Bulletin I27194 03/05

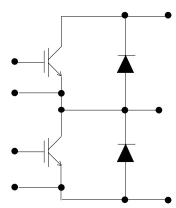
International
IOR Rectifier

40MT120UHA
40MT120UHTA

"HALF-BRIDGE" IGBT MTP — UltraFast NPT IGBT

Features

- UltraFast Non Punch Through (NPT) Technology
- Positive $V_{CE(ON)}$ Temperature Coefficient
- 10µs Short Circuit Capability
- HEXFRED ™ Antiparallel Diodes with UltraSoft Reverse Recovery and Low V_F
- Square RBSOA
- Al_2O_3 DBC
- Optional SMD Thermistor (NTC)
- Very Low Stray Inductance Design for High Speed Operation

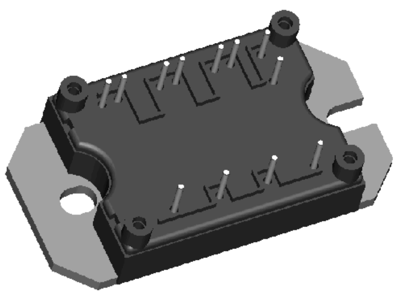


V_{CES} = 1200V

I_C = 80A

Benefits

- Optimized for Welding, UPS and SMPS Applications
- Rugged with UltraFast Performance
- Benchmark Efficiency above 20KHz
- Outstanding ZVS and Hard Switching Operation
- Low EMI, requires Less Snubbing
- Excellent Current Sharing in Parallel Operation
- Direct Mounting to Heatsink
- PCB Solderable Terminals
- Very Low Junction-to-Case Thermal Resis tance



MTP

Absolute Maximum Ratings

	Parameters		Max	Units
V_{CES}	Collector-to-Emitter Breakdown Voltage		1200	V
I_C	Continuous Collector Current	@ T_C = 22°C	80	A
		@ T_C = 104°C	40	
I_{CM}	Pulsed Collector Current		160	
I_{LM}	Clamped Inductive Load Current		160	
I_F	Diode Continuous Forward Current	@ T_C = 105°C	21	
I_{FM}	Diode Maximum Forward Current		160	
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 (only IGBT)	@ T_C = 25°C	463	W
		@ T_C = 100°C	185	

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

	Parameters	Min	Typ	Max	Units	Test Conditions
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	1200			V	V_{GE} = 0V, I_C = 250μA
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage		+1.1		V/°C	V_{GE} = 0V, I_C = 3mA (25-125°C)
$V_{CE(ON)}$	Collector-to-Emitter Saturation Voltage		3.36	3.59	V	V_{GE} = 15V, I_C = 40A
			4.53	4.91		V_{GE} = 15V, I_C = 80A
			3.88	4.10		V_{GE} = 15V, I_C = 40A T_J = 150°C
			5.35	5.68		V_{GE} = 15V, I_C = 80A T_J = 150°C
$V_{GE(th)}$	Gate Threshold Voltage	4		6	V	V_{CE} = V_{GE}, I_C = 500μA
$\Delta V_{GE(th)}/\Delta T_J$	Temperature Coeff. of Threshold Voltage		-12		mV/°C	V_{CE} = V_{GE}, I_C = 1mA (25-125°C)
g_{fe}	Transconductance		35		S	V_{CE} = 50V, I_C = 40A, PW = 80μs
I_{CES}	Zero Gate Voltage Collector Current			250	μA	V_{GE} = 0V, V_{CE} = 1200V, T_J = 25°C
			0.4	1.0	mA	V_{GE} = 0V, V_{CE} = 1200V, T_J = 125°C
			0.2	10		V_{GE} = 0V, V_{CE} = 1200V, T_J = 150°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)		399	599	nC	I_C = 40A
Q_{ge}	Gate-Emitter Charge (turn-on)		43	65		V_{CC} = 600V
Q_{gc}	Gate-Collector Charge (turn-on)		187	281		V_{GE} = 15V
E_{on}	Turn-On Switching Loss		1142	1713	μJ	V_{CC} = 600V, I_C = 40A
E_{off}	Turn-Off Switching Loss		1345	2018		V_{GE} = 15V, R_g = 5Ω, L = 200μH
E_{tot}	Total Switching Loss		2487	3731		T_J = 25°C, Energy losses include tail and diode reverse recovery
E_{on}	Turn-On Switching Loss		1598	2397	μJ	V_{CC} = 600V, I_C = 40A
E_{off}	Turn-Off Switching Loss		1618	2427		V_{GE} = 15V, R_g = 5Ω, L = 200μH
E_{tot}	Total Switching Loss		3216	4824		T_J = 125°C, Energy losses include tail and diode reverse recovery
C_{ies}	Input Capacitance		5521	8282	pF	V_{GE} = 0V
C_{oes}	Output Capacitance		380	570		V_{CC} = 30V
C_{res}	Reverse Transfer Capacitance		171	257		f = 1.0 MHz
RBSOA	Reverse Bias Safe Operating Area	full square				T_J = 150°C, I_C = 160A V_{CC} = 1000V, V_p = 1200V R_g = 5Ω, V_{GE} = +15V to 0V
SCSOA	Short Circuit Safe Operating Area	10			μs	T_J = 150°C V_{CC} = 900V, V_p = 1200V R_g = 5Ω, V_{GE} = +15V to 0V

Diode Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameters	Min	Typ	Max	Units	Test Conditions
V_{FM}	Diode Forward Voltage Drop		2.98	3.38	V	I_C = 40A
			3.90	4.41		I_C = 80A
			3.08	3.39		I_C = 40A, T_J = 125°C
			4.29	4.72		I_C = 80A, T_J = 125°C
			3.12	3.42		I_C = 40A, T_J = 150°C
E_{rec}	Reverse Recovery Energy of the Diode		574	861	µJ	V_{GE} = 15V, R_g = 5Ω, L = 200µH
trr	Diode Reverse Recovery Time		120	180	ns	V_{CC} = 600V, I_C = 40A
Irr	Peak Reverse Recovery Current		43	65	A	T_J = 125°C

Thermistor Specifications (40MT120UHTA 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 T_1 = 85°C

(1) T_0,T_1 are thermistor's temperatures

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

Thermal- Mechanical Specifications

	Parameters		Min	Typ	Max	Units
T_J	Operating Junction Temperature Range		- 40		150	°C
T_{STG}	Storage Temperature Range		- 40		125	
R_{thJC}	Junction-to-Case	IGBT			0.29	°C/ W
		Diode			0.61	
R_{thCS}	Case-to-Sink (Heatsink Compound Thermal Conductivity = 1 W/mK)	Module		0.06		
	Clearance (external shortest distance in air between two terminals)		5.5			mm
	Creepage (shortest distance along external surface of the insulating material between 2 terminals)		8			
T	Mounting torque to heatsink	(3)	3 ± 10%			Nm
Wt	Weight		66			g (oz)

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

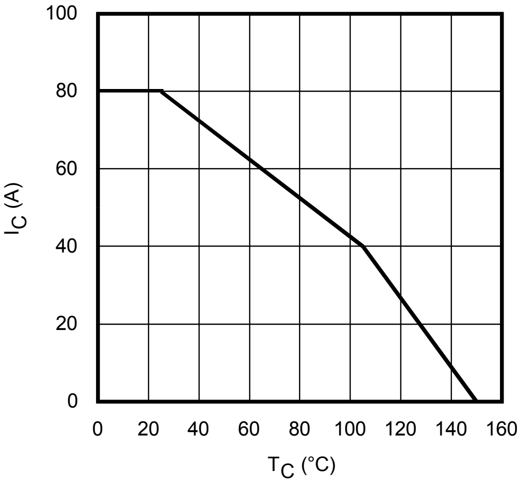


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

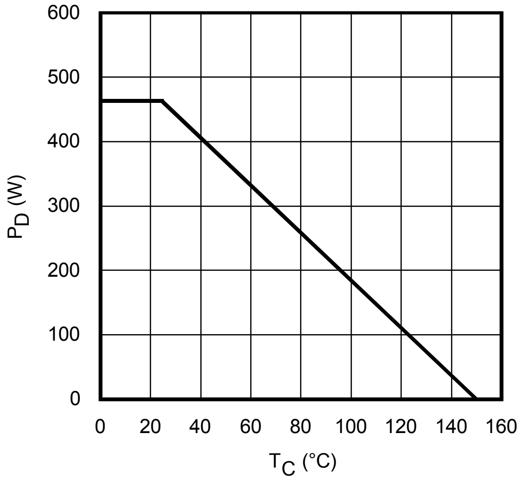


Fig. 2 - Power Dissipation vs. Case Temperature

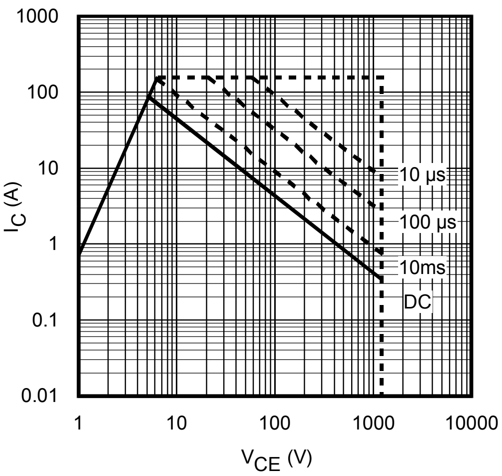


Fig. 3 - Forward SOA
T_C = 25°C; $T_J \leq$ 150°C

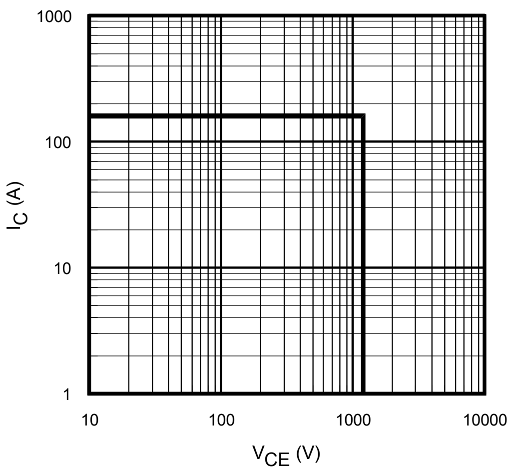


Fig. 4 - Reverse Bias SOA
T_J = 150°C; V_{GE} =15V

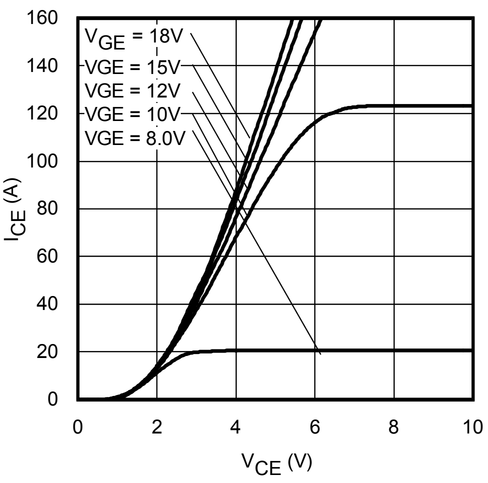


Fig. 5 - Typ. IGBT Output Characteristics
T_J = -40°C; tp = 80μs

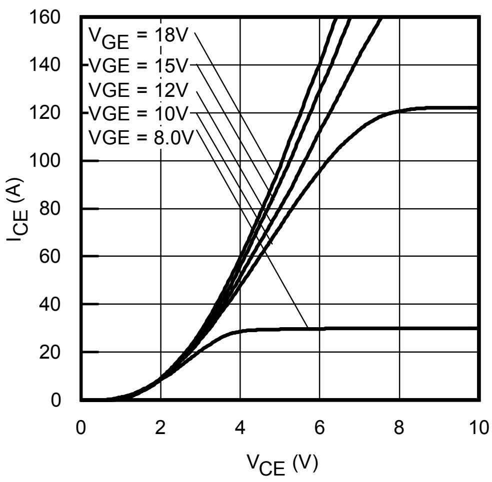


Fig. 6 - Typ. IGBT Output Characteristics
T_J = 25°C; tp = 80μs

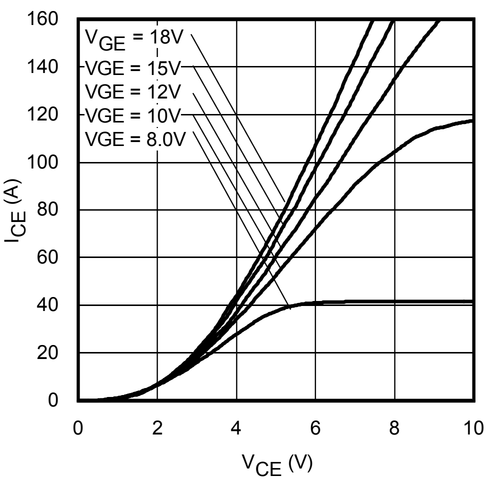


Fig. 7 - Typ. IGBT Output Characteristics
T_J = 125°C; tp = 80μs

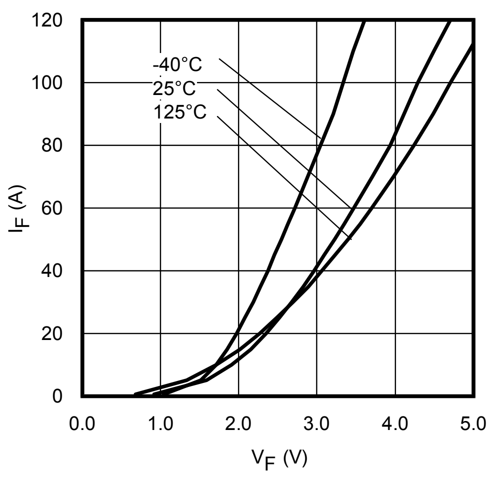


Fig. 8 - Typ. Diode Forward Characteristics
tp = 80μs

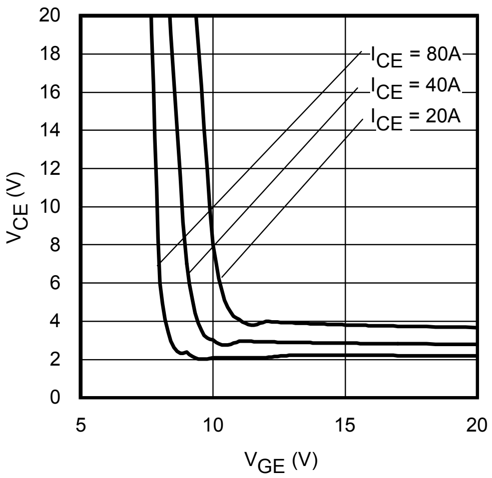


Fig. 9 - Typical V_{CE} vs. V_{GE}
T_J = -40°C

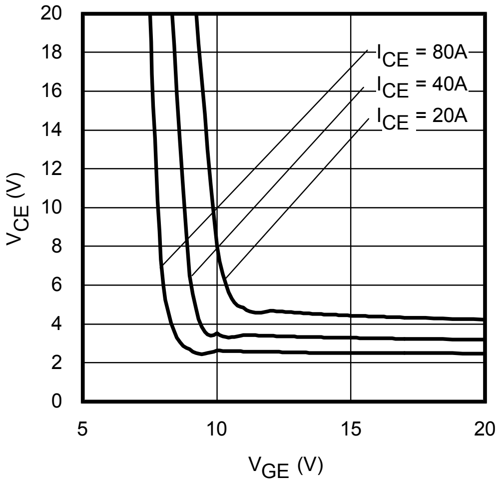


Fig. 10 - Typical V_{CE} vs. V_{GE}
T_J = 25°C

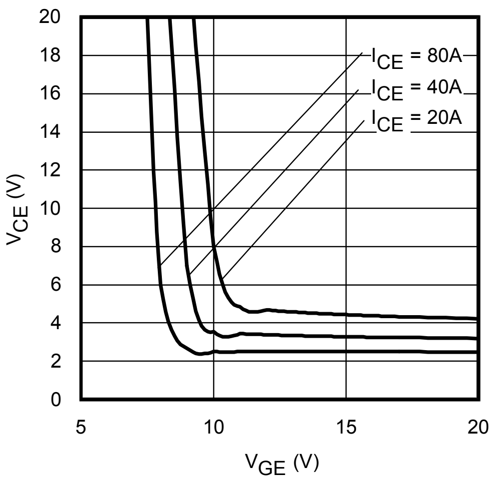


Fig. 11 - Typical V_{CE} vs. V_{GE}
T_J = 125°C

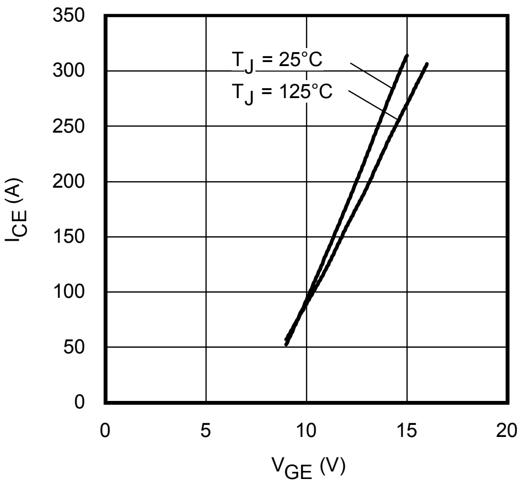


Fig. 12 - Typ. Transfer Characteristics
V_{CE} = 50V; tp = 10µs

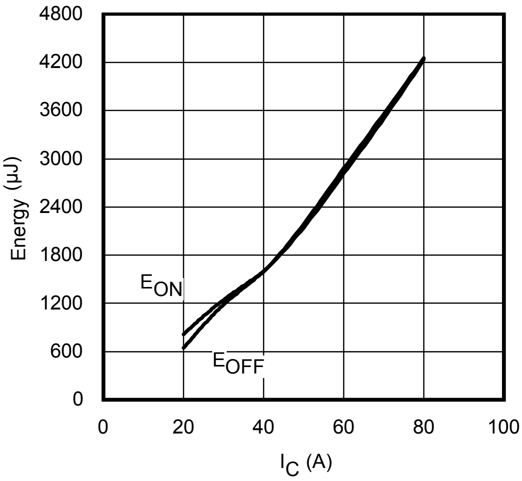


Fig. 13 - Typ. Energy Loss vs. I_C
T_J = 125°C; L=250µH; V_{CE}= 400V
R_G= 5Ω; V_{GE}= 15V

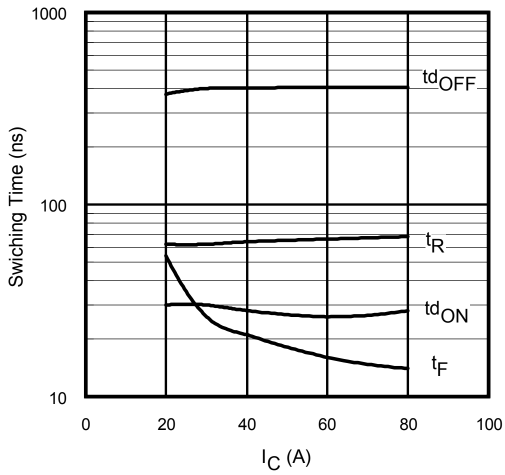


Fig. 14 - Typ. Switching Time vs. I_C
T_J = 125°C; L=250µH; V_{CE}= 400V
R_G= 5Ω; V_{GE}= 15V

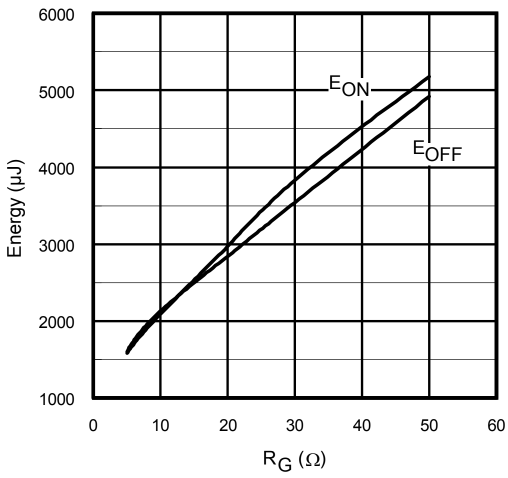


Fig. 15 - Typ. Energy Loss vs. R_G
T_J = 150°C; L=250µH; V_{CE}= 600V
I_{CE}= 40A; V_{GE}= 15V

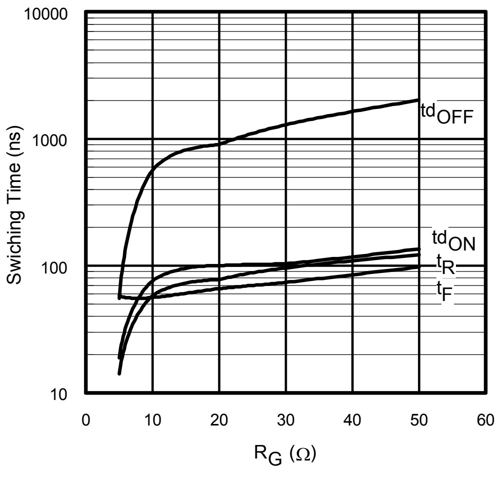


Fig. 16 - Typ. Switching Time vs. R_G
T_J = 150°C; L=250µH; V_{CE}= 600V
I_{CE}= 40A; V_{GE}= 15V

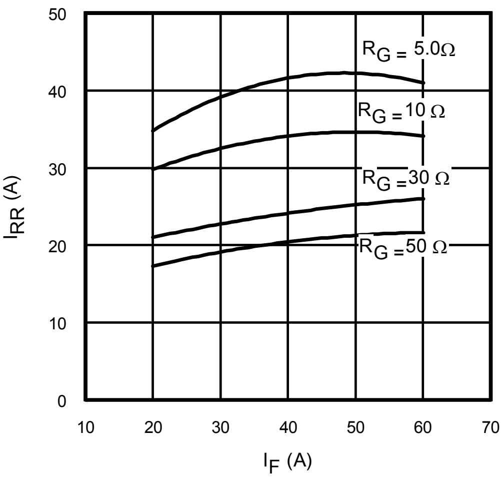


Fig. 17 - Typical Diode I_{RR} vs. I_F
T_J = 125°C

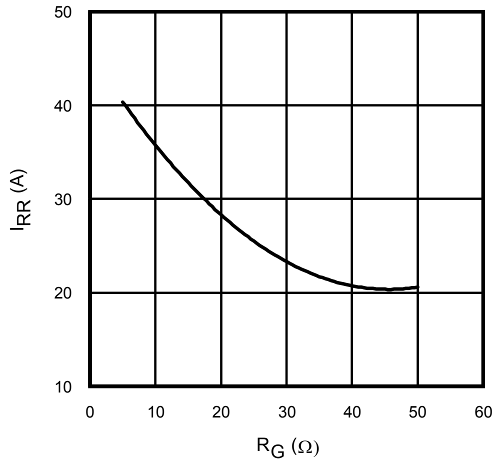


Fig. 18 - Typical Diode I_{RR} vs. R_G
T_J = 125°C; I_F = 40A

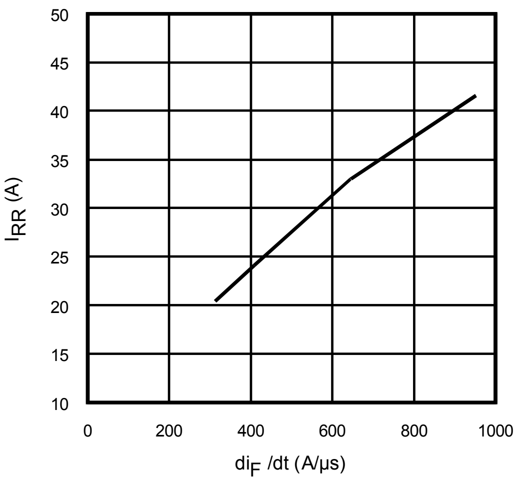


Fig. 19- Typical Diode I_{RR} vs. di_F/dt
V_{CC}= 600V; V_{GE}= 15V;
I_{CE}= 40A; T_J = 125°C

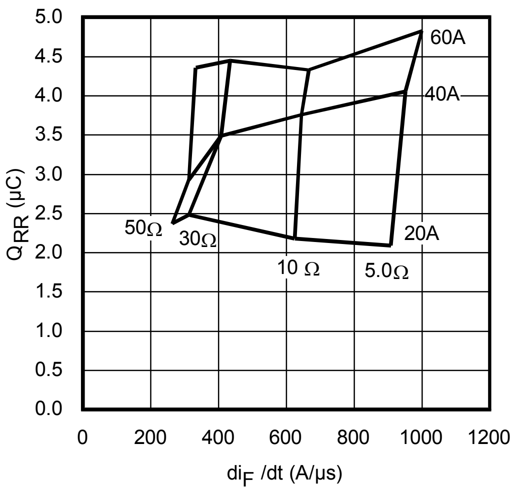


Fig. 20 - Typical Diode Q_{RR}
V_{CC}= 600V; V_{GE}= 15V;T_J = 125°C

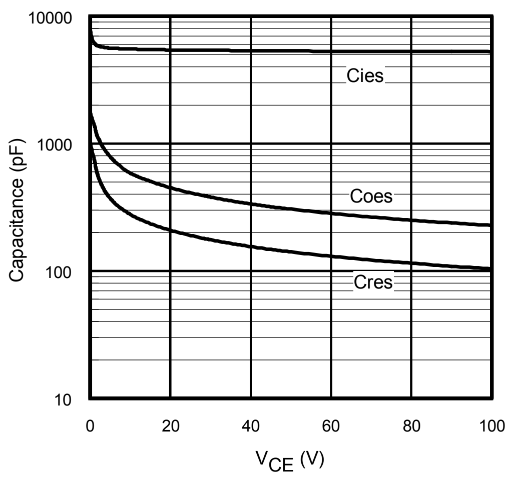


Fig. 21- Typ. Capacitance vs. V_{CE}
V_{GE}= 0V; f = 1MHz

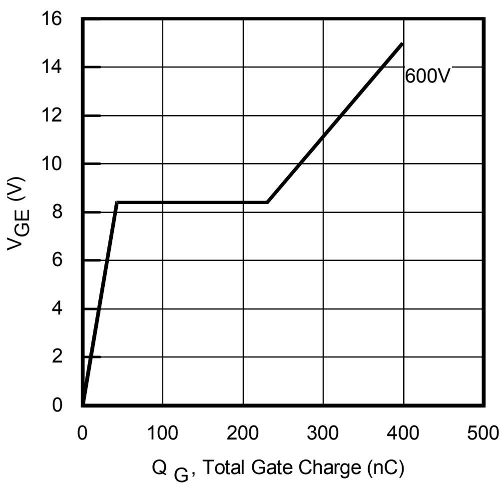


Fig. 22 - Typical Gate Charge vs. V_{GE}
I_{CE} = 5.0A; L = 600μH

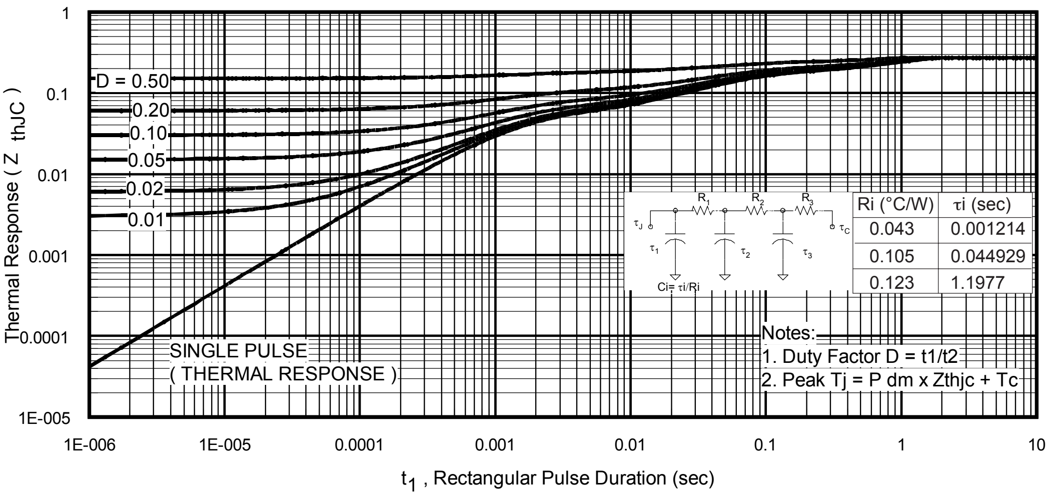


Fig 23. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

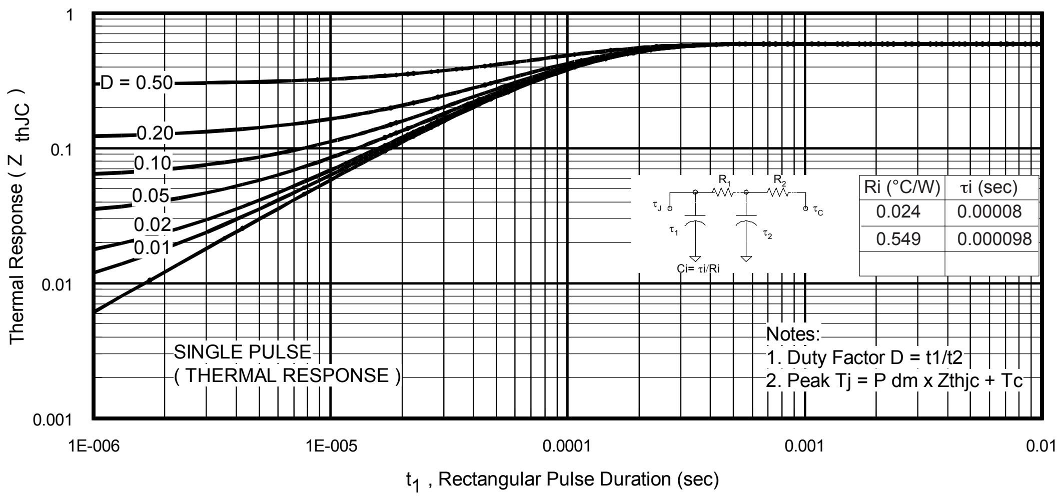


Fig 24. Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)

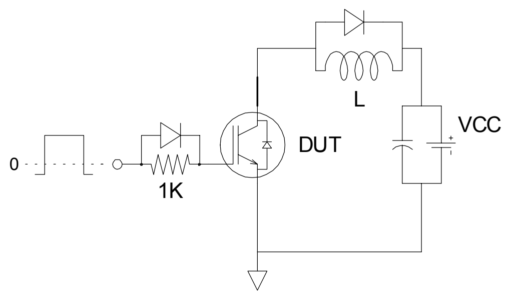


Fig. CT.1 - Gate Charge Circuit (turn-off)

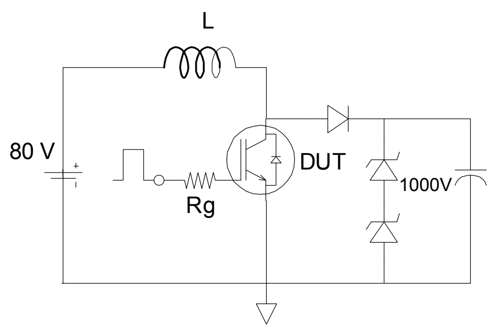


Fig. CT.2 - RBSOA Circuit

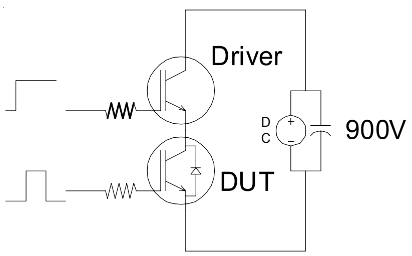


Fig. CT.3 - S.C. SOA Circuit

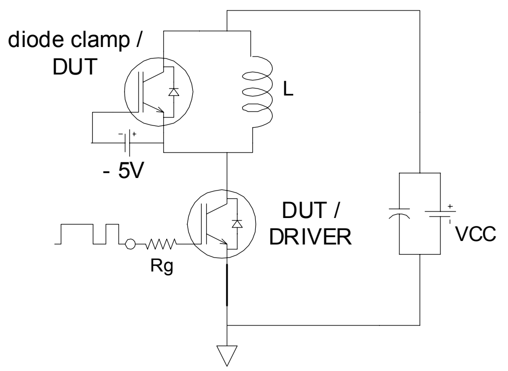
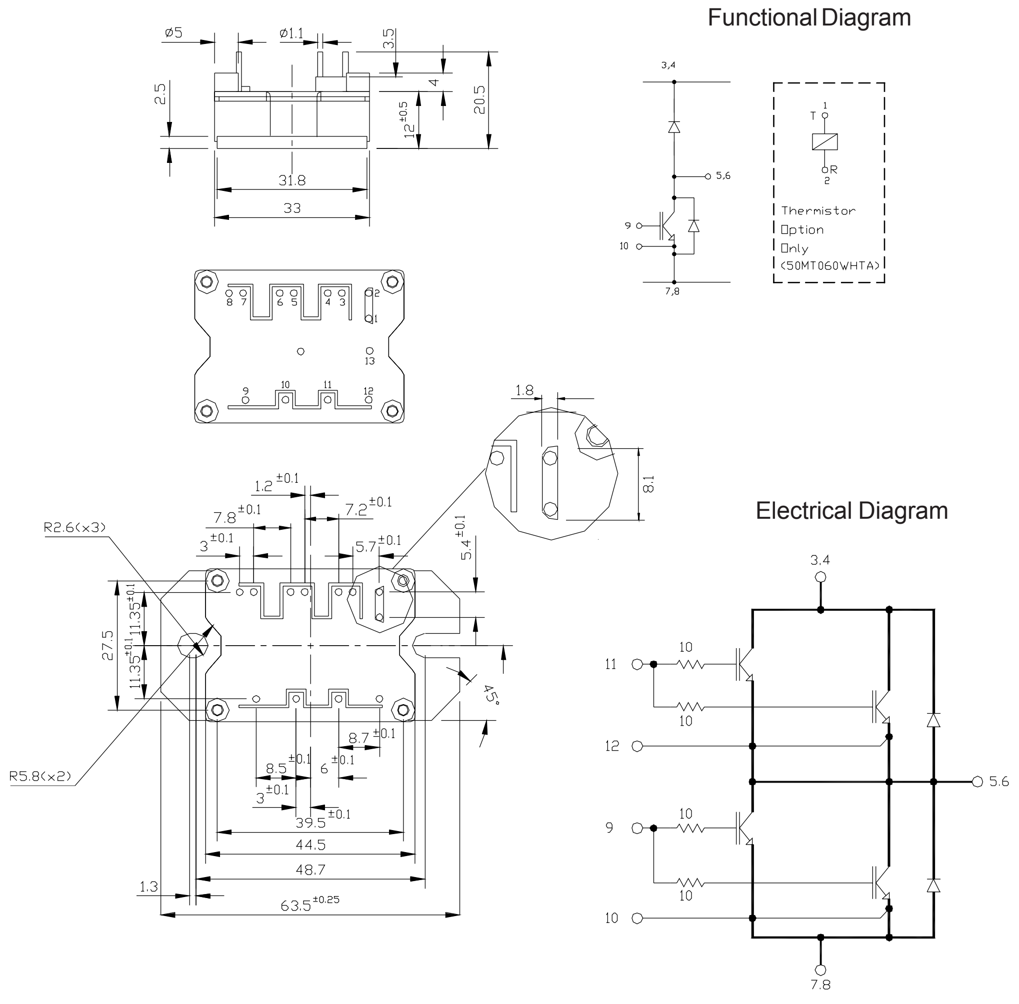


Fig. CT.4 - Switching Loss Circuit

Outline Table



Dimensions in millimetres

Note: unused terminals are not assembled in the package

Ordering Information Table

Device Code

40	MT	120	U	H	T	A
1	2	3	4	5	6	7

1 - Current rating (40 = 40A)
2 - Essential Part Number
3 - Voltage code (120 = 1200V)
4 - Speed/ Type (U = Ultra Fast 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.

International
IOR Rectifier

IR WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105
TAC Fax: (310) 252-7309
Visit us at www.irf.com for sales contact information. 03/05