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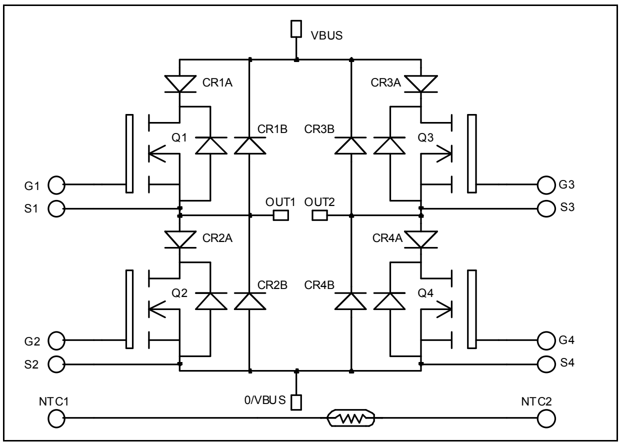
Microsemi
POWER PRODUCTS GROUP

APTM50HM75STG

Full bridge
Series & parallel diodes
MOSFET Power Module

V_{DSS} = 500V
R_{DSon} = 75mΩ typ @ Tj = 25°C
I_D = 46A @ Tc = 25°C

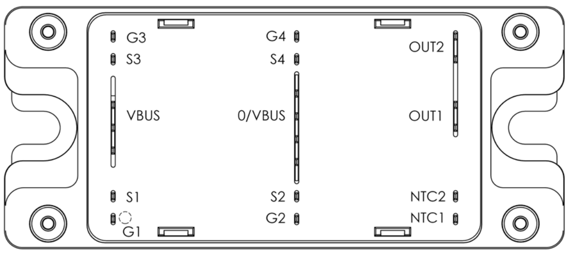


Application

- 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		500	V
I_D	Continuous Drain Current	T_c = 25°C	46	A
		T_c = 80°C	34	
I_{DM}	Pulsed Drain current		184	
V_{GS}	Gate - Source Voltage		±30	V
R_{DSon}	Drain - Source ON Resistance		90	mΩ
P_D	Maximum Power Dissipation	T_c = 25°C	357	W
I_{AR}	Avalanche current (repetitive and non repetitive)		46	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	$V_{GS} = 0V, V_{DS} = 500V$	$T_j = 25°C$			100	µA
		$V_{GS} = 0V, V_{DS} = 400V$	$T_j = 125°C$			500	
$R_{DS(on)}$	Drain – Source on Resistance	$V_{GS} = 10V, I_D = 23A$			75	90	mΩ
$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 2.5mA$		3		5	V
I_{GSS}	Gate – Source Leakage Current	$V_{GS} = \pm 30\ V, V_{DS} = 0V$				±100	nA

Dynamic Characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
C_{iss}	Input Capacitance	$V_{GS} = 0V$ $V_{DS} = 25V$ f = 1MHz		5600		pF
C_{oss}	Output Capacitance			1200		
C_{rss}	Reverse Transfer Capacitance			90		
Q_g	Total gate Charge	$V_{GS} = 10V$ $V_{Bus} = 250V$ $I_D = 46A$		123		nC
Q_{gs}	Gate – Source Charge			33		
Q_{gd}	Gate – Drain Charge			65		
$T_{d(on)}$	Turn-on Delay Time	**Inductive switching @ 125°C** $V_{GS} = 15V$ $V_{Bus} = 333V$ $I_D = 46A$ $R_G = 5\Omega$		18		ns
T_r	Rise Time			35		
$T_{d(off)}$	Turn-off Delay Time			87		
T_f	Fall Time			77		
E_{on}	Turn-on Switching Energy	**Inductive switching @ 25°C** $V_{GS} = 15V, V_{Bus} = 333V$ $I_D = 46A, R_G = 5\Omega$		755		µJ
E_{off}	Turn-off Switching Energy			726		
E_{on}	Turn-on Switching Energy	**Inductive switching @ 125°C** $V_{GS} = 15V, V_{Bus} = 333V$ $I_D = 46A, R_G = 5\Omega$		1241		µJ
E_{off}	Turn-off Switching Energy			846		
R_{thJC}	Junction to Case Thermal Resistance				0.35	°C/W

Series diode ratings and characteristics

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				250	µA
I_F	DC Forward Current		$T_c = 70°C$		30		A
V_F	Diode Forward Voltage	$I_F = 30A$			1.6	1.8	V
		$I_F = 60A$			1.9		
		$I_F = 30A$	$T_j = 125°C$		1.4		
t_{rr}	Reverse Recovery Time	$I_F = 30A$ $V_R = 400V$ di/dt = 200A/µs	$T_j = 25°C$		85		ns
			$T_j = 125°C$		160		
Q_{rr}	Reverse Recovery Charge		$T_j = 25°C$		130		nC
			$T_j = 125°C$		700		
R_{thJC}	Junction to Case Thermal Resistance					1.2	°C/W

Parallel diode ratings and characteristics

Symbol	*Characteristic*	*Test Conditions*		*Min*	*Typ*	*Max*	*Unit*
V_{RRM}	Maximum Peak Repetitive Reverse Voltage			600			V
I_{RM}	Maximum Reverse Leakage Current	$V_R = 600V$				250	µA
I_F	DC Forward Current		$T_c = 70°C$		30		A
V_F	Diode Forward Voltage	$I_F = 30A$			1.6	1.8	V
		$I_F = 60A$			1.9		
		$I_F = 30A$	$T_j = 125°C$		1.4		
t_{rr}	Reverse Recovery Time	$I_F = 30A$ $V_R = 400V$ $di/dt = 200A/µs$	$T_j = 25°C$		85		ns
			$T_j = 125°C$		160		
Q_{rr}	Reverse Recovery Charge		$T_j = 25°C$		130		nC
			$T_j = 125°C$		700		
R_{thJC}	Junction to Case Thermal Resistance					1.2	°C/W

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	150	°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	100	
Torque	Mounting torque	To heatsink	M5	2.5	4.7	N.m
Wt	Package Weight				160	g

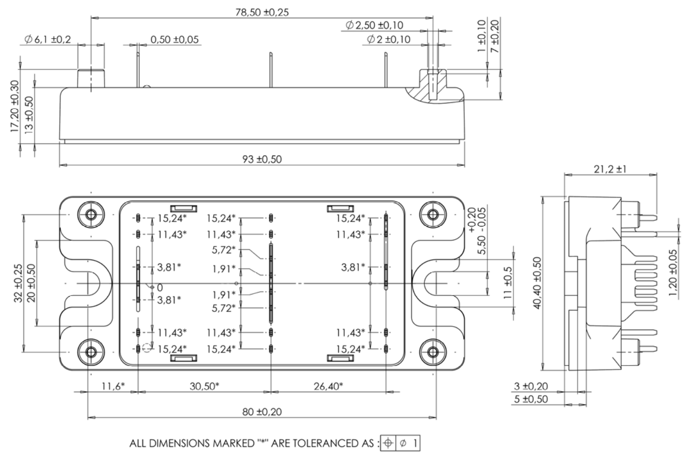
Temperature sensor NTC (see application note APT0406 on www.microsemi.com).

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

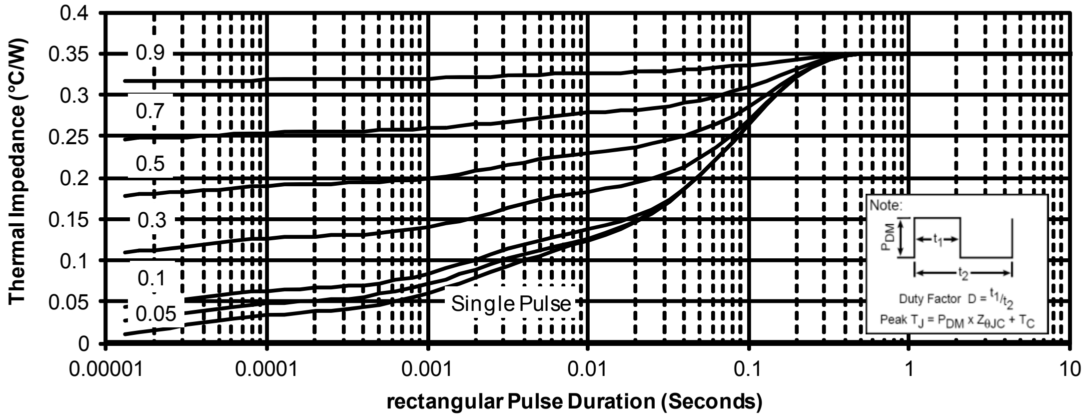
SP4 Package outline (dimensions in mm)



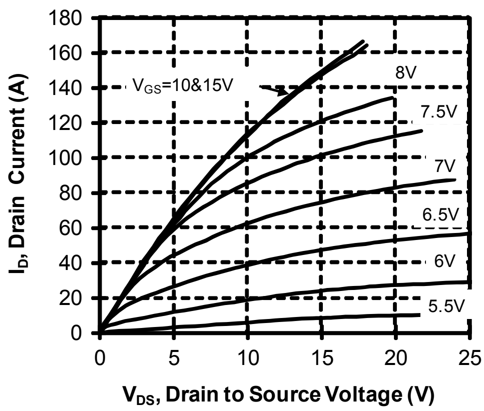
See application note APT0501 - Mounting Instructions for SP4 Power Modules on www.microsemi.com

Typical Performance Curve

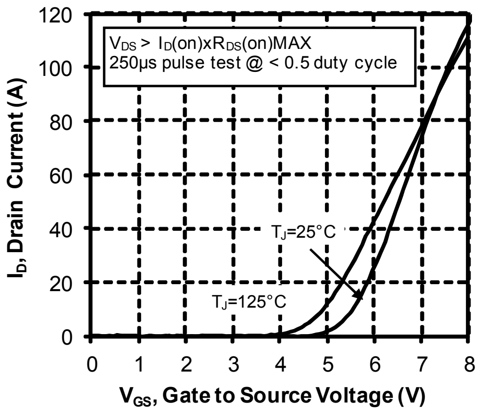
Maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration



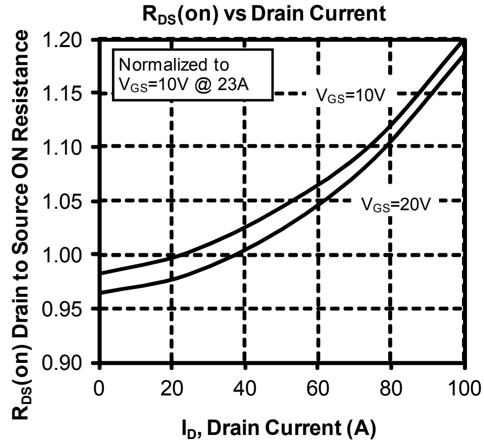
Low Voltage Output Characteristics



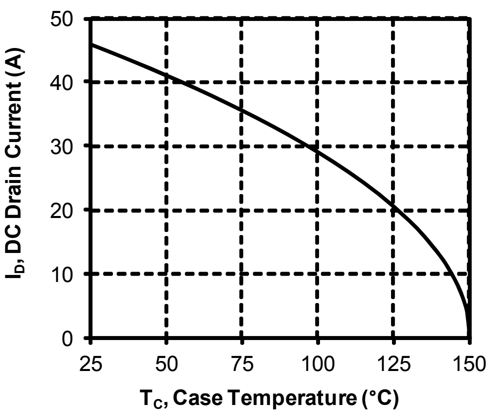
Transfert Characteristics

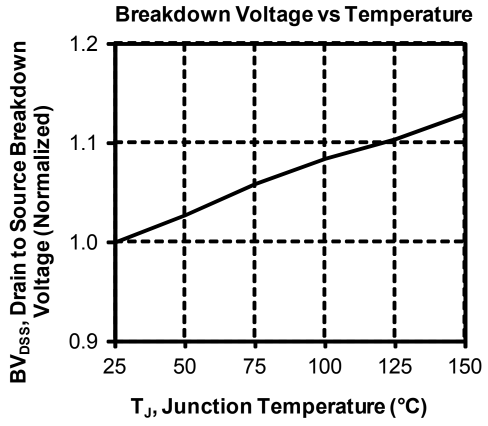


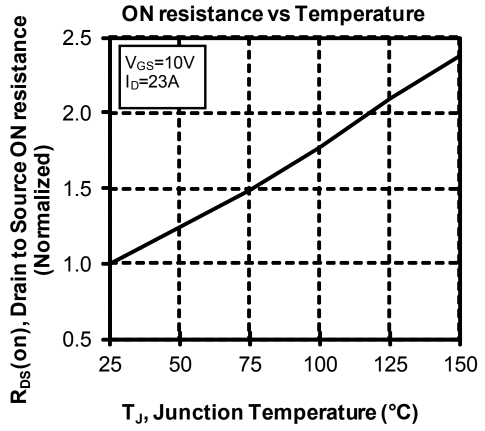
R_{DS}(on) vs Drain Current

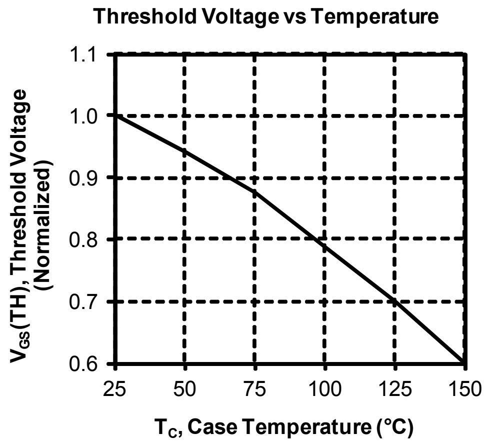


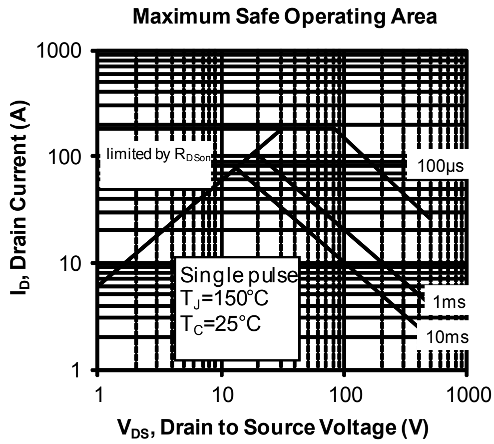
DC Drain Current vs Case Temperature

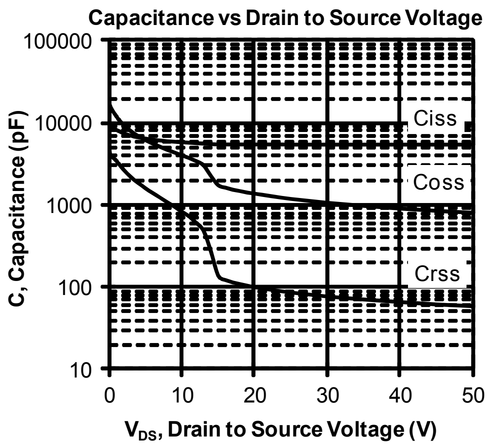


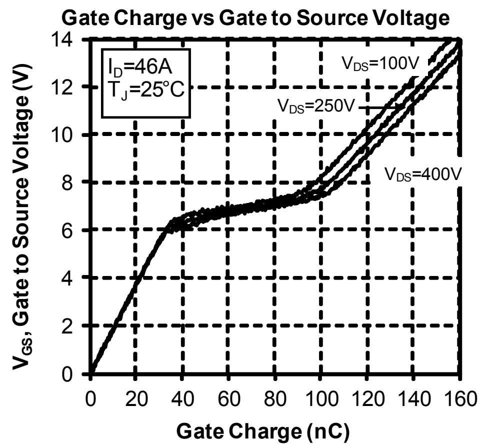

Breakdown Voltage vs Temperature
BVDSS, Drain to Source Breakdown Voltage (Normalized)
1.2
1.1
1.0
0.9
25
50
75
100
125
150
TJ, Junction Temperature (°C)

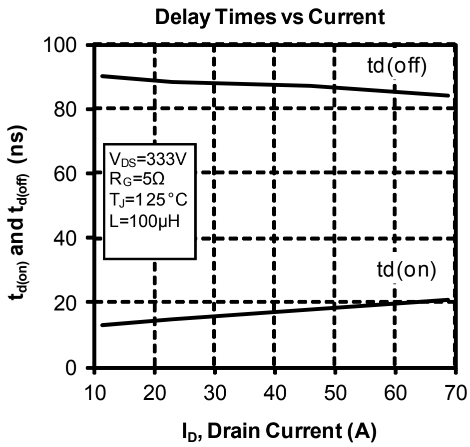

ON resistance vs Temperature
RDS(on), Drain to Source ON resistance (Normalized)
VGS=10V
ID=23A
2.5
2.0
1.5
1.0
0.5
25
50
75
100
125
150
TJ, Junction Temperature (°C)

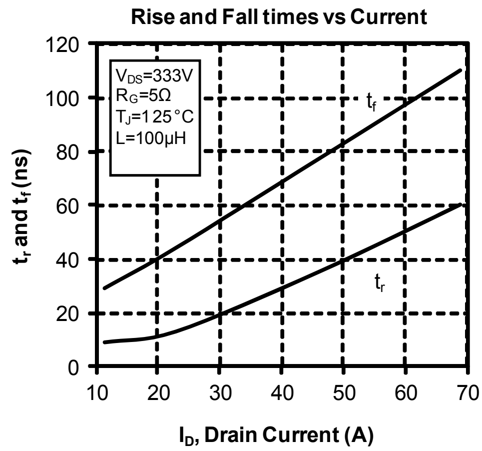

Threshold Voltage vs Temperature
VGS(TH), Threshold Voltage (Normalized)
1.1
1.0
0.9
0.8
0.7
0.6
25
50
75
100
125
150
TC, Case Temperature (°C)

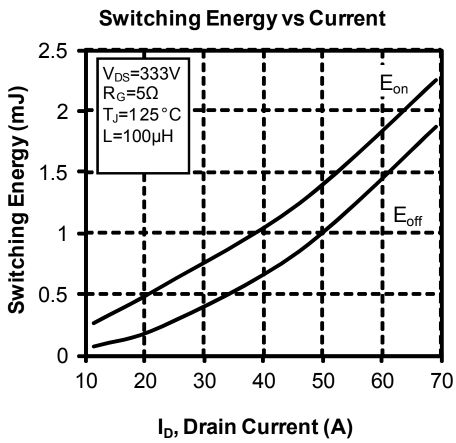

Maximum Safe Operating Area
ID, Drain Current (A)
limited by RDSon
100µs
Single pulse
TJ=150°C
TC=25°C
1ms
10ms
1000
100
10
1
1
10
100
1000
VDS, Drain to Source Voltage (V)

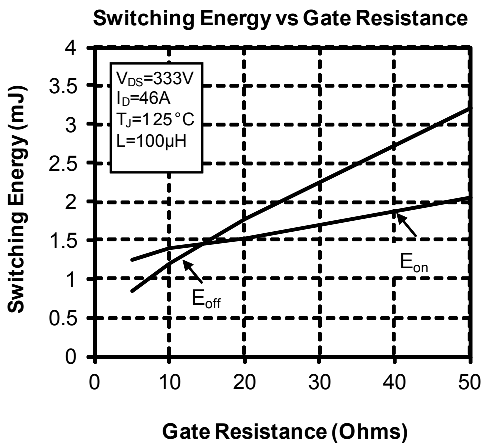

Capacitance vs Drain to Source Voltage
C, Capacitance (pF)
Ciss
Coss
Crss
100000
10000
1000
100
10
0
10
20
30
40
50
VDS, Drain to Source Voltage (V)

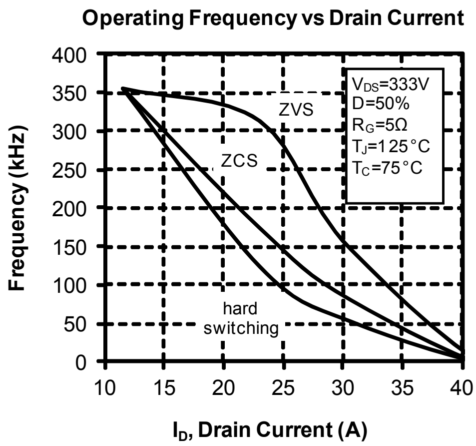

Gate Charge vs Gate to Source Voltage
VGS, Gate to Source Voltage (V)
ID=46A
TJ=25°C
VDS=100V
VDS=250V
VDS=400V
14
12
10
8
6
4
2
0
0
20
40
60
80
100
120
140
160
Gate Charge (nC)

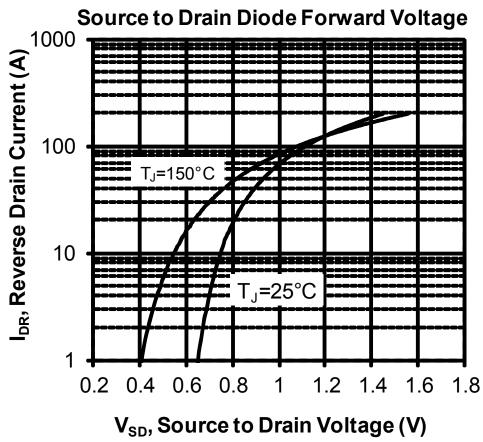

Delay Times vs Current
td(off)
td(on)
VDS=333V
RG=5Ω
TJ=125°C
L=100µH
td(on) and td(off) (ns)
ID, Drain Current (A)
0
20
40
60
80
100
10
20
30
40
50
60
70


Rise and Fall times vs Current
VDS=333V
RG=5Ω
TJ=125°C
L=100µH
tf
tr
tr and tf (ns)
ID, Drain Current (A)
0
20
40
60
80
100
120
10
20
30
40
50
60
70


Switching Energy vs Current
VDS=333V
RG=5Ω
TJ=125°C
L=100µH
Eon
Eoff
Switching Energy (mJ)
ID, Drain Current (A)
0
0.5
1
1.5
2
2.5
10
20
30
40
50
60
70


Switching Energy vs Gate Resistance
VDS=333V
ID=46A
TJ=125°C
L=100µH
Eon
Eoff
Switching Energy (mJ)
Gate Resistance (Ohms)
0
0.5
1
1.5
2
2.5
3
3.5
4
0
10
20
30
40
50


Operating Frequency vs Drain Current
VDS=333V
D=50%
RG=5Ω
TJ=125°C
TC=75°C
ZVS
ZCS
hard
switching
Frequency (kHz)
ID, Drain Current (A)
0
50
100
150
200
250
300
350
400
10
15
20
25
30
35
40


Source to Drain Diode Forward Voltage
TJ=150°C
TJ=25°C
IDR, Reverse Drain Current (A)
VSD, Source to Drain Voltage (V)
1
10
100
1000
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8

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