

International IOR Rectifier

I27126 rev. C 02/03

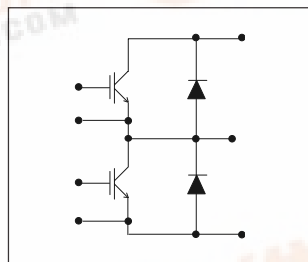
40MT120UH

"HALF-BRIDGE" IGBT MTP

UltraFast NPT IGBT

Features

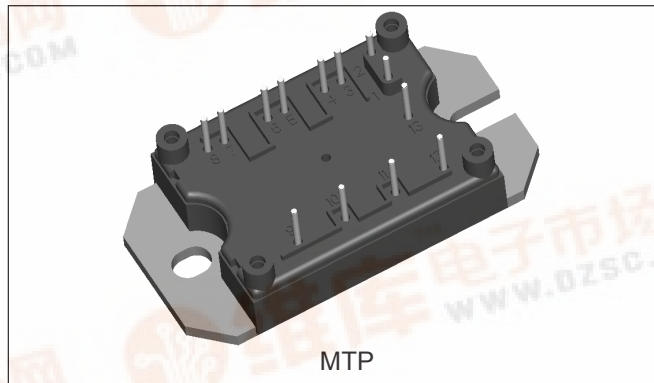
- UltraFast Non Punch Through (NPT) Technology
- Positive $V_{CE(ON)}$ Temperature Coefficient
- 10 μ s Short Circuit Capability
- HEXFRED™ Antiparallel Diodes with UltraSoft Reverse Recovery
- Low Diode V_F
- Square RBSOA
- Aluminum Nitride DBC
- Optional SMT Thermistor (NTC)
- Very Low Stray Inductance Design for High Speed Operation
- UL approved (file E78996)



$V_{CES} = 1200V$
$I_C = 80A$
$T_C = 25^\circ C$

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



Absolute Maximum Ratings

Parameters		Max	Units
V_{CES}	Collector-to-Emitter Breakdown Voltage	1200	V
I_C	Continuous Collector Current	@ $T_C = 25^\circ C$	80
		@ $T_C = 105^\circ C$	40
I_{CM}	Pulsed Collector Current	160	
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	
P_D	Maximum Power Dissipation (only IGBT)	@ $T_C = 25^\circ C$	463
		@ $T_C = 100^\circ C$	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
ΔV _{(BR)CES} /ΔT _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
ΔV _{GE(th)} /ΔT _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	mA	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 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 = 5Ω, L = 200μH T _J = 25°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 = 5Ω, L = 200μH T _J = 125°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 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°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⁾ 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		0.20	°C/ W
		Diode		0.39	
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

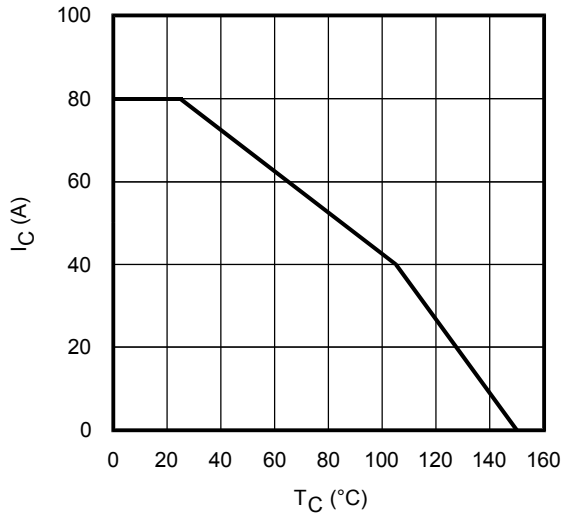


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

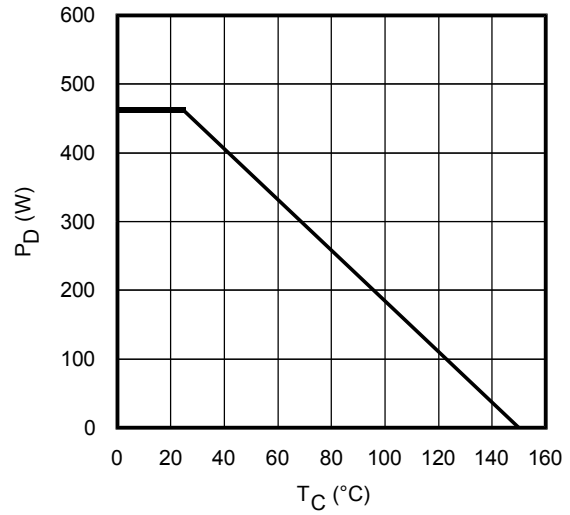


Fig. 2 - Power Dissipation vs. Case Temperature

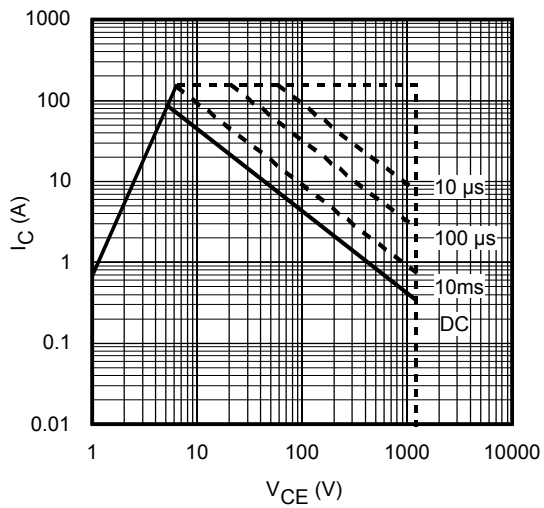


Fig. 3 - Forward SOA
 $T_C = 25^\circ\text{C}$; $T_J \leq 150^\circ\text{C}$

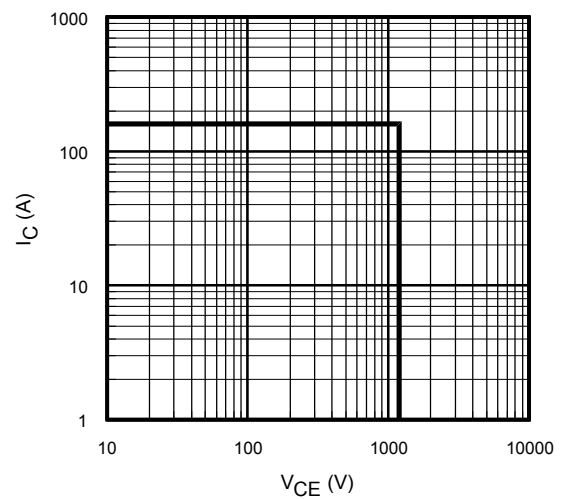


Fig. 4 - Reverse Bias SOA
 $T_J = 150^\circ\text{C}$; $V_{GE} = 15\text{V}$

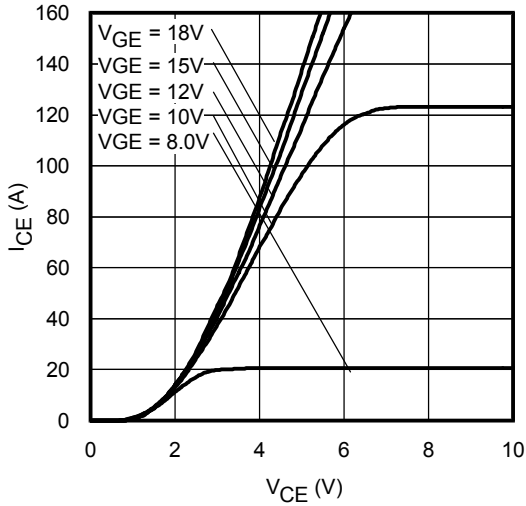


Fig. 5 - Typ. IGBT Output Characteristics
 $T_J = -40^{\circ}\text{C}$; $t_p = 80\mu\text{s}$

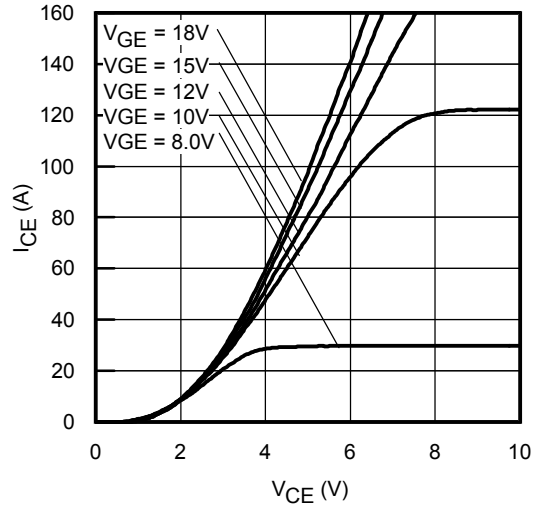


Fig. 6 - Typ. IGBT Output Characteristics
 $T_J = 25^{\circ}\text{C}$; $t_p = 80\mu\text{s}$

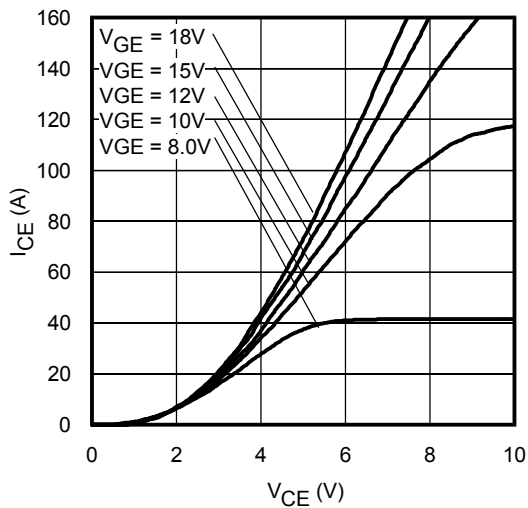


Fig. 7 - Typ. IGBT Output Characteristics
 $T_J = 125^{\circ}\text{C}$; $t_p = 80\mu\text{s}$

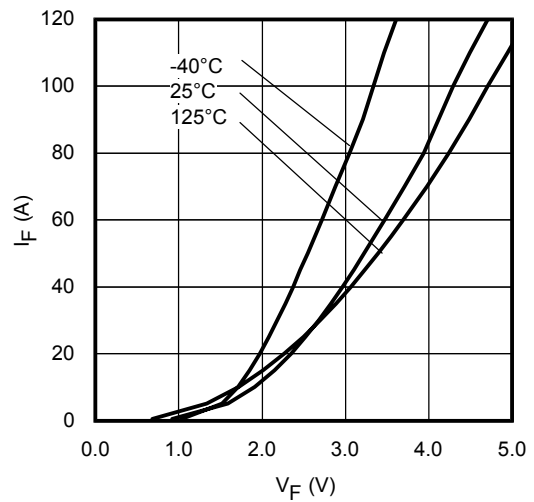


Fig. 8 - Typ. Diode Forward Characteristics
 $t_p = 80\mu\text{s}$

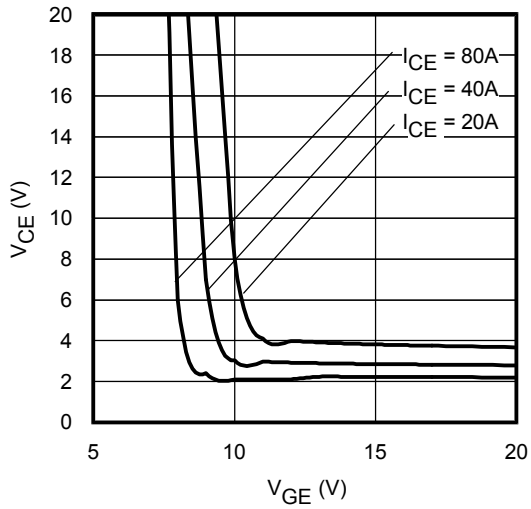


Fig. 9 - Typical V_{CE} vs. V_{GE}
 $T_J = -40^\circ\text{C}$

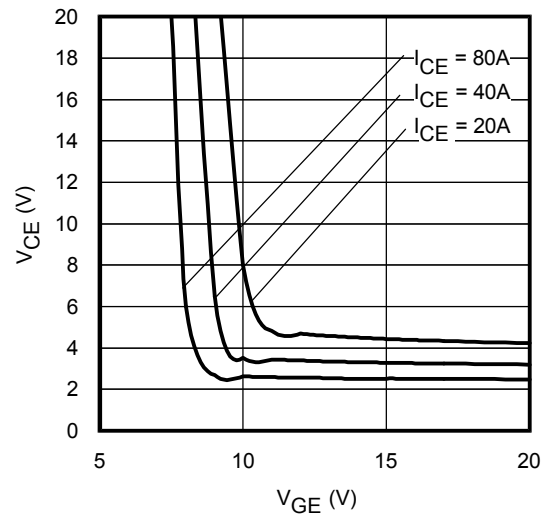


Fig. 10 - Typical V_{CE} vs. V_{GE}
 $T_J = 25^\circ\text{C}$

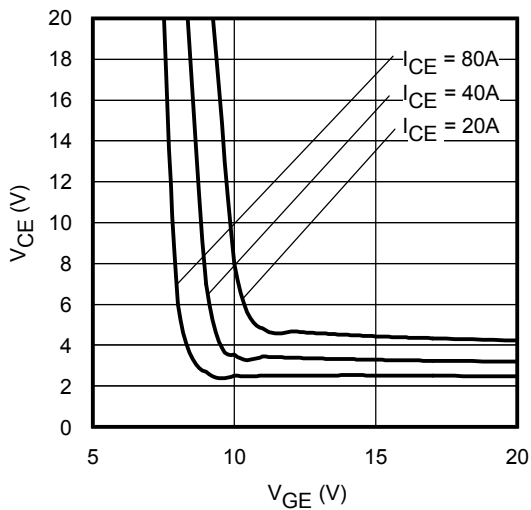


Fig. 11 - Typical V_{CE} vs. V_{GE}
 $T_J = 125^\circ\text{C}$

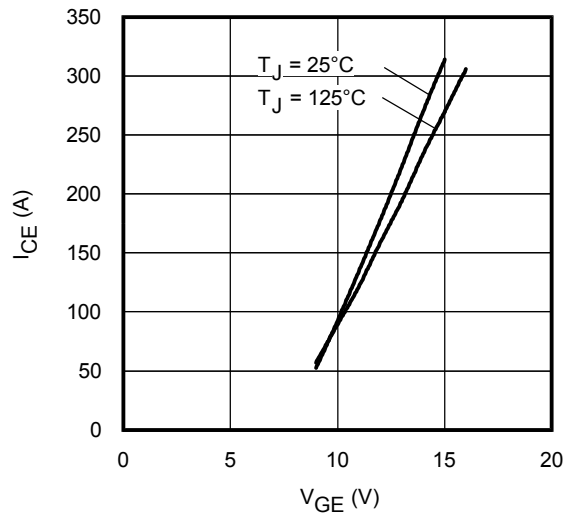


Fig. 12 - Typ. Transfer Characteristics
 $V_{CE} = 50\text{V}$; $t_p = 10\mu\text{s}$

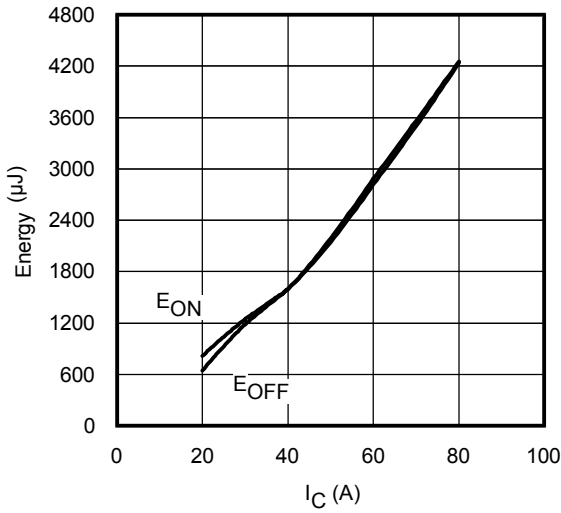


Fig. 13 - Typ. Energy Loss vs. I_C
 $T_J = 125^\circ\text{C}$; $L=250\mu\text{H}$; $V_{CE}=400\text{V}$
 $R_G=5\Omega$; $V_{GE}=15\text{V}$

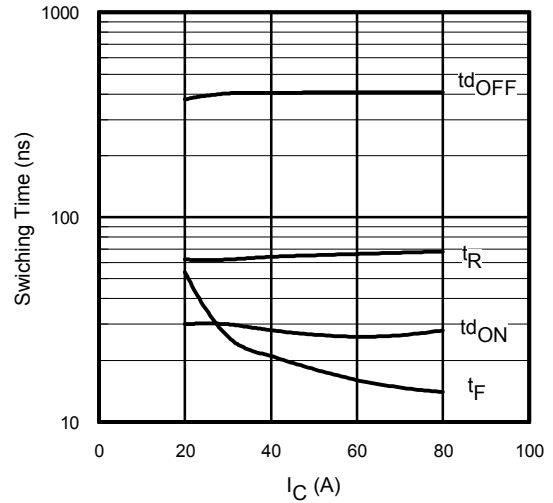


Fig. 14 - Typ. Switching Time vs. I_C
 $T_J = 125^\circ\text{C}$; $L=250\mu\text{H}$; $V_{CE}=400\text{V}$
 $R_G=5\Omega$; $V_{GE}=15\text{V}$

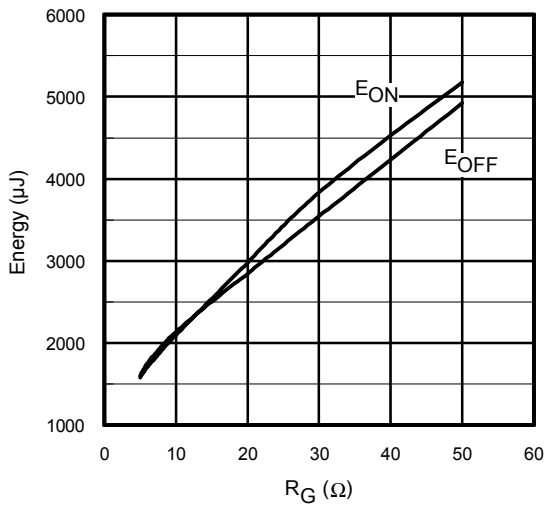


Fig. 15 - Typ. Energy Loss vs. R_G
 $T_J = 150^\circ\text{C}$; $L=250\mu\text{H}$; $V_{CE}=600\text{V}$
 $I_{CE}=40\text{A}$; $V_{GE}=15\text{V}$

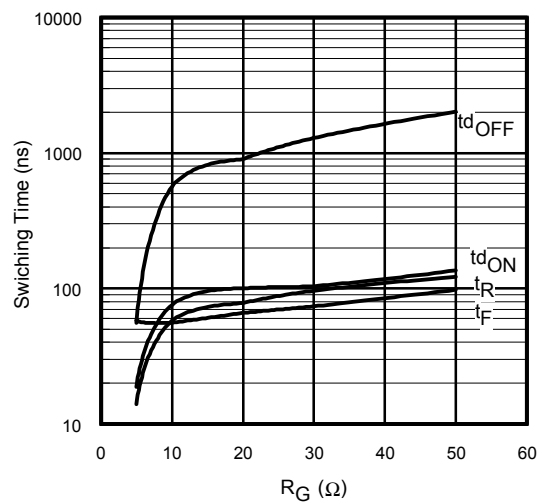


Fig. 16 - Typ. Switching Time vs. R_G
 $T_J = 150^\circ\text{C}$; $L=250\mu\text{H}$; $V_{CE}=600\text{V}$
 $I_{CE}=40\text{A}$; $V_{GE}=15\text{V}$

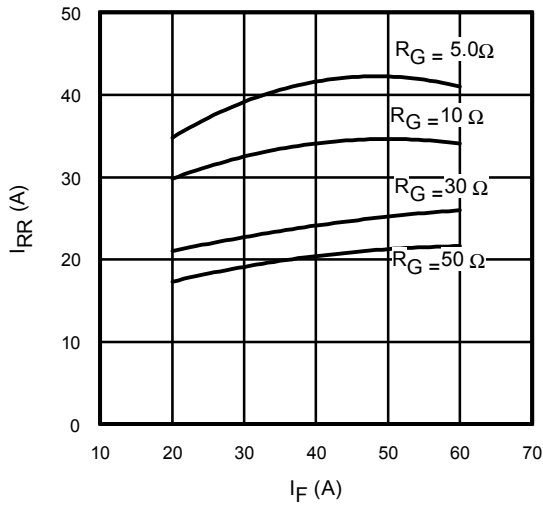


Fig. 17 - Typical Diode I_{RR} vs. I_F
 $T_J = 125^\circ\text{C}$

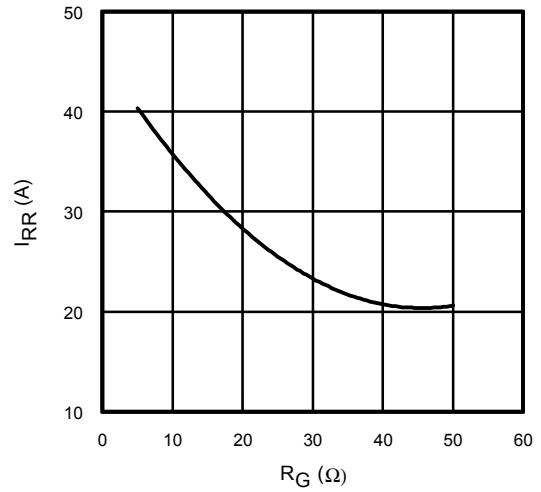


Fig. 18 - Typical Diode I_{RR} vs. R_G
 $T_J = 125^\circ\text{C}$; $I_F = 40\text{A}$

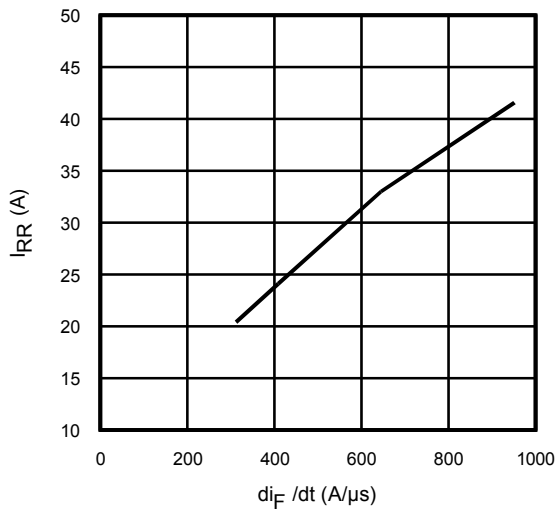


Fig. 19- Typical Diode I_{RR} vs. di_F/dt
 $V_{CC} = 600\text{V}$; $V_{GE} = 15\text{V}$;
 $I_{CE} = 40\text{A}$; $T_J = 125^\circ\text{C}$

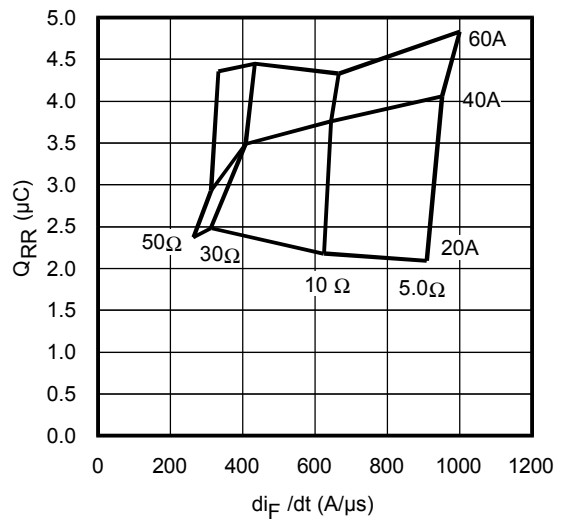


Fig. 20 - Typical Diode Q_{RR}
 $V_{CC} = 600\text{V}$; $V_{GE} = 15\text{V}$; $T_J = 125^\circ\text{C}$

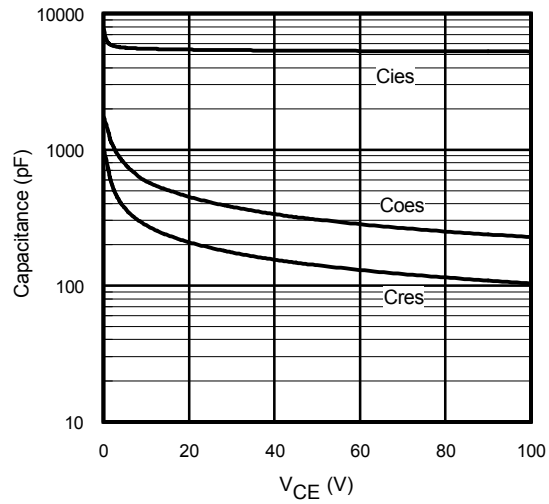


Fig. 21- Typ. Capacitance vs. V_{CE}
 V_{GE} = 0V; f = 1MHz

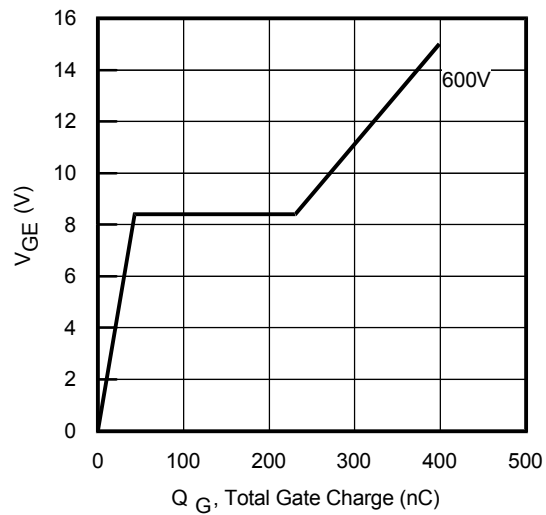


Fig. 22 - Typical Gate Charge vs. V_{GE}
 I_{CE} = 5.0A; L = 600μH

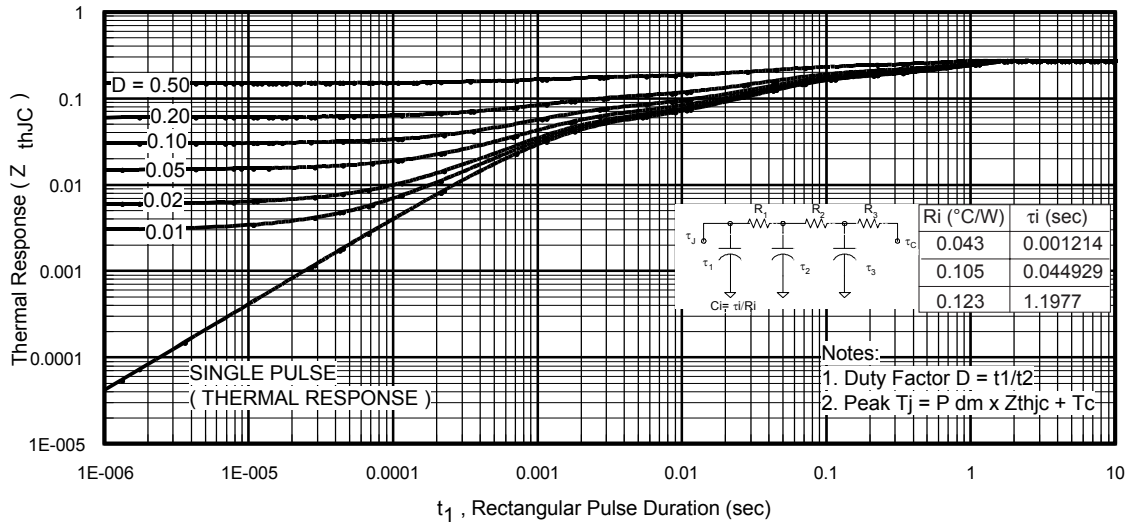


Fig 23. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

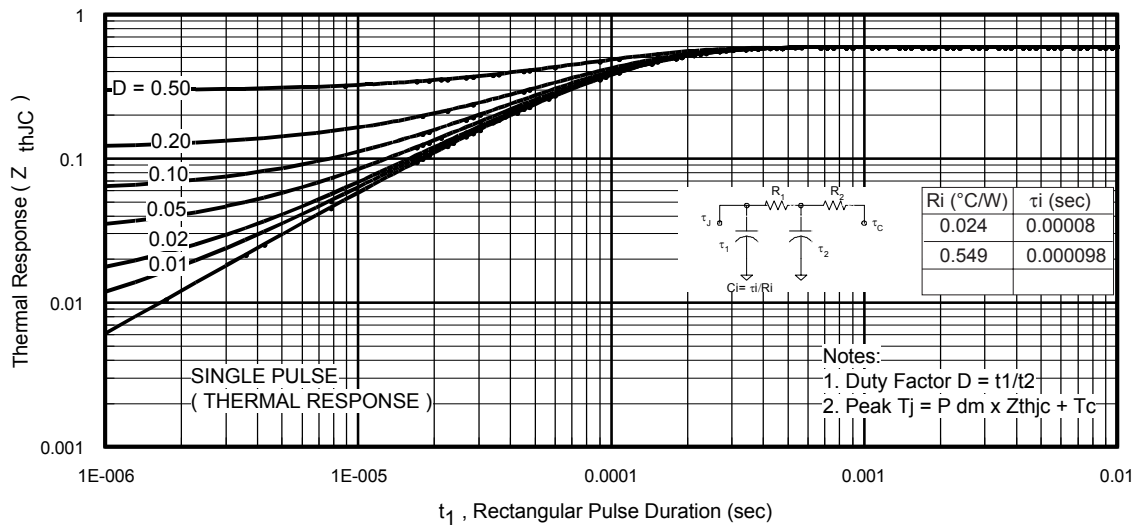


Fig 24. Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)

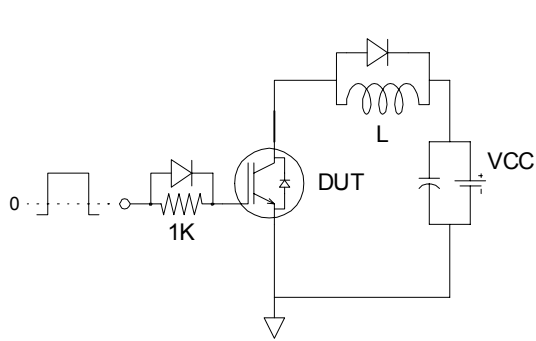


Fig. CT.1 - Gate Charge Circuit (turn-off)

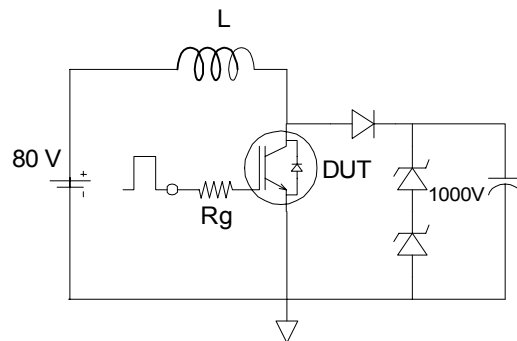


Fig. CT.2 - RBSOA Circuit

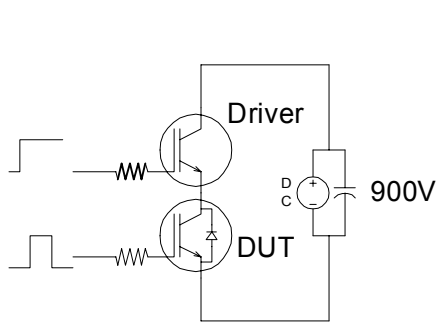


Fig. CT.3 - S.C. SOA Circuit

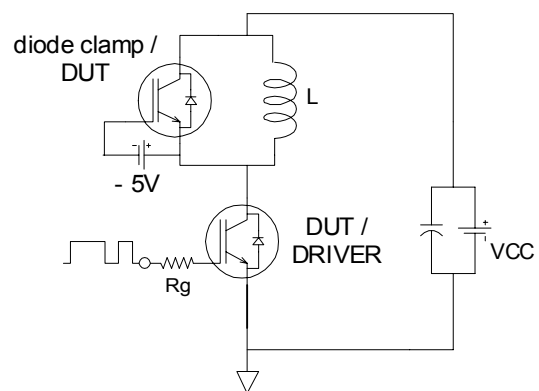
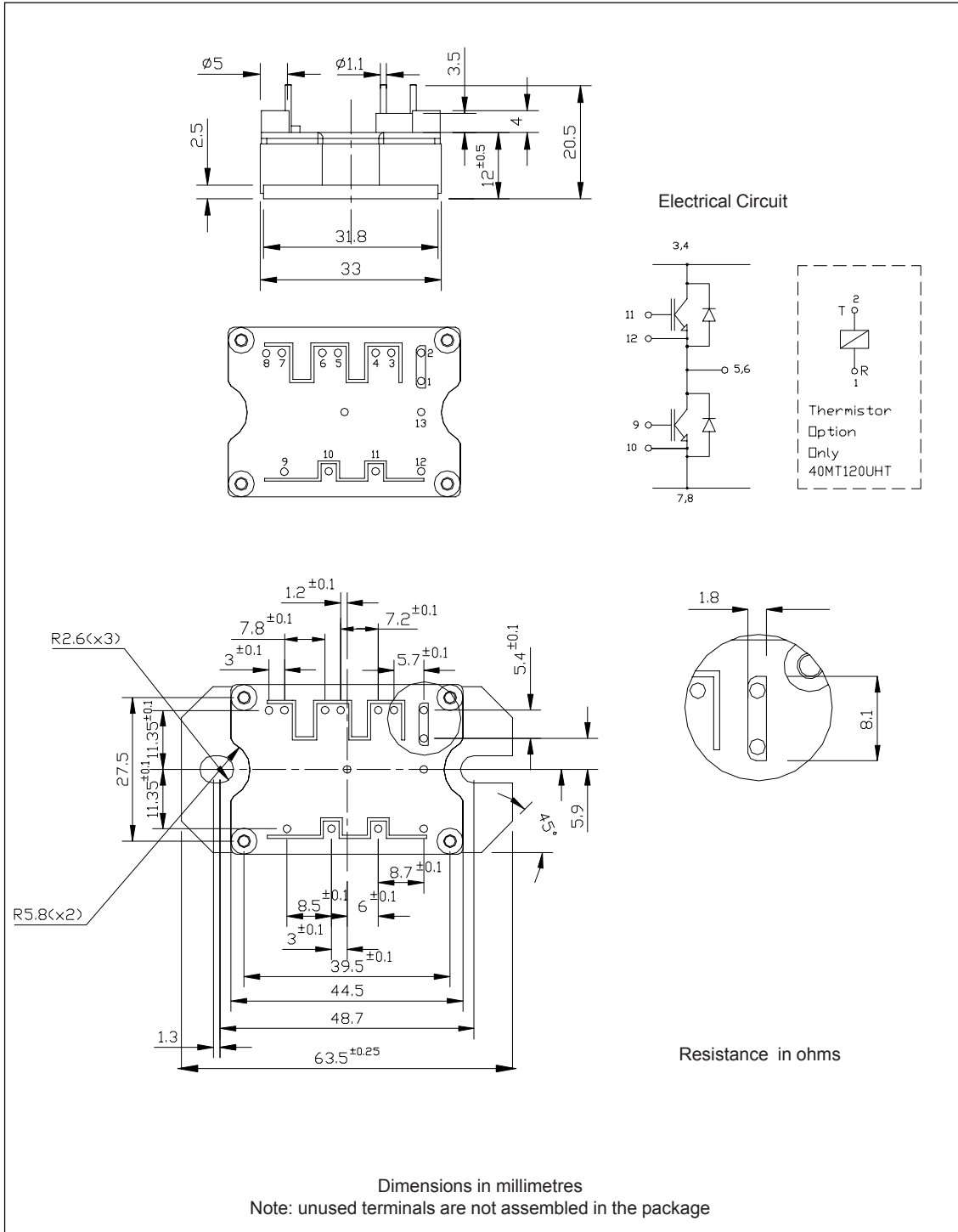


Fig. CT.4 - Switching Loss Circuit

Outline Table



Ordering Information Table

Device Code													
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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.