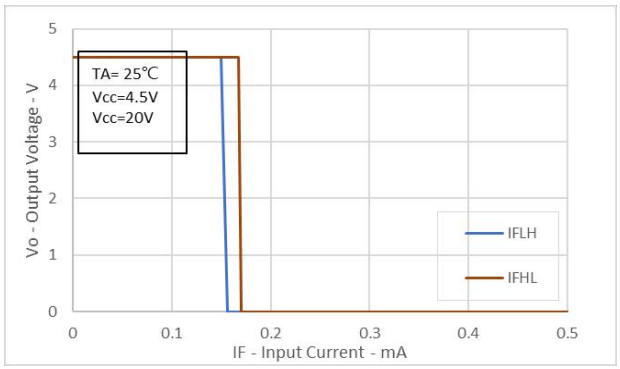


Fig.3 I_{FLH} Hysteresis

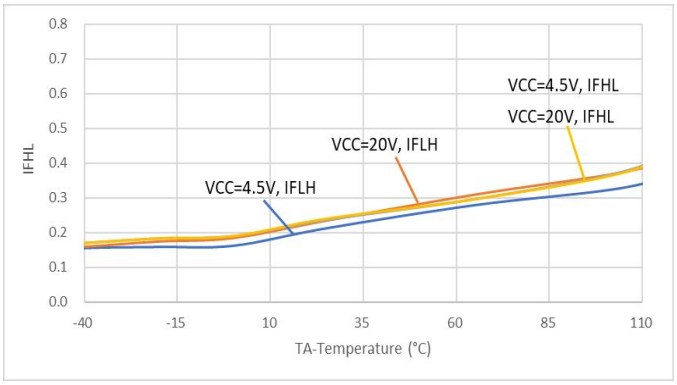


Fig.4 I_{FLH} vs. Temperature

CHARACTERISTIC CURVES

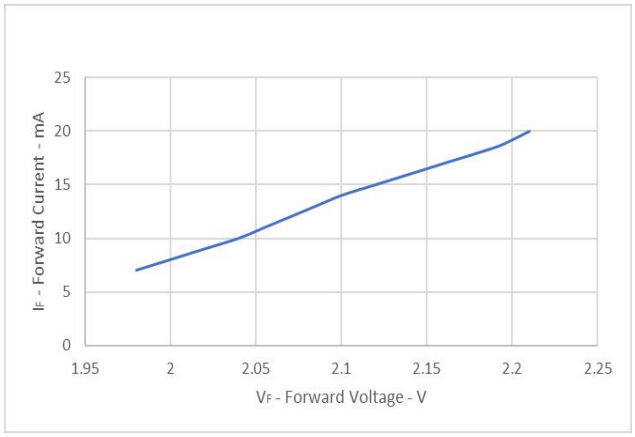


Fig.5 Input Current vs. Voltage

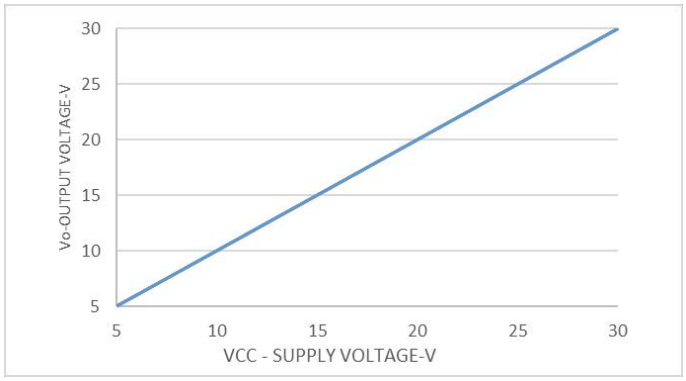


Fig.6 Supply Voltage vs. Output Voltage

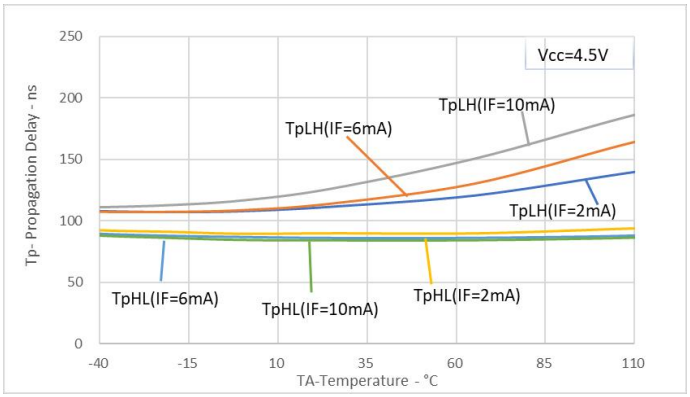


Fig.7 Propagation Delays vs. Temperature

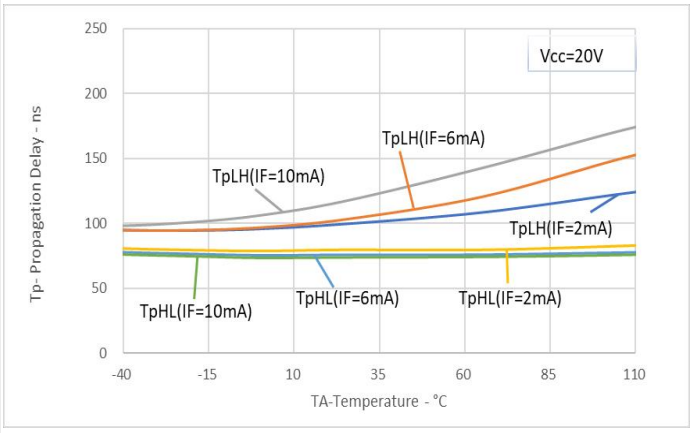


Fig.8 Propagation Delays vs. Temperature

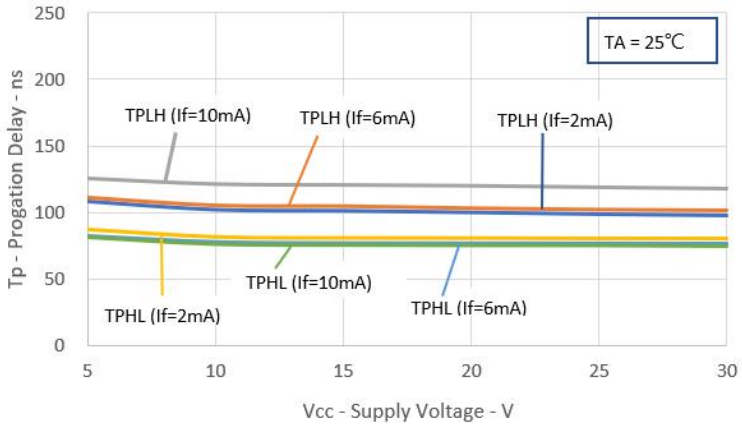


Fig.9 Propagation Delays vs. V_{CC}

TEST CIRCUITS

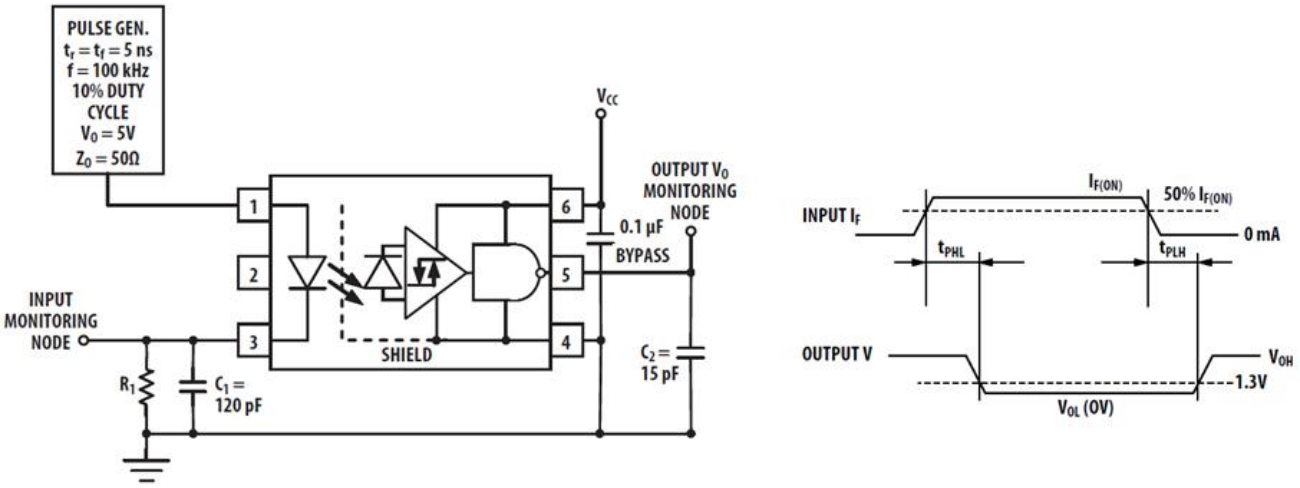


Fig.10 Test Circuit for tPLH、tPHL、tr and tf

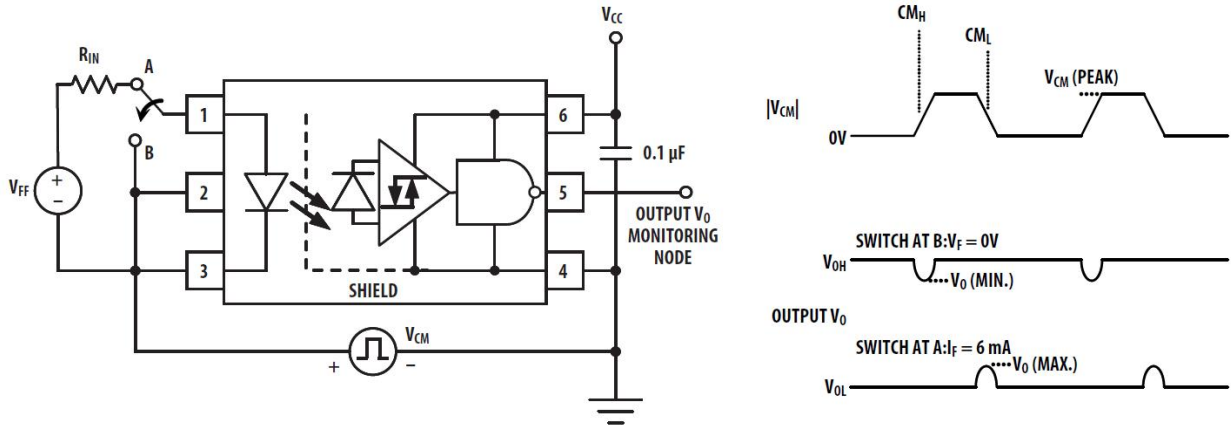
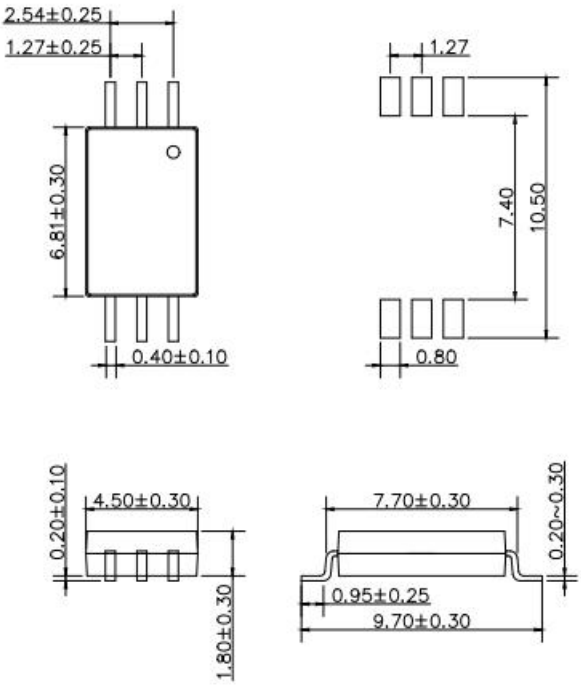


Fig.11 Common Mode Transient Immunity Test Circuit and Typical Waveforms

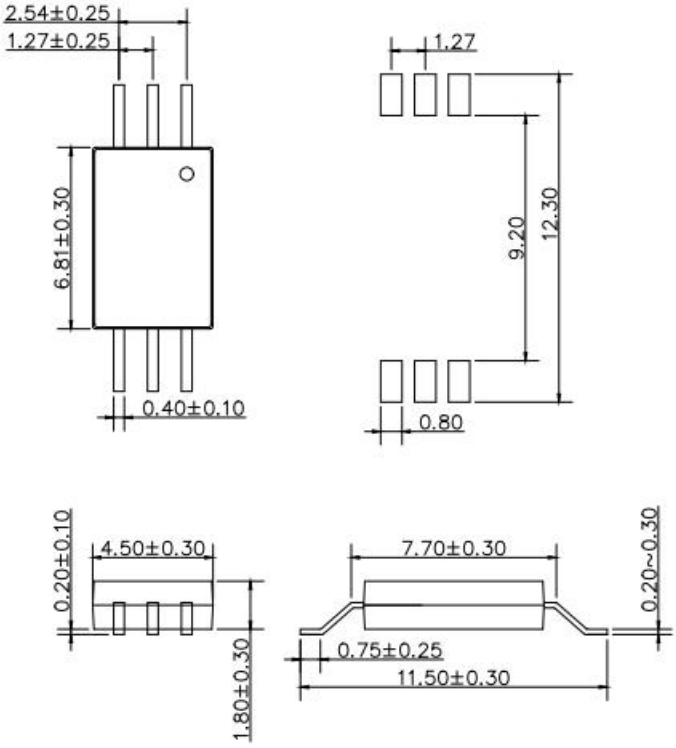
PACKAGE DIMENSIONS (Dimensions in mm unless otherwise stated)

Surface Mount Lead Forming

P type Dimension

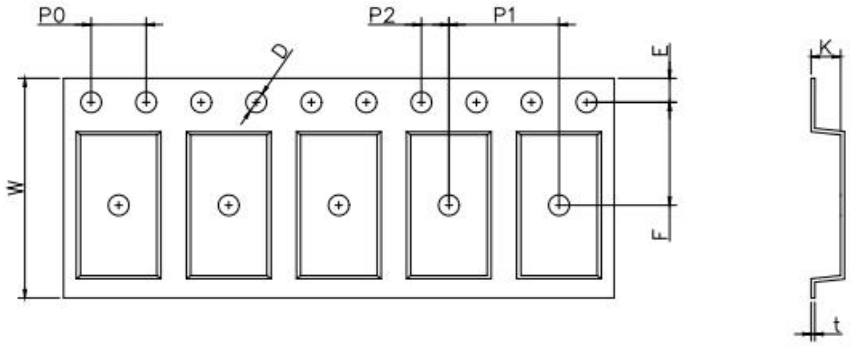


W type Dimension



TAPING DIMENSIONS (Dimensions in mm unless otherwise stated)

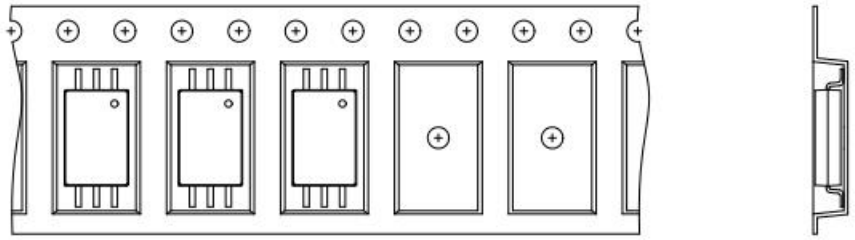
Taping Dimensions



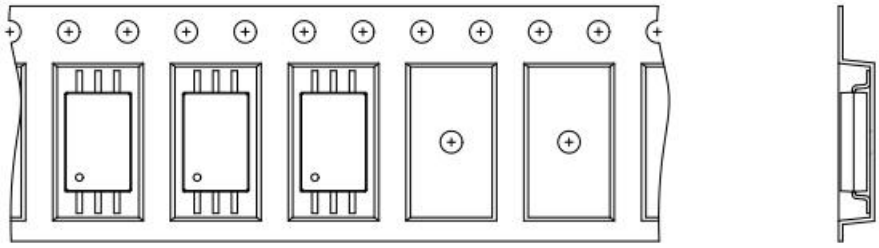
Dimension Symbol	D	E	F	P0	P1	P2	t	W	K
P type Dimension (mm)	1.5±0.1	1.75±0.1	7.5±0.1	4.0±0.1	8.0±0.1	2.0±0.1	0.3±0.1	16.0±0.3	2.15±0.1
W type Dimension (mm)	1.5±0.1	1.75±0.1	11.5±0.1	4.0±0.1	8.0±0.1	2.0±0.1	0.3±0.1	24.0±0.3	2.52±0.1

Tape & Reel Packing Specifications

Option T1



Option T2



ORDERING AND MARKING INFORMATION

MARKING INFORMATION

MP	: Company Abbr.
H	: High performance Photocoupler
481	: 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

MPH481(P/W)-VZ

MP– Company Abbr.

H – High performance Photocoupler

481 – 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

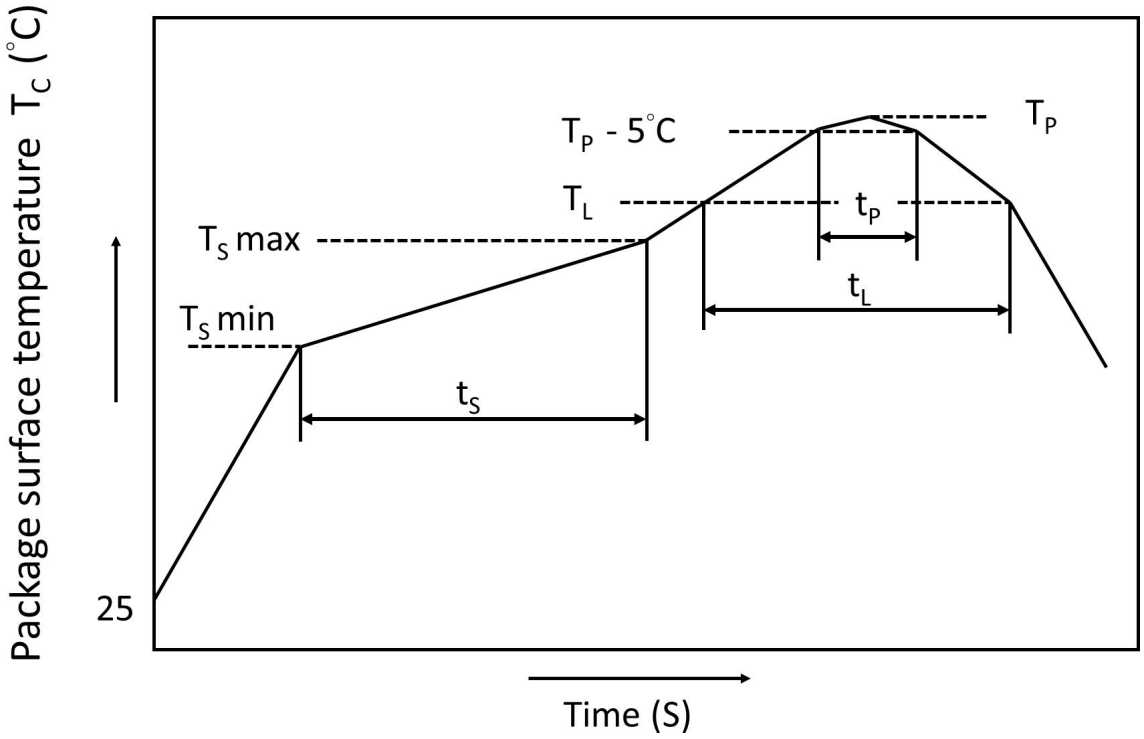
Option	Description	Quantity
P(T1)	Surface Mount Lead Forming – With Option 1 Taping	3000 Units/Reel
P(T2)	Surface Mount Lead Forming – With Option 2 Taping	3000 Units/Reel
W(T1)	Surface Mount Lead Forming – With Option 1 Taping	3000 Units/Reel
W(T2)	Surface Mount Lead Forming – With Option 2 Taping	3000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

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