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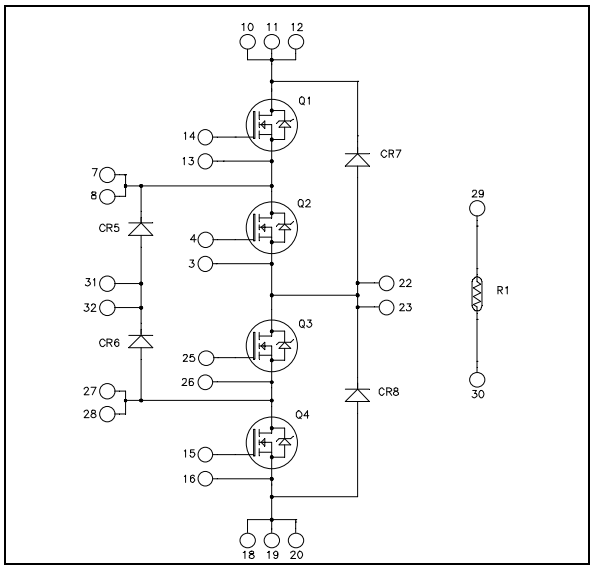
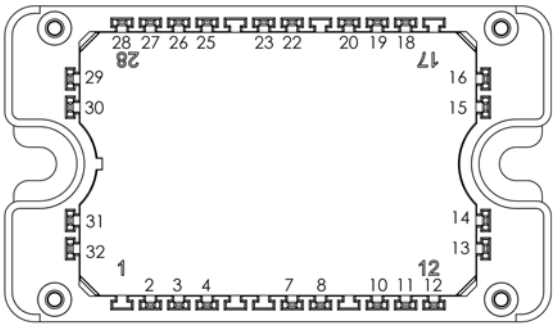
APTMC60TL11CT3AG

Three level inverter SiC MOSFET Power Module

***SiC Power MOSFET* :**
V_{DSS} = 1200V ; R_{DSon} = 98mΩ @ Tj = 25°C





All multiple inputs and outputs must be shorted together
10/11/12 ; 7/8 ; 27/28 ; …

Application

- Uninterruptible Power Supplies

Features

- ***SiC Power MOSFET***
  - Low $R_{DS(on)}$
  - High temperature performance
- ***SiC Schottky Diode***
  - Zero reverse recovery
  - Zero forward recovery
  - Temperature Independent switching behavior
  - Positive temperature coefficient on VF
- Kelvin emitter for easy drive
- Very low stray inductance
- High level of integration
- Internal thermistor for temperature monitoring
- AlN substrate for improved thermal performance

Benefits

- Stable temperature behavior
- Very rugged
- Direct mounting to heatsink (isolated package)
- Low junction to case thermal resistance
- Low profile
- RoHS Compliant

All ratings @ T_j = 25°C unless otherwise specified

Q1 to Q4 Absolute maximum ratings (per SiC MOSFET)

Symbol	*Parameter*		*Max ratings*	*Unit*
V_{DSS}	Drain - Source Voltage		1200	V
I_D	Continuous Drain Current	T_c = 25°C	28	A
		T_c = 80°C	22	
I_{DM}	Pulsed Drain current		55	
V_{GS}	Gate - Source Voltage		-10/+23	V
V_{GSOP}	Gate - Source Voltage ; recommended operation values		-5/+18	
R_{DSon}	Drain - Source ON Resistance		98	mΩ
P_D	Power Dissipation	T_c = 25°C	125	W

CAUTION: These Devices are sensitive to Electrostatic Discharge. Proper Handling Procedures Should Be Followed.

Q1 to Q4 Electrical Characteristics (per SiC MOSFET)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
I_{DSS}	Zero Gate Voltage Drain Current	V_{GS} = 0V , V_{DS} = 1200V				100	µA
$R_{DS(on)}$	Drain – Source on Resistance	V_{GS} = 20V; I_D = 20A	T_j = 25°C		80	98	mΩ
		V_{GS} = 18V; I_D = 20A	T_j = 175°C		153		
$V_{GS(th)}$	Gate Threshold Voltage	V_{GS} = V_{DS}, I_D = 5mA		2	2.6	4	V
I_{GSS}	Gate – Source Leakage Current	V_{GS} = 20 V, V_{DS} = 0V				250	nA

Q1 to Q4 Dynamic Characteristics (per SiC MOSFET)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
C_{iss}	Input Capacitance	V_{GS} = 0V V_{DS} = 1000V f = 1MHz			950		pF
C_{oss}	Output Capacitance				80		
C_{rss}	Reverse Transfer Capacitance				7.6		
Q_g	Total gate Charge	V_{GS} = -5/20V V_{Bus} = 800V I_D = 20A			62		nC
Q_{gs}	Gate – Source Charge				15		
Q_{gd}	Gate – Drain Charge				23		
$T_{d(on)}$	Turn-on Delay Time	V_{GS} = -2/+20V V_{Bus} = 800V I_D = 20A R_L = 40Ω ; R_G = 50Ω			12		ns
T_r	Rise Time				14		
$T_{d(off)}$	Turn-off Delay Time				23		
T_f	Fall Time				18		
E_{on}	Turn on Energy	Inductive Switching V_{GS} = -5/+20V V_{Bus} = 600V I_D = 20A R_G = 50Ω	T_j = 150°C		0.45		mJ
E_{off}	Turn off Energy		T_j = 150°C		0.25		
R_{Gint}	Internal gate resistance				4.6		Ω
R_{thJC}	Junction to Case Thermal Resistance					1	°C/W

Source - Drain diode ratings and characteristics (per SiC MOSFET)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
V_{SD}	Diode Forward Voltage	V_{GS} = 0V I_{SD} = 10A	T_j = 25°C		3.3		V
			T_j = 175°C		3.1		
t_{rr}	Reverse Recovery Time	I_{SD} = 20A ; V_{GS} = -5V V_R = 800V ; di_F/dt = 2400A/µs			32		ns
Q_{rr}	Reverse Recovery Charge				192		nC
I_{rr}	Reverse Recovery Current				10		A

CR5 & CR6 SiC diode ratings and characteristics (Per SiC diode)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
V_{RRM}	Peak Repetitive Reverse Voltage					600	V
I_{RM}	Reverse Leakage Current	V_R= 600V	T_j = 25°C		10	60	µA
			T_j = 175°C		20	300	
I_F	DC Forward Current		Tc = 125°C		10		A
V_F	Diode Forward Voltage	I_F = 10A	T_j = 25°C		1.6	1.8	V
			T_j = 175°C		2	2.4	
Q_C	Total Capacitive Charge	I_F = 10A, V_R = 600V di/dt =500A/µs			28		nC
C	Total Capacitance	f = 1MHz, V_R = 200V			65		pF
		f = 1MHz, V_R = 400V			50		
R_{thJC}	Junction to Case Thermal Resistance					2.2	°C/W

CR7 & CR8 SiC diode ratings and characteristics (Per SiC diode)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
V_{RRM}	Peak Repetitive Reverse Voltage					1200	V
I_{RM}	Reverse Leakage Current	V_R=1200V	T_j = 25°C		64	400	µA
			T_j = 175°C		112	2000	
I_F	DC Forward Current		Tc = 125°C		20		A
V_F	Diode Forward Voltage	I_F = 20A	T_j = 25°C		1.6	1.8	V
			T_j = 175°C		2.3	3	
Q_C	Total Capacitive Charge	I_F = 20A, V_R = 1200V di/dt =1000A/µs			160		nC
C	Total Capacitance	f = 1MHz, V_R = 200V			192		pF
		f = 1MHz, V_R = 400V			138		
R_{thJC}	Junction to Case Thermal Resistance					0.8	°C/W

Temperature sensor NTC (see application note APT0406 on www.microsemi.com).

Symbol	Characteristic		Min	Typ	Max	Unit
R_{25}	Resistance @ 25°C			50		kΩ
$\Delta R_{25}/R_{25}$				5		%
$B_{25/85}$	T_{25} = 298.15 K			3952		K
ΔB/B		T_C=100°C		4		%

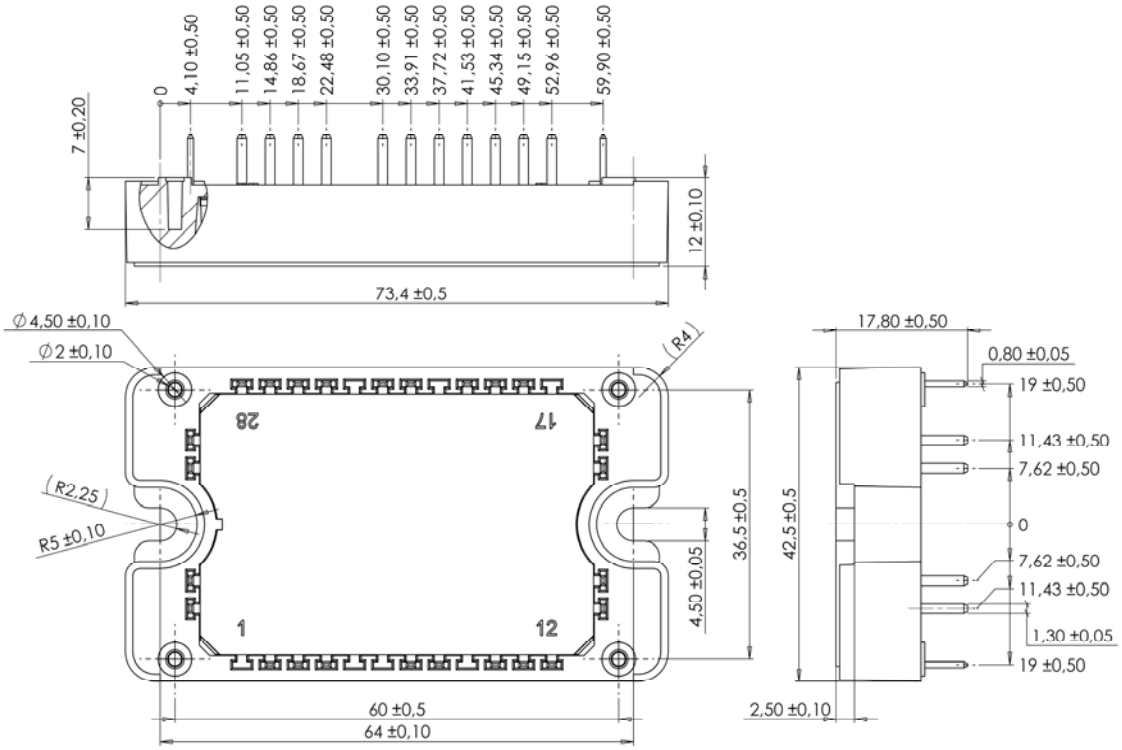
$$R_T = \frac{R_{25}}{\exp\left[B_{25/85}\left(\frac{1}{T_{25}} - \frac{1}{T}\right)\right]}$$

T: Thermistor temperature
R_T: Thermistor value at T

Thermal and package characteristics

Symbol	Characteristic			Min	Max	Unit
V_{ISOL}	RMS Isolation Voltage, any terminal to case t =1 min, 50/60Hz			4000		V
T_J	Operating junction temperature range			-40	175	°C
T_{JOP}	Recommended junction temperature under switching conditions			-40	$T_J$max -25	
T_{STG}	Storage Temperature Range			-40	125	
T_C	Operating Case Temperature			-40	125	
Torque	Mounting torque	To heatsink	M4	2	3	N.m
Wt	Package Weight				110	g

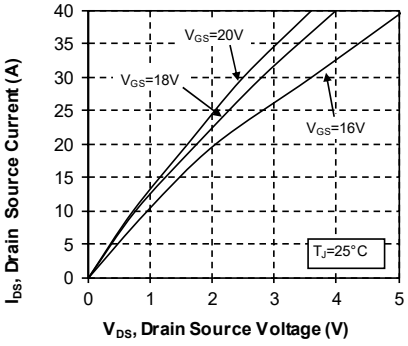
Package outline (dimensions in mm)



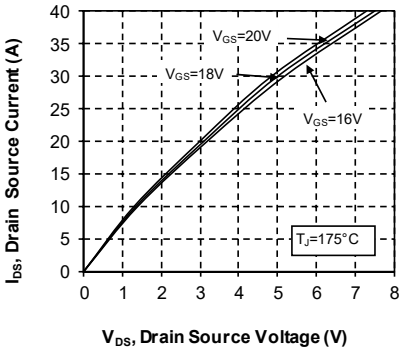
See application note 1906 - Mounting Instructions for SP3F Power Modules on www.microsemi.com

Q1 to Q4 Typical performance curve

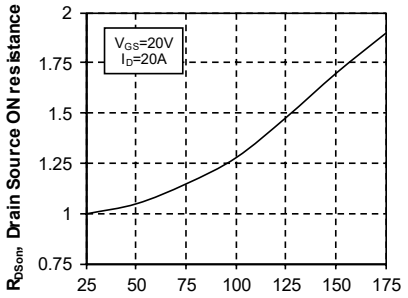
Output Characteristics



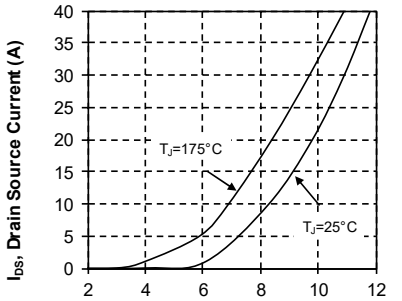
Output Characteristics



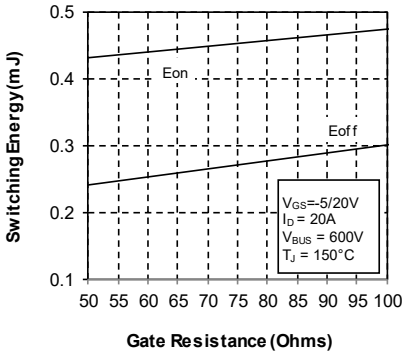
Normalized $R_{DS(on)}$ vs. Temperature



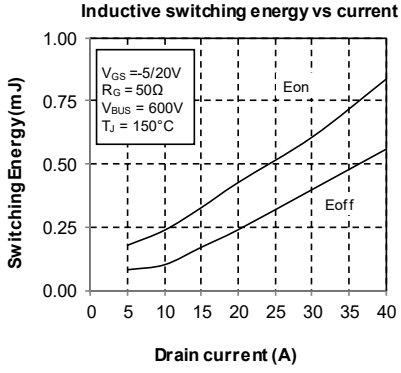
Transfert Characteristics



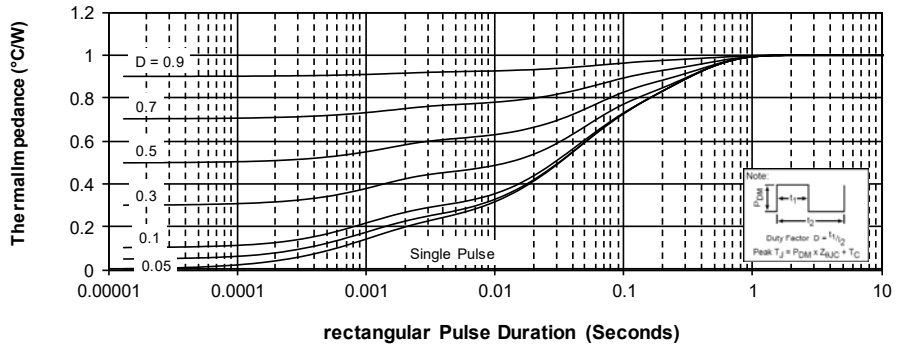
inductive switching energy vs RG



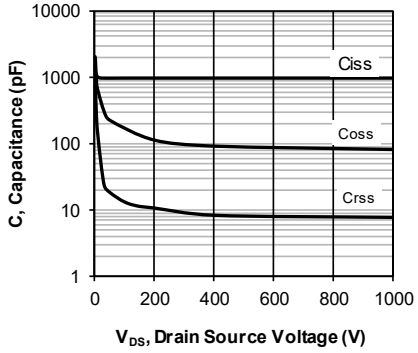
Inductive switching energy vs current



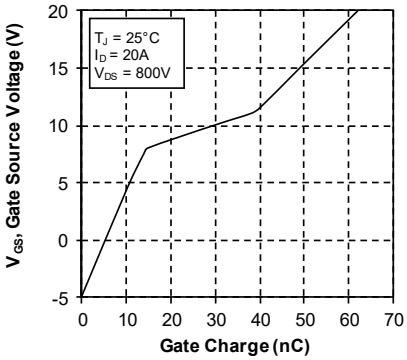
Maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration



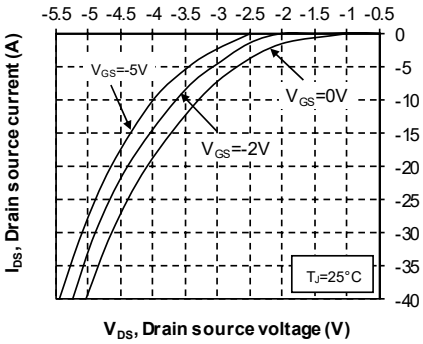
Capacitance vs Drain Source Voltage



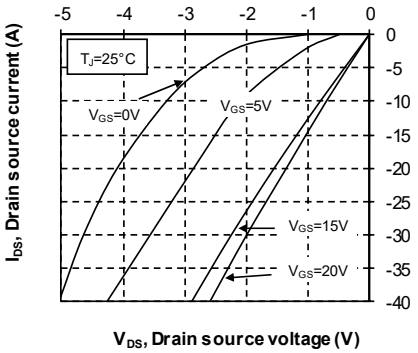
Gate Charge vs Gate Source Voltage



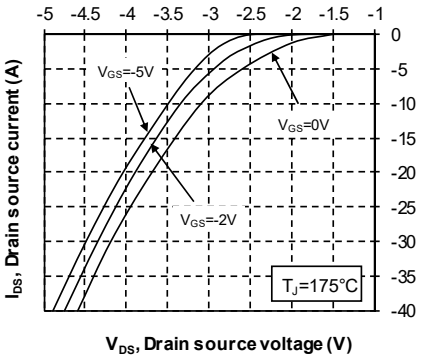
Body diode Characteristics



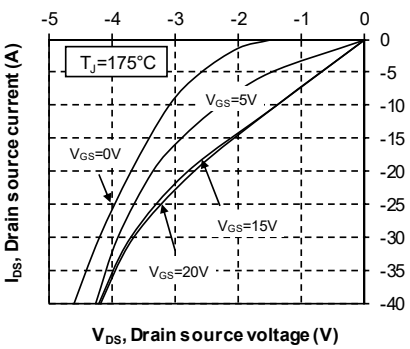
3rd quadrant Characteristics



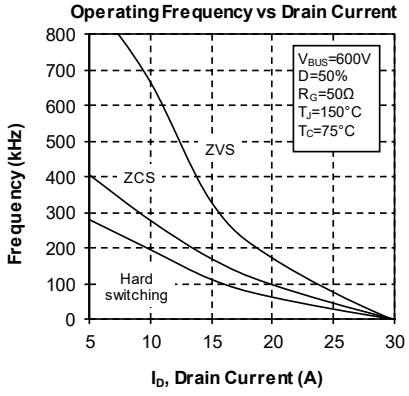
Body diode Characteristics



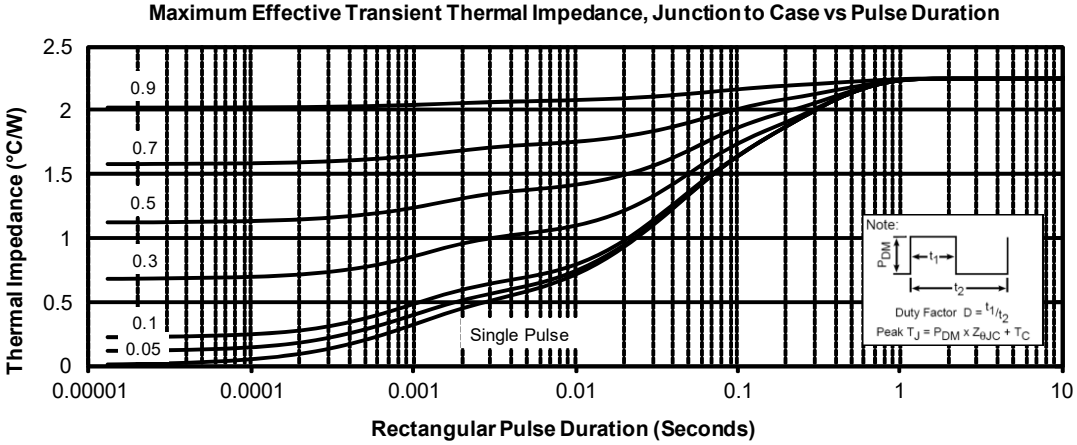
3rd quadrant Characteristics

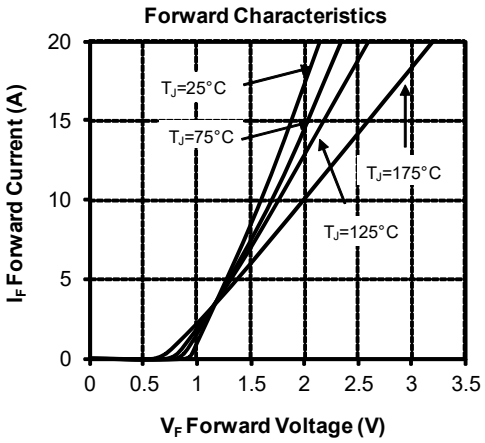


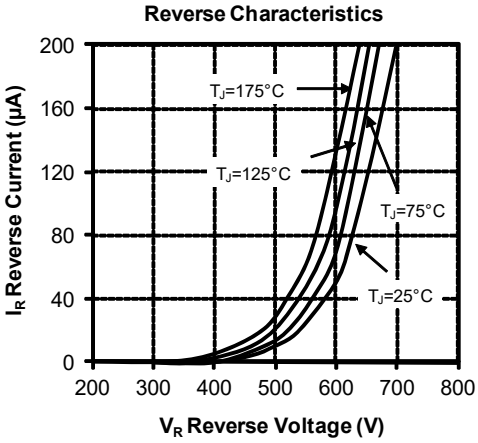
Operating Frequency vs Drain Current

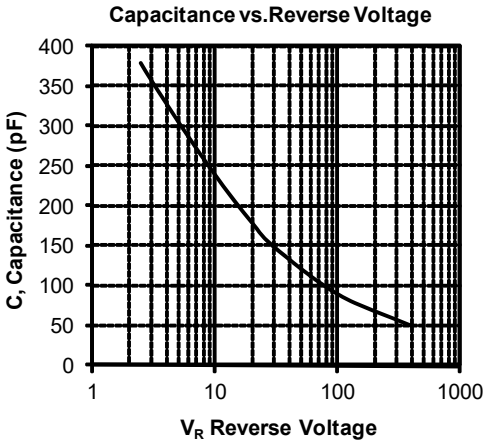


CR5 & CR6 Typical performance curve

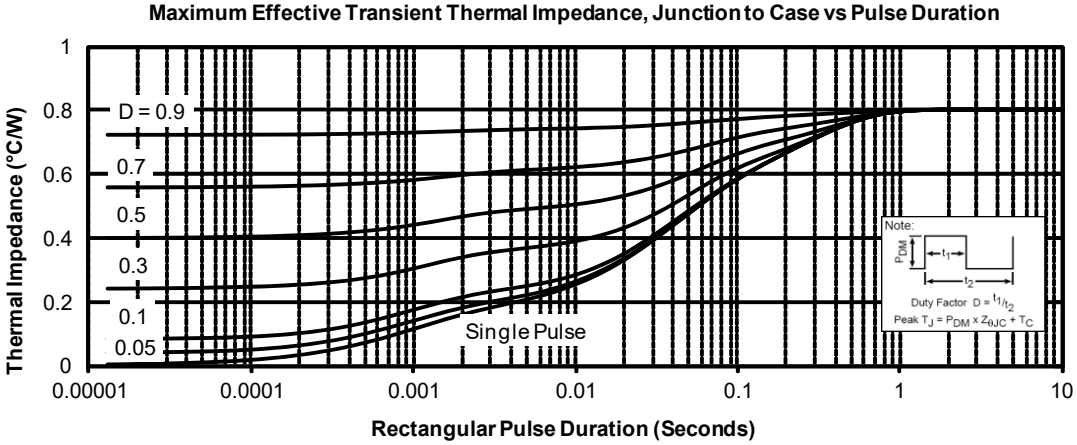


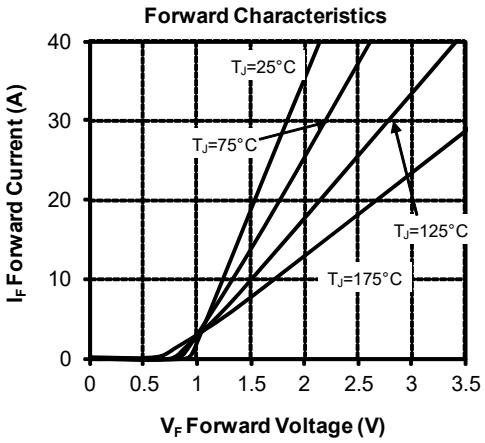


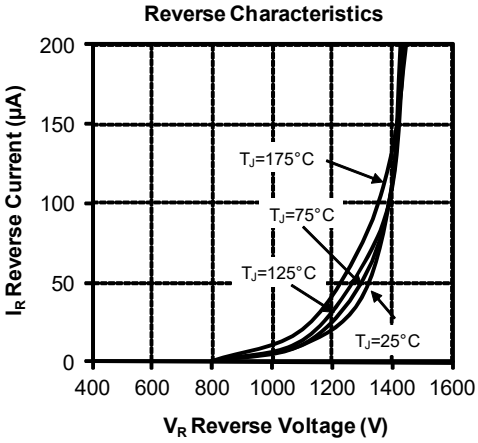


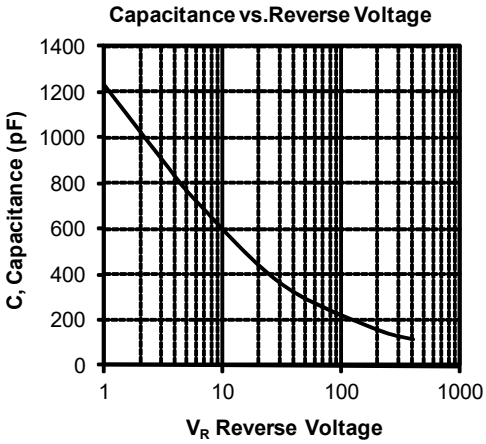


CR7 & CR8 Typical performance curve









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