

Designer's™ Data Sheet

Insulated Gate Bipolar Transistor with Anti-Parallel Diode

N-Channel Enhancement-Mode Silicon Gate

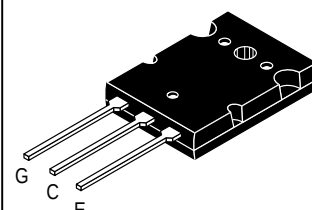
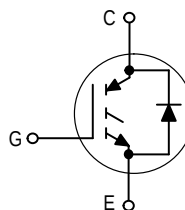
MGY30N60D

Motorola Preferred Device

IGBT & DIODE IN TO-264
30 A @ 90°C
50 A @ 25°C
600 VOLTS
SHORT CIRCUIT RATED

This Insulated Gate Bipolar Transistor (IGBT) is co-packaged with a soft recovery ultra-fast rectifier and uses an advanced termination scheme to provide an enhanced and reliable high voltage-blocking capability. Short circuit rated IGBT's are specifically suited for applications requiring a guaranteed short circuit withstand time such as Motor Control Drives. Fast switching characteristics result in efficient operations at high frequencies. Co-packaged IGBT's save space, reduce assembly time and cost.

- Industry Standard High Power TO-264 Package (TO-3PBL)
- High Speed E_{off} : 60 μ J per Amp typical at 125°C
- High Short Circuit Capability – 10 μ s minimum
- Soft Recovery Free Wheeling Diode is included in the package
- Robust High Voltage Termination
- Robust RBSOA



CASE 340G-02, Style 5
TO-264

MAXIMUM RATINGS ($T_C = 25^\circ\text{C}$ unless otherwise noted)

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CES}	600	Vdc
Collector-Gate Voltage ($R_{GE} = 1.0 \text{ M}\Omega$)	V_{CGR}	600	Vdc
Gate-Emitter Voltage — Continuous	V_{GE}	± 20	Vdc
Collector Current — Continuous @ $T_C = 25^\circ\text{C}$ — Continuous @ $T_C = 90^\circ\text{C}$ — Repetitive Pulsed Current (1)	I_{C25} I_{C90} I_{CM}	50 30 100	Adc Apk
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C	P_D	202 1.61	Watts W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-55 to 150	$^\circ\text{C}$
Short Circuit Withstand Time ($V_{CC} = 360 \text{ Vdc}$, $V_{GE} = 15 \text{ Vdc}$, $T_J = 25^\circ\text{C}$, $R_G = 20 \Omega$)	t_{sc}	10	μs
Thermal Resistance — Junction to Case – IGBT — Junction to Case – Diode — Junction to Ambient	$R_{\theta JC}$ $R_{\theta JD}$ $R_{\theta JA}$	0.62 1.41 35	$^\circ\text{C/W}$
Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 5 seconds	T_L	260	$^\circ\text{C}$
Mounting Torque, 6-32 or M3 screw	10 lbf•in (1.13 N•m)		

(1) Pulse width is limited by maximum junction temperature.

Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. SOA Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

Preferred devices are Motorola recommended choices for future use and best overall value.

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ELECTRICAL CHARACTERISTICS ($T_J = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-to-Emitter Breakdown Voltage ($V_{GE} = 0\text{ Vdc}$, $I_C = 250\text{ }\mu\text{Adc}$) Temperature Coefficient (Positive)	BV_{CES}	600 —	— 870	— —	Vdc mV/°C
Zero Gate Voltage Collector Current ($V_{CE} = 600\text{ Vdc}$, $V_{GE} = 0\text{ Vdc}$) ($V_{CE} = 600\text{ Vdc}$, $V_{GE} = 0\text{ Vdc}$, $T_J = 125^\circ\text{C}$)	I_{CES}	— —	— —	100 2500	μAdc
Gate-Body Leakage Current ($V_{GE} = \pm 20\text{ Vdc}$, $V_{CE} = 0\text{ Vdc}$)	I_{GES}	—	—	250	nAdc
ON CHARACTERISTICS (1)					
Collector-to-Emitter On-State Voltage ($V_{GE} = 15\text{ Vdc}$, $I_C = 15\text{ Adc}$) ($V_{GE} = 15\text{ Vdc}$, $I_C = 15\text{ Adc}$, $T_J = 125^\circ\text{C}$) ($V_{GE} = 15\text{ Vdc}$, $I_C = 30\text{ Adc}$)	$V_{CE(on)}$	— — —	2.20 2.10 2.60	2.90 — 3.45	Vdc
Gate Threshold Voltage ($V_{CE} = V_{GE}$, $I_C = 1\text{ mAdc}$) Threshold Temperature Coefficient (Negative)	$V_{GE(th)}$	4.0 —	6.0 10	8.0 —	Vdc mV/°C
Forward Transconductance ($V_{CE} = 10\text{ Vdc}$, $I_C = 30\text{ Adc}$)	g_{fe}	—	15	—	Mhos
DYNAMIC CHARACTERISTICS					
Input Capacitance	$(V_{CE} = 25\text{ Vdc}$, $V_{GE} = 0\text{ Vdc}$, $f = 1.0\text{ MHz}$)	C_{ies}	—	4280	pF
Output Capacitance		C_{oes}	—	225	
Transfer Capacitance		C_{res}	—	19	
SWITCHING CHARACTERISTICS (1)					
Turn-On Delay Time	$(V_{CC} = 360\text{ Vdc}$, $I_C = 30\text{ Adc}$, $V_{GE} = 15\text{ Vdc}$, $L = 300\text{ }\mu\text{H}$ $R_G = 20\text{ }\Omega$, $T_J = 25^\circ\text{C}$) Energy losses include "tail"	$t_{d(on)}$	—	76	ns
Rise Time		t_r	—	80	
Turn-Off Delay Time		$t_{d(off)}$	—	348	
Fall Time		t_f	—	188	
Turn-Off Switching Loss		E_{off}	—	0.98	mJ
Turn-On Switching Loss		E_{on}	—	2.00	
Total Switching Loss		E_{ts}	—	2.98	
Turn-On Delay Time	$(V_{CC} = 360\text{ Vdc}$, $I_C = 30\text{ Adc}$, $V_{GE} = 15\text{ Vdc}$, $L = 300\text{ }\mu\text{H}$ $R_G = 20\text{ }\Omega$, $T_J = 125^\circ\text{C}$) Energy losses include "tail"	$t_{d(on)}$	—	73	ns
Rise Time		t_r	—	95	
Turn-Off Delay Time		$t_{d(off)}$	—	394	
Fall Time		t_f	—	418	
Turn-Off Switching Loss		E_{off}	—	1.90	mJ
Turn-On Switching Loss		E_{on}	—	3.10	
Total Switching Loss		E_{ts}	—	5.00	
Gate Charge	$(V_{CC} = 360\text{ Vdc}$, $I_C = 30\text{ Adc}$, $V_{GE} = 15\text{ Vdc}$)	Q_T	—	150	nC
		Q_1	—	30	
		Q_2	—	45	
DIODE CHARACTERISTICS					
Diode Forward Voltage Drop ($I_{EC} = 15\text{ Adc}$) ($I_{EC} = 15\text{ Adc}$, $T_J = 125^\circ\text{C}$) ($I_{EC} = 30\text{ Adc}$)	V_{FEC}	— — —	1.30 1.10 1.45	1.80 — 2.05	Vdc

(1) Pulse Test: Pulse Width $\leq 300\text{ }\mu\text{s}$, Duty Cycle $\leq 2\%$.

(continued)

ELECTRICAL CHARACTERISTICS — continued ($T_J = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
DIODE CHARACTERISTICS — continued					
Reverse Recovery Time	$(I_F = 30 \text{ A dc}, V_R = 360 \text{ V dc}, dI_F/dt = 200 \text{ A}/\mu\text{s})$	t_{rr}	—	153	ns
		t_a	—	82	
		t_b	—	71	
Reverse Recovery Stored Charge		Q_{RR}	—	2.3	μC
Reverse Recovery Time	$(I_F = 30 \text{ A dc}, V_R = 360 \text{ V dc}, dI_F/dt = 200 \text{ A}/\mu\text{s}, T_J = 125^\circ\text{C})$	t_{rr}	—	208	ns
		t_a	—	117	
		t_b	—	91	
Reverse Recovery Stored Charge		Q_{RR}	—	3.8	μC
INTERNAL PACKAGE INDUCTANCE					
Internal Emitter Inductance (Measured from the emitter lead 0.25" from package to emitter bond pad)	L_E	—	13	—	nH

TYPICAL ELECTRICAL CHARACTERISTICS

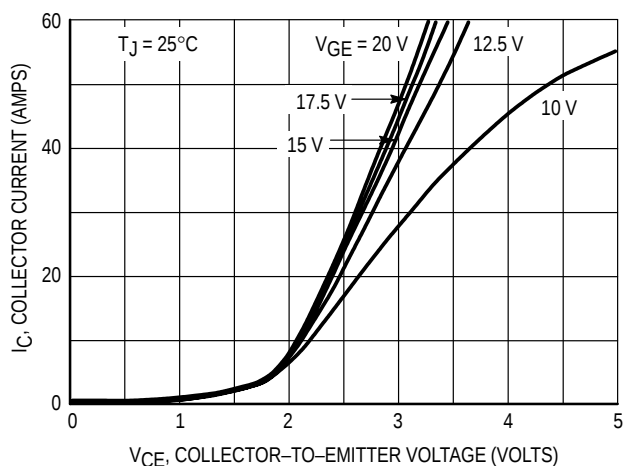


Figure 1. Output Characteristics, $T_J = 25^\circ\text{C}$

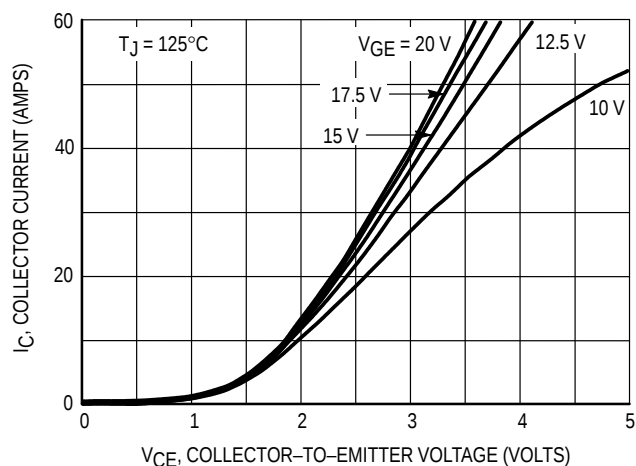


Figure 2. Output Characteristics, $T_J = 125^\circ\text{C}$

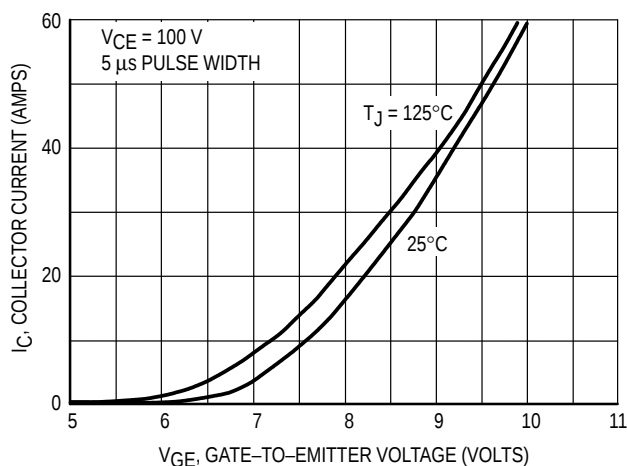


Figure 3. Transfer Characteristics

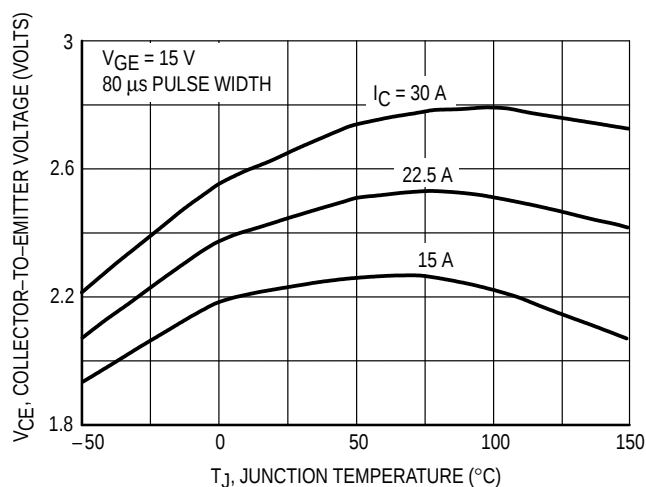


Figure 4. Collector-to-Emitter Saturation Voltage versus Junction Temperature

MGY30N60D

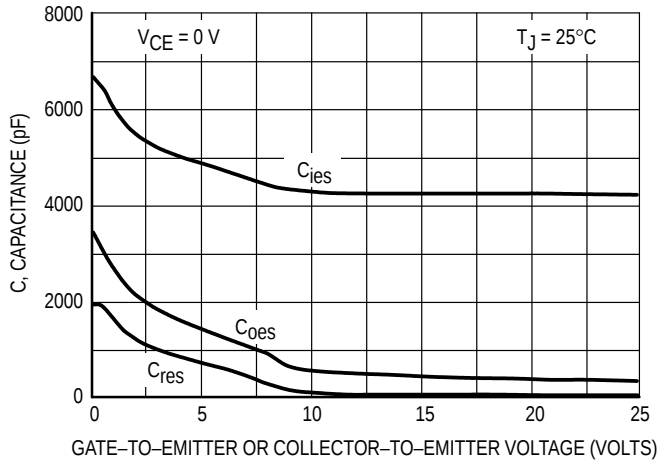


Figure 5. Capacitance Variation

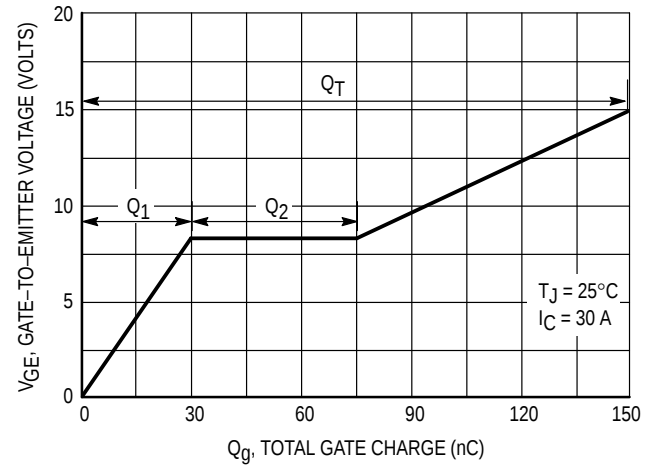


Figure 6. Gate-to-Emitter Voltage versus Total Charge

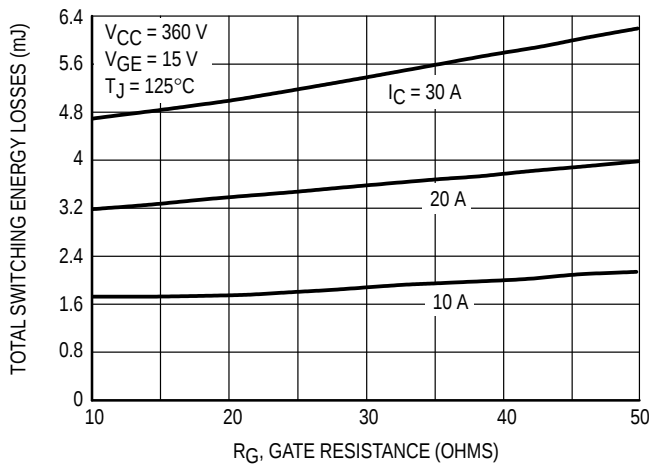


Figure 7. Total Switching Losses versus Gate Resistance

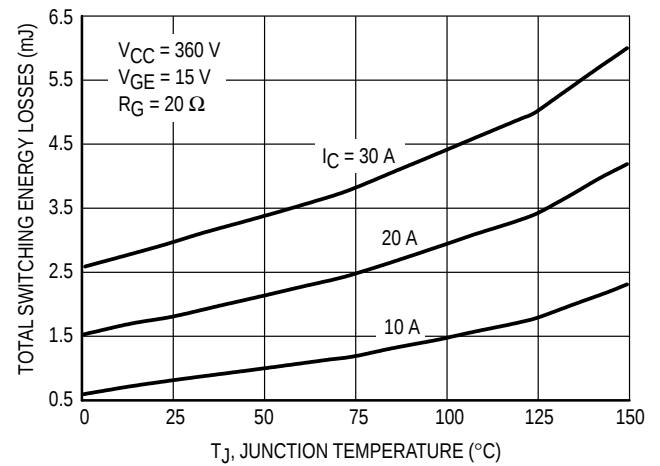


Figure 8. Total Switching Losses versus Junction Temperature

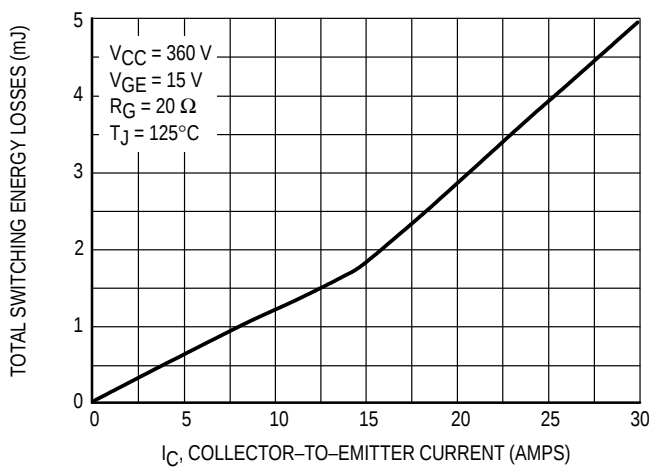


Figure 9. Total Switching Losses versus Collector-to-Emitter Current

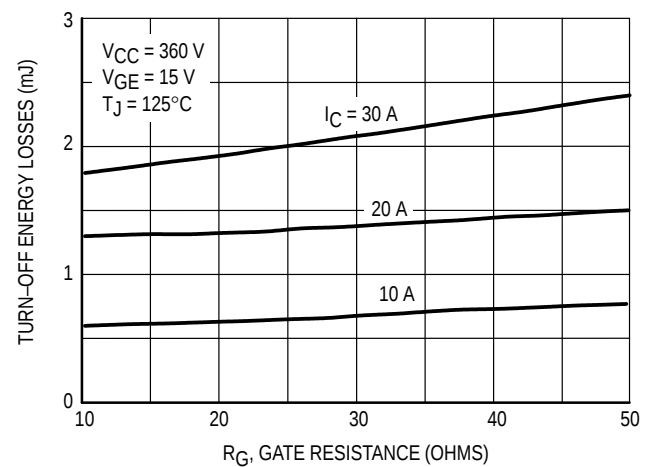


Figure 10. Turn-Off Losses versus Gate Resistance

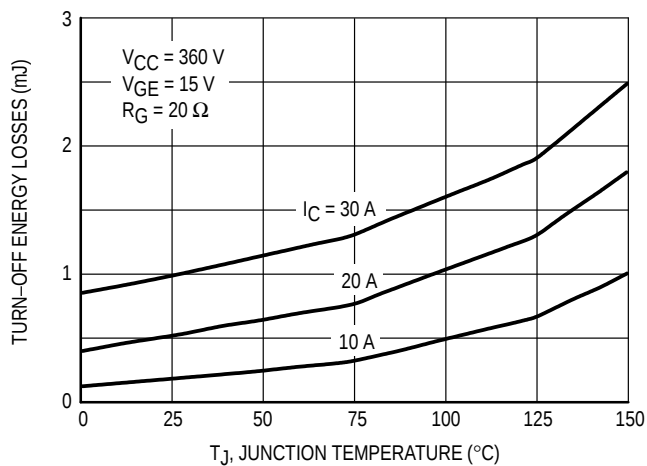


Figure 11. Turn-Off Losses versus Junction Temperature

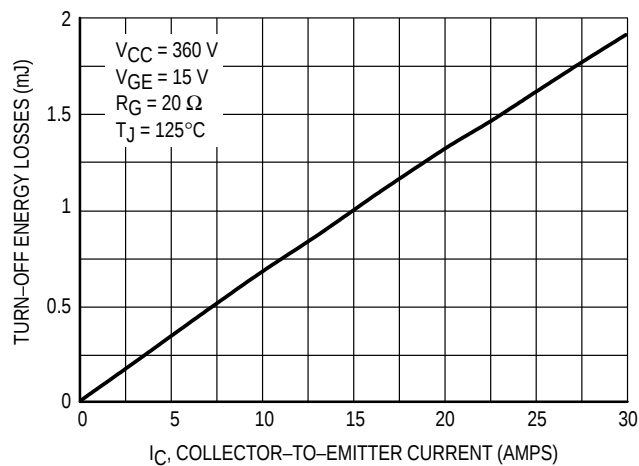


Figure 12. Turn-Off Losses versus Collector-to-Emitter Current

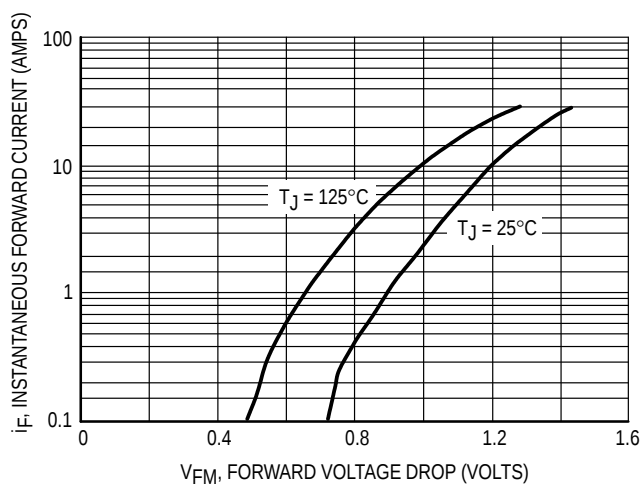


Figure 13. Typical Diode Forward Drop versus Instantaneous Forward Current

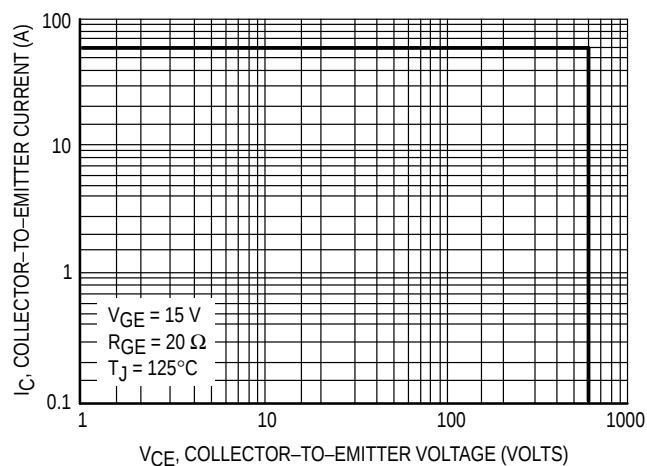
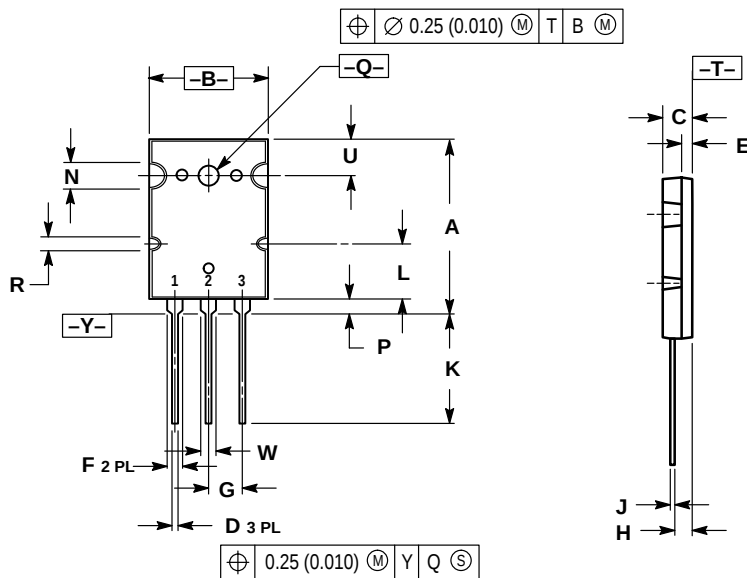


Figure 14. Reverse Biased Safe Operating Area

PACKAGE DIMENSIONS



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: MILLIMETER.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.8	2.9	1.102	1.142
B	19.3	20.3	0.760	0.800
C	4.7	5.3	0.185	0.209
D	0.93	1.48	0.037	0.058
E	1.9	2.1	0.075	0.083
F	2.2	2.4	0.087	0.102
G	5.45 BSC		0.215 BSC	
H	2.6	3.0	0.102	0.118
J	0.43	0.78	0.017	0.031
K	17.6	18.8	0.693	0.740
L	11.0	11.4	0.433	0.449
N	3.95	4.75	0.156	0.187
P	2.2	2.6	0.087	0.102
Q	3.1	3.5	0.122	0.137
R	2.15	2.35	0.085	0.093
U	6.1	6.5	0.240	0.256
W	2.8	3.2	0.110	0.125

STYLE 5:

1. GATE
2. COLLECTOR
3. EMITTER

CASE 340G-02
TO-264
ISSUE E

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