

Bulletin I27194 rev. A 01/06

International IR Rectifier

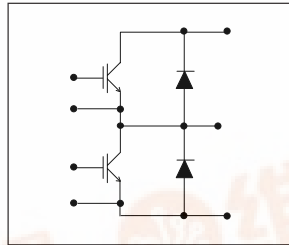
40MT120UHA 40MT120UHTA

"HALF-BRIDGE" IGBT MTP

UltraFast NPT IGBT

Features

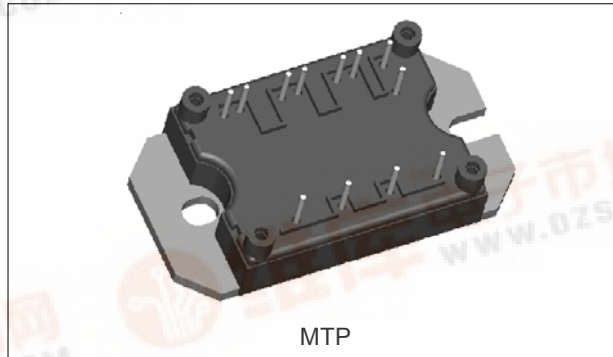
- UltraFast Non Punch Through (NPT) Technology
- Positive $V_{CE(ON)}$ Temperature Coefficient
- 10 μ s Short Circuit Capability
- HEXFRED™ Antiparallel Diodes with UltraSoft Reverse Recovery and Low V_F
- Square RBSOA
- Al₂O₃ DBC
- Optional SMD Thermistor (NTC)
- Very Low Stray Inductance Design for 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 Resistance



Absolute Maximum Ratings

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

Electrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

Parameters	Min	Typ	Max	Units	Test Conditions
$V_{(BR)CES}$ Collector-to-Emitter Breakdown Voltage	1200			V	$V_{GE} = 0V, I_C = 250\mu A$
$\Delta V_{(BR)CES}/\Delta T_J$ Temperature Coeff. of Breakdown Voltage		+1.1		V/ $^\circ\text{C}$	$V_{GE} = 0V, I_C = 3mA (25-125^\circ\text{C})$
$V_{CE(ON)}$ 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		$V_{GE} = 15V, I_C = 40A T_J = 150^\circ\text{C}$
		5.35	5.68		$V_{GE} = 15V, I_C = 80A T_J = 150^\circ\text{C}$
$V_{GE(th)}$ Gate Threshold Voltage	4		6	V	$V_{CE} = V_{GE}, I_C = 500\mu A$
$\Delta V_{GE(th)}/\Delta T_J$ Temperature Coeff. of Threshold Voltage		-12		mV/ $^\circ\text{C}$	$V_{CE} = V_{GE}, I_C = 1mA (25-125^\circ\text{C})$
g_{fe} Transconductance		35		S	$V_{CE} = 50V, I_C = 40A, PW = 80\mu s$
I_{CES} Zero Gate Voltage Collector Current			250	μA	$V_{GE} = 0V, V_{CE} = 1200V, T_J = 25^\circ\text{C}$
		0.4	1.0	mA	$V_{GE} = 0V, V_{CE} = 1200V, T_J = 125^\circ\text{C}$
		0.2	10		$V_{GE} = 0V, V_{CE} = 1200V, T_J = 150^\circ\text{C}$
I_{GES} Gate-to-Emitter Leakage Current			± 250	nA	$V_{GE} = \pm 20V$

Switching Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

Parameters	Min	Typ	Max	Units	Test Conditions
Q_g Total Gate Charge (turn-on)		399	599	nC	$I_C = 40A$ $V_{CC} = 600V$ $V_{GE} = 15V$
Q_{ge} Gate-Emitter Charge (turn-on)		43	65		
Q_{gc} Gate-Collector Charge (turn-on)		187	281		
E_{on} Turn-On Switching Loss		1142	1713	μJ	$V_{CC} = 600V, I_C = 40A$ $V_{GE} = 15V, R_g = 5\Omega, L = 200\mu H$ $T_J = 25^\circ\text{C}$, Energy losses include tail and diode reverse recovery
E_{off} Turn-Off Switching Loss		1345	2018		
E_{tot} Total Switching Loss		2487	3731		
E_{on} Turn-On Switching Loss		1598	2397	μJ	$V_{CC} = 600V, I_C = 40A$ $V_{GE} = 15V, R_g = 5\Omega, L = 200\mu H$ $T_J = 125^\circ\text{C}$, Energy losses include tail and diode reverse recovery
E_{off} Turn-Off Switching Loss		1618	2427		
E_{tot} Total Switching Loss		3216	4824		
C_{ies} Input Capacitance		5521	8282	pF	$V_{GE} = 0V$ $V_{CC} = 30V$ $f = 1.0\text{ MHz}$
C_{oes} Output Capacitance		380	570		
C_{res} Reverse Transfer Capacitance		171	257		
RBSOA Reverse Bias Safe Operating Area		full square			$T_J = 150^\circ\text{C}, I_C = 160A$ $V_{CC} = 1000V, V_p = 1200V$ $R_g = 5\Omega, V_{GE} = +15V\text{ to }0V$
SCSOA Short Circuit Safe Operating Area	10			μs	$T_J = 150^\circ\text{C}$ $V_{CC} = 900V, V_p = 1200V$ $R_g = 5\Omega, V_{GE} = +15V\text{ to }0V$

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
t _{rr} Diode Reverse Recovery Time		120	180	ns	V _{CC} = 600V, I _C = 40A
I _{rr} 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⁾ T₀, T₁ are thermistor's temperatures

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

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)		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

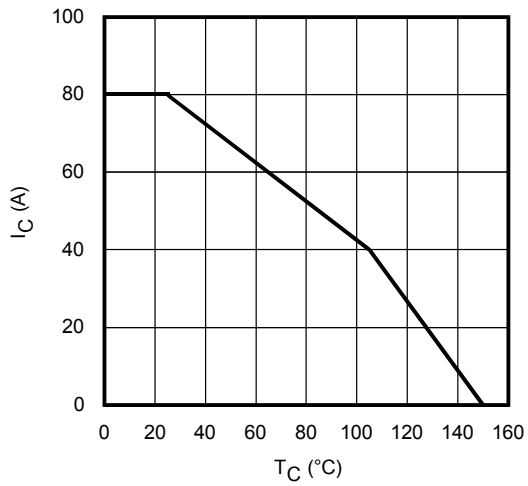


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

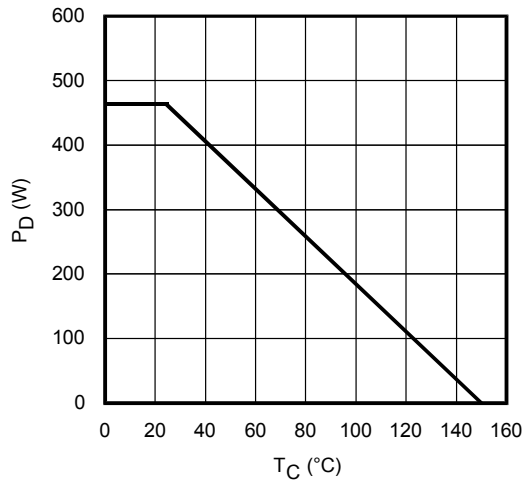


Fig. 2 - Power Dissipation vs. Case Temperature

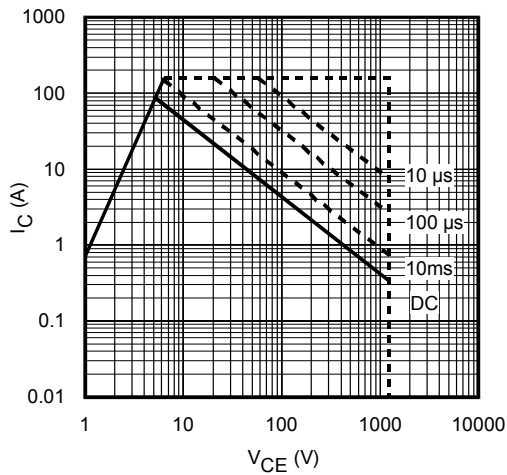


Fig. 3 - Forward SOA
 $T_C = 25^\circ\text{C}$; $T_J \leq 150^\circ\text{C}$

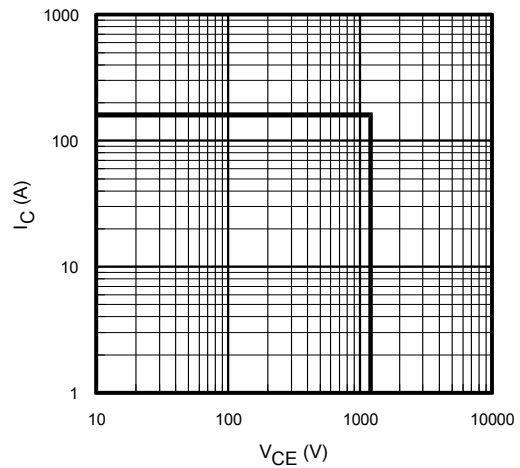


Fig. 4 - Reverse Bias SOA
 $T_J = 150^\circ\text{C}$; $V_{GE} = 15\text{V}$

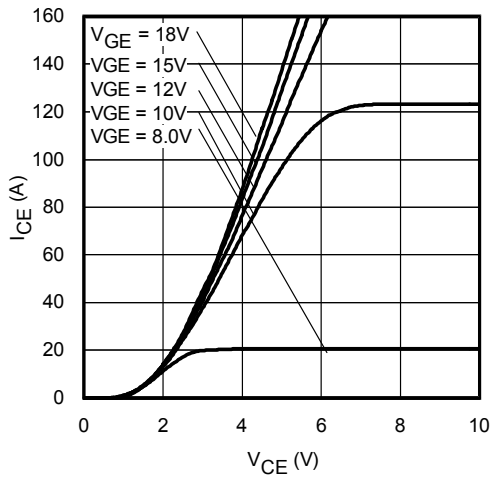


Fig. 5 - Typ. IGBT Output Characteristics
 $T_J = -40^\circ\text{C}$; $t_p = 80\mu\text{s}$

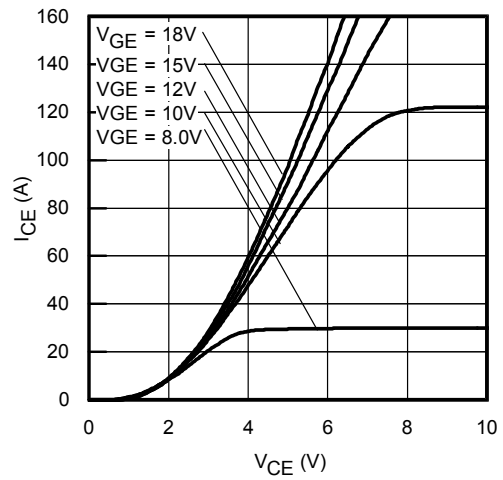


Fig. 6 - Typ. IGBT Output Characteristics
 $T_J = 25^\circ\text{C}$; $t_p = 80\mu\text{s}$

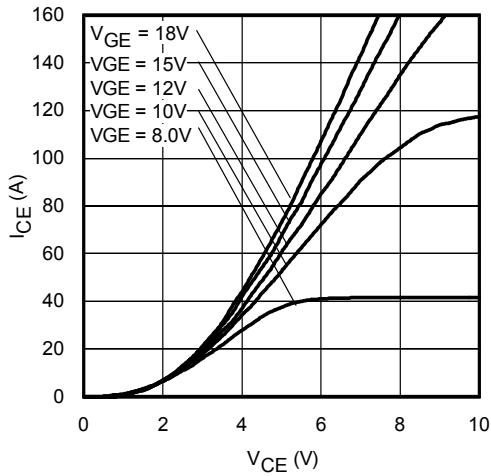


Fig. 7 - Typ. IGBT Output Characteristics
 $T_J = 125^\circ\text{C}$; $t_p = 80\mu\text{s}$

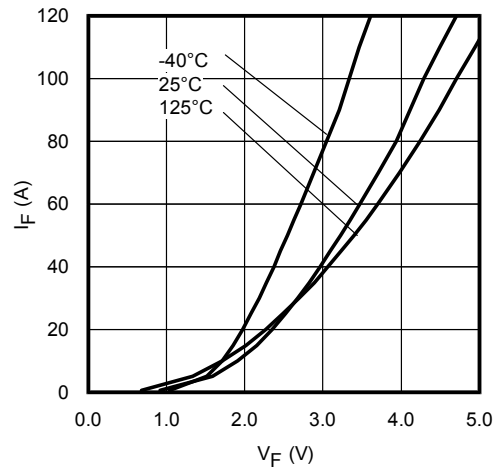


Fig. 8 - Typ. Diode Forward Characteristics
 $t_p = 80\mu\text{s}$

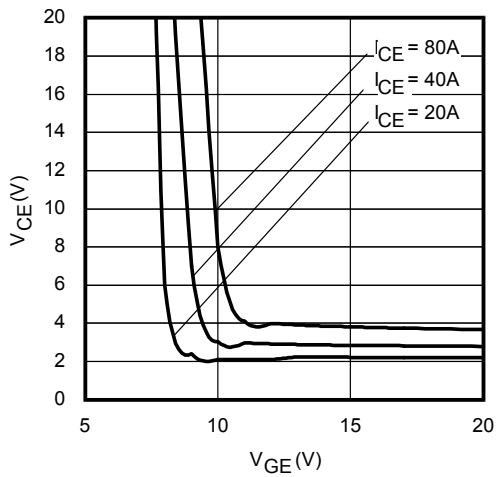


Fig. 9 - Typical V_{CE} vs. V_{GE}
 $T_J = -40^\circ\text{C}$

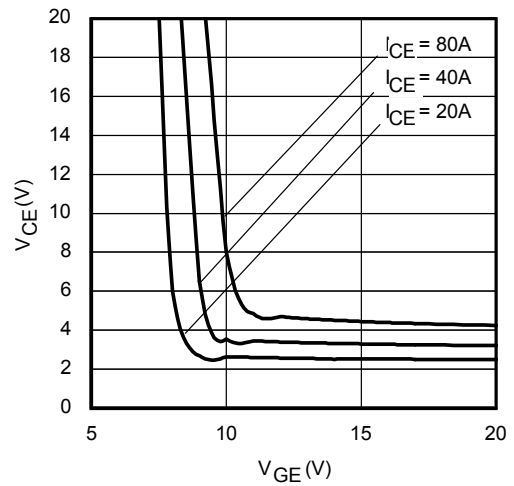


Fig. 10 - Typical V_{CE} vs. V_{GE}
 $T_J = 25^\circ\text{C}$

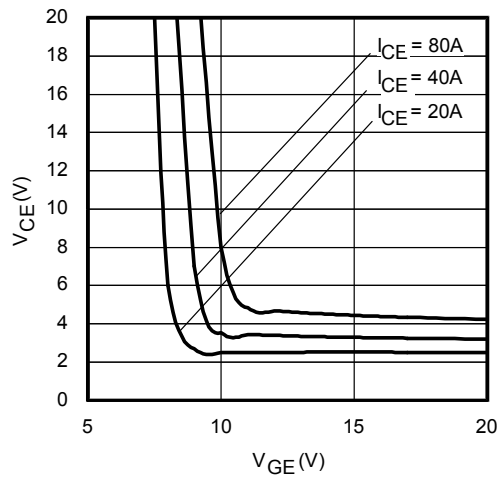


Fig. 11 - Typical V_{CE} vs. V_{GE}
 $T_J = 125^\circ\text{C}$

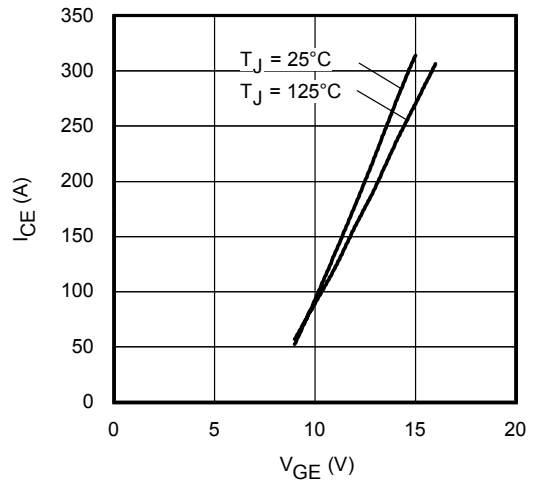


Fig. 12 - Typ. Transfer Characteristics
 $V_{CE} = 50\text{V}$; $t_p = 10\mu\text{s}$

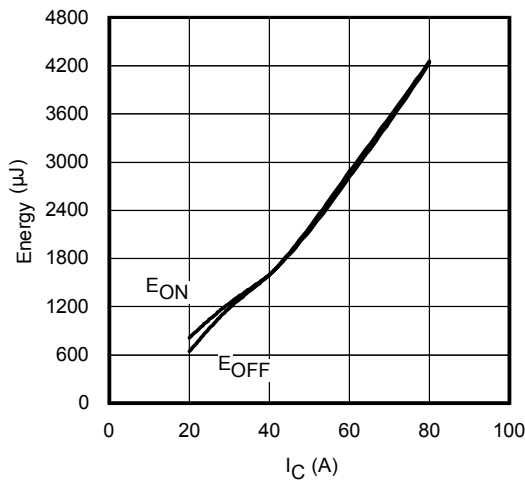


Fig. 13 - Typ. Energy Loss vs. I_C
 $T_J = 125^\circ\text{C}$; $L=250\mu\text{H}$; $V_{CE}=400\text{V}$
 $R_G=5\Omega$; $V_{GE}=15\text{V}$

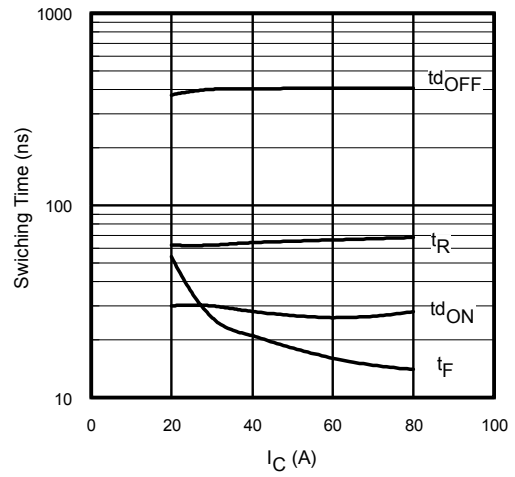


Fig. 14 - Typ. Switching Time vs. I_C
 $T_J = 125^\circ\text{C}$; $L=250\mu\text{H}$; $V_{CE}=400\text{V}$
 $R_G=5\Omega$; $V_{GE}=15\text{V}$

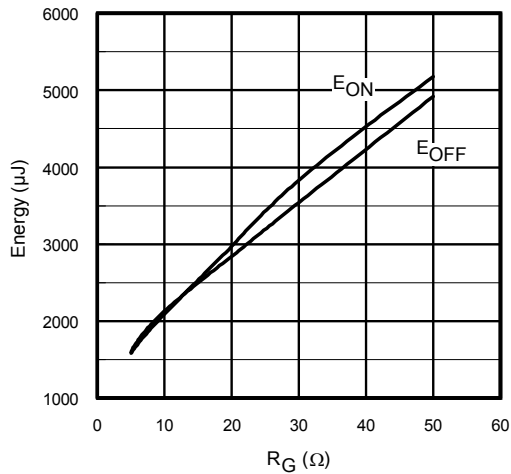


Fig. 15 - Typ. Energy Loss vs. R_G
 $T_J = 150^\circ\text{C}$; $L=250\mu\text{H}$; $V_{CE}=600\text{V}$
 $I_{CE}=40\text{A}$; $V_{GE}=15\text{V}$

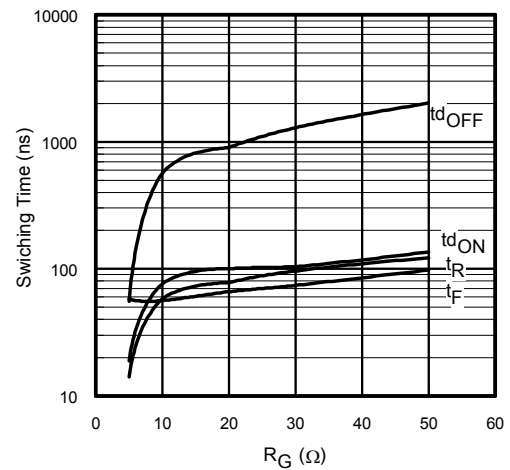


Fig. 16 - Typ. Switching Time vs. R_G
 $T_J = 150^\circ\text{C}$; $L=250\mu\text{H}$; $V_{CE}=600\text{V}$
 $I_{CE}=40\text{A}$; $V_{GE}=15\text{V}$

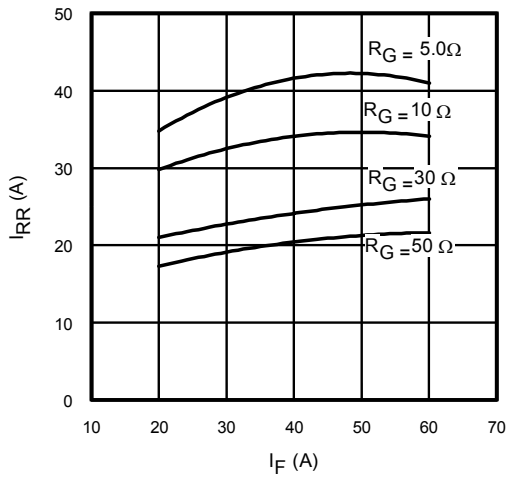


Fig. 17 - Typical Diode I_{RR} vs. I_F
 $T_J = 125^\circ\text{C}$

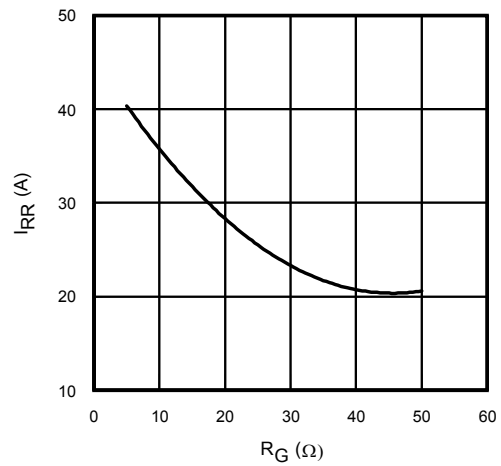


Fig. 18 - Typical Diode I_{RR} vs. R_G
 $T_J = 125^\circ\text{C}; I_F = 40\text{A}$

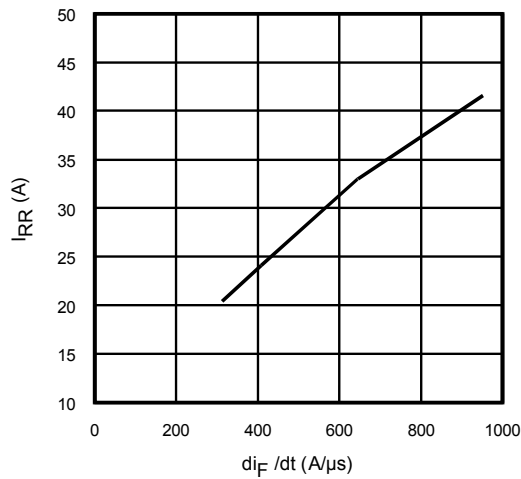


Fig. 19- Typical Diode I_{RR} vs. di_F/dt
 $V_{CC} = 600\text{V}; V_{GE} = 15\text{V};$
 $I_{CE} = 40\text{A}; T_J = 125^\circ\text{C}$

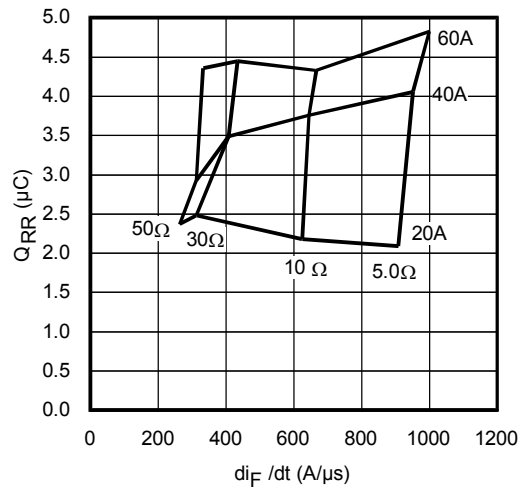


Fig. 20 - Typical Diode Q_{RR}
 $V_{CC} = 600\text{V}; V_{GE} = 15\text{V}; T_J = 125^\circ\text{C}$

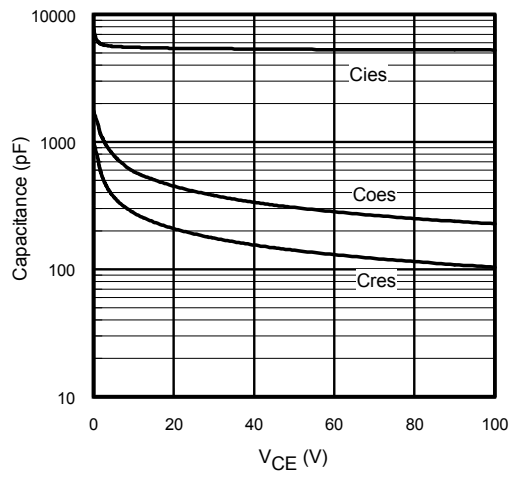


Fig. 21- Typ. Capacitance vs. V_{CE}
V_{GE}= 0V; f = 1MHz

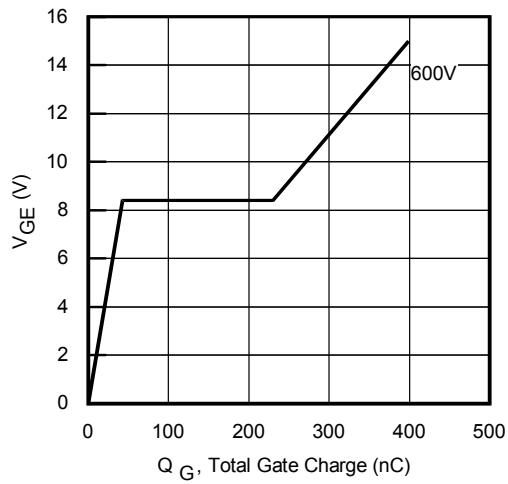


Fig. 22 - Typical Gate Charge vs. V_{GE}
I_{CE} = 5.0A; L = 600μH

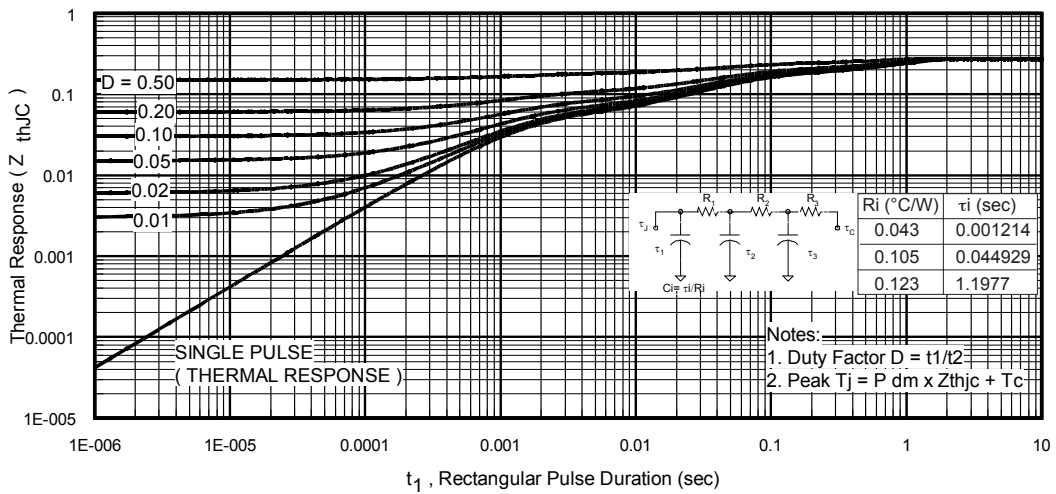


Fig 23. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

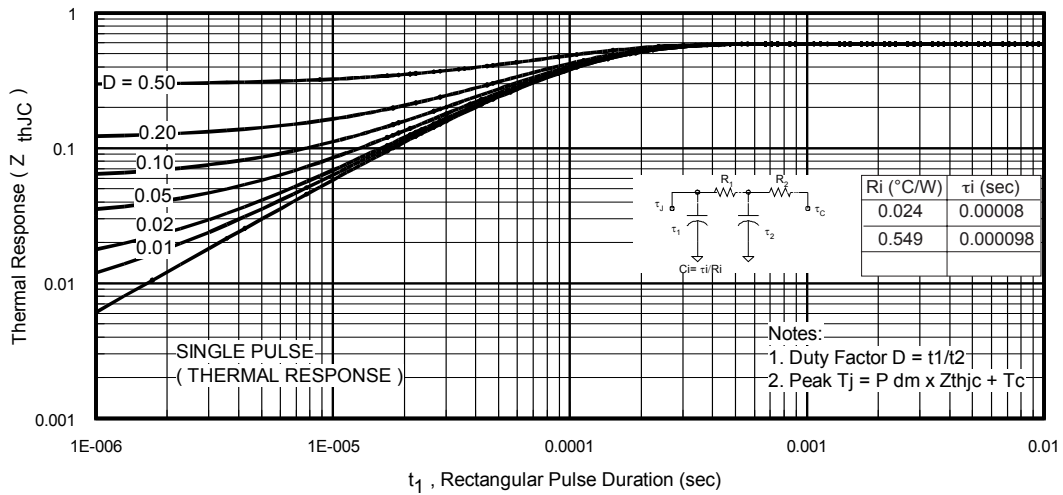


Fig 24. Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)

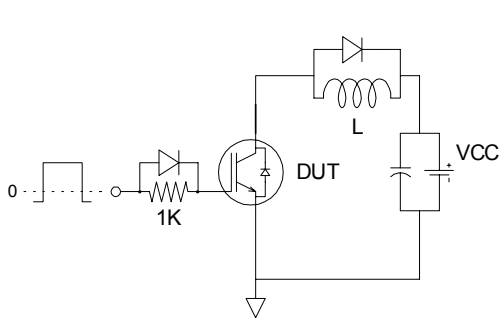


Fig. CT.1 - Gate Charge Circuit (turn-off)

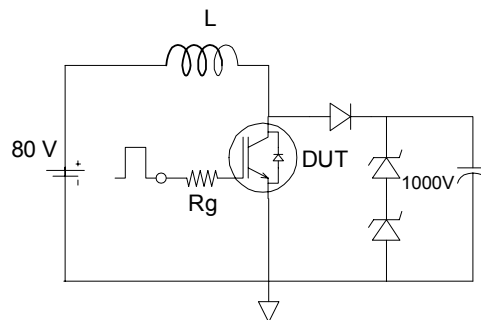


Fig. CT.2 - RBSOA Circuit

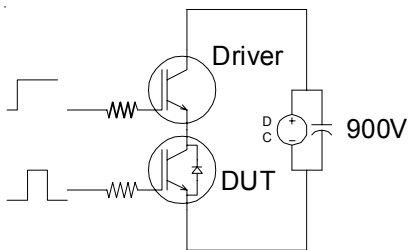


Fig. CT.3 - S.C. SOA Circuit

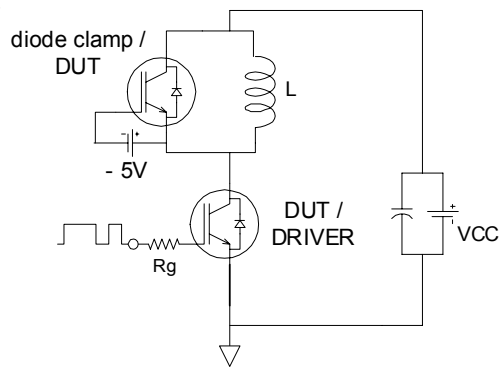
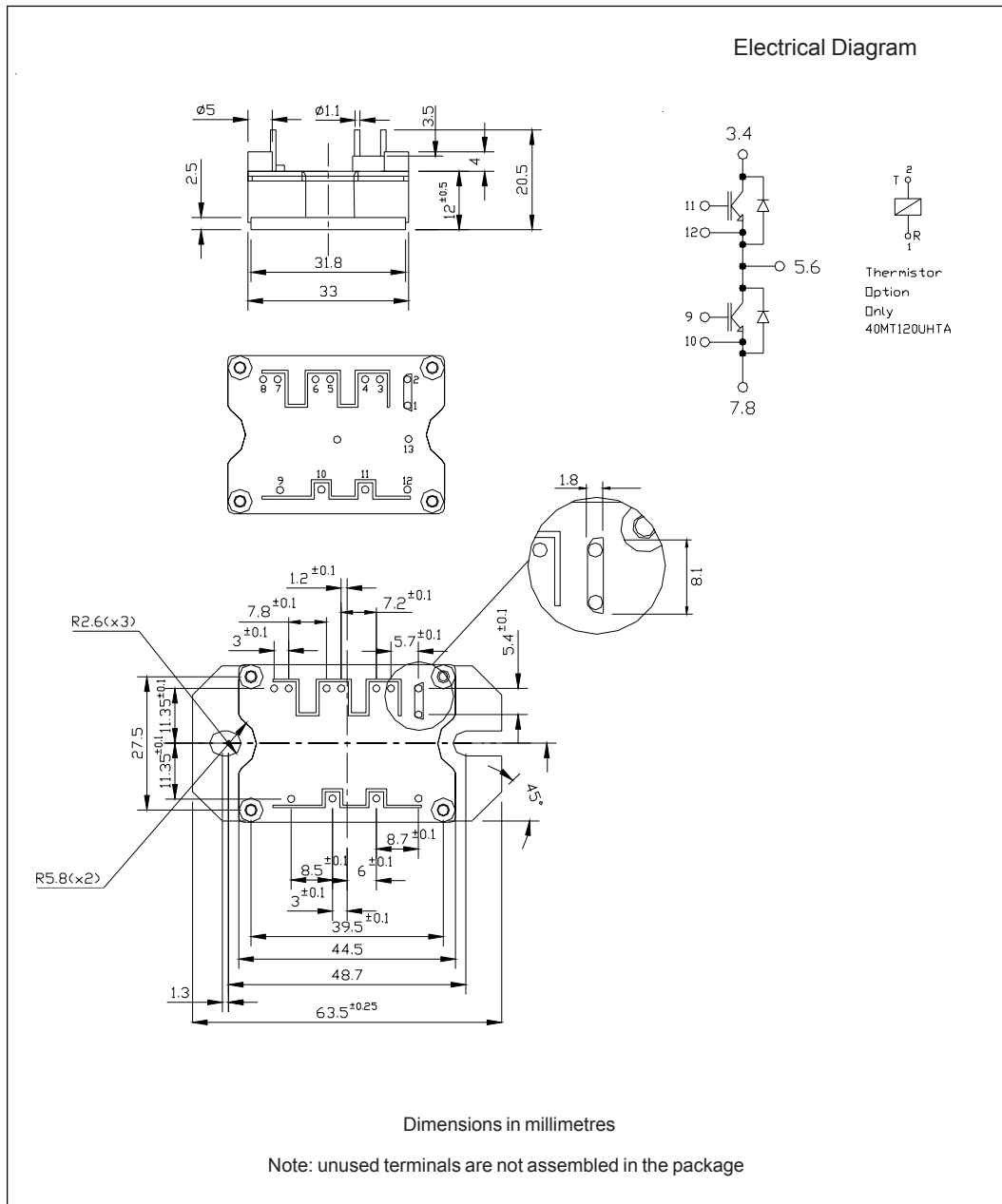


Fig. CT.4 - Switching Loss Circuit

Outline Table



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 ₂ O 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.