Designer's™ Data Sheet

Insulated Gate Bipolar Transistor

N–Channel Enhancement–Mode Silicon Gate

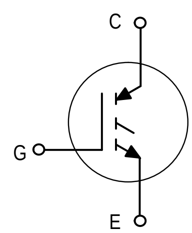
MGW12N120

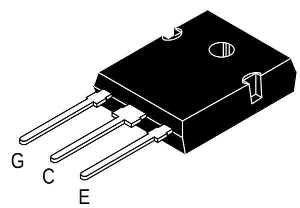
Motorola Preferred Device

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

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}: 160 µJ/A typical at 125°C
- High Short Circuit Capability – 10 µs minimum
- Robust High Voltage Termination





CASE 340F–03, Style 4
TO–247AE

MAXIMUM RATINGS (T_J = 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	123 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 Ambient	$R_{\theta JC}$ $R_{\theta JA}$	1.0 45	°C/W
Maximum Lead Temperature for Soldering Purposes, 1/8″ from case for 5 seconds	T_L	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.

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

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

Characteristic	Conditions	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Collector–to–Emitter Breakdown Voltage (V_{GE} = 0 Vdc, I_C = 25 μAdc)		BV_{CES}	1200	—	—	Vdc
Temperature Coefficient (Positive)			—	870	—	mV/°C
Emitter–to–Collector Breakdown Voltage (V_{GE} = 0 Vdc, I_{EC} = 100 mAdc)		BV_{ECS}	25	—	—	Vdc
Zero Gate Voltage Collector Current (V_{CE} = 1200 Vdc, V_{GE} = 0 Vdc)		I_{CES}	—	—	100	μAdc
(V_{CE} = 1200 Vdc, V_{GE} = 0 Vdc, T_J = 125°C)			—	—	2500	
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 Vdc, I_C = 5.0 Adc)		$V_{CE(on)}$	—	2.51	3.37	Vdc
(V_{GE} = 15 Vdc, I_C = 5.0 Adc, T_J = 125°C)			—	2.36	—	
(V_{GE} = 15 Vdc, I_C = 10 Adc)			—	3.21	4.42	
Gate Threshold Voltage (V_{CE} = V_{GE}, I_C = 1.0 mAdc)		$V_{GE(th)}$	4.0	6.0	8.0	Vdc
Threshold Temperature Coefficient (Negative)			—	10	—	mV/°C
Forward Transconductance (V_{CE} = 10 Vdc, I_C = 10 Adc)		g_{fe}	—	12	—	Mhos
DYNAMIC CHARACTERISTICS						
Input Capacitance	(V_{CE} = 25 Vdc, V_{GE} = 0 Vdc, f = 1.0 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 Vdc, I_C = 10 Adc, V_{GE} = 15 Vdc, L = 300 μH R_G = 20 Ω, T_J = 25°C) 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 Vdc, I_C = 10 Adc, V_{GE} = 15 Vdc, L = 300 μH R_G = 20 Ω, T_J = 125°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 Vdc, I_C = 10 Adc, V_{GE} = 15 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

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

TYPICAL ELECTRICAL CHARACTERISTICS

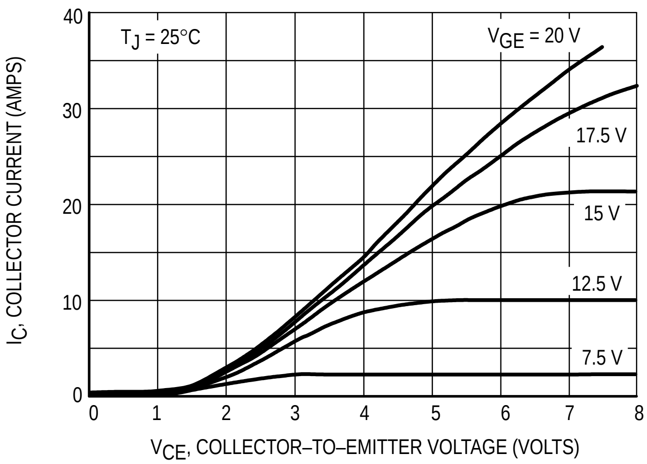


Figure 1. Output Characteristics, T_J = 25°C

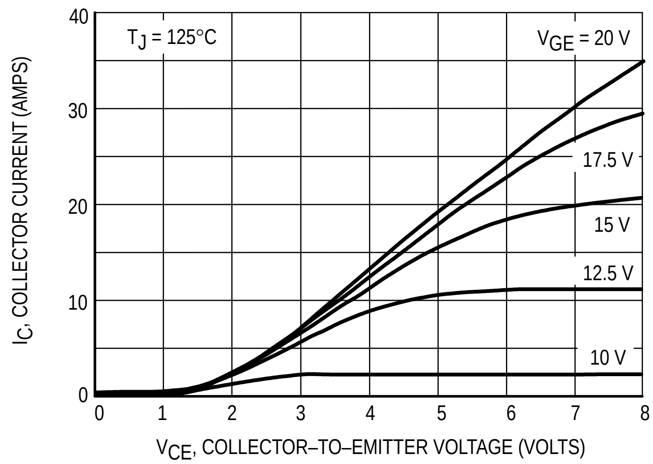


Figure 2. Output Characteristics, T_J = 125°C

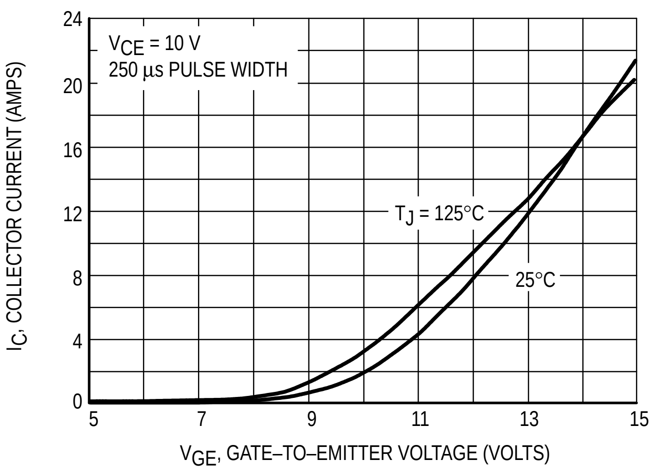


Figure 3. Transfer Characteristics

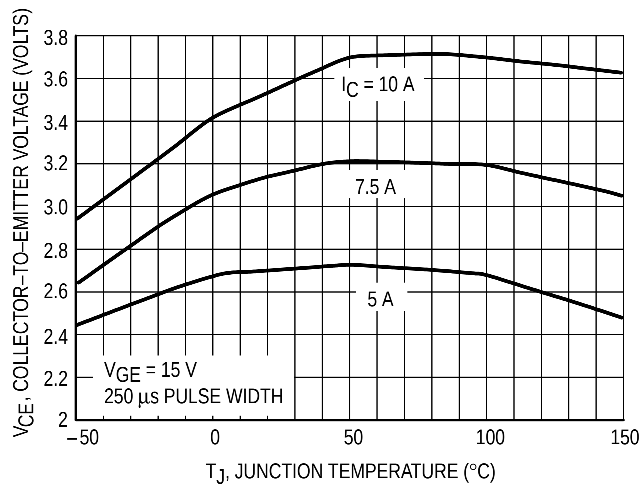


Figure 4. Collector–to–Emitter Saturation Voltage versus Junction Temperature

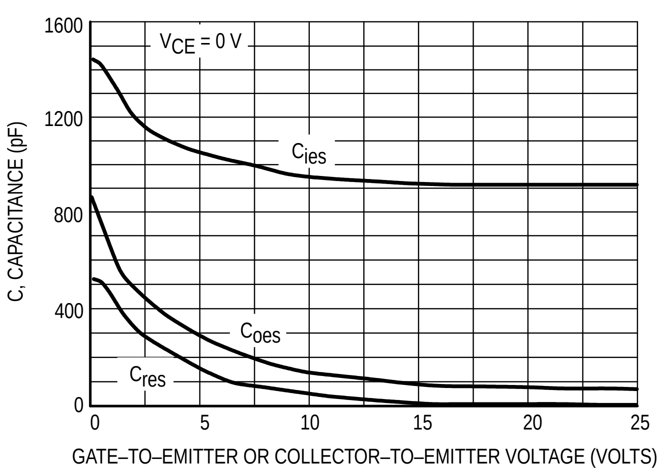


Figure 5. Capacitance Variation

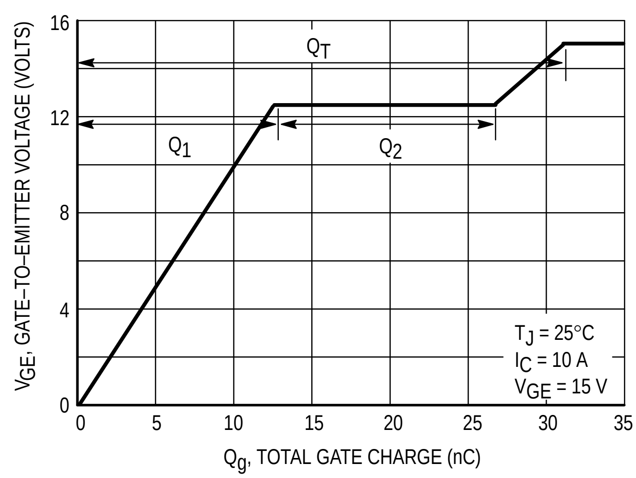


Figure 6. Gate–to–Emitter Voltage versus Total Charge

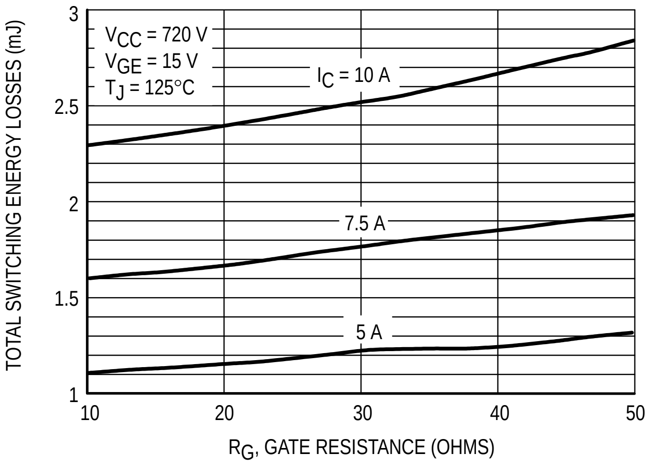


Figure 7. Total Switching Losses versus Gate Resistance

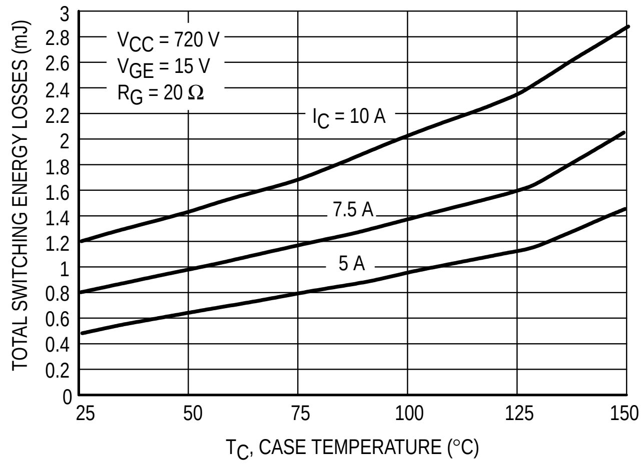


Figure 8. Total Switching Losses versus Case Temperature

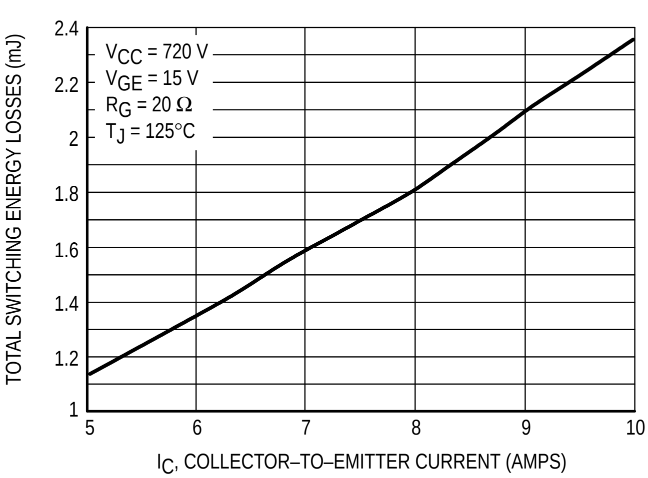


Figure 9. Total Switching Losses versus Collector–to–Emitter Current

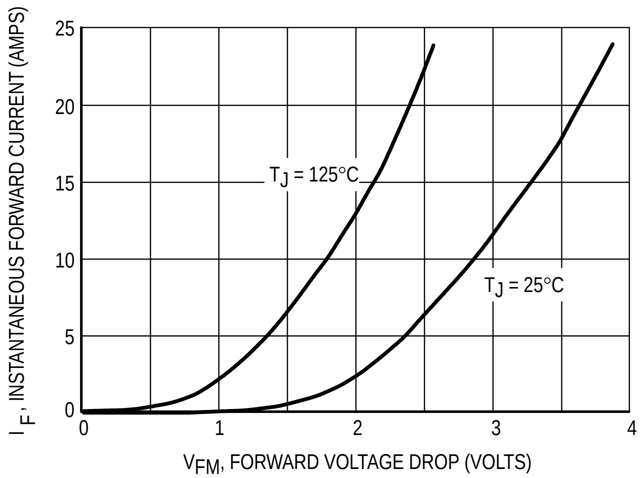


Figure 10. Maximum Forward Drop versus Instantaneous Forward Current

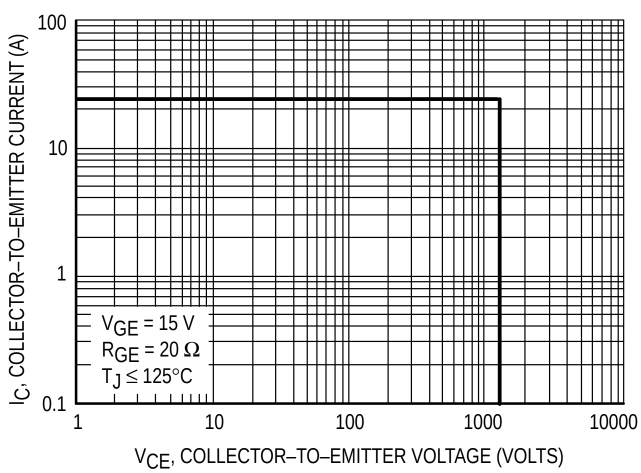


Figure 11. Reverse Biased Safe Operating Area

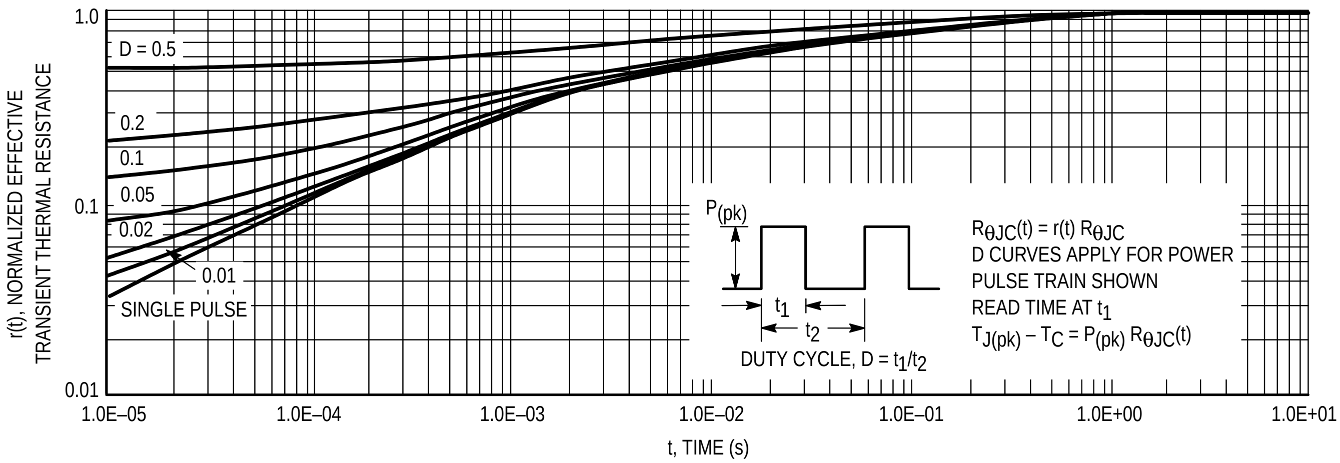
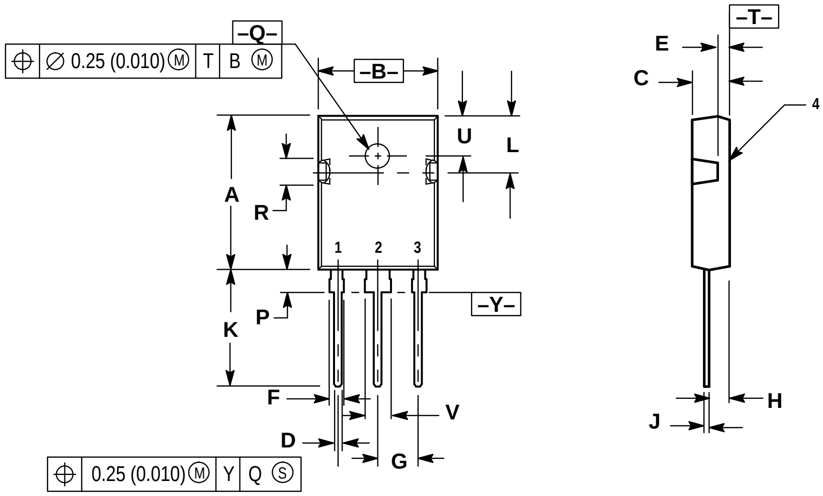


Figure 12. Thermal Response

PACKAGE DIMENSIONS



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

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	20.40	20.90	0.803	0.823
B	15.44	15.95	0.608	0.628
C	4.70	5.21	0.185	0.205
D	1.09	1.30	0.043	0.051
E	1.50	1.63	0.059	0.064
F	1.80	2.18	0.071	0.086
G	5.45 BSC		0.215 BSC	
H	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
P	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

CASE 340F–03
TO–247AE
ISSUE E

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