

# Designer's™ Data Sheet

## Insulated Gate Bipolar Transistor

### N-Channel Enhancement-Mode Silicon Gate

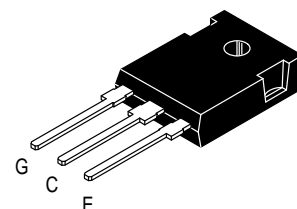
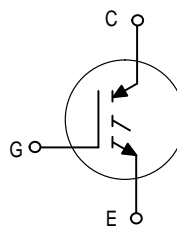
**MGW12N120**

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 operation at high frequencies.

- Industry Standard High Power TO-247 Package with Isolated Mounting Hole
- High Speed  $E_{off}$ : 150  $\mu$ J/A typical at 125°C
- High Short Circuit Capability – 10  $\mu$ s minimum
- Robust High Voltage Termination

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



**CASE 340K-01**  
**STYLE 4**  
**TO-247AE**

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

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	$V_{CES}$	1200	Vdc
Collector-Gate Voltage ( $R_{GE} = 1.0 \text{ M}\Omega$ )	$V_{CGR}$	1200	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)	$I_{C25}$ $I_{C90}$ $I_{CM}$	20 12 40	Adc Apk
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	125 0.98	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 ( $V_{CC} = 720 \text{ Vdc}$ , $V_{GE} = 15 \text{ Vdc}$ , $T_J = 125^\circ\text{C}$ , $R_G = 20 \Omega$ )	$t_{sc}$	10	$\mu\text{s}$
Thermal Resistance — Junction to Case – IGBT — Junction to Ambient	$R_{\theta JC}$ $R_{\theta JA}$	1.0 45	$^\circ\text{C/W}$
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. 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.

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

REV 2

## MGW12N120

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

Characteristic	Symbol	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>					
Collector-to-Emitter Breakdown Voltage ( $V_{GE} = 0\text{ Vdc}$ , $I_C = 25\text{ }\mu\text{Adc}$ ) Temperature Coefficient (Positive)	$V_{(BR)CES}$	1200 —	— 870	— —	Vdc mV/ $^\circ\text{C}$
Emitter-to-Collector Breakdown Voltage ( $V_{GE} = 0\text{ Vdc}$ , $I_{EC} = 100\text{ mAdc}$ )	$V_{(BR)ECS}$	25	—	—	Vdc
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	$\mu\text{Adc}$
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 ( $V_{GE} = 15\text{ Vdc}$ , $I_C = 5.0\text{ Adc}$ ) ( $V_{GE} = 15\text{ Vdc}$ , $I_C = 5.0\text{ Adc}$ , $T_J = 125^\circ\text{C}$ ) ( $V_{GE} = 15\text{ Vdc}$ , $I_C = 10\text{ Adc}$ )	$V_{CE(on)}$	— — —	2.51 2.36 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/ $^\circ\text{C}$
Forward Transconductance ( $V_{CE} = 10\text{ Vdc}$ , $I_C = 10\text{ Adc}$ )	$g_{fe}$	—	12	—	Mhos

### DYNAMIC CHARACTERISTICS

Input Capacitance	$(V_{CE} = 25\text{ Vdc}$ , $V_{GE} = 0\text{ Vdc}$ , $f = 1.0\text{ MHz}$ )	$C_{ies}$	—	930	—	pF
Output Capacitance		$C_{oes}$	—	126	—	
Transfer Capacitance		$C_{res}$	—	16	—	

### SWITCHING CHARACTERISTICS (1)

Turn-On Delay Time	$(V_{CC} = 720\text{ Vdc}$ , $I_C = 10\text{ Adc}$ , $V_{GE} = 15\text{ Vdc}$ , $L = 300\text{ }\mu\text{H}$ $R_G = 20\text{ }\Omega$ ) Energy losses include "tail"	$t_{d(on)}$	—	74	—	ns
Rise Time		$t_r$	—	83	—	
Turn-Off Delay Time		$t_{d(off)}$	—	76	—	
Fall Time		$t_f$	—	231	—	
Turn-Off Switching Loss		$E_{off}$	—	0.55	1.33	mJ
Turn-On Delay Time	$(V_{CC} = 720\text{ Vdc}$ , $I_C = 10\text{ Adc}$ , $V_{GE} = 15\text{ Vdc}$ , $L = 300\text{ }\mu\text{H}$ $R_G = 20\text{ }\Omega$ , $T_J = 125^\circ\text{C}$ ) Energy losses include "tail"	$t_{d(on)}$	—	66	—	ns
Rise Time		$t_r$	—	87	—	
Turn-Off Delay Time		$t_{d(off)}$	—	120	—	
Fall Time		$t_f$	—	575	—	
Turn-Off Switching Loss		$E_{off}$	—	1.49	—	mJ
Gate Charge	$(V_{CC} = 720\text{ Vdc}$ , $I_C = 10\text{ Adc}$ , $V_{GE} = 15\text{ Vdc}$ )	$Q_T$	—	31	—	nC
		$Q_1$	—	13	—	
		$Q_2$	—	14	—	

### INTERNAL PACKAGE INDUCTANCE

Internal Emitter Inductance (Measured from the emitter lead 0.25" from package to emitter bond pad)	$L_E$	—	13	—	nH
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(1) Pulse Test: Pulse Width  $\leq 300\text{ }\mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

# TYPICAL ELECTRICAL CHARACTERISTICS

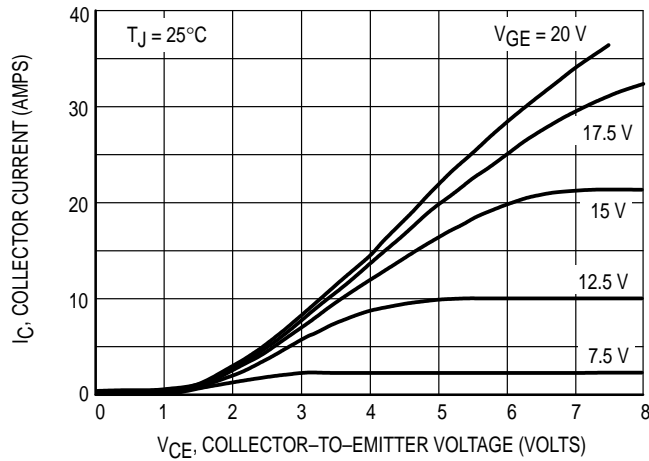


Figure 1. Output Characteristics

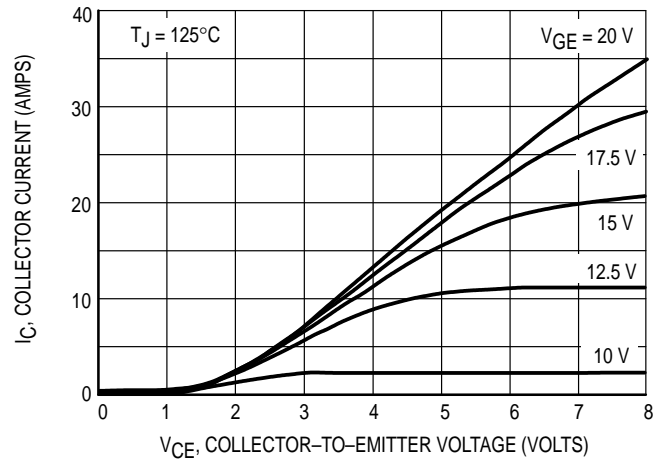


Figure 2. Output Characteristics

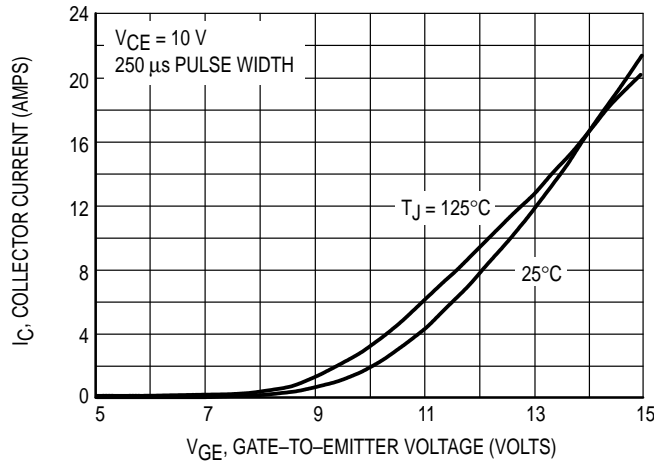


Figure 3. Transfer Characteristics

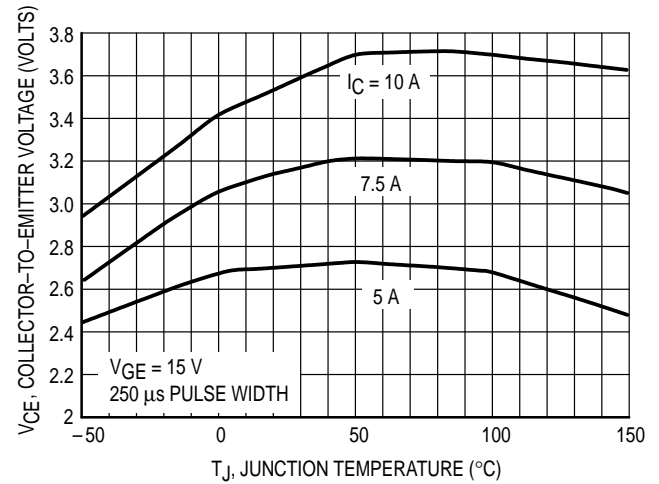


Figure 4. Collector-to-Emitter Saturation Voltage versus Junction Temperature

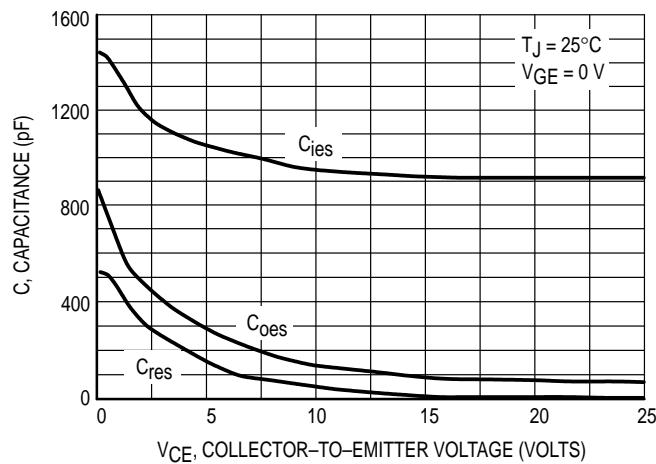


Figure 5. Capacitance Variation

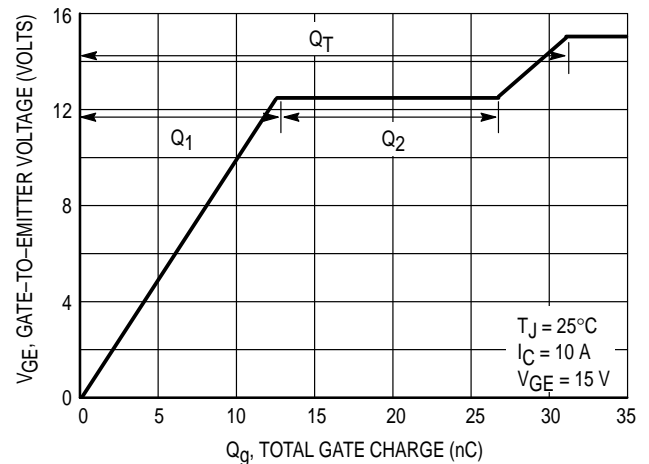


Figure 6. Gate-to-Emitter Voltage versus Total Charge

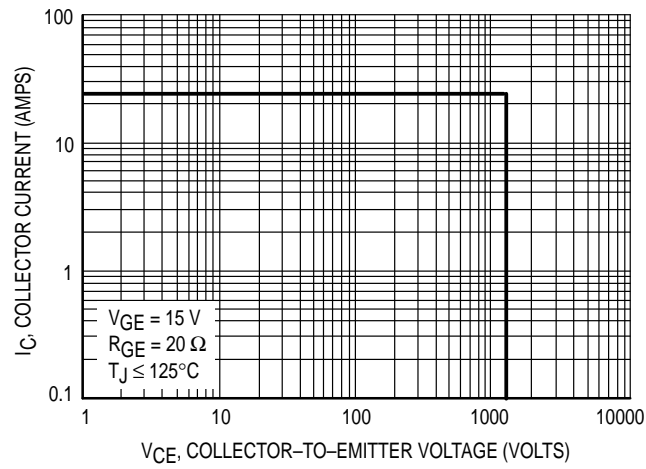


Figure 7. Reverse Biased Safe Operating Area

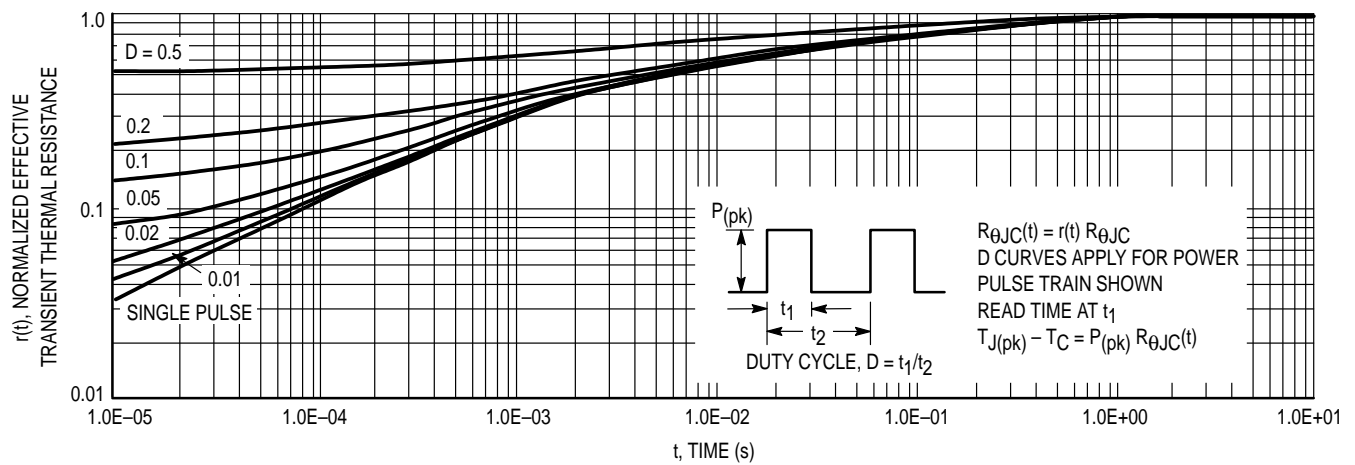
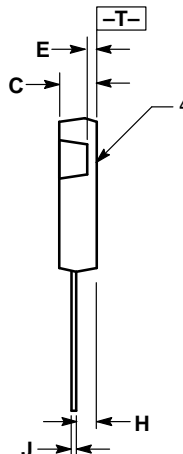
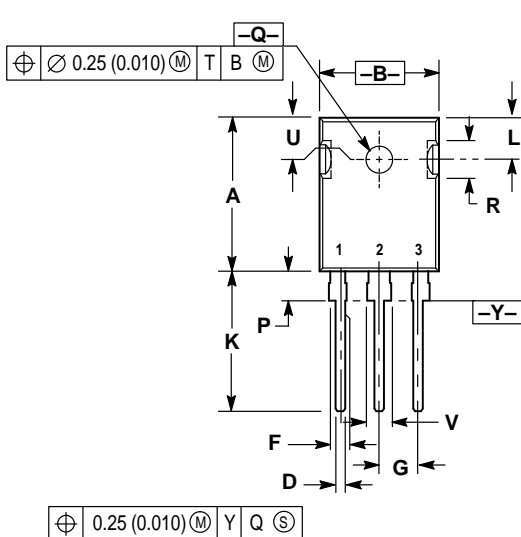


Figure 8. Thermal Response

## PACKAGE DIMENSIONS




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

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	19.7	20.3	0.776	0.799
B	15.3	15.9	0.602	0.626
C	4.7	5.3	0.185	0.209
D	1.0	1.4	0.039	0.055
E	1.27 REF		0.050 REF	
F	2.0	2.4	0.079	0.094
G	5.5 BSC		0.216 BSC	
H	2.2	2.6	0.087	0.102
J	0.4	0.8	0.016	0.031
K	14.2	14.8	0.559	0.583
L	5.5 NOM		0.217 NOM	
P	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	
V	3.0	3.4	0.118	0.134

- STYLE 4:
- PIN 1. GATE
  - COLLECTOR
  - EMITTER
  - COLLECTOR

**CASE 340K-01  
TO-247AE  
ISSUE A**

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