

## 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

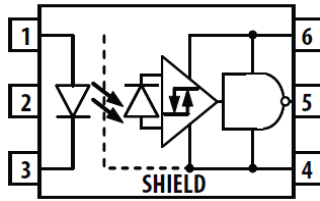
- Totem pole output inverter logic type
- Truth Table Guaranteed: VCC from 4.5V to 30V
- Performance Specified for Common IPM Applications Over Industrial Temperature Range.
- Short Maximum Propagation Delays
- Minimized Pulse Width Distortion (PWD)
- Very High Common Mode Rejection (CMR)
- Hysteresis
- 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  
 $V_{IORM} = 891 V_{peak}$  for EMD2A481-SK  
 $V_{IORM} = 1140 V_{peak}$  for EMD2A481-SL  
 Certificate No. 40055846
- CQC approved: GB4943.1-2011  
 Certificate No. CQC22001358589

SCHEMATIC	PIN DEFINITION	PACKAGE
	<ol style="list-style-type: none"> <li>1. Anode</li> <li>2. NC</li> <li>3. Cathode</li> <li>4. GND</li> <li>5. VO</li> <li>6. VCC</li> </ol>	

## 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	<div style="border: 1px solid black; padding: 5px; text-align: center;">                     EYYWW  <b>481</b>                      HV                 </div>	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	<div style="border: 1px solid black; padding: 5px; text-align: center;">                     EYYWW  <b>481</b>                      H                 </div>	

## 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 <sub>IORM</sub>	891	1140	V <sub>peak</sub>
Input to Output Test Voltage, Method b (Note 1) V <sub>IORM</sub> X 1.875 = V <sub>PR</sub> , 100% Production Test With t <sub>m</sub> = 1sec, Partial discharge < 5pC	V <sub>PR</sub>	1671	2137	V <sub>peak</sub>
Input to Output Test Voltage, Method a (Note 1) V <sub>IORM</sub> X 1.6 = V <sub>PR</sub> , 100% Production Test With t <sub>m</sub> = 10sec, Partial discharge < 5pC	V <sub>PR</sub>	1426	1824	V <sub>peak</sub>
Highest Allowable Overvoltage (Transient Overvoltage t <sub>ini</sub> = 60sec)	V <sub>IOTM</sub>	6000	8000	V <sub>peak</sub>
Safety-limiting values – maximum values allowed in the event of a failure				
Case Temperature	T <sub>s</sub>	175	175	°C
Input Current	I <sub>S, INPUT</sub>	150	150	mA
Output Power	P <sub>S, OUTPUT</sub>	600	600	mW
Insulation Resistance at T <sub>s</sub> , V <sub>IO</sub> = 500 V	R <sub>s</sub>	>10 <sup>9</sup>	>10 <sup>9</sup>	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 <sub>CC</sub> -V <sub>SS</sub> (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 (T<sub>a</sub> = 25°C unless otherwise specified)

Parameter	Symbol	Min	Max	Unit
Storage Temperature	T <sub>stg</sub>	-55	125	°C
Operating Temperature	T <sub>opr</sub>	-40	110	°C
Output IC Junction Temperature	T <sub>J</sub>	-	125	°C
Average Forward Input Current	I <sub>F</sub>	-	20	mA
Reverse Input Voltage	V <sub>R</sub>	-	5	V
Output Collector Current	I <sub>O</sub>		50	mA
Supply Voltage	V <sub>CC</sub>	0	35	V
Output Collector Voltage	V <sub>O</sub>	-0.5	V <sub>CC</sub>	V
Total Package Power Dissipation	P <sub>T</sub>	-	145	mW
Lead Solder Temperature	T <sub>sol</sub>	-	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 <sub>A</sub>	-40	110	°C
Supply Voltage	V <sub>CC</sub>	4.5	30	V
Input Current (ON) (Note 4)	I <sub>F(ON)</sub>	1.6	5	mA
Input Voltage (OFF) (Note 5)	V <sub>F(OFF)</sub>		0.8	V

Note 4: Detector requires a V<sub>CC</sub> of 4.5 V or higher for stable operation as output might be unstable if V<sub>CC</sub> 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  $T_A = 25^\circ\text{C}$ , unless otherwise specified; all minimum and maximum specifications are at recommended operating condition.

Parameter	Symbol	Min	Typ	Max	Unit	Test Condition
<b>Input Characteristics</b>						
Input Forward Voltage	VF	1.6	2.0	2.4	V	IF=10mA
Input Forward Voltage Temperature Coefficient	$\Delta VF / \Delta T$	-	-1.237	-	mV/°C	IF=10mA
Input Reverse Voltage	BVR	5	-	-	V	IR = 10 $\mu$ A
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
<b>Output Characteristics</b>						
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  $\mu$ s.

## Switching Specification

All Typical values at  $T_A = 25^\circ\text{C}$ , 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	$f = 10\text{kHz}$ , Duty Cycle = 50% $I_F = 2\text{mA}$ , $V_{CC} = 30\text{V}$
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/ $\mu\text{s}$	$V_F=0\text{V}$ $V_{CC}= 5\text{V}$ , $T_A= 25^\circ\text{C}$ , $V_{CM}= 1.5\text{KV}$
Common mode transient immunity at low level output (Note 11)	$ CM_L $	20	-	-	kV/ $\mu\text{s}$	$I_F=4\text{mA}$ $V_{CC}= 5\text{V}$ , $T_A= 25^\circ\text{C}$ , $V_{CM}= 1.5\text{KV}$

Note 8: The  $t_{PLH}$  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  $t_{PHL}$  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  $|t_{PHL} - t_{PLH}|$  for any given device.

Note 10: The difference of  $t_{PLH}$  and  $t_{PHL}$  between any two devices under the same test condition.

Note 11:  $CM_H$  is the maximum slew rate of the common mode voltage that can be sustained with the output voltage in the logic high state,  $V_O > 2.0\text{V}$ .  $CM_L$  is the maximum slew rate of the common mode voltage that can be sustained with the output voltage in the logic low state,  $V_O < 0.8\text{V}$ .

Note: Equal value split resistors ( $R_{in}/2$ ) must be used at both ends of the LED.

## Isolation characteristic

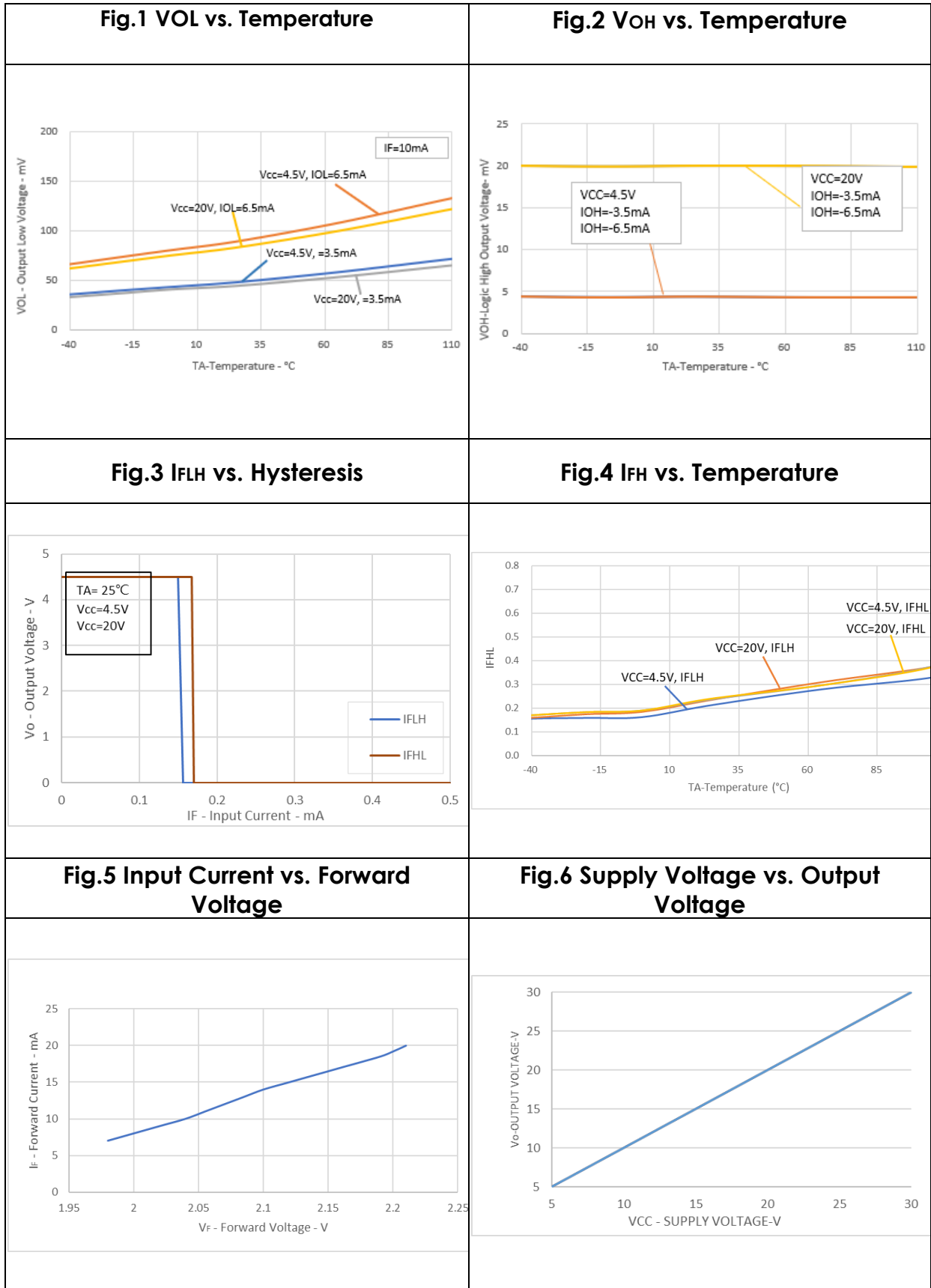
All Typical values at  $T_A = 25^\circ\text{C}$  and  $V_{CC} - V_{SS} = 30\text{V}$ , unless otherwise specified; all minimum and maximum specifications are at recommended operating condition.

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

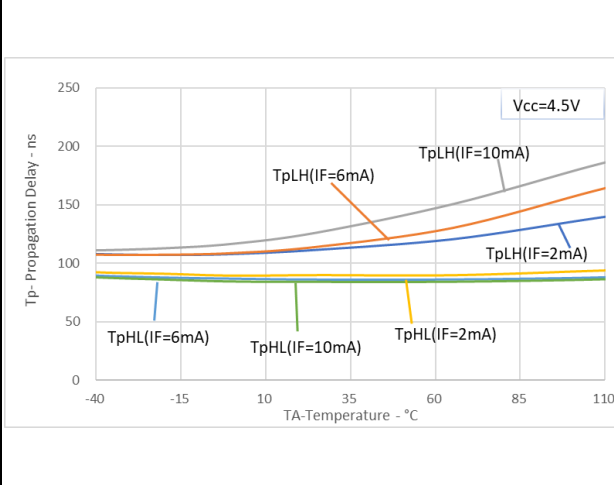
Note 12: Device is considered a two terminal device: pins 1, 2, 3 are shorted together and pins 4, 5, 6 are shorted together.

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

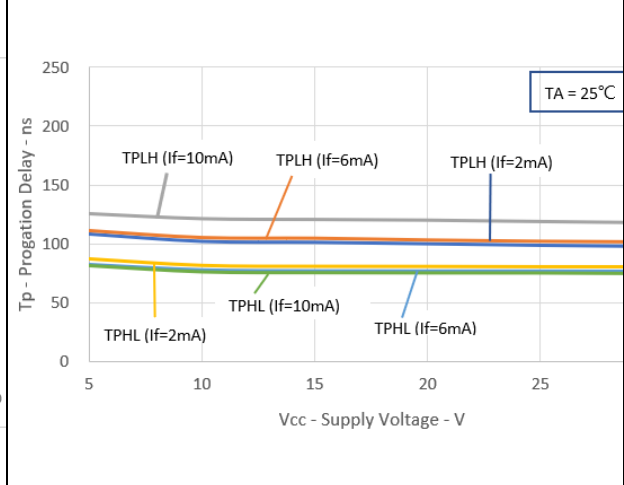
## Typical Performance Curves & Test Circuits



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

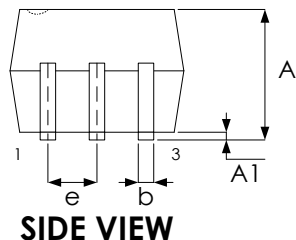
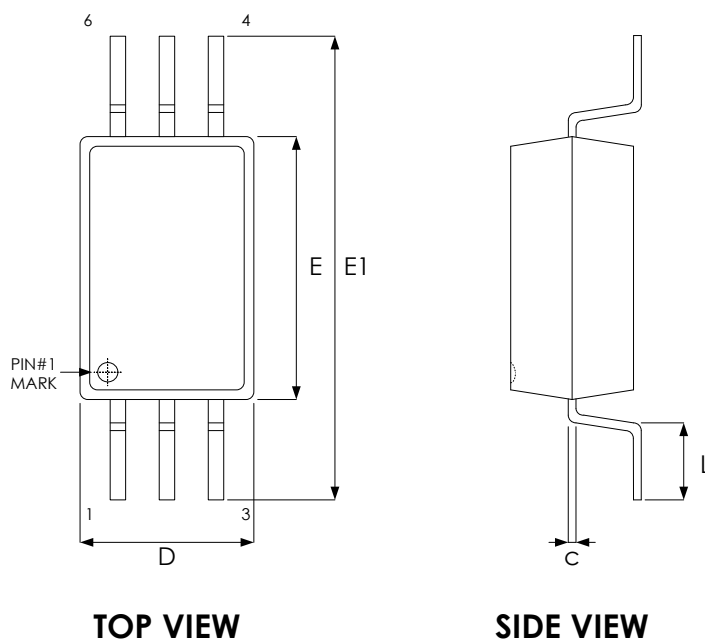


**Fig.8 Propagation Delays vs. V<sub>cc</sub>**



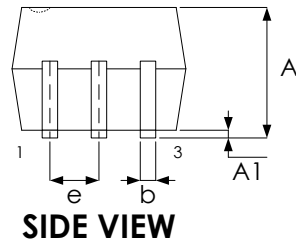
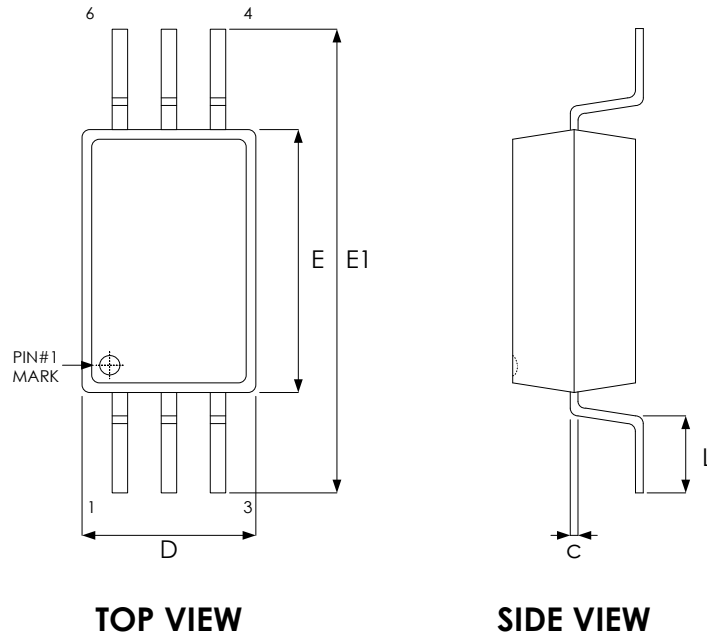


## Package Outline Drawing L-SOP 6L (277mil, 7mm clearance)



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)



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	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

### Important Notice

All rights reserved.

No part of this document may be reproduced or duplicated in any form or by any means without the prior permission of ESMT.

The contents contained in this document are believed to be accurate at the time of publication. ESMT assumes no responsibility for any error in this document, and reserves the right to change the products or specification in this document without notice.

The information contained herein is presented only as a guide or examples for the application of our products. No responsibility is assumed by ESMT for any infringement of patents, copyrights, or other intellectual property rights of third parties which may result from its use. No license, either express, implied or otherwise, is granted under any patents, copyrights or other intellectual property rights of ESMT or others.

Any semiconductor devices may have inherently a certain rate of failure. To minimize risks associated with customer's application, adequate design and operating safeguards against injury, damage, or loss from such failure, should be provided by the customer when making application designs.

ESMT's products are not authorized for use in critical applications such as, but not limited to, life support devices or system, where failure or abnormal operation may directly affect human lives or cause physical injury or property damage. If products described here are to be used for such kinds of application, purchaser must do its own quality assurance testing appropriate to such applications.