Designer's™ Data Sheet

Insulated Gate Bipolar Transistor with Anti-Parallel Diode

N-Channel Enhancement-Mode Silicon Gate

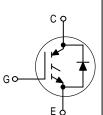
This Insulated Gate Bipolar Transistor (IGBT) is co-packaged with a soft recovery ultra-fast rectifier and uses an advanced termination scheme to provide an enhanced and reliable high voltage-blocking capability. Short circuit rated IGBT's are specifically suited for applications requiring a guaranteed 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.

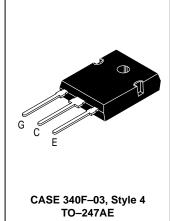
- Industry Standard High Power TO–247 Package with Isolated Mounting Hole
- High Speed E_{off}: 60 μJ per Amp typical at 125°C
- High Short Circuit Capability 10 μs minimum
- Soft Recovery Free Wheeling Diode is included in the package
- Robust High Voltage Termination
- Robust RBSOA

MGW20N60D

Motorola Preferred Device

IGBT & DIODE IN TO-247 20 A @ 90°C 32 A @ 25°C 600 VOLTS SHORT CIRCUIT RATED





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

Rating	Symbol	Value	Unit
Collector–Emitter Voltage	VCES	600	Vdc
Collector–Gate Voltage (R _{GE} = 1.0 MΩ)	VCGR	600	Vdc
Gate-Emitter Voltage — Continuous	V _{GE}	±20	Vdc
Collector Current — Continuous @ T _C = 25°C — Continuous @ T _C = 90°C — Repetitive Pulsed Current (1)	I _{C25} I _{C90} I _{CM}	32 20 64	Adc Apk
Total Power Dissipation @ T _C = 25°C Derate above 25°C	PD	142 1.14	Watts W/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to 150	°C
Short Circuit Withstand Time (V _{CC} = 360 Vdc, V _{GE} = 15 Vdc, T _J = 25°C, R _G = 20 Ω)	t _{sc}	10	μs
Thermal Resistance — Junction to Case – IGBT — Junction to Case – Diode — Junction to Ambient	R _θ JC R _θ JC R _θ JA	0.88 2.00 45	°C/W
Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 5 seconds	TL	260	°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 ($T_J = 25^{\circ}C$ unless otherwise noted)

Characteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						
Collector-to-Emitter Breakdown	BVCES	000			Vdc	
$(V_{GE}=0\ Vdc,\ I_{C}=250\ \mu Adc)$ Temperature Coefficient (Positive)			600	870	_	mV/°C
Zero Gate Voltage Collector Curr (VCE = 600 Vdc, VGE = 0 Vdc	ICES	_	_	100	μAdc	
$(V_{CE} = 600 \text{ Vdc}, V_{GE} = 0 \text{ Vdc})$		_	_	2500		
Gate–Body Leakage Current (VGE = ± 20 Vdc, VCE = 0 Vdc)		IGES	_	_	250	nAdc
ON CHARACTERISTICS (1)				_		1
Collector–to–Emitter On–State V (VGE = 15 Vdc, IC = 10 Adc)	oltage	VCE(on)	l _	2.30	2.85	Vdc
(VGE = 15 Vdc, IC = 10 Adc, T	J = 125°C)		_	2.20		
(V _{GE} = 15 Vdc, I _C = 20 Adc)			_	2.85	3.65	
Gate Threshold Voltage		VGE(th)		0.0	0.0	Vdc
(V _{CE} = V _{GE} , I _C = 1 mAdc) Threshold Temperature Coeffice	sient (Negative)		4.0	6.0 10	8.0 —	mV/°C
Forward Transconductance (VCE	= 10 Vdc, I _C = 20 Adc)	9fe	<u> </u>	12	_	Mhos
DYNAMIC CHARACTERISTICS	-		<u> </u>		<u> </u>	l
Input Capacitance		C _{ies}	_	2280	_	pF
Output Capacitance	$V_{CE} = 25 \text{ Vdc}, V_{GE} = 0 \text{ Vdc},$ f = 1.0 MHz)	C _{oes}	_	165	_	1
Transfer Capacitance	1 - 1.0 Wil 12)	C _{res}	<u> </u>	12	_	
SWITCHING CHARACTERISTICS	((1)	•		•		
Turn-On Delay Time		^t d(on)	_	59	_	ns
Rise Time	(V _{CC} = 360 Vdc, I _C = 20 Adc, V _{GE} = 15 Vdc, L = 300 μH	t _r	_	61	_	1
Turn-Off Delay Time	$R_G = 20 \Omega, T_J = 25^{\circ}C$	td(off)	_	150	_	1
Fall Time	Energy losses include "tail"	t _f	_	212	_	1
Turn-Off Switching Loss	7	E _{off}	_	0.60	0.85	mJ
Turn-On Switching Loss	7	E _{on}	_	0.75	_	1
Total Switching Loss	7	E _{ts}	_	1.35	_	
Turn-On Delay Time	0/4 000 V/4 1 00 A 4	^t d(on)	_	51	_	ns
Rise Time	V _{CC} = 360 Vdc, I _C = 20 Adc, V _{GE} = 15 Vdc, L = 300 μH	t _r	_	77	_	
Turn-Off Delay Time	$R_G = 20 \Omega, T_J = 125^{\circ}C)$	td(off)	_	184	_	1
Fall Time	Energy losses include "tail"	t _f	_	392	_	1
Turn-Off Switching Loss	7	E _{off}	_	1.20	_	mJ
Turn-On Switching Loss	7	E _{on}	_	1.50	_	1
Total Switching Loss	7	E _{ts}	_	2.70	_	1
Gate Charge		QT	_	74	_	nC
	(V _{CC} = 360 Vdc, I _C = 20 Adc, V _{GE} = 15 Vdc)	Q ₁	_	19	_	1
vGE = 15 vdc)		Q ₂	_	27	_	
DIODE CHARACTERISTICS	•	ı	•	•		
Diode Forward Voltage Drop		V _{FEC}				Vdc
(IEC = 10 Adc)		-	1.50	1.90		
(I _{EC} = 10 Adc, T _J = 125°C) (I _{EC} = 20 Adc)			1.30 1.70	 2.15		

(1) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.

(continued)

ELECTRICAL CHARACTERISTICS — **continued** (T_J = 25°C unless otherwise noted)

Cha	Symbol	Min	Тур	Max	Unit		
DIODE CHARACTERISTICS — continued							
Reverse Recovery Time		t _{rr}	_	117	_	ns	
	$(I_F = 20 \text{ Adc}, V_R = 360 \text{ Vdc}, \\ dI_F/dt = 200 \text{ A}/\mu\text{s})$	ta	_	70	_		
		t _b	_	47	_		
Reverse Recovery Stored Charge		Q _{RR}	_	1.2	_	μС	
Reverse Recovery Time			_	166	_	ns	
	(I _F = 20 Adc, V _R = 360 Vdc, dI _F /dt = 200 A/µs, T _J = 125°C)	t _a	_	98	_		
		t _b	_	68	_		
Reverse Recovery Stored Charge		Q _{RR}	_	1.9	_	μС	
NTERNAL PACKAGE INDUCTANCE							
Internal Emitter Inductance (Measured from the emitter lead 0.25" from package to emitter bond pad)		LE	_	13	_	nH	

TYPICAL ELECTRICAL CHARACTERISTICS

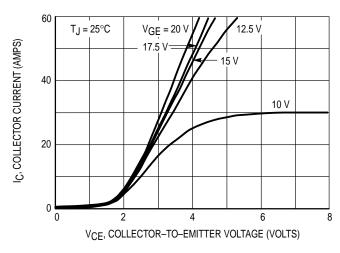


Figure 1. Output Characteristics, T_J = 25°C

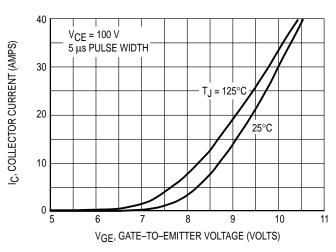


Figure 3. Transfer Characteristics

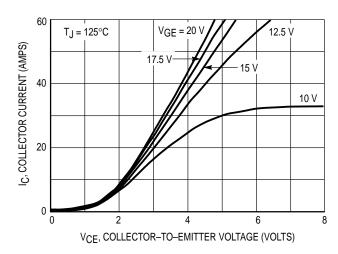


Figure 2. Output Characteristics, T_J = 125°C

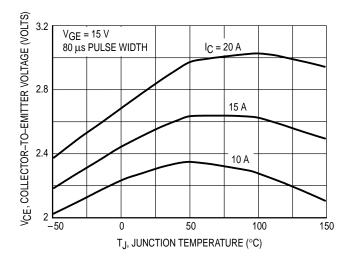


Figure 4. Collector-to-Emitter Saturation Voltage versus Junction Temperature

MGW20N60D

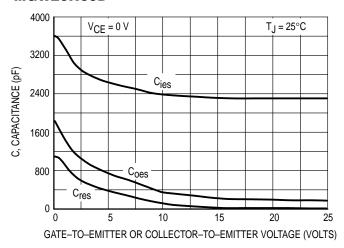


Figure 5. Capacitance Variation

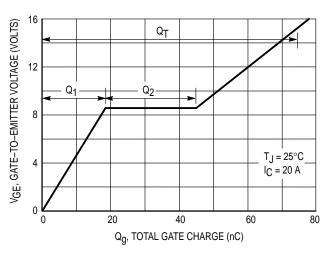


Figure 6. Gate-to-Emitter Voltage versus
Total Charge

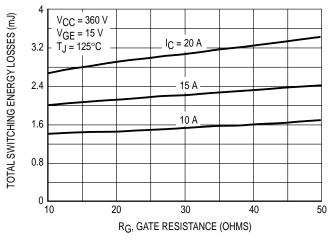


Figure 7. Total Switching Losses versus
Gate Resistance

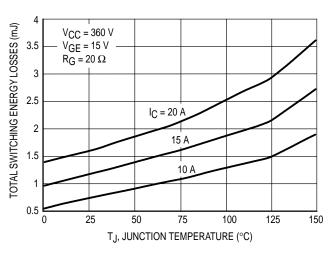


Figure 8. Total Switching Losses versus Junction Temperature

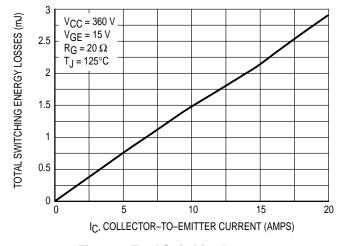


Figure 9. Total Switching Losses versus Collector-to-Emitter Current

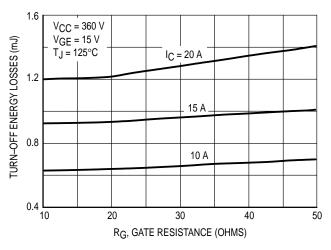
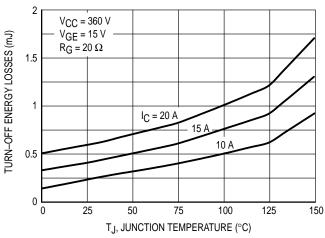


Figure 10. Turn-Off Losses versus
Gate Resistance



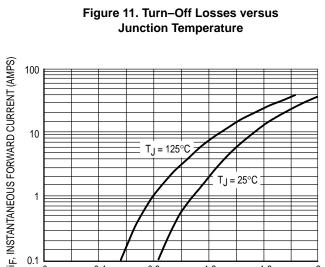


Figure 13. Typical Diode Forward Drop versus Instantaneous Forward Current

V_{FM}, FORWARD VOLTAGE DROP (VOLTS)

1.2

0.4

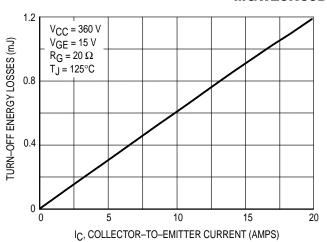


Figure 12. Turn-Off Losses versus Collector-to-Emitter Current

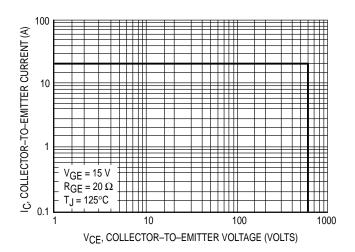
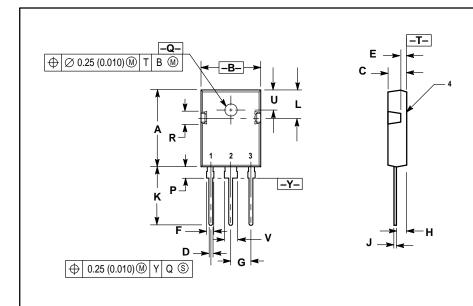


Figure 14. Reverse Biased Safe Operating Area

PACKAGE DIMENSIONS

CASE 340F-03 TO-247AE **ISSUE E**



NOTES:

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

	MILLIMETERS		INCHES		
DIM	MIN	MAX	MIN	MAX	
Α	20.40	20.90	0.803	0.823	
В	15.44	15.95	0.608	0.628	
С	4.70	5.21	0.185	0.205	
D	1.09	1.30	0.043	0.051	
Е	1.50	1.63	0.059	0.064	
F	1.80	2.18	0.071	0.086	
G	5.45 BSC		0.215 BSC		
Н	2.56	2.87	0.101	0.113	
J	0.48	0.68	0.019	0.027	
K	15.57	16.08	0.613	0.633	
L	7.26	7.50	0.286	0.295	
Р	3.10	3.38	0.122	0.133	
Q	3.50	3.70	0.138	0.145	
R	3.30	3.80	0.130	0.150	
U	5.30 BSC		0.209 BSC		
V	3.05	3 40	0.120	0.134	

STYLE 4: PIN 1. GATE

- 2. COLLECTOR 3. EMITTER
- 4. COLLECTOR

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