

# C3M0280090J

## Silicon Carbide Power MOSFET C3M™ MOSFET Technology N-Channel Enhancement Mode

### Features

- New C3M SiC MOSFET technology
- High blocking voltage with low On-resistance
- High speed switching with low capacitances
- New low impedance package with driver source
- Fast intrinsic diode with low reverse recovery (Qrr)
- Halogen free, RoHS compliant
- Wide creepage (~7mm) between drain and source

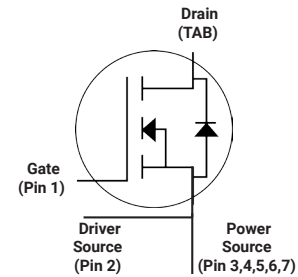
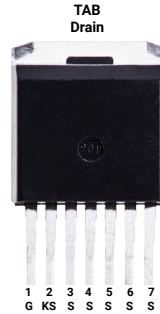
### Benefits

- Higher system efficiency
- Reduced cooling requirements
- Increased power density
- Increased system switching frequency

### Applications

- Renewable energy
- Lighting
- High voltage DC/DC converters
- Telecom Power Supplies
- Induction Heating

### Package



Part Number	Package
C3M0280090J	TO-263-7

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

Symbol	Parameter	Value	Unit	Test Conditions	Note
$V_{DSmax}$	Drain - Source Voltage	900	V	$V_{GS} = 0\text{ V}, I_D = 100\ \mu\text{A}$	
$V_{GSmax}$	Gate - Source Voltage	-8/+18	V	Absolute maximum values	
$V_{GSop}$	Gate - Source Voltage	-4/+15	V	Recommended operational values	Note (1)
$I_D$	Continuous Drain Current	11	A	$V_{GS} = 15\text{ V}, T_C = 25^\circ\text{C}$	Fig. 19
		7		$V_{GS} = 15\text{ V}, T_C = 100^\circ\text{C}$	
$I_{D(pulse)}$	Pulsed Drain Current	22	A	Pulse width $t_p$ limited by $T_{jmax}$	Fig. 22
$P_D$	Power Dissipation	49	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): MOSFET can also safely operate at 0/+15 V

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	900			V	$V_{GS} = 0\text{ V}, I_D = 100\ \mu\text{A}$	
$V_{GS(th)}$	Gate Threshold Voltage	1.8	2.7	3.5	V	$V_{DS} = V_{GS}, I_D = 1.2\ \text{mA}$	Fig. 11
			2.2		V	$V_{DS} = V_{GS}, I_D = 1.2\ \text{mA}, T_J = 150^\circ\text{C}$	
$I_{DSS}$	Zero Gate Voltage Drain Current		1	100	$\mu\text{A}$	$V_{DS} = 900\ \text{V}, V_{GS} = 0\ \text{V}$	
$I_{GSS}$	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		320	360	m $\Omega$	$V_{GS} = 15\ \text{V}, I_D = 7.5\ \text{A}$	Fig. 4, 5, 6
			416			$V_{GS} = 15\ \text{V}, I_D = 7.5\ \text{A}, T_J = 150^\circ\text{C}$	
$g_{fs}$	Transconductance		3.6		S	$V_{DS} = 15\ \text{V}, I_{DS} = 7.5\ \text{A}$	Fig. 7
			3.6			$V_{DS} = 15\ \text{V}, I_{DS} = 7.5\ \text{A}, T_J = 150^\circ\text{C}$	
$C_{iss}$	Input Capacitance		204		pF	$V_{GS} = 0\ \text{V}, V_{DS} = 600\ \text{V}$ $f = 1\ \text{MHz}$ $V_{AC} = 25\ \text{mV}$	Fig. 17, 18
$C_{oss}$	Output Capacitance		26				
$C_{rss}$	Reverse Transfer Capacitance		3				
$E_{oss}$	$C_{oss}$ Stored Energy		5.5		$\mu\text{J}$		Fig. 16
$E_{ON}$	Turn-On Switching Energy		18		$\mu\text{J}$	$V_{DS} = 400\ \text{V}, V_{GS} = -4\ \text{V}/15\ \text{V}, I_D = 7.5\ \text{A},$ $R_{G(ext)} = 2.5\ \Omega, L = 201\ \mu\text{H}, T_J = 150^\circ\text{C}$	Fig. 26, 29 Note(3)
$E_{OFF}$	Turn Off Switching Energy		2.4				
$t_{d(on)}$	Turn-On Delay Time		4		ns	$V_{DD} = 400\ \text{V}, V_{GS} = -4\ \text{V}/15\ \text{V}$ $I_D = 7.5\ \text{A}, R_{G(ext)} = 2.5\ \Omega,$ Timing relative to $V_{DS}$ Inductive load	Fig. 27, 29 Note(3)
$t_r$	Rise Time		7				
$t_{d(off)}$	Turn-Off Delay Time		7				
$t_f$	Fall Time		4				
$R_{G(int)}$	Internal Gate Resistance		23.5		$\Omega$	$f = 1\ \text{MHz}, V_{AC} = 25\ \text{mV}$	
$Q_{gs}$	Gate to Source Charge		4		nC	$V_{DS} = 400\ \text{V}, V_{GS} = -4\ \text{V}/15\ \text{V}$ $I_D = 7.5\ \text{A}$ Per IEC60747-8-4 pg 21	Fig. 12
$Q_{gd}$	Gate to Drain Charge		2				
$Q_g$	Total Gate Charge		10				

**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	4.8		V	$V_{GS} = -4\ \text{V}, I_{SD} = 4\ \text{A}$	Fig. 8, 9, 10
		4.4		V	$V_{GS} = -4\ \text{V}, I_{SD} = 4\ \text{A}, T_J = 150^\circ\text{C}$	
$I_S$	Continuous Diode Forward Current		9	A	$V_{GS} = -4\ \text{V}$	Note (2)
$I_{S,pulse}$	Diode pulse Current		22	A	$V_{GS} = -4\ \text{V}$ , pulse width $t_p$ limited by $T_{jmax}$	Note (2)
$t_{rr}$	Reverse Recover time	8		ns	$V_{GS} = -4\ \text{V}, I_{SD} = 7.5\ \text{A}, V_R = 400\ \text{V}$ $\text{dif}/\text{dt} = 2725\ \text{A}/\mu\text{s}, T_J = 150^\circ\text{C}$	Note (2)
$Q_{rr}$	Reverse Recovery Charge	39		nC		
$I_{rrm}$	Peak Reverse Recovery Current	8		A		

 Note (2): When using SiC Body Diode the maximum recommended  $V_{GS} = -4\text{V}$ 
**Thermal Characteristics**

Symbol	Parameter	Max.	Unit	Test Conditions	Note
$R_{\theta JC}$	Thermal Resistance from Junction to Case	2.5	$^\circ\text{C}/\text{W}$		Fig. 21
$R_{\theta JA}$	Thermal Resistance From Junction to Ambient	40			

## Typical Performance

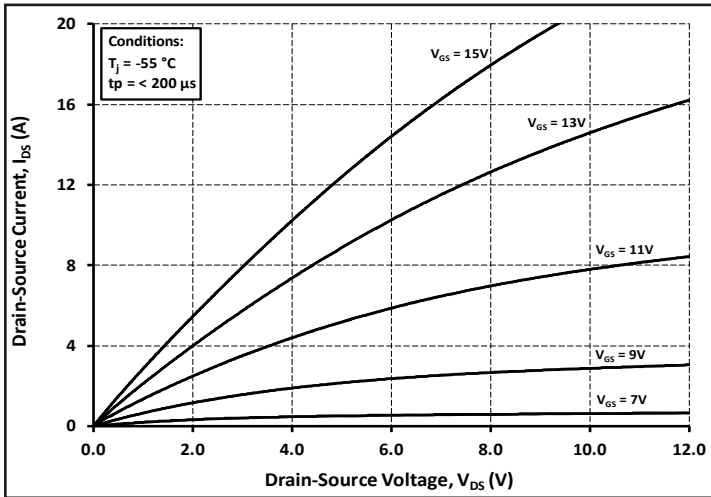


Figure 1. Output Characteristics  $T_J = -55\text{ }^\circ\text{C}$

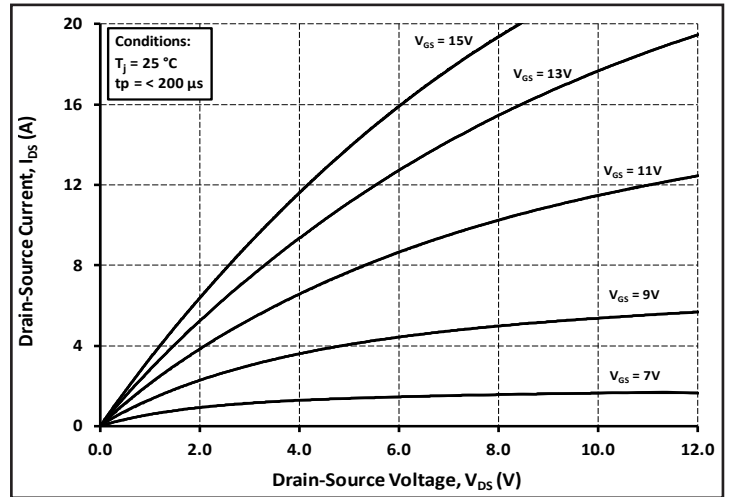


Figure 2. Output Characteristics  $T_J = 25\text{ }^\circ\text{C}$

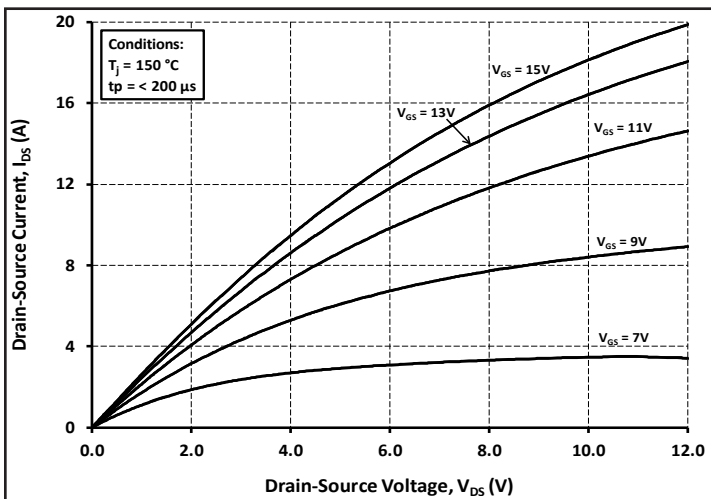


Figure 3. Output Characteristics  $T_J = 150\text{ }^\circ\text{C}$

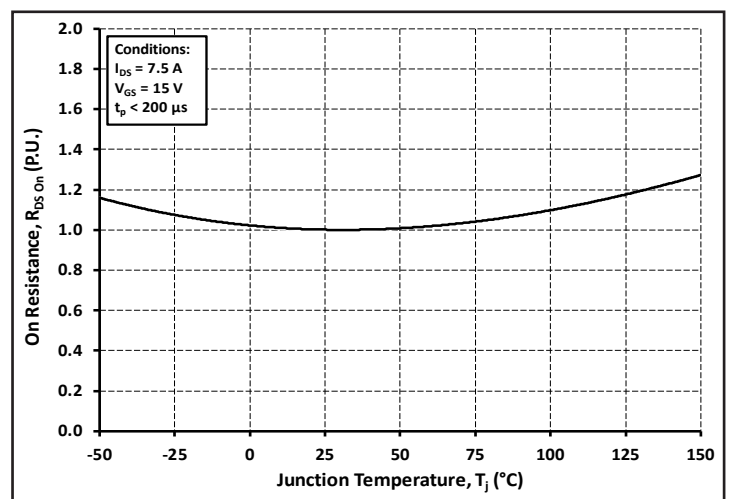


Figure 4. Normalized On-Resistance vs. Temperature

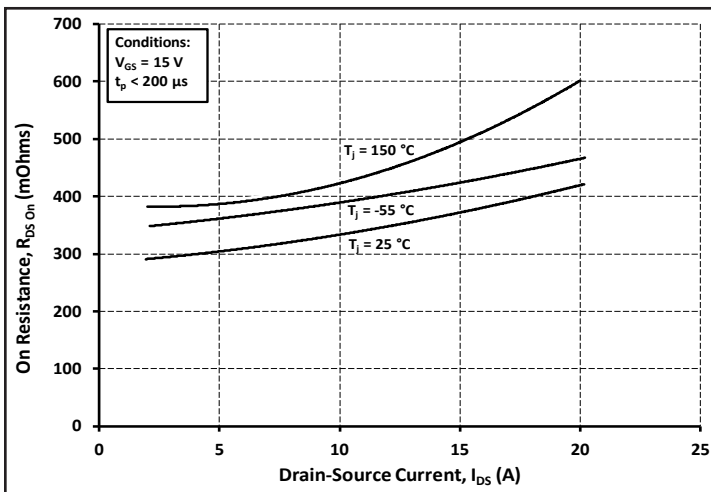


Figure 5. On-Resistance vs. Drain Current For Various Temperatures

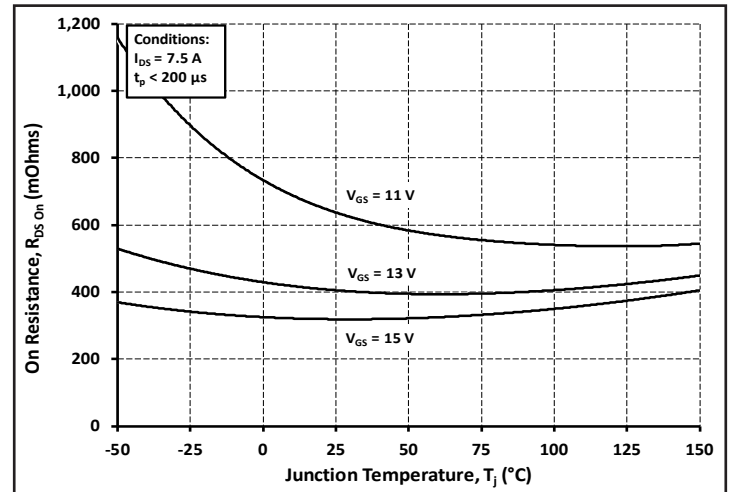


Figure 6. On-Resistance vs. Temperature For Various Gate Voltage

## Typical Performance

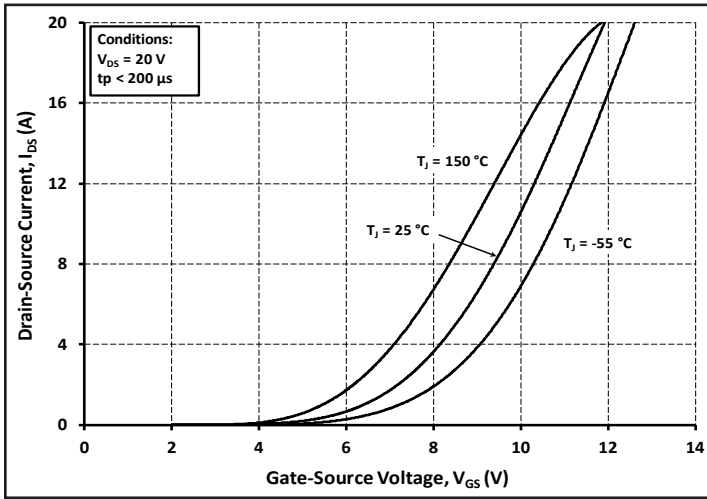


Figure 7. Transfer Characteristic for Various Junction Temperatures

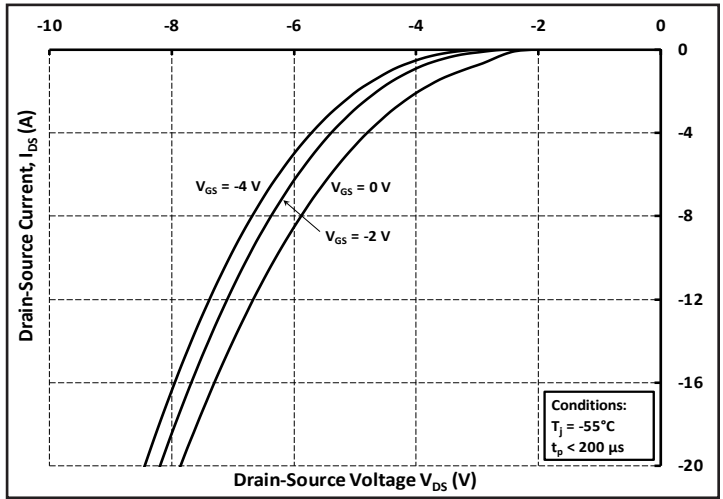


Figure 8. Body Diode Characteristic at -55 °C

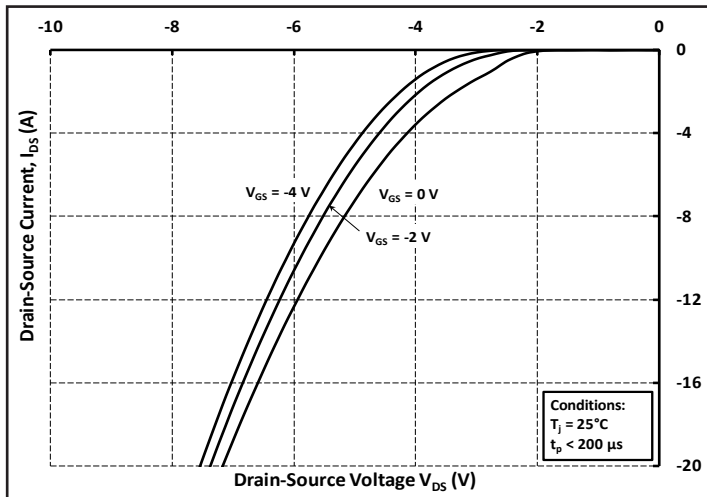


Figure 9. Body Diode Characteristic at 25 °C

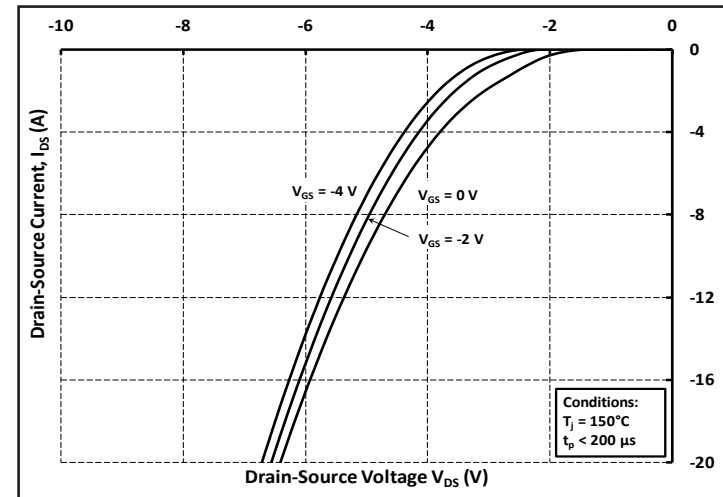


Figure 10. Body Diode Characteristic at 150 °C

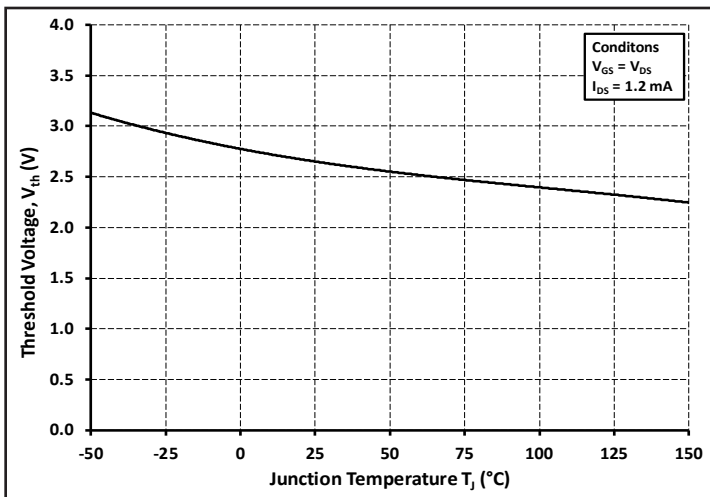


Figure 11. Threshold Voltage vs. Temperature

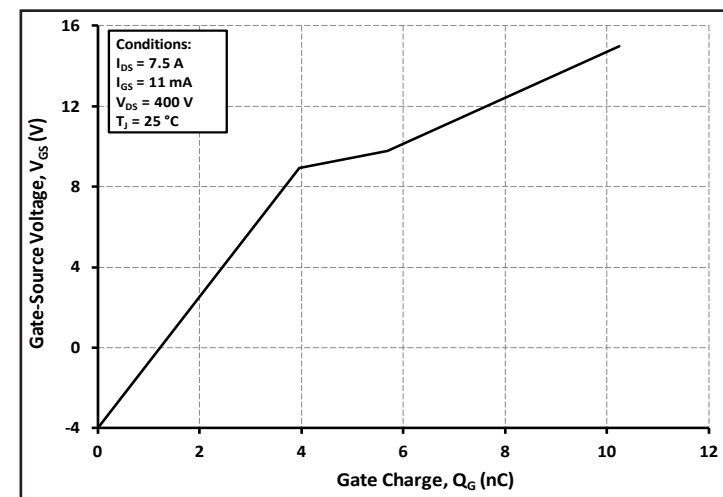


Figure 12. Gate Charge Characteristics

## Typical Performance

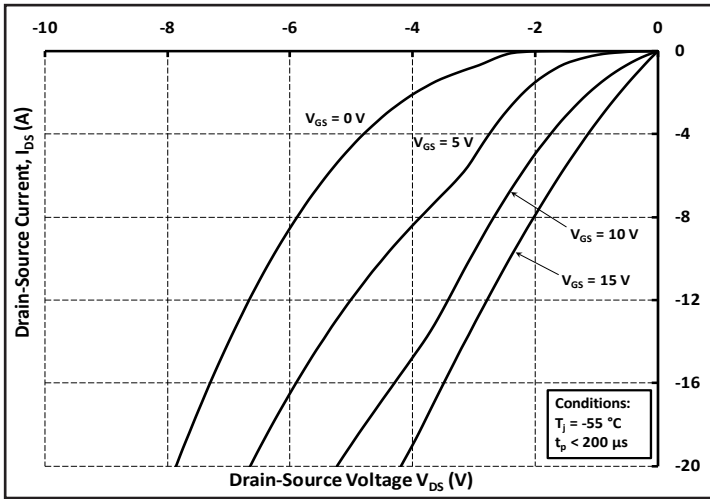


Figure 13. 3rd Quadrant Characteristic at  $-55\text{ }^{\circ}\text{C}$

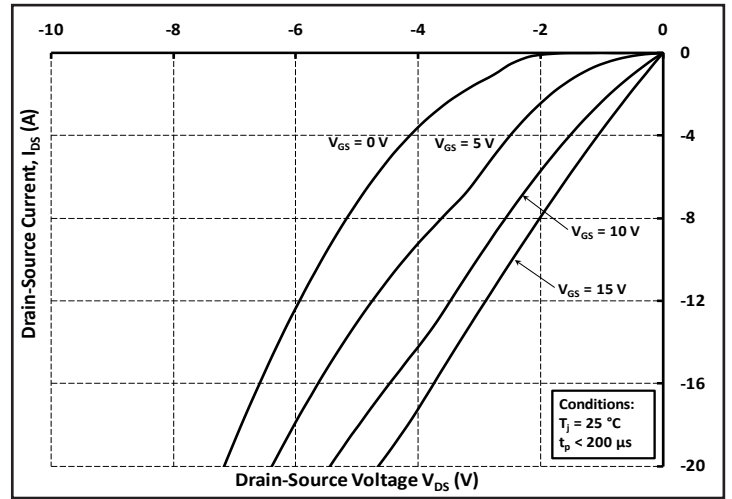


Figure 14. 3rd Quadrant Characteristic at  $25\text{ }^{\circ}\text{C}$

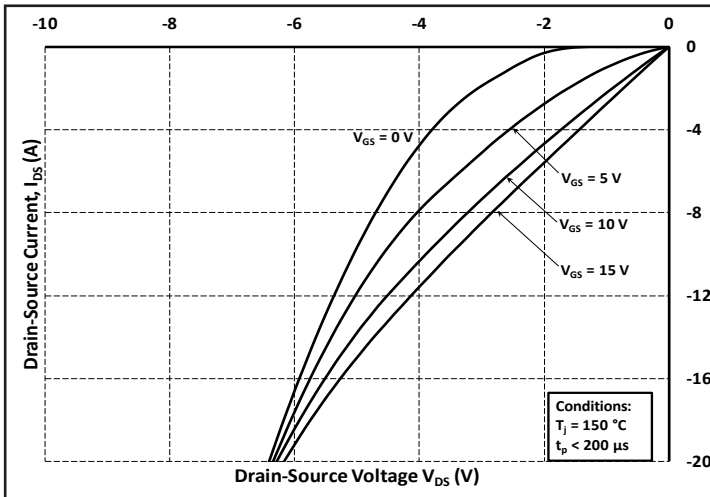


Figure 15. 3rd Quadrant Characteristic at  $150\text{ }^{\circ}\text{C}$

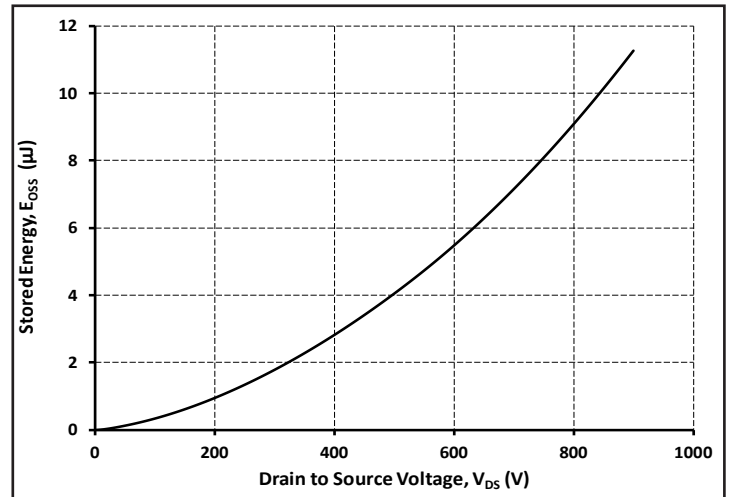


Figure 16. Output Capacitor Stored Energy

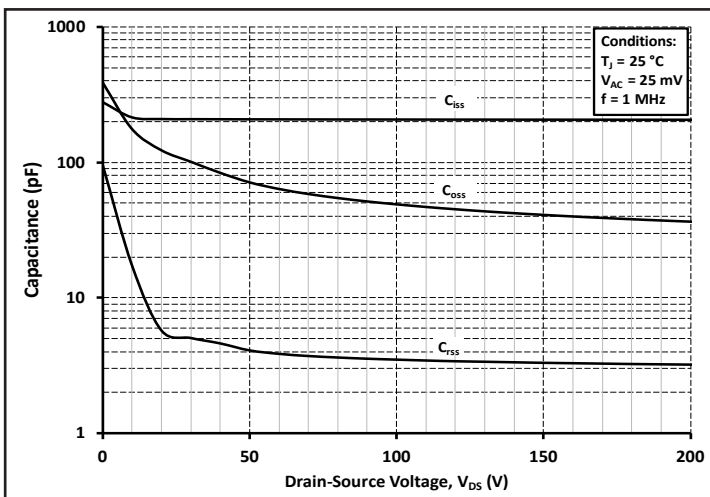


Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200V)

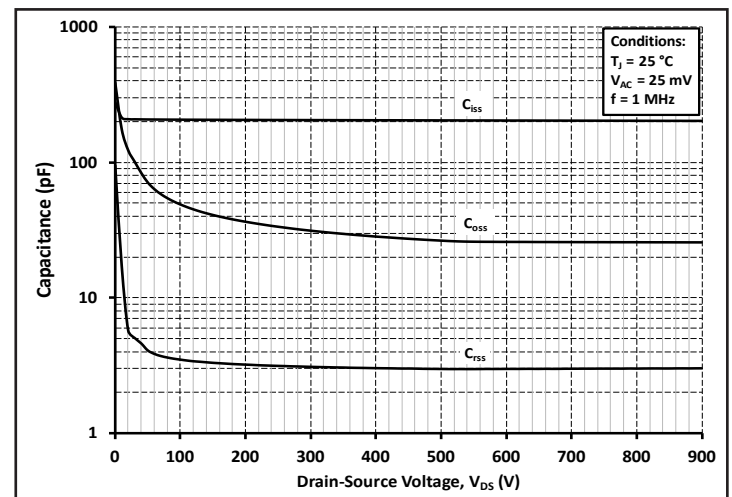


Figure 18. Capacitances vs. Drain-Source Voltage (0 - 900V)

## Typical Performance

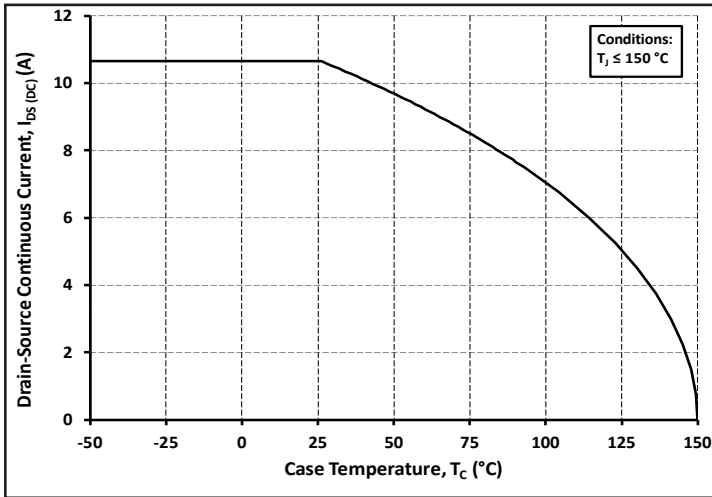


Figure 19. Continuous Drain Current Derating vs. Case Temperature

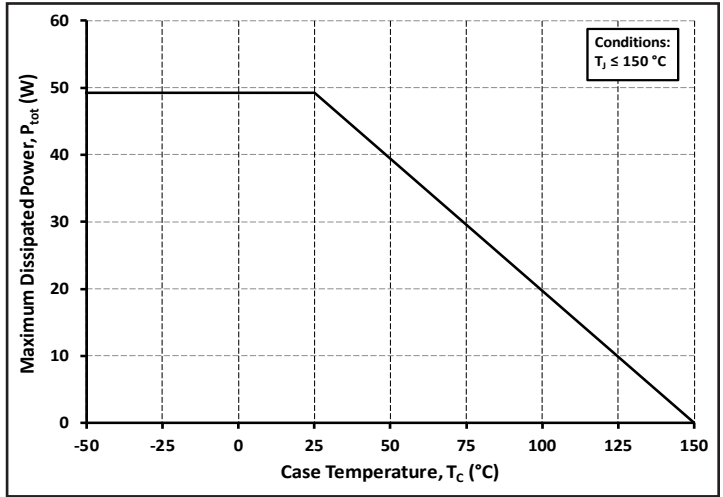


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

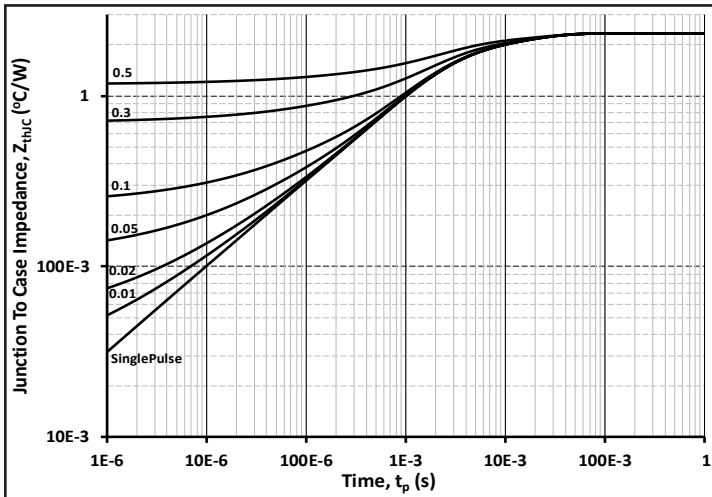


Figure 21. Transient Thermal Impedance (Junction - Case)

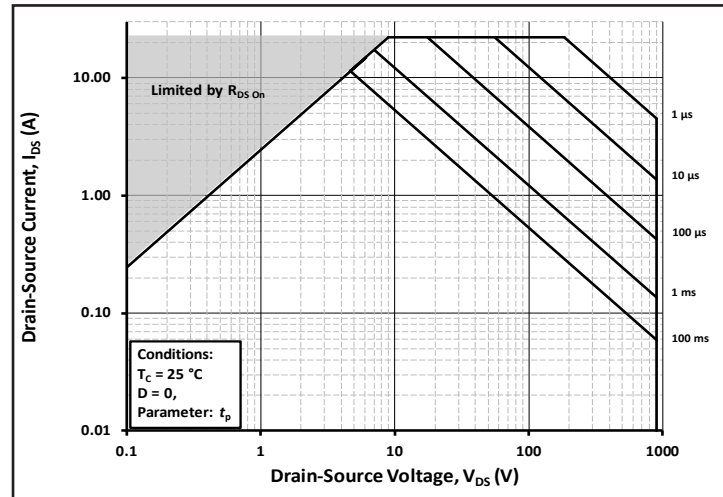


Figure 22. Safe Operating Area

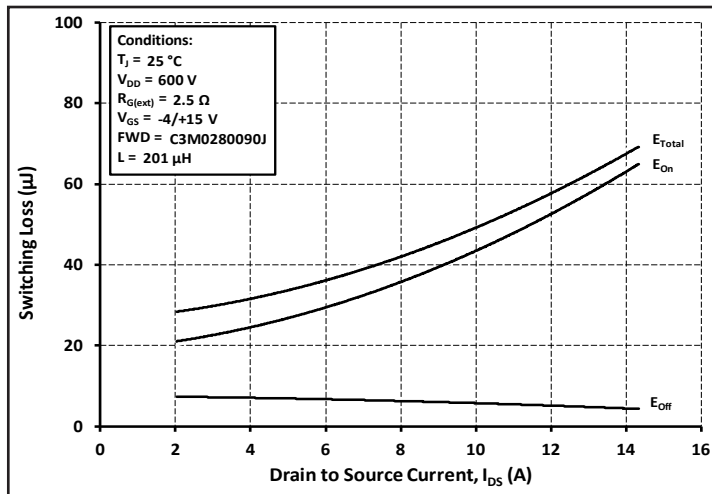


Figure 23. Clamped Inductive Switching Energy vs. Drain Current ( $V_{DD} = 600V$ )

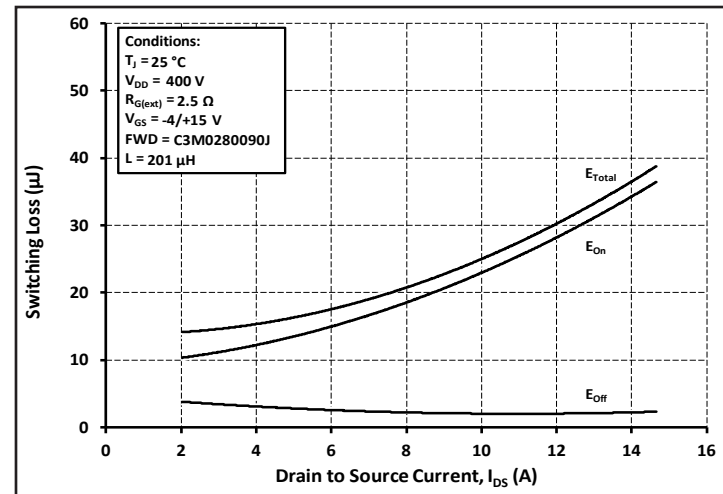


Figure 24. Clamped Inductive Switching Energy vs. Drain Current ( $V_{DD} = 400V$ )

## Typical Performance

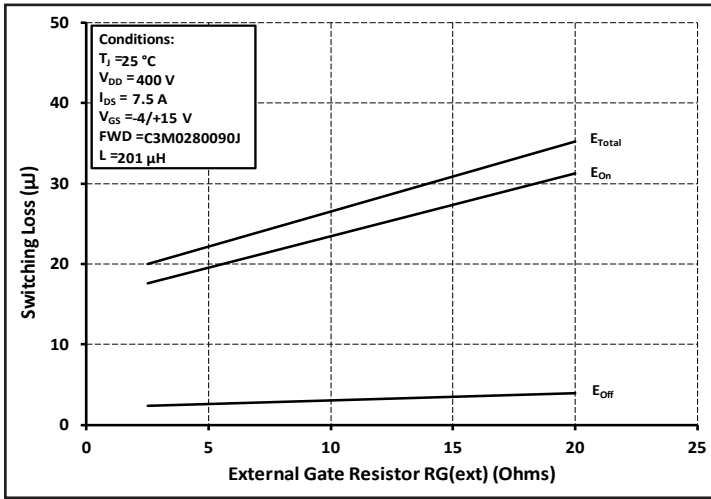


Figure 25. Clamped Inductive Switching Energy vs.  $R_{G(\text{ext})}$

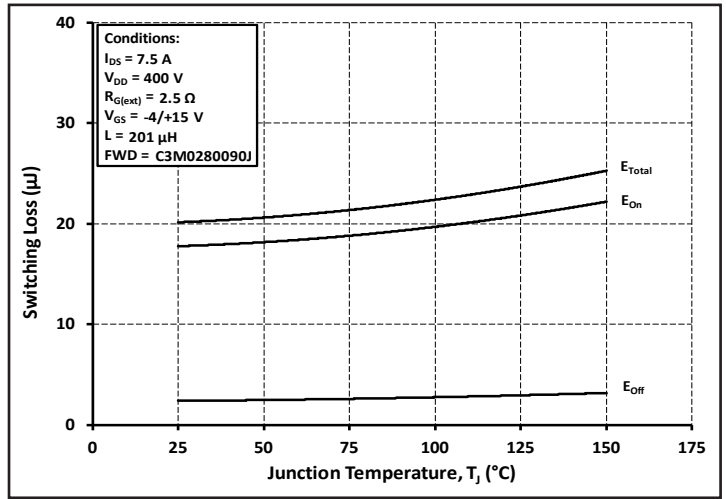


Figure 26. Clamped Inductive Switching Energy vs. Temperature

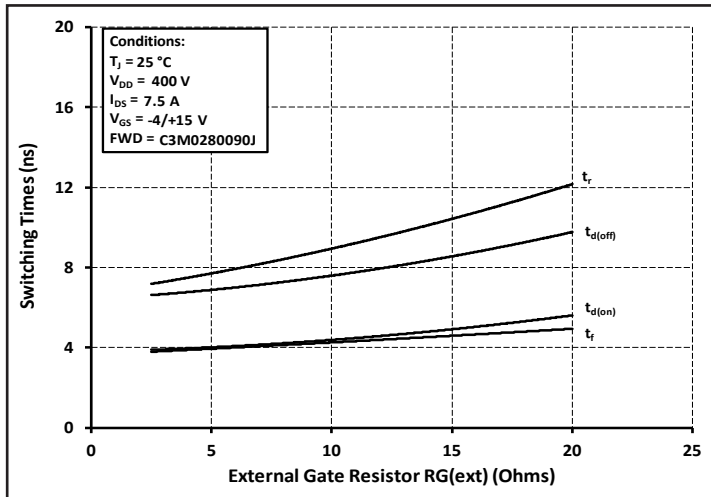


Figure 27. Switching Times vs.  $R_{G(\text{ext})}$

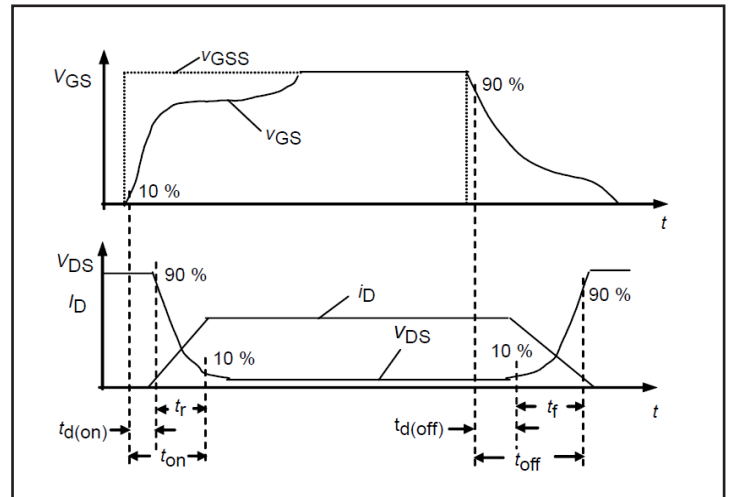


Figure 28. Switching Times Definition

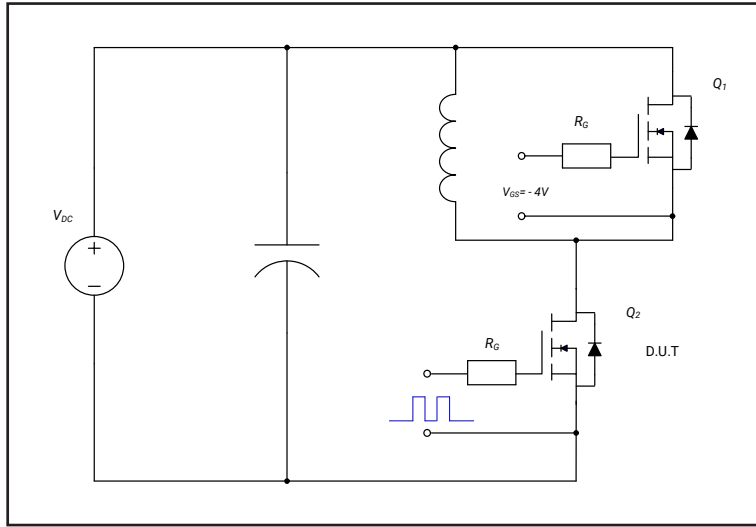


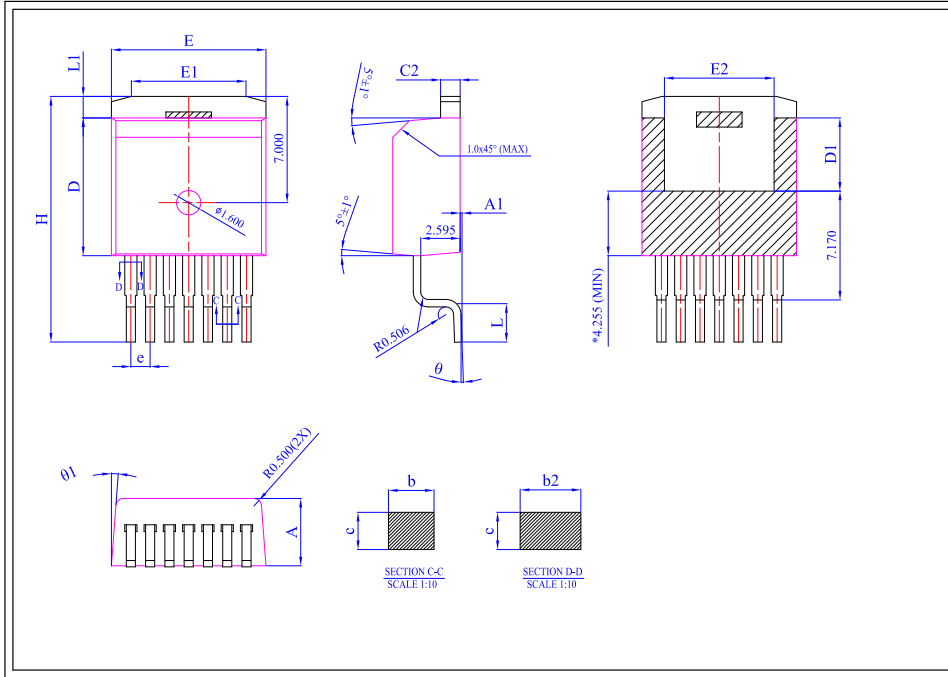
Figure 29. Clamped Inductive Switching Test Circuit

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

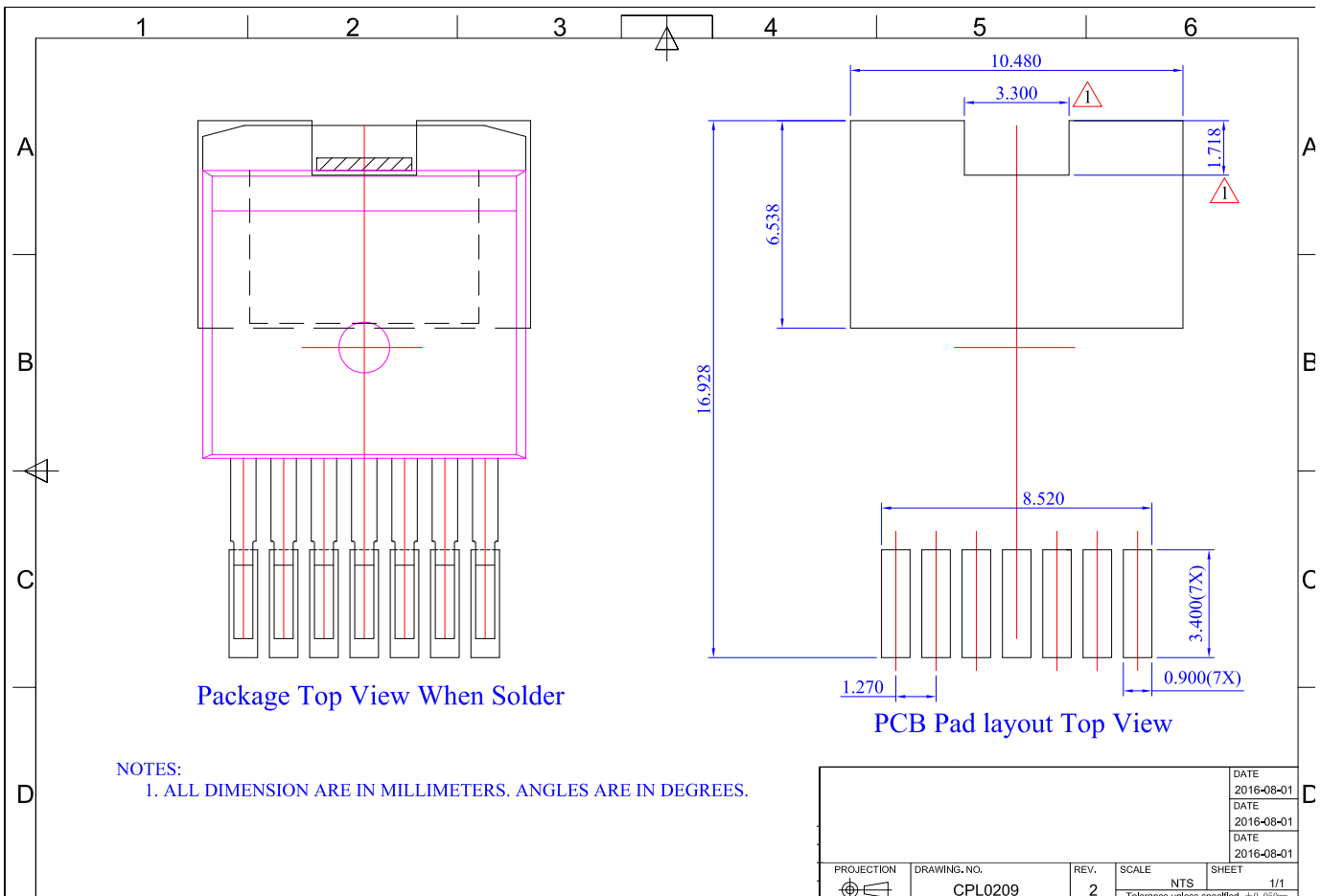


## Package Dimensions

TO-263-7




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
Ø	0°	4°	8°
Ø1	4.5°	5°	5.5°



Package Top View When Solder

PCB Pad layout Top View

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

PROJECTION	DRAWING NO.	REV.	SCALE	SHEET	DATE
	CPL0209	2	NTS	1/1	2016-08-01
Tolerance unless specified ±0.050mm					DATE
					2016-08-01
					DATE
					2016-08-01