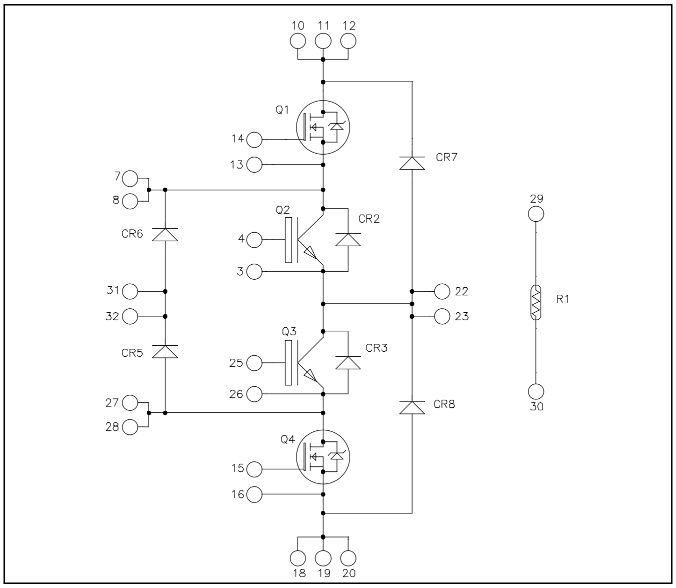
Microsemi
POWER PRODUCTS GROUP

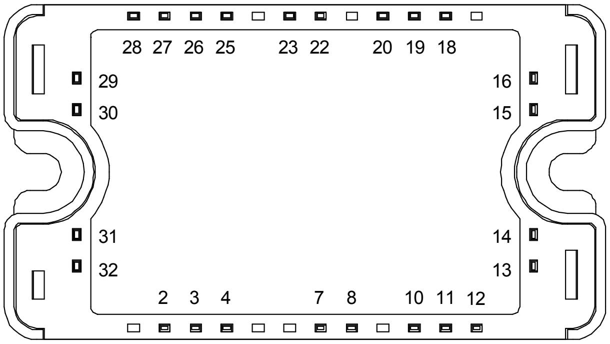
APTCV90TL12T3G

Three level inverter CoolMOS & Trench + Field Stop IGBT4 Power Module

Trench & Field Stop IGBT4 Q2, Q3:
V_{CES} = 1200V ; I_C = 50A @ Tc = 80°C

CoolMOS™ Q1, Q4:
V_{DSS} = 900V ; I_D = 23A @ Tc = 80°C





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

Application

- Solar converter
- Uninterruptible Power Supplies

Features

- ***Q2, Q3 Trench + Field Stop IGBT 4 Technology***
  - Low voltage drop
  - Low leakage current
  - Low switching losses
- ***Q1, Q4 CoolMOS™***
  - Ultra low R_{DSon}
  - Low Miller capacitance
  - Ultra low gate charge
  - Avalanche energy rated
  - Very rugged
- Kelvin emitter for easy drive
- Very low stray inductance
- High level of integration
- Internal thermistor for temperature monitoring

Benefits

- Stable temperature behavior
- Very rugged
- Direct mounting to heatsink (isolated package)
- Low junction to case thermal resistance
- Easy paralleling due to positive TC of VCEsat
- Low profile
- RoHS Compliant

All ratings @ T_j = 25°C unless otherwise specified

Q1 & Q4 Absolute maximum ratings

Symbol	Parameter		Max ratings	Unit
V_{DSS}	Drain - Source Breakdown Voltage		900	V
I_D	Continuous Drain Current	$T_c = 25°C$	30	A
		$T_c = 80°C$	23	
I_{DM}	Pulsed Drain current		75	
V_{GS}	Gate - Source Voltage		±20	V
R_{DSon}	Drain - Source ON Resistance		120	mΩ
P_D	Maximum Power Dissipation	$T_c = 25°C$	250	W
I_{AR}	Avalanche current (repetitive and non repetitive)		8.8	A
E_{AR}	Repetitive Avalanche Energy		2.9	mJ
E_{AS}	Single Pulse Avalanche Energy		1940	

Q1 & Q4 Electrical Characteristics

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
I_{DSS}	Zero Gate Voltage Drain Current	$V_{GS} = 0V, V_{DS} = 900V$	$T_j = 25°C$			100	µA
		$V_{GS} = 0V, V_{DS} = 900V$	$T_j = 125°C$		500		
$R_{DS(on)}$	Drain – Source on Resistance	$V_{GS} = 10V, I_D = 26A$			100	120	mΩ
$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 3mA$		2.5	3	3.5	V
I_{GSS}	Gate – Source Leakage Current	$V_{GS} = \pm 20\ V, V_{DS} = 0V$				100	nA

Q1 & Q4 Dynamic Characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
C_{iss}	Input Capacitance	$V_{GS} = 0V$; $V_{DS} = 100V$ f = 1MHz		6800		pF
C_{oss}	Output Capacitance			330		
Q_g	Total gate Charge	$V_{GS} = 10V$ $V_{Bus} = 400V$ $I_D = 26A$		270		nC
Q_{gs}	Gate – Source Charge			32		
Q_{gd}	Gate – Drain Charge			115		
$T_{d(on)}$	Turn-on Delay Time	**Inductive Switching (125°C)** $V_{GS} = 10V$ $V_{Bus} = 400V$ $I_D = 26A$ $R_G = 7.5\Omega$		70		ns
T_r	Rise Time			20		
$T_{d(off)}$	Turn-off Delay Time			400		
T_f	Fall Time			25		
R_{thJC}	Junction to Case Thermal resistance				0.5	°C/W

Q2 & Q3 Absolute maximum ratings

Symbol	Parameter		Max ratings	Unit
V_{CES}	Collector - Emitter Breakdown Voltage		1200	V
I_C	Continuous Collector Current	$T_C = 25°C$	80	A
		$T_C = 80°C$	60	
I_{CM}	Pulsed Collector Current	$T_C = 25°C$	100	
V_{GE}	Gate – Emitter Voltage		±20	V
P_D	Maximum Power Dissipation	$T_C = 25°C$	280	W
RBSOA	Reverse Bias Safe Operating Area	$T_j = 150°C$	100A @ 1100V	

Q2 & Q3 Electrical Characteristics

Symbol	*Characteristic*	*Test Conditions*		*Min*	*Typ*	*Max*	*Unit*
I_{CES}	Zero Gate Voltage Collector Current	V_{GE} = 0V, V_{CE} = 1200V				1	mA
$V_{CE(sat)}$	Collector Emitter saturation Voltage	V_{GE} = 15V I_C = 50A	T_j = 25°C		1.8	2.2	V
			T_j = 150°C		2.2		
$V_{GE(th)}$	Gate Threshold Voltage	V_{GE} = V_{CE} , I_C = 1.6mA		5.0	5.8	6.5	V
I_{GES}	Gate – Emitter Leakage Current	V_{GE} = 20V, V_{CE} = 0V				400	nA

Q2 & Q3 Dynamic Characteristics

Symbol	*Characteristic*	*Test Conditions*		*Min*	*Typ*	*Max*	*Unit*
C_{ies}	Input Capacitance	V_{GE} = 0V V_{CE} = 25V f = 1MHz			2770		pF
C_{oes}	Output Capacitance				205		
C_{res}	Reverse Transfer Capacitance				160		
Q_G	Gate charge	V_{GE}= ±15V ; V_{CE}=600V I_C=50A			0.38		µC
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching (25°C) V_{GE} = ±15V V_{CE} = 600V I_C = 50A R_G = 8.2Ω			50		ns
T_r	Rise Time				27		
$T_{d(off)}$	Turn-off Delay Time				270		
T_f	Fall Time				70		
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching (150°C) V_{GE} = ±15V V_{CE} = 600V I_C = 50A R_G = 8.2Ω			50		ns
T_r	Rise Time				30		
$T_{d(off)}$	Turn-off Delay Time				290		
T_f	Fall Time				80		
E_{on}	Turn-on Switching Energy	V_{GE} = ±15V V_{CE} = 600V I_C = 50A R_G = 8.2Ω	T_J = 25°C		3.8		mJ
			T_J = 150°C		5.5		
E_{off}	Turn-off Switching Energy		T_J = 25°C		2.5		mJ
			T_J = 150°C		4.5		
I_{sc}	Short Circuit data	V_{GE} ≤15V ; V_{Bus} = 900V t_p ≤10µs ; T_j = 150°C			200		A
R_{thJC}	Junction to Case Thermal Resistance					0.53	°C/W

CR5 & CR6 diode ratings and characteristics

Symbol	*Characteristic*	*Test Conditions*		*Min*	*Typ*	*Max*	*Unit*
V_{RRM}	Maximum Peak Repetitive Reverse Voltage			1000			V
I_{RM}	Maximum Reverse Leakage Current	V_R=1000V	T_j = 25°C			100	µA
			T_j = 125°C			500	
I_F	DC Forward Current		Tc = 80°C		40		A
V_F	Diode Forward Voltage	I_F = 40A			2.5	3	
		I_F = 80A			3.1		V
		I_F = 40A	T_j = 125°C		2		
t_{rr}	Reverse Recovery Time	I_F = 40A V_R = 667V di/dt =200A/µs	T_j = 25°C		250		ns
			T_j = 125°C		315		
Q_{rr}	Reverse Recovery Charge		T_j = 25°C		415		nC
			T_j = 125°C		1650		
E_{rr}	Reverse Recovery Energy	I_F = 40A V_R = 667V di/dt =1000A/µs	T_j = 125°C		1.3		mJ
R_{thJC}	Junction to Case Thermal Resistance					1.2	°C/W

CR2, CR3, CR7 & CR8 diode ratings and characteristics

Symbol	*Characteristic*	*Test Conditions*		*Min*	*Typ*	*Max*	*Unit*
V_{RRM}	Maximum Peak Repetitive Reverse Voltage			1200			V
I_{RM}	Maximum Reverse Leakage Current	V_R=1200V	T_j = 25°C			100	µA
			T_j = 125°C			500	
I_F	DC Forward Current		Tc = 80°C		40		A
V_F	Diode Forward Voltage	I_F = 30A			2.6	3.1	
		I_F = 60A			3.2		V
		I_F = 30A	T_j = 125°C		1.8		
t_{rr}	Reverse Recovery Time	I_F = 30A V_R = 800V di/dt =200A/µs	T_j = 25°C		300		ns
			T_j = 125°C		380		
Q_{rr}	Reverse Recovery Charge		T_j = 25°C		360		nC
			T_j = 125°C		1700		
E_{rr}	Reverse Recovery Energy	I_F = 30A V_R = 800V di/dt =1000A/µs	T_j = 125°C		1.6		mJ
R_{thJC}	Junction to Case Thermal Resistance					1.2	°C/W

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

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		%

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

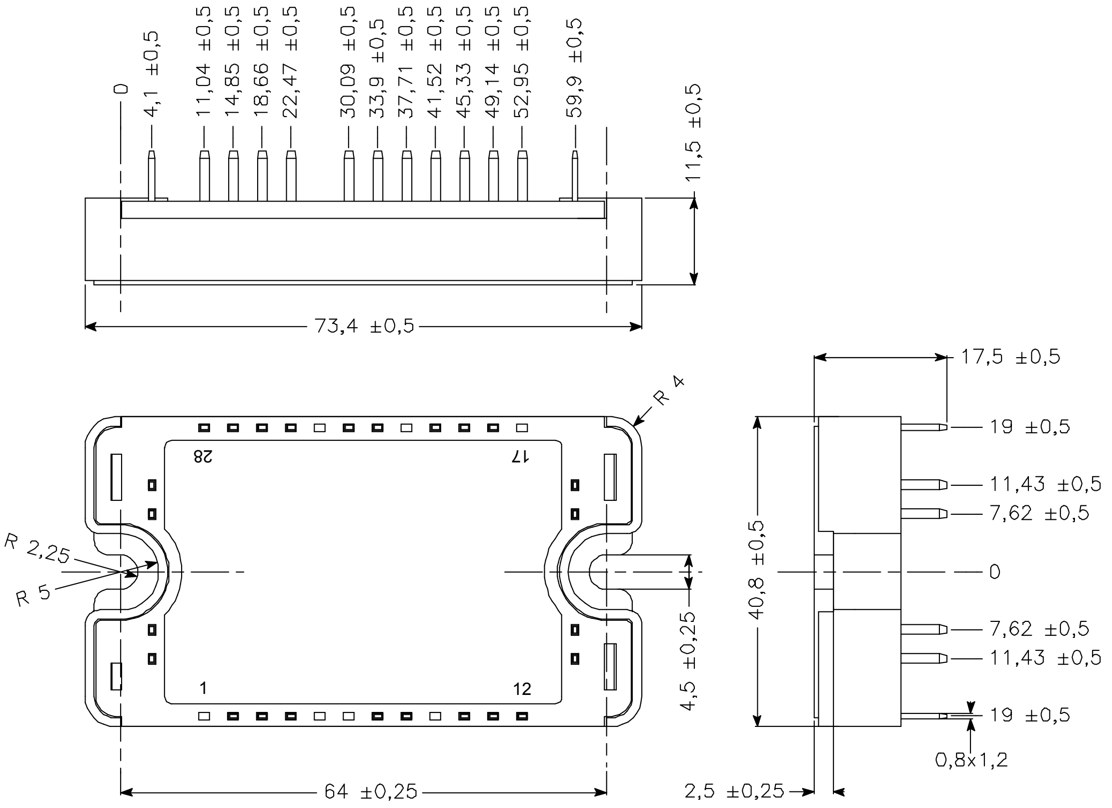
T: Thermistor temperature
R_T: Thermistor value at T

Thermal and package characteristics

Symbol	Characteristic			Min	Typ	Max	Unit
V_{ISOL}	RMS Isolation Voltage, any terminal to case t =1 min, I isol<1mA, 50/60Hz			2500			V
T_J	Operating junction temperature range			-40		175*	°C
T_{STG}	Storage Temperature Range			-40		125	
T_C	Operating Case Temperature			-40		100	
Torque	Mounting torque	To heatsink	M4	2.5		4.7	N.m
Wt	Package Weight					110	g

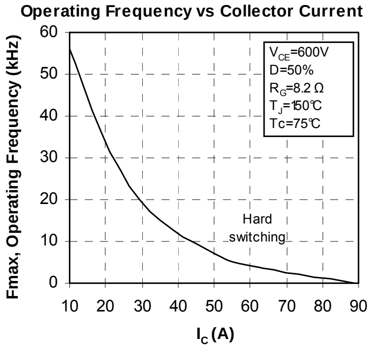
* Tjmax = 150°C for Q1 & Q4

SP3 Package outline (dimensions in mm)

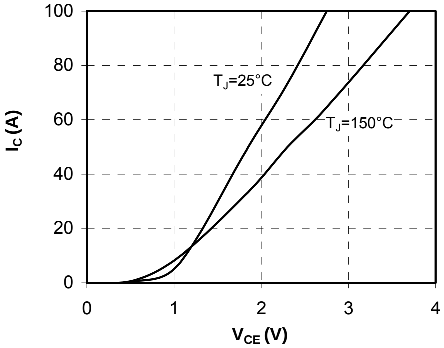


See application note 1901 - Mounting Instructions for SP3 Power Modules on www.microsemi.com

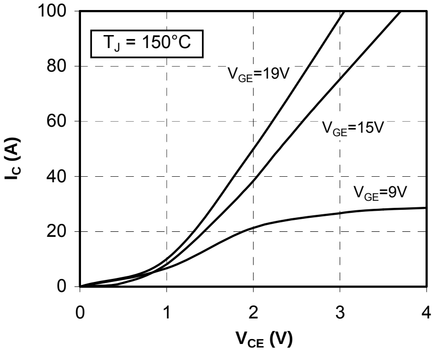
Q2 & Q3 Typical performance curve



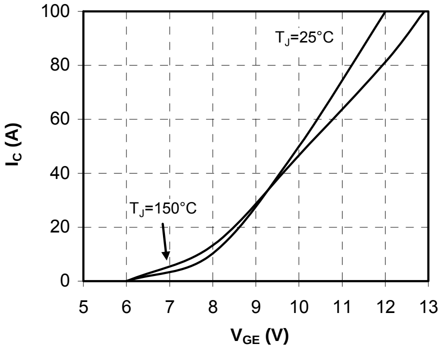
Output Characteristics (V_{GE}=15V)



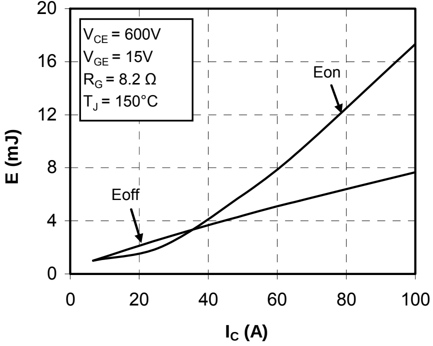
Output Characteristics



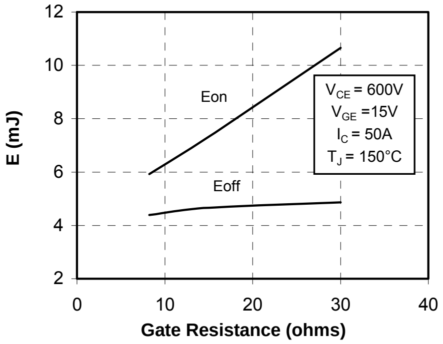
Transfert Characteristics



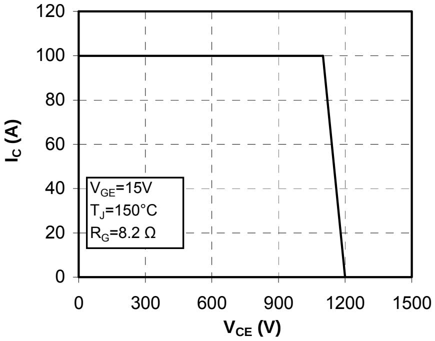
Energy losses vs Collector Current



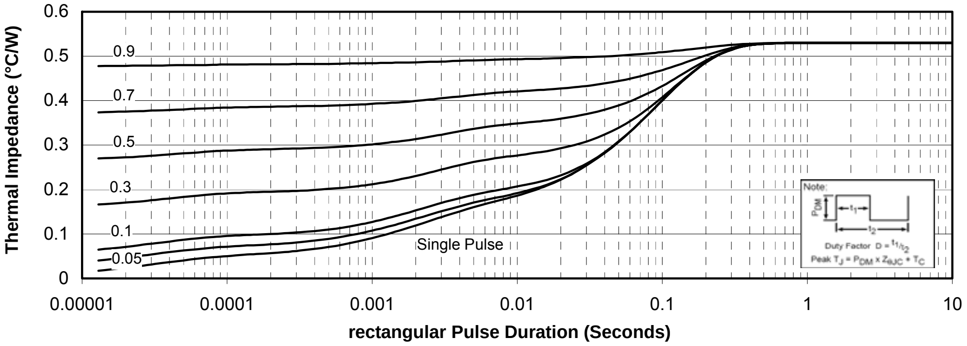
Switching Energy Losses vs Gate Resistance



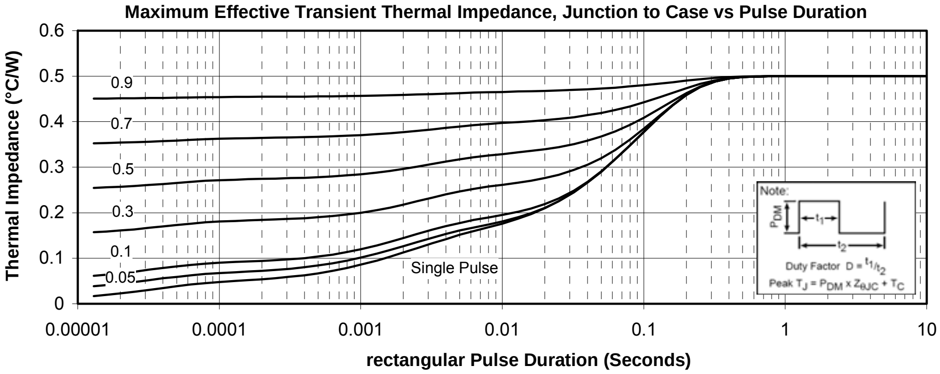
Reverse Bias Safe Operating Area

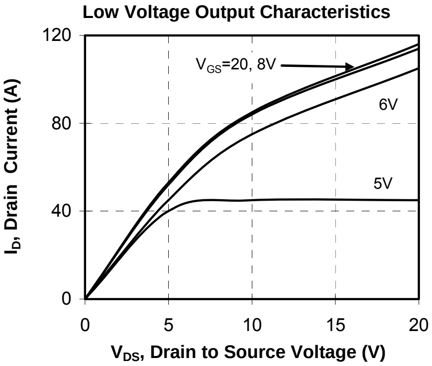


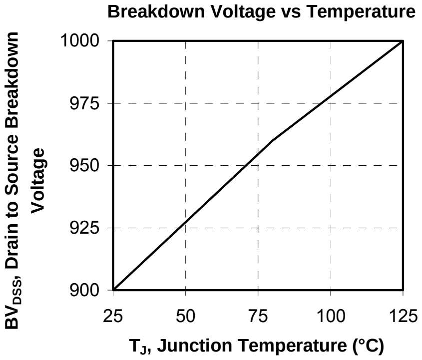
maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration

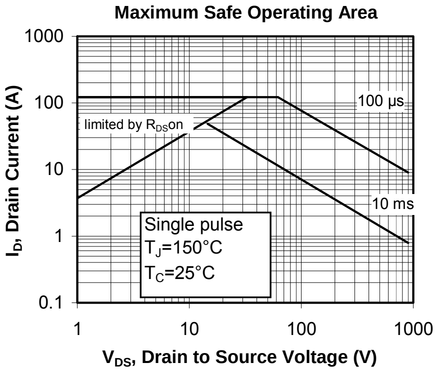


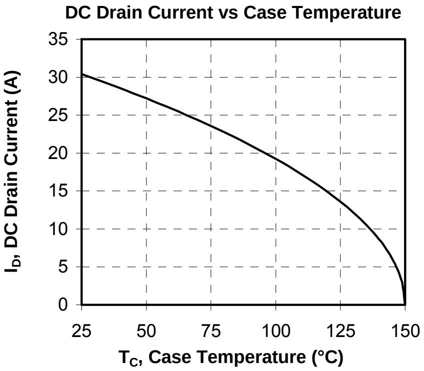
Q1 & Q4 Typical performance curve

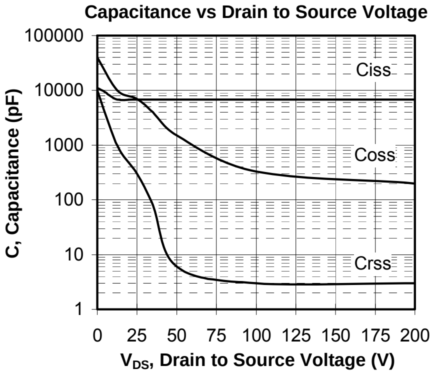

Maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration

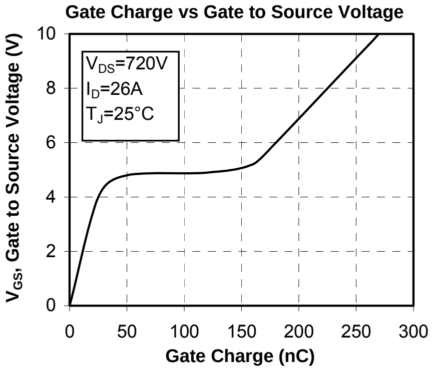

Low Voltage Output Characteristics


Breakdown Voltage vs Temperature

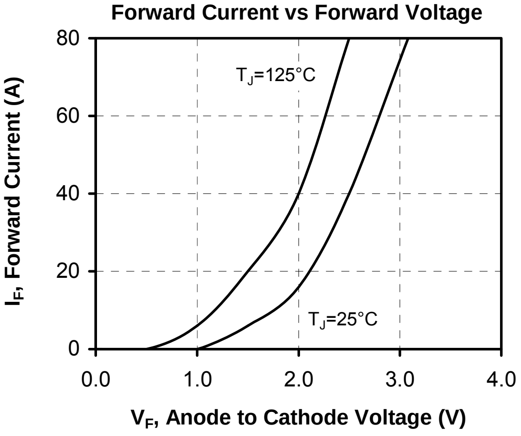

Maximum Safe Operating Area

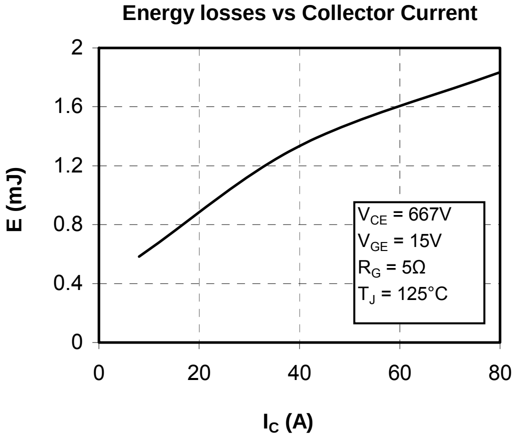

DC Drain Current vs Case Temperature

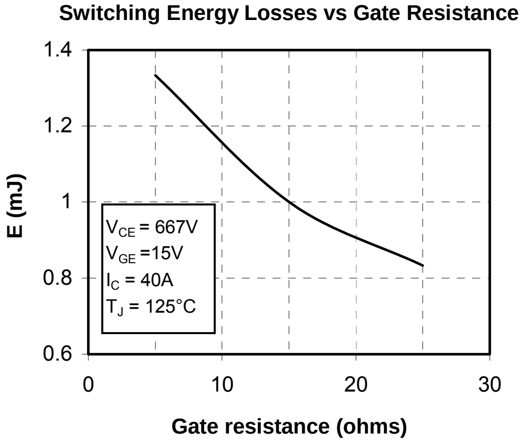

Capacitance vs Drain to Source Voltage

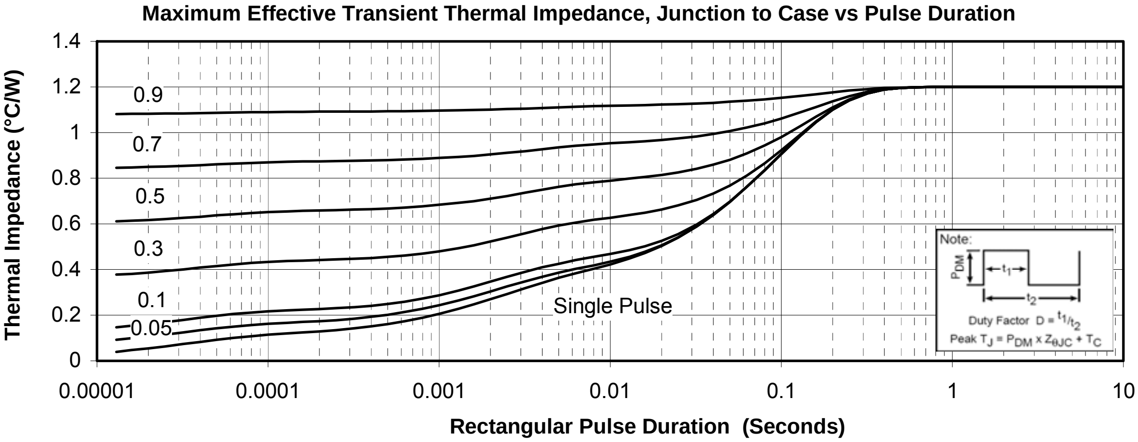

Gate Charge vs Gate to Source Voltage

CR5 & CR6 Typical performance curve


Forward Current vs Forward Voltage


Energy losses vs Collector Current


Switching Energy Losses vs Gate Resistance


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

CR2, CR3, CR7 & CR8 Typical performance curve