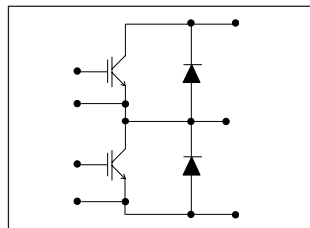


#### Features

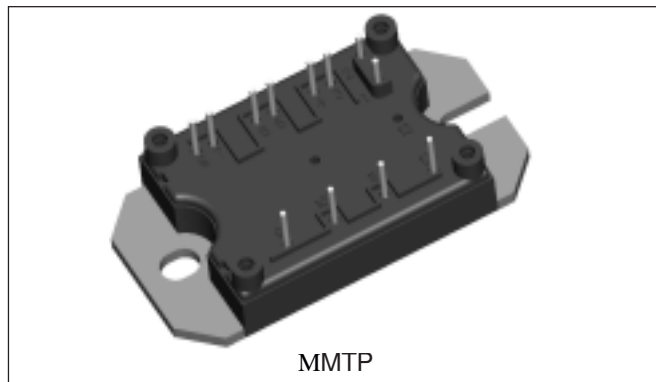
- Gen. 4 Warp Speed IGBT Technology
- HEXFRED™ Antiparallel Diodes with UltraSoft Reverse Recovery
- Very Low Conduction and Switching Losses
- Optional SMT Thermistor (NTC)
- Aluminum Nitride DBC
- Very Low Stray Inductance Design for High Speed Operation
- UL E78996 approved



$V_{CES} = 600V$   
 $V_{CE(on) \text{ typ.}} = 2.3V @$   
 $V_{GE} = 15V, I_C = 50A$   
 $T_C = 25^\circ C$

#### 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



#### Absolute Maximum Ratings

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

**Electrical Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)**

Parameters	Min	Typ	Max	Units	Test Conditions
V <sub>(BR)CES</sub> Collector-to-Emitter Breakdown Voltage	600			V	V <sub>GE</sub> = 0V, I <sub>C</sub> = 500μA
V <sub>CE(on)</sub> Collector-to-Emitter Voltage		2.3	3.15		V <sub>GE</sub> = 15V, I <sub>C</sub> = 50A
		2.5	3.2		V <sub>GE</sub> = 15V, I <sub>C</sub> = 100A
		1.72	2.17		V <sub>GE</sub> = 15V, I <sub>C</sub> = 50A, T <sub>J</sub> = 150°C
V <sub>GE(th)</sub> Gate Threshold Voltage	3		6		I <sub>C</sub> = 0.5mA
I <sub>CES</sub> Collector-to-Emitter Leaking Current			0.4	mA	V <sub>GE</sub> = 0V, V <sub>CE</sub> = 600V
			10		V <sub>GE</sub> = 0V, V <sub>CE</sub> = 600V, T <sub>J</sub> = 150°C
V <sub>FM</sub> Diode Forward Voltage Drop		1.58	1.80	V	I <sub>F</sub> = 50A, V <sub>GE</sub> = 0V
		1.49	1.68		I <sub>F</sub> = 50A, V <sub>GE</sub> = 0V, T <sub>J</sub> = 150°C
		1.9	2.17		I <sub>F</sub> = 100A, V <sub>GE</sub> = 0V, T <sub>J</sub> = 25°C
I <sub>GES</sub> Gate-to-Emitter Leakage Current			± 250	nA	V <sub>GE</sub> = ± 20V

**Switching Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)**

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

**Thermistor Specifications**

Parameters	Min	Typ	Max	Units	Test Conditions
R <sub>0</sub> <sup>(1)</sup> Resistance		30		kΩ	T <sub>0</sub> = 25°C
β <sup>(1)(2)</sup> Sensitivity index of the thermistor material		4000		K	T <sub>0</sub> = 25°C T <sub>1</sub> = 85°C

<sup>(1)</sup> T<sub>0</sub>, T<sub>1</sub> are thermistor's temperatures

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

### Thermal- Mechanical Specifications

Parameters			Min	Typ	Max	Units
T <sub>J</sub>	Operating Junction	IGBT, Diode	- 40		150	°C
	Temperature Range	Thermistor	- 40		125	
T <sub>STG</sub>	Storage Temperature Range		- 40		125	
R <sub>thJC</sub>	Junction-to-Case	IGBT			0.38	°C/ W
		Diode			0.8	
R <sub>thCS</sub>	Case-to-Sink	Module		0.06		
(Heatsink Compound Thermal Conductivity = 1 W/mK)						
	Clearance <sup>(3)</sup> (external shortest distance in air between two terminals)		5.5			mm
	Creepage <sup>(3)</sup> (shortest distance along the external surface of the insulating material between 2 terminals)		8			
T	Mounting torque to heatsink <sup>(4)</sup>		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

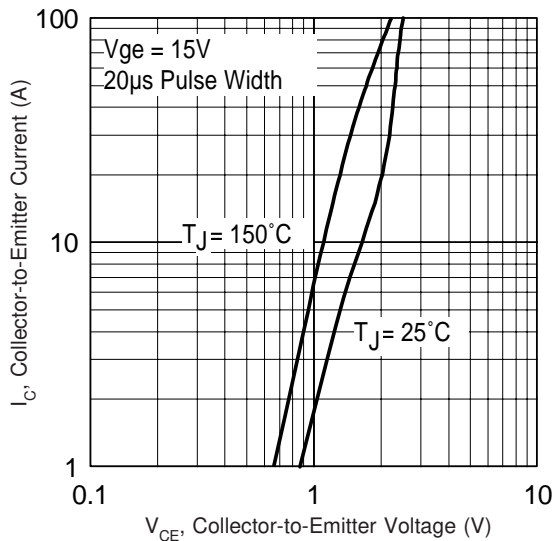


Fig. 1 - Typical Output Characteristics

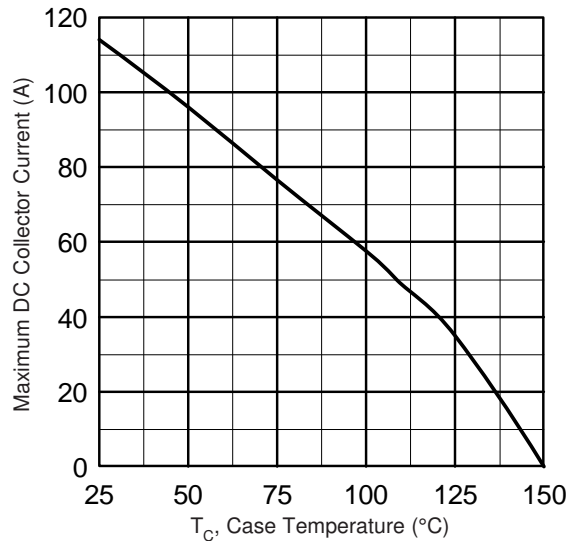


Fig. 2 - Maximum Collector Current vs. Case Temperature

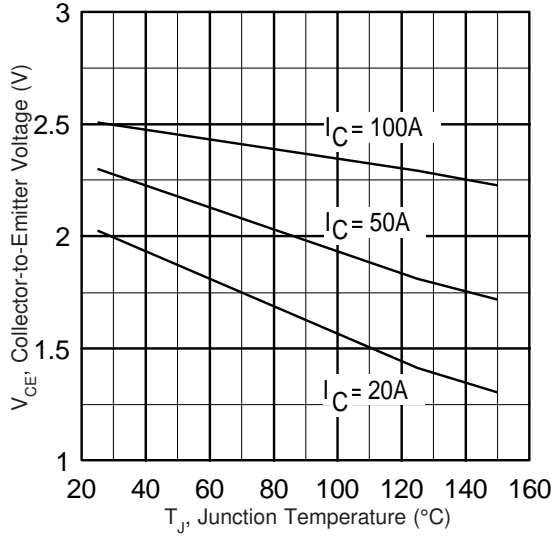


Fig. 3 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

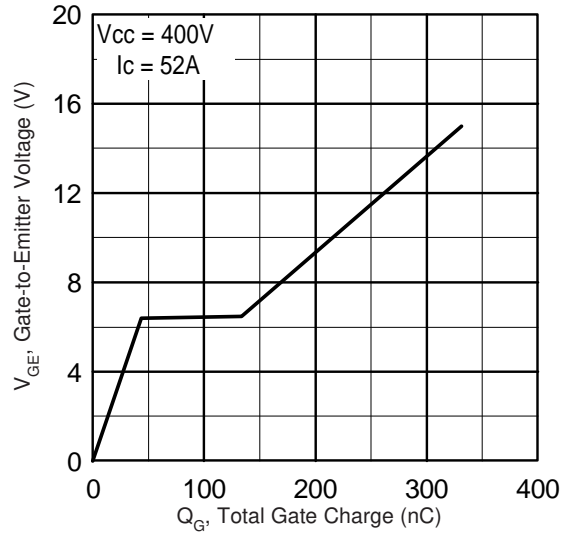


Fig. 4 - Typical Gate Charge vs. Gate-to-Emitter Voltage

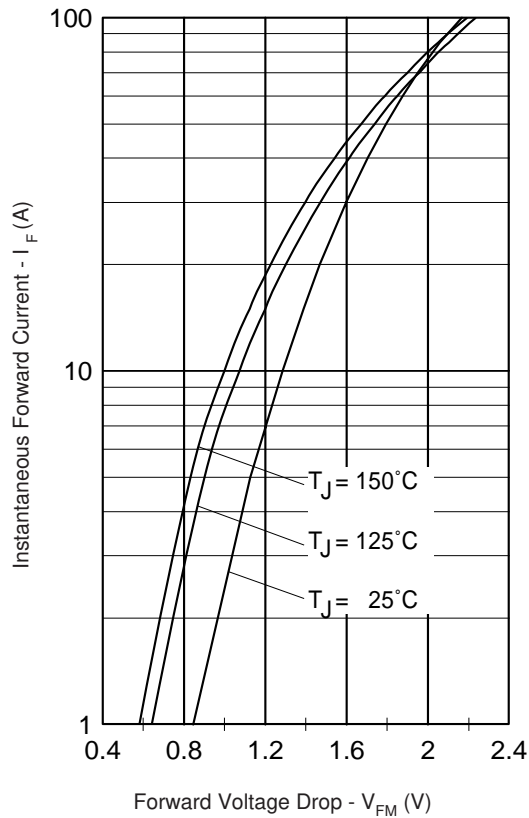


Fig. 5 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

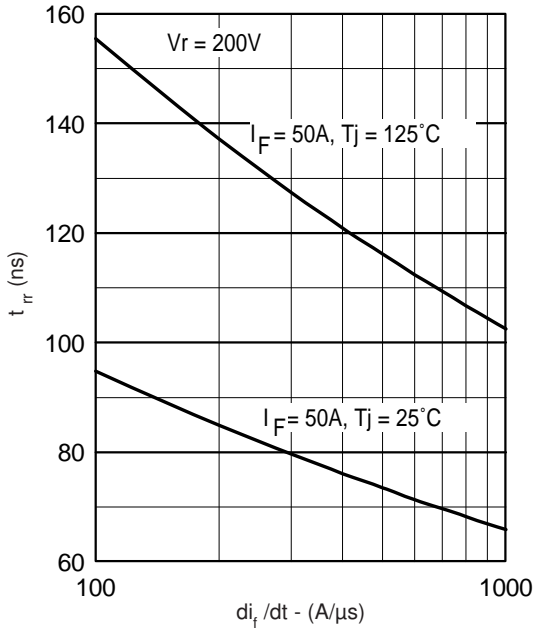


Fig. 6 - Typical Reverse Recovery vs.  $di_f/dt$

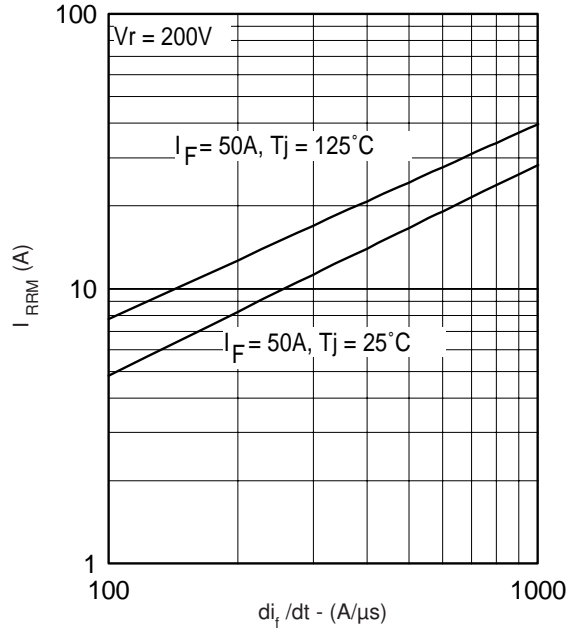


Fig. 7 - Typical Reverse Recovery Current vs.  $di_f/dt$

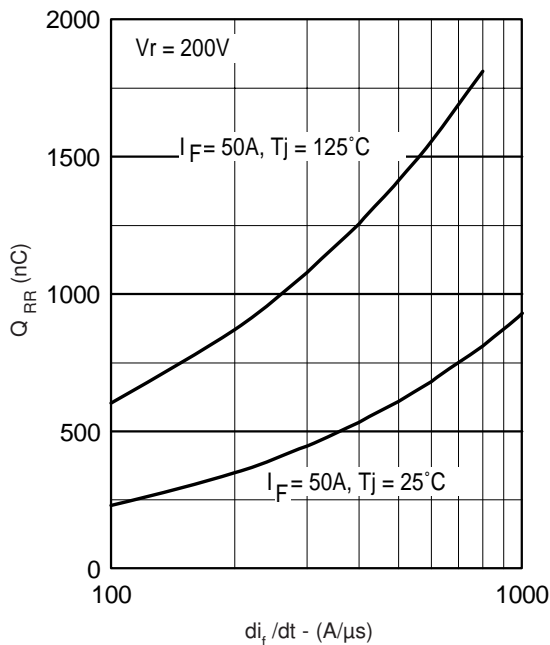
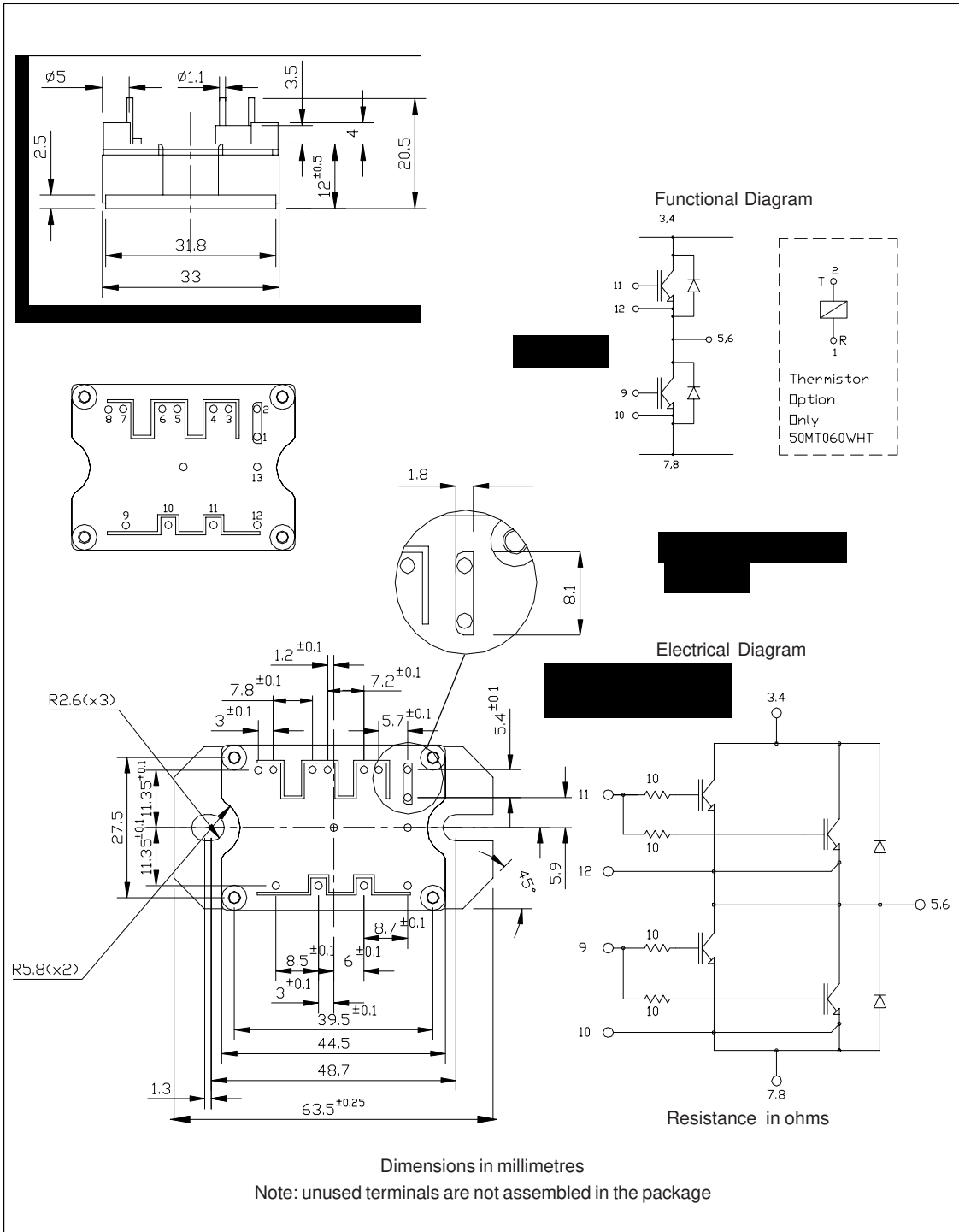


Fig. 8 - Typical Stored Charge vs.  $di_f/dt$

**Outline Table**



**Ordering Information Table**

Device Code	
50	MT 060 W H -
①	② ③ ④ ⑤ ⑥
1	- Current rating (50 = 50A)
2	- Essential Part Number
3	- Voltage code (060 = 600V)
4	- Speed/ Type (W = Warp IGBT)
5	- Circuit Configuration (H = Half Bridge)
6	- Special Option
	Empty = no special option T = Thermistor

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.