



## Features

- Optimized package with separate driver source pin
- High blocking voltage with low on-resistance
- High-speed switching with low capacitances
- Fast intrinsic diode with low reverse recovery ( $Q_{rr}$ )
- Halogen free, RoHS compliant

## Benefits

- Reduce switching losses and minimize gate ringing
- Higher system efficiency
- Reduce cooling requirements
- Increase power density
- Increase system switching frequency

## Applications

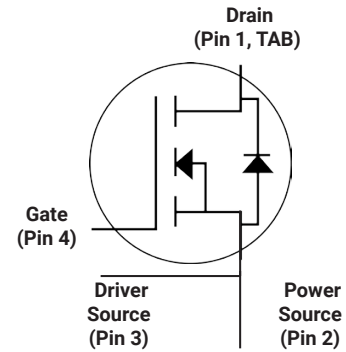
- Solar inverters
- EV motor drive
- High voltage DC/DC converters
- Switched mode power supplies
- Load switch

$V_{DS}$	1200 V
$I_D$ @ 25°C	100 A
$R_{DS(on)}$	21 mΩ



TO-247-4

## Package



Part Number	Package	Marking
GC3M0021120K	TO-247-4	GC3M0021120

## Maximum Ratings ( $T_C = 25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Value	Unit	Test Conditions	Note
$V_{DSmax}$	Drain - Source Voltage	1200	V	$V_{GS} = 0\text{ V}, I_D = 100\ \mu\text{A}$	
$V_{GSmax}$	Gate - Source Voltage (dynamic)	-8/+19	V	AC ( $f > 1\text{ Hz}$ )	Note 1
$V_{GSop}$	Gate - Source Voltage (static)	-4/+15	V	Static	Note 2
$I_D$	Continuous Drain Current	100	A	$V_{GS} = 15\text{ V}, T_C = 25^\circ\text{C}$	Fig. 19
		74		$V_{GS} = 15\text{ V}, T_C = 100^\circ\text{C}$	
$I_{D(pulse)}$	Pulsed Drain Current	200	A	Pulse width $t_p$ limited by $T_{jmax}$	
$P_D$	Power Dissipation	469	W	$T_C = 25^\circ\text{C}, T_J = 175^\circ\text{C}$	Fig. 20
$T_J, T_{stg}$	Operating Junction and Storage Temperature	-40 to +175	°C		
$T_L$	Solder Temperature	260	°C	1.6mm (0.063") from case for 10s	

Note (1): When using MOSFET Body Diode  $V_{GSmax} = -4\text{V}/+19\text{V}$

Note (2): MOSFET can also safely operate at 0/+15 V

**SUPSiC®****Electrical Characteristics** ( $T_c = 25^\circ\text{C}$  unless otherwise specified)

无锡国晶半导体技术有限公司  
Wuxi Gwok Semiconductor Co.,Ltd

GC3M0021120K  
Silicon Carbide Power MOSFET  
N-Channel Enhancement Mode

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	1200			V	$V_{GS} = 0\text{ V}, I_D = 100\ \mu\text{A}$	
$V_{GS(th)}$	Gate Threshold Voltage	1.8	2.5	3.6	V	$V_{DS} = V_{GS}, I_D = 17.7\ \text{mA}$	Fig. 11
			2.0		V	$V_{DS} = V_{GS}, I_D = 17.7\ \text{mA}, T_J = 175^\circ\text{C}$	
$I_{DSS}$	Zero Gate Voltage Drain Current		1	50	$\mu\text{A}$	$V_{DS} = 1200\ \text{V}, V_{GS} = 0\ \text{V}$	
$I_{GSS}$	Gate-Source Leakage Current		10	250	nA	$V_{GS} = 15\ \text{V}, V_{DS} = 0\ \text{V}$	
$R_{DS(on)}$	Drain-Source On-State Resistance		21	28.8	m $\Omega$	$V_{GS} = 15\ \text{V}, I_D = 50\ \text{A}$	Fig. 4, 5, 6
			38			$V_{GS} = 15\ \text{V}, I_D = 50\ \text{A}, T_J = 175^\circ\text{C}$	
$g_{fs}$	Transconductance		35		S	$V_{DS} = 20\ \text{V}, I_{DS} = 50\ \text{A}$	Fig. 7
			33			$V_{DS} = 20\ \text{V}, I_{DS} = 50\ \text{A}, T_J = 175^\circ\text{C}$	
$C_{iss}$	Input Capacitance		4818		pF	$V_{GS} = 0\ \text{V}, V_{DS} = 1000\ \text{V}$ $f = 1\ \text{MHz}$ $V_{AC} = 25\ \text{mV}$	Fig. 17, 18
$C_{oss}$	Output Capacitance		180				
$C_{rss}$	Reverse Transfer Capacitance		12				
$E_{oss}$	$C_{oss}$ Stored Energy		99				$\mu\text{J}$
$E_{ON}$	Turn-On Switching Energy (SiC Diode FWD)		0.69		mJ	$V_{DS} = 800\ \text{V}, V_{GS} = -4\ \text{V}/+15\ \text{V}, I_D = 50\ \text{A},$ $R_{G(ext)} = 2.5\ \Omega, L = 157\ \mu\text{H}, T_J = 175^\circ\text{C}$	Fig. 26, 29
$E_{OFF}$	Turn Off Switching Energy (SiC Diode FWD)		0.42				
$E_{ON}$	Turn-On Switching Energy (Body Diode FWD)		1.58		mJ	$V_{DS} = 800\ \text{V}, V_{GS} = -4\ \text{V}/+15\ \text{V}, I_D = 50\ \text{A},$ $R_{G(ext)} = 2.5\ \Omega, L = 157\ \mu\text{H}, T_J = 175^\circ\text{C}$	Fig. 26, 29
$E_{OFF}$	Turn Off Switching Energy (Body Diode FWD)		0.34				
$t_{d(on)}$	Turn-On Delay Time		29		ns	$V_{DD} = 800\ \text{V}, V_{GS} = -4\ \text{V}/15\ \text{V}$ $R_{G(ext)} = 2.5\ \Omega,$ $L = 157\ \mu\text{H}$	Fig. 27
$t_r$	Rise Time		33				
$t_{d(off)}$	Turn-Off Delay Time		57				
$t_f$	Fall Time		14				
$R_{G(int)}$	Internal Gate Resistance		3.3		$\Omega$	$f = 1\ \text{MHz}, V_{AC} = 25\ \text{mV}$	
$Q_{gs}$	Gate to Source Charge		49		nC	$V_{DS} = 800\ \text{V}, V_{GS} = -4\ \text{V}/15\ \text{V}$ $I_D = 50\ \text{A}$ Per IEC60747-8-4 pg 21	Fig. 12
$Q_{gd}$	Gate to Drain Charge		50				
$Q_g$	Total Gate Charge		162				

**Reverse Diode Characteristics** ( $T_c = 25^\circ\text{C}$  unless otherwise specified)

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
$V_{SD}$	Diode Forward Voltage	4.6		V	$V_{GS} = -4\ \text{V}, I_{SD} = 25\ \text{A}, T_J = 25^\circ\text{C}$	Fig. 8, 9, 10
		4.2		V	$V_{GS} = -4\ \text{V}, I_{SD} = 25\ \text{A}, T_J = 175^\circ\text{C}$	
$I_S$	Continuous Diode Forward Current		90	A	$V_{GS} = -4\ \text{V}, T_c = 25^\circ\text{C}$	Note 1
$I_{S, pulse}$	Diode pulse Current		200	A	$V_{GS} = -4\ \text{V},$ pulse width $t_p$ limited by $T_{jmax}$	Note 1
$t_{rr}$	Reverse Recover time	34		ns	$V_{GS} = -4\ \text{V}, I_{SD} = 50\ \text{A}, V_R = 800\ \text{V}$ $\text{diff}/\text{dt} = 2600\ \text{A}/\mu\text{s}, T_J = 175^\circ\text{C}$	Note 1
$Q_{rr}$	Reverse Recovery Charge	928		nC		
$I_{rrm}$	Peak Reverse Recovery Current	42		A		

**Thermal Characteristics**

Symbol	Parameter	Typ.	Unit	Test Conditions	Note
$R_{\theta JC}$	Thermal Resistance from Junction to Case	0.32	$^\circ\text{C}/\text{W}$		Fig. 21
$R_{\theta JA}$	Thermal Resistance From Junction to Ambient	40			

Typical Performance

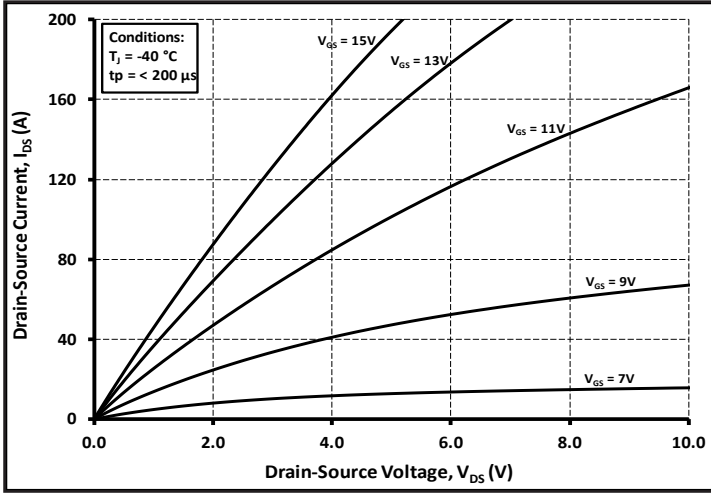


Figure 1. Output Characteristics  $T_J = -40\text{ }^\circ\text{C}$

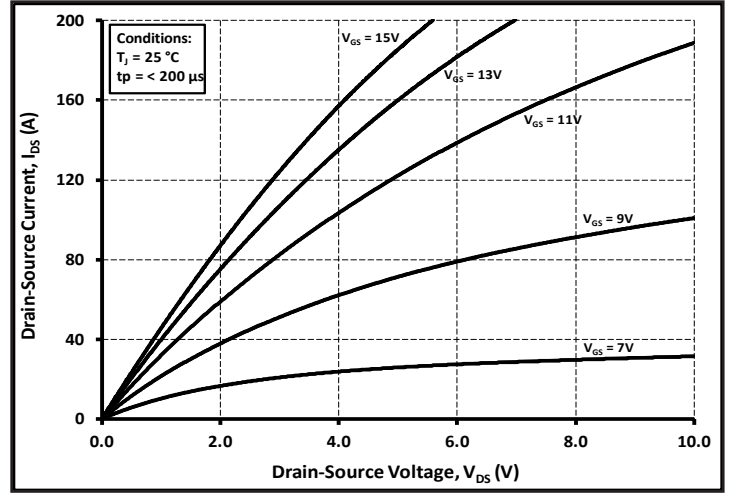


Figure 2. Output Characteristics  $T_J = 25\text{ }^\circ\text{C}$

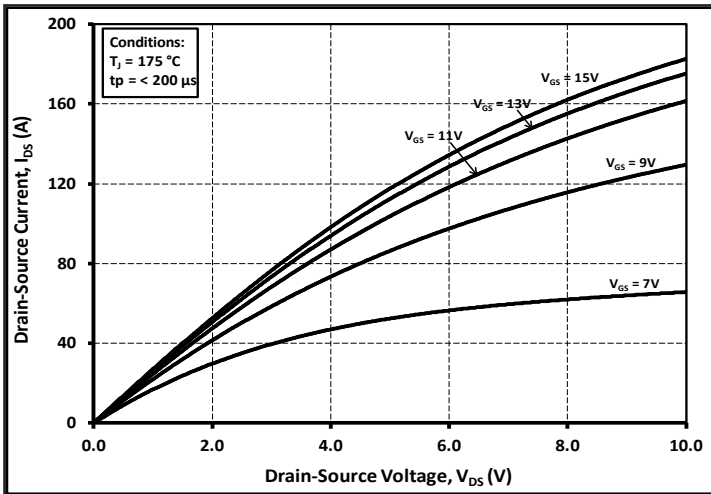


Figure 3. Output Characteristics  $T_J = 175\text{ }^\circ\text{C}$

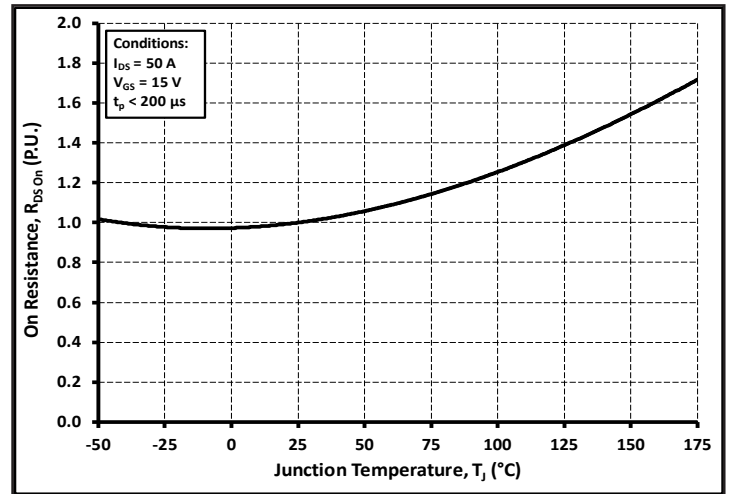


Figure 4. Normalized On-Resistance vs. Temperature

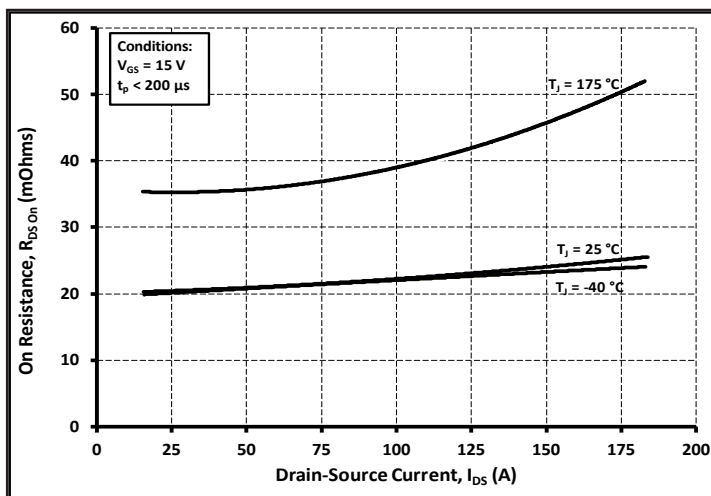


Figure 5. On-Resistance vs. Drain Current For Various Temperatures

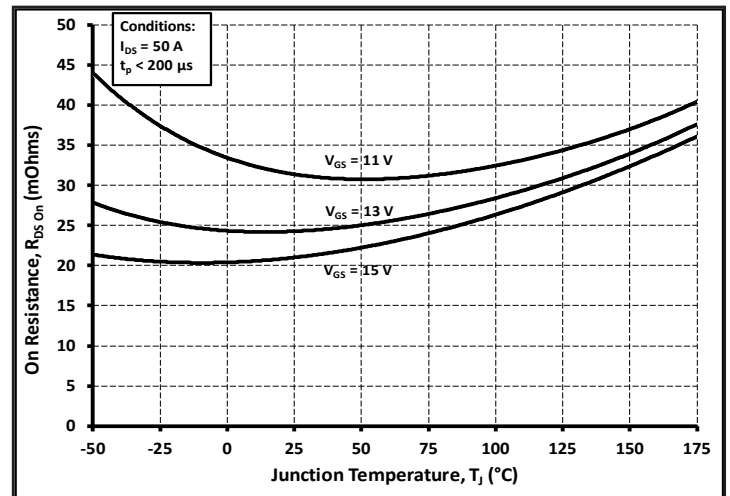


Figure 6. On-Resistance vs. Temperature For Various Gate Voltage

Typical Performance

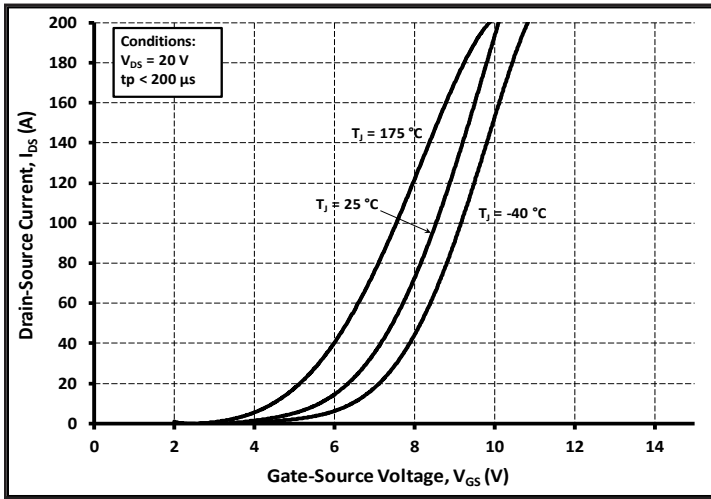


Figure 7. Transfer Characteristic for Various Junction Temperatures

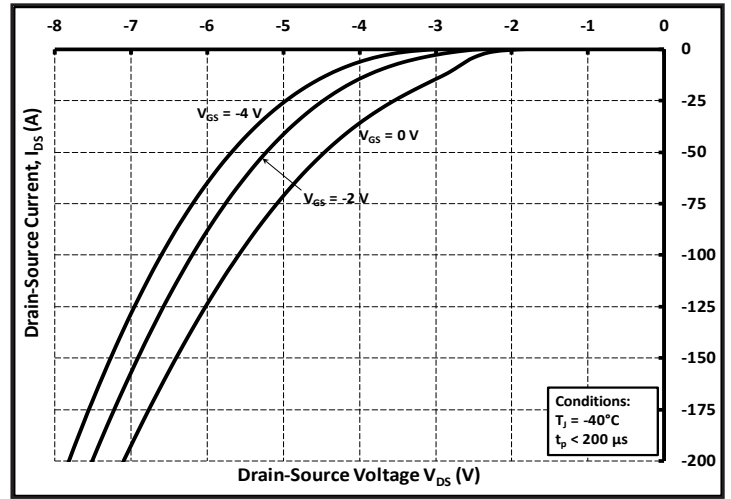


Figure 8. Body Diode Characteristic at -40 °C

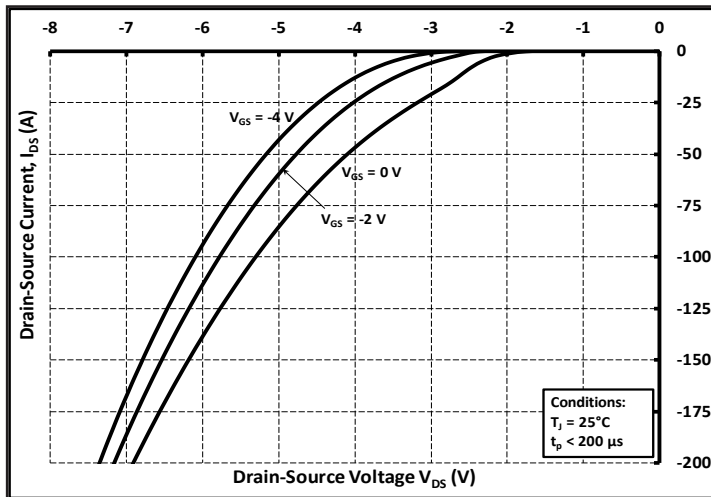


Figure 9. Body Diode Characteristic at 25 °C

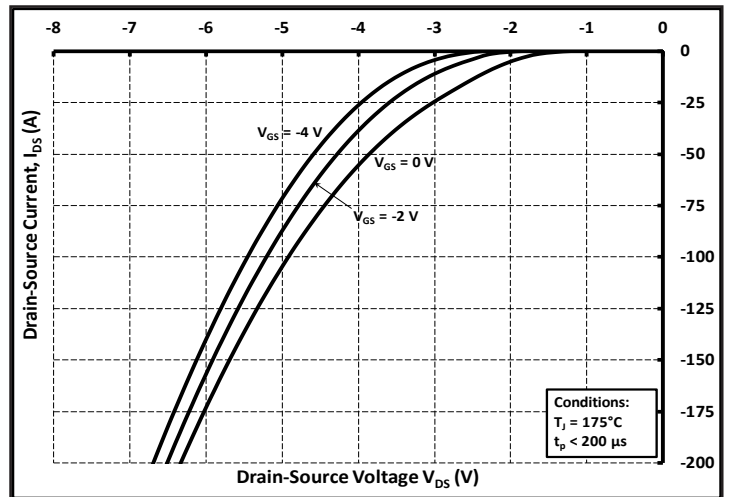


Figure 10. Body Diode Characteristic at 175 °C

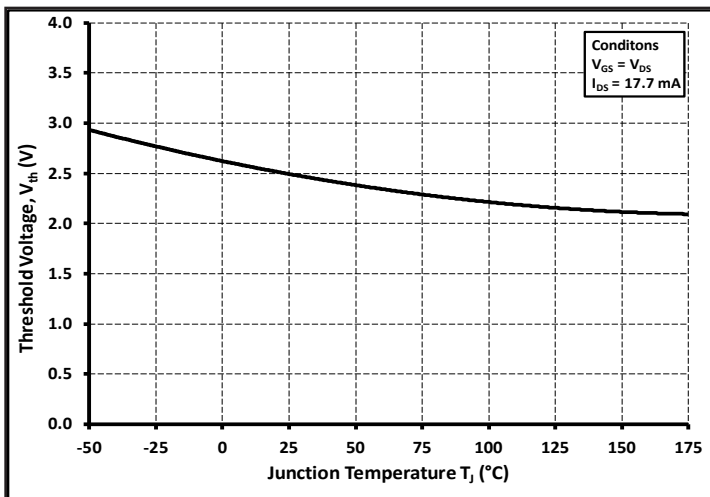


Figure 11. Threshold Voltage vs. Temperature

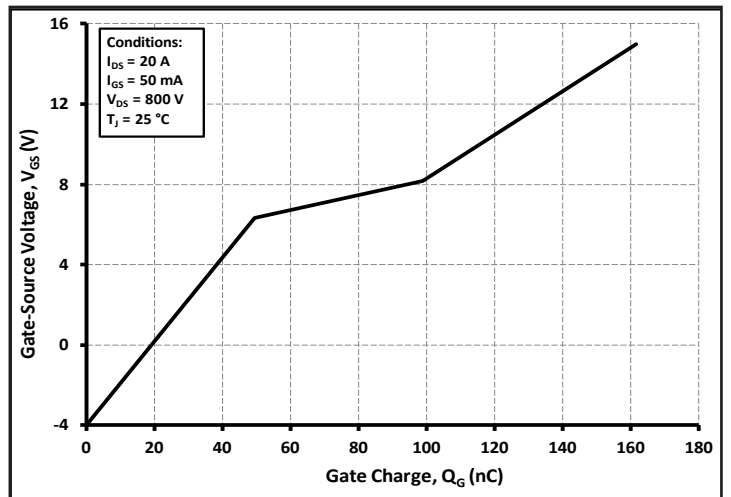


Figure 12. Gate Charge Characteristics

Typical Performance

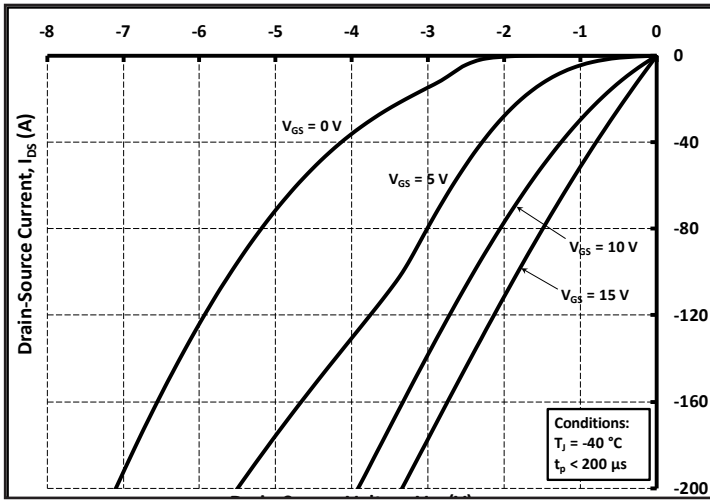


Figure 13. 3rd Quadrant Characteristic at -40 °C

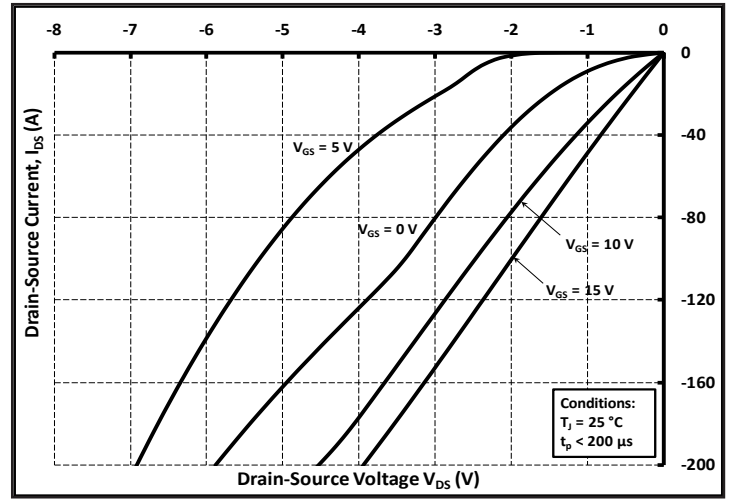


Figure 14. 3rd Quadrant Characteristic at 25 °C

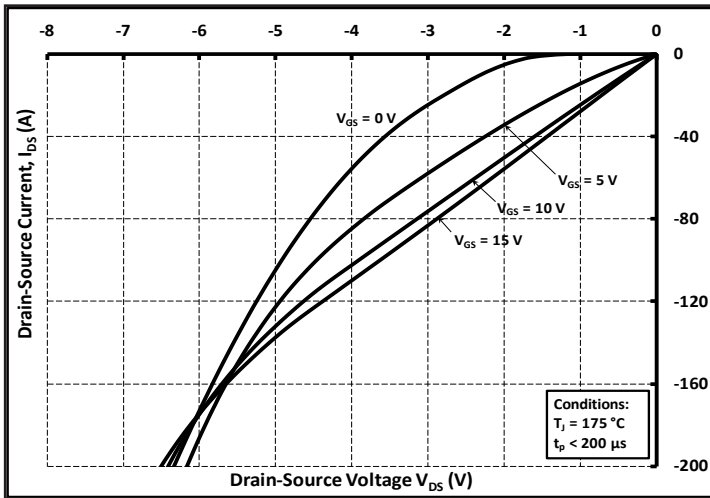


Figure 15. 3rd Quadrant Characteristic at 175 °C

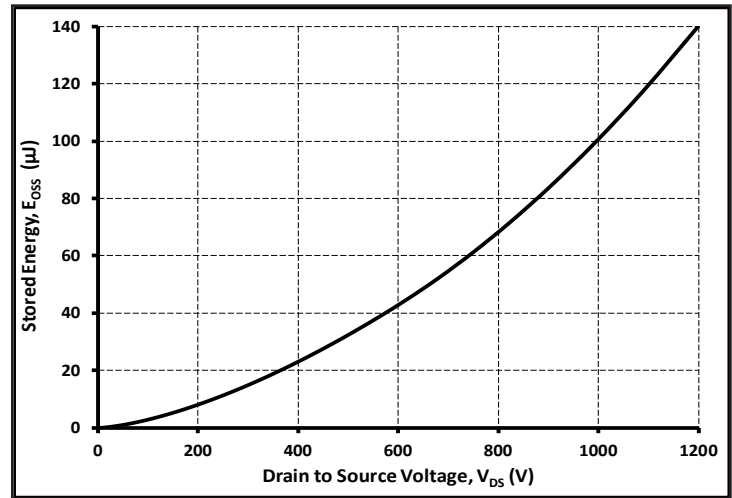


Figure 16. Output Capacitor Stored Energy

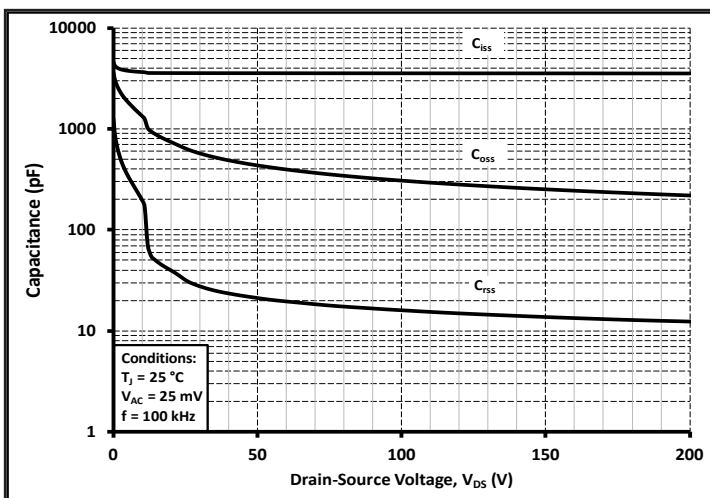


Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200V)

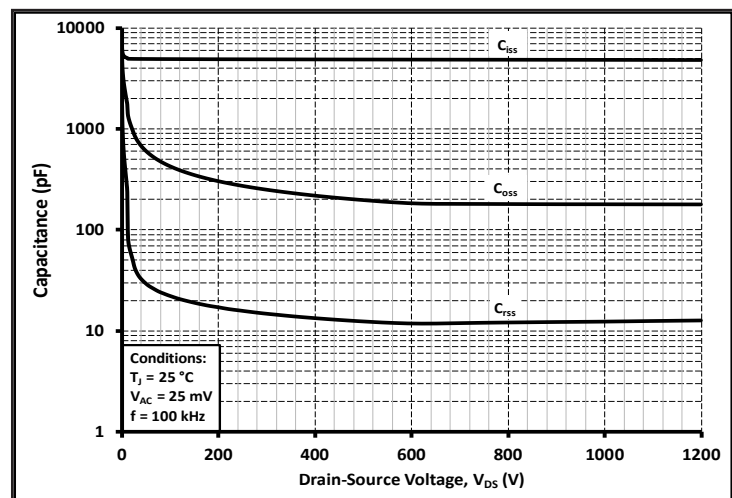


Figure 18. Capacitances vs. Drain-Source Voltage (0 - 1000V)

Typical Performance

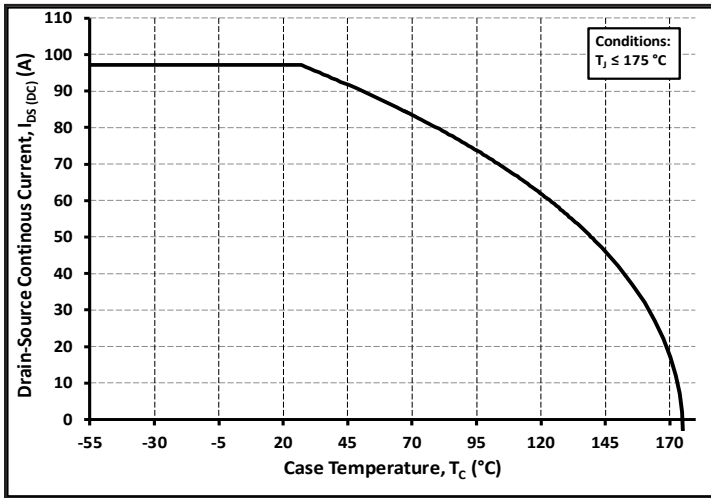


Figure 19. Continuous Drain Current Derating vs. Case Temperature

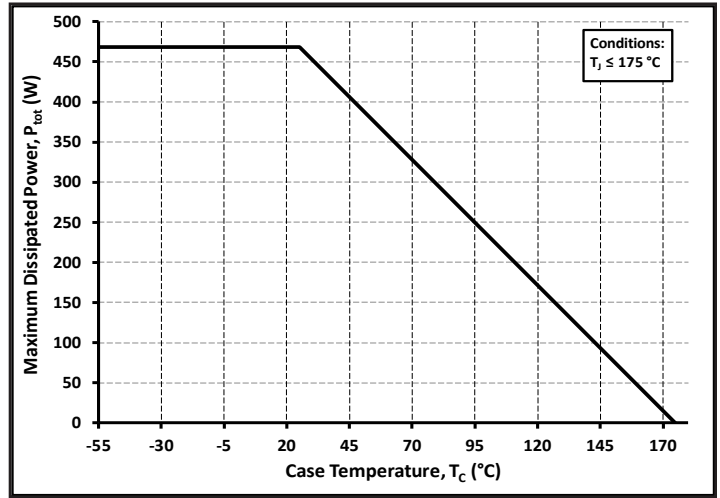


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

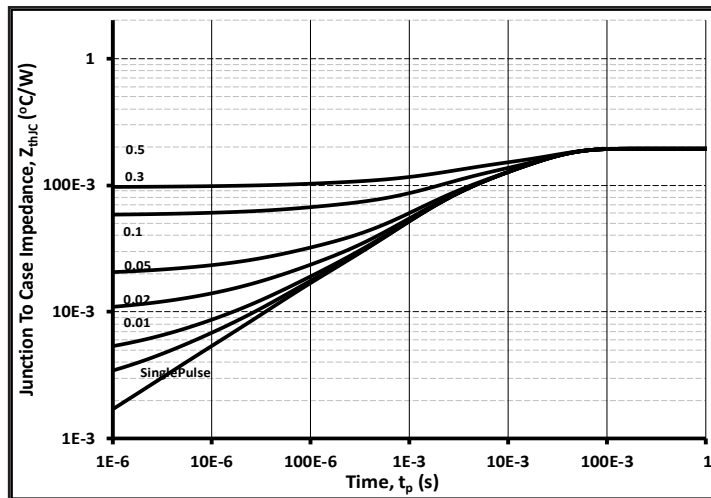


Figure 21. Transient Thermal Impedance (Junction - Case)

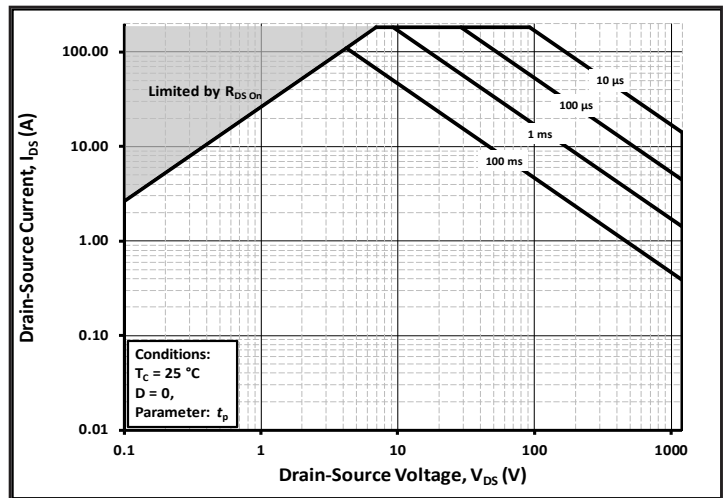


Figure 22. Safe Operating Area

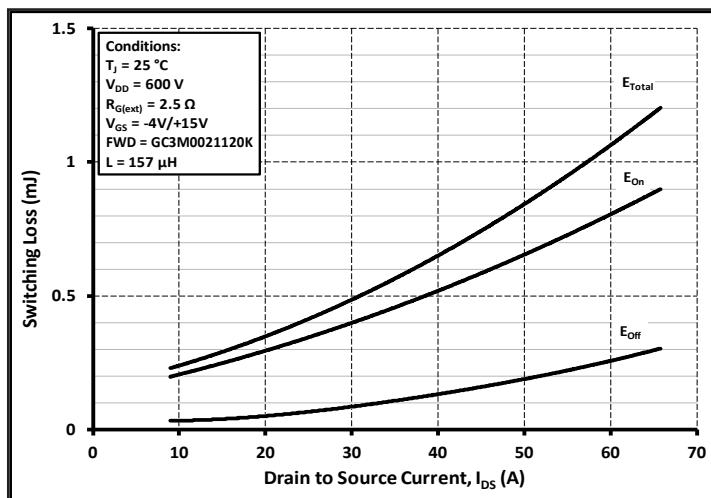


Figure 23. Clamped Inductive Switching Energy vs. Drain Current ( $V_{DD} = 600V$ )

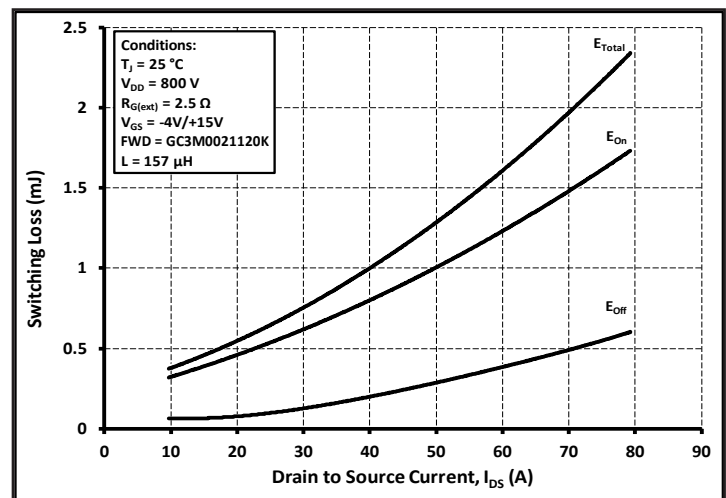


Figure 24. Clamped Inductive Switching Energy vs. Drain Current ( $V_{DD} = 800V$ )

Typical Performance

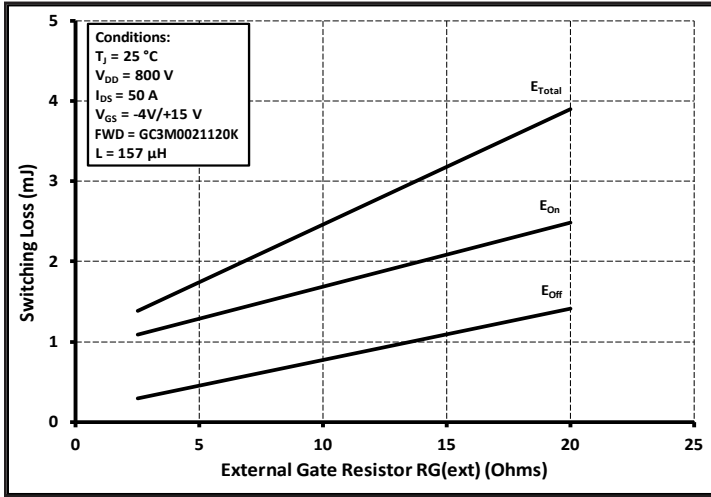


Figure 25. Clamped Inductive Switching Energy vs.  $R_{G(ext)}$

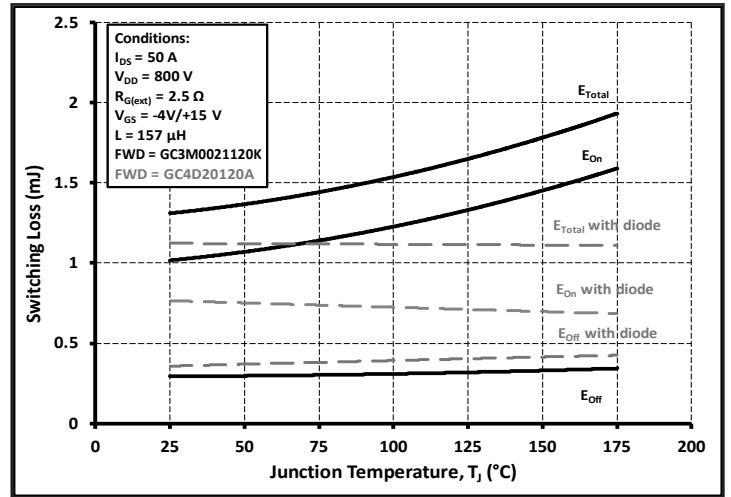


Figure 26. Clamped Inductive Switching Energy vs. Temperature

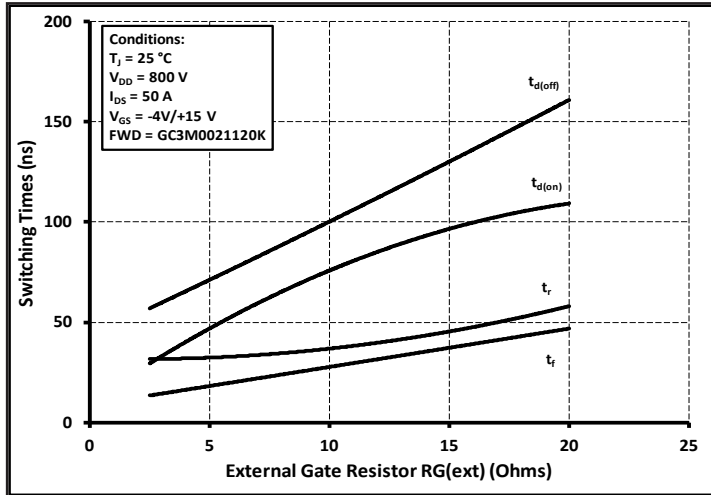


Figure 27. Switching Times vs.  $R_{G(ext)}$

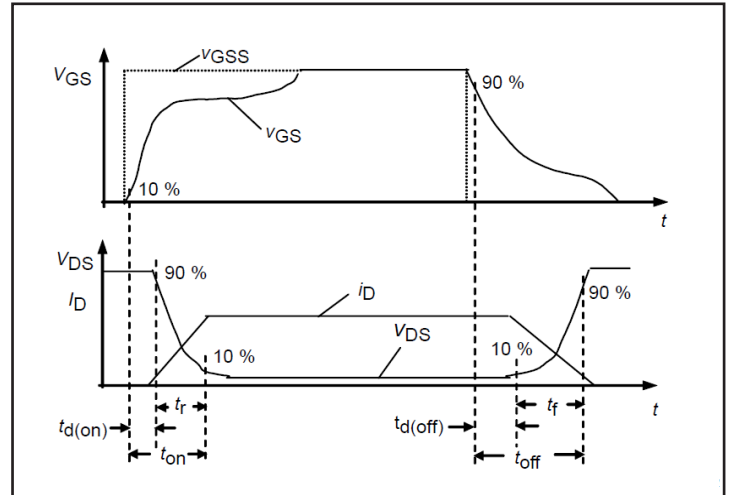


Figure 28. Switching Times Definition

**Test Circuit Schematic**

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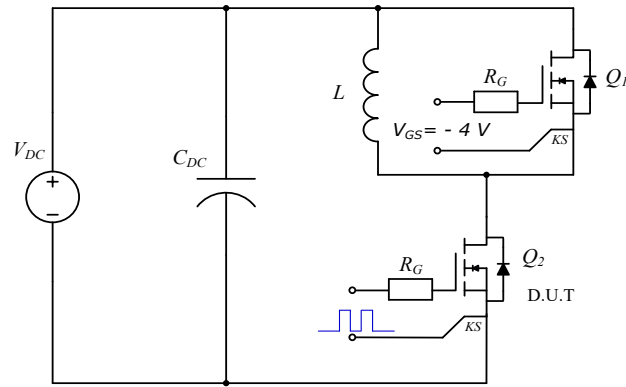


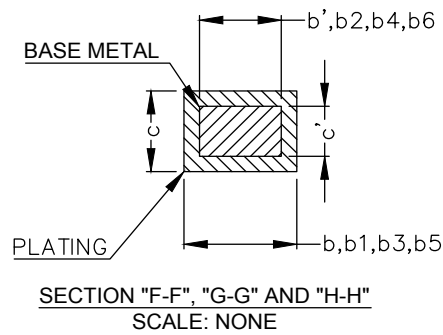
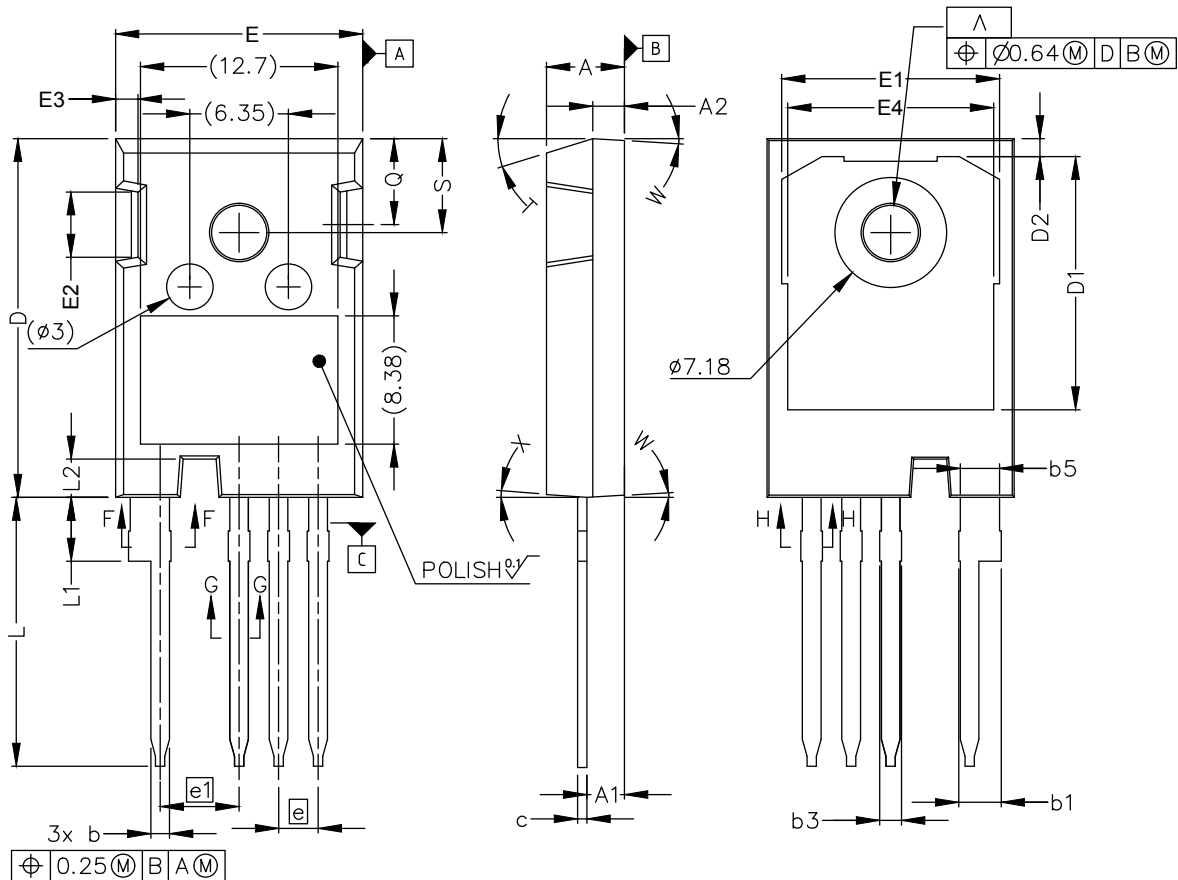
Figure 29. Clamped Inductive Switching Waveform Test Circuit

Note (3): Turn-off and Turn-on switching energy and timing values measured using SiC MOSFET Body Diode as shown above.



**Package Dimensions**

Package TO-247-4L

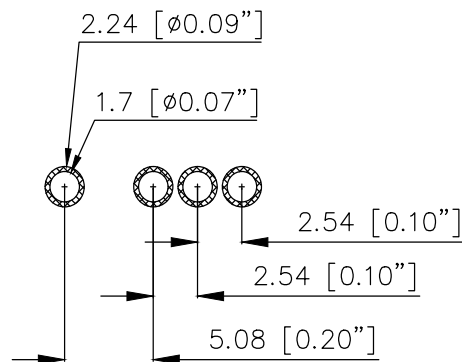


## Package Dimensions

Package TO-247-4L

SYM	MILLIMETERS		SYM	MILLIMETERS	
	MIN	MAX		MIN	MAX
A	4.83	5.21	E1	13.10	14.15
A1	2.29	2.54	E2	3.68	5.10
A2	1.91	2.16	E3	1.00	1.90
b'	1.07	1.28	E4	12.38	13.43
b	1.07	1.33	e	2.54 BSC	
b1	2.39	2.94	e1	5.08 BSC	
b2	2.39	2.84	N	4	
b3	1.07	1.60	L	17.31	17.82
b4	1.07	1.50	L1	3.97	4.37
b5	2.39	2.69	L2	2.35	2.65
b6	2.39	2.64	øP	3.51	3.65
c'	0.55	0.65	Q	5.49	6.00
c	0.55	0.68	S	6.04	6.30
D	23.30	23.60	T	17.5° REF.	
D1	16.25	17.65	W	3.5° REF.	
D2	0.95	1.25	X	4° REF.	
E	15.75	16.13			

## Recommended Solder Pad Layout



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