

Silicon Carbide (SiC) Cascode JFET – EliteSiC, Power N-Channel, TO-263-7, 750 V, 9 mohm

SiC JFET w/ Si MOSFET

UJ4SC075009B7S

Description

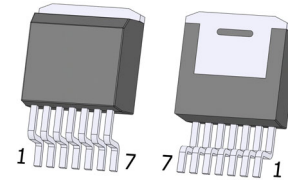
The UJ4SC075009B7S is a 750 V, 9 mΩ G4 SiC FET. It is based on a unique ‘cascode’ circuit configuration, in which a normally-on SiC JFET is co-packaged with a Si MOSFET to produce a normally-off SiC FET device. The device’s standard gate-drive characteristics allows for a true “drop-in replacement” to Si IGBTs, Si FETs, SiC MOSFETs or Si superjunction devices. Available in the TO-263-7 package, this device exhibits ultra-low gate charge and exceptional reverse recovery characteristics, making it ideal for switching inductive loads and any application requiring standard gate drive.

Features

- On-Resistance $R_{DS(on)}$: 9 mΩ (typ)
- Operating Temperature: 175 °C (Max)
- Excellent Reverse Recovery: Q_{rr} = 338 nC
- Low Body Diode V_{FSD} : 1.1 V
- Low Gate Charge : Q_G = 75 nC
- Threshold Voltage $V_{G(th)}$: 4.5 V (typ) Allowing 0 to 15 V Drive
- Low Intrinsic Capacitance
- ESD Protected: HBM Class 2
- TO-263-7 Package for Faster Switching, Clean Gate Waveforms
- This Device is Pb-Free, Halogen Free and is RoHS Compliant

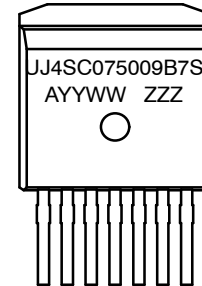
Typical Applications

- EV Charging
- PV Inverters
- Switch Mode Power Supplies
- Power Factor Correction Modules
- Motor Drives
- Induction Heating



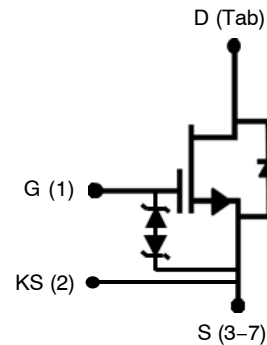
TO-263-7
CASE 418BA

MARKING DIAGRAM



UJ4SC075009B7S = Specific Device Number
A = Assembly Location
YY = Year
WW = Work Week
ZZZ = Lot ID

PIN CONNECTIONS



ORDERING INFORMATION

See detailed ordering and shipping information on page 9 of this data sheet.

MAXIMUM RATINGS

Symbol	Parameter	Test Conditions	Value	Unit
V_{DS}	Drain-Source Voltage		750	V
V_{GS}	Gate-Source Voltage	DC	-20 to +20	V
		AC ($f > 1$ Hz)	-25 to +25	V
I_D	Continuous Drain Current (Note 1)	$T_C < 61\text{ }^{\circ}\text{C}$	106	A
		$T_C = 100\text{ }^{\circ}\text{C}$	86	A
I_{DM}	Pulsed Drain Current (Note 2)	$T_C = 25\text{ }^{\circ}\text{C}$	344	A
E_{AS}	Single Pulsed Avalanche Energy (Note 3)	$L = 15\text{ mH}$, $I_{AS} = 5.2\text{ A}$	202	mJ
dv/dt	SiC FET dv/dt Ruggedness	$V_{DS} \leq 500\text{ V}$	100	V/ns
P_{tot}	Power Dissipation	$T_C = 25\text{ }^{\circ}\text{C}$	375	W
$T_{J,max}$	Maximum Junction Temperature		175	$^{\circ}\text{C}$
T_J , T_{STG}	Operating and Storage Temperature		-55 to 175	$^{\circ}\text{C}$
T_{SOLDER}	Reflow Soldering Temperature	Reflow MSL 1	245	$^{\circ}\text{C}$

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.

1. Limited by bondwires
2. Pulse width t_p limited by $T_{J,max}$
3. Starting $T_J = 25\text{ }^{\circ}\text{C}$

THERMAL CHARACTERISTICS

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case		-	0.31	0.40	$^{\circ}\text{C/W}$

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
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TYPICAL PERFORMANCE – STATIC

BV_{DS}	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}$, $I_D = 1\text{ mA}$	750	-	-	V
I_{DSS}	Total Drain Leakage Current	$V_{DS} = 750\text{ V}$, $V_{GS} = 0\text{ V}$, $T_J = 25\text{ }^{\circ}\text{C}$	-	4.0	84	μA
		$V_{DS} = 750\text{ V}$, $V_{GS} = 0\text{ V}$, $T_J = 175\text{ }^{\circ}\text{C}$	-	35	-	
I_{GSS}	Total Gate Leakage Current	$V_{DS} = 0\text{ V}$, $T_J = 25\text{ }^{\circ}\text{C}$ $V_{GS} = -20\text{ V} / +20\text{ V}$	-	2	± 20	μA
$R_{DS(on)}$	Drain-Source On-resistance	$V_{GS} = 12\text{ V}$, $I_D = 70\text{ A}$, $T_J = 25\text{ }^{\circ}\text{C}$	-	9	11.5	$\text{m}\Omega$
		$T_J = 125\text{ }^{\circ}\text{C}$	-	14.8	-	
		$T_J = 175\text{ }^{\circ}\text{C}$	-	19.4	-	
$V_{G(th)}$	Gate Threshold Voltage	$V_{DS} = 5\text{ V}$, $I_D = 10\text{ mA}$	3.5	4.5	5.5	V
R_G	Gate Resistance	$f = 1\text{ MHz}$, open drain	-	2.3	-	Ω

TYPICAL PERFORMANCE – REVERSE DIODE

I_S	Diode Continuous Forward Current (Note 1)	$T_C < 61\text{ }^{\circ}\text{C}$	-	-	106	A
$I_{S,pulse}$	Diode Pulse Current (Note 2)	$T_C = 25\text{ }^{\circ}\text{C}$	-	-	344	A
V_{FSD}	Forward Voltage	$V_{GS} = 0\text{ V}$, $I_S = 35\text{ A}$, $T_J = 25\text{ }^{\circ}\text{C}$	-	1.10	1.24	V
		$V_{GS} = 0\text{ V}$, $I_S = 35\text{ A}$, $T_J = 175\text{ }^{\circ}\text{C}$	-	1.14	-	
Q_{rr}	Reverse Recovery Charge	$V_{DS} = 400\text{ V}$, $I_S = 70\text{ A}$, $V_{GS} = 0\text{ V}$, $R_{G_EXT} = 33\text{ }\Omega$, $di/dt = 2500\text{ A}/\mu\text{s}$, $T_J = 25\text{ }^{\circ}\text{C}$	-	338	-	nC
t_{rr}	Reverse Recovery Time		-	29	-	ns
Q_{rr}	Reverse Recovery Charge	$V_{DS} = 400\text{ V}$, $I_S = 70\text{ A}$, $V_{GS} = 0\text{ V}$, $R_{G_EXT} = 33\text{ }\Omega$, $di/dt = 2500\text{ A}/\mu\text{s}$, $T_J = 150\text{ }^{\circ}\text{C}$	-	375	-	nC
t_{rr}	Reverse Recovery Time		-	32	-	ns

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
TYPICAL PERFORMANCE – DYNAMIC						
C_{iss}	Input Capacitance	$V_{DS} = 400\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$	–	3340	–	pF
C_{oss}	Output Capacitance		–	230	–	
C_{rss}	Reverse Transfer Capacitance		–	1.4	–	
$C_{oss(er)}$	Effective Output Capacitance, Energy Related	$V_{DS} = 0\text{ V to }400\text{ V}$, $V_{GS} = 0\text{ V}$	–	286	–	pF
$C_{oss(tr)}$	Effective Output Capacitance, Time Related		–	605	–	pF
E_{oss}	C_{oss} Stored Energy	$V_{DS} = 400\text{ V}$, $V_{GS} = 0\text{ V}$	–	23	–	μJ
Q_G	Total Gate Charge	$V_{DS} = 400\text{ V}$, $I_D = 70\text{ A}$, $V_{GS} = 0\text{ V to }15\text{ V}$	–	75	–	nC
Q_{GD}	Gate-Drain Charge		–	13	–	
Q_{GS}	Gate-Source Charge		–	22	–	
$t_{d(on)}$	Turn-on Delay Time	Notes 4 and 5 $V_{DS} = 400\text{ V}$, $I_D = 70\text{ A}$, Gate Driver = 0 V , to $+15\text{ V}$, Turn-on $R_{G,EXT} = 1\text{ }\Omega$, Turn-off $R_{G,EXT} = 5\text{ }\Omega$, Inductive Load, FWD: same device with $V_{GS} = 0\text{ V}$ and $R_G = 5\text{ }\Omega$, RC snubber: $R_S = 5\text{ }\Omega$ and $C_S = 560\text{ pF}$, $T_J = 25\text{ }^{\circ}\text{C}$	–	17	–	ns
t_r	Rise Time		–	25	–	
$t_{d(off)}$	Turn-off Delay Time		–	65	–	
t_f	Fall Time		–	14	–	
E_{ON}	Turn-on Energy Including R_S Energy		–	220	–	μJ
E_{OFF}	Turn-off Energy Including R_S Energy		–	181	–	
E_{TOTAL}	Total Switching Energy		–	401	–	
E_{RS_ON}	Snubber R_S Energy During Turn-on		–	13	–	
E_{RS_OFF}	Snubber R_S Energy During Turn-off		–	50	–	
$t_{d(on)}$	Turn-on Delay Time	Notes 4 and 5 $V_{DS} = 400\text{ V}$, $I_D = 70\text{ A}$, Gate Driver = 0 V , to $+15\text{ V}$, Turn-on $R_{G,EXT} = 1\text{ }\Omega$, Turn-off $R_{G,EXT} = 5\text{ }\Omega$, Inductive Load, FWD: same device with $V_{GS} = 0\text{ V}$ and $R_G = 5\text{ }\Omega$, RC snubber: $R_S = 5\text{ }\Omega$ and $C_S = 560\text{ pF}$, $T_J = 150\text{ }^{\circ}\text{C}$	–	18	–	ns
t_r	Rise Time		–	28	–	
$t_{d(off)}$	Turn-off Delay Time		–	68	–	
t_f	Fall Time		–	13	–	
E_{ON}	Turn-on Energy Including R_S Energy		–	245	–	μJ
E_{OFF}	Turn-off Energy Including R_S Energy		–	211	–	
E_{TOTAL}	Total Switching Energy		–	456	–	
E_{RS_ON}	Snubber R_S Energy During Turn-on		–	13	–	
E_{RS_OFF}	Snubber R_S Energy During Turn-off		–	50	–	

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.

4. Measured with the switching test circuit in Figure 26.

5. In this datasheet, all the switching energies (turn-on energy, turn-off energy and total energy) presented in the tables and Figures include the device RC snubber energy losses.

TYPICAL CHARACTERISTICS

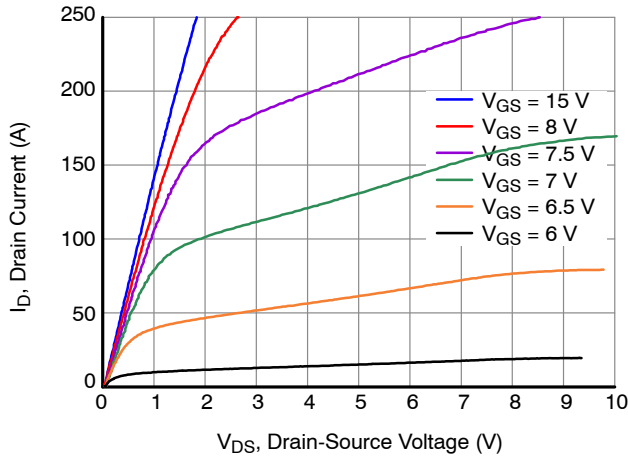


Figure 1. Typical Output Characteristics at $T_J = -55\text{ }^{\circ}\text{C}$, $t_p < 250\text{ }\mu\text{s}$

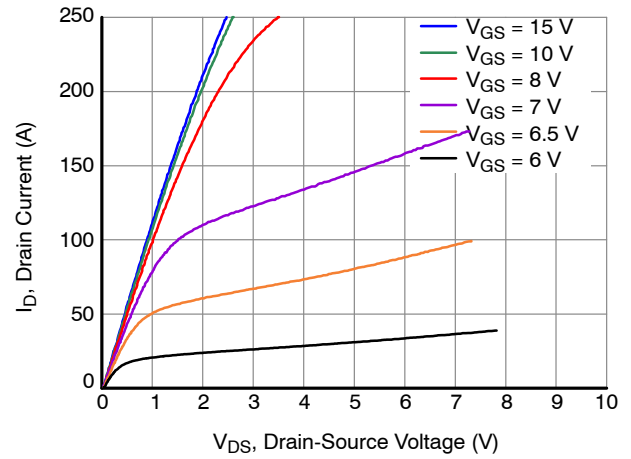


Figure 2. Typical Output Characteristics at $T_J = 25\text{ }^{\circ}\text{C}$, $t_p < 250\text{ }\mu\text{s}$

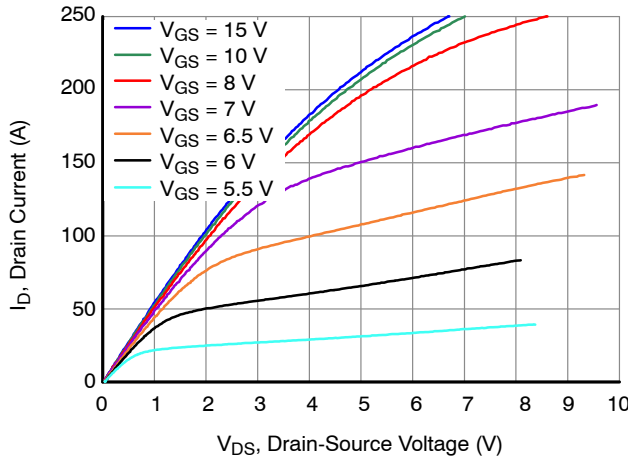


Figure 3. Typical Output Characteristics at $T_J = 175\text{ }^{\circ}\text{C}$, $t_p < 250\text{ }\mu\text{s}$

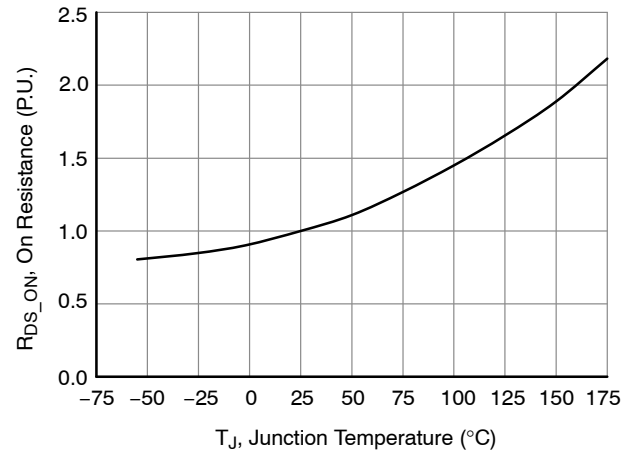


Figure 4. Normalized On-Resistance vs. Temperature at $V_{GS} = 12\text{ V}$ and $I_D = 70\text{ A}$

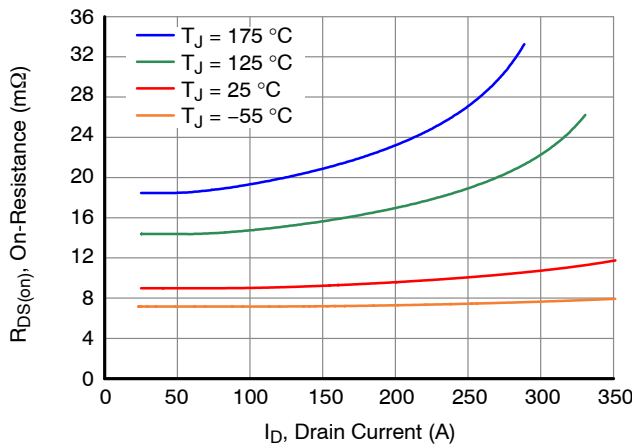


Figure 5. Typical Drain-Source On-Resistances at $V_{GS} = 12\text{ V}$

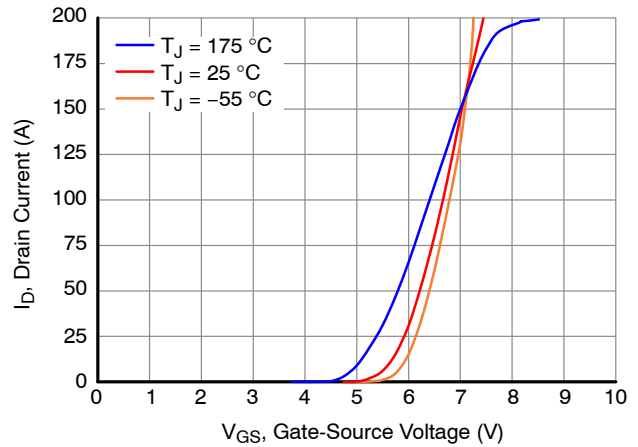


Figure 6. Typical Transfer Characteristics at $V_{DS} = 5\text{ V}$

TYPICAL CHARACTERISTICS (continued)

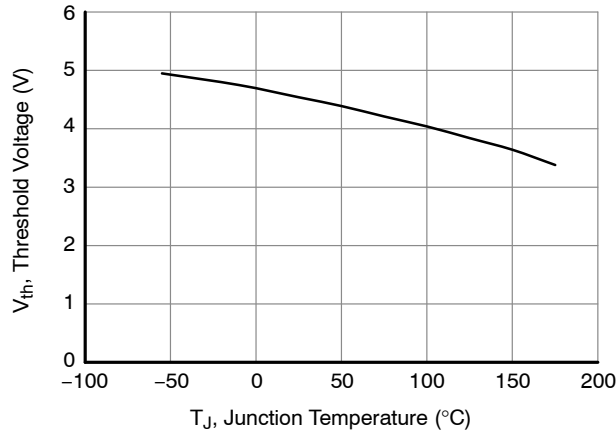


Figure 7. Threshold Voltage vs. Junction Temperature at $V_{DS} = 5\text{ V}$ and $I_D = 10\text{ mA}$

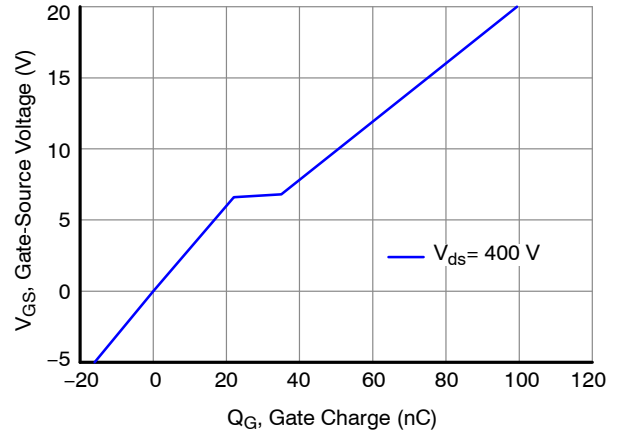


Figure 8. Typical Gate Charge at $I_D = 70\text{ A}$

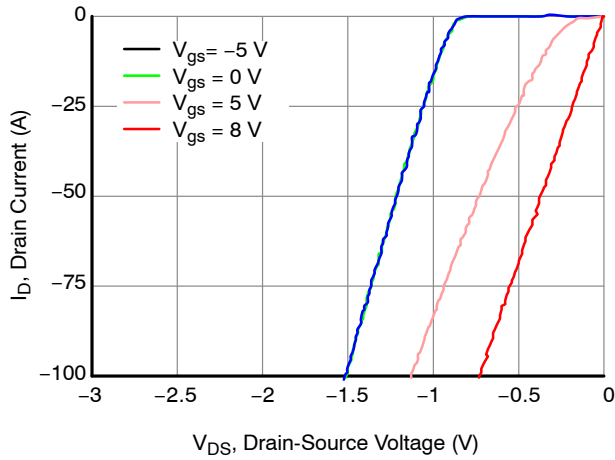


Figure 9. 3rd Quadrant Characteristics at $T_J = -55\text{ °C}$

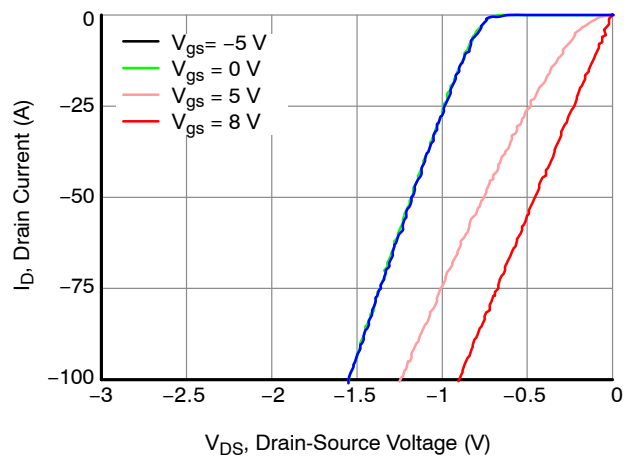


Figure 10. 3rd Quadrant Characteristics at $T_J = 25\text{ °C}$

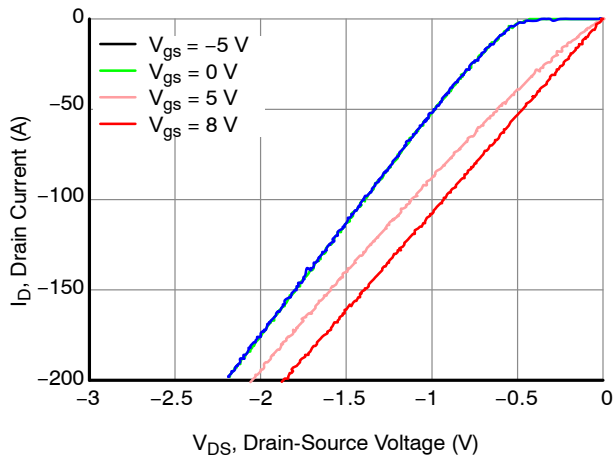


Figure 11. 3rd Quadrant Characteristics at $T_J = 175\text{ °C}$

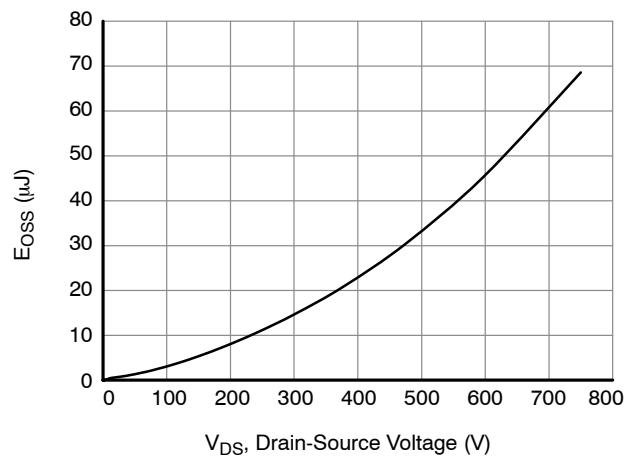


Figure 12. Typical Stored Energy in C_{OSS} at $V_{GS} = 0\text{ V}$

TYPICAL CHARACTERISTICS (continued)

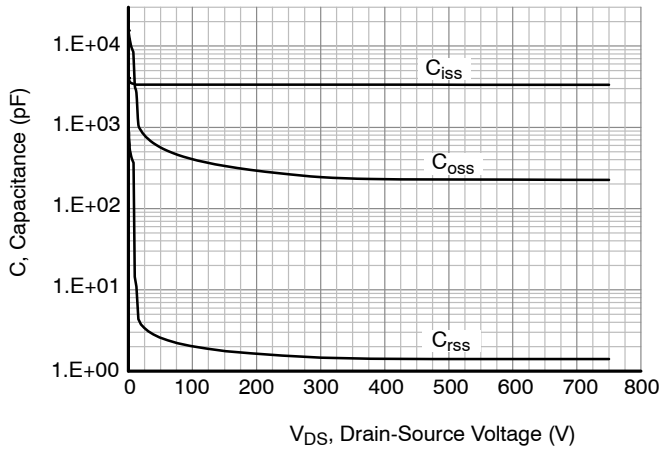


Figure 13. Typical Capacitances at $f = 100 \text{ kHz}$ and $V_{GS} = 0 \text{ V}$

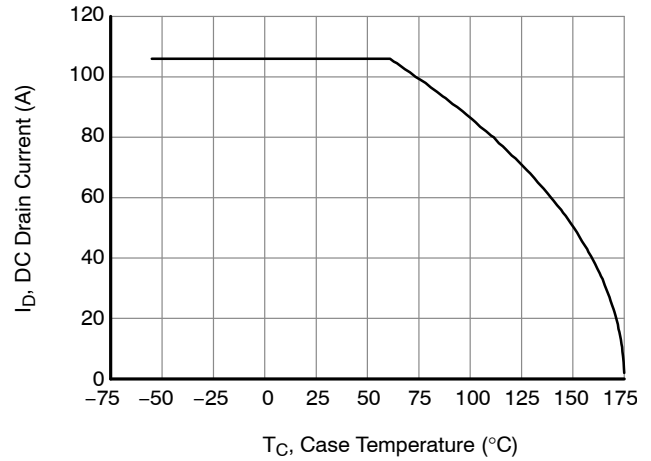


Figure 14. DC Drain Current Derating

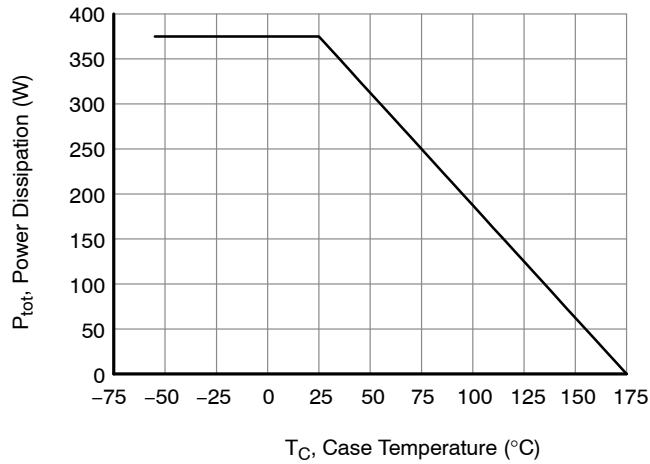


Figure 15. Total Power Dissipation

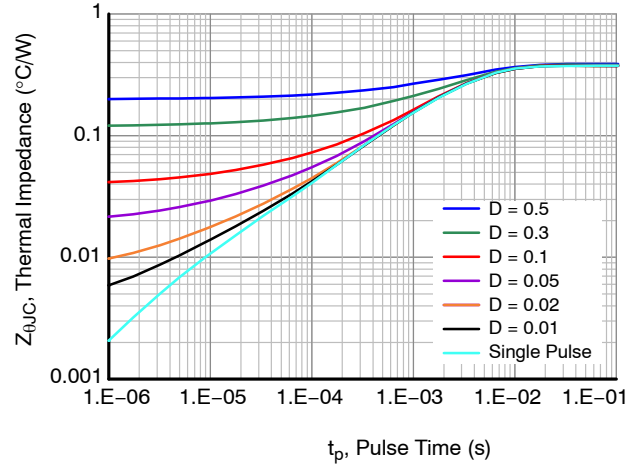


Figure 16. Maximum Transient Thermal Impedance

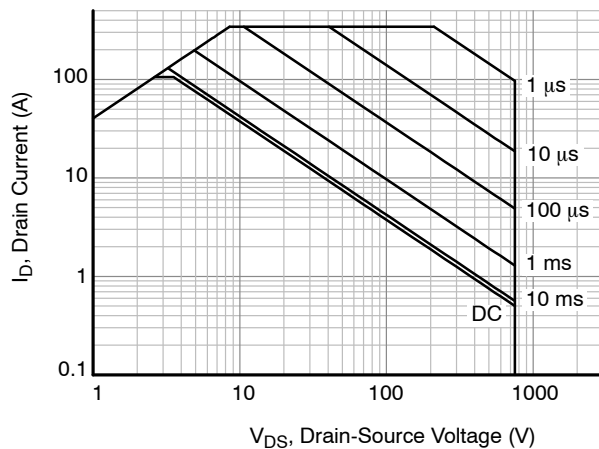


Figure 17. Safe Operation Area at $T_C = 25 \text{ °C}$, $D = 0$, Parameter t_p

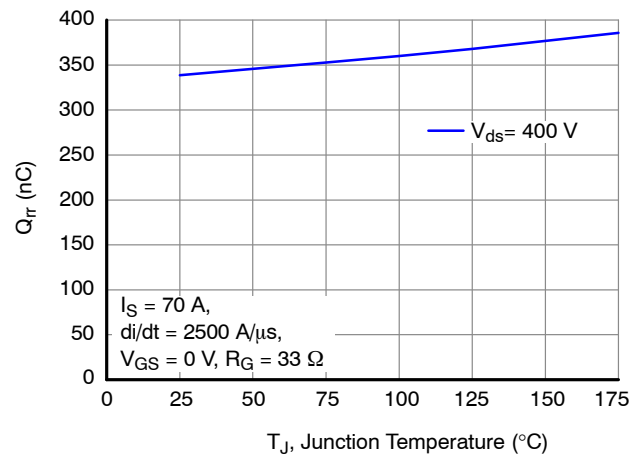


Figure 18. Reverse Recovery Charge Q_{rr} vs. Junction Temperature

TYPICAL CHARACTERISTICS (continued)

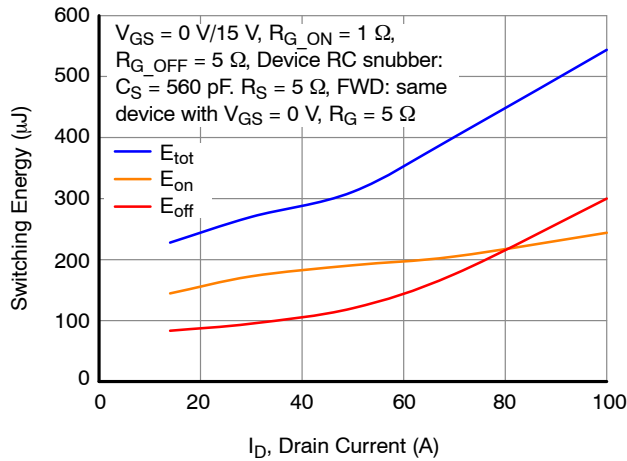


Figure 19. Clamped Inductive Switching Energy vs. Drain Current at $V_{DS} = 400$ V and $T_J = 25$ °C

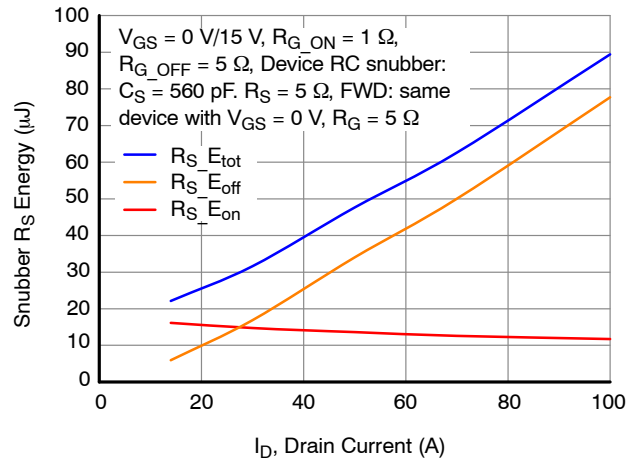


Figure 20. RC Snubber Energy Loss vs. Drain Current at $V_{DS} = 400$ V and $T_J = 25$ °C

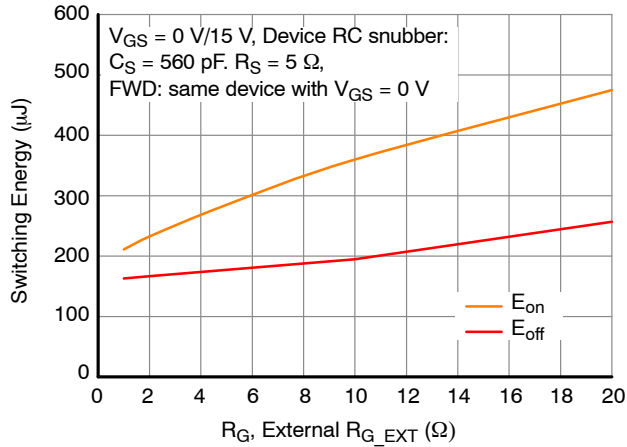


Figure 21. Clamped Inductive Switching Energy vs. R_{G_EXT} at $V_{DS} = 400$ V, $I_D = 70$ A and $T_J = 25$ °C

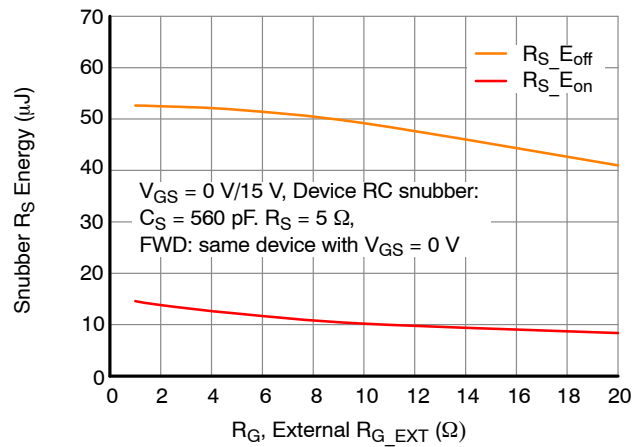


Figure 22. RC Snubber Energy Losses vs. R_{G_EXT} at $V_{DS} = 400$ V, $I_D = 70$ A and $T_J = 25$ °C

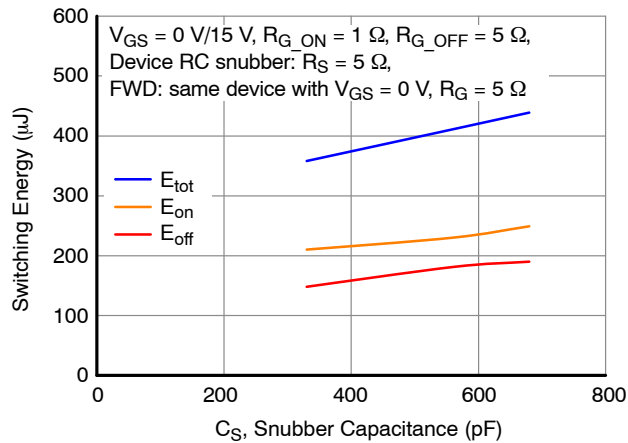


Figure 23. Clamped Inductive Switching Energy vs. Snubber Capacitance C_S at $V_{DS} = 400$ V, $I_D = 70$ A and $T_J = 25$ °C

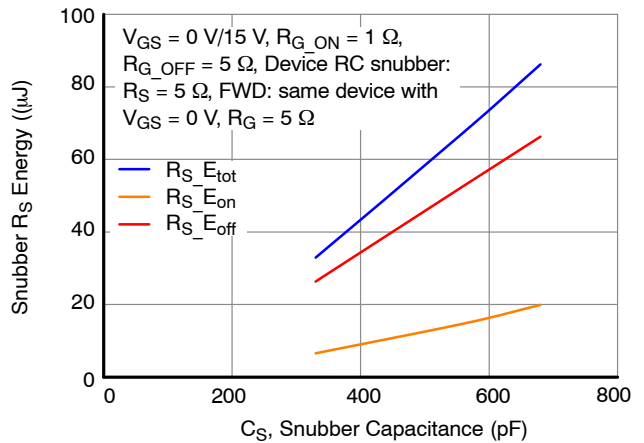


Figure 24. RC Snubber Energy Losses vs. Snubber Capacitance C_S at $V_{DS} = 400$ V, $I_D = 70$ A and $T_J = 25$ °C

TYPICAL CHARACTERISTICS (continued)

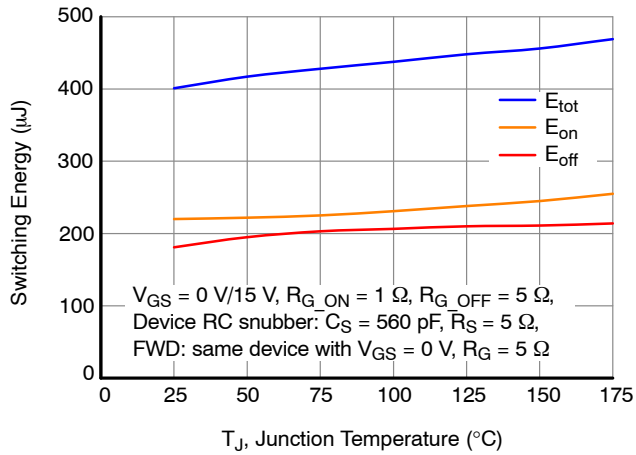


Figure 25. Clamped Inductive Switching Energy vs. Junction Temperature at $V_{\text{DS}} = 400 \text{ V}$ and $I_{\text{D}} = 70 \text{ A}$

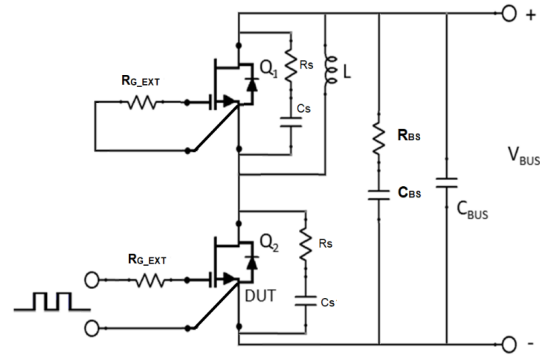


Figure 26. Schematic of the Half-Bridge Mode Switching Test Circuit. Note, a Bus RC Snubber ($R_{\text{BS}} = 1 \Omega$, $C_{\text{BS}} = 100 \text{ nF}$) is Used to Reduce the Power Loop High Frequency Oscillations.

APPLICATIONS INFORMATION

SiC FETs are enhancement-mode power switches formed by a high-voltage SiC depletion-mode JFET and a low-voltage silicon MOSFET connected in series. The silicon MOSFET serves as the control unit while the SiC JFET provides high voltage blocking in the off state. This combination of devices in a single package provides compatibility with standard gate drivers and offers superior performance in terms of low on-resistance ($R_{DS(on)}$), output capacitance (C_{oss}), gate charge (Q_G), and reverse recovery charge (Q_{rr}) leading to low conduction and switching losses. The SiC FETs also provide excellent reverse conduction capability eliminating the need for an external anti-parallel diode.

Like other high performance power switches, proper PCB layout design to minimize circuit parasitics is strongly recommended due to the high dv/dt and di/dt rates. An external gate resistor is recommended when the FET is

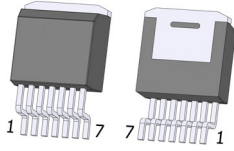
working in the diode mode in order to achieve the optimum reverse recovery performance. For more information on SiC FET operation, see www.onsemi.com.

A snubber circuit with a small $R_{(G)}$, or gate resistor, provides better EMI suppression with higher efficiency compared to using a high $R_{(G)}$ value. There is no extra gate delay time when using the snubber circuitry, and a small $R_{(G)}$ will better control both the turn-off $V_{(DS)}$ peak spike and ringing duration, while a high $R_{(G)}$ will damp the peak spike but result in a longer delay time. In addition, the total switching loss when using a snubber circuit is less than using high $R_{(G)}$, while greatly reducing $E_{(OFF)}$ from mid-to-full load range with only a small increase in $E_{(ON)}$. Efficiency will therefore improve with higher load current. For more information on how a snubber circuit will improve overall system performance, visit the **onsemi** website at www.onsemi.com.

ORDERING INFORMATION

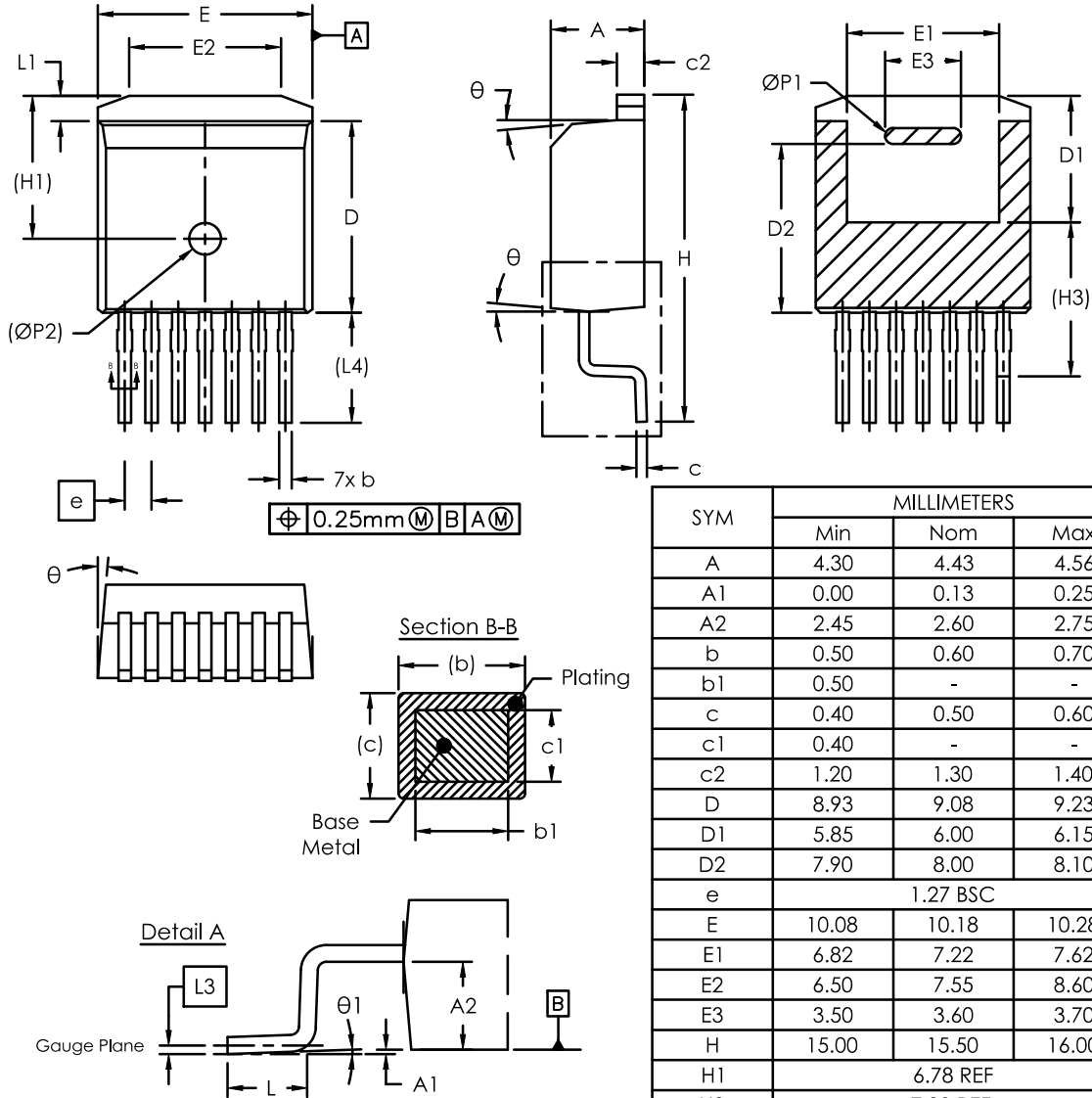
Part Number	Marking	Package	Shipping [†]
UJ4SC075009B7S	UJ4SC075009B7S	TO-263-7 (Pb-Free, Halogen Free)	800 units / Tape and Reel

[†]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](http://www.onsemi.com).



TO-263-7 10.18x9.08x4.43, 1.27P
CASE 418BA
ISSUE B

DATE 17 APR 2025



SYM	MILLIMETERS		
	Min	Nom	Max
A	4.30	4.43	4.56
A1	0.00	0.13	0.25
A2	2.45	2.60	2.75
b	0.50	0.60	0.70
b1	0.50	-	-
c	0.40	0.50	0.60
c1	0.40	-	-
c2	1.20	1.30	1.40
D	8.93	9.08	9.23
D1	5.85	6.00	6.15
D2	7.90	8.00	8.10
e	1.27 BSC		
E	10.08	10.18	10.28
E1	6.82	7.22	7.62
E2	6.50	7.55	8.60
E3	3.50	3.60	3.70
H	15.00	15.50	16.00
H1	6.78 REF		
H3	7.30 REF.		
L	1.90	2.20	2.50
L1	0.98	1.20	1.42
L3	0.25 BSC		
L4	5.22 REF		
ØP1	0.65	0.75	0.85
ØP2	1.50 REF		
θ	5°		
θ_1	3°		

Notes:

1. Dimensioning and Tolerancing as per ASME Y14.5M, 2018.
2. Controlling Dimension : Millimeters
3. Package body sides exclude mold flash and gate burrs.
4. Dimension L is measured on gauge plane.
5. Dimension c1 and b1 applies to base metal only.

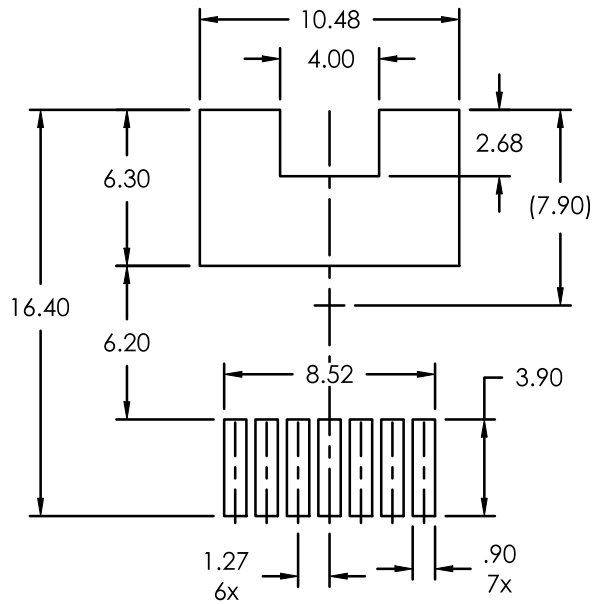
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DESCRIPTION:	TO-263-7 10.18x9.08x4.43, 1.27P	PAGE 1 OF 2

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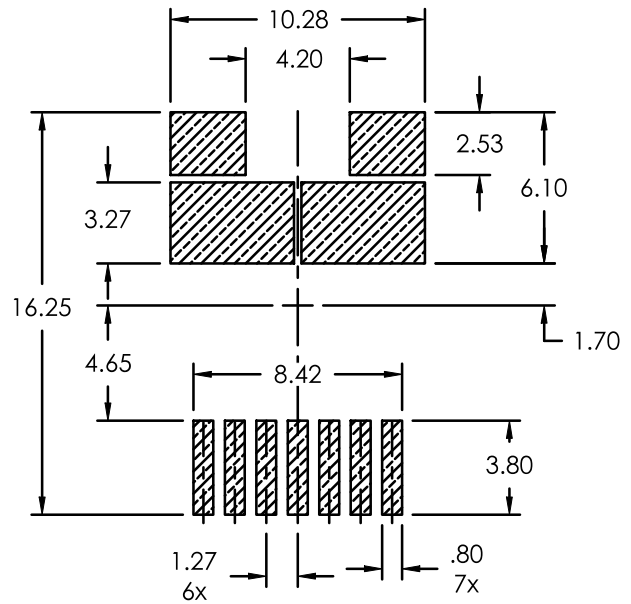
TO-263-7 10.18x9.08x4.43, 1.27P
CASE 418BA
ISSUE B

DATE 17 APR 2025

RECOMMENDED PCB FOOTPRINT

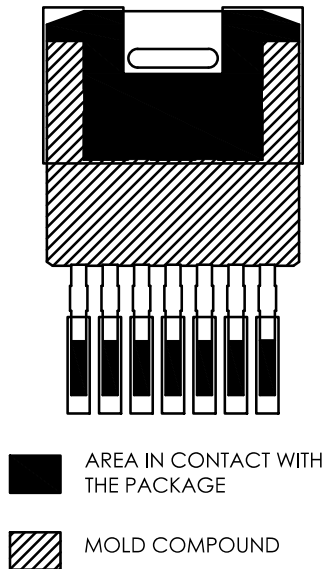


RECOMMENDED STENCIL APERTURE



NOTE: LAND PATTERN AND STENCIL APERTURE DIMENSIONS SERVE ONLY AS AN INITIAL GUIDE. END-USER PCB DESIGN RULES AND TOLERANCES SHOULD ALWAYS PREVAIL.

PCB FOOTPRINT with PACKAGE OVERLAY



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