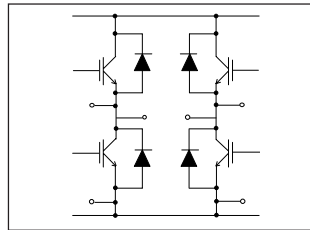


#### Features

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



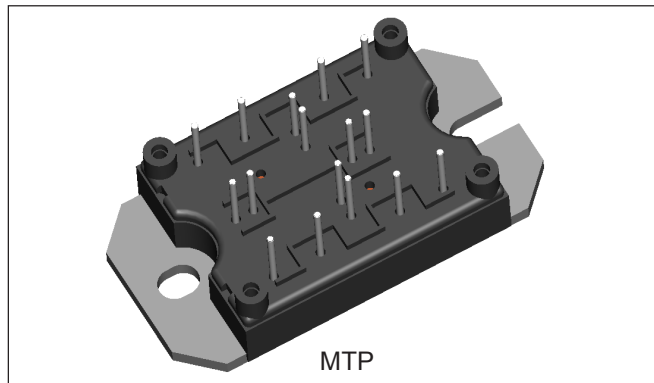
$$V_{CES} = 1200V$$

$$I_C = 40A$$

$$T_C = 25^\circ C$$

#### 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
- Very Low Junction-to-Case Thermal Resistance



#### Absolute Maximum Ratings

Parameters		Max	Units
$V_{CES}$	Collector-to-Emitter Breakdown Voltage	1200	V
$I_C$	Continuos Collector Current	@ $T_C = 25^\circ C$	40
		@ $T_C = 106^\circ C$	20
$I_{CM}$	Pulsed Collector Current	100	
$I_{LM}$	Clamped Inductive Load Current	100	
$I_F$	Diode Continuous Forward Current	@ $T_C = 106^\circ C$	25
$I_{FM}$	Diode Maximum Forward Current	100	
$V_{GE}$	Gate-to-Emitter Voltage	$\pm 20$	V
$V_{ISOL}$	RMS Isolation Voltage, Any Terminal to Case, $t = 1$ min	2500	
$P_D$	Maximum Power Dissipation (only IGBT)	@ $T_C = 25^\circ C$	240
		@ $T_C = 100^\circ C$	96

**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	1200			V	V <sub>GE</sub> = 0V, I <sub>C</sub> = 250μA
ΔV <sub>(BR)CES</sub> /ΔT <sub>J</sub> Temperature Coeff. of Breakdown Voltage		+1.3		V/°C	V <sub>GE</sub> = 0V, I <sub>C</sub> = 3mA (25-125°C)
V <sub>CE(ON)</sub> Collector-to-Emitter Saturation Voltage		3.29	3.59	V	V <sub>GE</sub> = 15V, I <sub>C</sub> = 20A
		4.42	4.66		V <sub>GE</sub> = 15V, I <sub>C</sub> = 40A
		3.87	4.11		V <sub>GE</sub> = 15V, I <sub>C</sub> = 20A T <sub>J</sub> = 125°C
		5.32	5.70		V <sub>GE</sub> = 15V, I <sub>C</sub> = 40A T <sub>J</sub> = 125°C
		3.99	4.27		V <sub>GE</sub> = 15V, I <sub>C</sub> = 20A T <sub>J</sub> = 150°C
V <sub>GE(th)</sub> Gate Threshold Voltage	4		6	V	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 250μA
ΔV <sub>GE(th)</sub> /ΔT <sub>J</sub> Temperature Coeff. of Threshold Voltage		-14		mV/°C	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 3mA (25-125°C)
g <sub>fe</sub> Transconductance		17.5		S	V <sub>CE</sub> = 50V, I <sub>C</sub> = 20A, PW = 80μs
I <sub>CES</sub> Zero Gate Voltage Collector Current <sup>(1)</sup>			250	μA	V <sub>GE</sub> = 0V, V <sub>CE</sub> = 1200V, T <sub>J</sub> = 25°C
		0.7	3.0	mA	V <sub>GE</sub> = 0V, V <sub>CE</sub> = 1200V, T <sub>J</sub> = 125°C
		2.9	9.0		V <sub>GE</sub> = 0V, V <sub>CE</sub> = 1200V, T <sub>J</sub> = 150°C
I <sub>GES</sub> Gate-to-Emitter Leakage Current			±250	nA	V <sub>GE</sub> = ± 20V

(1) I<sub>CES</sub> includes also opposite leg overall leakage

**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)		176	264	nC	I <sub>C</sub> = 20A V <sub>CC</sub> = 600V V <sub>GE</sub> = 15V
Q <sub>ge</sub> Gate-Emitter Charge (turn-on)		19	30		
Q <sub>gc</sub> Gate-Collector Charge (turn-on)		89	134		
E <sub>on</sub> Turn-On Switching Loss		513	770	μJ	V <sub>CC</sub> = 600V, I <sub>C</sub> = 20A V <sub>GE</sub> = 15V, R <sub>g</sub> = 5Ω, L = 200μH T <sub>J</sub> = 25°C, Energy losses include tail and diode reverse recovery
E <sub>off</sub> Turn-Off Switching Loss		402	603		
E <sub>tot</sub> Total Switching Loss		915	1373		
E <sub>on</sub> Turn-On Switching Loss		930	1395	μJ	V <sub>CC</sub> = 600V, I <sub>C</sub> = 20A V <sub>GE</sub> = 15V, R <sub>g</sub> = 5Ω, L = 200μH T <sub>J</sub> = 125°C, Energy losses include tail and diode reverse recovery
E <sub>off</sub> Turn-Off Switching Loss		610	915		
E <sub>tot</sub> Total Switching Loss		1540	2310		
C <sub>ies</sub> Input Capacitance		2530	3790	pF	V <sub>GE</sub> = 0V V <sub>CC</sub> = 30V f = 1.0 MHz
C <sub>oes</sub> Output Capacitance		344	516		
C <sub>res</sub> Reverse Transfer Capacitance		78	117		
RBSOA Reverse Bias Safe Operating Area	full square				T <sub>J</sub> = 150°C, I <sub>C</sub> = 120A V <sub>CC</sub> = 1000V, V <sub>p</sub> = 1200V R <sub>g</sub> = 5Ω, V <sub>GE</sub> = +15V to 0V
SCSOA Short Circuit Safe Operating Area	10			μs	T <sub>J</sub> = 150°C V <sub>CC</sub> = 900V, V <sub>p</sub> = 1200V R <sub>g</sub> = 5Ω, V <sub>GE</sub> = +15V to 0V

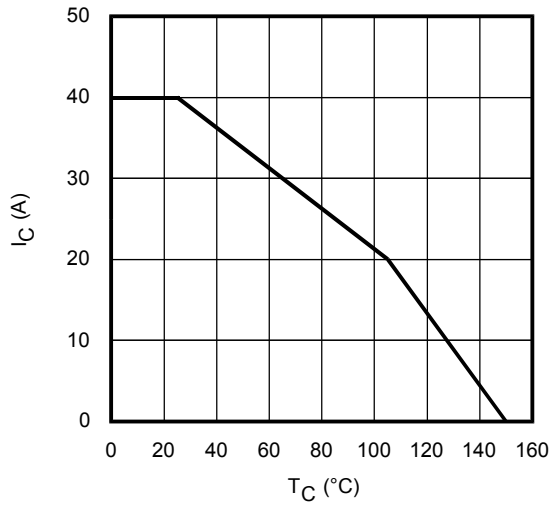
**Diode Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)**

Parameters	Min	Typ	Max	Units	Test Conditions
V <sub>FM</sub> Diode Forward Voltage Drop		2.48	2.94	V	I <sub>C</sub> = 20A
		3.28	3.90		I <sub>C</sub> = 40A
		2.44	2.84		I <sub>C</sub> = 20A, T <sub>J</sub> = 125°C
		3.45	4.14		I <sub>C</sub> = 40A, T <sub>J</sub> = 125°C
		2.21	2.93		I <sub>C</sub> = 20A, T <sub>J</sub> = 150°C
E <sub>rec</sub> Reverse Recovery Energy of the Diode		420	630	μJ	V <sub>GE</sub> = 15V, R <sub>g</sub> = 5Ω, L = 200μH
trr Diode Reverse Recovery Time		98	150	ns	V <sub>CC</sub> = 600V, I <sub>C</sub> = 20A
I <sub>rr</sub> Peak Reverse Recovery Current		33	50	A	T <sub>J</sub> = 125°C

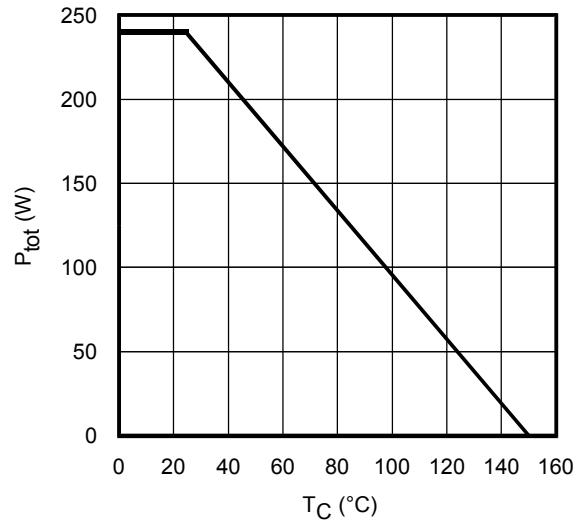
**Thermal- Mechanical Specifications**

Parameters	Min	Typ	Max	Units
T <sub>J</sub> Operating Junction Temperature Range	- 40		150	°C
T <sub>STG</sub> Storage Temperature Range	- 40		125	
R <sub>thJC</sub> Junction-to-Case	IGBT		0.35	°C/ W
	Diode		0.40	
R <sub>thCS</sub> 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 (2)		3 ± 10%		Nm
Wt Weight		66		g (oz)

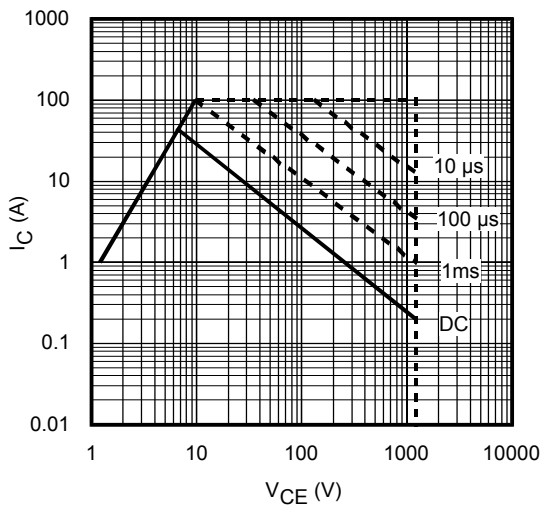
(2) A mounting compound is recommended and the torque should be checked after 3 hours to allow for the spread of the compound. Lubricated threads



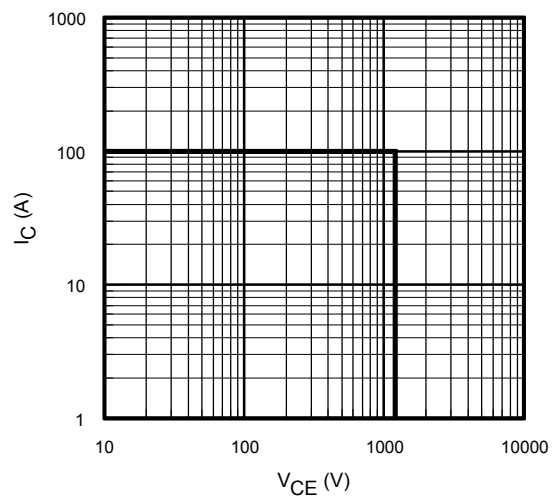
**Fig. 1** - Maximum DC Collector Current vs. Case Temperature



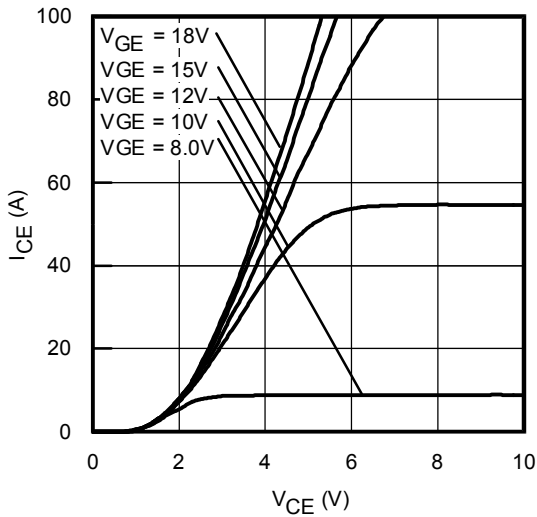
**Fig. 2** - Power Dissipation vs. Case Temperature



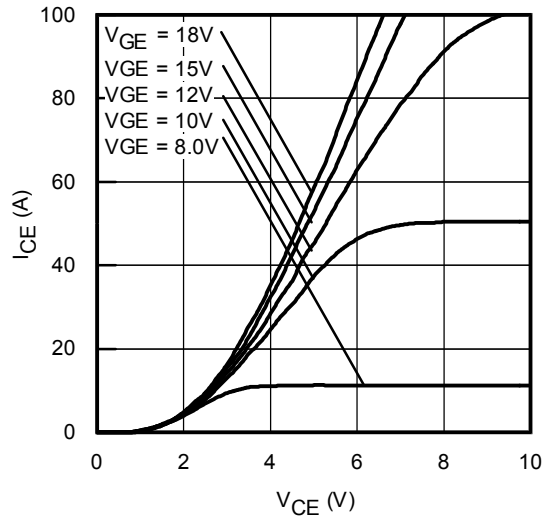
**Fig. 3** - Forward SOA  
 $T_C = 25^\circ\text{C}$ ;  $T_J \leq 150^\circ\text{C}$



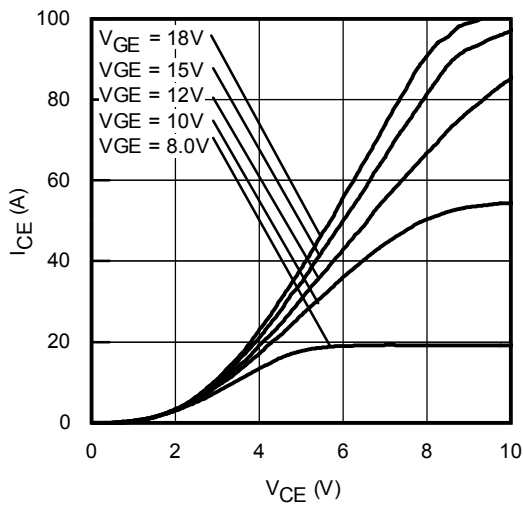
**Fig. 4** - Reverse Bias SOA  
 $T_J = 150^\circ\text{C}$ ;  $V_{GE} = 15\text{V}$



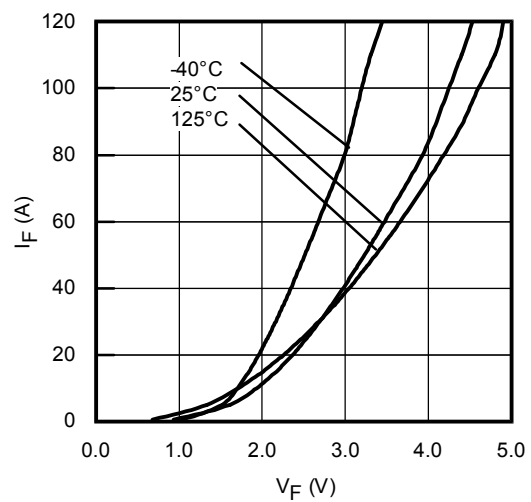
**Fig. 5 - Typ. IGBT Output Characteristics**  
 $T_J = -40^\circ\text{C}; t_p = 80\mu\text{s}$



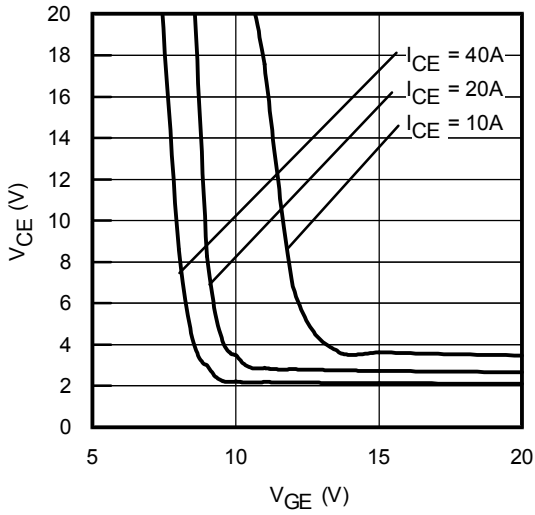
**Fig. 6 - Typ. IGBT Output Characteristics**  
 $T_J = 25^\circ\text{C}; t_p = 80\mu\text{s}$



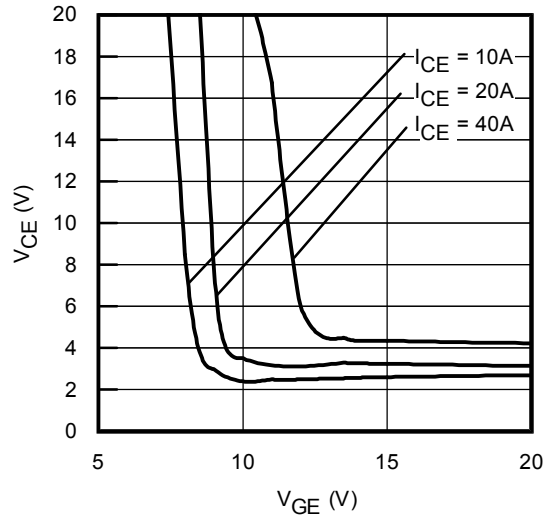
**Fig. 7 - Typ. IGBT Output Characteristics**  
 $T_J = 125^\circ\text{C}; t_p = 80\mu\text{s}$



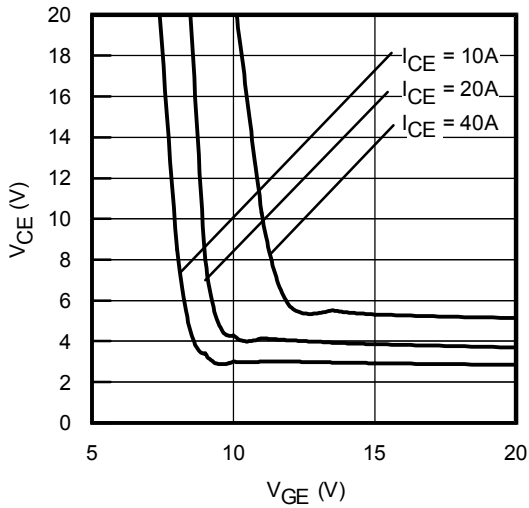
**Fig. 8 - Typ. Diode Forward Characteristics**  
 $t_p = 80\mu\text{s}$



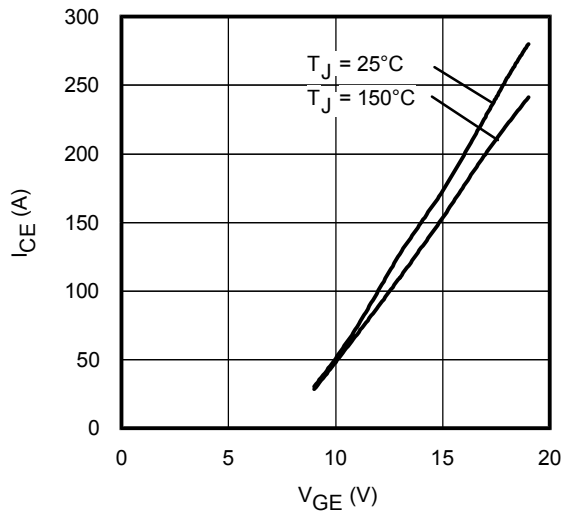
**Fig. 9** - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = -40^\circ\text{C}$



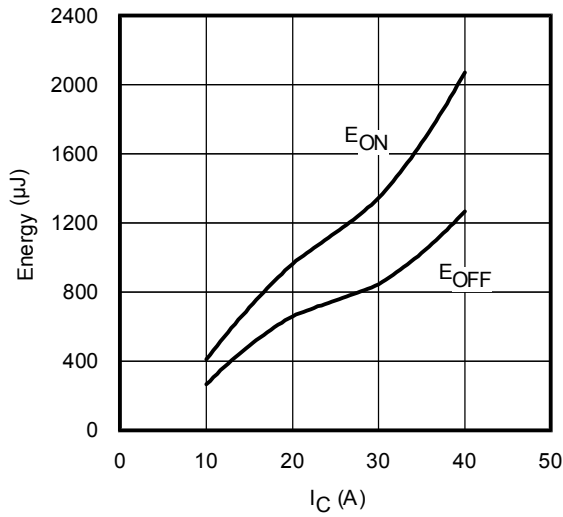
**Fig. 10** - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = 25^\circ\text{C}$



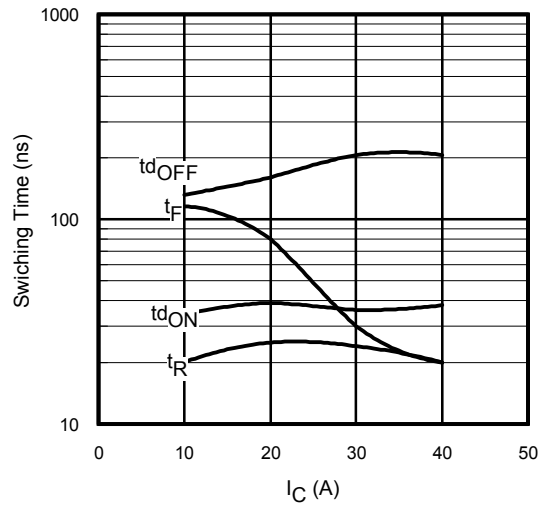
**Fig. 11** - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = 125^\circ\text{C}$



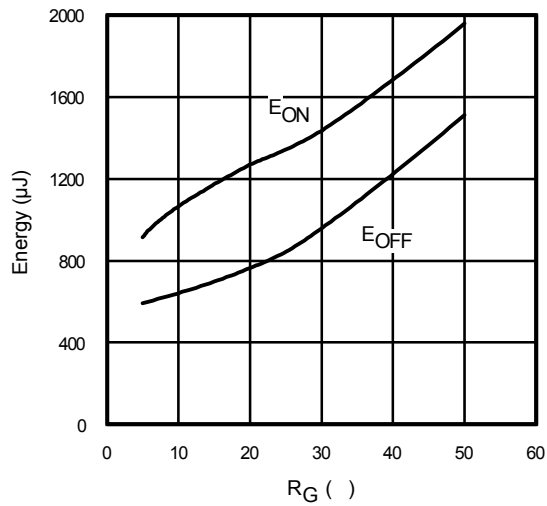
**Fig. 12** - Typ. Transfer Characteristics  
 $V_{CE} = 50\text{V}$ ;  $t_p = 10\mu\text{s}$



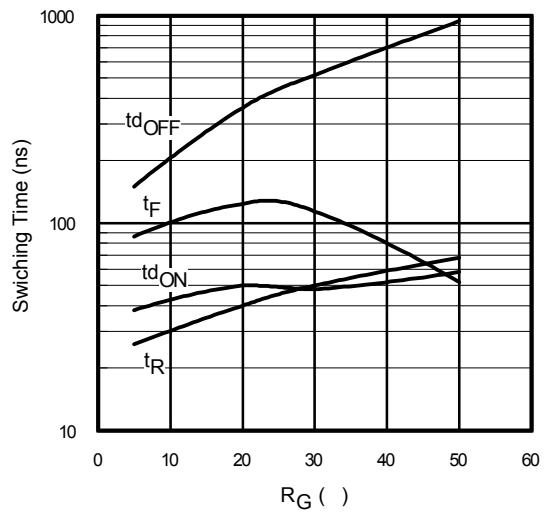
**Fig. 13** - Typ. Energy Loss vs.  $I_C$   
 $T_J = 150^\circ\text{C}$ ;  $L = 1.4\text{mH}$ ;  $V_{CE} = 400\text{V}$   
 $R_G = 5\Omega$ ;  $V_{GE} = 15\text{V}$



**Fig. 14** - Typ. Switching Time vs.  $I_C$   
 $T_J = 150^\circ\text{C}$ ;  $L = 1.4\text{mH}$ ;  $V_{CE} = 400\text{V}$   
 $R_G = 100\Omega$ ;  $V_{GE} = 15\text{V}$



**Fig. 15** - Typ. Energy Loss vs.  $R_G$   
 $T_J = 150^\circ\text{C}$ ;  $L = 1.4\text{mH}$ ;  $V_{CE} = 400\text{V}$   
 $I_{CE} = 5.0\text{A}$ ;  $V_{GE} = 15\text{V}$



**Fig. 16** - Typ. Switching Time vs.  $R_G$   
 $T_J = 150^\circ\text{C}$ ;  $L = 1.4\text{mH}$ ;  $V_{CE} = 400\text{V}$   
 $I_{CE} = 5.0\text{A}$ ;  $V_{GE} = 15\text{V}$

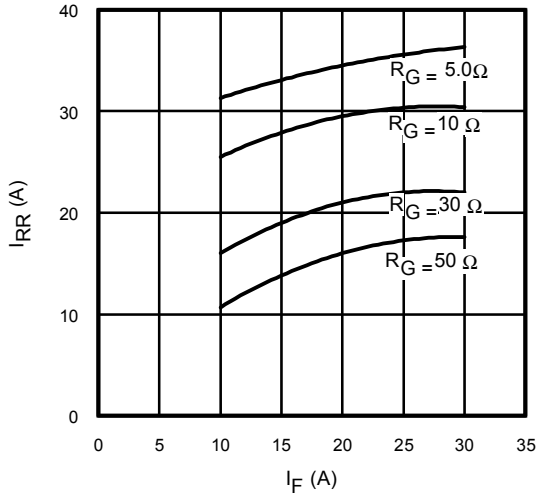


Fig. 17 - Typical Diode  $I_{RR}$  vs.  $I_F$   
 $T_J = 150^\circ\text{C}$

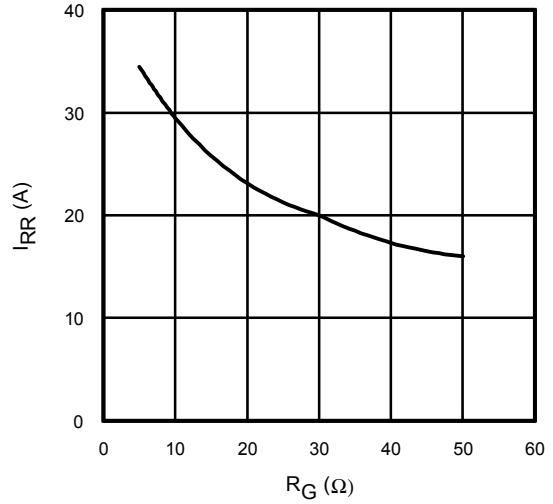


Fig. 18 - Typical Diode  $I_{RR}$  vs.  $R_G$   
 $T_J = 150^\circ\text{C}; I_F = 5.0\text{A}$

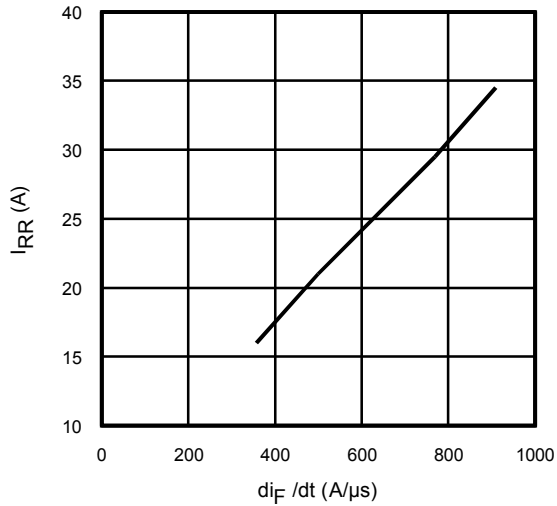


Fig. 19- Typical Diode  $I_{RR}$  vs.  $di_F/dt$   
 $V_{CC} = 400\text{V}; V_{GE} = 15\text{V};$   
 $I_{CE} = 5.0\text{A}; T_J = 150^\circ\text{C}$

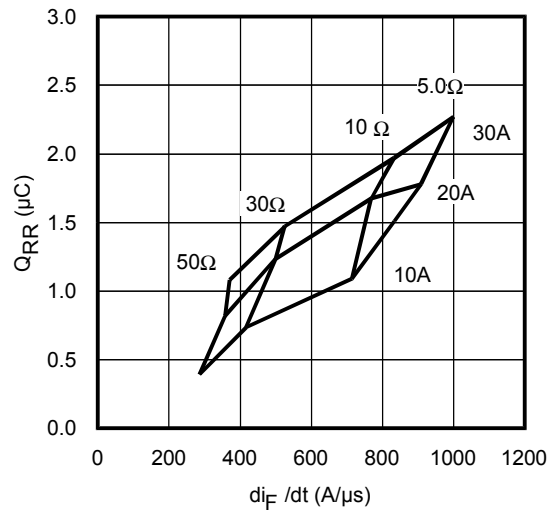
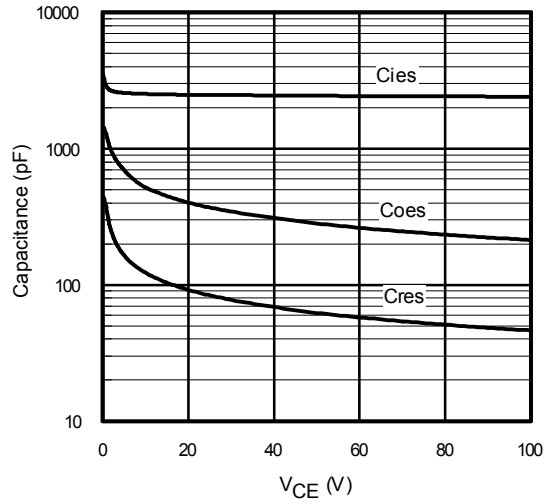
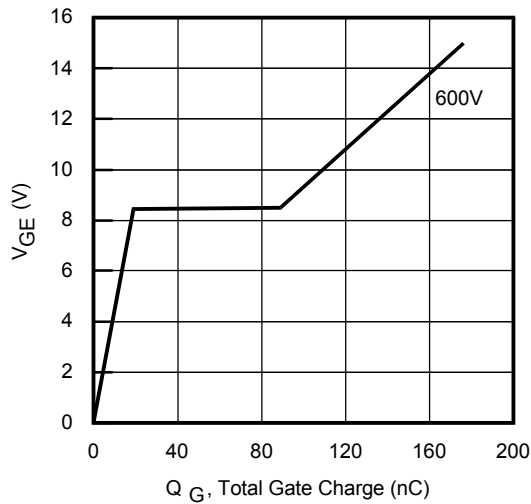


Fig. 20 - Typical Diode  $Q_{RR}$   
 $V_{CC} = 400\text{V}; V_{GE} = 15\text{V}; T_J = 150^\circ\text{C}$





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



**Fig. 22** - Typical Gate Charge vs.  $V_{GE}$   
 $I_{CE} = 5.0A$ ;  $L = 600\mu H$

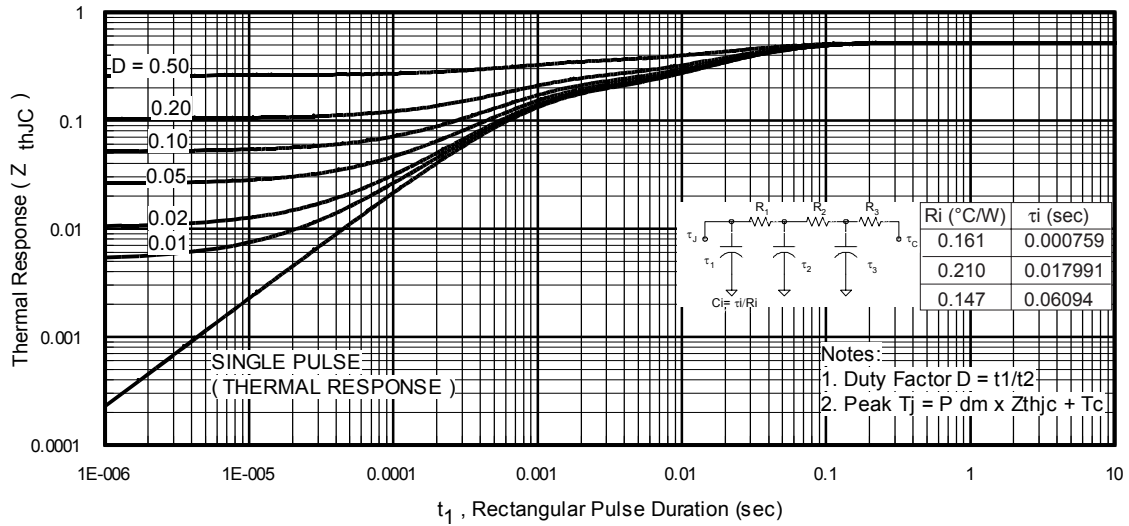


Fig 23. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

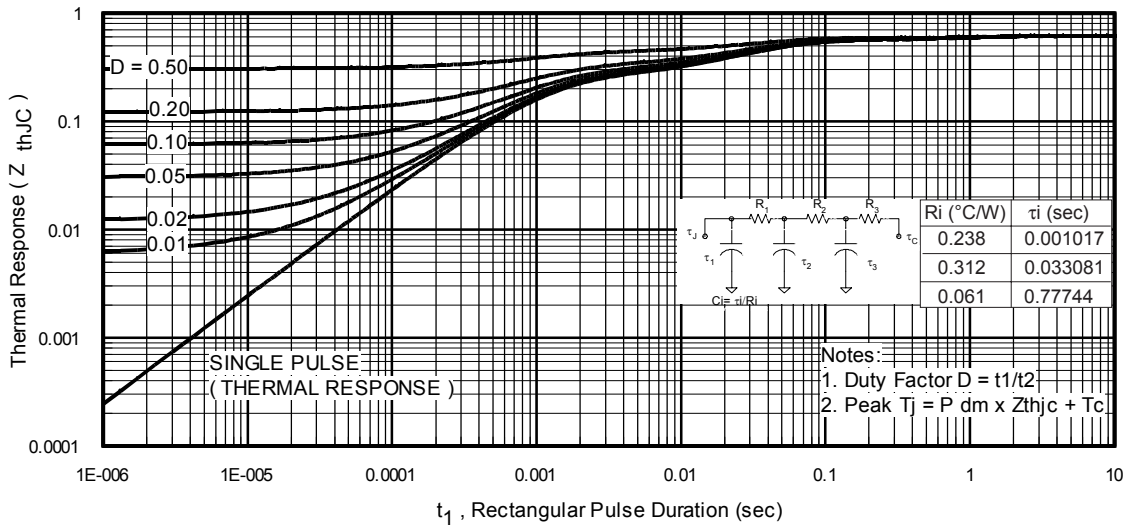
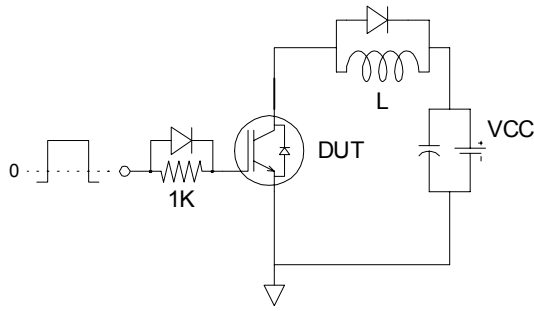
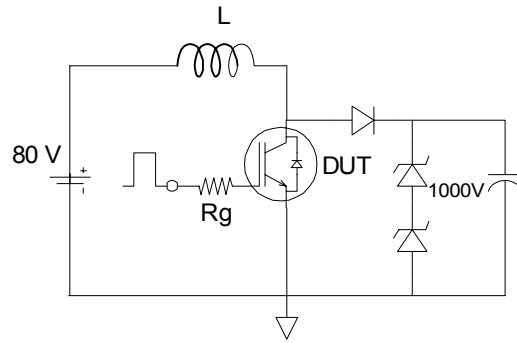


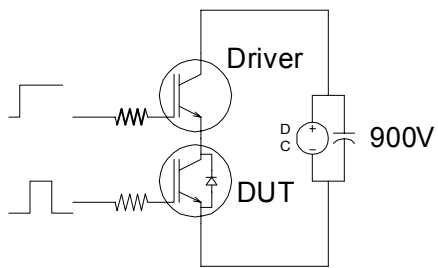
Fig 24. Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)



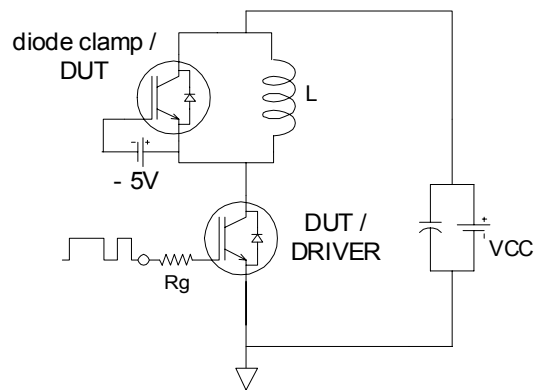
**Fig. CT.1** - Gate Charge Circuit (turn-off)



**Fig. CT.2** - RBSOA Circuit

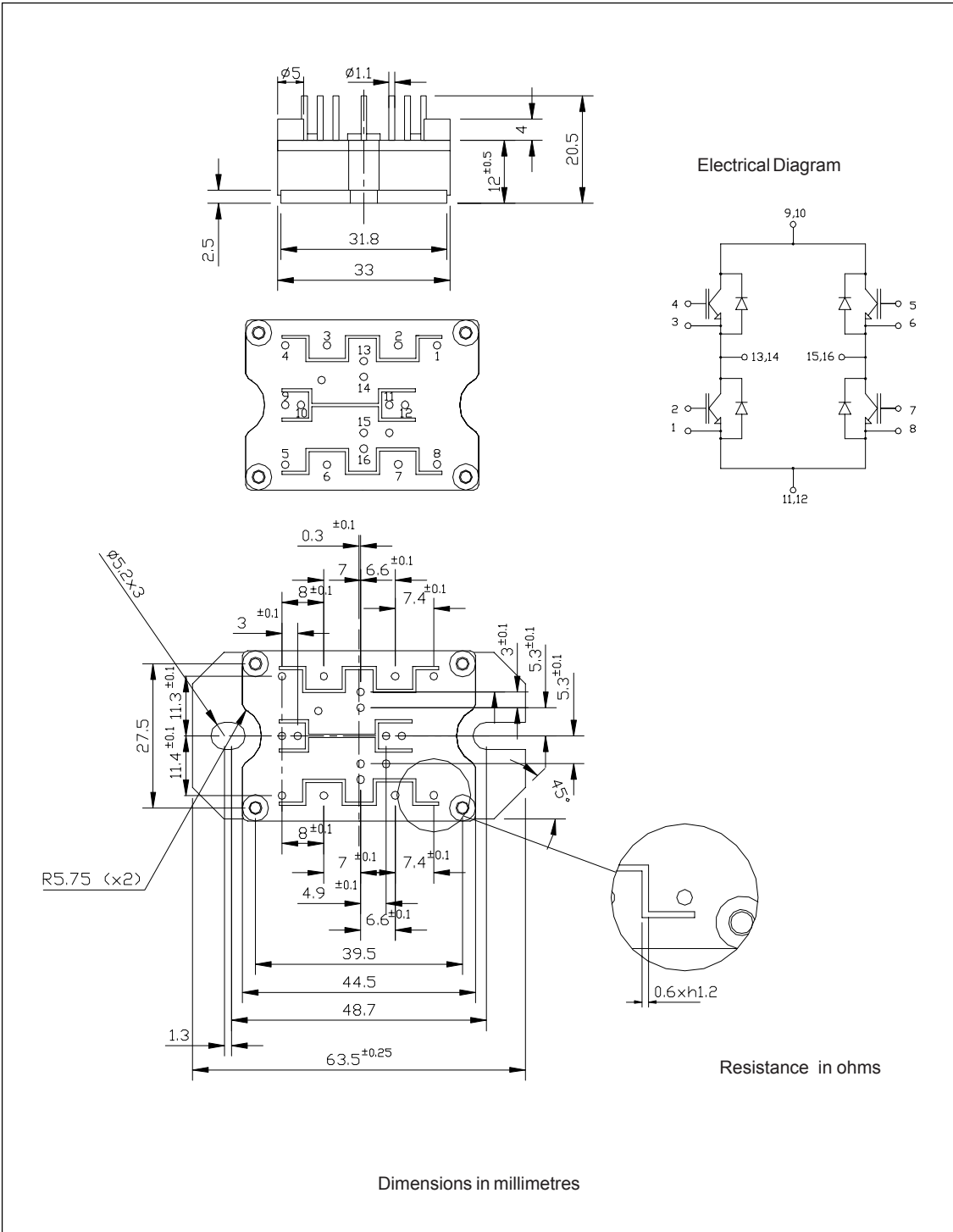


**Fig. CT.3** - S.C. SOA Circuit



**Fig. CT.4** - Switching Loss Circuit

**Outline Table**



### Ordering Information Table

Device Code	
	<b>20 MT 120 U F</b>
	① ② ③ ④ ⑤
<b>1</b>	- Current rating (20 = 20A)
<b>2</b>	- Essential Part Number
<b>3</b>	- Voltage code (120 = 1200V)
<b>4</b>	- Speed/ Type (U = Ultra Fast IGBT)
<b>5</b>	- Circuit Configuration (F = Full Bridge)
	- Special Option

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  
**IR** Rectifier

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