EMI2180

Common Mode Filter with ESD Protection

ON Semiconductor®

http://onsemi.com

Functional Description

The EMI2180 is an industry first Common Mode Filter tuned to MHL speed (CMF) with integrated ESD protection. Differential signaling I/Os can now have both common mode filtering and ESD protection in one package, instead of using separate devices for each function. In addition, traditional common mode chokes are coil−based, while the EMI2180 is silicon−based. This enables the EMI2180 to have a smaller footprint and profile. The EMI2180 protects against ESD pulses up to ±8 kV contact per the IEC61000−4−2 standard.

The EMI2180 is particularly well−suited for protecting systems using high−speed differential ports such as MHL, MHL to USB interface corresponding ports in removable storage, digital camcorders, DVD−RW drives; and other applications where ESD protection are required in a small footprint package.

The EMI2180 is available in a RoHS−compliant, WDFN-8 package.

Features

- Single Integrated Package for Common Mode Filter (CMF) and ESD Protection for MHL High Speed Data Lines
- High Differential Mode Bandwidth Cutoff Frequency for Best Signal Integrity
- Low Profile with Small Footprint in WDFN6 1.6 x 2.0 mm Package
- Provides ESD Protection to IEC61000−4−2 Level 4, ±8 kV Contact Discharge
- Low Channel Input Capacitance
- These Devices are Pb−Free and are RoHS Compliant

Applications

- I/O Ports, Display, MHL in Mobile Phones, Wireless Handsets and Cameras
- MHL to USB Interface
- High−Speed Differential Data Lines

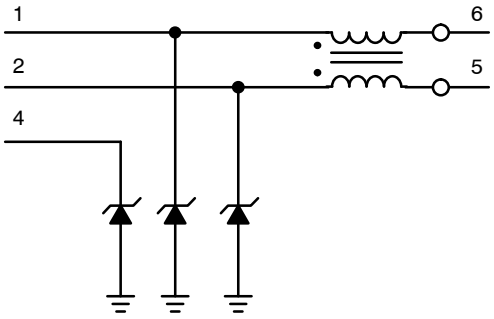
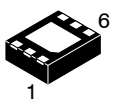
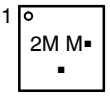


Figure 1. EMI2180 Electrical Schematic



WDFN6
CASE 511BV

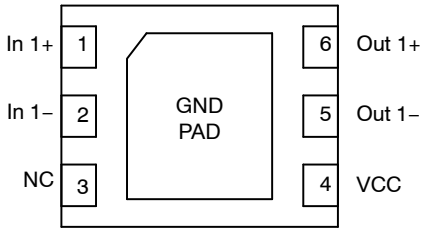
MARKING DIAGRAM



2M = Specific Device Code
M = Date Code
▪ = Pb−Free Package

(*Note: Microdot may be in either location)

PIN CONNECTIONS



(Top View)

ORDERING INFORMATION

Device	Package	Shipping†
EMI2180MTTBG	WDFN6 (Pb−Free)	3000 / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

PIN FUNCTION DESCRIPTION

Pin Name	Pin No.	Type	Description
MHL_In+	1	I/O	CMF Channel 1+ to Connector
MHL_In−	2	I/O	CMF Channel 1− to Connector
MHL_Out+	6	I/O	CMF Channel 1+ to ASIC
MHL_Out−	5	I/O	CMF Channel 1− to ASIC
VCC	4	VCC	
NC	3	NC	No Connect
GND	Belly Pad	GND	GND

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Parameter	Symbol	Value	Unit
Operating Temperature Range	Top	−40 to +85	°C
Storage Temperature Range	Tstg	−65 to +150	°C
DC Voltage at any channel input	Vdc	−0.5 to 5.5	V
ESD Discharge IEC61000−4−2 Contact Discharge	V_{PP}	±8	kV
Maximum Lead Temperature for Soldering Purposes (1/8” from Case for 10 seconds)	TL	260	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
I_{LEAK}	Channel Leakage Current	T_A = 25°C, V_{IN} = 5 V, V_N = 0 V			1.0	μA
V_F	Channel Negative Voltage	I_F = 10 mA, T_A = 25°C	0.1		1.5	V
C_{ID}	Channel ID Capacitance (Pin 4 to GND)	T_A = 25°C, At 1 MHz, V_N = 0 V		0.8	1.3	pF
C_{IN}	Channel Input Capacitance (Pins 1, 2 to GND)	T_A = 25°C, At 1 MHz, V_N = 0 V		2.0		pF
R_{CH}	Channel Resistance (Pins 1−6 and 2−5)	T_A = 25°C, At 1 MHz, V_N = 0 V		3.5	5.0	Ω
f_{3dB}	Differential Mode (Sdd21) Cut−off Frequency	50 Ω Source and Load Termination		4.0		GHz
f_{ATTN}	Common Mode (Scc21) Stop Band Attenuation	@ 75 MHz		3		dB
		@ 500 MHz		10		dB
		@ 1 GHz ~ 3 GHz		15		dB
f_{ATTN}	Mode−to−Mode Conversion (Sdc21, Scd21)	up to 6 GHz		40	35	dB
V_{ESD}	ESD Protection − Peak Discharge Voltage at any channel input, in system: Contact discharge per IEC61000−4−2 standard	T_A = 25°C, (Notes 2 and 3)	±8			kV
V_{RWM}	Reverse Working Voltage	(Note 3)			5.0	V
V_{BR}	Breakdown Voltage	IT = 1 mA, (Note 4)	5.6		9.0	V

1. Standard IEC61000−4−2 with $C_{Discharge}$ = 150 pF, $R_{Discharge}$ = 330, V_N grounded.
2. These measurements performed with no external capacitor.
3. TVS devices are normally selected according to the working peak reverse voltage (V_{RWM}), which should be equal or greater than the DC or continuous peak operating voltage level
4. V_{BR} is measured at pulse test current I_T.

TYPICAL CHARACTERISTICS

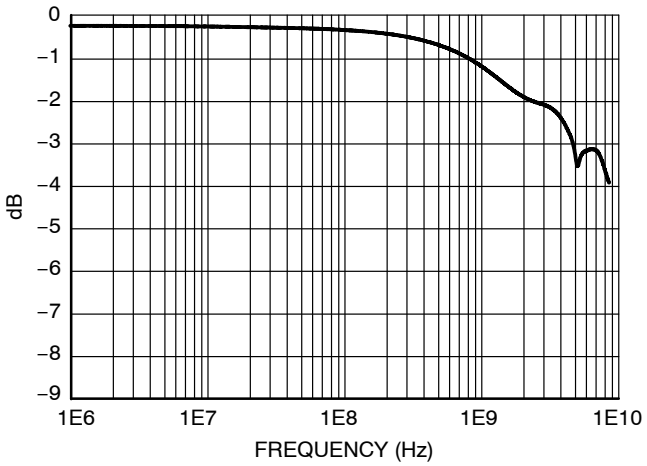


Figure 2. Differential Mode Attenuation vs. Frequency

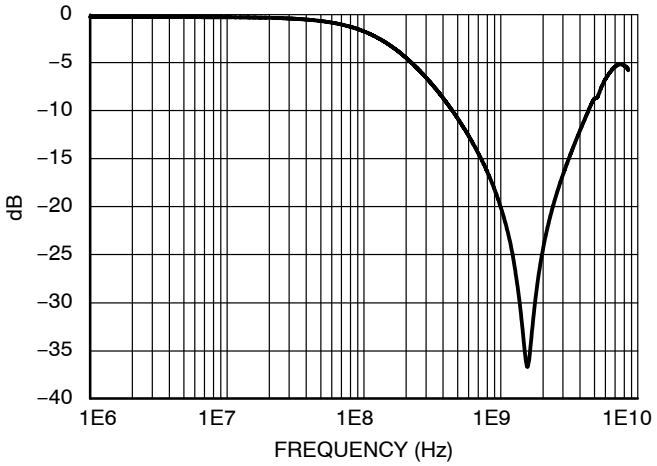


Figure 3. Common Mode Attenuation vs. Frequency

TRANSMISSION LINE PULSE (TLP) MEASUREMENTS

Transmission Line Pulse (TLP) provides current versus voltage (I−V) curves in which each data point is obtained from a 100 ns long rectangular pulse from a charged transmission line. A simplified schematic of a typical TLP system is shown in Figure 4. TLP I−V curves of ESD protection devices accurately demonstrate the product's ESD capability because the 10 s of amps current levels and under 100 ns time scale match those of an ESD event. This is illustrated in Figure 5 where an 8 kV IEC61000−4−2 current waveform is compared with TLP current pulses at 8 and 16 A. A TLP curve shows the voltage at which the device turns on as well as how well the device clamps voltage over a range of current levels. Typical TLP I−V curves for the EMI2180 are shown in Figure 6.

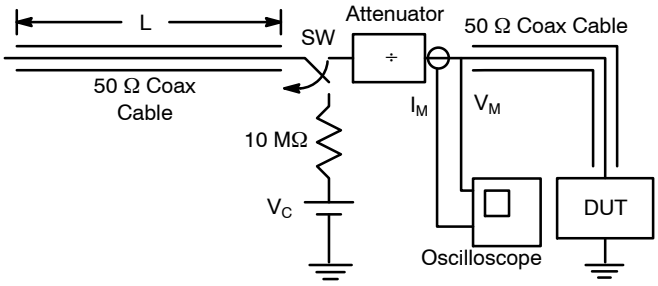


Figure 4. Simplified Schematic of a Typical TLP System

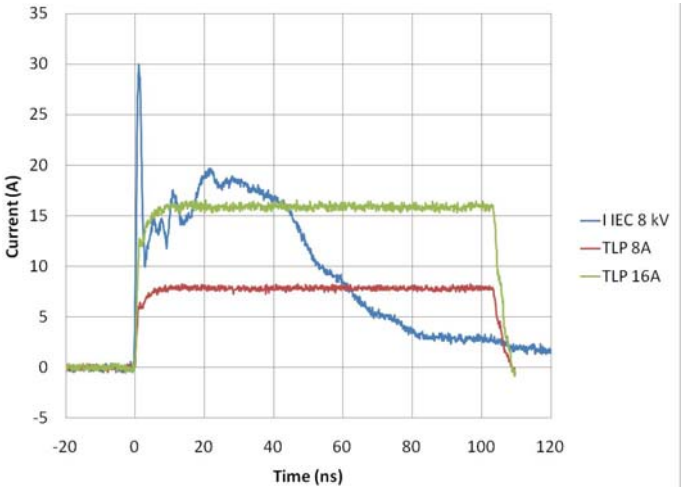


Figure 5. Comparison Between 8 kV IEC61000−4−2 and 8 A and 16 A TLP Waveforms

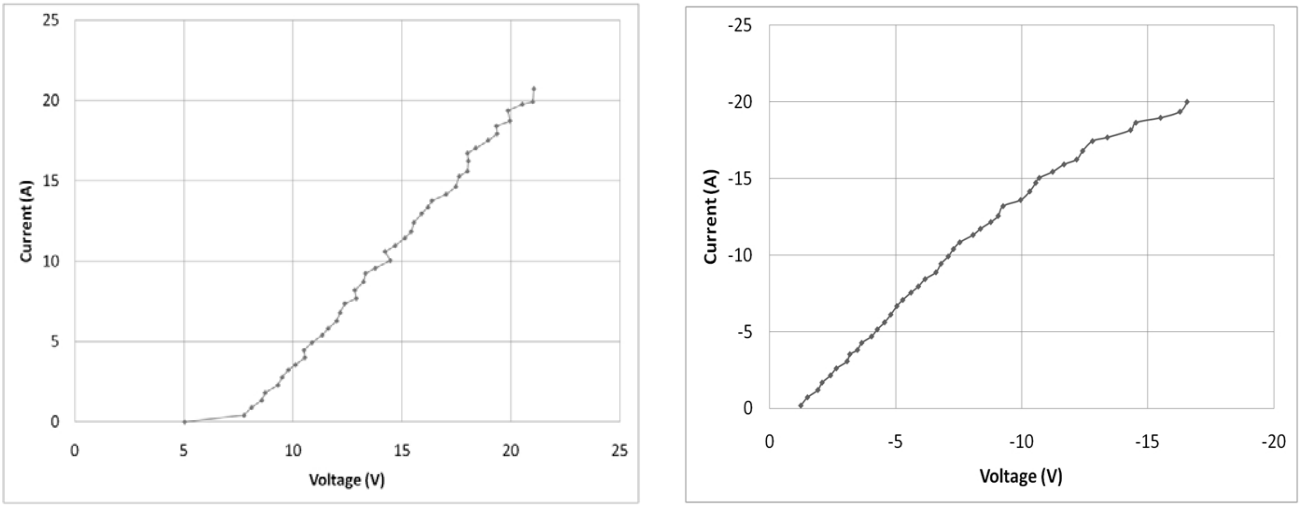


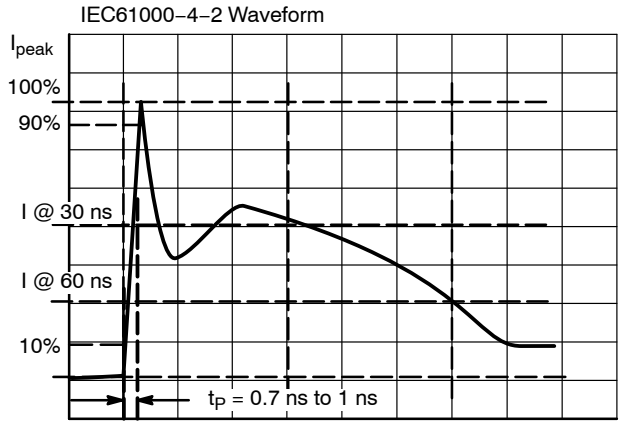
Figure 6. Positive and Negative TLP Waveforms

ESD VOLTAGE CLAMPING

For sensitive circuit elements it is important to limit the voltage that an IC will be exposed to during an ESD event to as low a voltage as possible. The ESD clamping voltage is the voltage drop across the ESD protection diode during an ESD event per the IEC61000−4−2 waveform. Since the IEC61000−4−2 was written as a pass/fail spec for larger systems such as cell phones or laptop computers it is not clearly defined in the spec how to specify a clamping voltage at the device level. ON Semiconductor has developed a way to examine the entire voltage waveform across the ESD protection diode over the time domain of an ESD pulse in the form of an oscilloscope screenshot, which can be found on the datasheets for all ESD protection diodes. For more information on how ON Semiconductor creates these screenshots and how to interpret them please refer to On Semiconductor Application Notes AND8307/D and AND8308/D.

IEC61000−4−2 Spec.

Level	Test Voltage (kV)	First Peak Current (A)	Current at 30 ns (A)	Current at 60 ns (A)
1	2	7.5	4	2
2	4	15	8	4
3	6	22.5	12	6
4	8	30	16	8



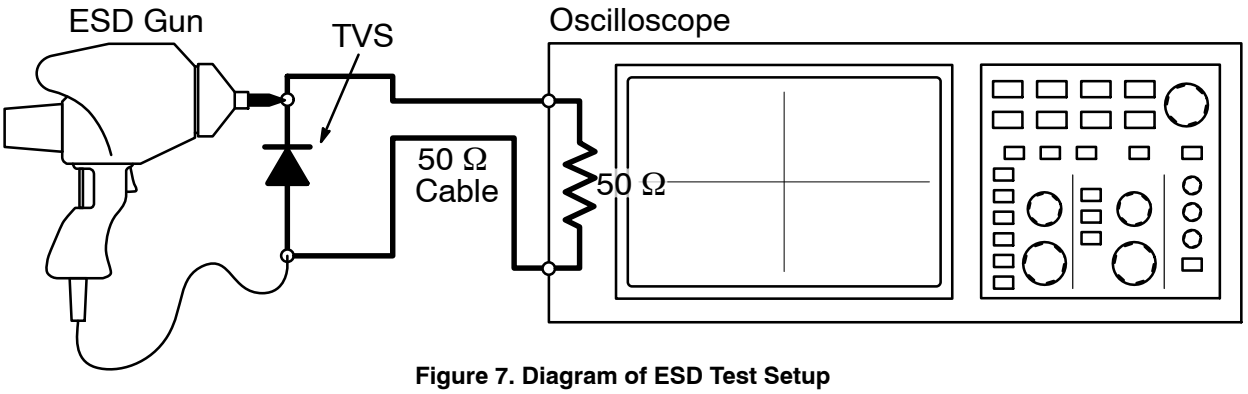


Figure 7. Diagram of ESD Test Setup

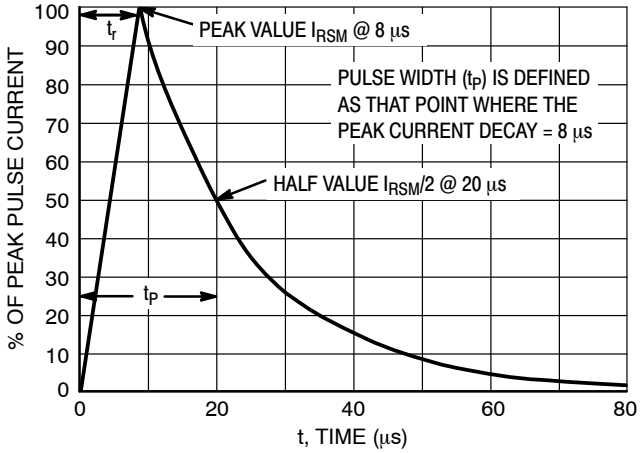


Figure 8. 8 x 20 μs Pulse Waveform

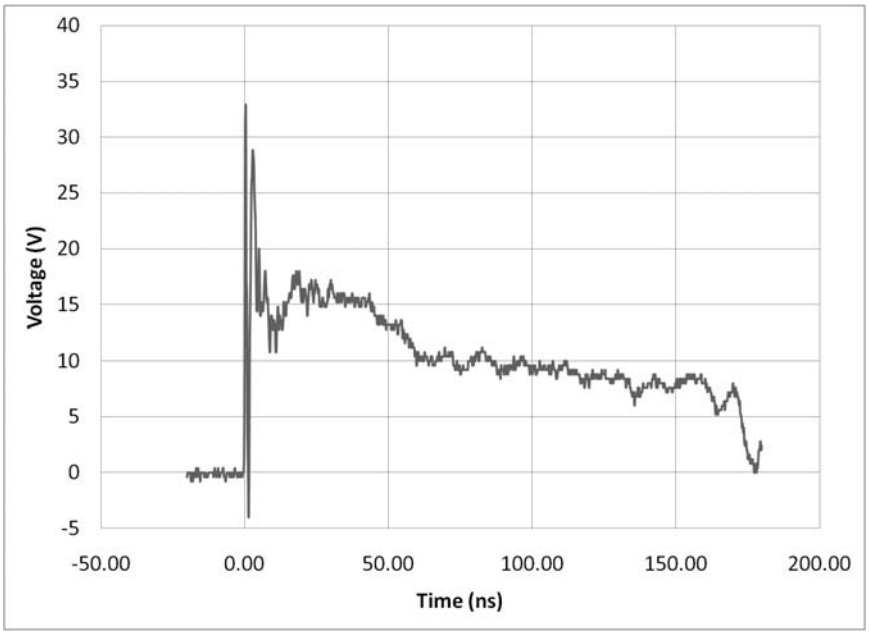


Figure 9. ESD Clamping Voltage +8 kV per IEC6100−4−2 (external to internal pin)

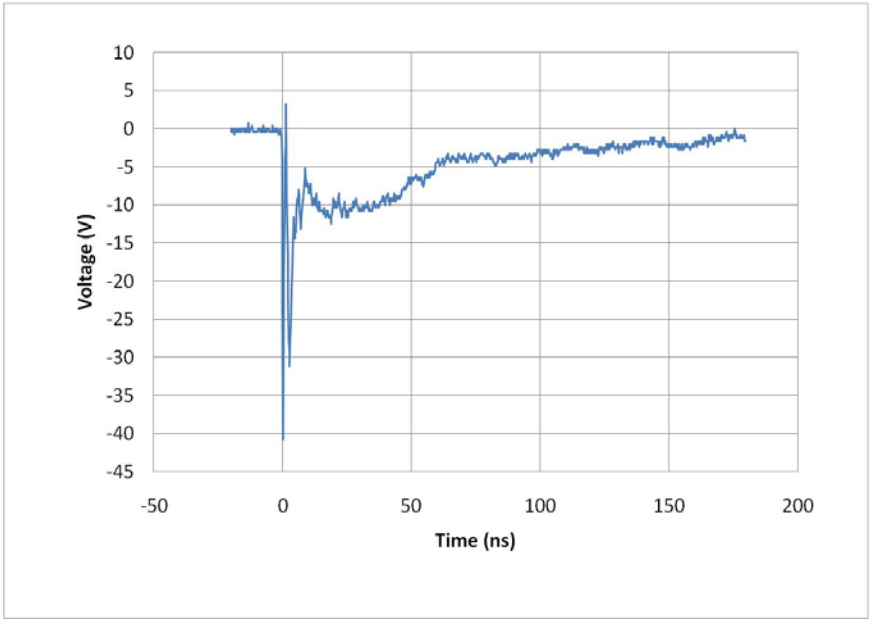
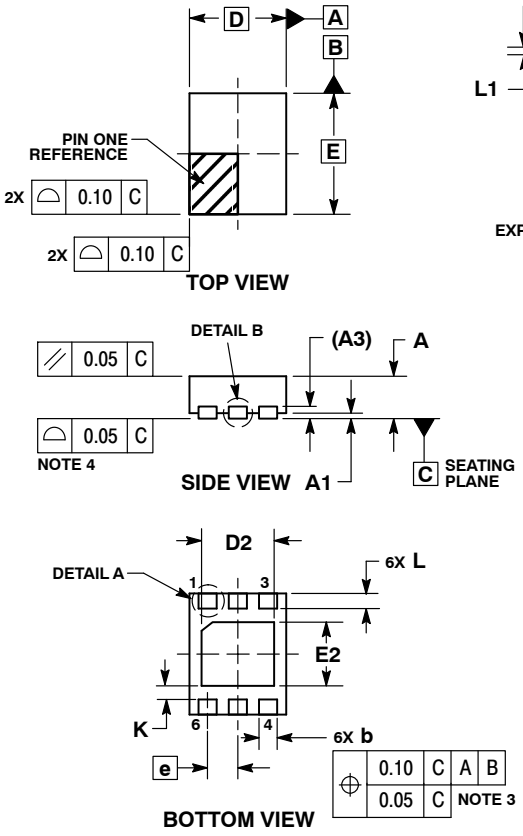
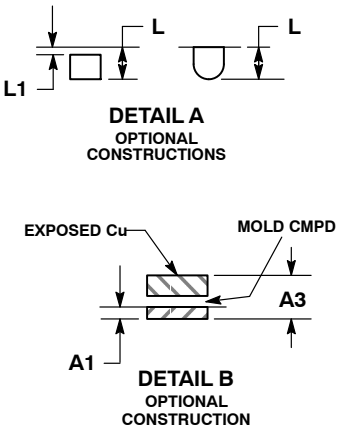


Figure 10. ESD Clamping Voltage −8 kV per IEC6100−4−2 (external to internal pin)

PACKAGE DIMENSIONS

WDFN6 1.6x2.0, 0.5P
CASE 511BV
ISSUE O

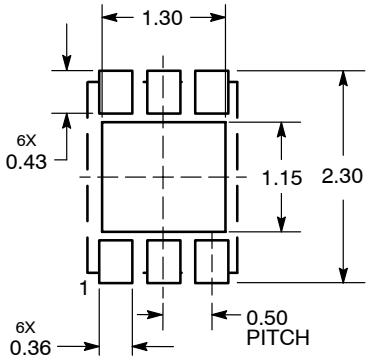




NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.20 mm FROM THE TERMINAL TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

	MILLIMETERS	
DIM	MIN	MAX
A	0.60	0.80
A1	0.00	0.05
A3	0.20 REF	
b	0.20	0.40
D	1.60 BSC	
D2	1.10	1.30
E	2.00 BSC	
E2	0.95	1.15
e	0.50 BSC	
K	0.20	---
L	0.15	0.35
L1	---	0.10

RECOMMENDED MOUNTING FOOTPRINT



DIMENSIONS: MILLIMETERS

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 USA
Phone: 303−675−2175 or 800−344−3860 Toll Free USA/Canada
Fax: 303−675−2176 or 800−344−3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800−282−9855 Toll Free USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910
Japan Customer Focus Center
Phone: 81−3−5817−1050

ON Semiconductor Website: **www.onsemi.com**

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For additional information, please contact your local Sales Representative

EMI2180/D