

MOSFET – N-Channel, POWERTRENCH®

60 V, 158 A, 2.5 mΩ

FDMS86500L

General Description

This N-Channel MOSFET has been designed specifically to improve the overall efficiency and to minimize switch node ringing of DC/DC converters using either synchronous or synchronous or conventional switching PWM controllers. It has been optimized for low gate charge, low $R_{DS(on)}$, fast switching speed and body diode reverse recovery performance.

Features

- Max $R_{DS(on)}$ = 2.5 mΩ at V_{GS} = 10 V, I_D = 25 A
- Max $R_{DS(on)}$ = 3.7 mΩ at V_{GS} = 4.5 V, I_D = 20 A
- Advanced Package and Silicon Combination for Low $R_{DS(on)}$ and High Efficiency
- Next Generation Enhanced Body Diode Technology, Engineered for Soft Recovery
- MSL1 Robust Package Design
- 100% UIL Tested
- RoHS Compliant

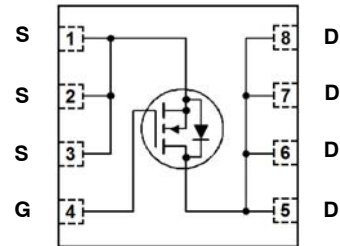
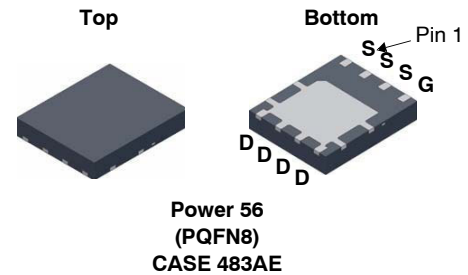
Applications

- Primary Switch in Isolated DC–DC
- Synchronous Rectifier
- Load Switch

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

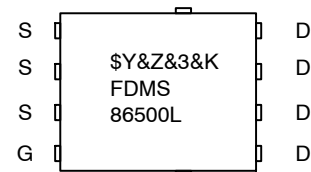
Symbol	Parameter	Ratings	Unit
V_{DS}	Drain to Source Voltage	60	V
V_{GS}	Gate to Source Voltage	±20	V
I_D	Drain Current: – Continuous T_C = 25°C (Note 5) – Continuous T_C = 100°C (Note 5) – Continuous T_A = 25°C (Note 1a) – Pulsed (Note 4)	158 100 25 799	A
E_{AS}	Single Pulse Avalanche Energy (Note 3)	240	mJ
P_D	Power Dissipation: T_C = 25°C T_A = 25°C (Note 1a)	104 2.5	W
T_J, T_{STG}	Operating and Storage Junction Temperature Range	–55 to +150	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.



N-Channel MOSFET

MARKING DIAGRAM



\$Y = onsemi Logo
 &Z = Assembly Plant Code
 &3 = Data Code (Year & Week)
 &K = Lot
 FDMS86500L = Specific Device Code

ORDERING INFORMATION

See detailed ordering and shipping information on page 6 of this data sheet.

THERMAL CHARACTERISTICS

Symbol	Parameter	Value	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case	1.2	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Note 1a)	50	

ELECTRICAL CHARACTERISTICS ($T_J = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
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OFF CHARACTERISTICS

BV_{DSS}	Drain to Source Breakdown Voltage	$I_D = 250\ \mu\text{A}$, $V_{GS} = 0\ \text{V}$	60			V
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250\ \mu\text{A}$, referenced to 25°C		30		mV/°C
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 48\ \text{V}$, $V_{GS} = 0\ \text{V}$			1	μA
I_{GSS}	Gate to Source Leakage Current, Forward	$V_{GS} = \pm 20\ \text{V}$, $V_{DS} = 0\ \text{V}$			± 100	nA

ON CHARACTERISTICS

$V_{GS(th)}$	Gate to Source Threshold Voltage	$V_{GS} = V_{DS}$, $I_D = 250\ \mu\text{A}$	1	1.8	3	V
$\Delta V_{GS(th)}/\Delta T_J$	Gate to Source Threshold Voltage Temperature Coefficient	$I_D = 250\ \mu\text{A}$, referenced to 25°C		-7		mV/°C
$r_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10\ \text{V}$, $I_D = 25\ \text{A}$		2.1	2.5	m Ω
		$V_{GS} = 4.5\ \text{V}$, $I_D = 20\ \text{A}$		2.9	3.7	
		$V_{GS} = 10\ \text{V}$, $I_D = 25\ \text{A}$, $T_J = 125^\circ\text{C}$		3.1	3.7	
g_{FS}	Forward Transconductance	$V_{DS} = 5\ \text{V}$, $I_D = 20\ \text{A}$		95		S

DYNAMIC CHARACTERISTICS

C_{iss}	Input Capacitance	$V_{DS} = 30\ \text{V}$, $V_{GS} = 0\ \text{V}$, $f = 1\ \text{MHz}$		9420	12530	pF
C_{oss}	Output Capacitance			1470	1955	pF
C_{rss}	Reverse Transfer Capacitance			50	80	pF
R_g	Gate Resistance	$f = 1\ \text{MHz}$	0.1	1.1	3.0	Ω

SWITCHING CHARACTERISTICS

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 30\ \text{V}$, $I_D = 25\ \text{A}$, $V_{GS} = 10\ \text{V}$, $R_{GEN} = 6\ \Omega$		27	43	ns
t_r	Rise Time			16	28	ns
$t_{d(off)}$	Turn-Off Delay Time			63	100	ns
t_f	Fall Time			7.8	16	ns
Q_g	Total Gate Charge	$V_{GS} = 0\ \text{V}$ to $10\ \text{V}$, $V_{DD} = 30\ \text{V}$, $I_D = 25\ \text{A}$		117	165	nC
		$V_{GS} = 0\ \text{V}$ to $4.5\ \text{V}$, $V_{DD} = 30\ \text{V}$, $I_D = 25\ \text{A}$		54	108	nC
Q_{gs}	Gate to Source Charge	$V_{DD} = 30\ \text{V}$, $I_D = 25\ \text{A}$		26.6		nC
Q_{gd}	Gate to Drain "Miller" Charge			11.5		nC

DRAIN-SOURCE DIODE CHARACTERISTICS

I_S	Continuous Drain to Source Diode Forward Current	$T_C = 25^\circ\text{C}$			80	A
$I_{S,pulse}$	Pulse Drain to Source Diode Forward Current	$T_C = 25^\circ\text{C}$			799	A
V_{SD}	Source to Drain Diode Forward Voltage	$V_{GS} = 0\ \text{V}$, $I_S = 2.1\ \text{A}$ (Note 2)		0.68	1.2	V
		$V_{GS} = 0\ \text{V}$, $I_S = 25\ \text{A}$ (Note 2)		0.79	1.3	
t_{rr}	Reverse Recovery Time	$I_F = 25\ \text{A}$, $di/dt = 100\ \text{A}/\mu\text{s}$		54	87	ns
Q_{rr}	Reverse Recovery Charge			42	67	nC

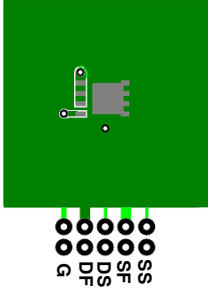
ELECTRICAL CHARACTERISTICS ($T_J = 25^\circ\text{C}$ unless otherwise noted) (continued)

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
t_{rr}	Reverse Recovery Time	$I_F = 25\text{ A}$, $di/dt = 300\text{ A}/\mu\text{s}$		46	73	ns
Q_{rr}	Reverse Recovery Charge			84	134	nC

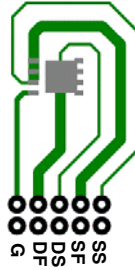
Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

NOTES:

- $R_{\theta JA}$ is determined with the device mounted on a 1 in² pad 2 oz copper pad on a 1.5 × 1.5 in. board of FR-4 material. $R_{\theta CA}$ is determined by the user's board design.



a. 50 °C/W when mounted on a 1 in² pad of 2 oz copper.



b. 125 °C/W when mounted on a minimum pad of 2 oz copper.

- Pulse Test: Pulse Width < 300 μs , Duty cycle < 2.0%.
- E_{AS} of 220 mJ is based on starting $T_J = 25^\circ\text{C}$, $L = 0.3\text{ mH}$, $I_{AS} = 40\text{ A}$, $V_{DD} = 54\text{ V}$, $V_{GS} = 10\text{ V}$. 100% test at $L = 0.1\text{ mH}$, $I_{AS} = 66\text{ A}$.
- Pulsed I_d please refer to Figure 11 SOA graph for more details.
- Computed continuous current limited to Max Junction Temperature only, actual continuous current will be limited by thermal & electro-mechanical application board design.

TYPICAL CHARACTERISTICS

($T_J = 25^\circ\text{C}$ unless otherwise noted)

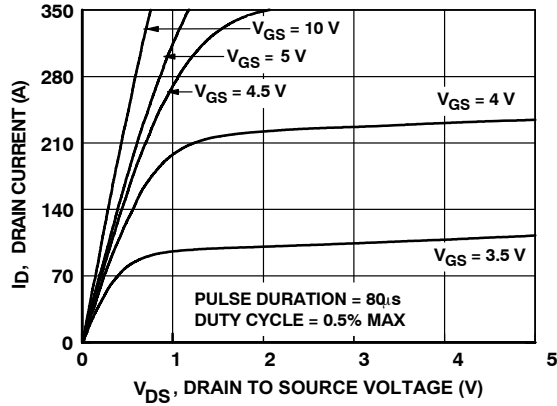


Figure 1. On Region Characteristics

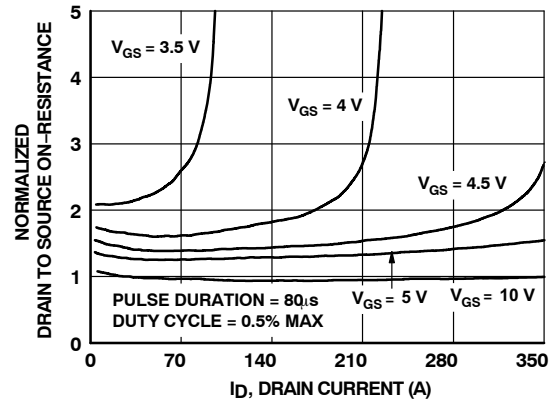


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

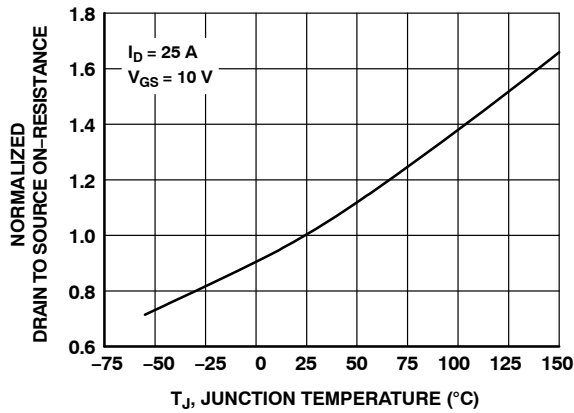


Figure 3. Normalized On Resistance vs. Junction Temperature

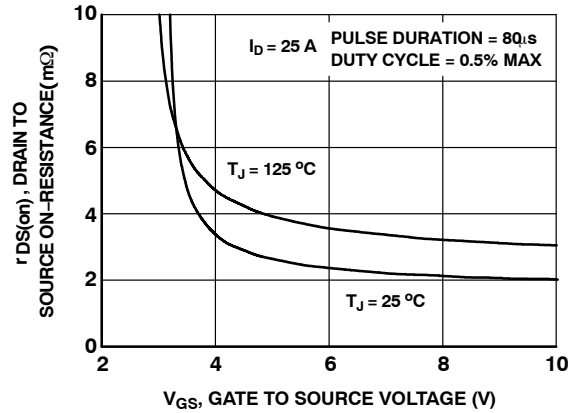


Figure 4. On-Resistance vs. Gate to Source Voltage

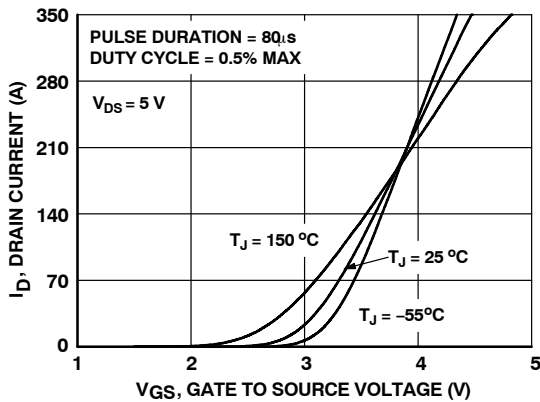


Figure 5. Transfer Characteristics

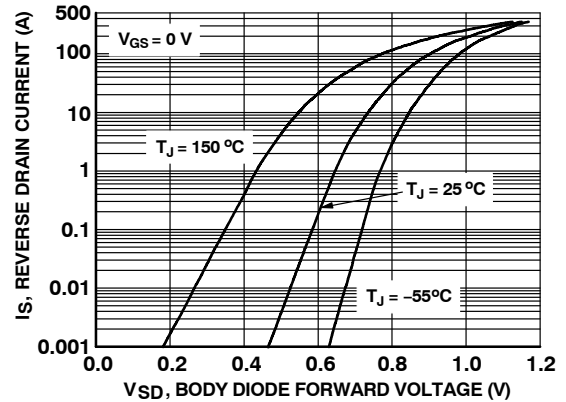


Figure 6. Source to Drain Diode Forward Voltage vs. Source Current

TYPICAL CHARACTERISTICS (continued)

($T_J = 25^\circ\text{C}$ unless otherwise noted)

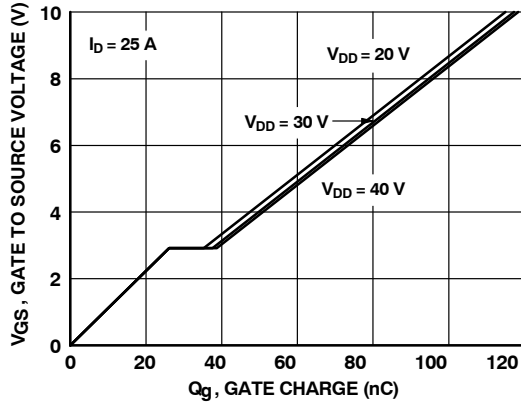


Figure 7. Gate Charge Characteristics

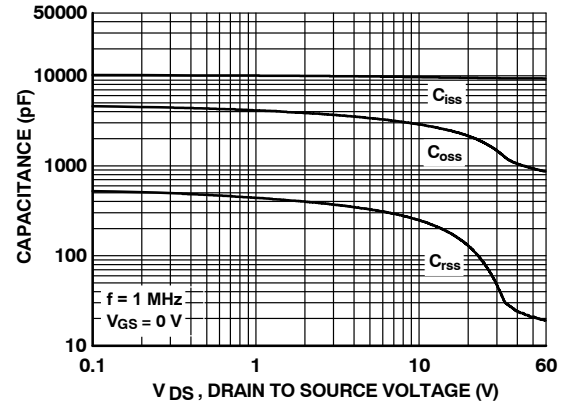


Figure 8. Capacitance vs. Drain to Source Voltage

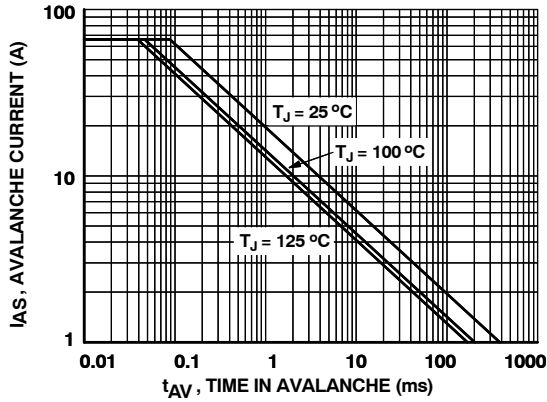


Figure 9. Unclamped Inductive Switching Capability

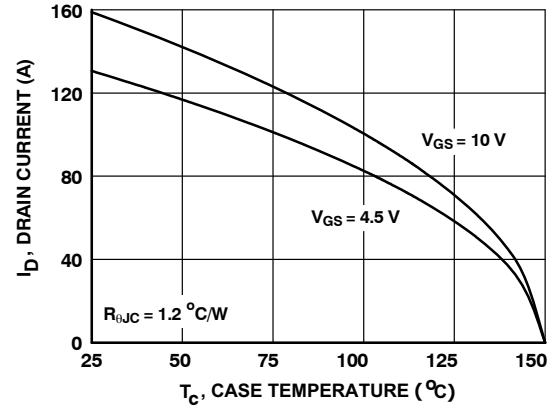


Figure 10. Maximum Continuous Drain Current vs. Case Temperature

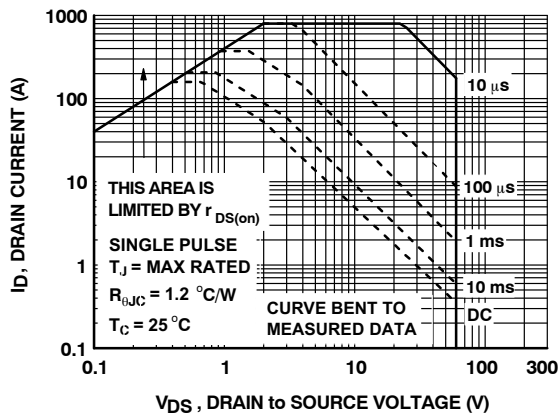


Figure 11. Forward Bias Safe Operating Area

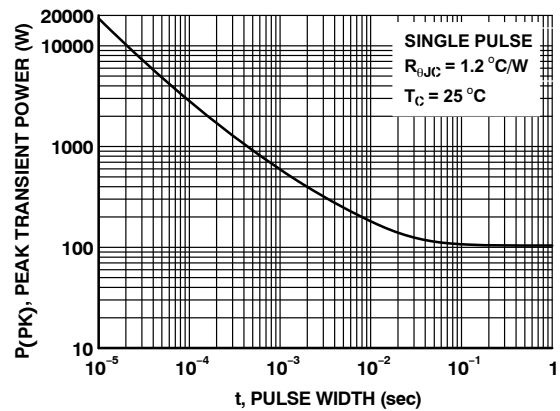
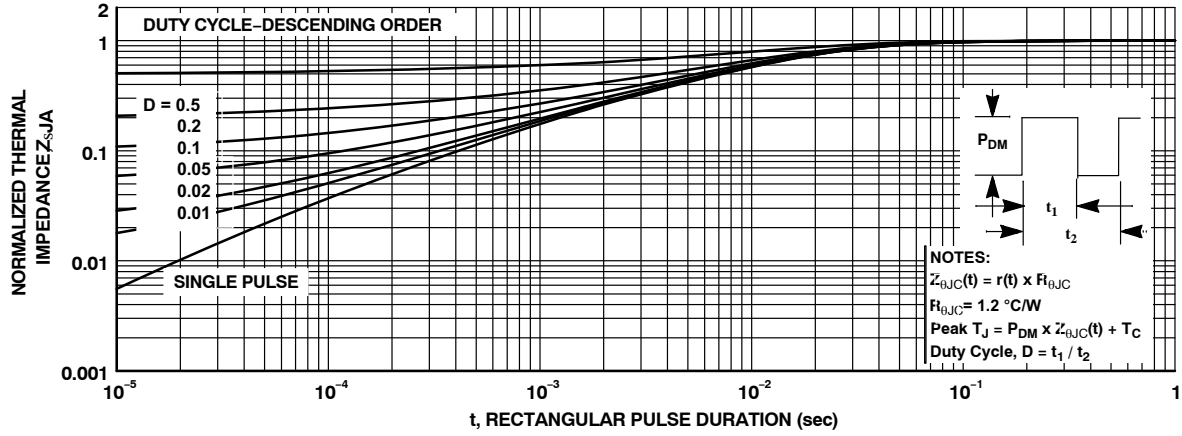


Figure 12. Single Pulse Maximum Power Dissipation

FDMS86500L

TYPICAL CHARACTERISTICS (continued)

($T_J = 25^\circ\text{C}$ unless otherwise noted)

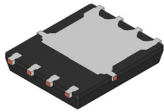


PACKAGE MARKING AND ORDERING INFORMATION

Device Marking	Device	Package	Shipping [†]
FDMS86500L	FDMS86500L	Power 56 (PQFN8) (Pb-Free / Halogen Free)	3,000/Tape&Reel

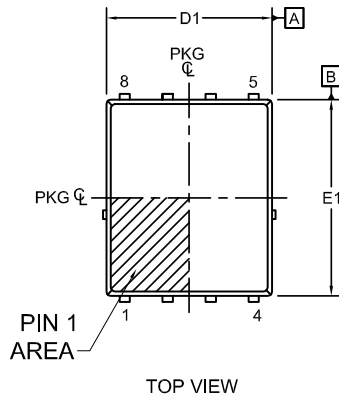
[†]For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, [BRD8011/D](#).

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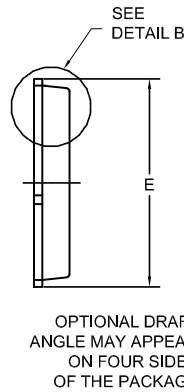


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DATE 21 JAN 2022



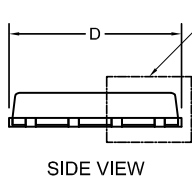
TOP VIEW



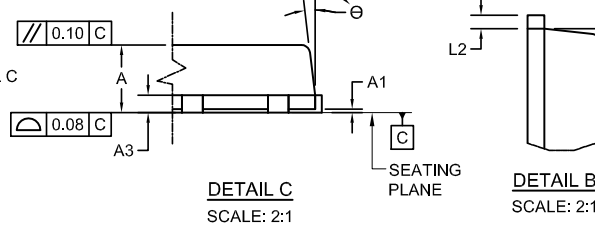
OPTIONAL DRAFT
ANGLE MAY APPEAR
ON FOUR SIDES
OF THE PACKAGE

NOTES:

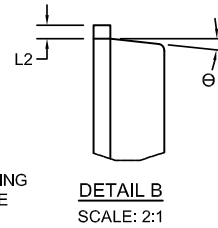
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. COPLANARITY APPLIES TO THE EXPOSED PADS AS WELL AS THE TERMINALS.
4. DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.
5. SEATING PLANE IS DEFINED BY THE TERMINALS. "A1" IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT ON THE PACKAGE BODY.
6. IT IS RECOMMENDED TO HAVE NO TRACES OR VIAS WITHIN THE KEEP OUT AREA.



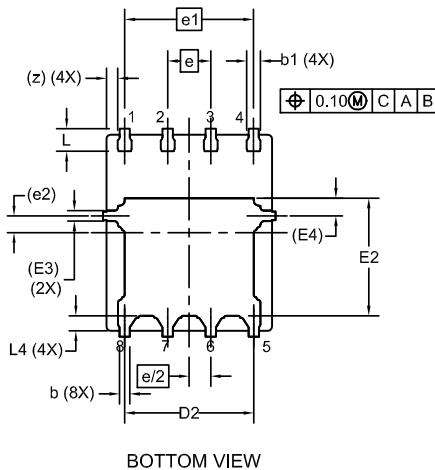
SIDE VIEW



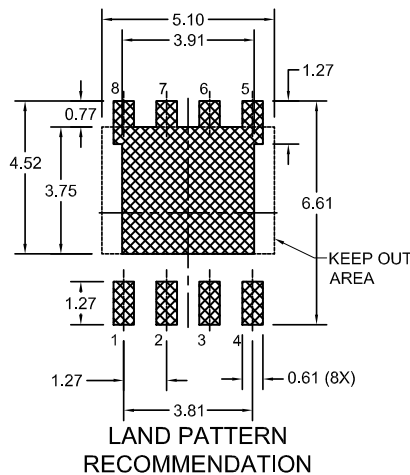
DETAIL C
SCALE: 2:1



DETAIL B
SCALE: 2:1



BOTTOM VIEW



LAND PATTERN
RECOMMENDATION

*FOR ADDITIONAL INFORMATION ON OUR PB-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ON SEMICONDUCTOR SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERM/D.

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	0.90	1.00	1.10
A1	0.00	-	0.05
b	0.21	0.31	0.41
b1	0.31	0.41	0.51
A3	0.15	0.25	0.35
D	4.90	5.00	5.20
D1	4.80	4.90	5.00
D2	3.61	3.82	3.96
E	5.90	6.15	6.25
E1	5.70	5.80	5.90
E2	3.38	3.48	3.78
E3	0.30 REF		
E4	0.52 REF		
e	1.27 BSC		
e/2	0.635 BSC		
e1	3.81 BSC		
e2	0.50 REF		
L	0.51	0.66	0.76
L2	0.05	0.18	0.30
L4	0.34	0.44	0.54
z	0.34 REF		
θ	0°	-	12°

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