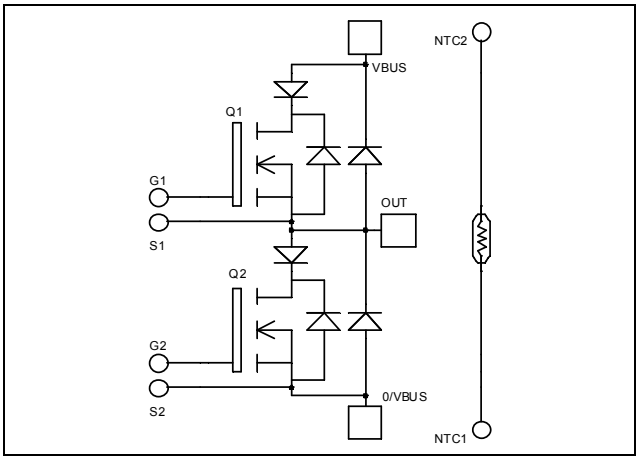
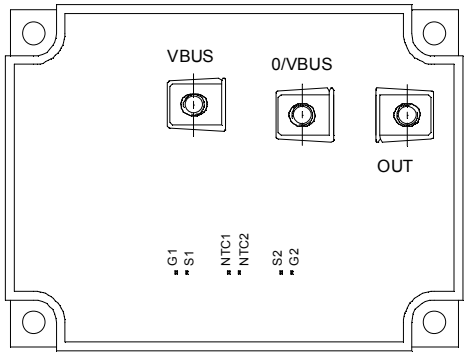
# APTM50AM19ST

## *Phase leg Schottky Series & parallel diodes MOSFET Power Module*

$V_{DSS}$ = 500V
$R_{DSon}$ = 19mΩ max @ Tj = 25°C
$I_D$ = 170A @ 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
  - M5 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 for signal and M5 for power for easy PCB mounting

## 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 | 170 | A |
| | | $T_c$ = 80°C | 125 | |
| $I_{DM}$ | Pulsed Drain current | | 360 | |
| $V_{GS}$ | Gate - Source Voltage | | ±30 | V |
| $R_{DSon}$ | Drain - Source ON Resistance | | 19 | mΩ |
| $P_D$ | Maximum Power Dissipation | $T_c$ = 25°C | 1250 | 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 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, $I_D$ = 500µA | | 500 | | | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{GS}$ = 0V, $V_{DS}$ = 500V | $T_j$ = 25°C | | | 500 | µA |
| | | $V_{GS}$ = 0V, $V_{DS}$ = 400V | $T_j$ = 125°C | | | 2000 | |
| $R_{DS(on)}$ | Drain – Source on Resistance | $V_{GS}$ = 10V, $I_D$ = 85A | | | | 19 | 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<br>$V_{DS}$ = 25V<br>f = 1MHz | | 22.4 | | nF |
| $C_{oss}$ | Output Capacitance | | | 4.8 | | |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 0.36 | | |
| $Q_g$ | Total gate Charge | $V_{GS}$ = 10V<br>$V_{Bus}$ = 250V<br>$I_D$ = 170A | | 492 | | nC |
| $Q_{gs}$ | Gate – Source Charge | | | 132 | | |
| $Q_{gd}$ | Gate – Drain Charge | | | 260 | | |
| $T_{d(on)}$ | Turn-on Delay Time | **Inductive switching @ 125°C**<br>$V_{GS}$ = 15V<br>$V_{Bus}$ = 333V<br>$I_D$ = 170A<br>$R_G$ = 1Ω | | 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 ❶ | **Inductive switching @ 25°C**<br>$V_{GS}$ = 15V, $V_{Bus}$ = 333V<br>$I_D$ = 170A, $R_G$ = 1Ω | | 3020 | | µJ |
| $E_{off}$ | Turn-off Switching Energy ❷ | | | 2904 | | |
| $E_{on}$ | Turn-on Switching Energy ❶ | **Inductive switching @ 125°C**<br>$V_{GS}$ = 15V, $V_{Bus}$ = 333V<br>$I_D$ = 170A, $R_G$ = 1Ω | | 4964 | | µJ |
| $E_{off}$ | Turn-off Switching Energy ❷ | | | 3384 | | |

## Series Schottky diode ratings and characteristics

| *Symbol* | *Characteristic* | *Test Conditions* | | *Min* | *Typ* | *Max* | *Unit* |
|---|---|---|---|---|---|---|---|
| $I_{F(AV)}$ | Maximum Average Forward Current | 50% duty cycle | $T_c$ = 85°C | | 120 | | A |
| $V_F$ | Diode Forward Voltage | $I_F$ = 120A | | | 0.77 | | V |
| | | $I_F$ = 120A | $T_j$ = 125°C | | 0.62 | | |

❶ $E_{on}$ includes diode reverse recovery.
❷ In accordance with JEDEC standard JESD24-1.

## Parallel diode ratings and characteristics

| Symbol | Characteristic | Test Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $I_{F(AV)}$ | Maximum Average Forward Current | 50% duty cycle | $T_c$ = 70°C | | 180 | | A |
| $V_F$ | Diode Forward Voltage | $I_F$ = 180A | | | 1.6 | 1.8 | V |
| | | $I_F$ = 360A | | | 1.9 | | |
| | | $I_F$ = 180A | $T_j$ = 125°C | | 1.4 | | |
| $t_{rr}$ | Reverse Recovery Time | $I_F$ = 180A<br>$V_R$ = 400V<br>di/dt = 600A/µs | $T_j$ = 25°C | | 130 | | ns |
| | | | $T_j$ = 125°C | | 170 | | |
| $Q_{rr}$ | Reverse Recovery Charge | $I_F$ = 180A<br>$V_R$ = 400V<br>di/dt = 600A/µs | $T_j$ = 25°C | | 660 | | nC |
| | | | $T_j$ = 125°C | | 2760 | | |

## Thermal and package characteristics

| Symbol | Characteristic | | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $R_{thJC}$ | Junction to Case | Transistor | | | | 0.1 | °C/W |
| | | Series Diode | | | | 0.5 | |
| | | Parallel diode | | | | 0.32 | |
| $V_{ISOL}$ | 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 | |
| $T_C$ | Operating Case Temperature | | | -40 | | 100 | |
| Torque | Mounting torque | To heatsink | M5 | 2 | | 3.5 | N.m |
| | | For terminals | M5 | 2 | | 3.5 | |
| Wt | Package Weight | | | | | 620 | g |

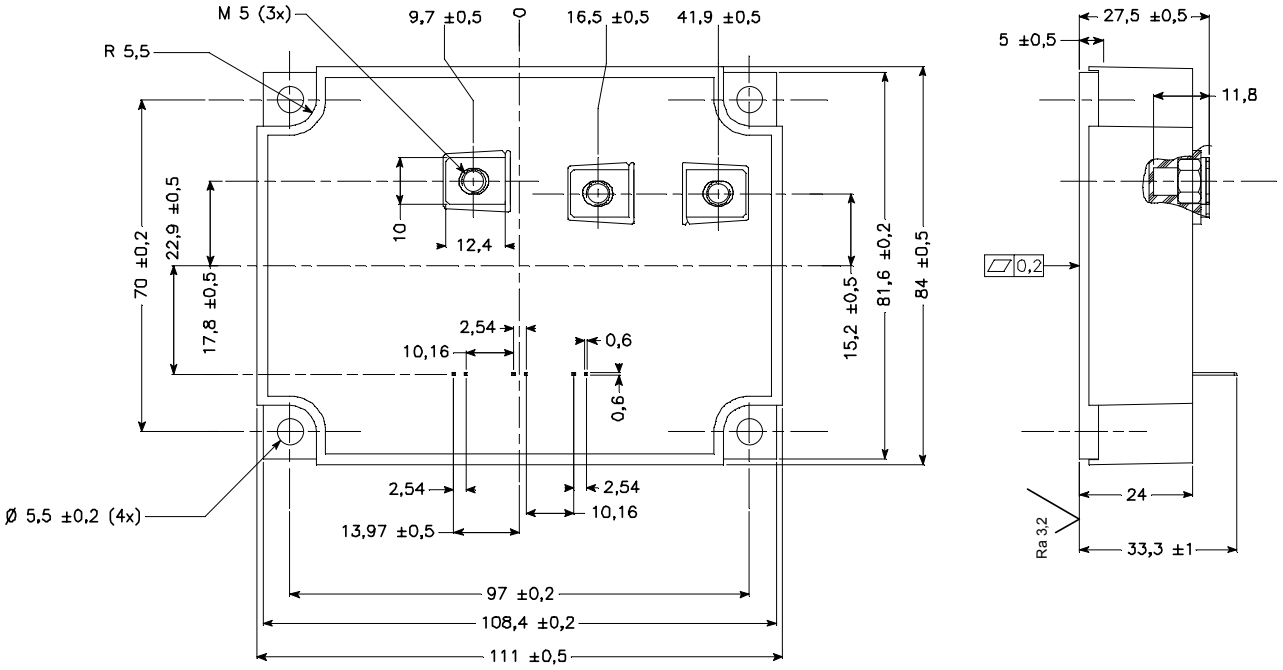
## Temperature sensor NTC

| Symbol | Characteristic | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| $R_{25}$ | Resistance @ 25°C | | 68 | | kΩ |
| $B_{25/85}$ | $T_{25}$ = 298.16 K | | 4080 | | K |

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

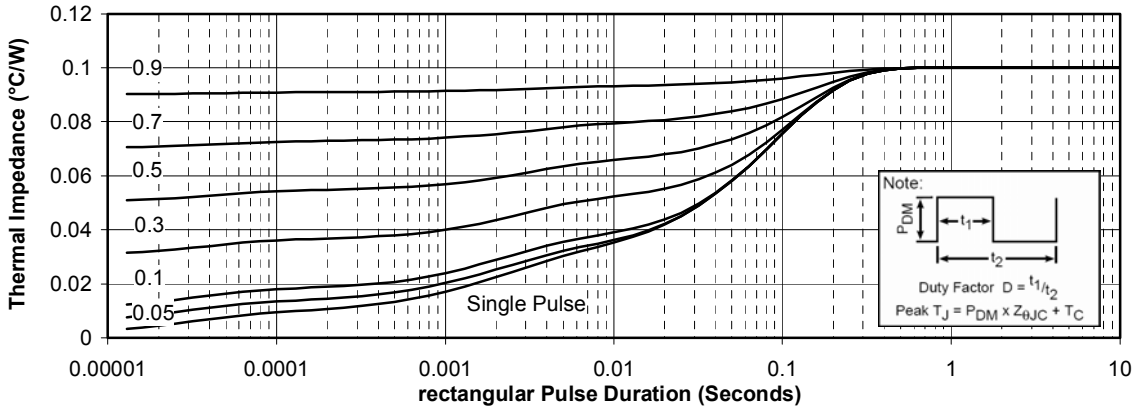
T: Thermistor temperature
$R_T$: Thermistor value at T

## Package outline

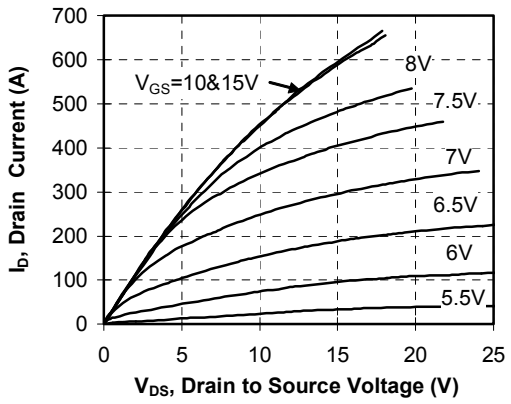


## Typical Performance Curve

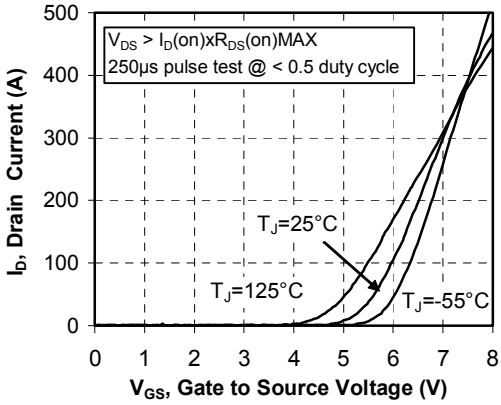
**Maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration**



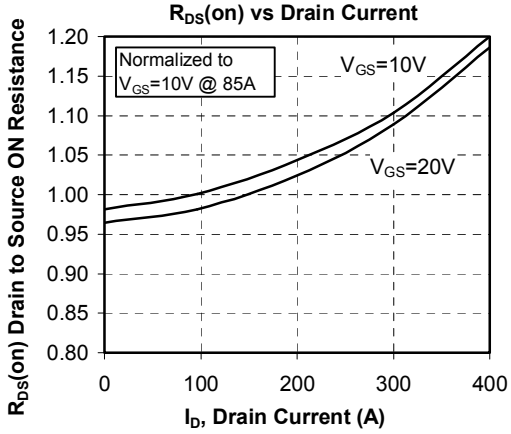

**Low Voltage Output Characteristics**



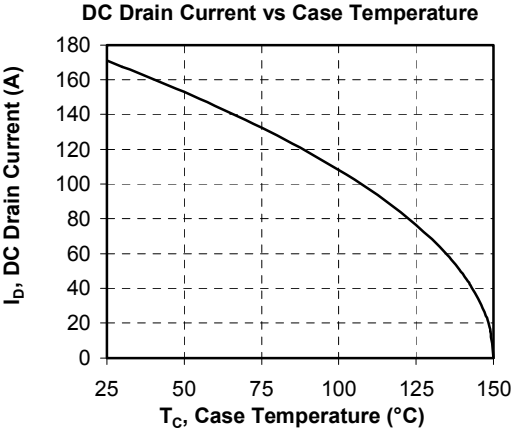

**Transfert Characteristics**



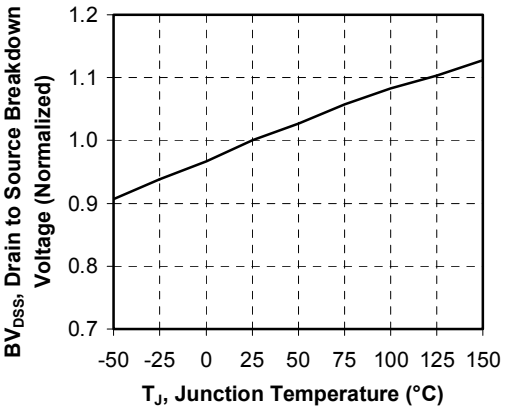

**$R_{DS}$(on) vs Drain Current**



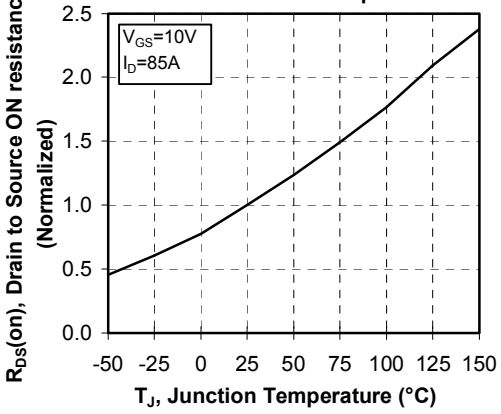

**DC Drain Current vs Case Temperature**



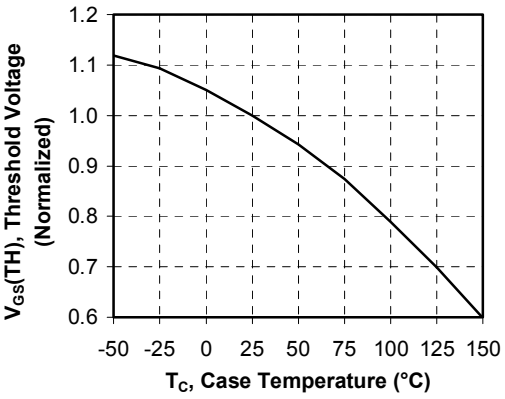
**Breakdown Voltage vs Temperature**



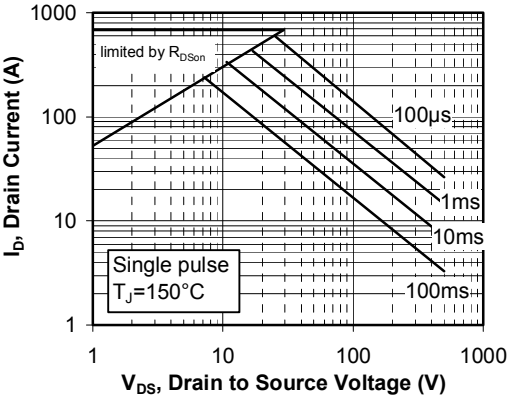

**ON resistance vs Temperature**



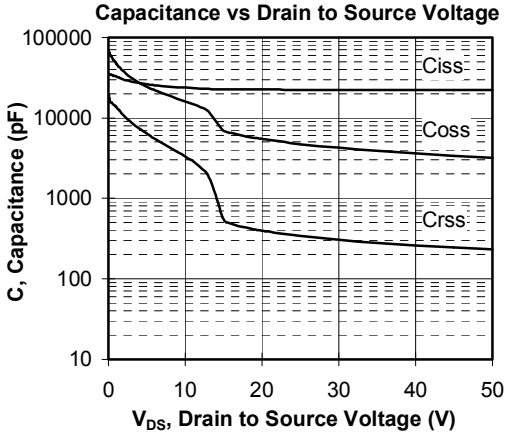

**Threshold Voltage vs Temperature**




**Maximum Safe Operating Area**




**Capacitance vs Drain to Source Voltage**




**Gate Charge vs Gate to Source Voltage**