Bulletin I27190 02/05

International
IOR Rectifier

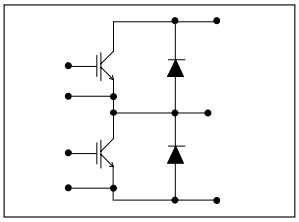
# 50MT060WHA
# 50MT060WHTA

## "HALF-BRIDGE" IGBT MTP

## Warp Speed IGBT

### Features

- Gen. 4 Warp Speed IGBT Technology
- HEXFRED ™ Antiparallel Diodes with UltraSoft Reverse Recovery
- Very Low Conduction and Switching Losses
- Optional SMD Thermistor (NTC)
- $Al_2O_3$ DBC
- Very Low Stray Inductance Design for High Speed Operation
- UL E78996 approved



$V_{CES}$ = 600V

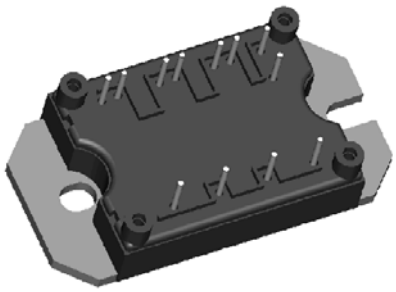
$V_{CE(on)\ typ.}$ = 2.3V @

$V_{GE}$ = 15V, $I_C$ = 50A

$T_C$ = 25°C

### Benefits

- Optimized for Welding, UPS and SMPS Applications
- Operating Frequencies > 20 kHz Hard Switching, >200 kHz Resonant Mode
- Low EMI, requires Less Snubbing
- Direct Mounting to Heatsink
- PCB Solderable Terminals
- Very Low Junction-to-Case Thermal Resistance



MTP

### Absolute Maximum Ratings

| | Parameters | | Max | Units |
|---|---|---|---|---|
| $V_{CES}$ | Collector-to-Emitter Voltage | | 600 | V |
| $I_C$ | Continuos Collector Current | @ $T_C$ = 25°C | 114 | A |
| | | @ $T_C$ = 109°C | 50 | |
| $I_{CM}$ | Pulsed Collector Current | | 350 | |
| $I_{LM}$ | Peak Switching Current | | 350 | |
| $I_F$ | Diode Continuous Forward Current | @ $T_C$ = 109°C | 34 | |
| $I_{FM}$ | Peak Diode Forward Current | | 200 | |
| $V_{GE}$ | Gate-to-Emitter Voltage | | ± 20 | V |
| $V_{ISOL}$ | RMS Isolation Voltage, Any Terminal to Case, t = 1 min | | 2500 | |
| $P_D$ | Maximum Power Dissipation | @ $T_C$ = 25°C | 658 | W |
| | | @ $T_C$ = 100°C | 263 | |

## Electrical Characteristics @ $T_J$ = 25°C (unless otherwise specified)

| | Parameters | Min | Typ | Max | Units | Test Conditions |
|---|---|---|---|---|---|---|
| $V_{(BR)CES}$ | Collector-to-Emitter Breakdown Voltage | 600 | | | V | $V_{GE}$ = 0V, $I_C$ = 500µA |
| $V_{CE(on)}$ | Collector-to-Emitter Voltage | | 2.3 | 3.15 | | $V_{GE}$ = 15V, $I_C$ = 50A |
| | | | 2.5 | 3.2 | | $V_{GE}$ = 15V, $I_C$ = 100A |
| | | | 1.72 | 2.17 | | $V_{GE}$ = 15V, $I_C$ = 50A, $T_J$ = 150°C |
| $V_{GE(th)}$ | Gate Threshold Voltage | 3 | | 6 | | $I_C$ = 0.5mA |
| $I_{CES}$ | Collector-to-Emiter Leaking Current | | | 0.4 | mA | $V_{GE}$ = 0V, $V_{CE}$ = 600V |
| | | | | 10 | | $V_{GE}$ = 0V, $V_{CE}$ = 600V, $T_J$ = 150°C |
| $V_{FM}$ | Diode Forward Voltage Drop | | 1.58 | 1.80 | V | $I_F$ = 50A, $V_{GE}$ = 0V |
| | | | 1.49 | 1.68 | | $I_F$ = 50A, $V_{GE}$ = 0V, $T_J$ = 150°C |
| | | | 1.9 | 2.17 | | $I_F$ = 100A, $V_{GE}$ = 0V, $T_J$ = 25°C |
| $I_{GES}$ | Gate-to-Emitter Leakage Current | | | ± 250 | nA | $V_{GE}$ = ± 20V |

## Switching Characteristics @ $T_J$ = 25°C (unless otherwise specified)

| | Parameters | Min | Typ | Max | Units | Test Conditions |
|---|---|---|---|---|---|---|
| $Q_g$ | Total Gate Charge (turn-on) | | 331 | 385 | nC | $I_C$ = 52A |
| $Q_{ge}$ | Gate-Emitter Charge (turn-on) | | 44 | 52 | | $V_{CC}$ = 400V |
| $Q_{gc}$ | Gate-Collector Charge (turn-on) | | 133 | 176 | | $V_{GE}$ = 15V |
| $E_{on}$ | Turn-On Switching Loss | | 0.26 | | mJ | Internal gate resistors (see Electrical Diagram) |
| $E_{off}$ | Turn-Off Switching Loss | | 1.2 | | | $I_C$ = 50A, $V_{CC}$ = 480V, $V_{GE}$ = 15V, L = 200µH |
| $E_{ts}$ | Total Switching Loss | | 1.46 | | | Energy losses include tail and diode reverse recovery |
| $E_{on}$ | Turn-On Switching Loss | | 0.73 | | mJ | Internal gate resistors (see Electrical diagram) |
| $E_{off}$ | Turn-Off Switching Loss | | 1.66 | | | $I_C$ = 50A, $V_{CC}$ = 480V, $V_{GE}$ = 15V, L = 200µH |
| $E_{ts}$ | Total Switching Loss | | 2.39 | | | Energy losses include tail and diode reverse recovery, $T_J$ = 150°C |
| $C_{ies}$ | Input Capacitance | | 7100 | | pF | $V_{GE}$ = 0V |
| $C_{oes}$ | Output Capacitance | | 510 | | | $V_{CC}$ = 30V |
| $C_{res}$ | Reverse Transfer Capacitance | | 140 | | | f = 1.0 MHz |
| trr | Diode Reverse Recovery Time | | 82 | 97 | ns | $V_{CC}$ = 200V, $I_C$ = 50A |
| Irr | Diode Peak Reverse Current | | 8.3 | 10.6 | A | di/dt = 200A/µs |
| Qrr | Diode Recovery Charge | | 340 | 514 | nC | |
| trr | Diode Reverse Recovery Time | | 137 | 153 | ns | $V_{CC}$ = 200V, $I_C$ = 50A |
| Irr | Diode Peak Reverse Current | | 12.7 | 14.8 | A | di/dt = 200A/µs |
| Qrr | Diode Recovery Charge | | 870 | 1132 | nC | $T_J$ = 125°C |

## Thermistor Specifications (50MT060WHTA only)

| | Parameters | Min | Typ | Max | Units | Test Conditions |
|---|---|---|---|---|---|---|
| $R_0$ (1) | Resistance | | 30 | | kΩ | $T_0$ = 25°C |
| β (1)(2) | Sensitivity index of the thermistor material | | 4000 | | K | $T_0$ = 25°C<br>$T_1$ = 85°C |

(1) $T_0$,$T_1$ are thermistor's temperatures

(2) $\frac{R_0}{R_1} = \exp\left[\beta\left(\frac{1}{T_0} - \frac{1}{T_1}\right)\right]$

## Thermal- Mechanical Specifications

| | Parameters | | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| $T_J$ | Operating Junction | IGBT, Diode | - 40 | | 150 | °C |
| | Temperature Range | Thermistor | - 40 | | 125 | |
| $T_{STG}$ | Storage Temperature Range | | - 40 | | 125 | |
| $R_{thJC}$ | Junction-to-Case | IGBT | | | 0.38 | °C/ W |
| | | Diode | | | 0.8 | |
| $R_{thCS}$ | Case-to-Sink | Module | | 0.06 | | |
| | (Heatsink Compound Thermal Conductivity = 1 W/mK) | | | | | |
| | Clearance (3) (external shortest distance in air between two terminals) | | 5.5 | | | mm |
| | Creepage (3) (shortest distance along the external surface of the insulating material between 2 terminals) | | 8 | | | |
| T | Mounting torque to heatsink (4) | | 3 ± 10% | | | Nm |
| Wt | Weight | | 66 | | | g |

(3) Standard version only i.e. without optional thermistor

(4) A mounting compound is recommended and the torque should be checked after 3 hours to allow for the spread of the compound. Lubricated threads

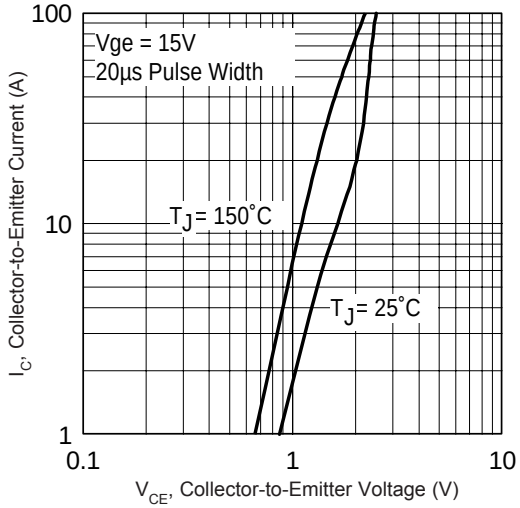



Fig. 1 - Typical Output Characteristics

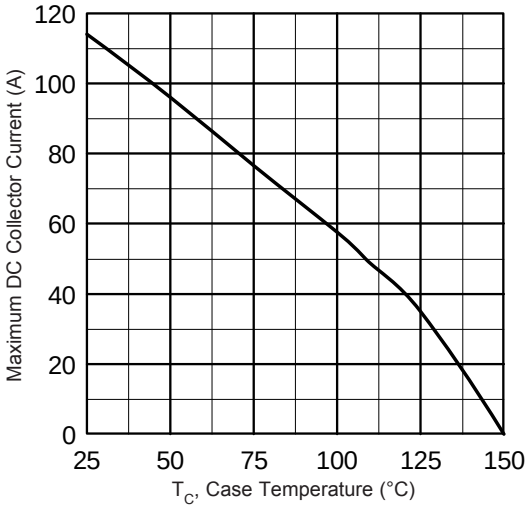



Fig. 2 - Maximum Collector Current vs. Case Temperature

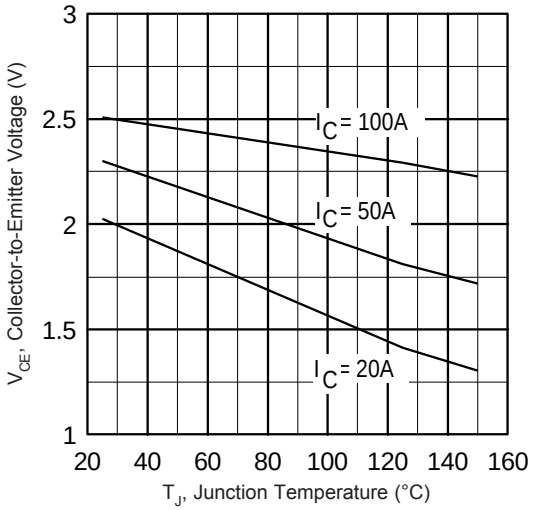



Fig. 3 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

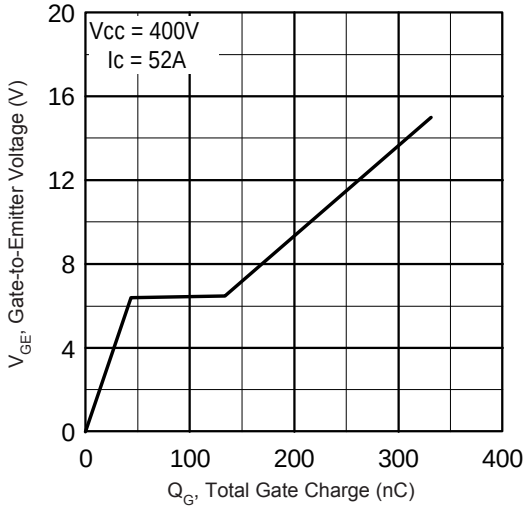



Fig. 4 - Typical Gate Charge vs. Gate-to-Emitter Voltage

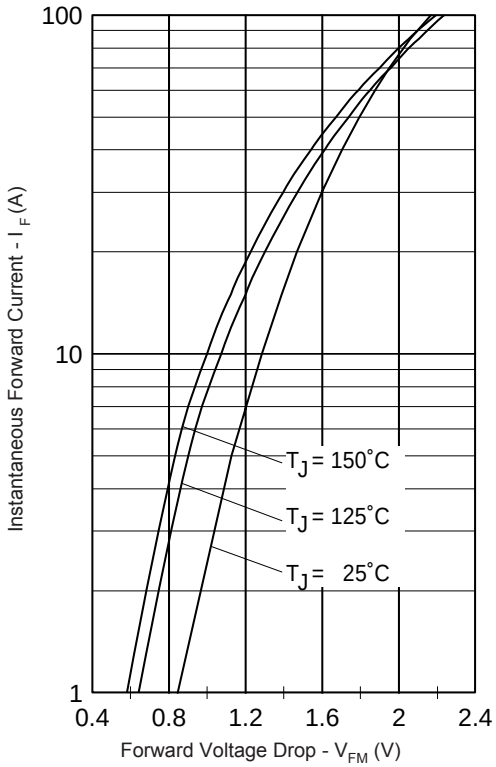



Fig. 5 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

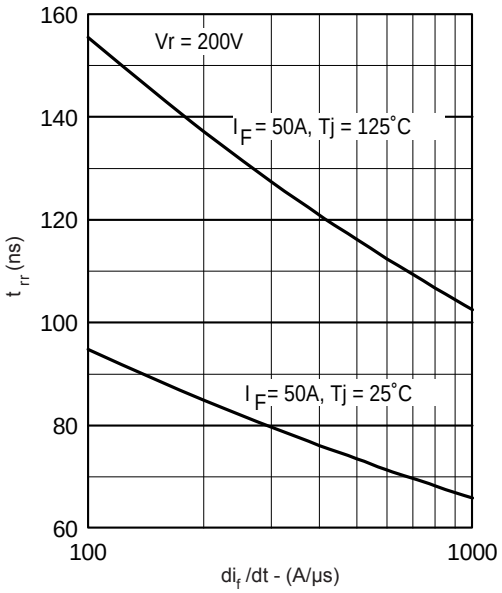



Fig. 6 - Typical Reverse Recovery vs. $di_f/dt$

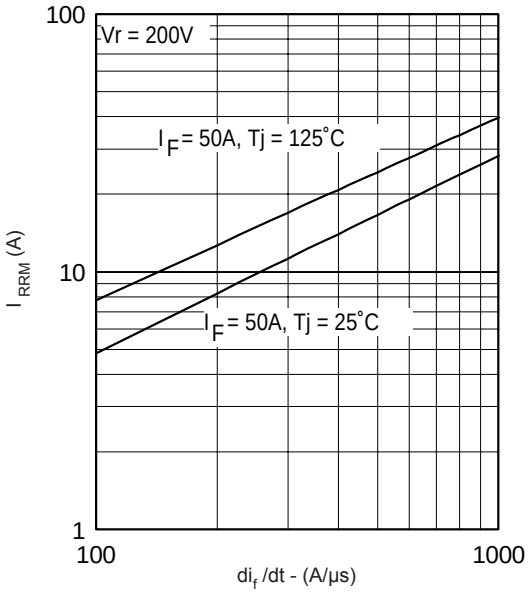



Fig. 7 - Typical Reverse Recovery Current vs. $di_f/dt$

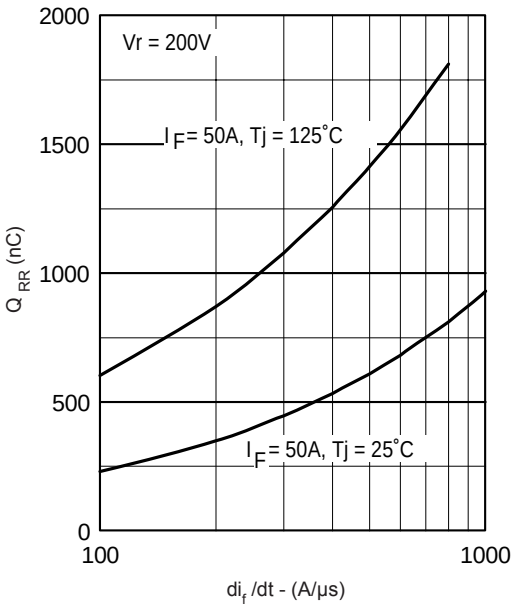
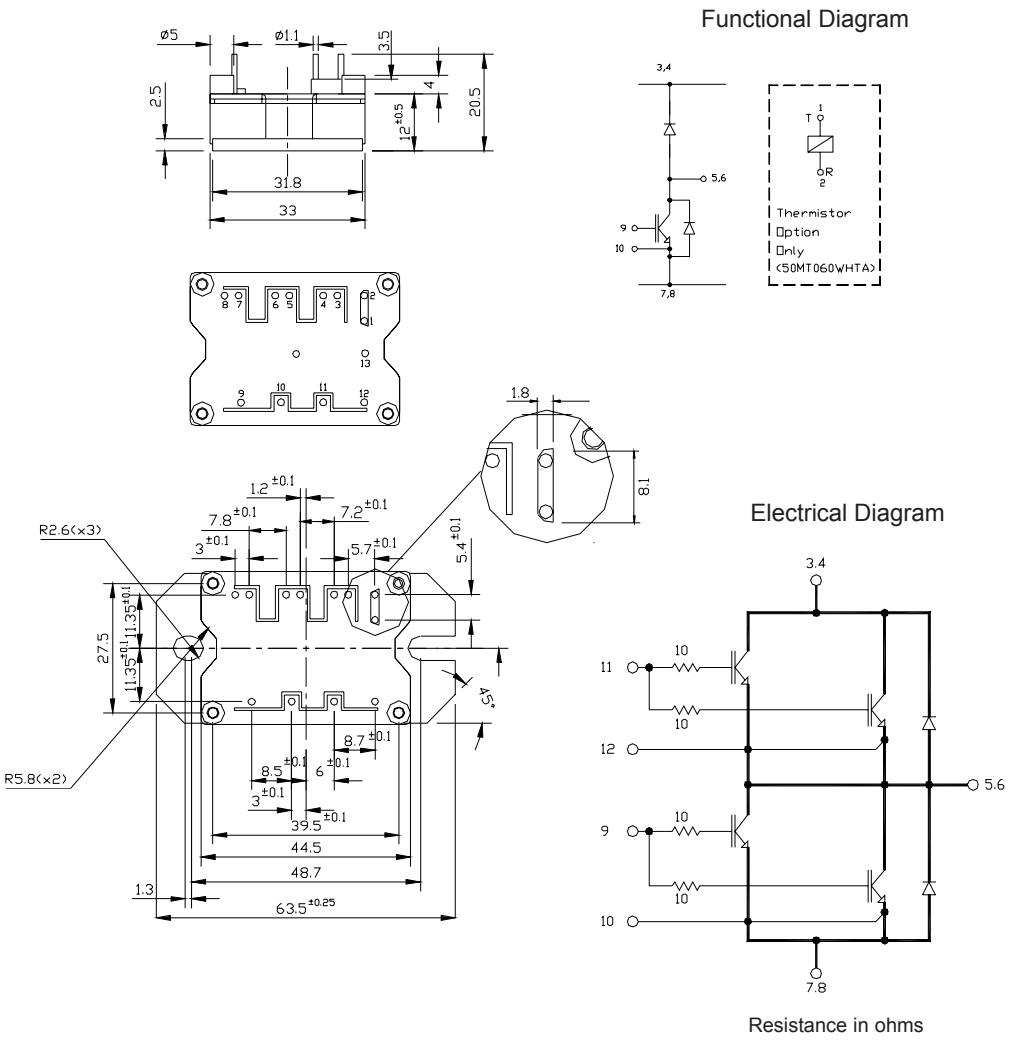



Fig. 8 - Typical Stored Charge vs. $di_f/dt$

## Outline Table

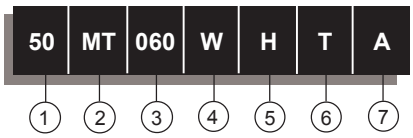



Dimensions in millimetres

Note: unused terminals are not assembled in the package

## Ordering Information Table

**Device Code**




1 - Current Rating (50 = 50A)
2 - Essential Part Number
3 - Voltage rating (060 = 600V)
4 - Speed/ Type (W = Warp IGBT)
5 - Circuit Configuration (H = Half Bridge)
6 - Special Option
- none = no special option
- T = Thermistor

7 - A = $Al_2O_3$ DBC Substrate

Data and specifications subject to change without notice.
This product has been designed and qualified for Industrial Level.
Qualification Standards can be found on IR's Web site.

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