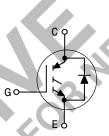
Designer's™ Data Sheet

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 operation at high frequencies. Co-packaged IGBT's save space, reduce assembly time and cost.

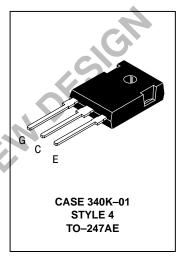
- Industry Standard High Power TO–247 Package with Isolated Mounting Hole
- High Speed E_{off}: 150 μJ/A typical at 125°C
- High Short Circuit Capability 10 μs minimum
- Soft Recovery Free Wheeling Diode is included in the package
- · Robust High Voltage Termination
- Robust RBSOA



MGW12N120D

Motorola Preferred Device

IGBT & DIODE IN TO-247 12 A @ 90°C 20 A @ 25°C 1200 VOLTS SHORT CIRCUIT RATED



MAXIMUM RATINGS (T_{.1} = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Collector–Emitter Voltage	V _{CES}	1200	Vdc
Collector–Gate Voltage (R _{GE} = 1.0 MΩ)	V _{CGR}	1200	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}	20 12 40	Adc Apk
Total Power Dissipation @ T _C = 25°C Derate above 25°C	P _D	125 0.98	Watts W/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to 150	°C
Short Circuit Withstand Time (V_{CC} = 720 Vdc, V_{GE} = 15 Vdc, T_J = 125°C, R_G = 20 Ω)	t _{sc}	10	μS
Thermal Resistance — Junction to Case – IGBT — Junction to Case – Diode — Junction to Ambient	R _{θJC} R _{θJC} R _{θJA}	1.0 1.4 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. Repetitive rating.

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.

Designer's is a trademark of Motorola, Inc.

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

REV₃



MGW12N120D

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

Characteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						
Collector–to–Emitter Breakdown Voltage ($V_{GE} = 0 \text{ Vdc}, I_C = 25 \mu \text{Adc}$)		V _{(BR)CES}	1200	_	_	Vdc
Temperature Coefficient (Positive	e)			870	_	mV/°C
Zero Gate Voltage Collector Current $(V_{CE} = 1200 \text{ Vdc}, V_{GE} = 0 \text{ Vdc})$ $(V_{CE} = 1200 \text{ Vdc}, V_{GE} = 0 \text{ Vdc}, T_{J} = 125^{\circ}\text{C})$		I _{CES}	_ _	_ _	100 2500	μAdc
Gate–Body Leakage Current (V _{GE} = ± 20 Vdc, V _{CE} = 0 Vdc)		I _{GES}	_	_	250	nAdc
ON CHARACTERISTICS (1)						
Collector-to-Emitter On-State Voltage $ (V_{GE} = 15 \text{ Vdc, } I_C = 5.0 \text{ Adc}) $ $ (V_{GE} = 15 \text{ Vdc, } I_C = 5.0 \text{ Adc, } T_J = 125^{\circ}\text{C}) $ $ (V_{GE} = 15 \text{ Vdc, } I_C = 10 \text{ Adc}) $		V _{CE(on)}	_ _ _	2.71 3.78 3.5	3.37 — 4.42	Vdc
Gate Threshold Voltage $(V_{CE} = V_{GE}, I_C = 1.0 \text{ mAdc})$ Threshold Temperature Coefficient (Negative)		V _{GE(th)}	4.0 —	6.0 10	8.0	Vdc mV/°C
Forward Transconductance (V _{CE} =	: 10 Vdc, I _C = 10 Adc)	9 _{fe}	_	12	_	Mhos
DYNAMIC CHARACTERISTICS		. < /	A .1			
Input Capacitance		C _{ies}	77	1003	_	pF
Output Capacitance	$(V_{CE} = 25 \text{ Vdc}, V_{GE} = 0 \text{ Vdc}, f = 1.0 \text{ MHz})$	C _{oes}	TV	126	_	
Transfer Capacitance	1	C _{res}		106		
SWITCHING CHARACTERISTICS (1)					
Turn-On Delay Time		t _{d(on)}	_	74	_	ns
Rise Time		t _r	_	83	_	
Turn-Off Delay Time	$(V_{CC} = 720 \text{ Vdc}, I_{C} = 10 \text{ Adc},$	t _{d(off)}	_	76	_	
Fall Time	$V_{GE} = 15 \text{ Vdc}, L = 300 \mu H$ $R_{G} = 20 \Omega$)	t _f	_	231	_	
Turn-Off Switching Loss	Energy losses include "tail"	E _{off}	_	0.55	1.33	mJ
Turn-On Switching Loss		E _{on}	_	1.21	1.88	
Total Switching Loss		E _{ts}	_	1.76	3.21	
Turn-On Delay Time		t _{d(on)}	_	66	_	ns
Rise Time		t _r	_	87	_	
Turn-Off Delay Time	$(V_{CC} = 720 \text{ Vdc}, I_{C} = 10 \text{ Adc},$	t _{d(off)}	_	120	_	
Fall Time	$V_{GE} = 15 \text{ Vdc}, L = 300 \mu H$ $R_{G} = 20 \Omega, T_{J} = 125^{\circ}C)$	t _f	_	575	_	
Turn-Off Switching Loss	Energy losses include "tail"	E _{off}	_	1.49	_	mJ
Turn-On Switching Loss	X	E _{on}	_	2.37	_	
Total Switching Loss		E _{ts}	_	3.86	_	1
Gate Charge		Q _T	_	29	_	nC
	$(V_{CC} = 720 \text{ Vdc}, I_{C} = 10 \text{ Adc}, V_{GE} = 15 \text{ Vdc})$	Q ₁	_	13	_	1
v _{GE} = 10 vuc)		Q ₂	_	12		1
DIODE CHARACTERISTICS	•	•				•
Diode Forward Voltage Drop $(I_{EC} = 5.0 \text{ Adc})$ $(I_{EC} = 5.0 \text{ Adc}, T_{J} = 125^{\circ}\text{C})$ $(I_{EC} = 10 \text{ Adc})$		V _{FEC}	_ _ _	2.26 1.37 2.86	3.32 — 4.18	Vdc

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

(continued)

V_{GE} = 20 V

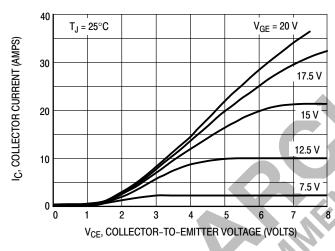
ELECTRICAL CHARACTERISTICS — **continued** (T_J = 25°C unless otherwise noted)

Characteristic		Symbol	Min	Тур	Max	Unit
DIODE CHARACTERISTICS — continued						
Reverse Recovery Time		t _{rr}	_	116	_	ns
	(I _F = 10 Adc, V _R = 720 Vdc, dI _F /dt = 100 A/μs)	ta	_	69	_	
		t _b	_	47	_	
Reverse Recovery Stored Charge		Q _{RR}	_	0.36	_	μC
Reverse Recovery Time		t _{rr}	_	234	_	ns
	(I _F = 10 Adc, V _R = 720 Vdc, dI _F /dt = 100 A/μs, T _J = 125°C)	ta	_	149	_	
		t _b	_	85	_	
Reverse Recovery Stored Charge		Q _{RR}	_	1.40	_	μC
NTERNAL PACKAGE INDUCTANCE						
Internal Emitter Inductance (Measured from the emitter lead 0	0.25" from package to emitter bond pad)	L _E	_	13		nH

TYPICAL ELECTRICAL CHARACTERISTICS

40

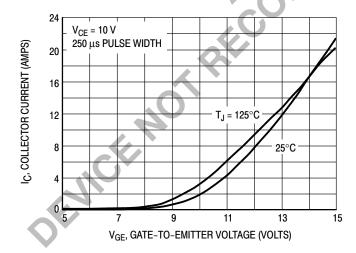
 $T_J = 125^{\circ}C$



30 17.5 V 17.5 V 15 V 12.5 V 10 V 0 1 2 3 4 5 6 7 8 V_{CE}, COLLECTOR-TO-EMITTER VOLTAGE (VOLTS)

Figure 1. Output Characteristics

Figure 2. Output Characteristics



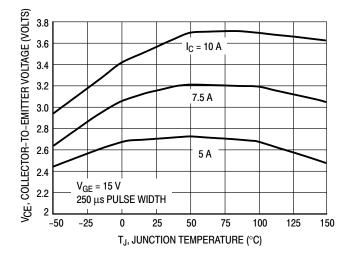


Figure 3. Transfer Characteristics

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

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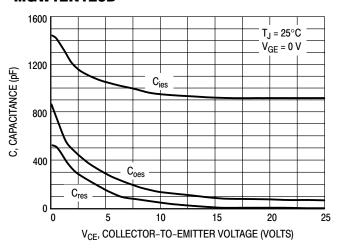


Figure 5. Capacitance Variation

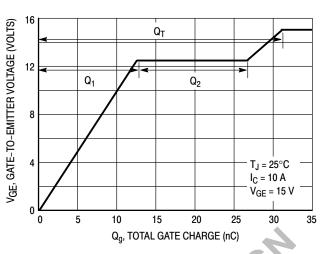


Figure 6. Gate-to-Emitter Voltage versus **Total Charge**

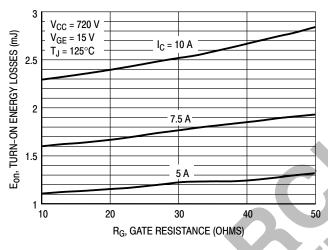


Figure 7. Turn-On Losses versus **Gate Resistance**

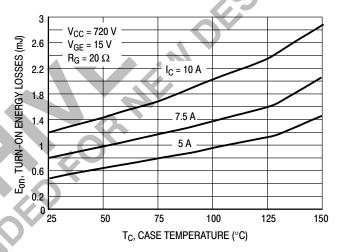


Figure 8. Turn-On Losses versus **Case Temperature**

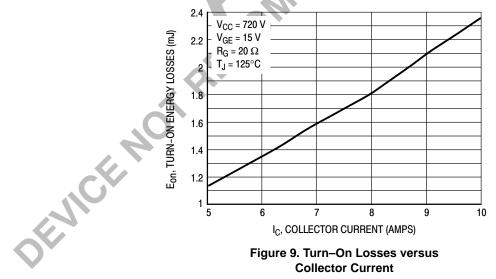


Figure 9. Turn-On Losses versus **Collector Current**

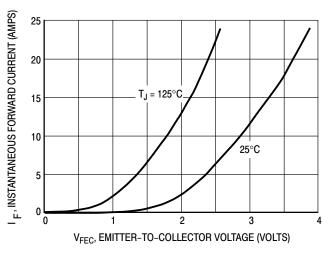


Figure 10. Diode Forward Voltage Drop

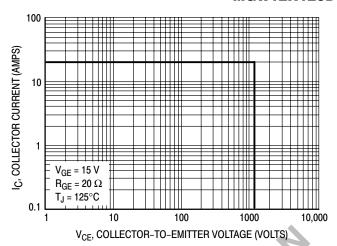


Figure 11. Reverse Biased Safe Operating Area

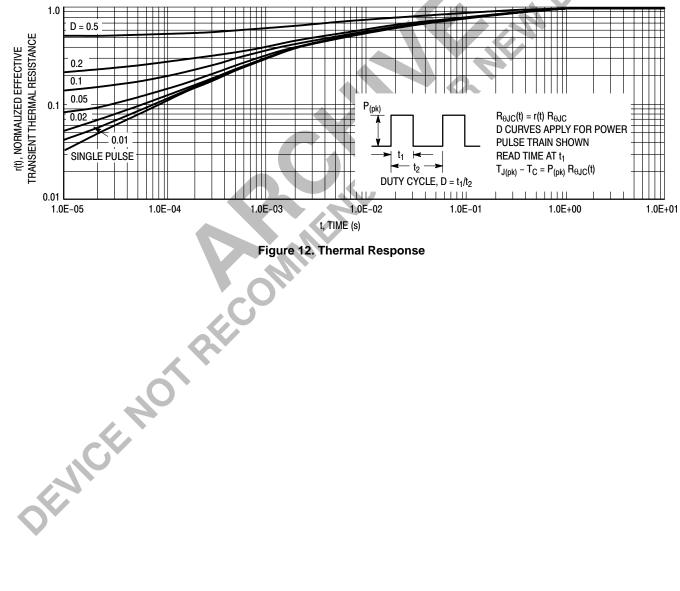
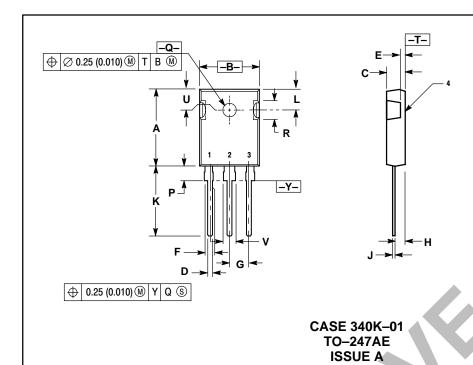


Figure 12. Thermal Response

PACKAGE DIMENSIONS



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

	MILLIMETERS		INCHES		
DIM	MIN	MAX	MIN	MAX	
Α	19.7	20.3	0.776	0.799	
В	15.3	15.9	0.602	0.626	
С	4.7	5.3	0.185	0.209	
D	1.0	1.4	0.039	0.055	
Е	1.27 REF		0.050 REF		
F	2.0	2.4	0.079	0.094	
G	5.5 BSC		0.216 BSC		
Н	2.2	2.6	0.087	0.102	
_	0.4	0.8	0.016	0.031	
K	14.2	14.8	0.559	0.583	
L	5.5 NOM		0.217 NOM		
Р	3.7	4.3	0.146	0.169	
Q	3.55	3.65	0.140	0.144	
R	5.0 NOM		0.197 NOM		
U	5.5	BSC	0.217 BSC		
٧	3.0	3.4	0.118	0.134	

STYLE 4: PIN 1. GATE

2. COLLECTOR
3. EMITTER
4. COLLECTOR

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