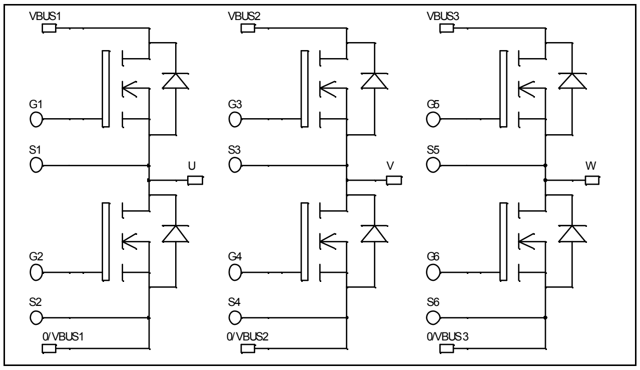
ADVANCED POWER TECHNOLOGY® EUROPE

APTM20TAM16FP

Triple phase leg MOSFET Power Module

V_{DSS} = 200V
R_{DSon} = 16mΩ max @ Tj = 25°C
I_D = 104A @ Tc = 25°C

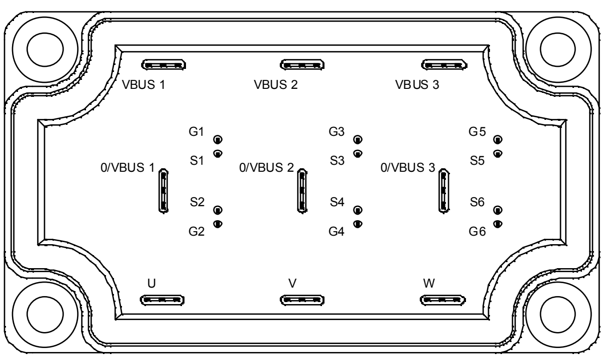


Application

- 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
  - Lead frames for power connections
- 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
- Very low (12mm) profile
- Each leg can be easily paralleled to achieve a phase leg of three times the current capability
- Module can be configured as a three phase bridge
- Module can be configured as a boost followed by a full bridge

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	104	A
		T_c = 80°C	74	
I_{DM}	Pulsed Drain current		416	
V_{GS}	Gate - Source Voltage		±30	V
R_{DSon}	Drain - Source ON Resistance		16	mΩ
P_D	Maximum Power Dissipation	T_c = 25°C	390	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 Handing Procedures Should Be Followed.

All ratings @ $T_j = 25°C$ unless otherwise specified

Electrical Characteristics

Symbol	*Characteristic*	*Test Conditions*		*Min*	*Typ*	*Max*	*Unit*
BV_{DSS}	Drain - Source Breakdown Voltage	$V_{GS} = 0V, I_D = 250\mu A$		200			V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{GS} = 0V, V_{DS} = 200V$	$T_j = 25°C$			250	µA
		$V_{GS} = 0V, V_{DS} = 160V$	$T_j = 125°C$			1000	
$R_{DS(on)}$	Drain – Source on Resistance	$V_{GS} = 10V, I_D = 52A$				16	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	$V_{GS} = 0V$		7220		pF
C_{oss}	Output Capacitance	$V_{DS} = 25V$		2330		
C_{rss}	Reverse Transfer Capacitance	$f = 1MHz$		146		
Q_g	Total gate Charge	$V_{GS} = 10V$		140		nC
Q_{gs}	Gate – Source Charge	$V_{Bus} = 100V$		53		
Q_{gd}	Gate – Drain Charge	$I_D = 104A$		67		
$T_{d(on)}$	Turn-on Delay Time	**Inductive switching @ 125°C**		32		ns
T_r	Rise Time	$V_{GS} = 15V$, $V_{Bus} = 133V$		64		
$T_{d(off)}$	Turn-off Delay Time	$I_D = 104A$		88		
T_f	Fall Time	$R_G = 5\Omega$		116		
E_{on}	Turn-on Switching Energy ❶	**Inductive switching @ 25°C** $V_{GS} = 15V, V_{Bus} = 133V$		849		µJ
E_{off}	Turn-off Switching Energy ❷	$I_D = 104A, R_G = 5\Omega$		929		
E_{on}	Turn-on Switching Energy ❶	**Inductive switching @ 125°C** $V_{GS} = 15V, V_{Bus} = 133V$		936		µJ
E_{off}	Turn-off Switching Energy ❷	$I_D = 104A, R_G = 5\Omega$		986		

Source - Drain diode ratings and characteristics

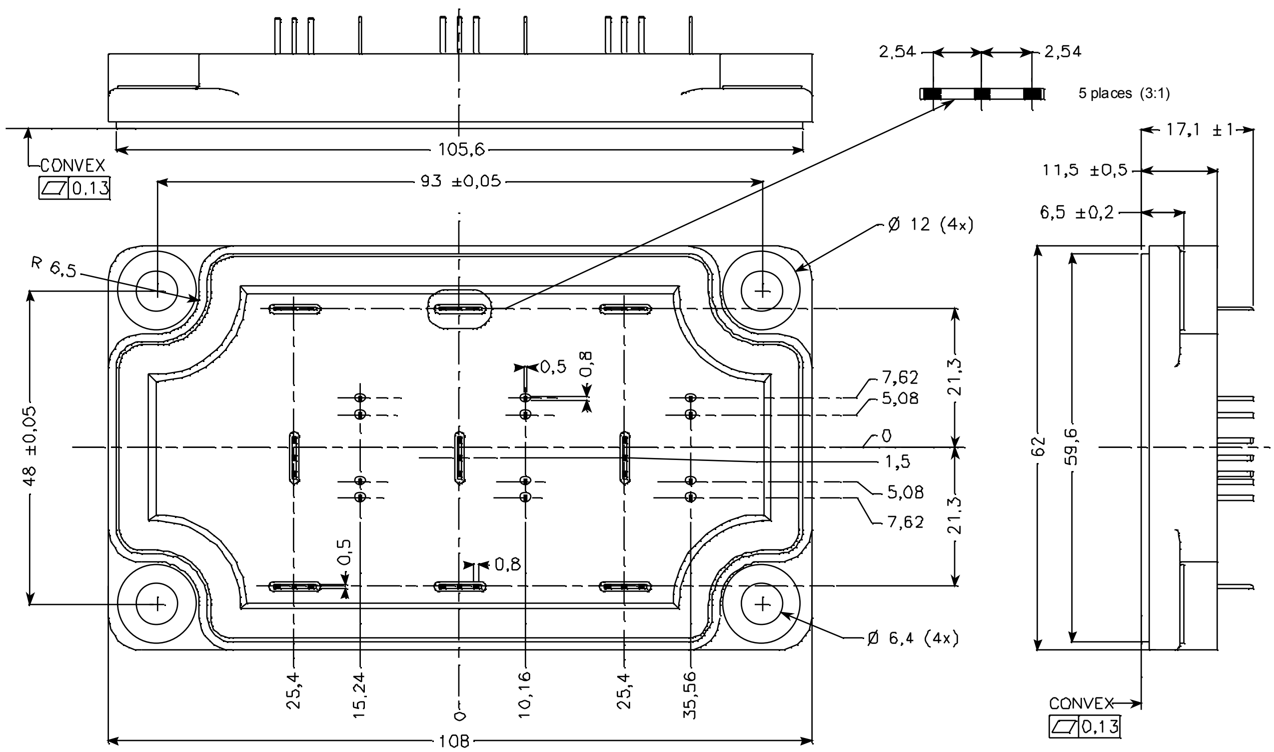
Symbol	*Characteristic*	*Test Conditions*		*Min*	*Typ*	*Max*	*Unit*
I_S	Continuous Source current (Body diode)		Tc = 25°C			104	A
			Tc = 80°C			74	
V_{SD}	Diode Forward Voltage	$V_{GS} = 0V, I_S = -104A$				1.3	V
dv/dt	Peak Diode Recovery ❸					5	V/ns
t_{rr}	Reverse Recovery Time	$I_S = -104A$, $V_R = 133V$, $di_S/dt = 100A/\mu s$	$T_j = 25°C$			230	ns
			$T_j = 125°C$			450	
Q_{rr}	Reverse Recovery Charge	$I_S = -104A$, $V_R = 133V$, $di_S/dt = 100A/\mu s$	$T_j = 25°C$		0.9		µC
			$T_j = 125°C$		3.4		

❶ E_{on} includes diode reverse recovery.
❷ In accordance with JEDEC standard JESD24-1.
❸ dv/dt numbers reflect the limitations of the circuit rather than the device itself.
$I_S \leq -104A$ $di/dt \leq 700A/\mu s$ $V_R \leq V_{DSS}$ $T_j \leq 150°C$

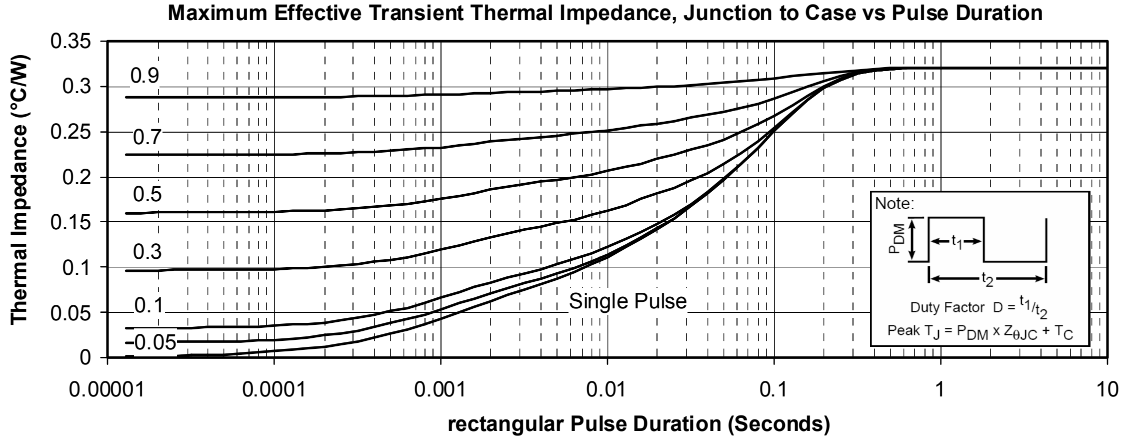
Thermal and package characteristics

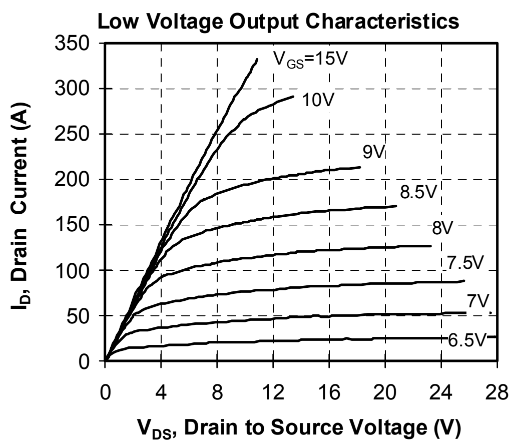
Symbol	*Characteristic*			*Min*	*Typ*	*Max*	*Unit*
R_{thJC}	Junction to Case		IGBT			0.32	°C/W
V_{ISOL}	RMS Isolation Voltage, any terminal to case t =1 min, I isol<1mA, 50/60Hz			2500			V
T_J	Operating junction temperature range			-40		150	°C
T_{STG}	Storage Temperature Range			-40		125	°C
T_C	Operating Case Temperature			-40		100	°C
Torque	Mounting torque	To heatsink	M6	3		5	N.m
Wt	Package Weight					250	g

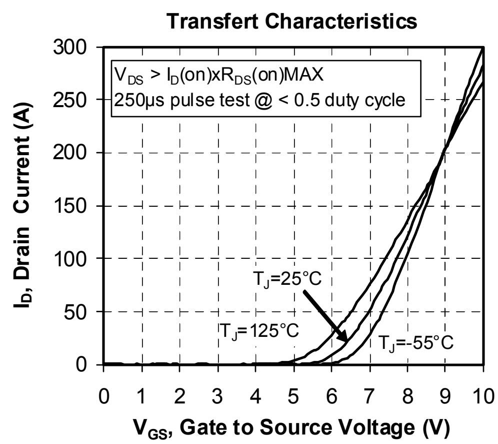
Package outline

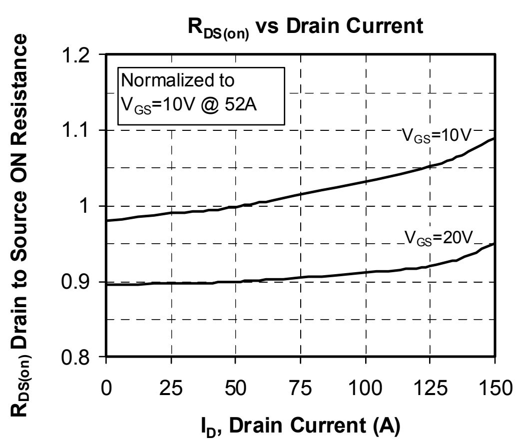


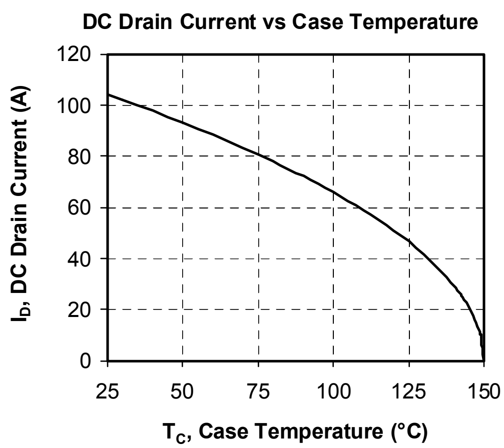
Typical Performance Curve

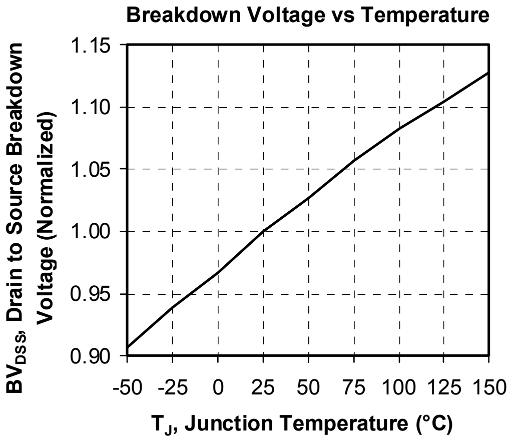


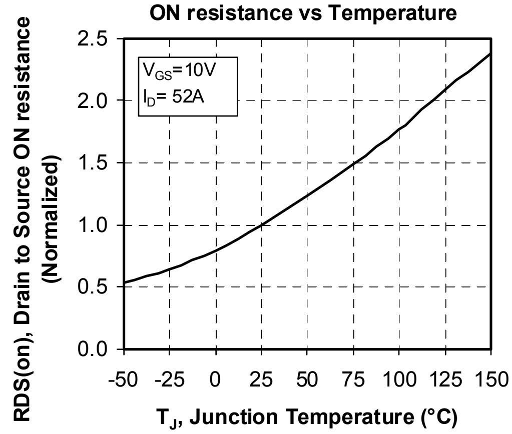


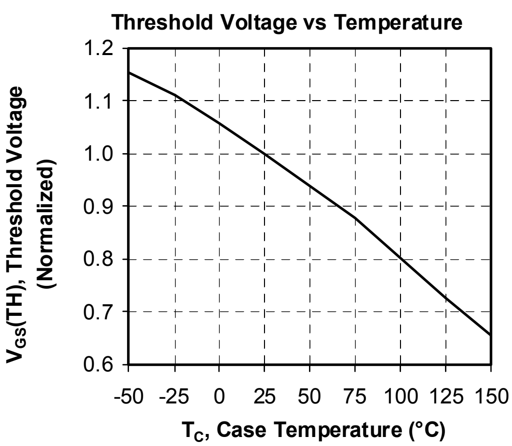


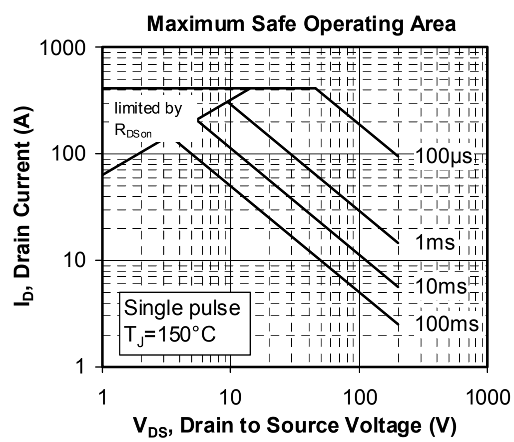


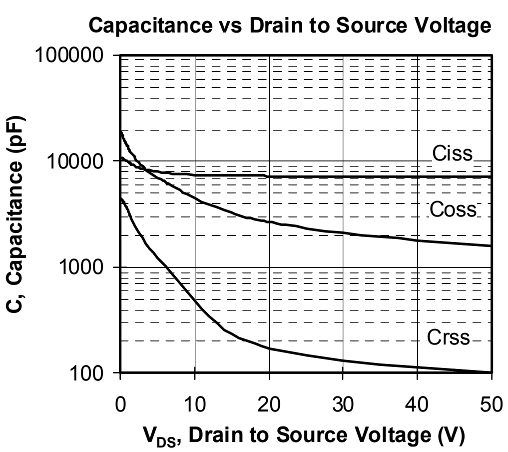


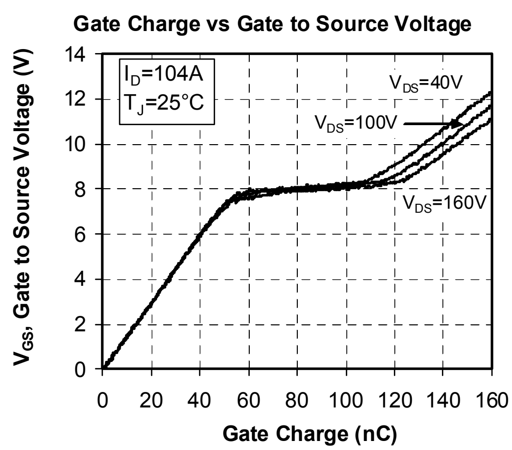

Breakdown Voltage vs Temperature
BVDSS, Drain to Source Breakdown Voltage (Normalized)
1.15
1.10
1.05
1.00
0.95
0.90
-50 -25 0 25 50 75 100 125 150
TJ, Junction Temperature (°C)


ON resistance vs Temperature
RDS(on), Drain to Source ON resistance (Normalized)
VGS=10V
ID= 52A
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)

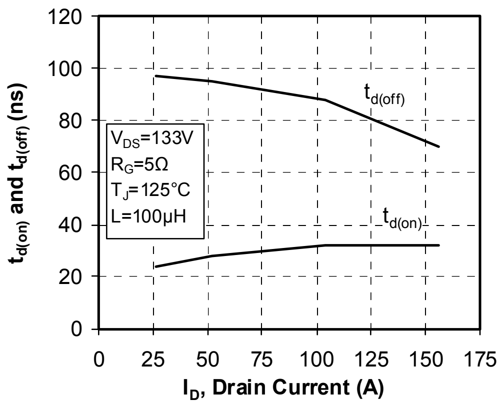

Threshold Voltage vs Temperature
VGS(TH), Threshold Voltage (Normalized)
1.2
1.1
1.0
0.9
0.8
0.7
0.6
-50 -25 0 25 50 75 100 125 150
TC, Case Temperature (°C)


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

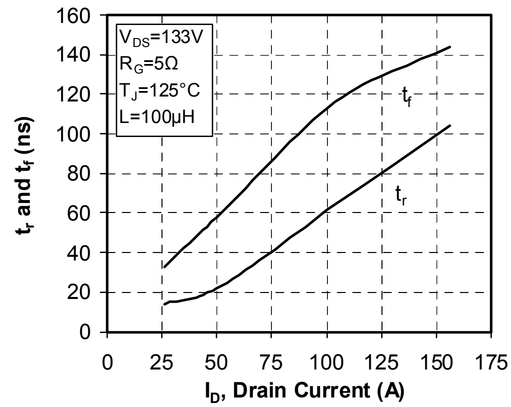

Capacitance vs Drain to Source Voltage
C, Capacitance (pF)
Ciss
Coss
Crss
100000
10000
1000
100
0 10 20 30 40 50
VDS, Drain to Source Voltage (V)


Gate Charge vs Gate to Source Voltage
VGS, Gate to Source Voltage (V)
ID=104A
TJ=25°C
VDS=40V
VDS=100V
VDS=160V
14
12
10
8
6
4
2
0
0 20 40 60 80 100 120 140 160
Gate Charge (nC)

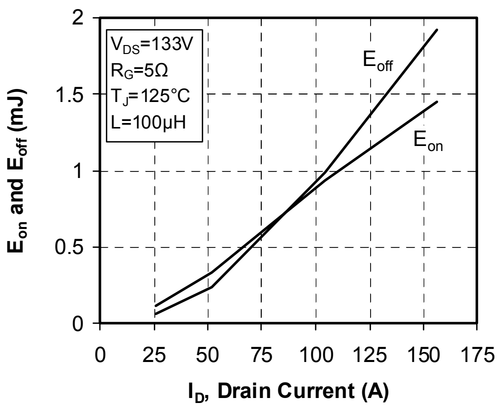
Delay Times vs Current



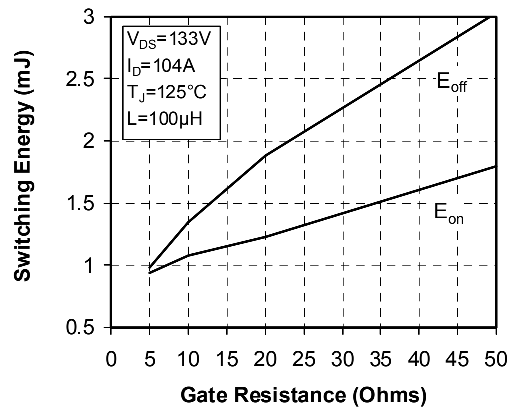
Rise and Fall times vs Current



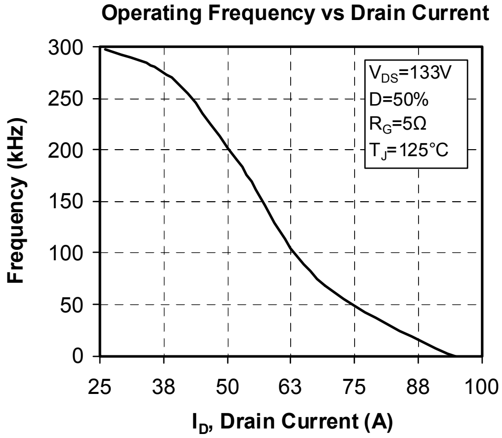
Switching Energy vs Current



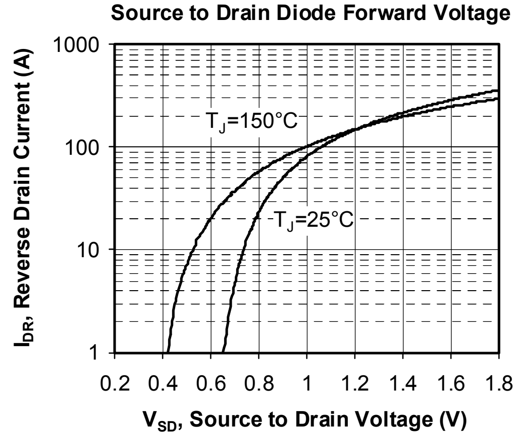
Switching Energy vs Gate Resistance



Operating Frequency vs Drain Current



Source to Drain Diode Forward Voltage



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