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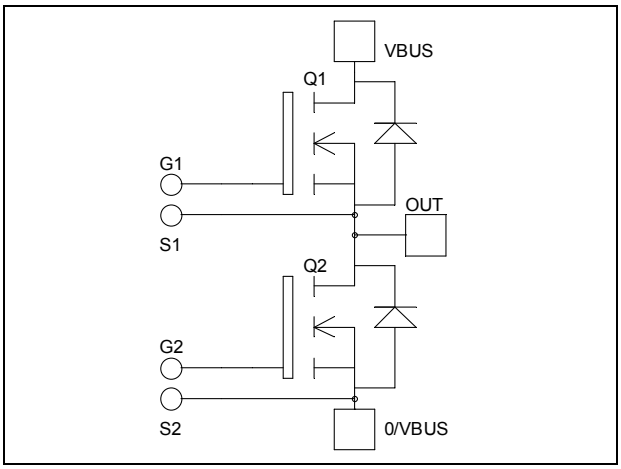
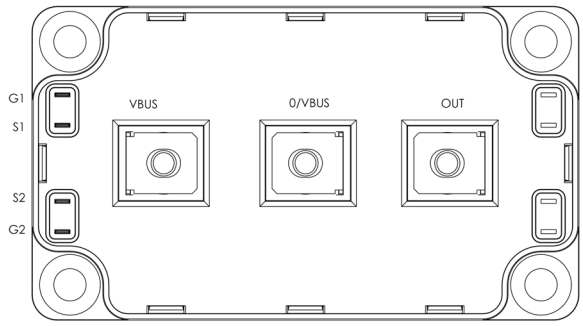
Phase leg MOSFET Power Module

V_{DSS} = 200V
R_{DSon} = 4mΩ typ @ Tj = 25°C
I_D = 372A @ Tc = 25°C





Application

- Welding converters
- Switched Mode Power Supplies
- Uninterruptible Power Supplies
- Motor control

Features

- Power MOS 7® FREDFETs
  - Low R_{DSon}
  - Low input and Miller capacitance
  - Low gate charge
  - Fast intrinsic reverse diode
  - Avalanche energy rated
  - Very rugged
- Kelvin source for easy drive
- Very low stray inductance
  - Symmetrical design
  - M5 power connectors
- High level of integration

Benefits

- Outstanding performance at high frequency operation
- Direct mounting to heatsink (isolated package)
- Low junction to case thermal resistance
- Low profile
- RoHS Compliant

Absolute maximum ratings

Symbol	*Parameter*		*Max ratings*	*Unit*
V_{DSS}	Drain - Source Breakdown Voltage		200	V
I_D	Continuous Drain Current	T_c = 25°C	372	A
		T_c = 80°C	278	
I_{DM}	Pulsed Drain current		1488	
V_{GS}	Gate - Source Voltage		±30	V
R_{DSon}	Drain - Source ON Resistance		5	mΩ
P_D	Maximum Power Dissipation	T_c = 25°C	1250	W
I_{AR}	Avalanche current (repetitive and non repetitive)		100	A
E_{AR}	Repetitive Avalanche Energy		50	mJ
E_{AS}	Single Pulse Avalanche Energy		3000	

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

All ratings @ T_j = 25°C unless otherwise specified

Electrical Characteristics

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
I_{DSS}	Zero Gate Voltage Drain Current	V_{GS} = 0V, V_{DS} = 200V	T_j = 25°C			500	µA
		V_{GS} = 0V, V_{DS} = 160V	T_j = 125°C			2000	
$R_{DS(on)}$	Drain – Source on Resistance	V_{GS} = 10V, I_D = 186A			4	5	mΩ
$V_{GS(th)}$	Gate Threshold Voltage	V_{GS} = V_{DS}, I_D = 10mA		3		5	V
I_{GSS}	Gate – Source Leakage Current	V_{GS} = ±30 V, V_{DS} = 0V				±200	nA

Dynamic Characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
C_{iss}	Input Capacitance	V_{GS} = 0V V_{DS} = 25V f = 1MHz		28.9		nF
C_{oss}	Output Capacitance			9.32		
C_{rss}	Reverse Transfer Capacitance			0.58		
Q_g	Total gate Charge	V_{GS} = 10V V_{Bus} = 100V I_D = 372A		560		nC
Q_{gs}	Gate – Source Charge			212		
Q_{gd}	Gate – Drain Charge			268		
$T_{d(on)}$	Turn-on Delay Time	**Inductive switching @ 125°C** V_{GS} = 15V V_{Bus} = 133V I_D = 372A R_G = 1.2Ω		32		ns
T_r	Rise Time			64		
$T_{d(off)}$	Turn-off Delay Time			88		
T_f	Fall Time			116		
E_{on}	Turn-on Switching Energy	**Inductive switching @ 25°C** V_{GS} = 15V, V_{Bus} = 133V I_D = 372A, R_G = 1.2Ω		3396		µJ
E_{off}	Turn-off Switching Energy			3716		
E_{on}	Turn-on Switching Energy	**Inductive switching @ 125°C** V_{GS} = 15V, V_{Bus} = 133V I_D = 372A, R_G = 1.2Ω		3744		µJ
E_{off}	Turn-off Switching Energy			3944		

Source - Drain diode ratings and characteristics

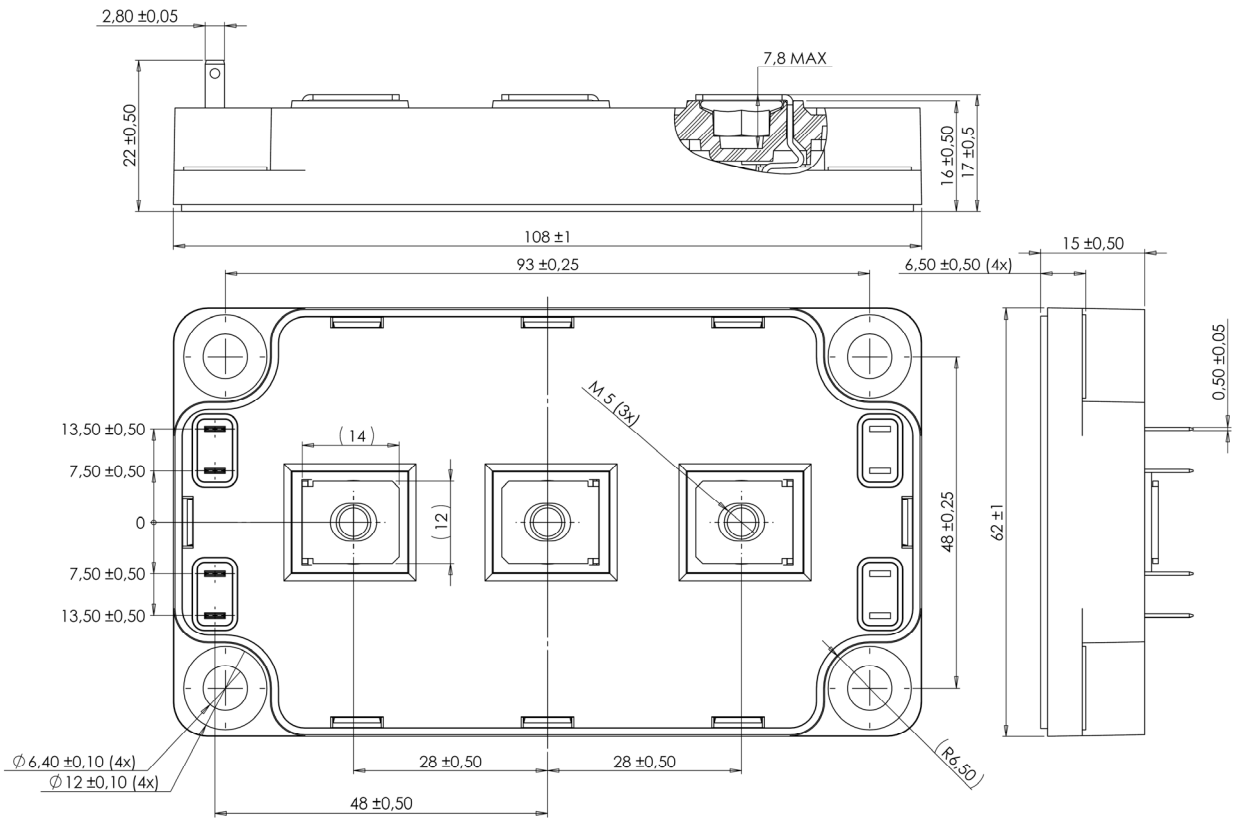
Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
I_S	Continuous Source current (Body diode)		Tc = 25°C			372	A
			Tc = 80°C			278	
V_{SD}	Diode Forward Voltage	V_{GS} = 0V, I_S = - 372A				1.3	V
dv/dt	Peak Diode Recovery ❶					5	V/ns
t_{rr}	Reverse Recovery Time	I_S = -372A V_R = 133V di_S/dt = 400A/µs	T_j = 25°C			230	ns
			T_j = 125°C			450	
Q_{rr}	Reverse Recovery Charge	I_S = -372A V_R = 133V di_S/dt = 400A/µs	T_j = 25°C		3.6		µC
			T_j = 125°C		13.6		

❶ dv/dt numbers reflect the limitations of the circuit rather than the device itself.
$I_S \leq$ - 372A di/dt ≤ 700A/µs $V_R \leq V_{DSS}$ $T_j \leq$ 150°C

Thermal and package characteristics

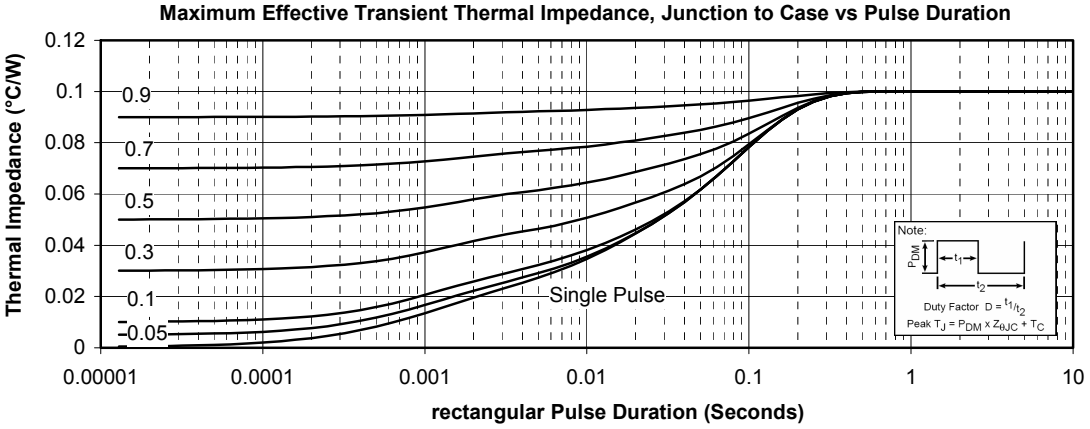
Symbol	Characteristic			Min	Typ	Max	Unit
R_{thJC}	Junction to Case Thermal Resistance					0.1	°C/W
V_{ISOL}	RMS Isolation Voltage, any terminal to case t =1 min, 50/60Hz			4000			V
T_J	Operating junction temperature range			-40		150	°C
T_{STG}	Storage Temperature Range			-40		125	°C
T_C	Operating Case Temperature			-40		100	°C
Torque	Mounting torque	To heatsink	M6	3		5	N.m
		For terminals	M5	2		3.5	N.m
Wt	Package Weight					300	g

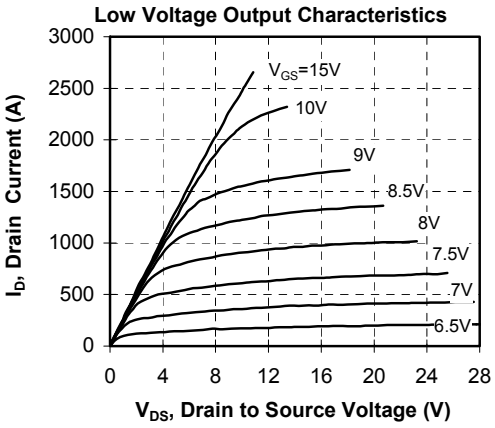
SP6 Package outline (dimensions in mm)

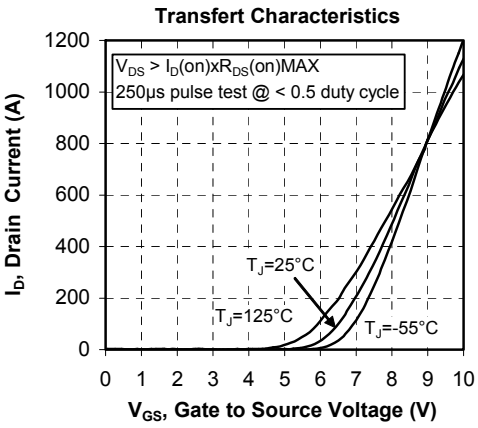


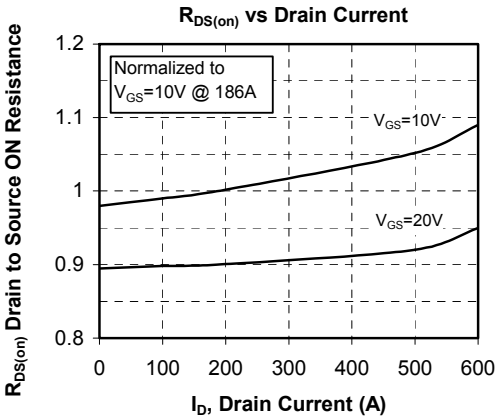
See application note APT0601 - Mounting Instructions for SP6 Power Modules on www.microsemi.com

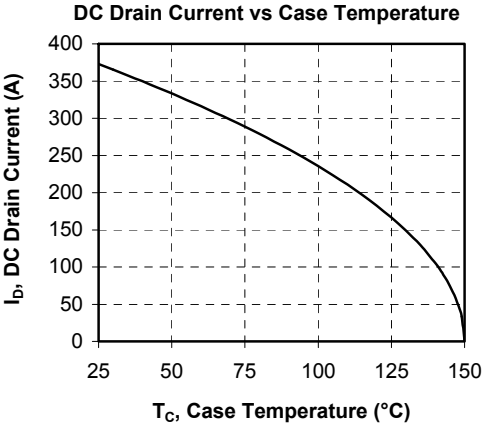
Typical Performance Curve

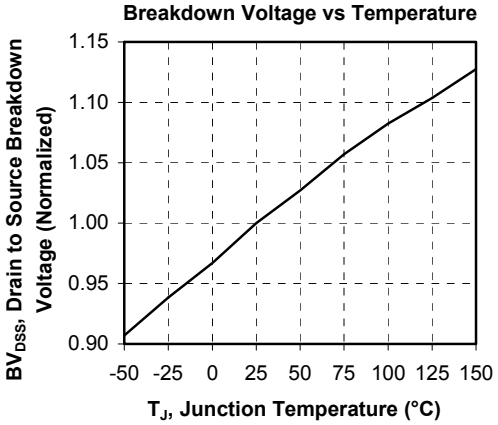


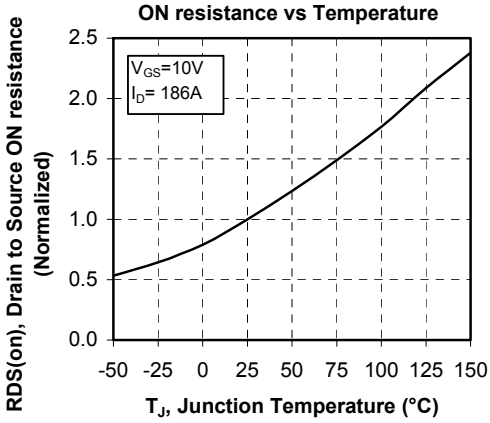


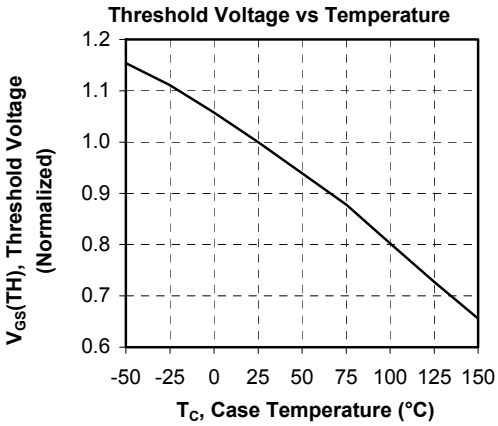


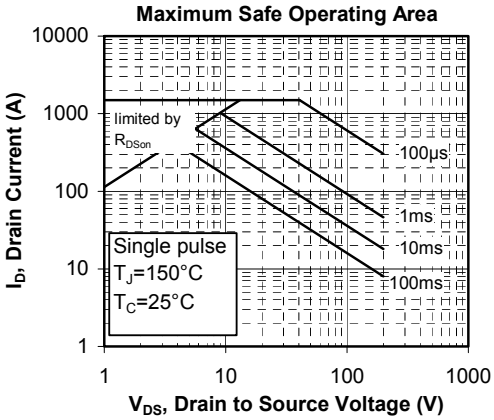


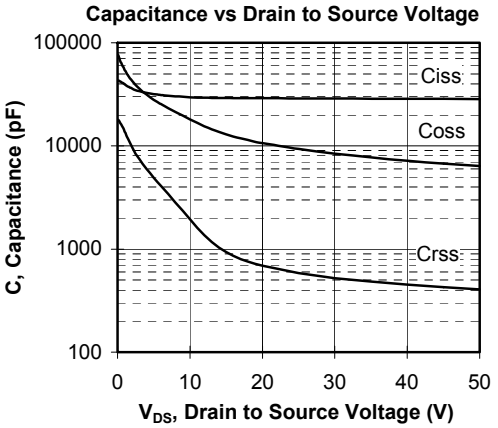


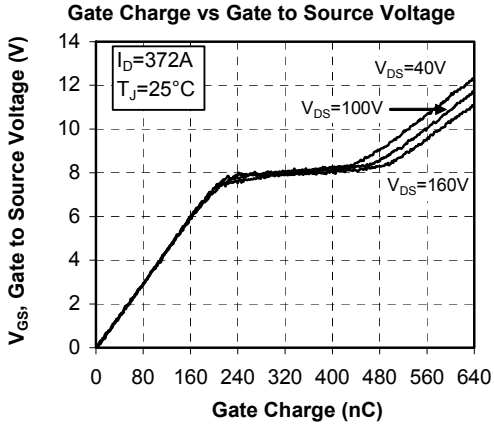

Breakdown Voltage vs Temperature
BVDSS, Drain to Source Breakdown Voltage (Normalized)
1.15
1.10
1.05
1.00
0.95
0.90
-50 -25 0 25 50 75 100 125 150
TJ, Junction Temperature (°C)

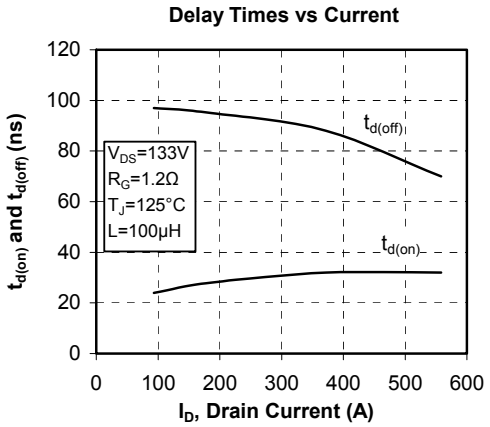

ON resistance vs Temperature
RDS(on), Drain to Source ON resistance (Normalized)
VGS=10V
ID= 186A
2.5
2.0
1.5
1.0
0.5
0.0
-50 -25 0 25 50 75 100 125 150
TJ, Junction Temperature (°C)

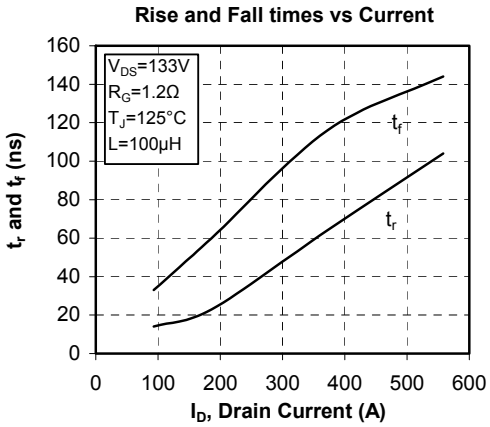

Threshold Voltage vs Temperature
VGS(TH), Threshold Voltage (Normalized)
1.2
1.1
1.0
0.9
0.8
0.7
0.6
-50 -25 0 25 50 75 100 125 150
TC, Case Temperature (°C)

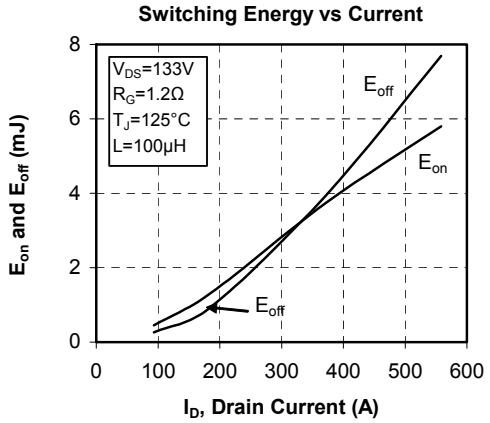

Maximum Safe Operating Area
ID, Drain Current (A)
10000
1000
100
10
1
limited by RDSon
100µs
1ms
10ms
100ms
Single pulse
TJ=150°C
TC=25°C
1 10 100 1000
VDS, Drain to Source Voltage (V)

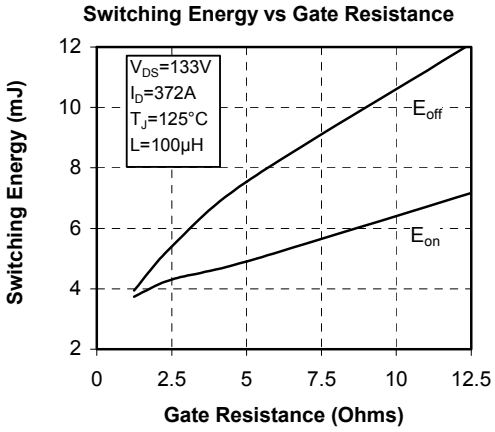

Capacitance vs Drain to Source Voltage
C, Capacitance (pF)
100000
10000
1000
100
Ciss
Coss
Crss
0 10 20 30 40 50
VDS, Drain to Source Voltage (V)

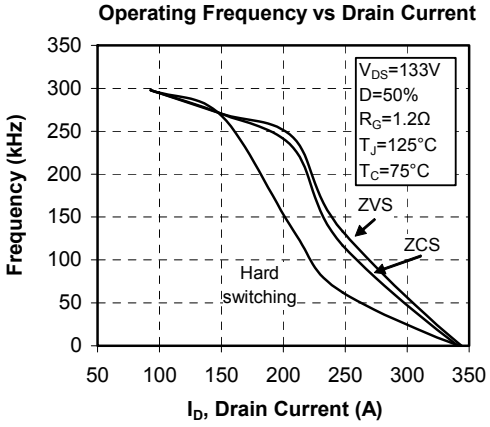

Gate Charge vs Gate to Source Voltage
VGS, Gate to Source Voltage (V)
ID=372A
TJ=25°C
VDS=40V
VDS=100V
VDS=160V
14
12
10
8
6
4
2
0
0 80 160 240 320 400 480 560 640
Gate Charge (nC)

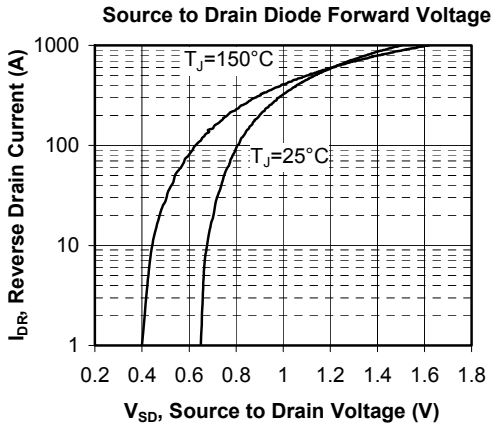

Delay Times vs Current
V_{DS}=133V
R_G=1.2Ω
T_J=125°C
L=100µH
$t_{d(off)}$
$t_{d(on)}$
$t_{d(on)}$ and $t_{d(off)}$ (ns)
I_D, Drain Current (A)


Rise and Fall times vs Current
V_{DS}=133V
R_G=1.2Ω
T_J=125°C
L=100µH
t_f
t_r
t_r and t_f (ns)
I_D, Drain Current (A)


Switching Energy vs Current
V_{DS}=133V
R_G=1.2Ω
T_J=125°C
L=100µH
E_{off}
E_{on}
E_{off}
E_{on} and E_{off} (mJ)
I_D, Drain Current (A)


Switching Energy vs Gate Resistance
V_{DS}=133V
I_D=372A
T_J=125°C
L=100µH
E_{off}
E_{on}
Switching Energy (mJ)
Gate Resistance (Ohms)


Operating Frequency vs Drain Current
V_{DS}=133V
D=50%
R_G=1.2Ω
T_J=125°C
T_C=75°C
ZVS
ZCS
Hard
switching
Frequency (kHz)
I_D, Drain Current (A)


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

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