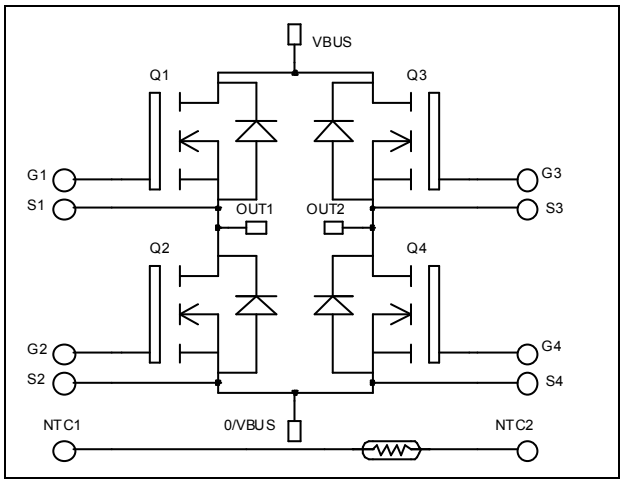
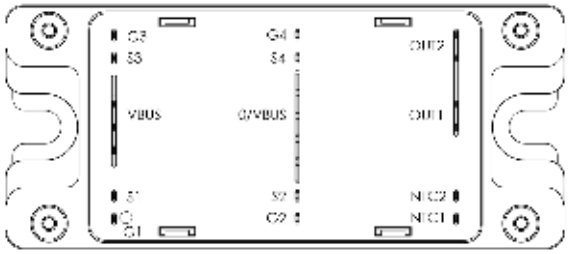
# APTM100H35FTG

## *Full - Bridge MOSFET Power Module*

**$V_{DSS}$ = 1000V**
**$R_{DSon}$ = 350mΩ typ @ Tj = 25°C**
**$I_D$ = 22A @ 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
- 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

## 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 | 22 | A |
| | | $T_c$ = 80°C | 17 | |
| $I_{DM}$ | Pulsed Drain current | | 88 | |
| $V_{GS}$ | Gate - Source Voltage | | ±30 | V |
| $R_{DSon}$ | Drain - Source ON Resistance | | 420 | mΩ |
| $P_D$ | Maximum Power Dissipation | $T_c$ = 25°C | 390 | W |
| $I_{AR}$ | Avalanche current (repetitive and non repetitive) | | 25 | 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, $V_{DS}$ = 1000V | $T_j$ = 25°C | | | 100 | µA |
| | | $V_{GS}$ = 0V, $V_{DS}$ = 800V | $T_j$ = 125°C | | | 500 | |
| $R_{DS(on)}$ | Drain – Source on Resistance | $V_{GS}$ = 10V, $I_D$ = 11A | | | 350 | 420 | mΩ |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = 2.5mA | | 3 | | 5 | V |
| $I_{GSS}$ | Gate – Source Leakage Current | $V_{GS}$ = ±30V, $V_{DS}$ = 0V | | | | ±100 | nA |

## Dynamic Characteristics

| Symbol | Characteristic | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $C_{iss}$ | Input Capacitance | $V_{GS}$ = 0V<br>$V_{DS}$ = 25V<br>f = 1MHz | | 5.2 | | nF |
| $C_{oss}$ | Output Capacitance | | | 0.88 | | |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 0.16 | | |
| $Q_g$ | Total gate Charge | $V_{GS}$ = 10V<br>$V_{Bus}$ = 500V<br>$I_D$ = 22A | | 186 | | nC |
| $Q_{gs}$ | Gate – Source Charge | | | 24 | | |
| $Q_{gd}$ | Gate – Drain Charge | | | 122 | | |
| $T_{d(on)}$ | Turn-on Delay Time | **Inductive switching @ 125°C**<br>$V_{GS}$ = 15V<br>$V_{Bus}$ = 670V<br>$I_D$ = 22A<br>$R_G$ = 5Ω | | 18 | | ns |
| $T_r$ | Rise Time | | | 12 | | |
| $T_{d(off)}$ | Turn-off Delay Time | | | 155 | | |
| $T_f$ | Fall Time | | | 40 | | |
| $E_{on}$ | Turn-on Switching Energy | **Inductive switching @ 25°C**<br>$V_{GS}$ = 15V, $V_{Bus}$ = 670V<br>$I_D$ = 22A, $R_G$ = 5Ω | | 900 | | µJ |
| $E_{off}$ | Turn-off Switching Energy | | | 623 | | |
| $E_{on}$ | Turn-on Switching Energy | **Inductive switching @ 125°C**<br>$V_{GS}$ = 15V, $V_{Bus}$ = 670V<br>$I_D$ = 22A, $R_G$ = 5Ω | | 1423 | | µJ |
| $E_{off}$ | Turn-off Switching Energy | | | 779 | | |

## Source - Drain diode ratings and characteristics

| Symbol | Characteristic | Test Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $I_S$ | Continuous Source current (Body diode) | | Tc = 25°C | | | 22 | A |
| | | | Tc = 80°C | | | 17 | |
| $V_{SD}$ | Diode Forward Voltage | $V_{GS}$ = 0V, $I_S$ = - 22A | | | | 1.3 | V |
| dv/dt | Peak Diode Recovery ❶ | | | | | 18 | V/ns |
| $t_{rr}$ | Reverse Recovery Time | $I_S$ = - 22A<br>$V_R$ = 670V<br>$di_S/dt$ = 100A/µs | $T_j$ = 25°C | | | 320 | ns |
| | | | $T_j$ = 125°C | | | 650 | |
| $Q_{rr}$ | Reverse Recovery Charge | | $T_j$ = 25°C | | 3.6 | | µC |
| | | | $T_j$ = 125°C | | 9.72 | | |

❶ dv/dt numbers reflect the limitations of the circuit rather than the device itself.
$I_S \leq$ - 22A  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 | | | | | 0.32 | °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 | |
| $T_C$ | Operating Case Temperature | | | -40 | | 100 | |
| Torque | Mounting torque | To Heatsink | M5 | 2.5 | | 4.7 | N.m |
| Wt | Package Weight | | | | | 160 | g |

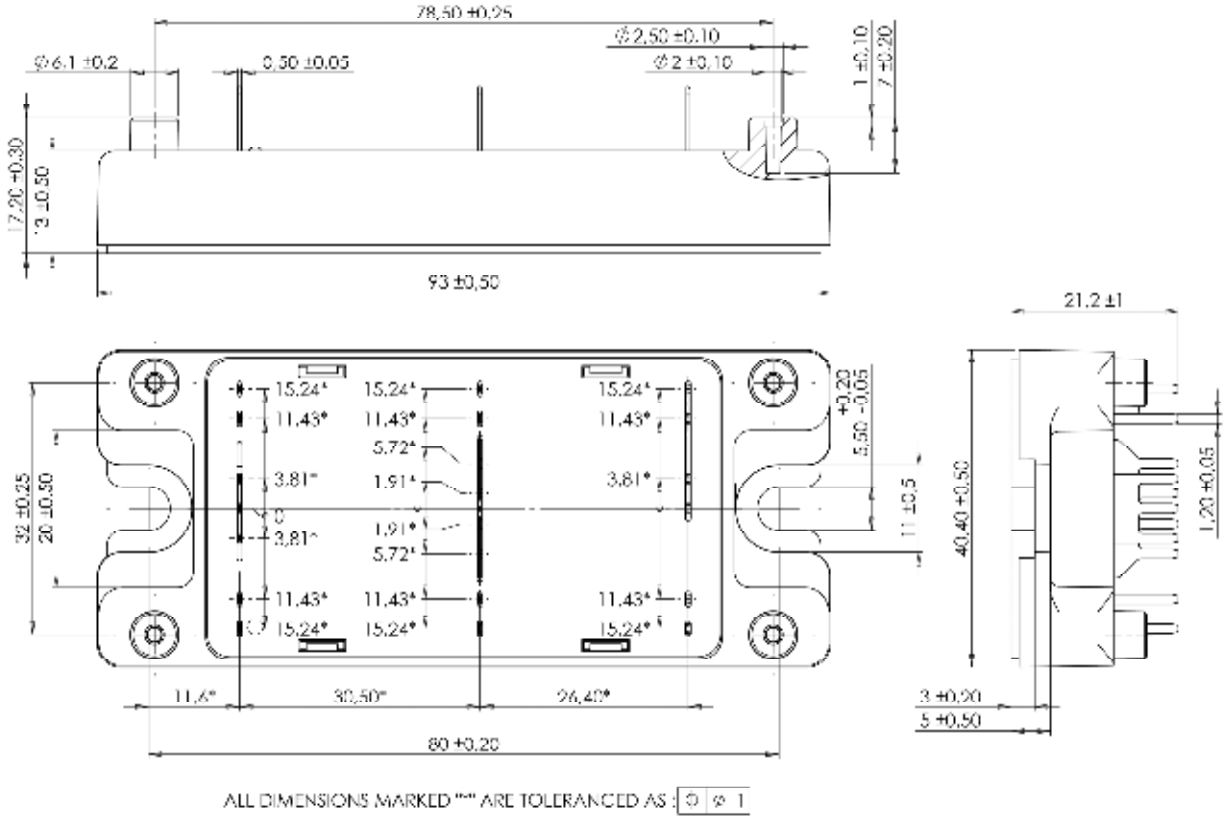
## Temperature sensor NTC (see application note APT0406 on www.microsemi.com for more information).

| Symbol | Characteristic | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| $R_{25}$ | Resistance @ 25°C | | 50 | | kΩ |
| $B_{25/85}$ | $T_{25}$ = 298.15 K | | 3952 | | K |

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

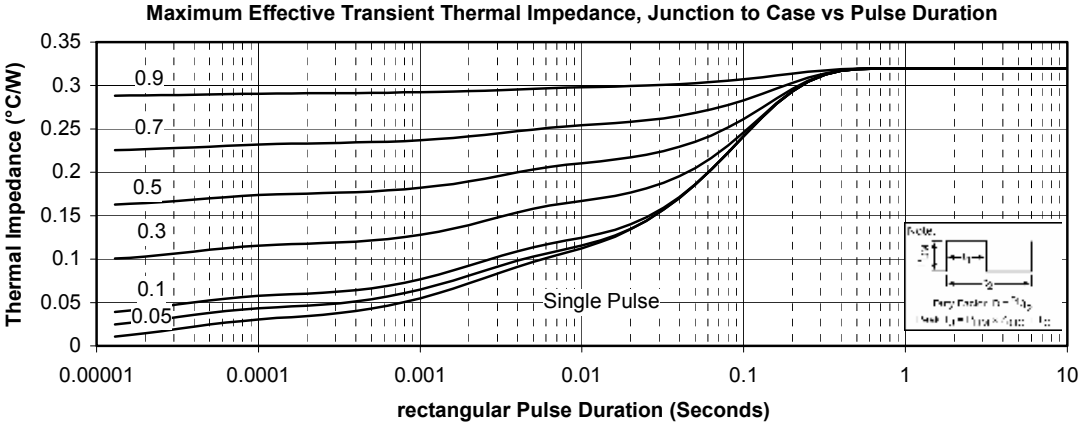
T: Thermistor temperature
$R_T$: Thermistor value at T

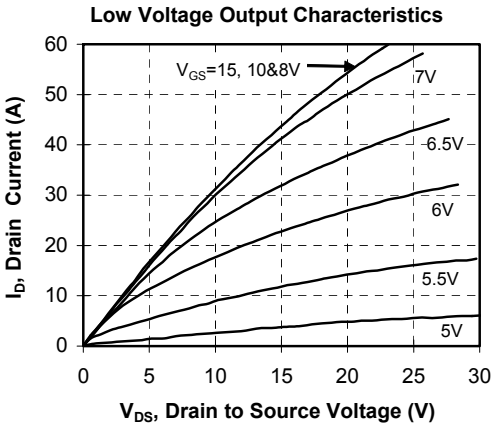
## SP4 Package outline (dimensions in mm)

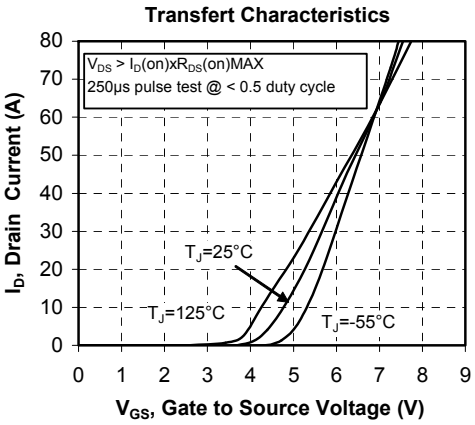


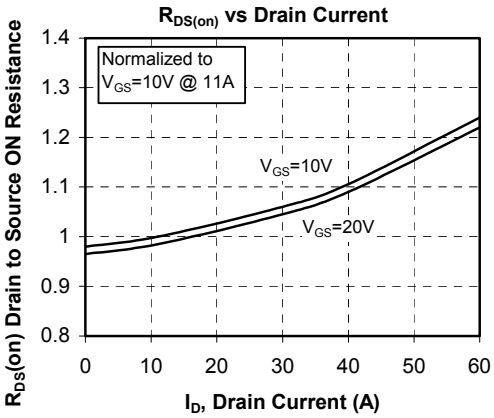

See application note APT0501 - Mounting Instructions for SP4 Power Modules on www.microsemi.com

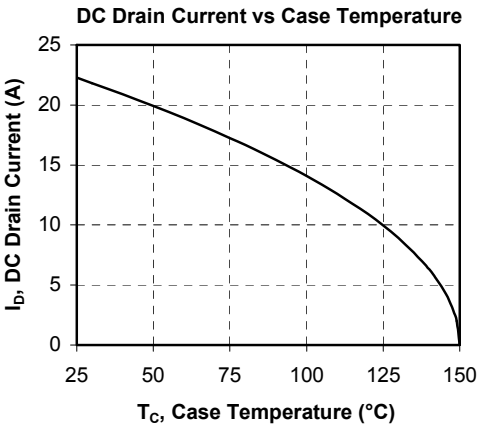
## Typical Performance Curve

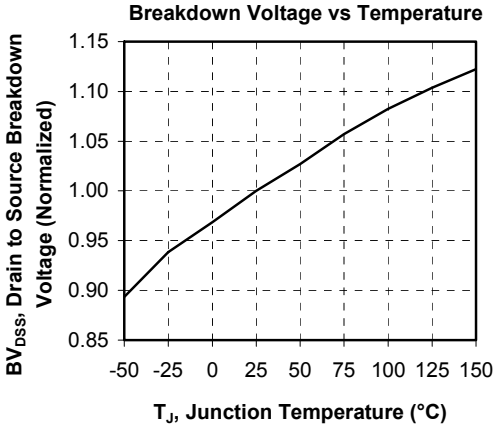


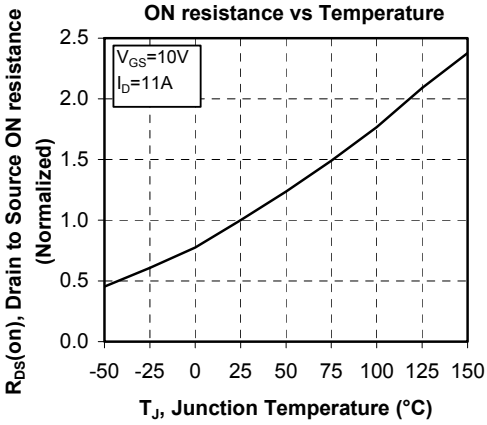



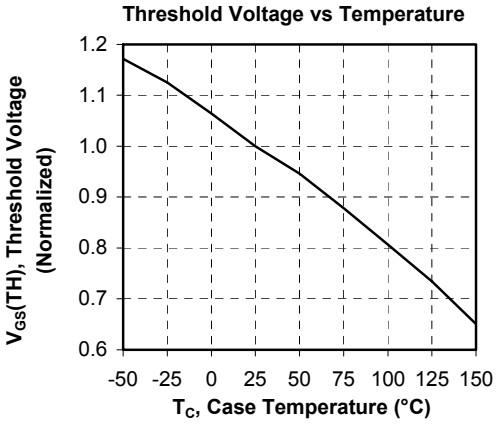



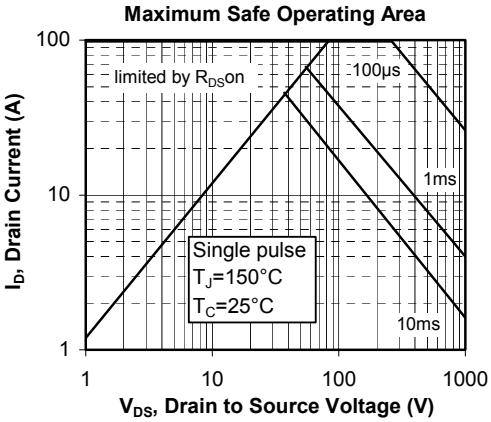



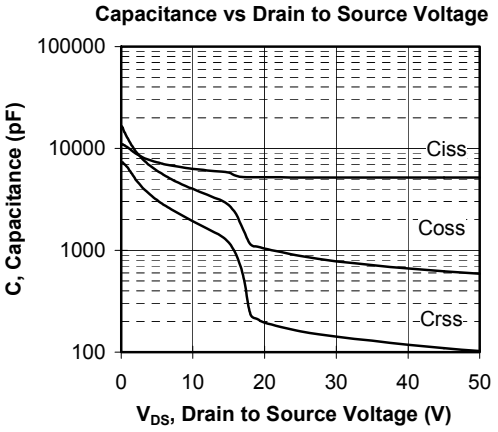



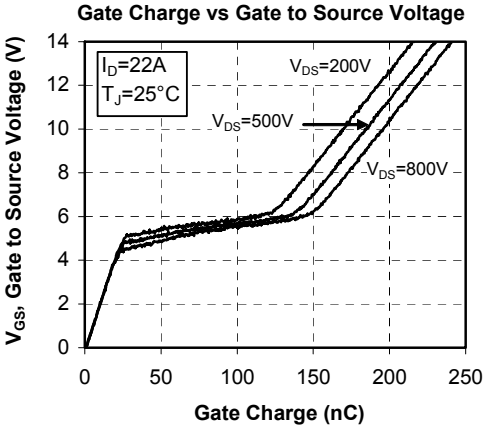

Breakdown Voltage vs Temperature
BVDSS, Drain to Source Breakdown Voltage (Normalized)
1.15
1.10
1.05
1.00
0.95
0.90
0.85
-50 -25 0 25 50 75 100 125 150
TJ, Junction Temperature (°C)

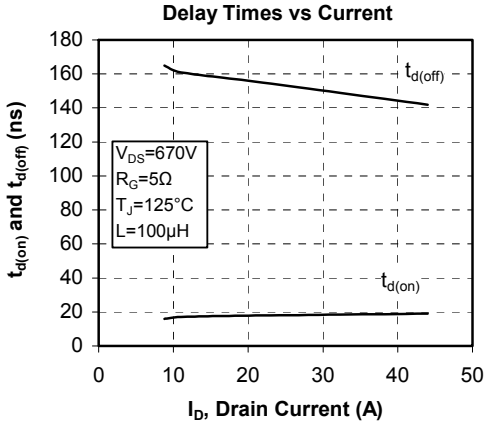

ON resistance vs Temperature
VGS=10V
ID=11A
RDS(on), Drain to Source ON resistance (Normalized)
2.5
2.0
1.5
1.0
0.5
0.0
-50 -25 0 25 50 75 100 125 150
TJ, Junction Temperature (°C)

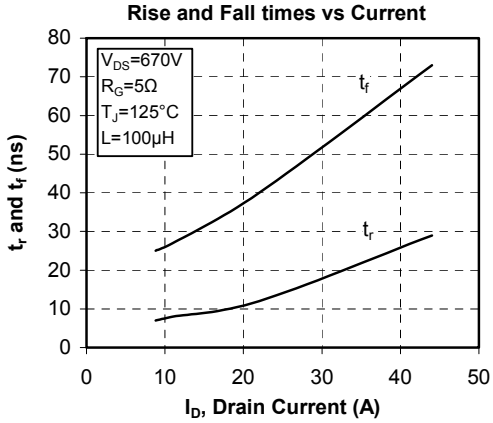

Threshold Voltage vs Temperature
VGS(TH), Threshold Voltage (Normalized)
1.2
1.1
1.0
0.9
0.8
0.7
0.6
-50 -25 0 25 50 75 100 125 150
TC, Case Temperature (°C)

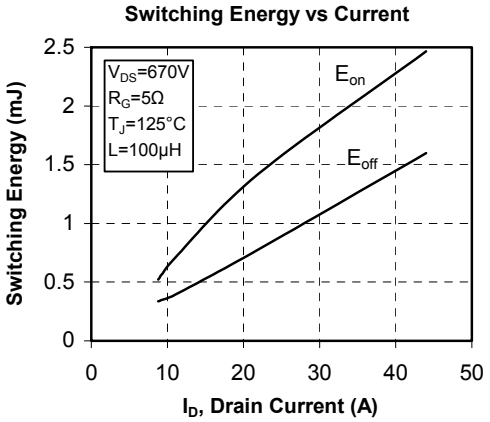

Maximum Safe Operating Area
limited by RDSon
100µs
1ms
10ms
Single pulse
TJ=150°C
TC=25°C
ID, Drain Current (A)
100
10
1
1 10 100 1000
VDS, Drain to Source Voltage (V)

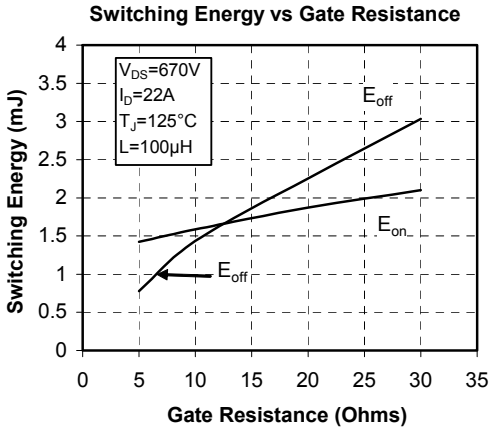

Capacitance vs Drain to Source Voltage
C, Capacitance (pF)
100000
10000
1000
100
Ciss
Coss
Crss
0 10 20 30 40 50
VDS, Drain to Source Voltage (V)

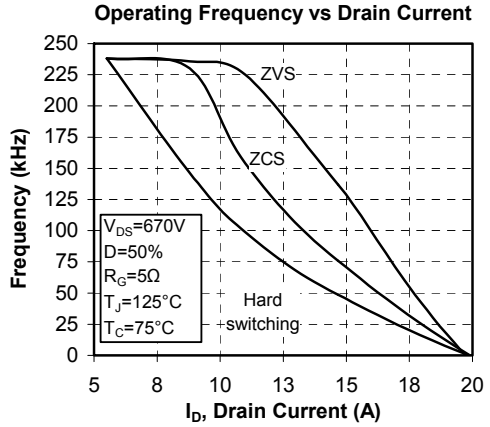

Gate Charge vs Gate to Source Voltage
ID=22A
TJ=25°C
VDS=200V
VDS=500V
VDS=800V
VGS, Gate to Source Voltage (V)
14
12
10
8
6
4
2
0
0 50 100 150 200 250
Gate Charge (nC)

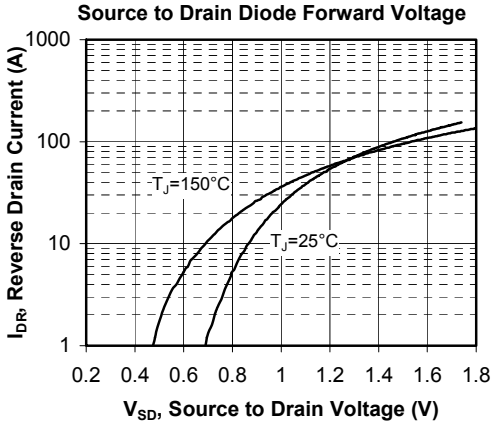

Delay Times vs Current
$t_{d(on)}$ and $t_{d(off)}$ (ns)
$I_D$, Drain Current (A)
$V_{DS}$=670V
$R_G$=5Ω
$T_J$=125°C
L=100µH
$t_{d(off)}$
$t_{d(on)}$


Rise and Fall times vs Current
$t_r$ and $t_f$ (ns)
$I_D$, Drain Current (A)
$V_{DS}$=670V
$R_G$=5Ω
$T_J$=125°C
L=100µH
$t_f$
$t_r$


Switching Energy vs Current
Switching Energy (mJ)
$I_D$, Drain Current (A)
$V_{DS}$=670V
$R_G$=5Ω
$T_J$=125°C
L=100µH
$E_{on}$
$E_{off}$


Switching Energy vs Gate Resistance
Switching Energy (mJ)
Gate Resistance (Ohms)
$V_{DS}$=670V
$I_D$=22A
$T_J$=125°C
L=100µH
$E_{off}$
$E_{on}$
$E_{off}$


Operating Frequency vs Drain Current
Frequency (kHz)
$I_D$, Drain Current (A)
$V_{DS}$=670V
D=50%
$R_G$=5Ω
$T_J$=125°C
$T_C$=75°C
ZVS
ZCS
Hard
switching


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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