I27126 rev. C 02/03

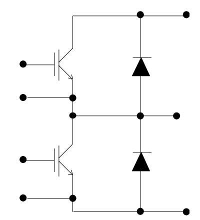
International Rectifier

40MT120UH

"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 TM Antiparallel Diodes with UltraSoft Reverse Recovery
- Low Diode V_F
- Square RBSOA
- Aluminum Nitride DBC
- Optional SMT Thermistor (NTC)
- Very Low Stray Inductance Design for High Speed Operation
- UL approved (file E78996)



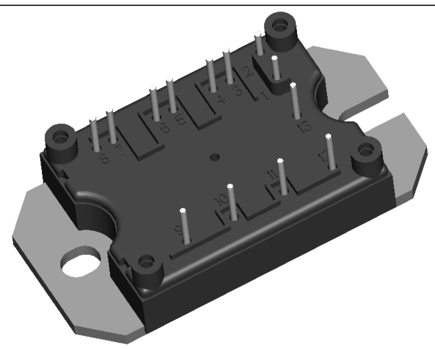
V_{CES} = 1200V

I_C = 80A

T_C = 25°C

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



MTP

Absolute Maximum Ratings

	Parameters		Max	Units
V_{CES}	Collector-to-Emitter Breakdown Voltage		1200	V
I_C	Continuos Collector Current	@ T_C = 25°C	80	A
		@ T_C = 105°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 (40MT120UHT 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		0.20	0.27	°C/ W
		Diode		0.39	0.59	
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

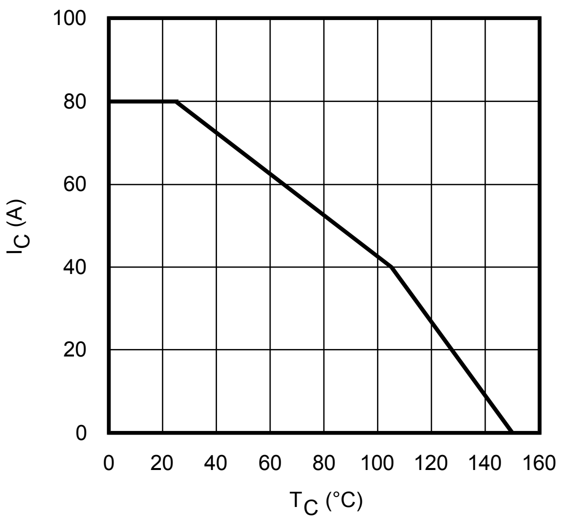


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

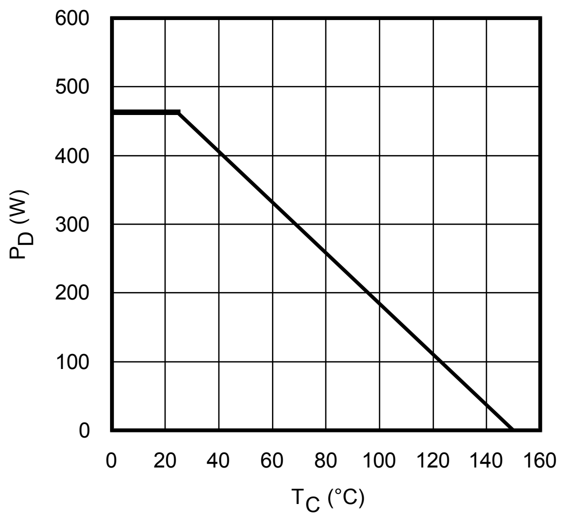


Fig. 2 - Power Dissipation vs. Case Temperature

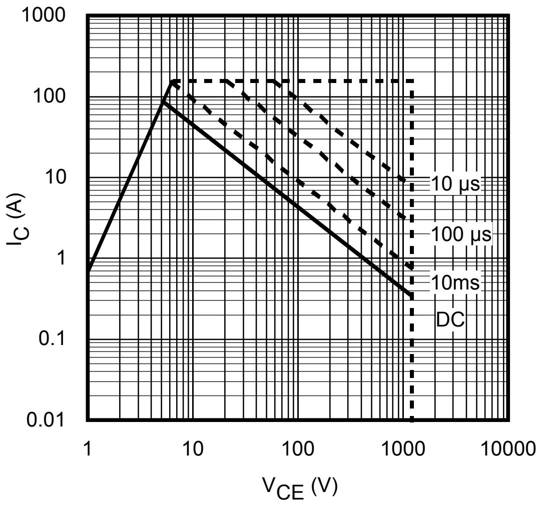


Fig. 3 - Forward SOA
T_C = 25°C; $T_J \leq$ 150°C

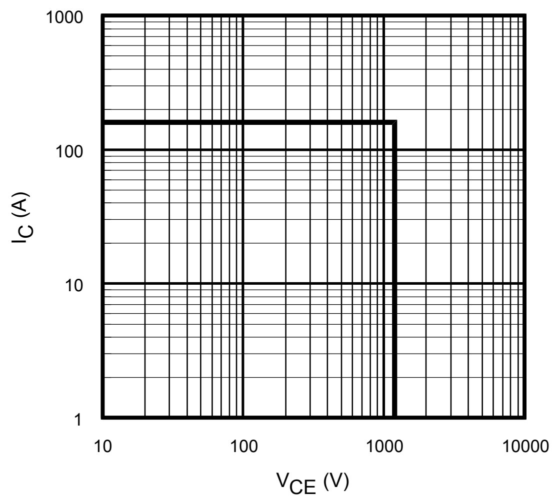


Fig. 4 - Reverse Bias SOA
T_J = 150°C; V_{GE} =15V

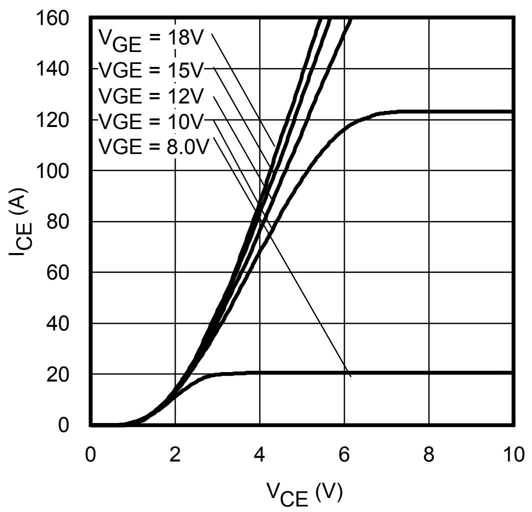


Fig. 5 - Typ. IGBT Output Characteristics
T_J = -40°C; tp = 80µs

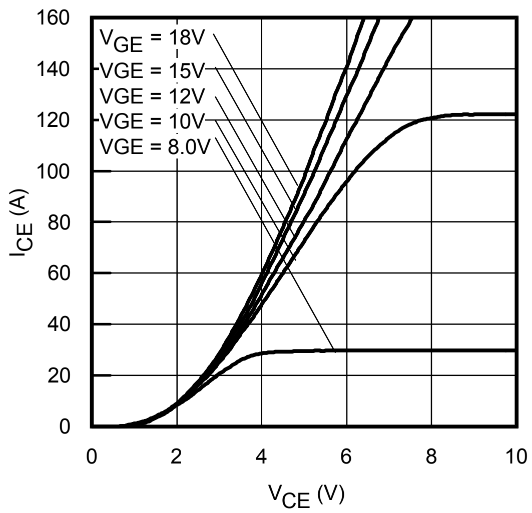


Fig. 6 - Typ. IGBT Output Characteristics
T_J = 25°C; tp = 80µs

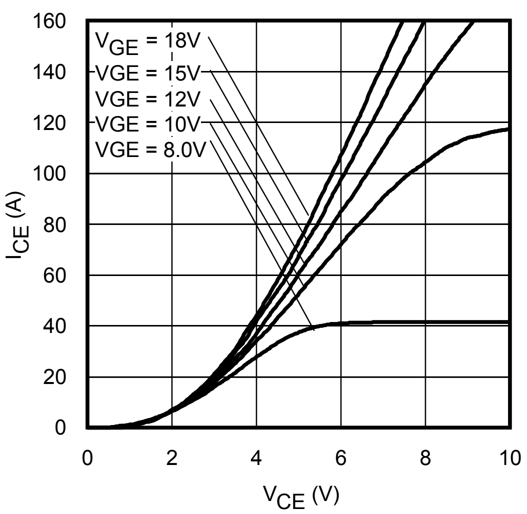


Fig. 7 - Typ. IGBT Output Characteristics
T_J = 125°C; tp = 80µs

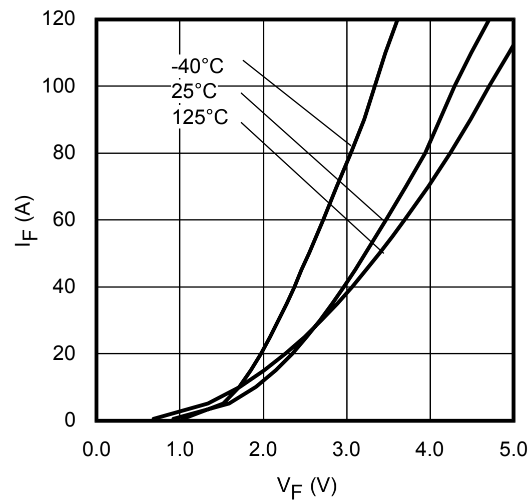


Fig. 8 - Typ. Diode Forward Characteristics
tp = 80µs

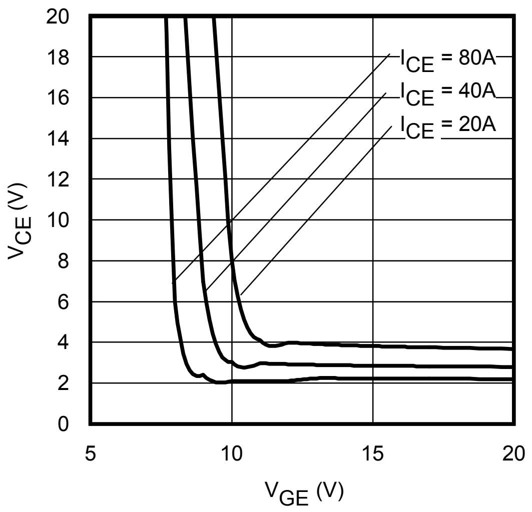


Fig. 9 - Typical V_{CE} vs. V_{GE}
T_J = -40°C

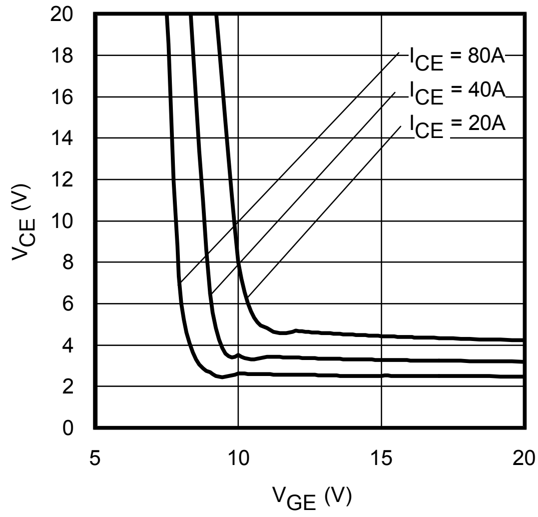


Fig. 10 - Typical V_{CE} vs. V_{GE}
T_J = 25°C

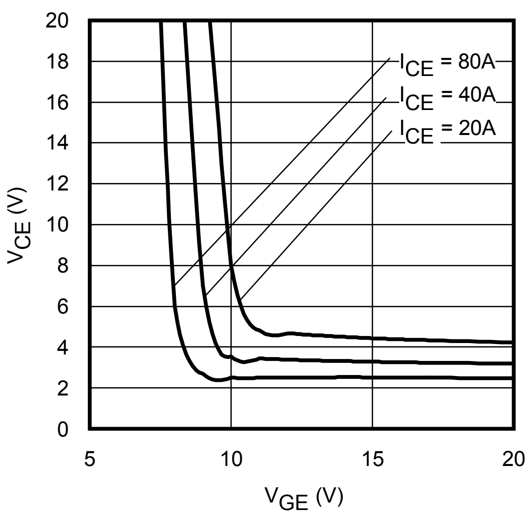


Fig. 11 - Typical V_{CE} vs. V_{GE}
T_J = 125°C

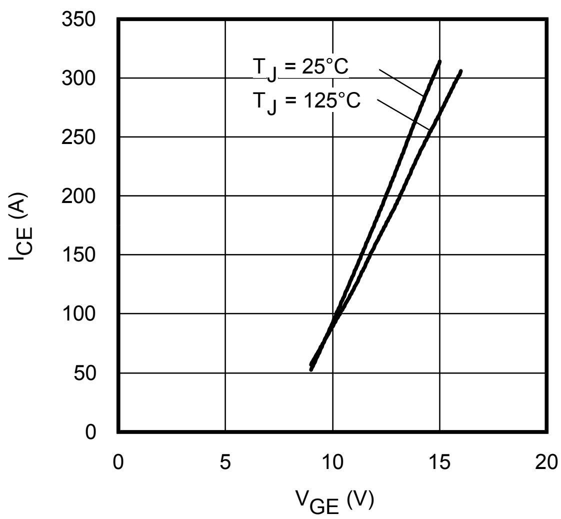


Fig. 12 - Typ. Transfer Characteristics
V_{CE} = 50V; tp = 10µs

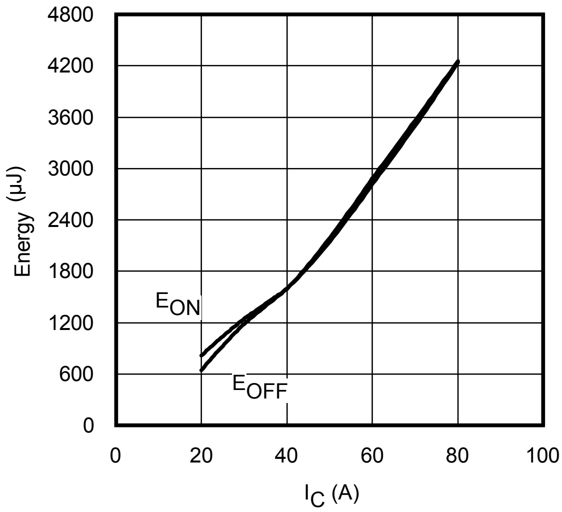


Fig. 13 - Typ. Energy Loss vs. I_C
T_J = 125°C; L=250µH; V_{CE}= 400V
R_G= 5Ω; V_{GE}= 15V

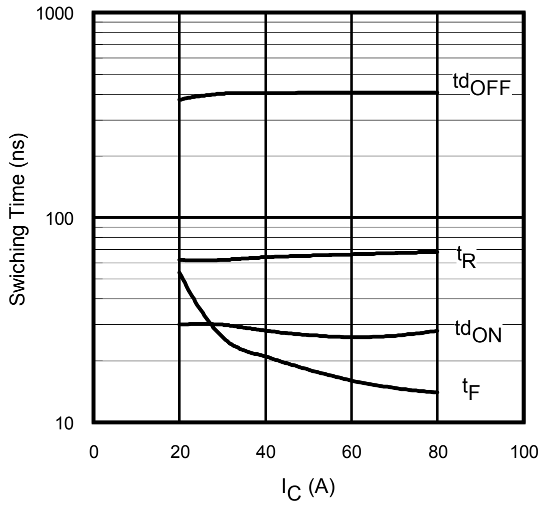


Fig. 14 - Typ. Switching Time vs. I_C
T_J = 125°C; L=250µH; V_{CE}= 400V
R_G= 5Ω; V_{GE}= 15V

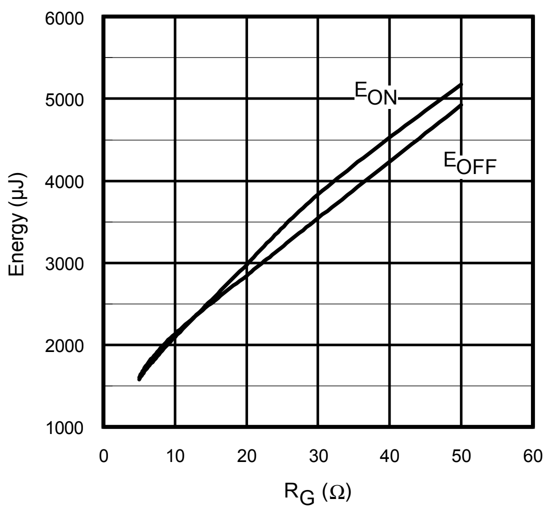


Fig. 15 - Typ. Energy Loss vs. R_G
T_J = 150°C; L=250µH; V_{CE}= 600V
I_{CE}= 40A; V_{GE}= 15V

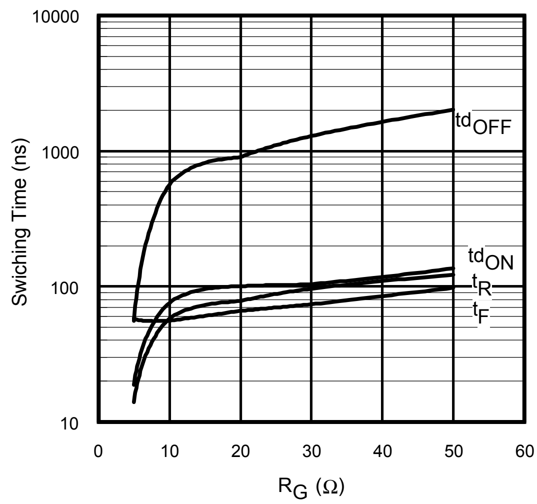


Fig. 16 - Typ. Switching Time vs. R_G
T_J = 150°C; L=250µH; V_{CE}= 600V
I_{CE}= 40A; V_{GE}= 15V

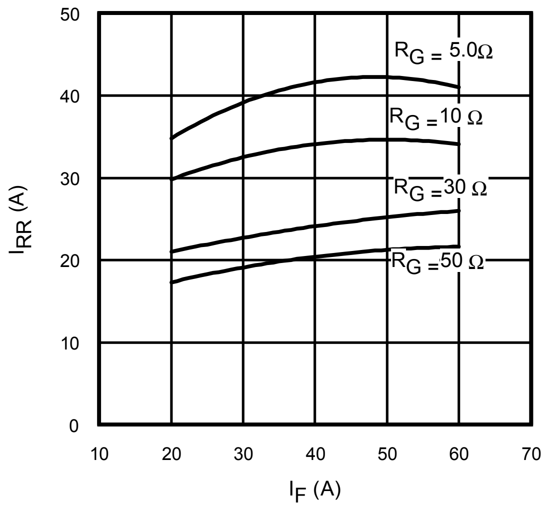


Fig. 17 - Typical Diode I_{RR} vs. I_F
T_J = 125°C

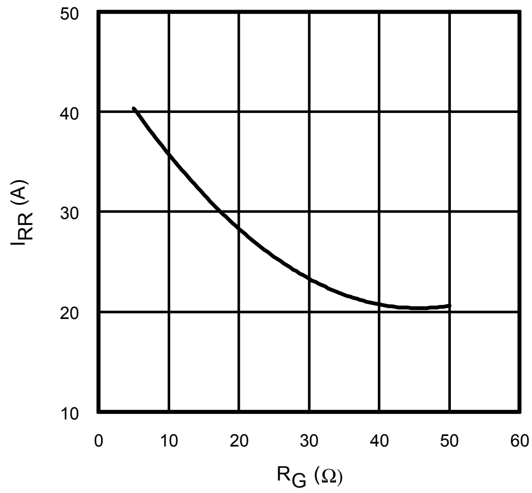


Fig. 18 - Typical Diode I_{RR} vs. R_G
T_J = 125°C; I_F = 40A

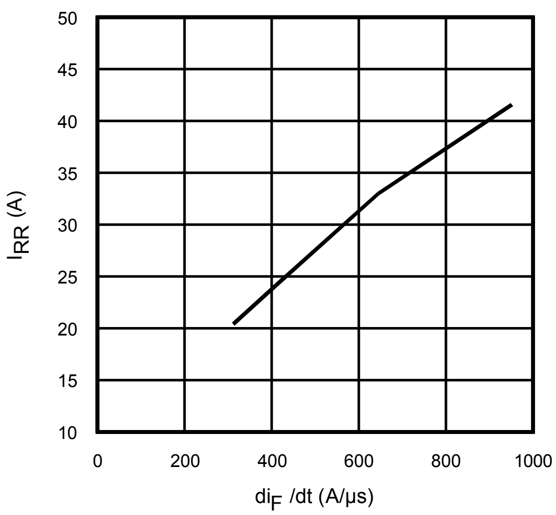


Fig. 19- Typical Diode I_{RR} vs. di_F/dt
V_{CC}= 600V; V_{GE}= 15V;
I_{CE}= 40A; T_J = 125°C

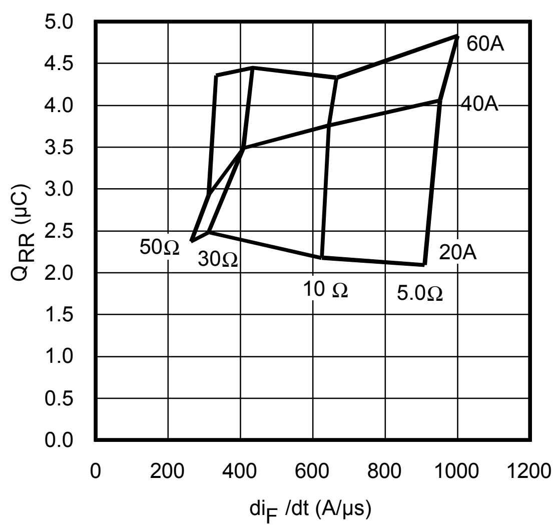


Fig. 20 - Typical Diode Q_{RR}
V_{CC}= 600V; V_{GE}= 15V;T_J = 125°C

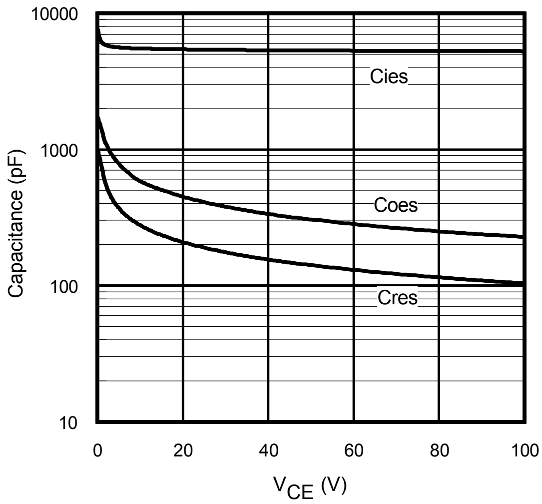


Fig. 21- Typ. Capacitance vs. V_{CE}
V_{GE}= 0V; f = 1MHz

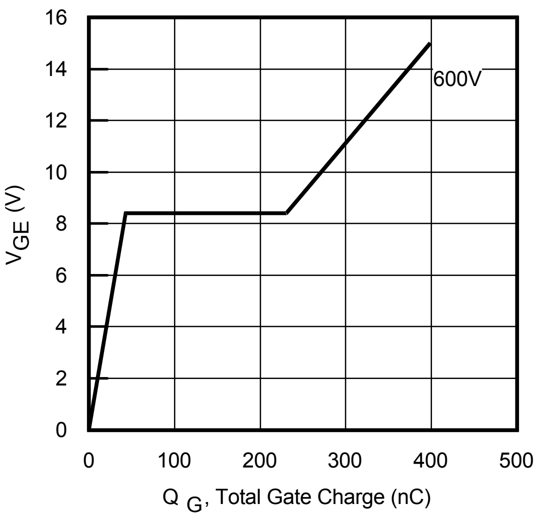


Fig. 22 - Typical Gate Charge vs. V_{GE}
I_{CE} = 5.0A; L = 600μH

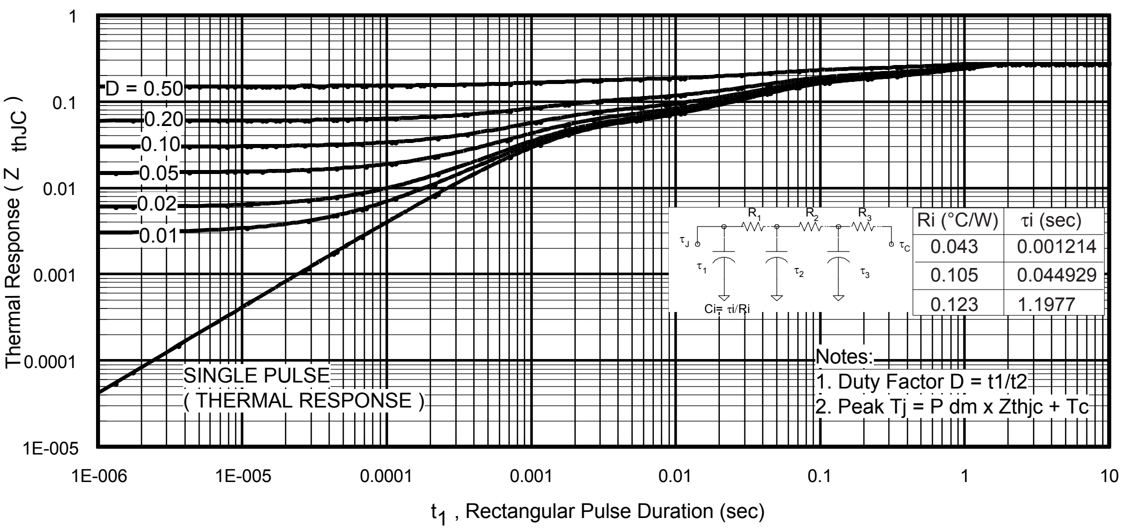


Fig 23. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

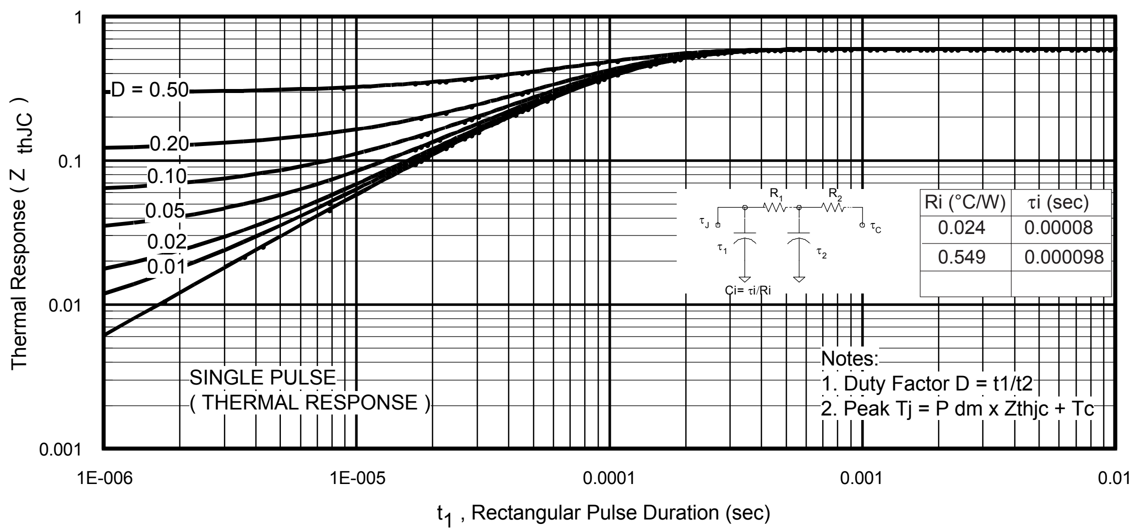


Fig 24. Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)

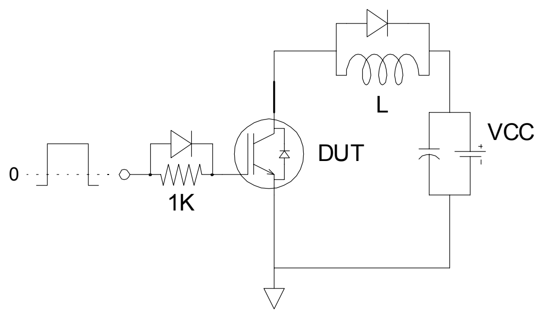


Fig. CT.1 - Gate Charge Circuit (turn-off)

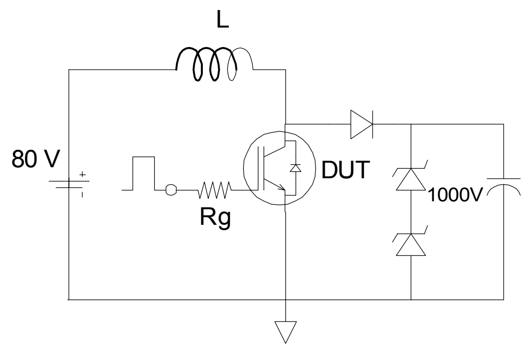


Fig. CT.2 - RBSOA Circuit

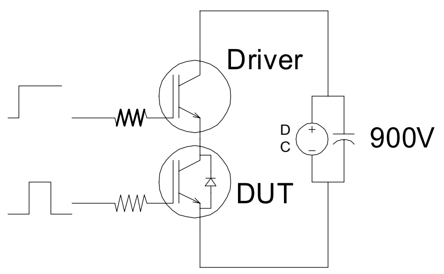


Fig. CT.3 - S.C. SOA Circuit

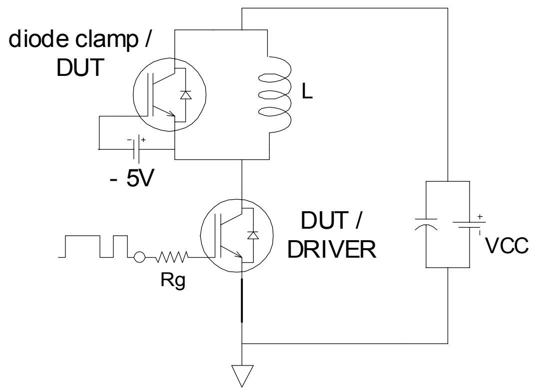


Fig. CT.4 - Switching Loss Circuit

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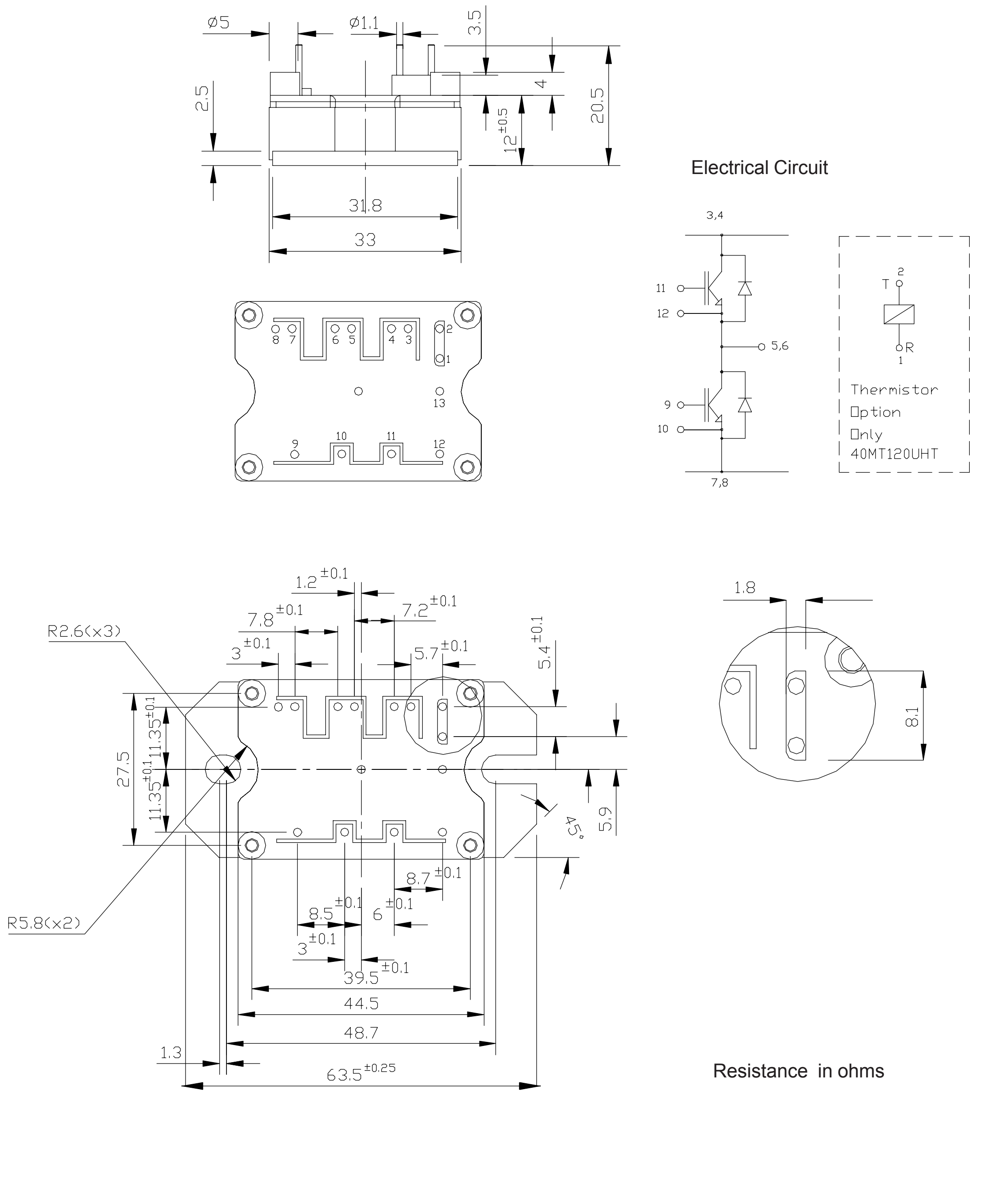
Outline Table



Dimensions in millimetres
Note: unused terminals are not assembled in the package

Ordering Information Table

Device Code

40	MT	120	U	H	-
1	2	3	4	5	6

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	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.

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