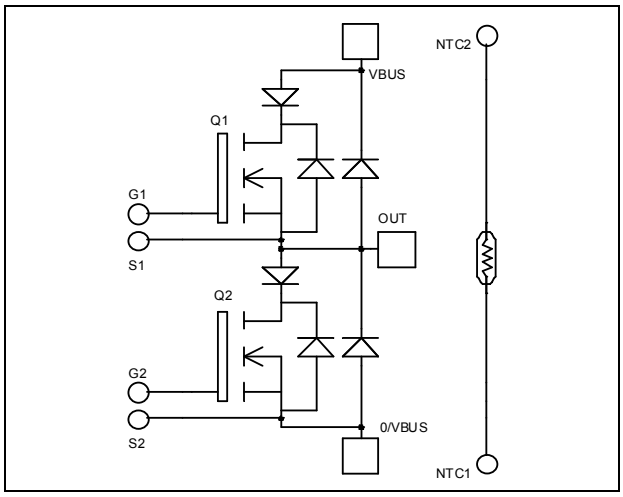
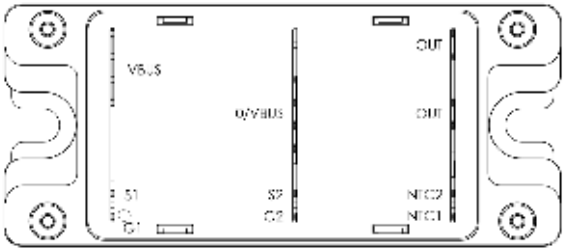
APTM100A23STG

Phase leg
Series & parallel diodes
MOSFET Power Module

V_{DSS} = 1000V
R_{DSon} = 230mΩ typ @ Tj = 25°C
I_D = 36A @ Tc = 25°C





Application
- Motor control
- Switched Mode Power Supplies
- Uninterruptible Power Supplies

Features
- Power MOS 7® MOSFETs
  - Low R_{DSon}
  - Low input and Miller capacitance
  - Low gate charge
  - Avalanche energy rated
  - Very rugged
- Kelvin source for easy drive
- Very low stray inductance
  - Symmetrical design
  - Lead frames for power connections
- Internal thermistor for temperature monitoring
- High level of integration

Benefits
- Outstanding performance at high frequency operation
- 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
- RoHS Compliant

All ratings @ T_j = 25°C unless otherwise specified

Absolute maximum ratings

Symbol	*Parameter*		*Max ratings*	*Unit*
V_{DSS}	Drain - Source Breakdown Voltage		1000	V
I_D	Continuous Drain Current	T_c = 25°C	36	A
		T_c = 80°C	27	
I_{DM}	Pulsed Drain current		144	
V_{GS}	Gate - Source Voltage		±30	V
R_{DSon}	Drain - Source ON Resistance		270	mΩ
P_D	Maximum Power Dissipation	T_c = 25°C	694	W
I_{AR}	Avalanche current (repetitive and non repetitive)		18	A
E_{AR}	Repetitive Avalanche Energy		50	mJ
E_{AS}	Single Pulse Avalanche Energy		2500	

CAUTION: These Devices are sensitive to Electrostatic Discharge. Proper Handling 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}= 1000V	T_j = 25°C			200	µA
		V_{GS} = 0V, V_{DS}= 800V	T_j = 125°C			1000	
$R_{DS(on)}$	Drain – Source on Resistance	V_{GS} = 10V, I_D = 18A			230	270	mΩ
$V_{GS(th)}$	Gate Threshold Voltage	V_{GS} = V_{DS}, I_D = 5mA		3		5	V
I_{GSS}	Gate – Source Leakage Current	V_{GS} = ±30 V, V_{DS} = 0V				±150	nA

Dynamic Characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
C_{iss}	Input Capacitance	V_{GS} = 0V V_{DS} = 25V f = 1MHz		8700		pF
C_{oss}	Output Capacitance			1430		
C_{rss}	Reverse Transfer Capacitance			240		
Q_g	Total gate Charge	V_{GS} = 10V V_{Bus} = 500V I_D = 36A		308		nC
Q_{gs}	Gate – Source Charge			52		
Q_{gd}	Gate – Drain Charge			194		
$T_{d(on)}$	Turn-on Delay Time	**Inductive switching @ 125°C** V_{GS} = 15V V_{Bus} = 667V I_D = 36A R_G = 2.5Ω		10		ns
T_r	Rise Time			12		
$T_{d(off)}$	Turn-off Delay Time			121		
T_f	Fall Time			35		
E_{on}	Turn-on Switching Energy	**Inductive switching @ 25°C** V_{GS} = 15V, V_{Bus} = 667V I_D = 36A, R_G = 2.5Ω		1278		µJ
E_{off}	Turn-off Switching Energy			760		
E_{on}	Turn-on Switching Energy	**Inductive switching @ 125°C** V_{GS} = 15V, V_{Bus} = 667V I_D = 36A, R_G = 2.5Ω		2092		µJ
E_{off}	Turn-off Switching Energy			902		
R_{thJC}	Junction to Case Thermal Resistance				0.18	°C/W

Series 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				500	µA
I_F	DC Forward Current		T_c = 65°C		90		A
V_F	Diode Forward Voltage	I_F = 90A			1.9	2.3	V
		I_F = 180A			2.2		
		I_F = 90A	T_j = 125°C		1.7		
t_{rr}	Reverse Recovery Time	I_F = 90A V_R = 667V di/dt = 400A/µs	T_j = 25°C		290		ns
			T_j = 125°C		390		
Q_{rr}	Reverse Recovery Charge		T_j = 25°C		2010		nC
			T_j = 125°C		7050		
R_{thJC}	Junction to Case Thermal Resistance					0.45	°C/W

Parallel 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				150	µA
I_F	DC Forward Current		T_c = 80°C		80		A
V_F	Diode Forward Voltage	I_F = 80A			2.5	3.5	V
		I_F = 140A			3.1		
		I_F = 80A	T_j = 125°C		2		
t_{rr}	Reverse Recovery Time	I_F = 80A V_R = 667V di/dt = 400A/µs	T_j = 25°C		250		ns
			T_j = 125°C		315		
Q_{rr}	Reverse Recovery Charge		T_j = 25°C		830		nC
			T_j = 125°C		3300		
R_{thJC}	Junction to Case Thermal Resistance					0.65	°C/W

Thermal and 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	M5	2.5		4.7	N.m
Wt	Package Weight					160	g

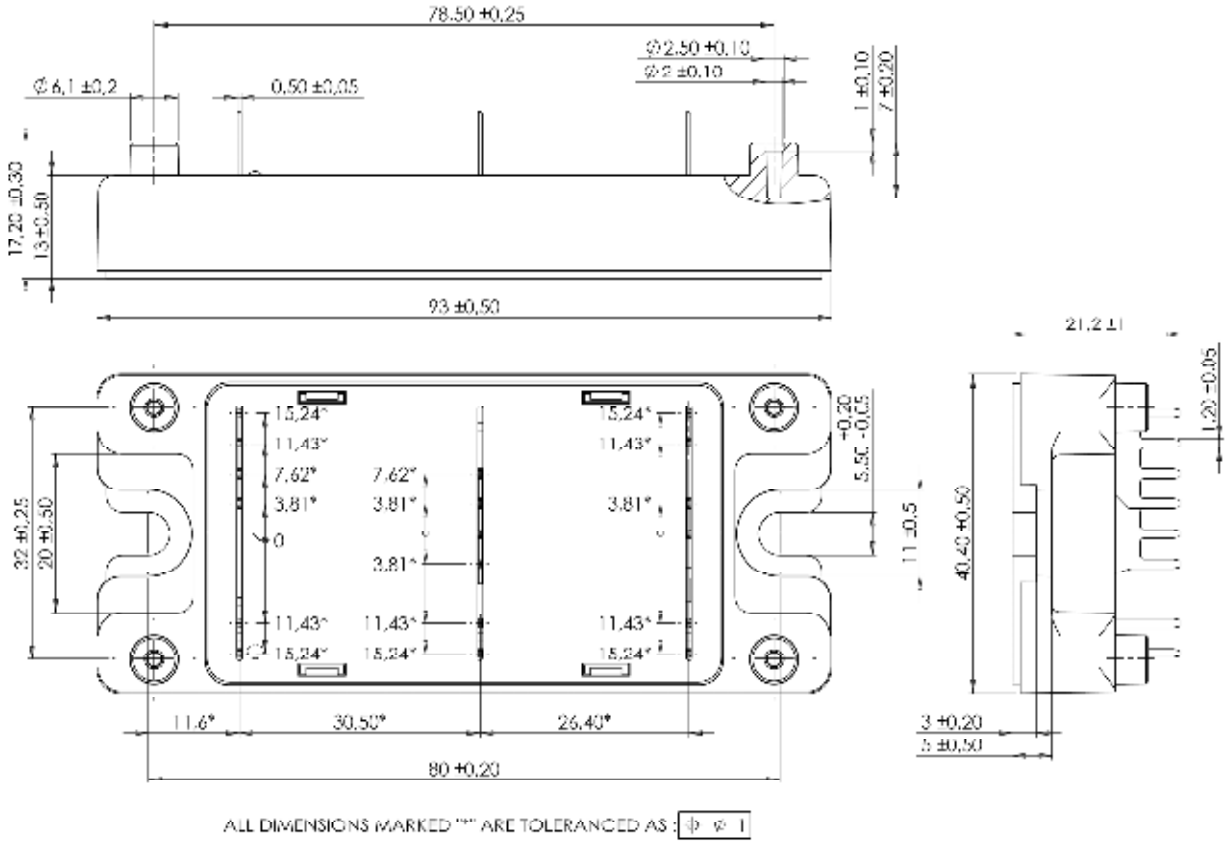
Temperature sensor NTC (see application note APT0406 on www.microsemi.com).

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
$\Delta B/B$		T_C=100°C		4		%

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

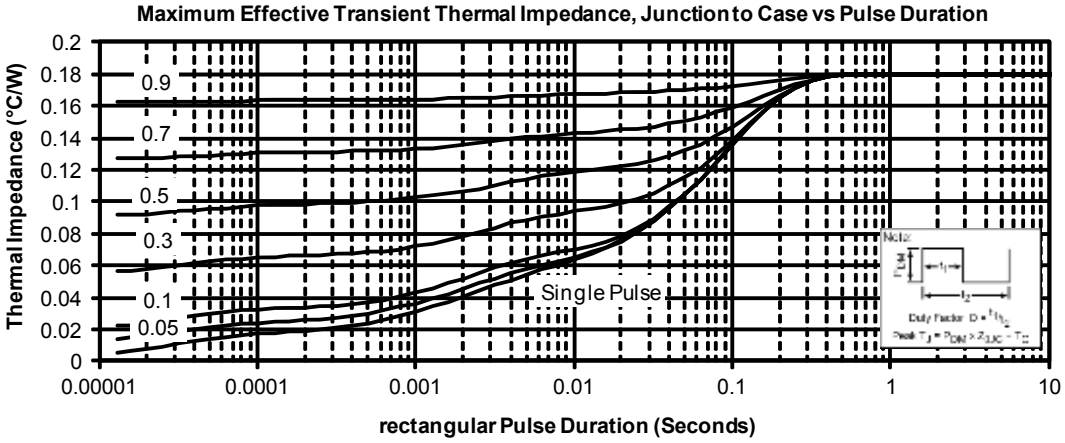
T: Thermistor temperature
R_T: Thermistor value at T

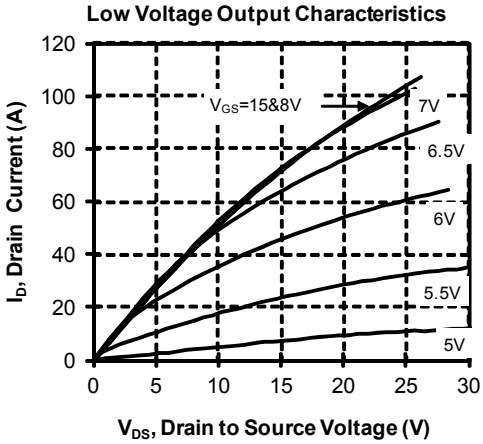
SP4 Package outline (dimensions in mm)

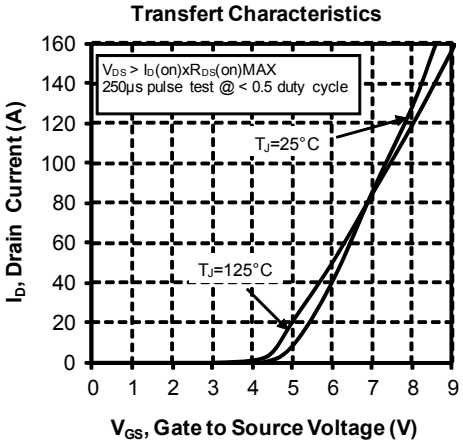


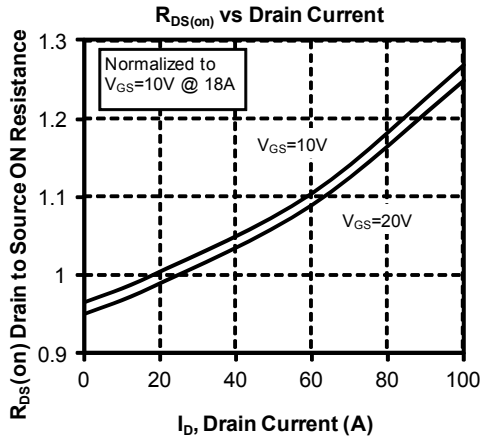
See application note APT0501 - Mounting Instructions for SP4 Power Modules on www.microsemi.com

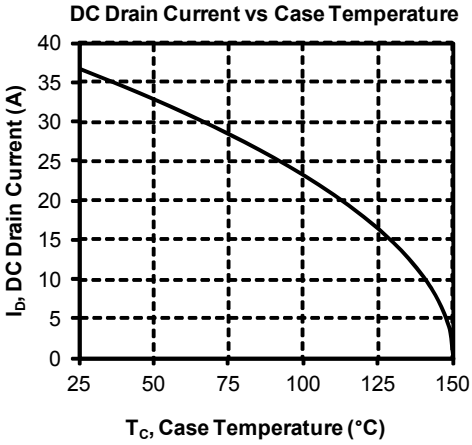
Typical Performance Curve

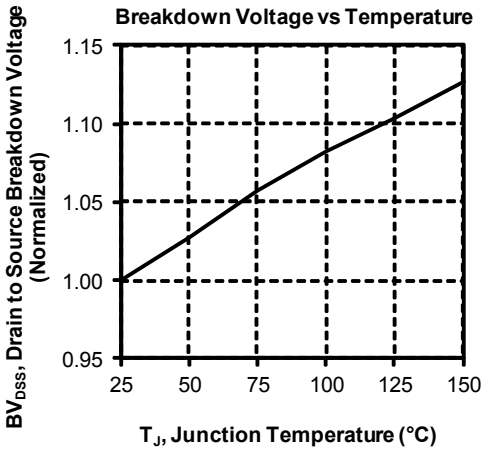


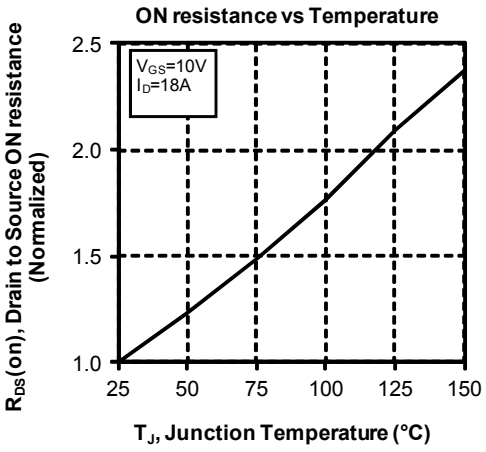


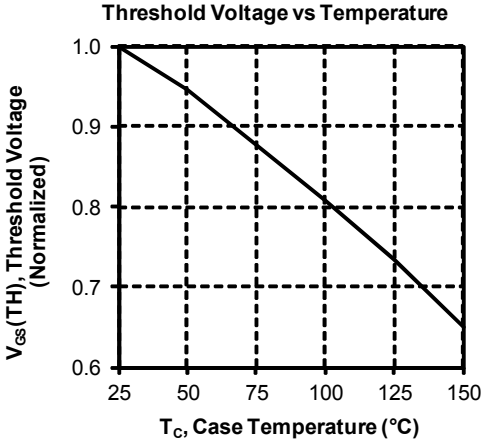


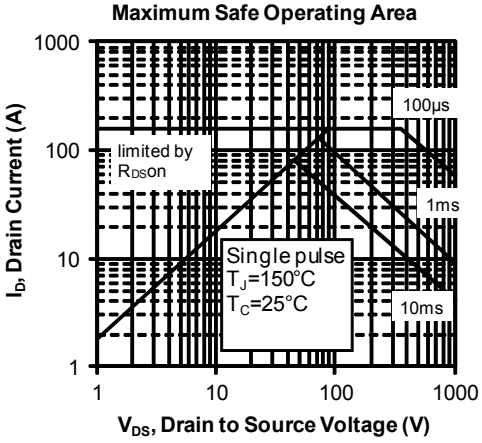


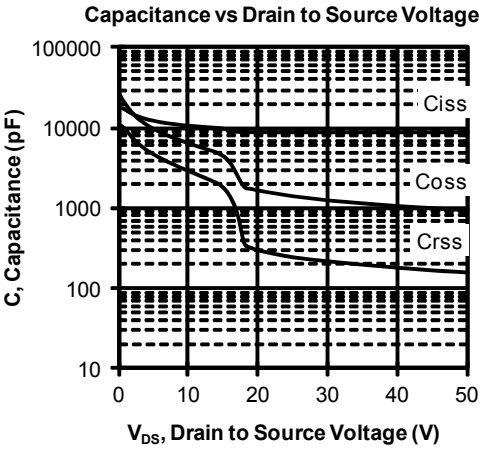


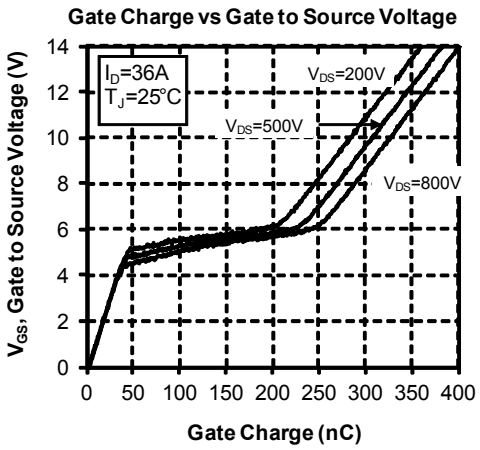

Breakdown Voltage vs Temperature
BVDSS, Drain to Source Breakdown Voltage (Normalized)
1.15
1.10
1.05
1.00
0.95
25 50 75 100 125 150
TJ, Junction Temperature (°C)

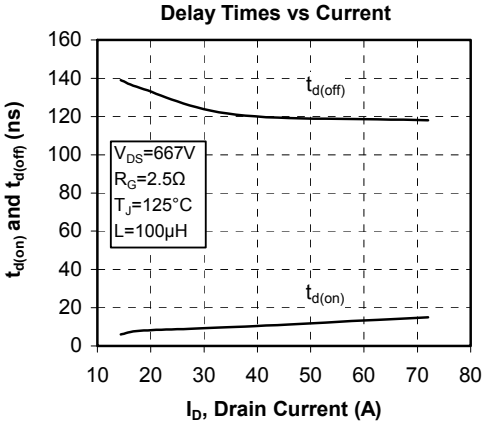

ON resistance vs Temperature
RDS(on), Drain to Source ON resistance (Normalized)
VGS=10V
ID=18A
2.5
2.0
1.5
1.0
25 50 75 100 125 150
TJ, Junction Temperature (°C)

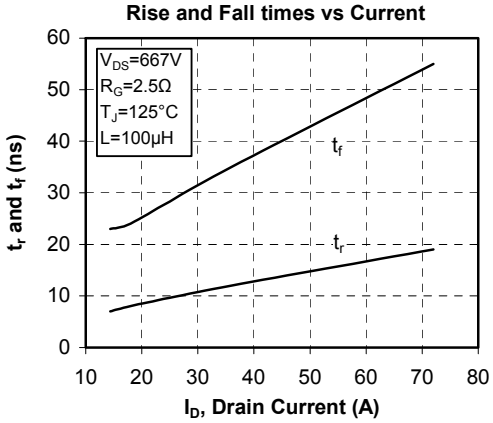

Threshold Voltage vs Temperature
VGS(TH), Threshold Voltage (Normalized)
1.0
0.9
0.8
0.7
0.6
25 50 75 100 125 150
TC, Case Temperature (°C)

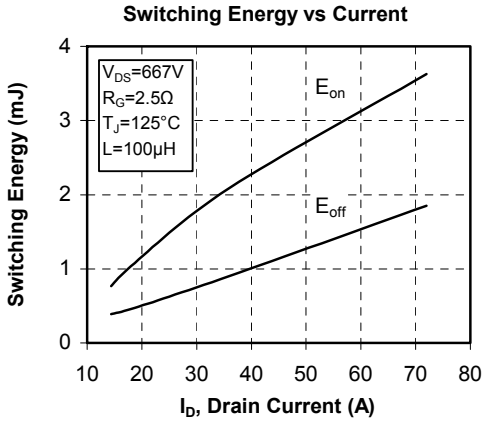

Maximum Safe Operating Area
ID, Drain Current (A)
1000
100
10
1
limited by RDSon
100µs
1ms
10ms
Single pulse
TJ=150°C
TC=25°C
1 10 100 1000
VDS, Drain to Source Voltage (V)

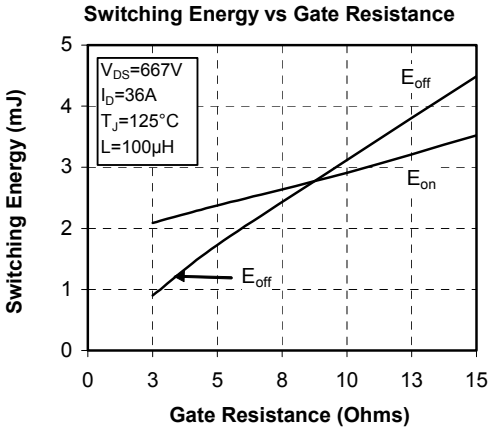

Capacitance vs Drain to Source Voltage
C, Capacitance (pF)
100000
10000
1000
100
10
Ciss
Coss
Crss
0 10 20 30 40 50
VDS, Drain to Source Voltage (V)

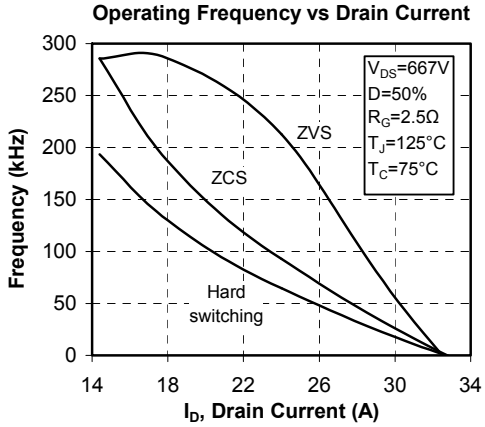

Gate Charge vs Gate to Source Voltage
VGS, Gate to Source Voltage (V)
ID=36A
TJ=25°C
VDS=200V
VDS=500V
VDS=800V
14
12
10
8
6
4
2
0
0 50 100 150 200 250 300 350 400
Gate Charge (nC)

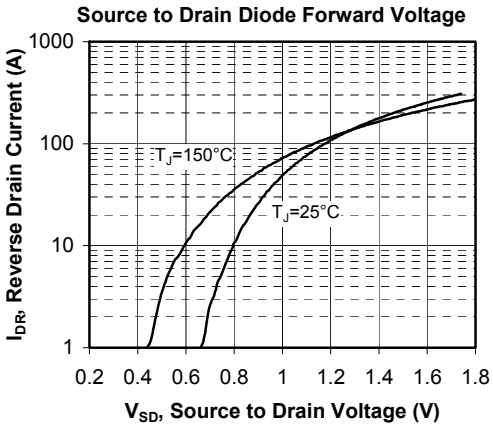

Delay Times vs Current
$t_{d(on)}$ and $t_{d(off)}$ (ns)
I_D, Drain Current (A)
$t_{d(off)}$
$t_{d(on)}$
V_{DS}=667V
R_G=2.5Ω
T_J=125°C
L=100µH


Rise and Fall times vs Current
t_r and t_f (ns)
I_D, Drain Current (A)
t_f
t_r
V_{DS}=667V
R_G=2.5Ω
T_J=125°C
L=100µH


Switching Energy vs Current
Switching Energy (mJ)
I_D, Drain Current (A)
E_{on}
E_{off}
V_{DS}=667V
R_G=2.5Ω
T_J=125°C
L=100µH


Switching Energy vs Gate Resistance
Switching Energy (mJ)
Gate Resistance (Ohms)
E_{off}
E_{on}
E_{off}
V_{DS}=667V
I_D=36A
T_J=125°C
L=100µH


Operating Frequency vs Drain Current
Frequency (kHz)
I_D, Drain Current (A)
ZVS
ZCS
Hard switching
V_{DS}=667V
D=50%
R_G=2.5Ω
T_J=125°C
T_C=75°C


Source to Drain Diode Forward Voltage
I_{DR}, Reverse Drain Current (A)
V_{SD}, Source to Drain Voltage (V)
T_J=150°C
T_J=25°C

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