

# C3M0075120J

## Silicon Carbide Power MOSFET

### C3M™ MOSFET Technology

#### N-Channel Enhancement Mode

#### Features

- 3rd generation SiC MOSFET technology
- Low impedance package with driver source pin
- 7mm of creepage distance between drain and source
- 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

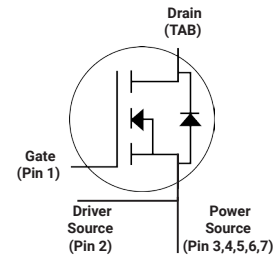
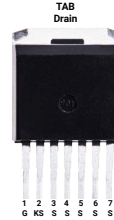
- Reduce switching losses and minimize gate ringing
- Higher system efficiency
- Reduce cooling requirements
- Increase power density
- Increase system switching frequency

#### Applications

- Renewable energy
- EV battery chargers
- High voltage DC/DC converters
- Switch Mode Power Supplies

$V_{DS}$	1200 V
$I_D @ 25^\circ\text{C}$	30 A
$R_{DS(on)}$	75 m $\Omega$

#### Package



Part Number	Package	Marking
C3M0075120J	TO-263-7	C3M0075120J

#### 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	30	A	$V_{GS} = 15\text{ V}, T_C = 25^\circ\text{C}$	Fig. 19
		19.7		$V_{GS} = 15\text{ V}, T_C = 100^\circ\text{C}$	
$I_{D(pulse)}$	Pulsed Drain Current	80	A	Pulse width $t_p$ limited by $T_{jmax}$	Fig. 22
$P_D$	Power Dissipation	113.6	W	$T_C = 25^\circ\text{C}, T_J = 150^\circ\text{C}$	Fig. 20
$T_J, T_{stg}$	Operating Junction and Storage Temperature	-55 to +150	$^\circ\text{C}$		
$T_L$	Solder Temperature	260	$^\circ\text{C}$	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  $0/+15\text{ V}$

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

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	$V_{DS} = V_{GS}, I_D = 5\ \text{mA}$	Fig. 11
			2.2		V	$V_{DS} = V_{GS}, I_D = 5\ \text{mA}, T_J = 150^\circ\text{C}$	
$I_{DSS}$	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		75	90	m $\Omega$	$V_{GS} = 15\ \text{V}, I_D = 20\ \text{A}$	Fig. 4, 5, 6
			100			$V_{GS} = 15\ \text{V}, I_D = 20\ \text{A}, T_J = 150^\circ\text{C}$	
$g_{fs}$	Transconductance		12		S	$V_{DS} = 20\ \text{V}, I_{DS} = 20\ \text{A}$	Fig. 7
			13			$V_{DS} = 20\ \text{V}, I_{DS} = 20\ \text{A}, T_J = 150^\circ\text{C}$	
$C_{iss}$	Input Capacitance		1390		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		58				
$C_{rss}$	Reverse Transfer Capacitance		2				
$E_{oss}$	$C_{oss}$ Stored Energy		33		$\mu\text{J}$		Fig. 16
$E_{ON}$	Turn-On Switching Energy (Body Diode FWD)		200		$\mu\text{J}$	$V_{DS} = 800\ \text{V}, V_{GS} = -4\ \text{V}/15\ \text{V}, I_D = 20\ \text{A},$ $R_{G(ext)} = 0\ \Omega, L = 156\ \mu\text{H}, T_J = 150^\circ\text{C}$	Fig. 26, 29
$E_{OFF}$	Turn-Off Switching Energy (Body Diode FWD)		90				
$t_{d(on)}$	Turn-On Delay Time		7		ns	$V_{DD} = 800\ \text{V}, V_{GS} = -4\ \text{V}/15\ \text{V}$ $I_D = 20\ \text{A}, R_{G(ext)} = 0\ \Omega,$ Timing relative to $V_{DS}$ Inductive load	Fig. 27, 28, 29
$t_r$	Rise Time		15				
$t_{d(off)}$	Turn-Off Delay Time		24				
$t_f$	Fall Time		8				
$R_{G(int)}$	Internal Gate Resistance		9		$\Omega$	$f = 1\ \text{MHz}, V_{AC} = 25\ \text{mV}$	
$Q_{gs}$	Gate to Source Charge		18		nC	$V_{DS} = 800\ \text{V}, V_{GS} = -4\ \text{V}/15\ \text{V}$ $I_D = 20\ \text{A}$ Per IEC60747-8-4 pg 21	Fig. 12
$Q_{gd}$	Gate to Drain Charge		12				
$Q_g$	Total Gate Charge		48				

**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	4.5		V	$V_{GS} = -4\ \text{V}, I_{SD} = 10\ \text{A}$	Fig. 8, 9, 10
		4.0		V	$V_{GS} = -4\ \text{V}, I_{SD} = 10\ \text{A}, T_J = 150^\circ\text{C}$	
$I_S$	Continuous Diode Forward Current		22.4	A	$V_{GS} = -4\ \text{V}$	Note 1
$I_{S, pulse}$	Diode pulse Current	80		A	$V_{GS} = -4\ \text{V}$ , pulse width $t_p$ limited by $T_{jmax}$	Note 1
$t_{rr}$	Reverse Recover time	25		ns	$V_{GS} = -4\ \text{V}, I_{SD} = 20\ \text{A}, V_R = 800\ \text{V}$ $dif/dt = 1925\ \text{A}/\mu\text{s}, T_J = 25^\circ\text{C}$	Note 1, Fig. 29
$Q_{rr}$	Reverse Recovery Charge	109		nC		
$I_{rrm}$	Peak Reverse Recovery Current	11		A		

**Thermal Characteristics**

Symbol	Parameter	Max.	Unit	Test Conditions	Note
$R_{\theta JC}$	Thermal Resistance from Junction to Case	1.1	$^\circ\text{C}/\text{W}$		Fig. 21
$R_{\theta JA}$	Thermal Resistance From Junction to Ambient	40			

## Typical Performance

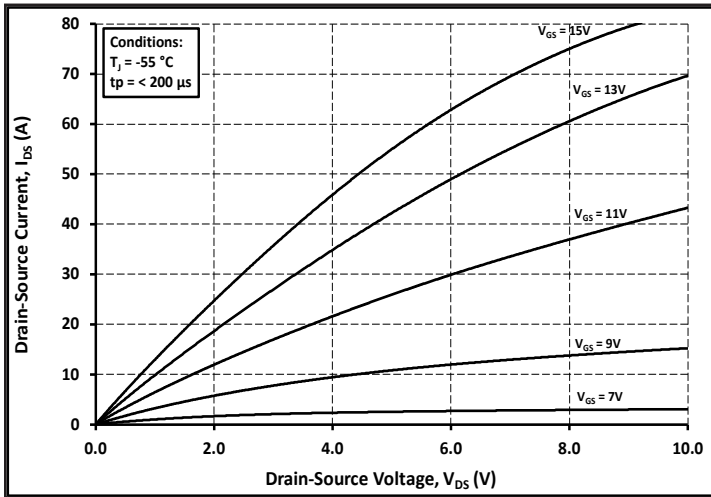


Figure 1. Output Characteristics  $T_J = -55\text{ }^\circ\text{C}$

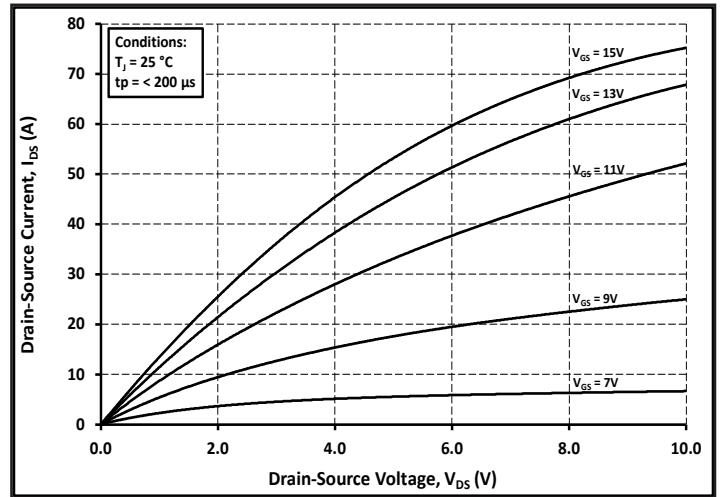


Figure 2. Output Characteristics  $T_J = 25\text{ }^\circ\text{C}$

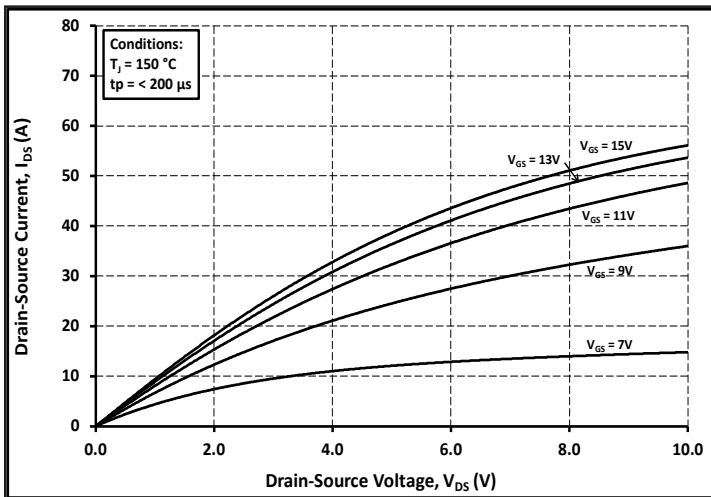


Figure 3. Output Characteristics  $T_J = 150\text{ }^\circ\text{C}$

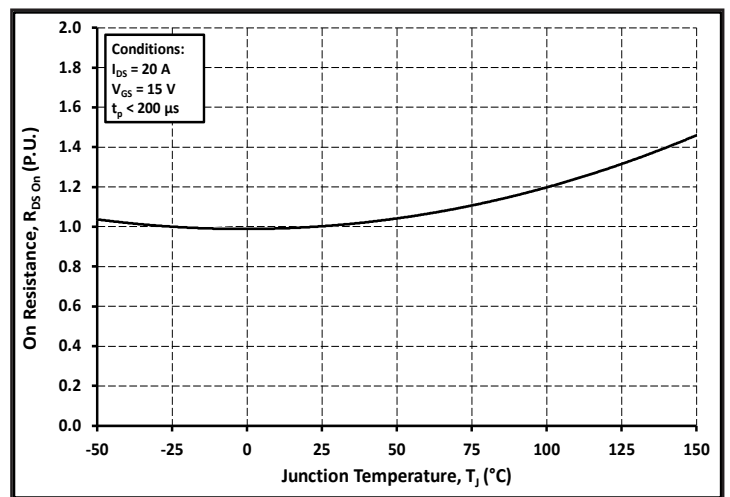


Figure 4. Normalized On-Resistance vs. Temperature

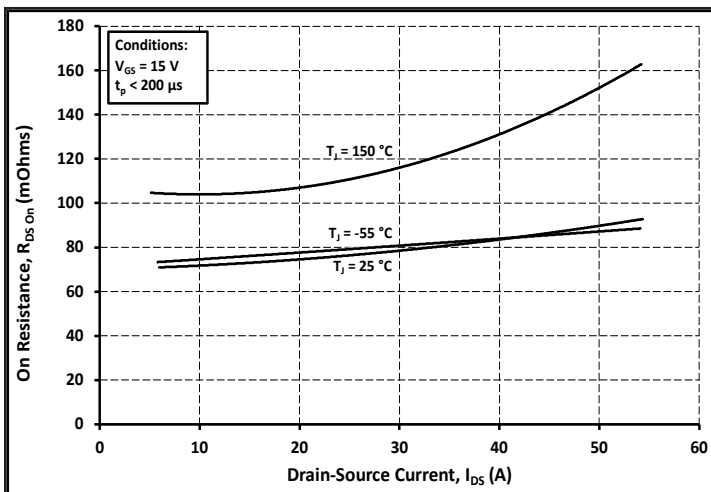


Figure 5. On-Resistance vs. Drain Current For Various Temperatures

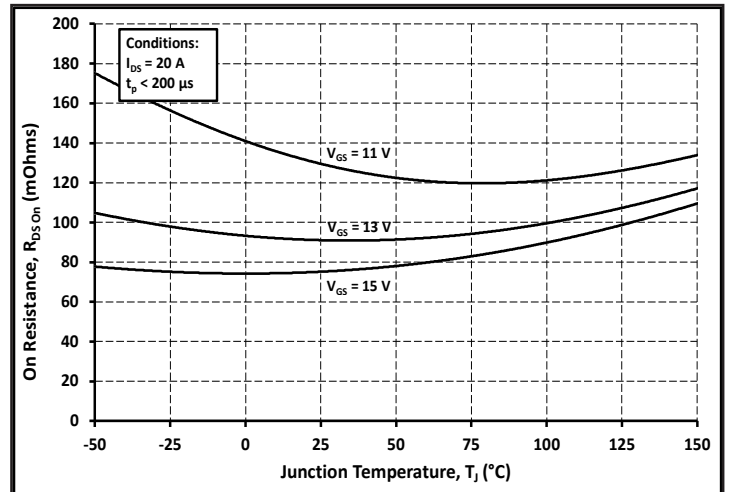


Figure 6. On-Resistance vs. Temperature For Various Gate Voltage

## Typical Performance

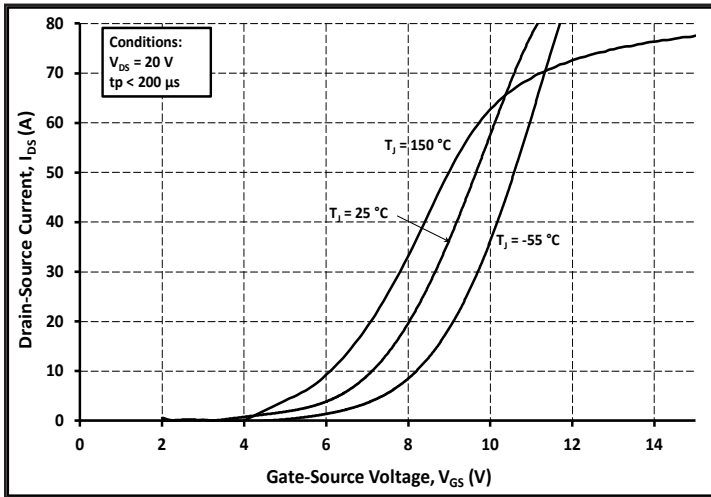


Figure 7. Transfer Characteristic for Various Junction Temperatures

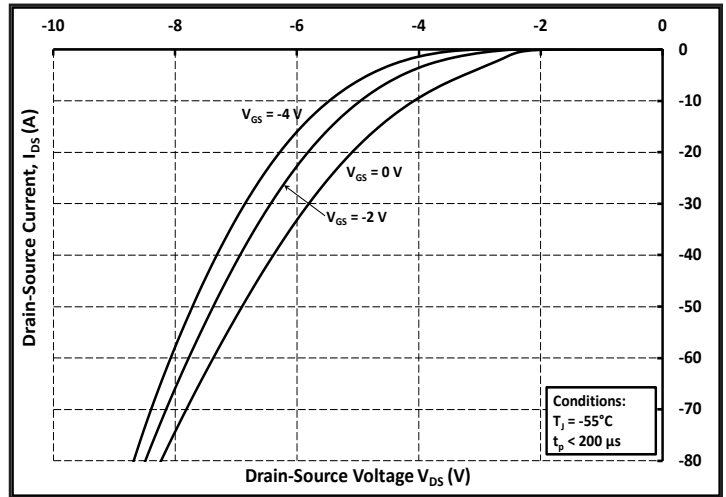


Figure 8. Body Diode Characteristic at  $-55\text{ }^\circ\text{C}$

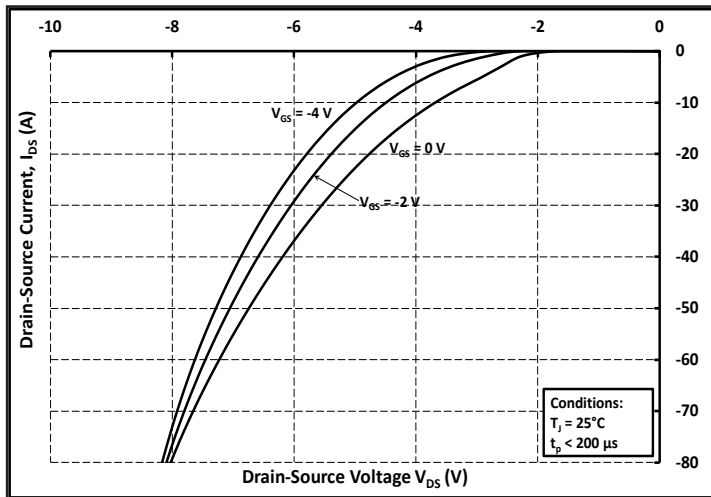


Figure 9. Body Diode Characteristic at  $25\text{ }^\circ\text{C}$

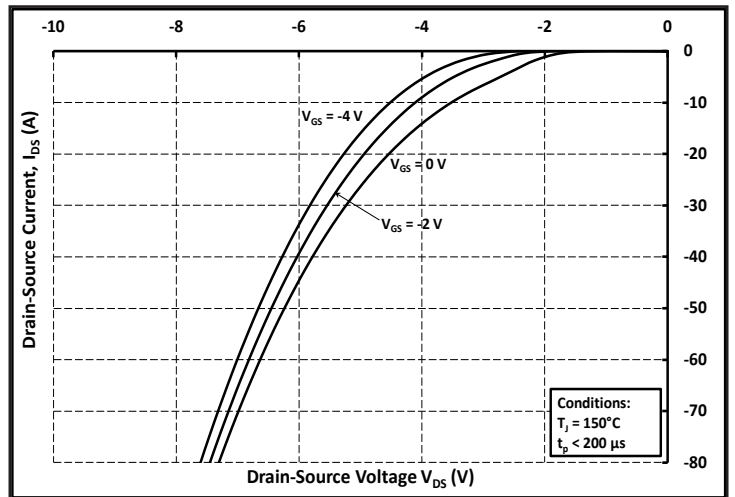


Figure 10. Body Diode Characteristic at  $150\text{ }^\circ\text{C}$

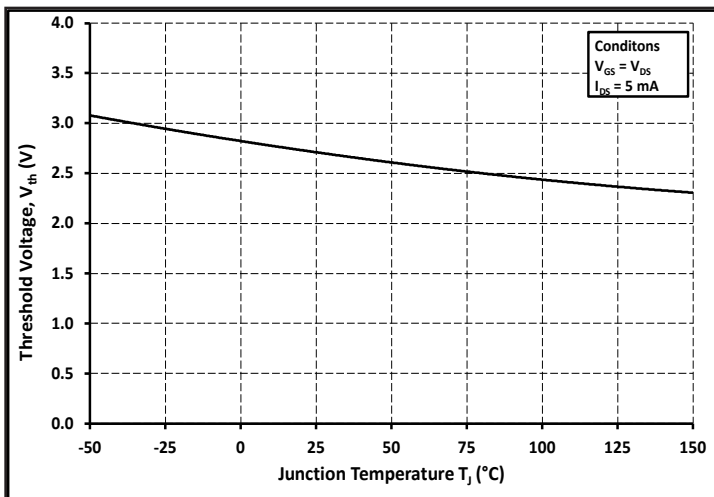


Figure 11. Threshold Voltage vs. Temperature

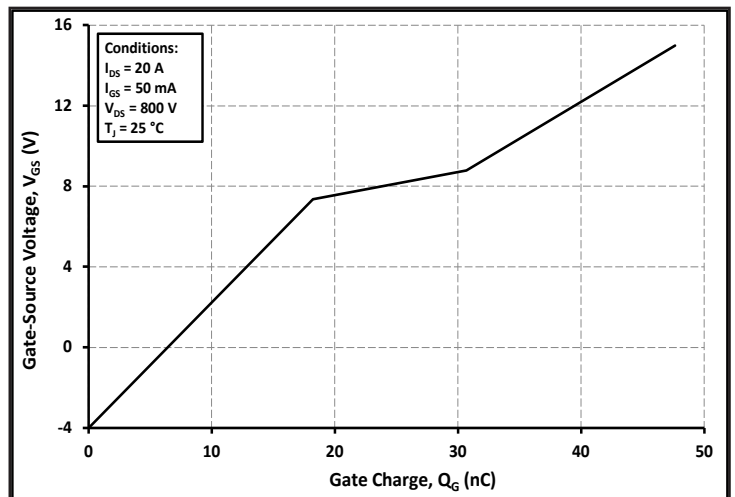


Figure 12. Gate Charge Characteristics

## Typical Performance

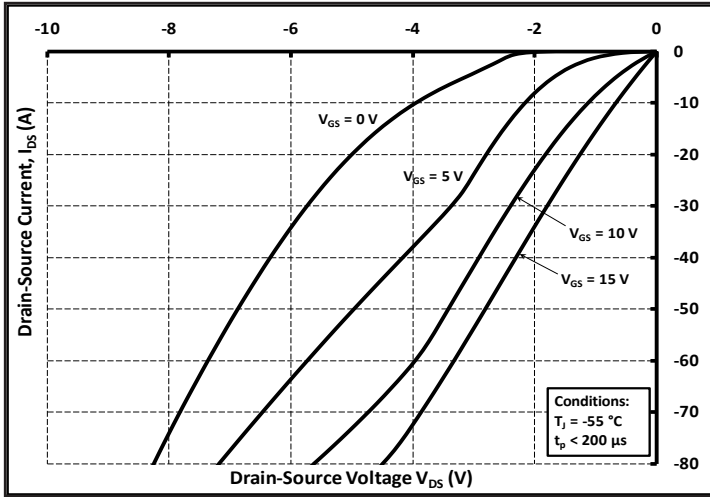


Figure 13. 3rd Quadrant Characteristic at -55 °C

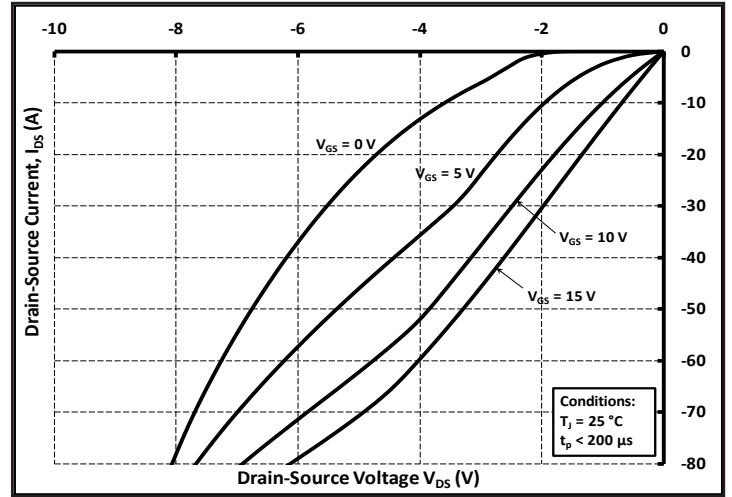


Figure 14. 3rd Quadrant Characteristic at 25 °C

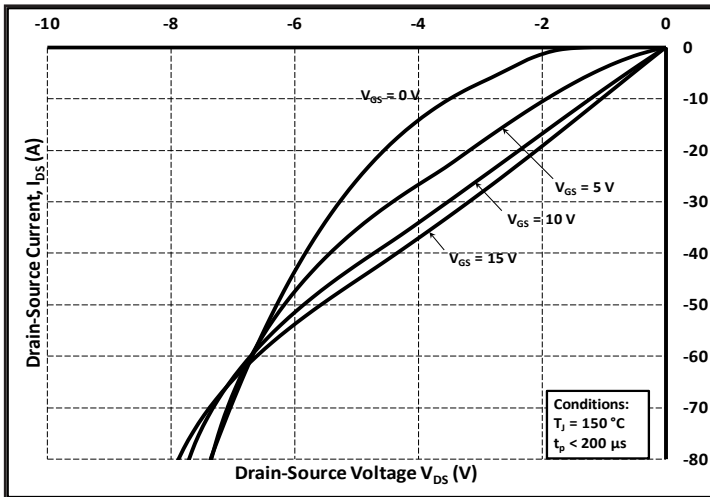


Figure 15. 3rd Quadrant Characteristic at 150 °C

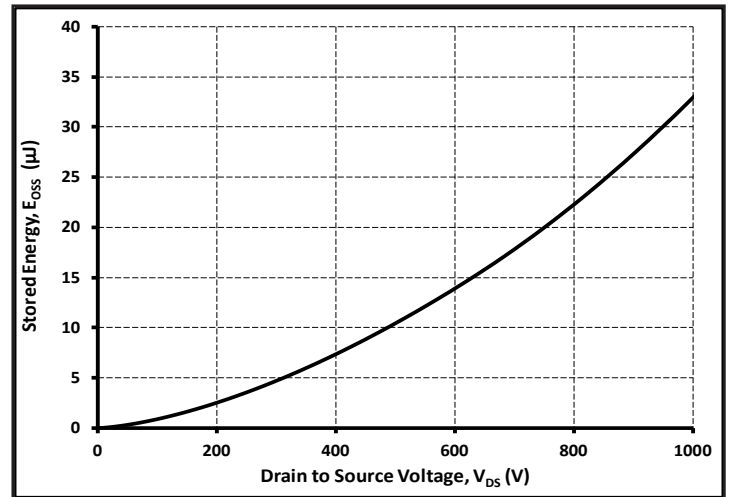


Figure 16. Output Capacitor Stored Energy

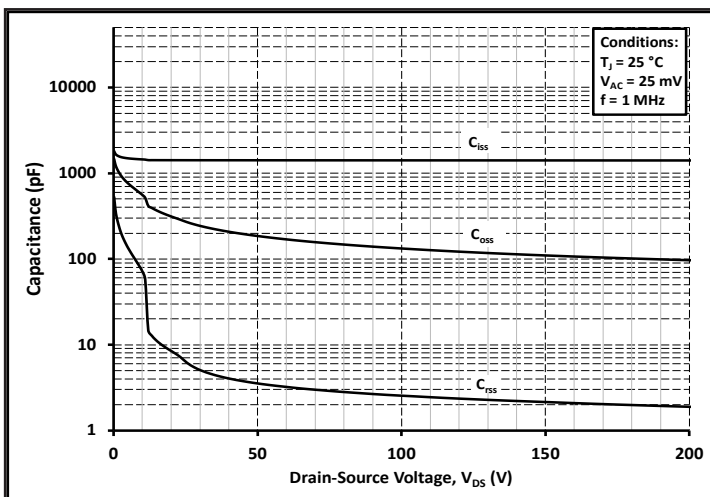


Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200V)

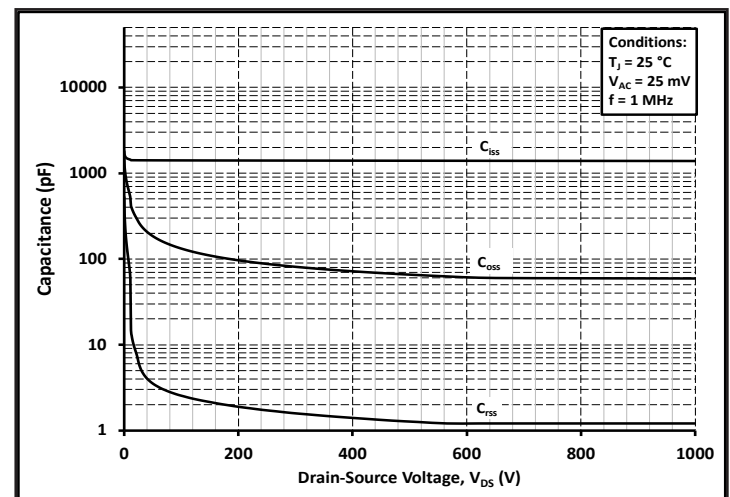


Figure 18. Capacitances vs. Drain-Source Voltage (0 - 1000V)

## Typical Performance

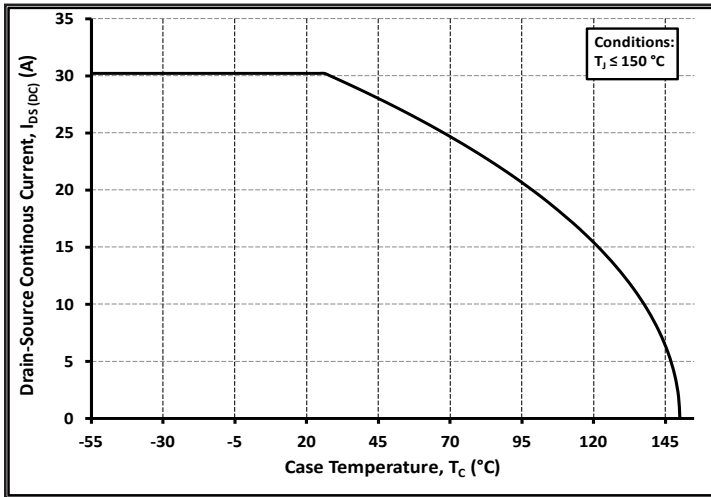


Figure 19. Continuous Drain Current Derating vs. Case Temperature

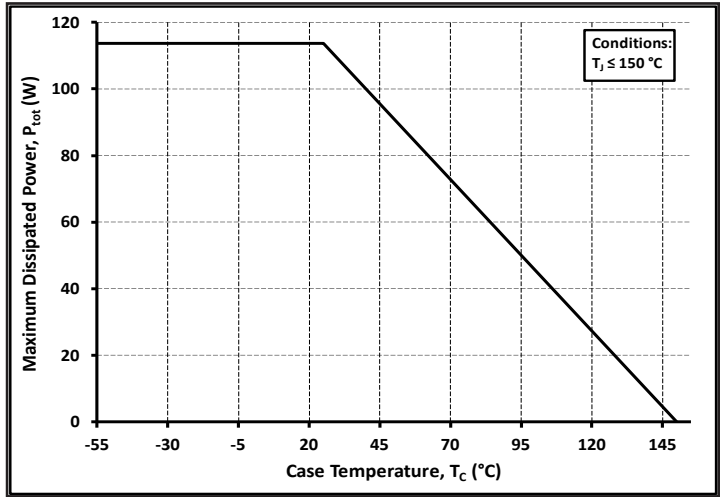


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

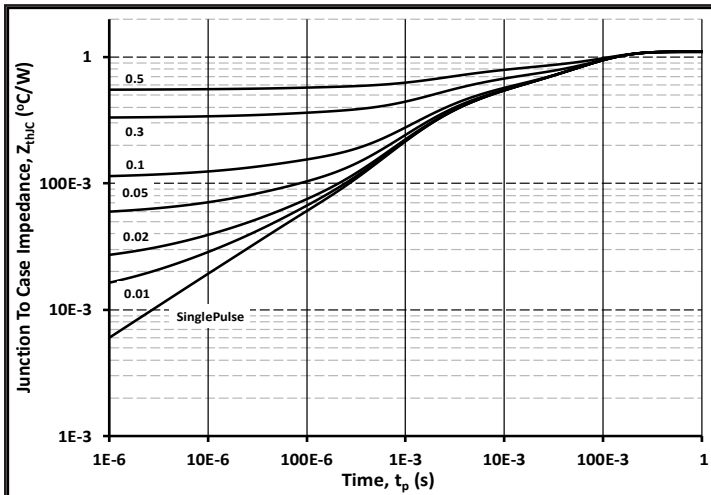


Figure 21. Transient Thermal Impedance (Junction - Case)

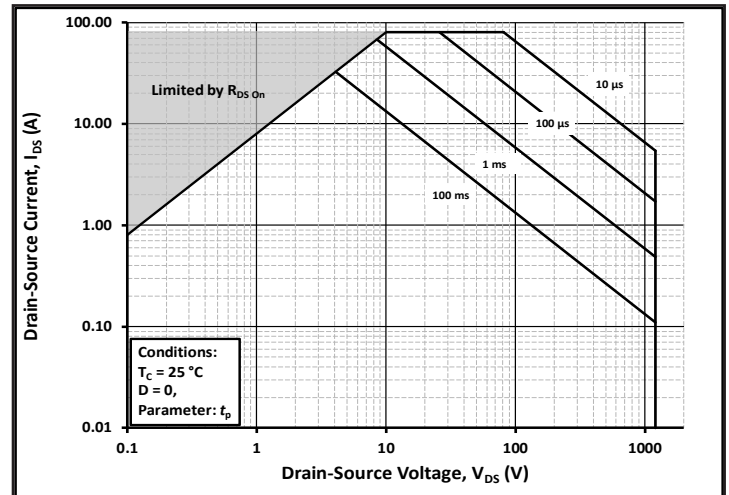


Figure 22. Safe Operating Area

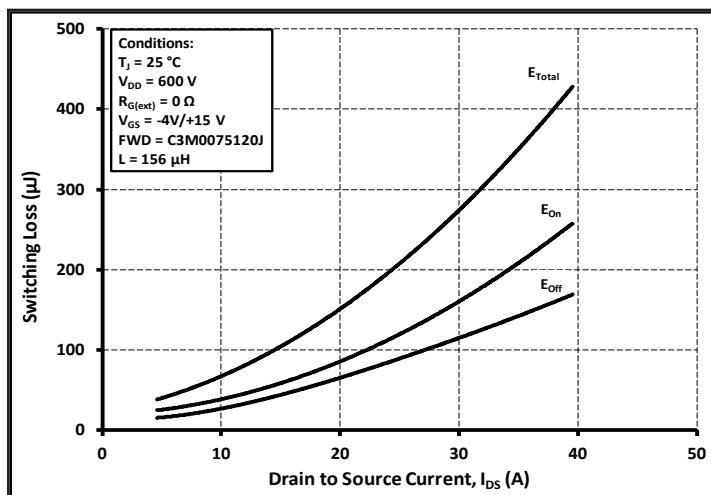


Figure 23. Clamped Inductive Switching Energy vs. Drain Current ( $V_{DD} = 600V$ )

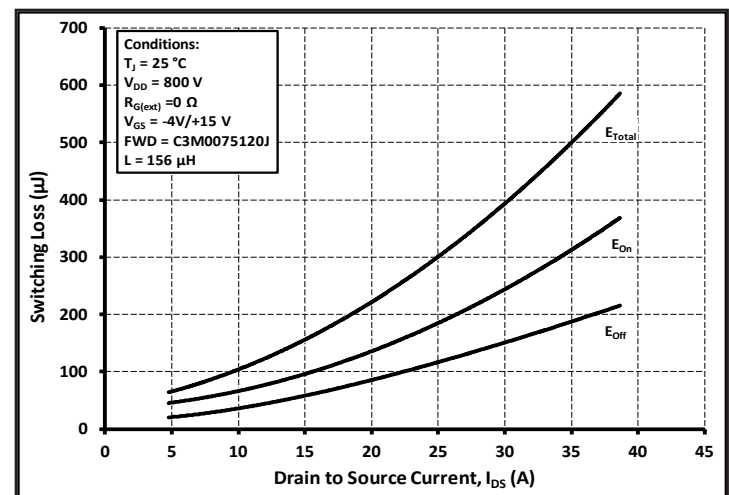


Figure 24. Clamped Inductive Switching Energy vs. Drain Current ( $V_{DD} = 800V$ )

## Typical Performance

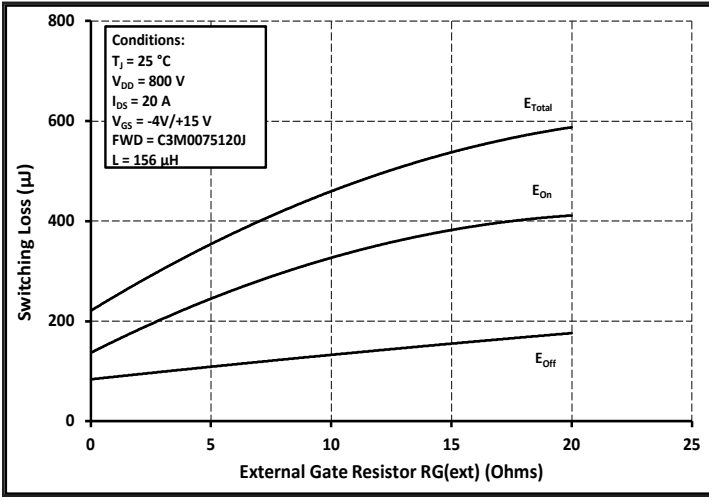


Figure 25. Clamped Inductive Switching Energy vs.  $R_{G(ext)}$

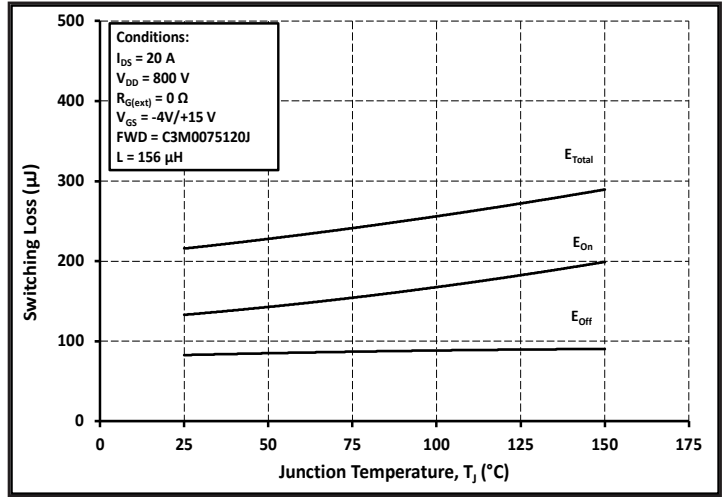


Figure 26. Clamped Inductive Switching Energy vs. Temperature

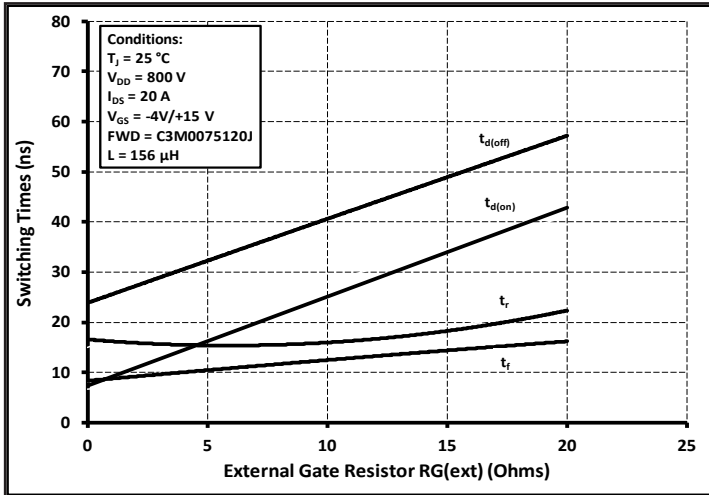


Figure 27. Switching Times vs.  $R_{G(ext)}$

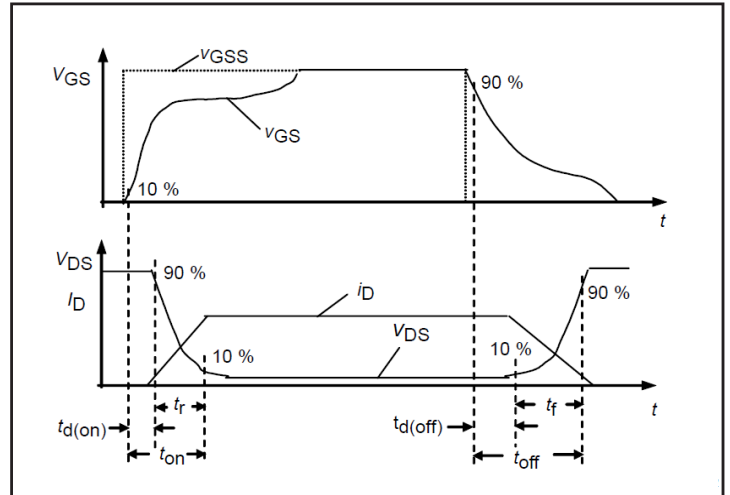


Figure 28. Switching Times Definition

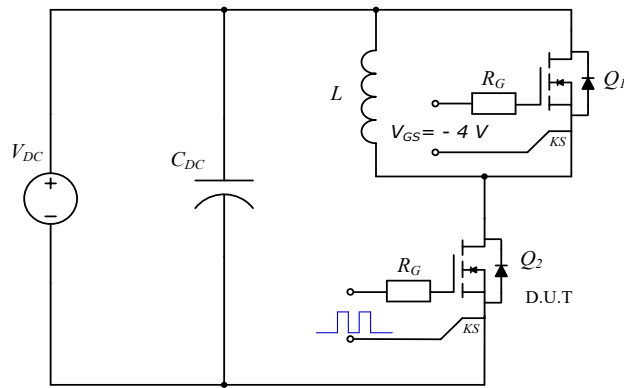


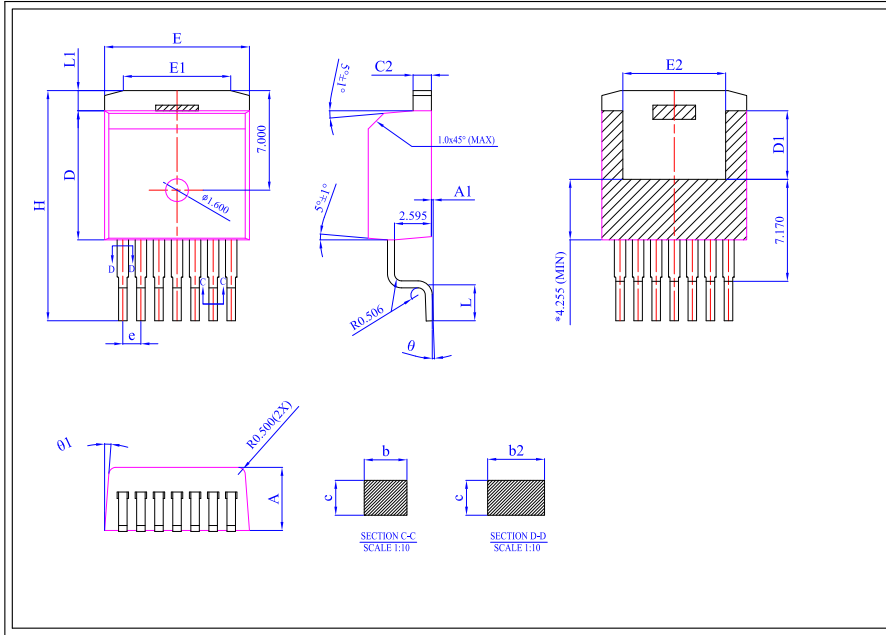
Figure 29. Clamped Inductive Switching Waveform Test Circuit

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

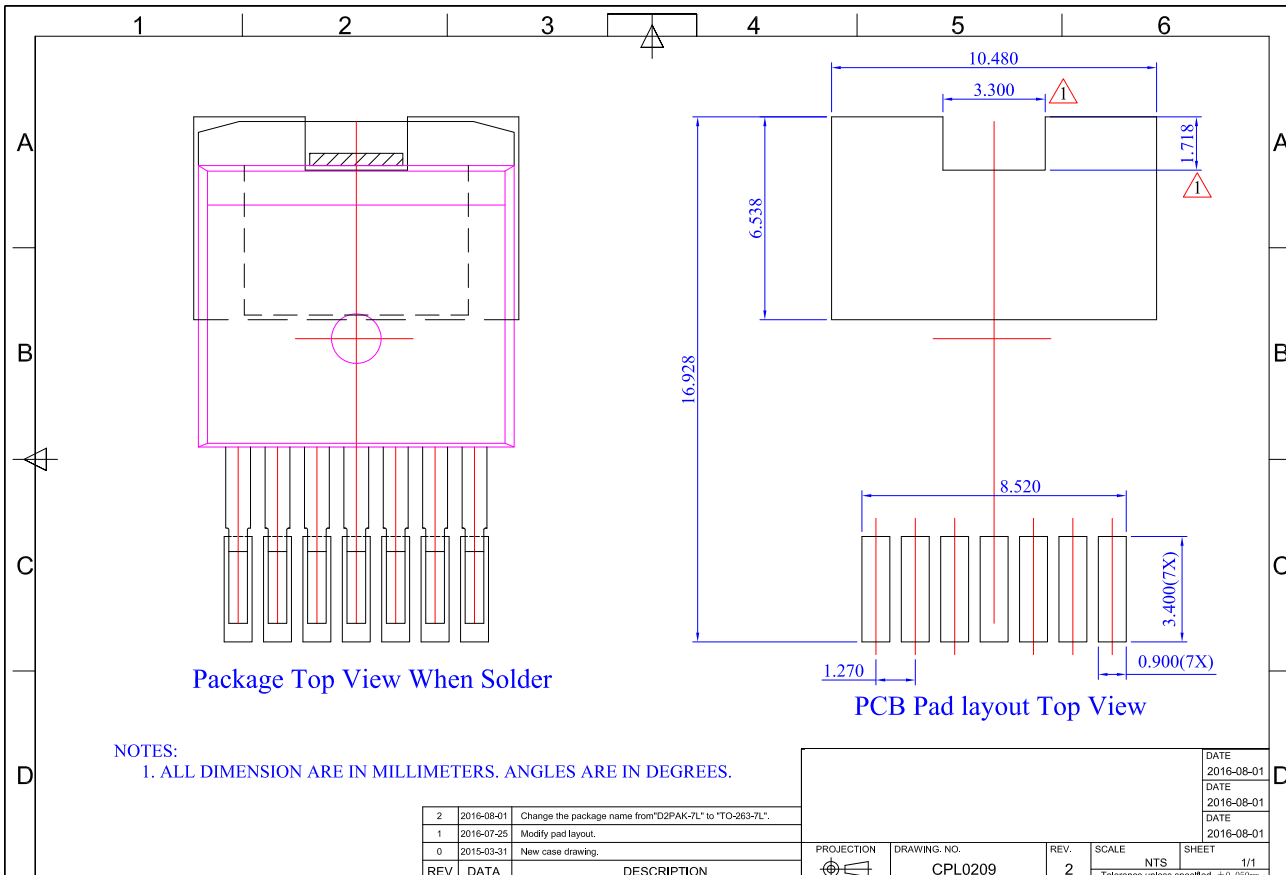


## Package Dimensions

### Package 7L D2PAK




Dim	All Dimensions in Millimeters		
	Min	typ	Max
A	4.300	4.435	4.570
A1	0.00	0.125	0.25
b	0.500	0.600	0.700
b2	0.600	0.800	1.000
c	0.330	0.490	0.650
C2	1.170	1.285	1.400
D	9.025	9.075	9.125
D1	4.700	4.800	4.900
E	10.130	10.180	10.230
E1	6.500	7.550	8.600
E2	6.778	7.223	7.665
e	1.27		
H	15.043	16.178	17.313
L	2.324	2.512	2.700
L1	0.968	1.418	1.868
∅	0°	4°	8°
∅1	4.5°	5°	5.5°



NOTES:  
1. ALL DIMENSION ARE IN MILLIMETERS. ANGLES ARE IN DEGREES.

REV	DATA	DESCRIPTION
2	2016-08-01	Change the package name from "D2PAK-7L" to "TO-263-7L".
1	2016-07-25	Modify pad layout.
0	2015-03-31	New case drawing.

PROJECTION	DRAWING NO.	REV.	SCALE	NTS	SHEET
	CPL0209	2			1/1

Tolerance unless specified ±0.050mm