IPM Photocoupler

Product Description

The EMD2A481 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

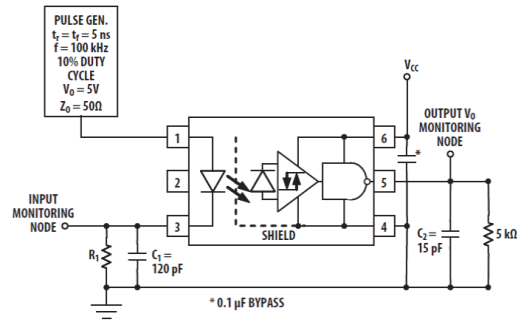
- IPM Interface Isolation
- Isolated IGBT/MOSFET Gate Drive
- AC and Brushless DC Motor Drives
- Industrial Inverters

Features

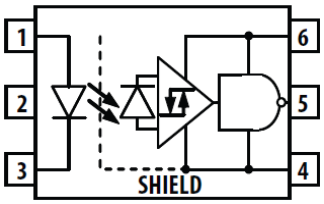
- Totem pole output inverter logic type
- Truth Table Guaranteed: VCC from 4.5V to 30V
- Performance Specified for Common IPM Applications Over Industrial Temperature Range.
- Short Maximum Propagation Delays
- Minimized Pulse Width Distortion (PWD)
- Very High Common Mode Rejection (CMR)
- Hysteresis
- Data rate: 5Mbps (typ.)

Safety approved

- UL1577 recognized with 3750 Vrms for 1 minute for EMD2A481-SK and 5000 Vrms for 1 minute for EMD2A481-SL
  Certificate No. E529603
- IEC/EN/DIN EN 60747-5-5 Approved
  V_{IORM} = 891 Vpeak for EMD2A481-SK
  V_{IORM} = 1140 Vpeak for EMD2A481-SL
  Certificate No. 40055846
- CQC approved: GB4943.1-2011
  Certificate No. CQC22001358589

SCHEMATIC	PIN DEFINITION	PACKAGE
	1.Anode 2.NC 3.Cathode 4.GND 5.VO 6.V_{CC}	

Connection Diagram



Order Information

EMD2A481-00S###%FR1

EMD2A	Photo coupler product series
481	Part Number
00	Internal control Code
S###	SK06: LSOP-6 Package 7mm clearance
	SL06: LSOP-6 Package 8mm clearance
%	E: RoHS & Halogen free package with VDE
	N: RoHS & Halogen free package
F	-40 to 110°C temperature rating
R1	Packing in Tape & Reel

Order, Mark & Packing Information

Package	Product ID	Mark		Packing
LSOP-6	EMD2A481-00SK06EFR1 EMD2A481-00SL06EFR1	EYYWW 481 HV	E : ESMT YY : Date code (Year) WW : Date code (Week) 481 : Part Number H : Internal Tracking Code V : VDE ID Option	Tape & Reel 3Kpcs
	EMD2A481-00SK06NFR1 EMD2A481-00SL06NFR1	EYYWW 481 H		

IEC/EN/DIN EN 60747-5-5 Insulation Characteristics

Description	Symbol	EMD2A481-SK	EMD2A481-SL	Unit
Climatic Classification	--	55/100/21	55/100/21	--
Pollution Degree (DIN VDE 0110/1.89)	--	2	2	--
Maximum Working Insulation Voltage	V_{IORM}	891	1140	V_{peak}
Input to Output Test Voltage, Method b (Note 1) V_{IORM} x 1.875=V_{PR}, 100% Production Test With t_m=1sec, Partial discharge < 5pC	V_{PR}	1671	2137	V_{peak}
Input to Output Test Voltage, Method a (Note 1) V_{IORM} x 1.6=V_{PR}, 100% Production Test With t_m=10sec, Partial discharge < 5pC	V_{PR}	1426	1824	V_{peak}
Highest Allowable Overvoltage (Transient Overvoltage t_{ini} = 60sec)	V_{IOTM}	6000	8000	V_{peak}
Safety-limiting values – maximum values allowed in the event of a failure				
Case Temperature	Ts	175	175	℃
Input Current	Is, INPUT	150	150	mA
Output Power	Ps, OUTPUT	600	600	mW
Insulation Resistance at TS, V_{IO} = 500 V	Rs	$>10^9$	$>10^9$	Ω

Note 1 : Refer to the optocoupler section of the Isolation and Control Components Designer's Catalog, under Product Safety Regulations section, (IEC/EN/DIN EN 60747-5-5) for a detailed description of Method a and Method b partial discharge test profiles.

These optocouplers are suitable for "safe electrical isolation" only within the safety limit data. Maintenance of the safety data shall be ensured by means of protective circuits. Surface mount classification is Class A accordance with CECC 00802.

Insulation and Safety-Related Specifications

Parameter	Symbol	EMD2A		Unit	Conditions
		481-SK	481-SL		
Minimum External Air Gap (External Clearance)	L(101)	7.0	8.0	mm	Measured from input terminals to output terminals, shortest distance through air.
Minimum External Tracking (External Creepage)	L(102)	8.0	8.0	mm	Measured from input terminals to output terminals, shortest distance path along body.
Tracking Resistance (Comparative Tracking Index)	CTI	>175	>175	V	DIN IEC 112/VDE 0303 Part 1.

Truth Table

LED	V_{CC}-V_{SS} (Turn-ON)
LED	OUT
ON	L
OFF	H

Note 2: A 0.1μF bypass capacitor must be connected between Pin 4 and 6.

Absolute Maximum Ratings (Ta = 25°C unless otherwise specified)

Parameter	Symbol	Min	Max	Unit
Storage Temperature	Tstg	-55	125	°C
Operating Temperature	Topr	-40	110	°C
Output IC Junction Temperature	TJ	-	125	°C
Average Forward Input Current	IF	-	20	mA
Reverse Input Voltage	VR	-	5	V
Output Collector Current	IO		50	mA
Supply Voltage	VCC	0	35	V
Output Collector Voltage	VO	-0.5	Vcc	V
Total Package Power Dissipation	PT	-	145	mW
Lead Solder Temperature	Tsol	-	260	°C

Note 3: 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 Condition

Parameter	Symbol	Min	Max	Unit
Operating Temperature	T_A	-40	110	°C
Supply Voltage	V_{CC}	4.5	30	V
Input Current (ON) (Note 4)	$I_{F(ON)}$	1.6	5	mA
Input Voltage (OFF) (Note 5)	$V_{F(OFF)}$		0.8	V

Note 4: Detector requires a VCC of 4.5 V or higher for stable operation as output might be unstable if VCC is lower than 4.5 V. Be sure to check the power ON/OFF operation other than the supply current.

Note 5: 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 Characteristics

All Typical values at T_A = 25°C, unless otherwise specified; all minimum and maximum specifications are at recommended operating condition.

Parameter	Symbol	Min	Typ	Max	Unit	Test Condition
Input Characteristics						
Input Forward Voltage	VF	1.6	2.0	2.4	V	IF=10mA
Input Forward Voltage Temperature Coefficient	ΔVF/ ΔT	-	-1.237	-	mV/°C	IF=10mA
Input Reverse Voltage	BVR	5	-	-	V	IR = 10μA
Input Threshold Current (Low to High)	IFLH	-	0.25	1.5	mA	VCC = 30 V, VO< 5V
Input Threshold Voltage (High to Low)	VFHL	0.8	-	-	V	VCC = 30 V, VO> 5V
Input Capacitance (Note 6)	CIN	-	60	-	pF	f = 1 MHz, VF = 0 V
Output Characteristics						
High Level Supply Current	ICCH	-	-	3.0	mA	VCC = 5.5 V, VF = 0V, IO = 0 mA
			1.9	3.0		VCC = 30 V, VF = 0V, IO = 0 mA
Low Level Supply Current	ICCL	-	-	3.0	mA	VCC = 5.5 V, IF = 5 mA, IO = 0 mA
			2.0	3.0		VCC = 30 V, IF = 5 mA, IO = 0 mA
High level output current (Note 7)	IOH	-	-	-100	mA	VCC = 5.5V, VF = 0V , VO = GND
		-	-	-200		VCC = 20V, VF = 0V, VO = GND
Low level output current (Note 7)	IOL	100	-	-	mA	VO =VCC = 5.5V, IF = 5mA
		200	-	-		VO =VCC = 20V, IF = 5mA
High level output voltage	VOH	VCC-0.5	VCC-0.05	-	V	IOL = -6.5mA
Low level output voltage	VOL	-	0.09	0.5	V	IOL = 6.5mA

Note 6: Input capacitance is measured between pin 1 and pin 3.
Note 7: Duration of output short circuit time should not exceed 10 μs.

Switching Specification

All Typical values at TA = 25°C, unless otherwise specified; all minimum and maximum specifications are at recommended operating condition.

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Condition
Propagation Delay Time to Output High Level (Note 8)	t_{PLH}	-	110	220	ns	f = 10kHz, Duty Cycle = 50% I_F = 2mA, V_{CC} = 30V
Propagation Delay Time to Output Low Level (Note 8)	t_{PHL}	-	90	220		
Pulse Width Distortion (Note 9)	PWD	-	20	120		
Propagation Delay Difference Between Any Two Parts (Note 10)	PDD (t_{PHL} - t_{PLH})	-200	-	+200		
Output Rise Time (10 to 90%)	t_r	-	6	-		
Output Fall Time (90 to 10%)	t_f	-	7	-		
Common mode transient immunity at high level output (Note 11)	$\|CM_H\|$	20	-	-	kV/μs	V_F=0 V V_{CC}= 5V, T_A= 25 °C, V_{CM}= 1.5KV
Common mode transient immunity at low level output (Note 11)	$\|CM_L\|$	20	-	-	kV/μs	I_F=4mA V_{CC}= 5V, T_A= 25 °C, V_{CM}= 1.5KV

Note 8: 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 9 Pulse Width Distortion (PWD) is defined as |tPHL - tPLH | for any given device.

Note 10: The difference of tPLH and tPHL between any two devices under the same test condition.

Note 11: CMH is the maximum slew rate of the common mode voltage that can be sustained with the output voltage in the logic high state, VO > 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, VO < 0.8 V. Note: Equal value split resistors (Rin/2) must be used at both ends of the LED.

Isolation characteristic

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.

Parameter	Symbol	Device	Min.	Typ.	Max.	Unit	Test Condition
Withstand Insulation Test Voltage (Note 12, 13)	V_{ISO}	EMD2A481-SK	5000	-	-	V	RH ≤ 40%-60%, t = 1min, T_A = 25 °C
		EMD2A481-SL					
Input-Output Resistance (Note 12)	R_{I-O}	-	-	10^{12}	-	Ω	V_{I-O} = 500V DC

Note 12: Device is considered a two terminal device: pins 1, 2, 3 are shorted together and pins 4, 5, 6 are shorted together.

Note 13: According to UL1577, each photo coupler is tested by applying an insulation test voltage 6000VRMS for one second.

Typical Performance Curves & Test Circuits

Fig.1 VOL vs. Temperature

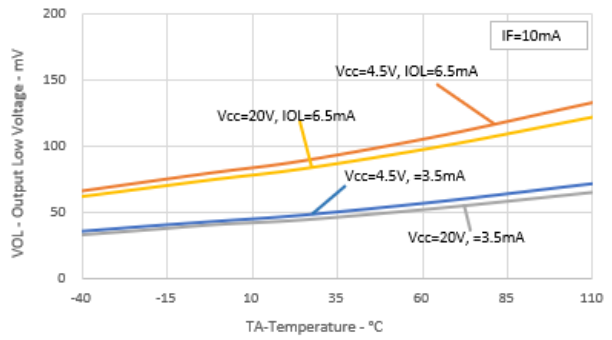


Fig.2 VOH vs. Temperature

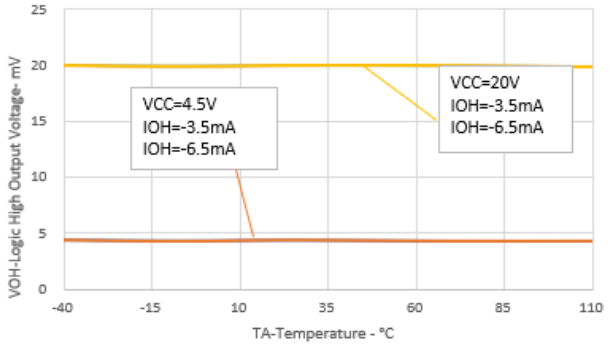


Fig.3 IFLH vs. Hysteresis

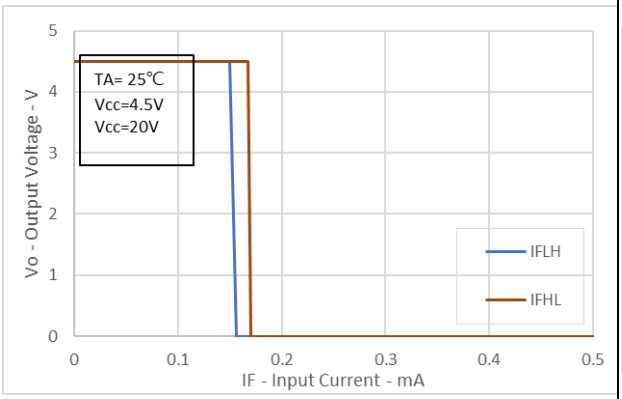


Fig.4 IFH vs. Temperature

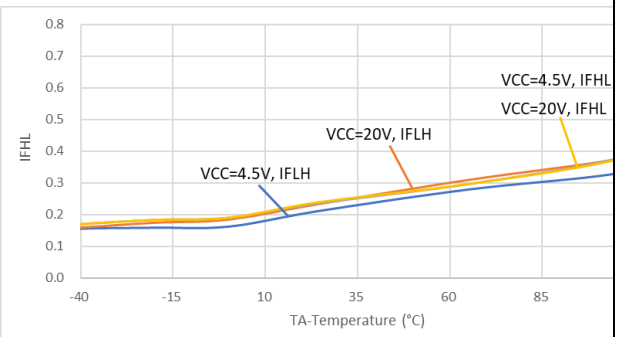


Fig.5 Input Current vs. Forward Voltage

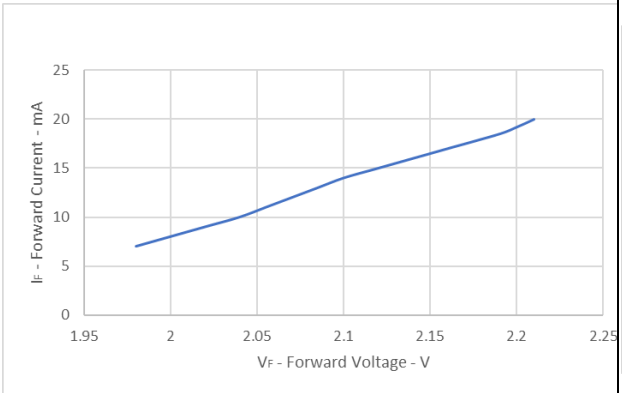


Fig.6 Supply Voltage vs. Output Voltage

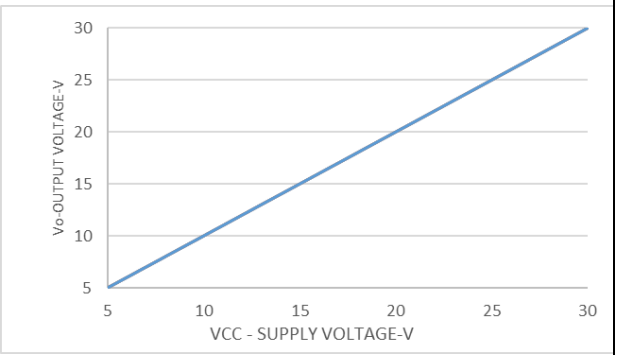


Fig.7 Propagation Delays vs. Temperature

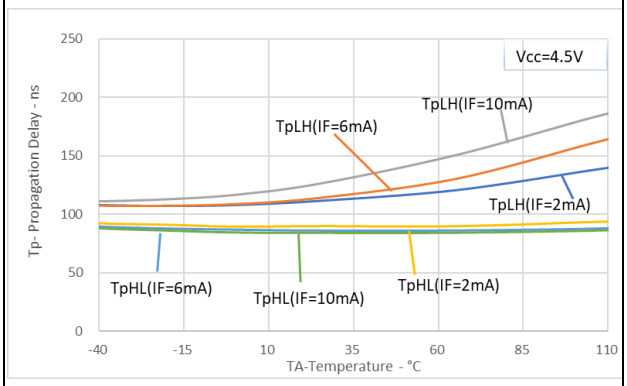
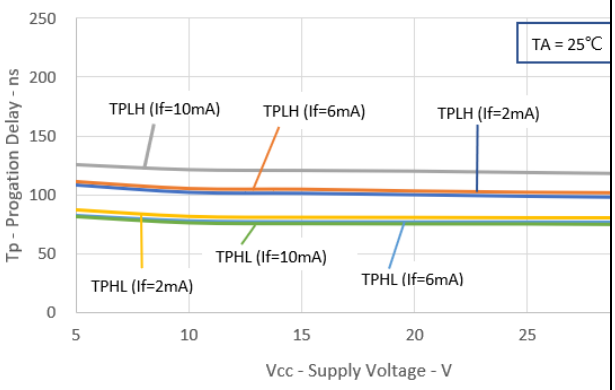
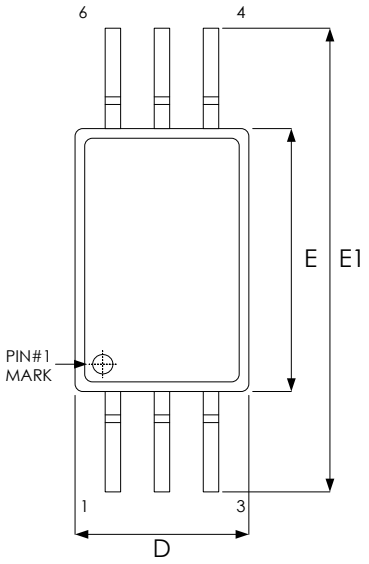


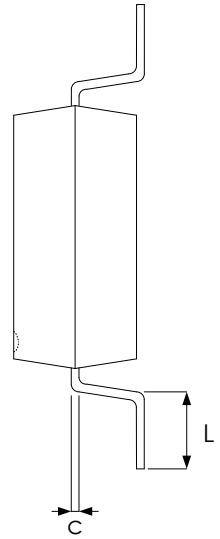
Fig.8 Propagation Delays vs. Vcc



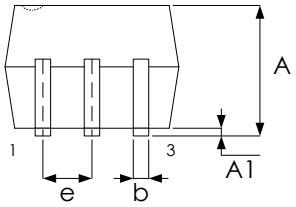
Package Outline Drawing
L-SOP 6L (277mil, 7mm clearance)



TOP VIEW



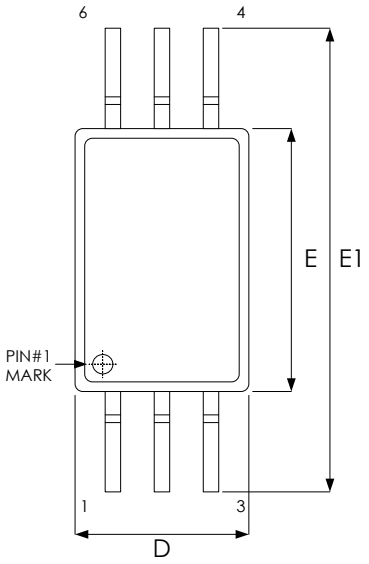
SIDE VIEW



SIDE VIEW

Symbol	Dimension in mm	
	Min.	Max.
A	1.70	2.30
A1	0.10	0.30
b	0.30	0.50
c	0.20	0.30
D	4.20	4.80
E	6.51	7.11
E1	9.40	10.00
e	1.27 BSC	
L	0.70	1.20

Package Outline Drawing
L-SOP 6L (277mil, 8mm clearance)



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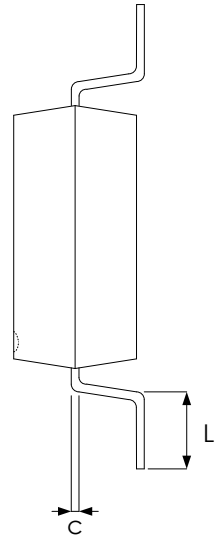
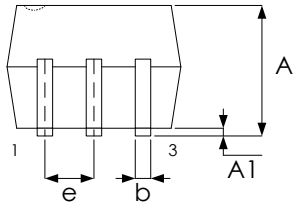


SIDE VIEW



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D	4.20	4.80
E	6.51	7.11
E1	11.20	11.80
e	1.27 BSC	
L	0.50	1.00

Revision History

Revision	Date	Description
0.1	2023.02.17	Preliminary version
0.2	2023.08.24	Update: Insulation Characteristics (Page3) AMR unit (Page4) Note7 (Page5) |CMH||CML| Test condition (Page6)
1.0	2024.03.05	1.Revise IOH/IOL spec 2.Update POD 3. Remove "preliminary" to V1.0

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