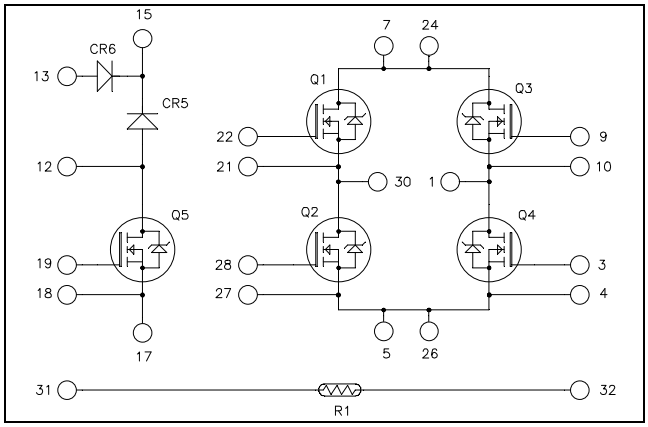
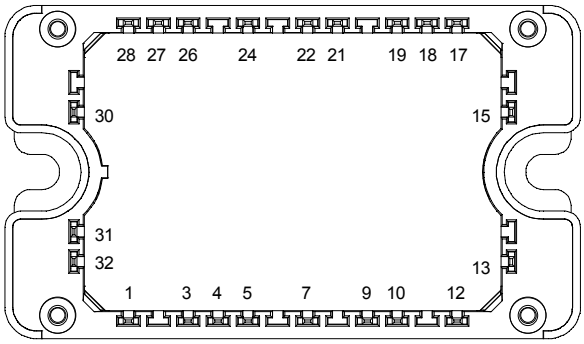
APTC60HM70BT3G

Full – Bridge + boost chopper
CoolMOS Power module





All multiple inputs and outputs must be shorted together
7/24 ; 5/26

CoolMOS™ Q1 to Q4:
V_{DSS} = 600V
R_{DSon} = 70mΩ max @ Tj = 25°C

CoolMOS™ Q5:
V_{DSS} = 600V
R_{DSon} = 45mΩ max @ Tj = 25°C

Application

- Solar converter

Features

- ***CoolMOS™***
  - Ultra low R_{DSon}
  - Low Miller capacitance
  - Ultra low gate charge
  - Avalanche energy rated
- Very low stray inductance
- Kelvin source for easy drive
- Internal thermistor for temperature monitoring
- High level of integration

Benefits

- Optimized conduction & switching losses
- Direct mounting to heatsink (isolated package)
- Low junction to case thermal resistance
- Solderable terminals both for power and signal for easy PCB mounting
- Low profile
- Easy paralleling due to positive T_C of V_{CEsat}
- RoHS Compliant

All ratings @ T_j = 25°C unless otherwise specified

1. Full bridge switches

1.1 CoolMOS™ characteristics (Per CoolMOS™)

Absolute maximum ratings

Symbol	*Parameter*		*Max ratings*	*Unit*
V_{DSS}	Drain - Source Breakdown Voltage		600	V
I_D	Continuous Drain Current	T_c = 25°C	39	A
		T_c = 80°C	29	
I_{DM}	Pulsed Drain current		160	
V_{GS}	Gate - Source Voltage		±20	V
R_{DSon}	Drain - Source ON Resistance		70	mΩ
P_D	Maximum Power Dissipation	T_c = 25°C	250	W
I_{AR}	Avalanche current (repetitive and non repetitive)		20	A
E_{AR}	Repetitive Avalanche Energy		1	mJ
E_{AS}	Single Pulse Avalanche Energy		1800	

CAUTION: These Devices are sensitive to Electrostatic Discharge. Proper Handing Procedures Should Be Followed. See application note APT0502 on www.microsemi.com

Electrical Characteristics

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
I_{DSS}	Zero Gate Voltage Drain Current	V_{GS} = 0V, V_{DS} = 600V	T_j = 25°C			25	µA
		V_{GS} = 0V, V_{DS} = 600V	T_j = 125°C			250	
$R_{DS(on)}$	Drain – Source on Resistance	V_{GS} = 10V, I_D = 39A				70	mΩ
$V_{GS(th)}$	Gate Threshold Voltage	V_{GS} = V_{DS}, I_D = 2.7mA		2.1	3	3.9	V
I_{GSS}	Gate – Source Leakage Current	V_{GS} = ±20 V, V_{DS} = 0V				±100	nA

Dynamic Characteristics

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
C_{iss}	Input Capacitance	V_{GS} = 0V V_{DS} = 25V f = 1MHz			7		nF
C_{oss}	Output Capacitance				2.56		
C_{rss}	Reverse Transfer Capacitance				0.21		
Q_g	Total gate Charge	V_{GS} = 10V V_{Bus} = 300V I_D = 39A			259		nC
Q_{gs}	Gate – Source Charge				29		
Q_{gd}	Gate – Drain Charge				111		
$T_{d(on)}$	Turn-on Delay Time	**Inductive Switching @ 125°C** V_{GS} = 15V V_{Bus} = 400V I_D = 39A R_G = 5Ω			21		ns
T_r	Rise Time				30		
$T_{d(off)}$	Turn-off Delay Time				283		
T_f	Fall Time				84		
E_{off}	Turn-off Switching Energy	V_{GS} = 15V V_{Bus} = 400V I_D = 39A R_G = 5Ω	T_j = 25°C		980		µJ
E_{off}	Turn-off Switching Energy		T_j = 125°C		1206		
R_{thJC}	Junction to Case Thermal resistance					0.5	°C/W

Source - Drain diode ratings and characteristics

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
I_S	Continuous Source current (Body diode)		Tc = 25°C		39		A
			Tc = 80°C		29		
V_{SD}	Diode Forward Voltage	V_{GS} = 0V, I_S = - 39A				1.2	V
dv/dt	Peak Diode Recovery ❶					6	V/ns
t_{rr}	Reverse Recovery Time	I_S = - 39A V_R = 350V di_S/dt = 100A/µs	T_j = 25°C		580		ns
Q_{rr}	Reverse Recovery Charge		T_j = 25°C		23		µC

❶ dv/dt numbers reflect the limitations of the circuit rather than the device itself.
$I_S \le$ - 39A di/dt ≤ 100A/µs $V_R \le V_{DSS}$ $T_j \le$ 150°C

2. Boost chopper Q5, CR5

2.1 Q5 CoolMOS™ characteristics

Absolute maximum ratings

Symbol	*Parameter*		*Max ratings*	*Unit*
V_{DSS}	Drain - Source Breakdown Voltage		600	V
I_D	Continuous Drain Current	T_c = 25°C	49	A
		T_c = 80°C	38	
I_{DM}	Pulsed Drain current		130	
V_{GS}	Gate - Source Voltage		±20	V
R_{DSon}	Drain - Source ON Resistance		45	mΩ
P_D	Maximum Power Dissipation	T_c = 25°C	250	W
I_{AR}	Avalanche current (repetitive and non repetitive)		15	A
E_{AR}	Repetitive Avalanche Energy		3	mJ
E_{AS}	Single Pulse Avalanche Energy		1900	

Electrical Characteristics

Symbol	*Characteristic*	*Test Conditions*		*Min*	*Typ*	*Max*	*Unit*
I_{DSS}	Zero Gate Voltage Drain Current	V_{GS} = 0V, V_{DS} = 600V	T_j = 25°C			250	µA
		V_{GS} = 0V, V_{DS} = 600V	T_j = 125°C			500	
$R_{DS(on)}$	Drain – Source on Resistance	V_{GS} = 10V, I_D = 24.5A			40	45	mΩ
$V_{GS(th)}$	Gate Threshold Voltage	V_{GS} = V_{DS}, I_D = 3mA		2.1	3	3.9	V
I_{GSS}	Gate – Source Leakage Current	V_{GS} = ±20 V, V_{DS} = 0V				100	nA

Dynamic Characteristics

Symbol	*Characteristic*	*Test Conditions*	*Min*	*Typ*	*Max*	*Unit*
C_{iss}	Input Capacitance	V_{GS} = 0V ; V_{DS} = 25V f = 1MHz		7.2		nF
C_{oss}	Output Capacitance			8.5		
Q_g	Total gate Charge	V_{GS} = 10V V_{Bus} = 300V I_D = 49A		150		nC
Q_{gs}	Gate – Source Charge			34		
Q_{gd}	Gate – Drain Charge			51		
$T_{d(on)}$	Turn-on Delay Time	**Inductive Switching (125°C)** V_{GS} = 10V V_{Bus} = 400V I_D = 49A R_G = 5Ω		21		ns
T_r	Rise Time			30		
$T_{d(off)}$	Turn-off Delay Time			100		
T_f	Fall Time			45		
E_{on}	Turn-on Switching Energy	**Inductive switching @ 25°C** V_{GS} = 10V ; V_{Bus} = 400V I_D = 49A ; R_G = 5Ω		675		µJ
E_{off}	Turn-off Switching Energy			520		
E_{on}	Turn-on Switching Energy	**Inductive switching @ 125°C** V_{GS} = 10V ; V_{Bus} = 400V I_D = 49A ; R_G = 5Ω		1096		µJ
E_{off}	Turn-off Switching Energy			635		
R_{thJC}	Junction to Case Thermal resistance				0.5	°C/W

Source - Drain diode ratings and characteristics

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
I_S	Continuous Source current (Body diode)		Tc = 25°C		49		A
			Tc = 80°C		38		
V_{SD}	Diode Forward Voltage	V_{GS} = 0V, I_S = - 49A				1.2	V
dv/dt	Peak Diode Recovery ❶					4	V/ns
t_{rr}	Reverse Recovery Time	I_S = - 49A V_R = 350V di_S/dt = 100A/µs	T_j = 25°C		600		ns
Q_{rr}	Reverse Recovery Charge		T_j = 25°C		17		µC

❶ dv/dt numbers reflect the limitations of the circuit rather than the device itself.
$I_S \leq$ - 49A di/dt ≤ 100A/µs $V_R \leq V_{DSS}$ $T_j \leq$ 150°C

2.2 Chopper diode characteristics (CR5)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
V_{RRM}	Maximum Peak Repetitive Reverse Voltage			600			V
I_{RM}	Maximum Reverse Leakage Current	V_R=600V	T_j = 25°C			25	µA
			T_j = 125°C			500	
I_F	DC Forward Current		Tc = 80°C		30		A
V_F	Diode Forward Voltage	I_F = 30A			1.8	2.2	V
		I_F = 60A			2.2		
		I_F = 30A	T_j = 125°C		1.5		
t_{rr}	Reverse Recovery Time	I_F = 30A V_R = 400V di/dt =200A/µs	T_j = 25°C		25		ns
			T_j = 125°C		160		
Q_{rr}	Reverse Recovery Charge		T_j = 25°C		35		nC
			T_j = 125°C		480		
R_{thJC}	Junction to Case Thermal resistance					1.2	°C/W

3. By pass diode (CR6)

Absolute maximum ratings

Symbol	Parameter			Max ratings	Unit
V_R	Maximum DC reverse Voltage			1600	V
V_{RRM}	Maximum Peak Repetitive Reverse Voltage				
I_F	DC Forward Current		T_C = 80°C	40	A
I_{FSM}	Non-Repetitive Forward Surge Current	t=10ms	T_J = 45°C	400	

Electrical Characteristics

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
I_R	Reverse Current	V_R = 1600V	T_j = 25°C		20		µA
			T_j = 125°C		2		mA
V_F	Forward Voltage	I_F = 40A	T_j = 25°C		1.3		V
			T_j = 125°C		1.1		
V_T	On – state Voltage				0.8		V
r_T	On – state Slope resistance				10.5		mΩ
R_{thJC}	Junction to Case Thermal resistance					1.5	°C/W

4. Temperature sensor

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		%

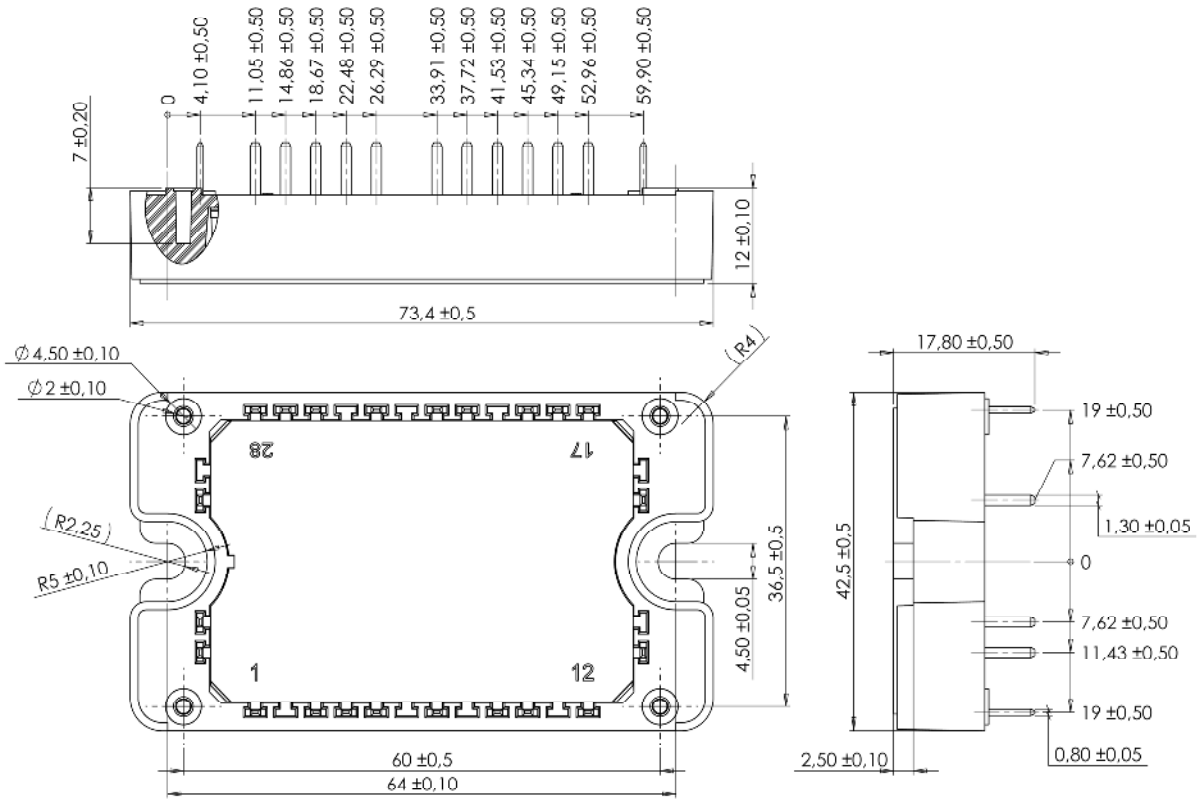
$$R_T = \frac{R_{25}}{\exp\left[B_{25/85}\left(\frac{1}{T_{25}} - \frac{1}{T}\right)\right]}$$

T: Thermistor temperature
R_T: Thermistor value at T

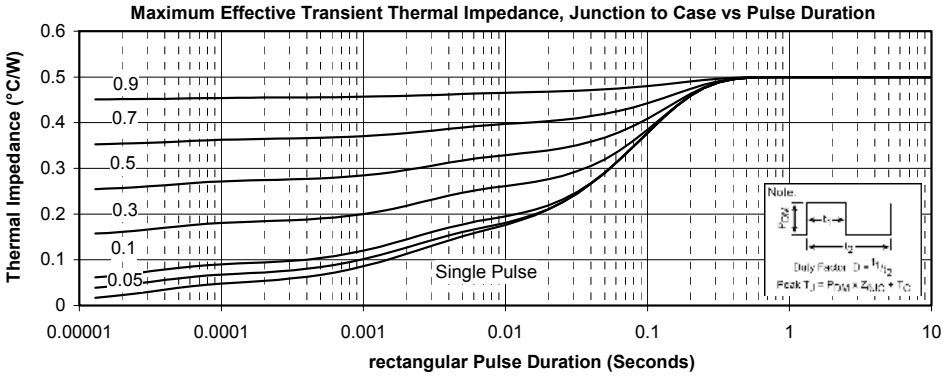
5. Package characteristics

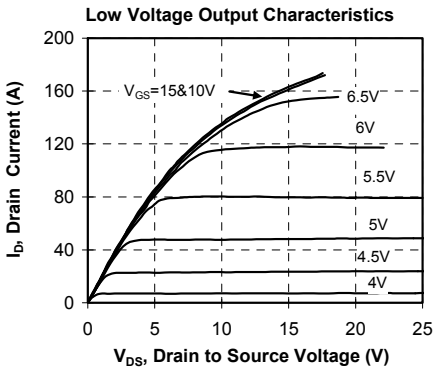
Symbol	*Characteristic*			*Min*	*Typ*	*Max*	*Unit*
V_{ISOL}	RMS Isolation Voltage, any terminal to case t =1 min, 50/60Hz			4000			V
T_J	Operating junction temperature range			-40		150	°C
T_{STG}	Storage Temperature Range			-40		125	
T_C	Operating Case Temperature			-40		100	
Torque	Mounting torque	To heatsink	M4	2		3	N.m
Wt	Package Weight					110	g

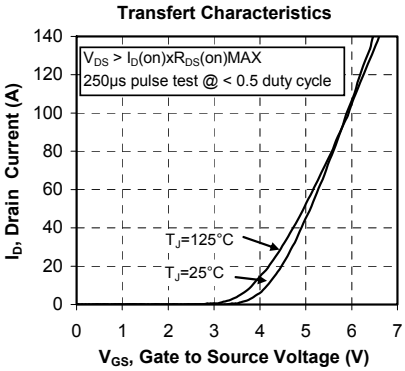
6. SP3F Package outline (dimensions in mm)

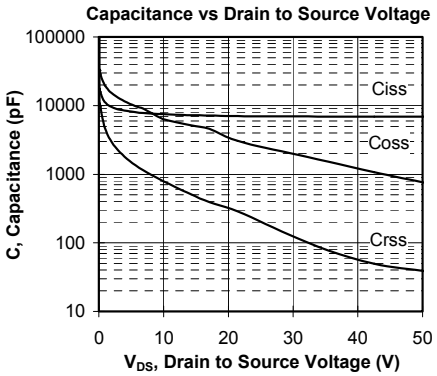


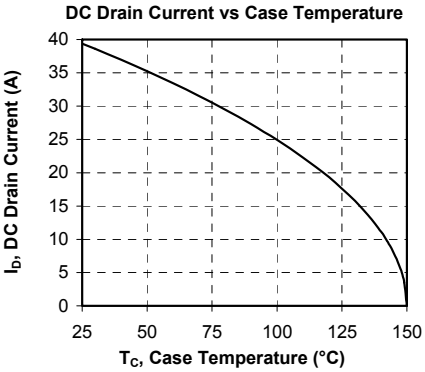
7. Full bridge switches curves (Per CoolMOS™)

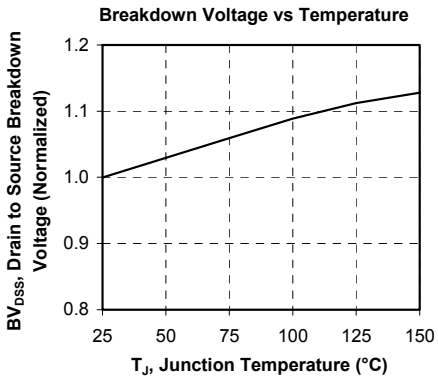


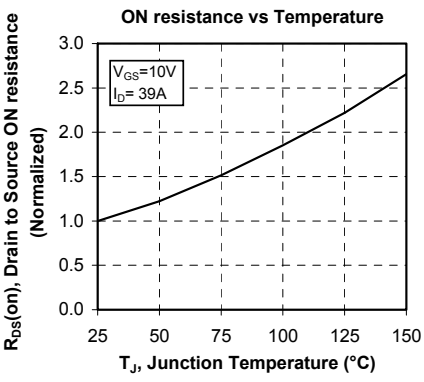




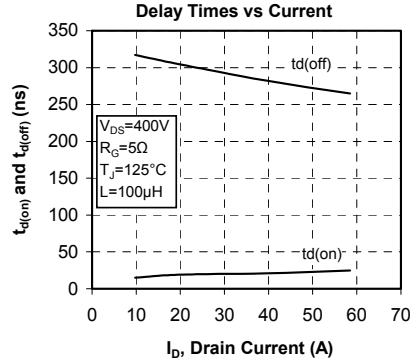




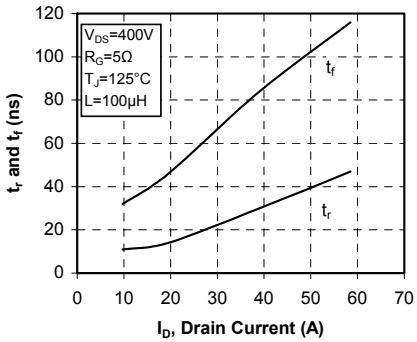




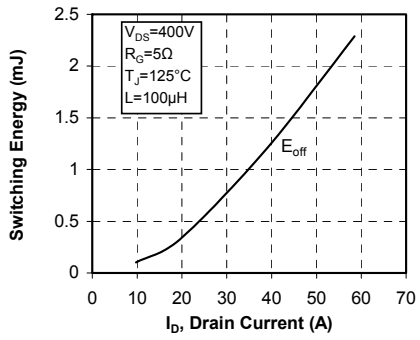
Delay Times vs Current



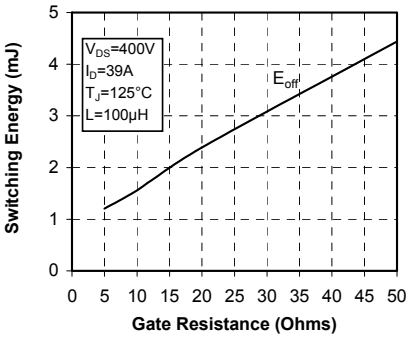
Rise and Fall times vs Current



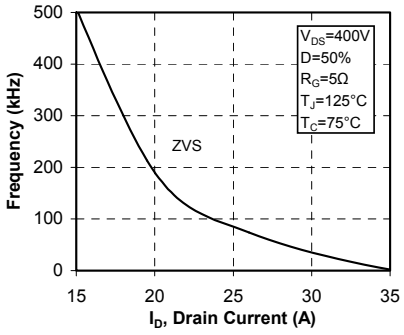
Switching Energy vs Current



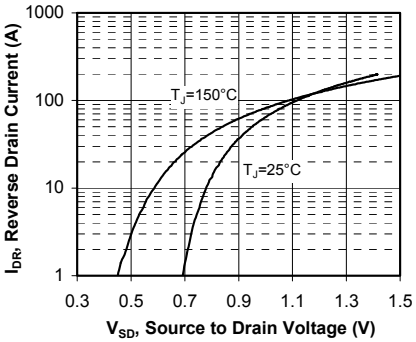
Switching Energy vs Gate Resistance



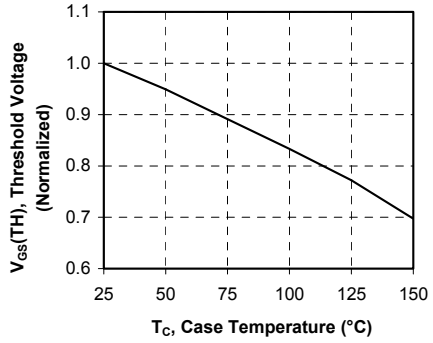
Operating Frequency vs Drain Current



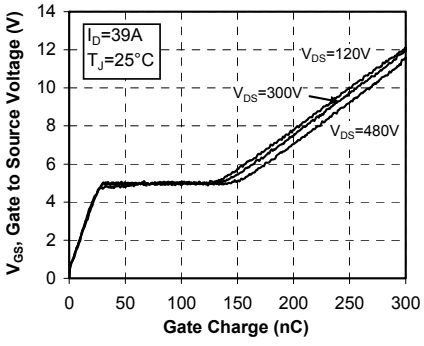
Source to Drain Diode Forward Voltage



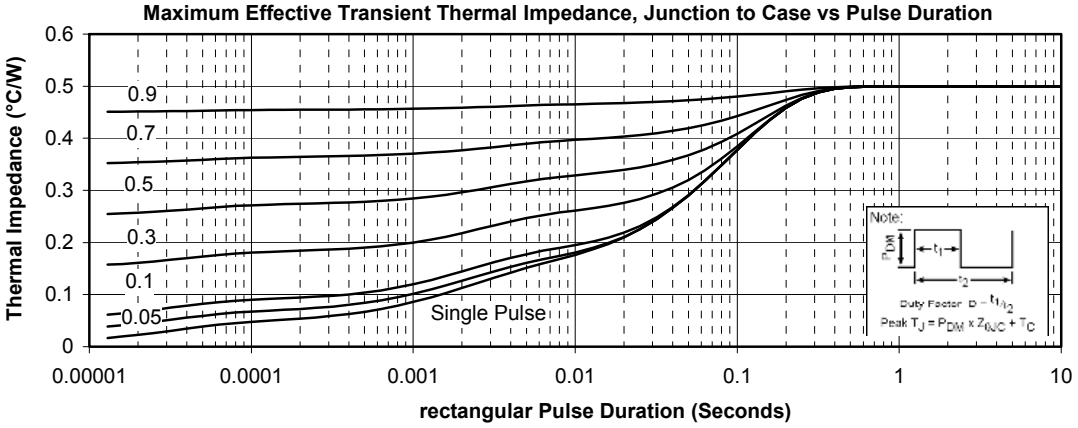
Threshold Voltage vs Temperature

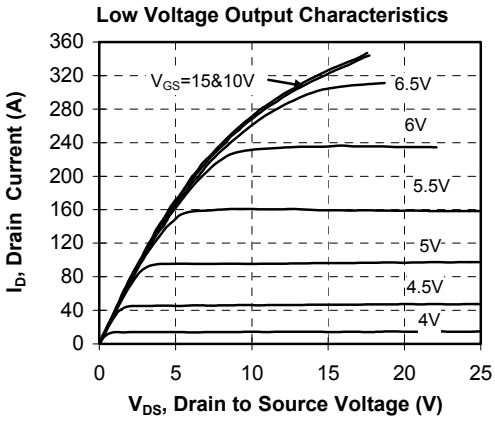


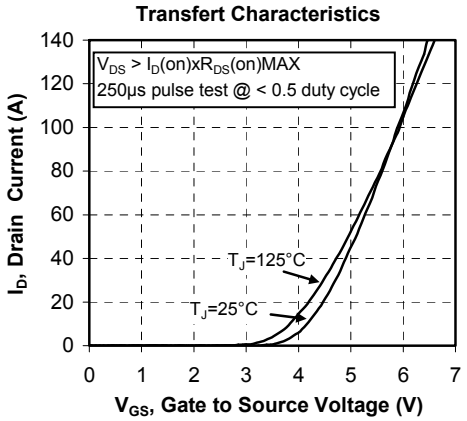
Gate Charge vs Gate to Source Voltage

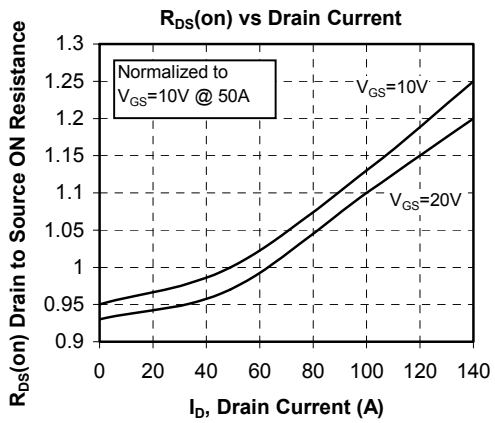


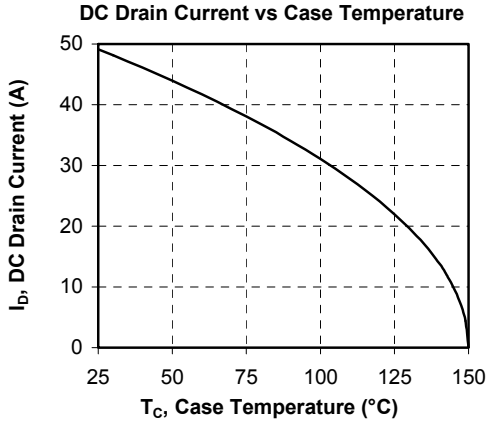
8. Chopper CoolMOS™



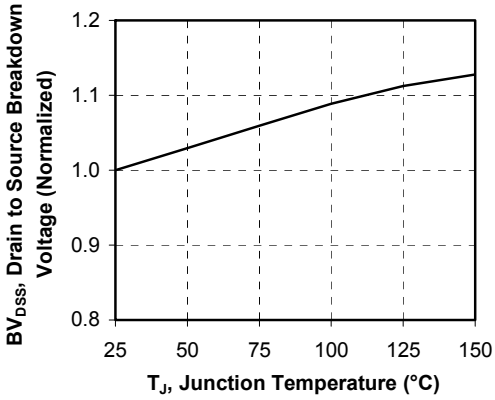




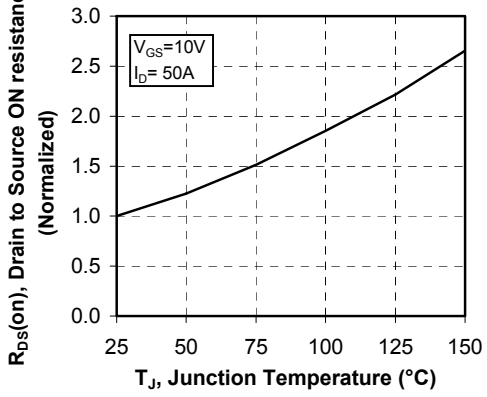




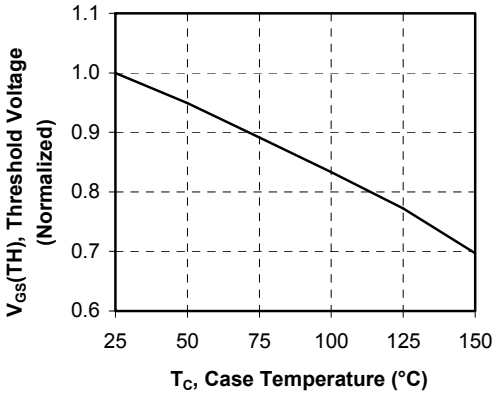
Breakdown Voltage vs Temperature



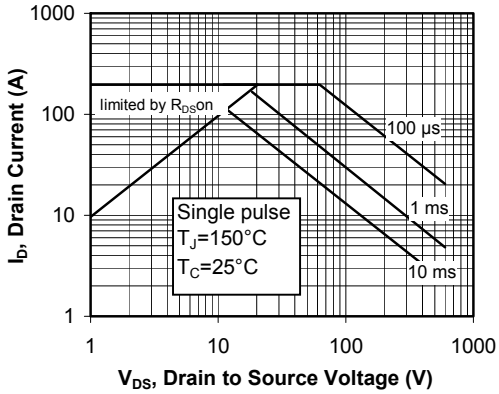
ON resistance vs Temperature



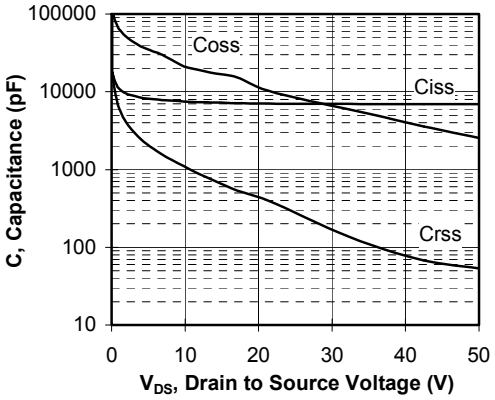
Threshold Voltage vs Temperature



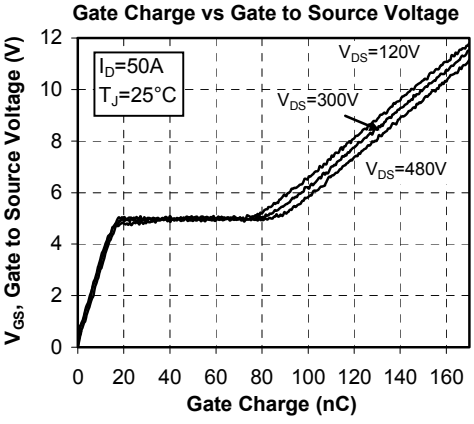
Maximum Safe Operating Area



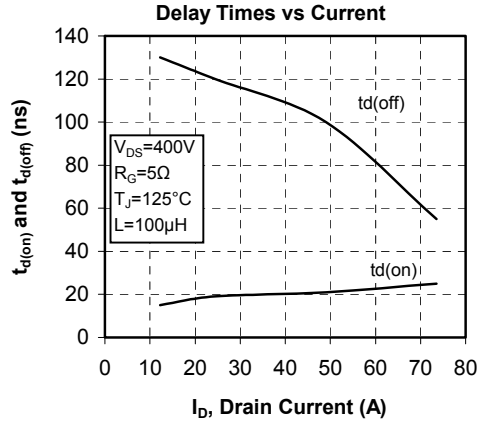
Capacitance vs Drain to Source Voltage



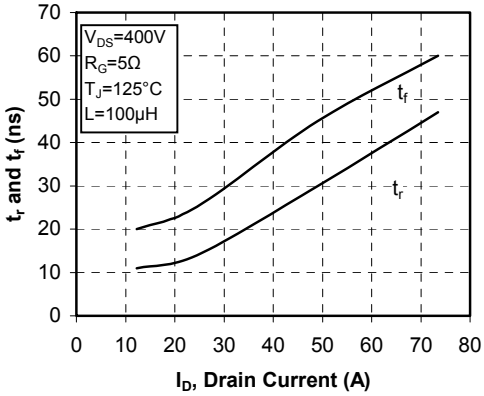
Gate Charge vs Gate to Source Voltage



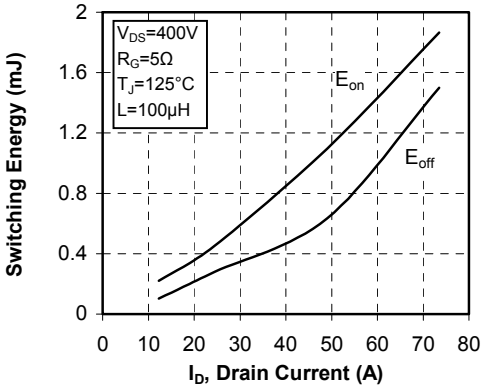
Delay Times vs Current



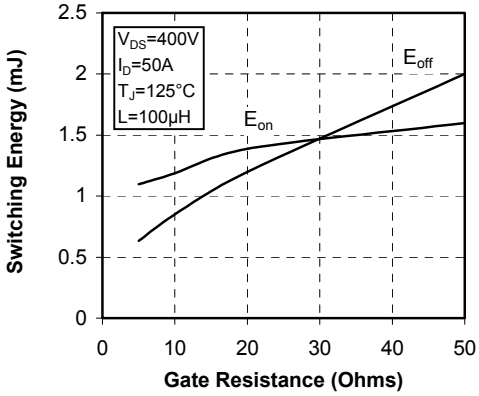
Rise and Fall times vs Current



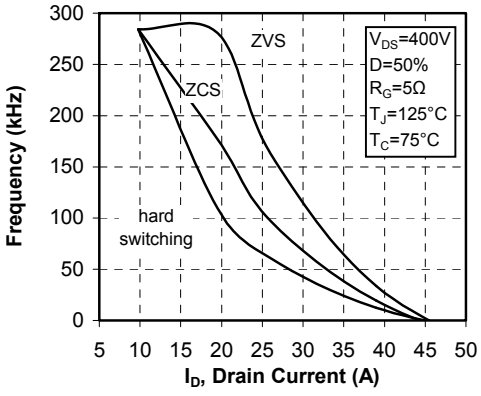
Switching Energy vs Current



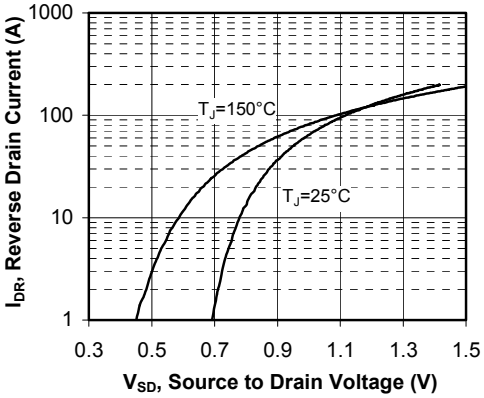
Switching Energy vs Gate Resistance



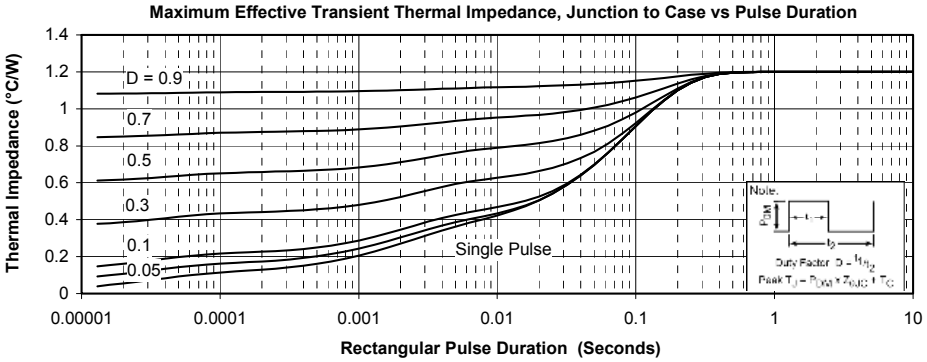
Operating Frequency vs Drain Current

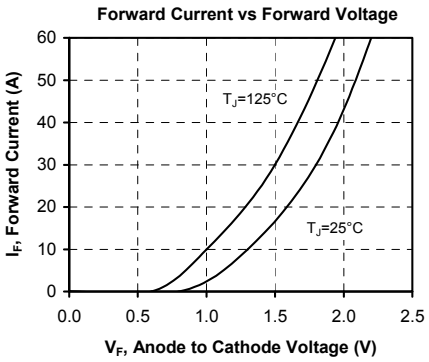


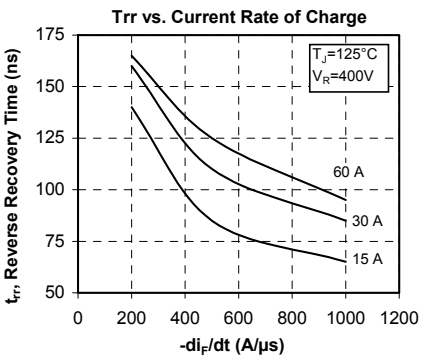
Source to Drain Diode Forward Voltage

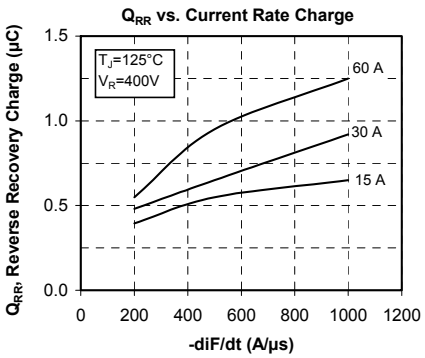


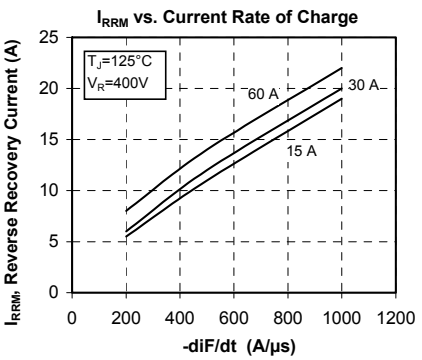
9. Chopper diode curves

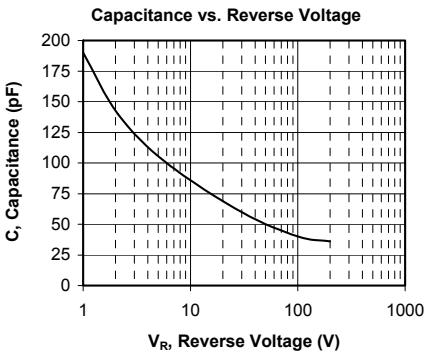




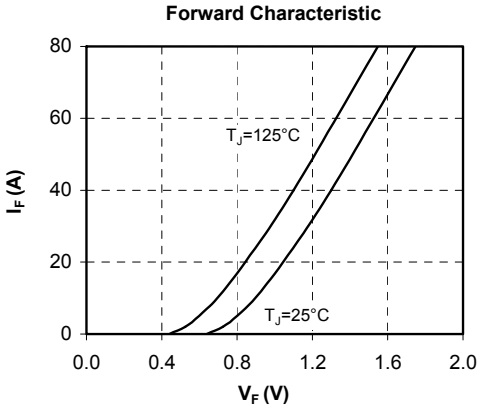


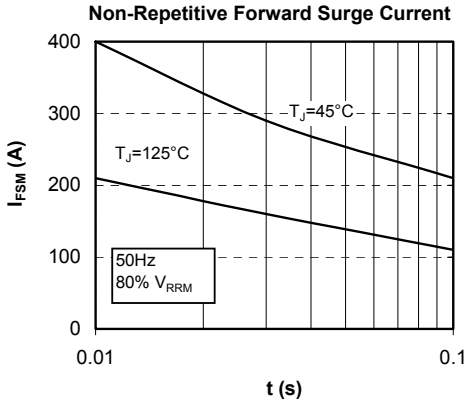


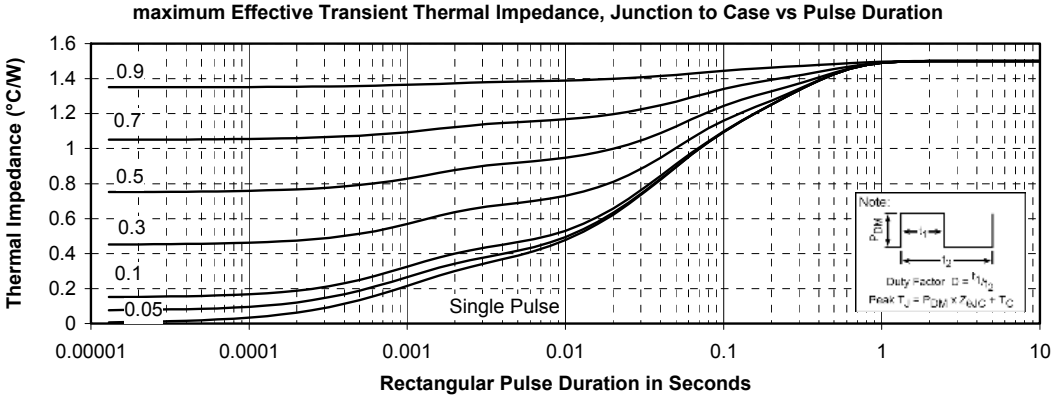




10. Typical by pass CR6 diode curves







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