

# Designer's™ Data Sheet

## Insulated Gate Bipolar Transistor

### N-Channel Enhancement-Mode Silicon Gate

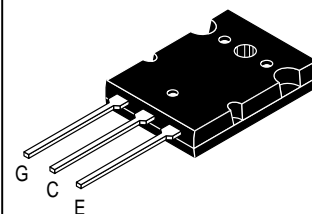
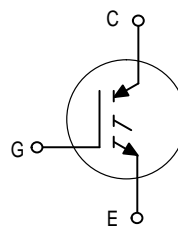
**MGY40N60**

Motorola Preferred Device

This Insulated Gate Bipolar Transistor (IGBT) 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.

- Industry Standard High Power TO-264 Package (TO-3PBL)
- High Speed  $E_{off}$ : 60  $\mu$ J per Amp typical at 125°C
- High Short Circuit Capability – 10  $\mu$ s minimum
- Robust High Voltage Termination
- Robust RBSOA

**IGBT IN TO-264**  
**40 A @ 90°C**  
**66 A @ 25°C**  
**600 VOLTS**  
**SHORT CIRCUIT RATED**



**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	$V_{GE}$	$\pm 20$	Vdc
Collector Current — Continuous @ $T_C = 25^\circ\text{C}$ — Continuous @ $T_C = 90^\circ\text{C}$ — Repetitive Pulsed Current (1)	$I_{C25}$ $I_{C90}$ $I_{CM}$	66 40 132	Adc Apk
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	260 2.08	Watts $\text{W}/^\circ\text{C}$
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	$\mu\text{s}$
Thermal Resistance — Junction to Case – IGBT — Junction to Ambient	$R_{\theta JC}$ $R_{\theta JA}$	0.48 35	$^\circ\text{C}/\text{W}$
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.

# MGY40N60

## ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>					
Collector-to-Emitter Breakdown Voltage (V <sub>GE</sub> = 0 Vdc, I <sub>C</sub> = 250 μAdc) Temperature Coefficient (Positive)	BV <sub>CES</sub>	600 —	— 870	— —	Vdc mV/°C
Emitter-to-Collector Breakdown Voltage (V <sub>GE</sub> = 0 Vdc, I <sub>EC</sub> = 100 mAdc)	BV <sub>ECS</sub>	25	—	—	Vdc
Zero Gate Voltage Collector Current (V <sub>CE</sub> = 600 Vdc, V <sub>GE</sub> = 0 Vdc) (V <sub>CE</sub> = 600 Vdc, V <sub>GE</sub> = 0 Vdc, T <sub>J</sub> = 125°C)	I <sub>CES</sub>	— —	— —	100 2500	μAdc
Gate-Body Leakage Current (V <sub>GE</sub> = ± 20 Vdc, V <sub>CE</sub> = 0 Vdc)	I <sub>GES</sub>	—	—	250	nAdc

## ON CHARACTERISTICS (1)

Collector-to-Emitter On-State Voltage (V <sub>GE</sub> = 15 Vdc, I <sub>C</sub> = 20 Adc) (V <sub>GE</sub> = 15 Vdc, I <sub>C</sub> = 20 Adc, T <sub>J</sub> = 125°C) (V <sub>GE</sub> = 15 Vdc, I <sub>C</sub> = 40 Adc)	V <sub>CE(on)</sub>	— — —	2.20 2.10 2.60	2.80 — 3.25	Vdc
Gate Threshold Voltage (V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 1 mAdc) Threshold Temperature Coefficient (Negative)	V <sub>GE(th)</sub>	4.0 —	6.0 10	8.0 —	Vdc mV/°C
Forward Transconductance (V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 40 Adc)	g <sub>fe</sub>	—	12	—	Mhos

## DYNAMIC CHARACTERISTICS

Input Capacitance	(V <sub>CE</sub> = 25 Vdc, V <sub>GE</sub> = 0 Vdc, f = 1.0 MHz)	C <sub>ies</sub>	—	6810	—	pF
Output Capacitance		C <sub>oes</sub>	—	464	—	
Transfer Capacitance		C <sub>res</sub>	—	15	—	

## SWITCHING CHARACTERISTICS (1)

Turn-On Delay Time	(V <sub>CC</sub> = 360 Vdc, I <sub>C</sub> = 40 Adc, V <sub>GE</sub> = 15 Vdc, L = 300 μH R <sub>G</sub> = 20 Ω, T <sub>J</sub> = 25°C) Energy losses include "tail"	t <sub>d(on)</sub>	—	126	—	ns
Rise Time		t <sub>r</sub>	—	95	—	
Turn-Off Delay Time		t <sub>d(off)</sub>	—	530	—	
Fall Time		t <sub>f</sub>	—	180	—	
Turn-Off Switching Loss		E <sub>off</sub>	—	1.50	2.10	
Turn-On Delay Time	(V <sub>CC</sub> = 360 Vdc, I <sub>C</sub> = 40 Adc, V <sub>GE</sub> = 15 Vdc, L = 300 μH R <sub>G</sub> = 20 Ω, T <sub>J</sub> = 125°C) Energy losses include "tail"	t <sub>d(on)</sub>	—	113	—	ns
Rise Time		t <sub>r</sub>	—	104	—	
Turn-Off Delay Time		t <sub>d(off)</sub>	—	588	—	
Fall Time		t <sub>f</sub>	—	346	—	
Turn-Off Switching Loss		E <sub>off</sub>	—	2.70	—	
Gate Charge	(V <sub>CC</sub> = 360 Vdc, I <sub>C</sub> = 40 Adc, V <sub>GE</sub> = 15 Vdc)	Q <sub>T</sub>	—	248	—	nC
		Q <sub>1</sub>	—	49	—	
		Q <sub>2</sub>	—	81	—	

## INTERNAL PACKAGE INDUCTANCE

Internal Emitter Inductance (Measured from the emitter lead 0.25" from package to emitter bond pad)	L <sub>E</sub>	—	13	—	nH
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(1) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.

TYPICAL ELECTRICAL CHARACTERISTICS

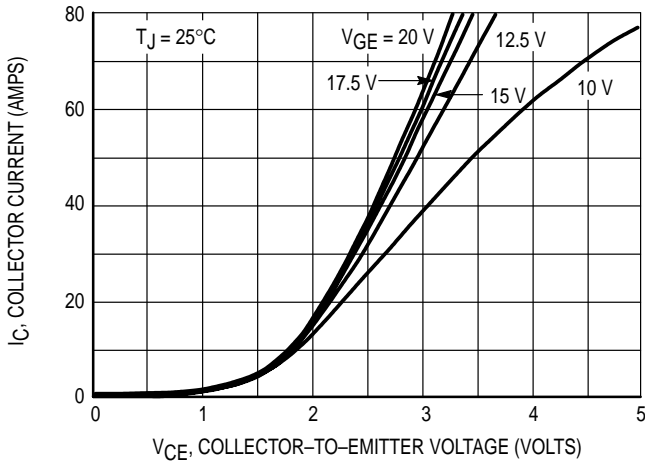


Figure 1. Output Characteristics,  $T_J = 25^\circ\text{C}$

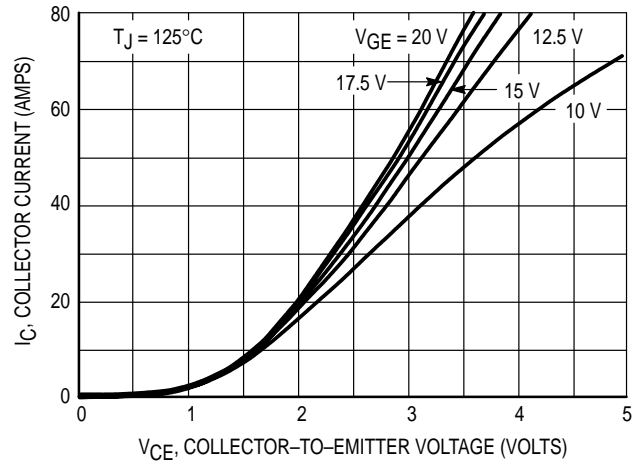


Figure 2. Output Characteristics,  $T_J = 125^\circ\text{C}$

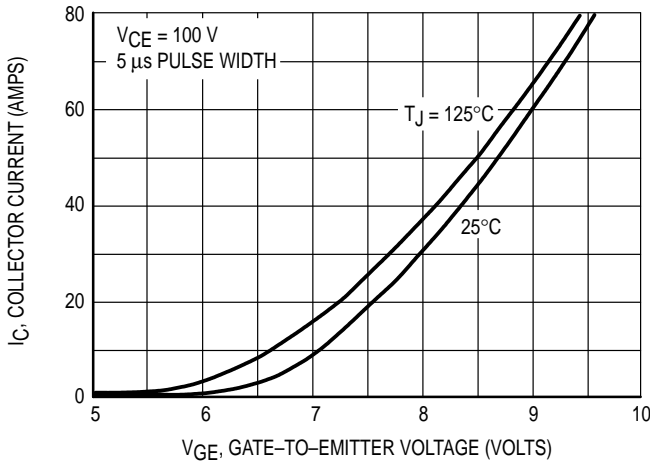


Figure 3. Transfer Characteristics

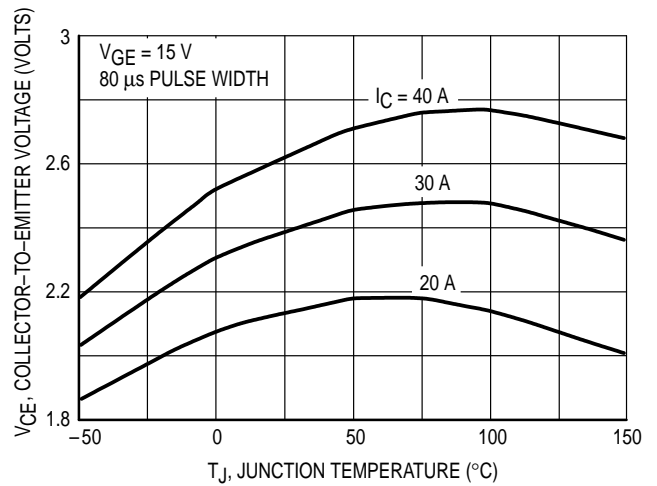


Figure 4. Collector-to-Emitter Saturation Voltage versus Junction Temperature

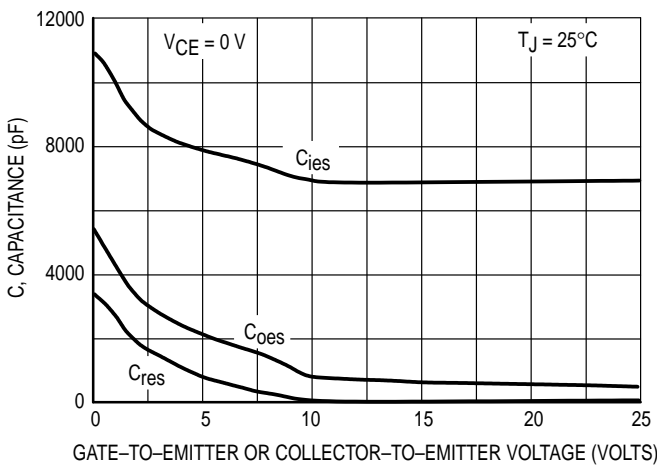


Figure 5. Capacitance Variation

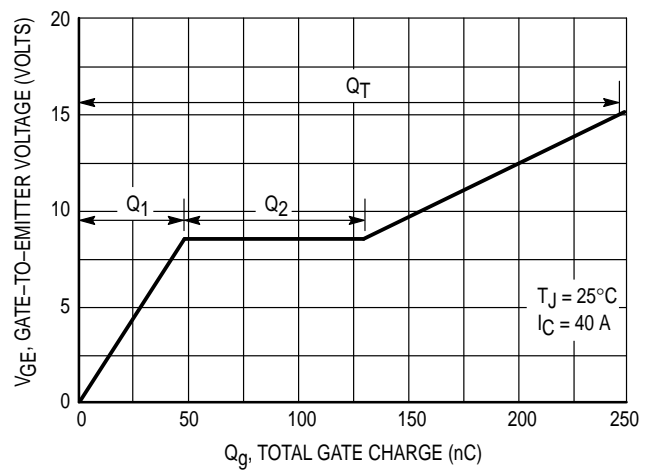
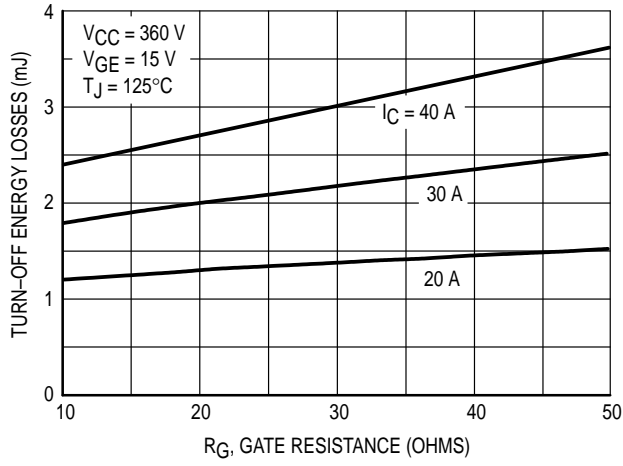
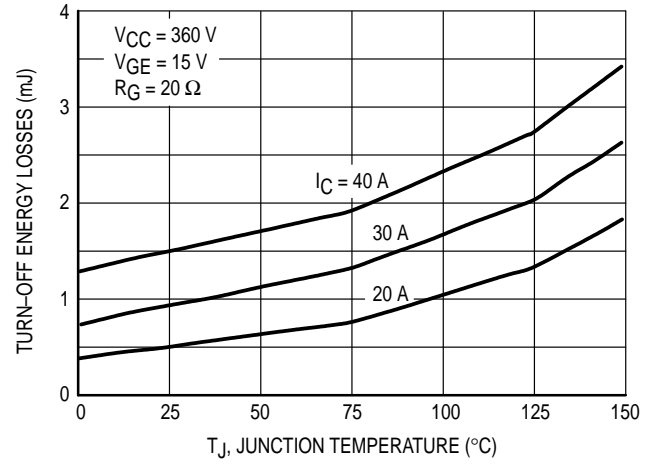


Figure 6. Gate-to-Emitter Voltage versus Total Charge

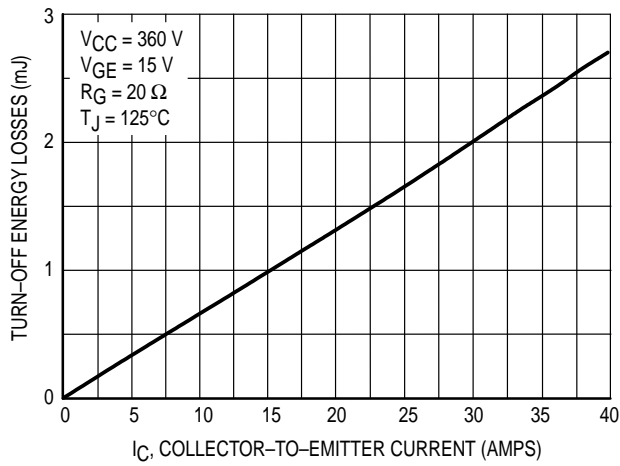
# MGY40N60



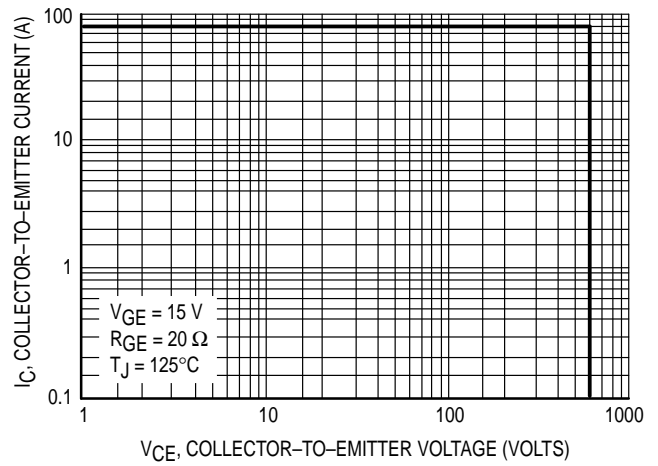
**Figure 7. Turn-Off Losses versus Gate Resistance**



**Figure 8. Turn-Off Losses versus Junction Temperature**

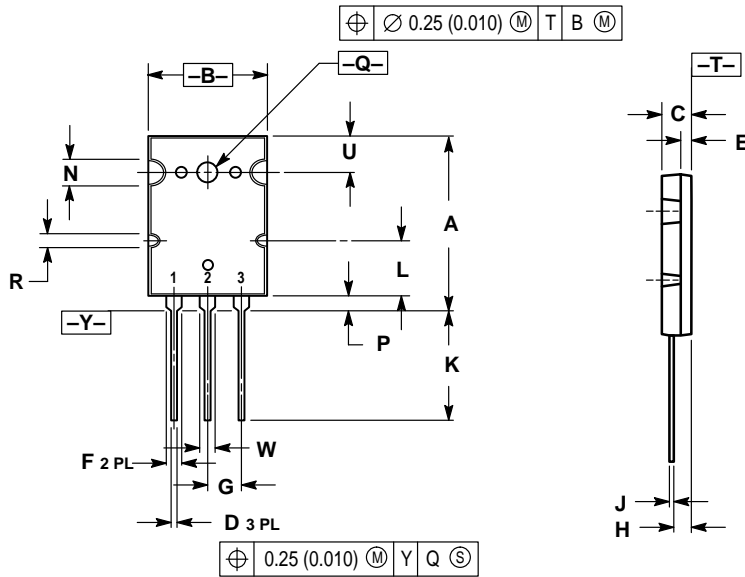


**Figure 9. Turn-Off Losses versus Collector-to-Emitter Current**



**Figure 10. 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:  
 PIN 1. GATE  
 2. COLLECTOR  
 3. EMITTER

CASE 340G-02  
 TO-264  
 ISSUE E

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