Designer's™ Data Sheet

Insulated Gate Bipolar Transistor

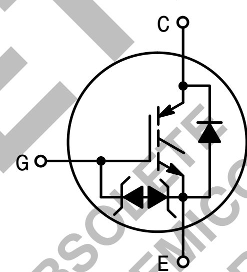
N−Channel Enhancement−Mode Silicon Gate

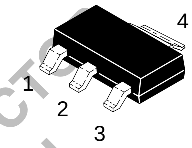
MMG05N60D

IGBT
0.5 A @ 25°C
600 V

This IGBT contains a built−in free wheeling diode and a gate protection zener diodes. Fast switching characteristics result in efficient operation at higher frequencies. This device is ideally suited for high frequency electronic ballasts.

- Built−In Free Wheeling Diode
- Built−In Gate Protection Zener Diodes
- Industry Standard Package (SOT223)
- High Speed E_{off}: Typical 6.5 μJ @ I_C = 0.3 A; T_C = 125°C and dV/dt = 1000 V/μs
- Robust High Voltage Termination
- Robust Turn−Off SOA





1 = G
2 = 4 = C
3 = E

CASE 318E−04
STYLE 13
TO−261A

MAXIMUM RATINGS (T_J = 25°C unless otherwise noted)

Parameters	Symbol	Value	Unit
Collector−Emitter Voltage	V_{CES}	600	Vdc
Collector−Gate Voltage (R_{GE} = 1.0 MΩ)	V_{CGR}	600	Vdc
Gate−Emitter Voltage — Continuous	V_{CGR}	±15	Vdc
Collector Current — Continuous @ T_C = 25°C — Continuous @ T_C = 90°C — Repetitive Pulsed Current (1)	I_{C25} I_{C90} I_{CM}	0.5 0.3 2.0	Adc
Total Device Dissipation @ T_C = 25°C	P_D	1.0	Watt
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−55 to 150	°C
Thermal Resistance — Junction to Case − IGBT — Junction to Ambient	$R_{\theta JC}$ $R_{\theta JA}$	30 150	°C/W
Maximum Lead Temperature for Soldering Purposes, 1/8″ from case for 5 seconds	T_L	260	°C

UNCLAMPED DRAIN−TO−SOURCE AVALANCHE CHARACTERISTICS (T_C ≤ 150°C)

Single Pulse Drain−to−Source Avalanche Energy − Starting @ T_C = 25°C @ T_C = 125°C V_{CE} = 100 V, V_{GE} = 15 V, Peak I_L = 2.0 A, L = 3.0 mH, R_G = 25 Ω	E_{AS}	 125 40	mJ

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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector−to−Emitter Breakdown Voltage (V_{GE} = 0 Vdc, I_C = 250 μAdc)	$V_{(BR)CES}$	600	680	—	Vdc
Temperature Coefficient (Positive)		—	0.7	—	V/°C
Zero Gate Voltage Collector Current (V_{CE} = 600 Vdc, V_{GE} = 0 Vdc, T_C = 25°C)	I_{CES}	—	0.1	5.0	μAdc
(V_{CE} = 600 Vdc, V_{GE} = 0 Vdc, T_C = 125°C)	I_{CES}	—	5.0	50	
Gate−Body Leakage Current (V_{GE} = ±15 Vdc, V_{CE} = 0 Vdc)	I_{GES}	—	10	100	μAdc
ON CHARACTERISTICS					
Collector−to−Emitter On−State Voltage (V_{GE} = 15 Vdc, I_C = 0.3 Adc, T_C = 25°C)	$V_{CE(on)}$	—	1.6	2.0	Vdc
(V_{GE} = 15 Vdc, I_C = 0.3 Adc, T_C = 125°C)		—	1.5	—	
Gate Threshold Voltage (V_{CE} = V_{GE}, I_C = 250 μAdc)	$V_{GE(th)}$	3.5	—	6.0	Vdc
Threshold Temperature Coefficient (Negative)		—	6.0	—	mV/°C
Forward Transconductance (V_{CE} = 10 Vdc, I_C = 0.5 Adc)	g_{fe}	0.3	0.42	—	Mhos

DYNAMIC CHARACTERISTICS

Characteristic	Conditions	Symbol	Min	Typ	Max	Unit
Input Capacitance	(V_{CE} = 20 Vdc, V_{GE} = 0 Vdc, f = 1.0 MHz)	C_{ies}	—	75	100	pF
Output Capacitance		C_{oes}	—	11	20	
Transfer Capacitance		C_{res}	—	1.6	5.0	

DIODE CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Diode Forward Voltage Drop (I_{EC} = 0.3 Adc, T_C = 25°C)	V_{FEC}	—	5.0	6.0	Vdc
(I_{EC} = 0.3 Adc, T_C = 125°C)		—	5.2	—	
(I_{EC} = 0.1 Adc, T_C = 25°C)		—	2.3	3.0	
(I_{EC} = 0.1 Adc, T_C = 125°C)		—	2.3	—	
Reverse Recovery Time @ T_C = 25°C I_F = 0.4 Adc, V_R = 300 Vdc, dIF/dt = 10 A/μs	t_{rr}	—	150	—	ns
Reverse Recovery Stored Charge I_F = 0.4 Adc, V_R = 300 Vdc, dIF/dt = 10 A/μs	Q_{RR}	—	35	—	μC

SWITCHING CHARACTERISTICS (1)

Characteristic	Conditions	Symbol	Min	Typ	Max	Unit
Turn−Off Delay Time	(V_{CC} = 300 Vdc, I_C = 0.4 Adc, V_{GE} = 15 Vdc, L = 3.0 mH, R_G = 25 Ω, T_C = 25°C, dV/dt = 1000 V/μs) Energy losses include “tail”	$t_{d(off)}$	—	28	—	ns
Fall Time		t_f	—	150	—	
Turn−Off Switching Loss		E_{off}	—	3.25	4.25	μJ
Turn−Off Delay Time	(V_{CC} = 300 Vdc, I_C = 0.4 Adc, V_{GE} = 15 Vdc, L = 3.0 mH, R_G = 25 Ω, T_C = 125°C, dV/dt = 1000 V/μs) Energy losses include “tail”	$t_{d(off)}$	—	21	—	ns
Fall Time		t_f	—	280	—	
Turn−Off Switching Loss		E_{off}	—	8.0	10	μJ
Gate Charge	(V_{CC} = 300 Vdc, I_C = 0.3 Adc, V_{GE} = 15 Vdc)	Q_T	—	6.4	—	nC

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

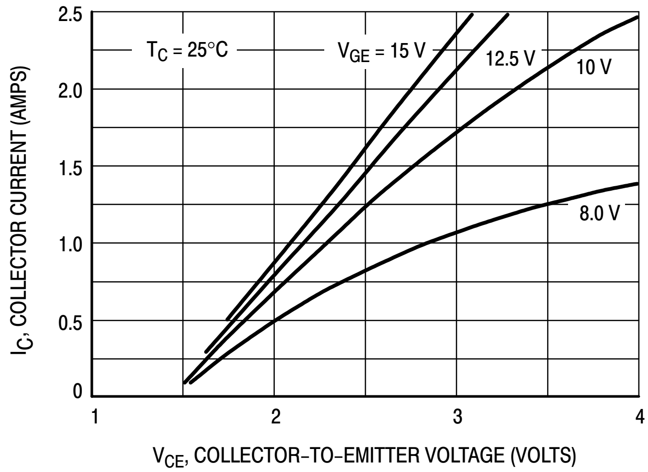


Figure 1. Saturation Characteristics

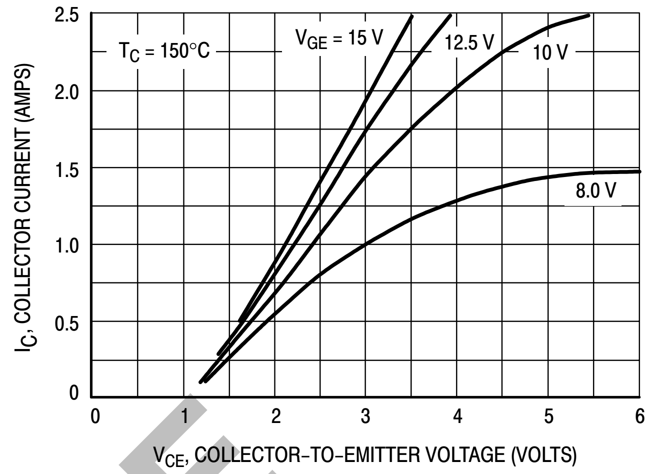


Figure 2. Saturation Characteristics

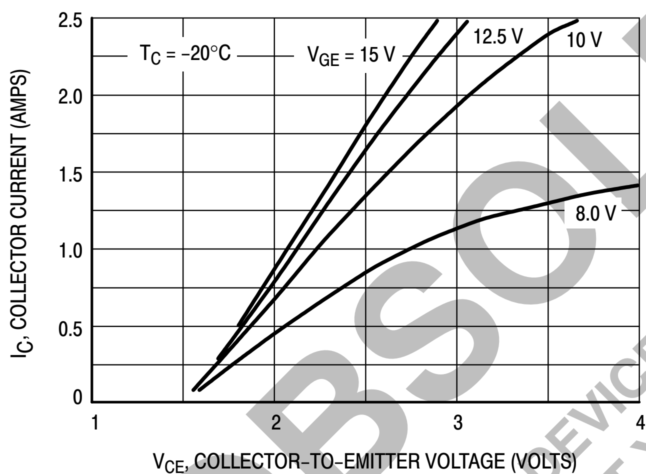


Figure 3. Saturation Characteristics

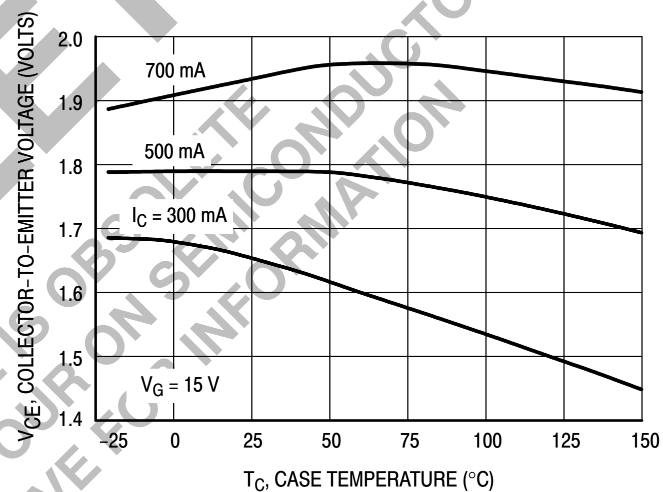


Figure 4. Collector−To−Emitter Saturation Voltage versus Case Temperature

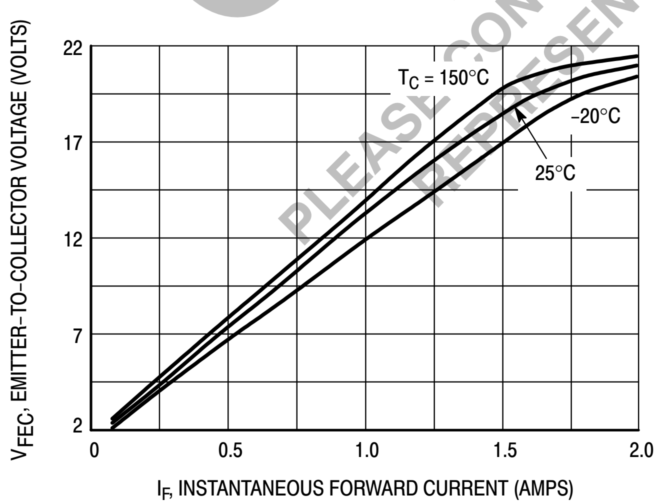


Figure 5. Diode Forward Voltage

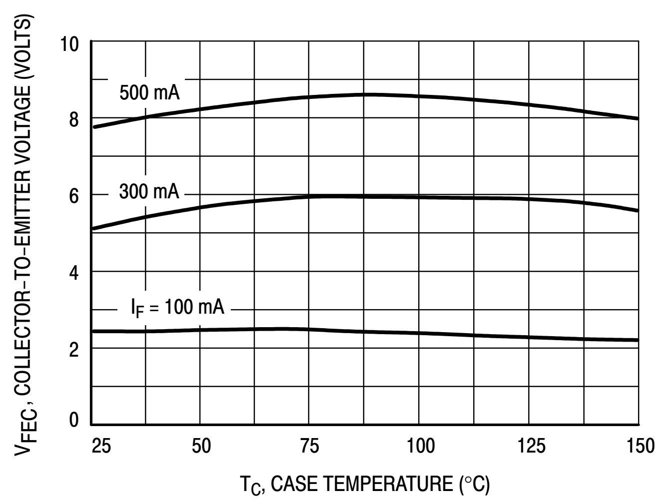


Figure 6. Diode Forward Voltage versus Case Temperature

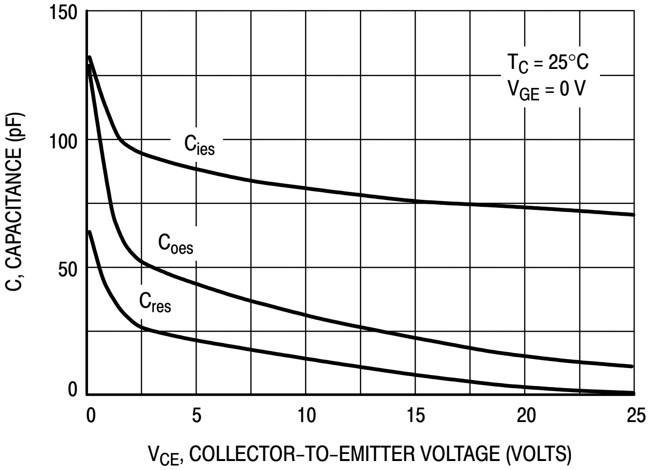


Figure 7. Capacitance Variation

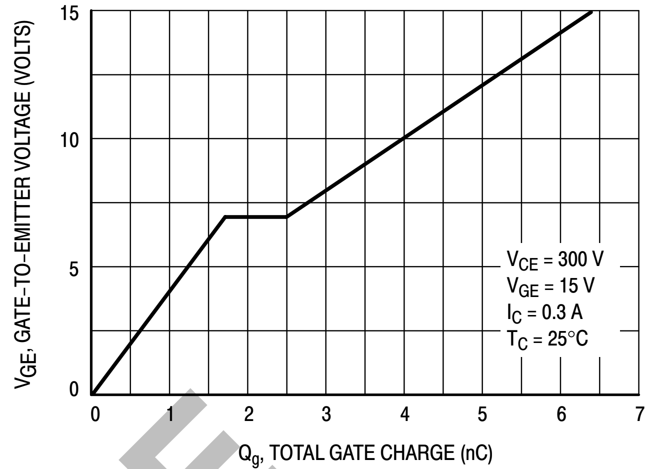


Figure 8. Gate−To−Emitter Voltage versus Total Charge

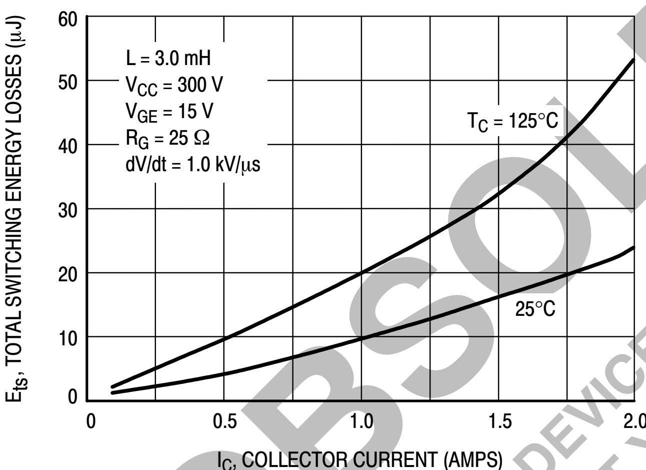


Figure 9. Total Switching Losses versus Collector Current

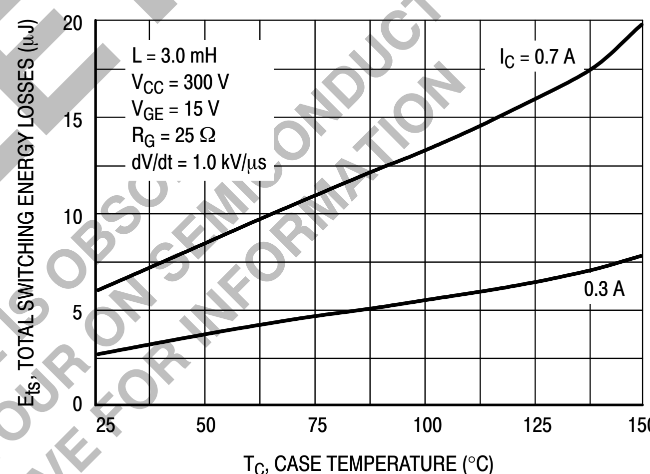


Figure 10. Total Switching Losses versus Case Temperature

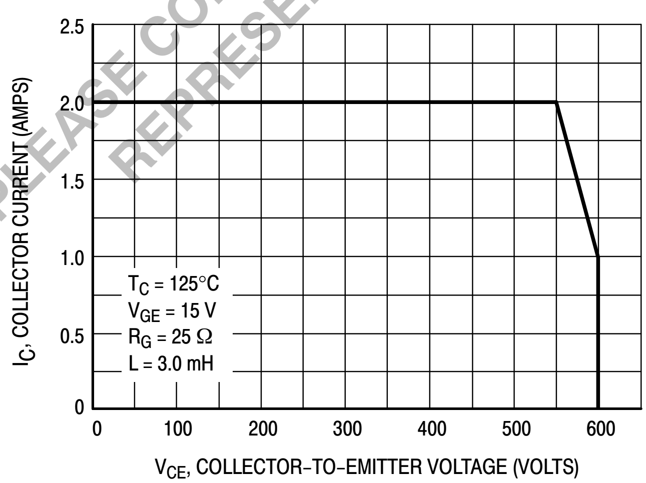


Figure 11. Minimum Turn−Off Safe Operating Area

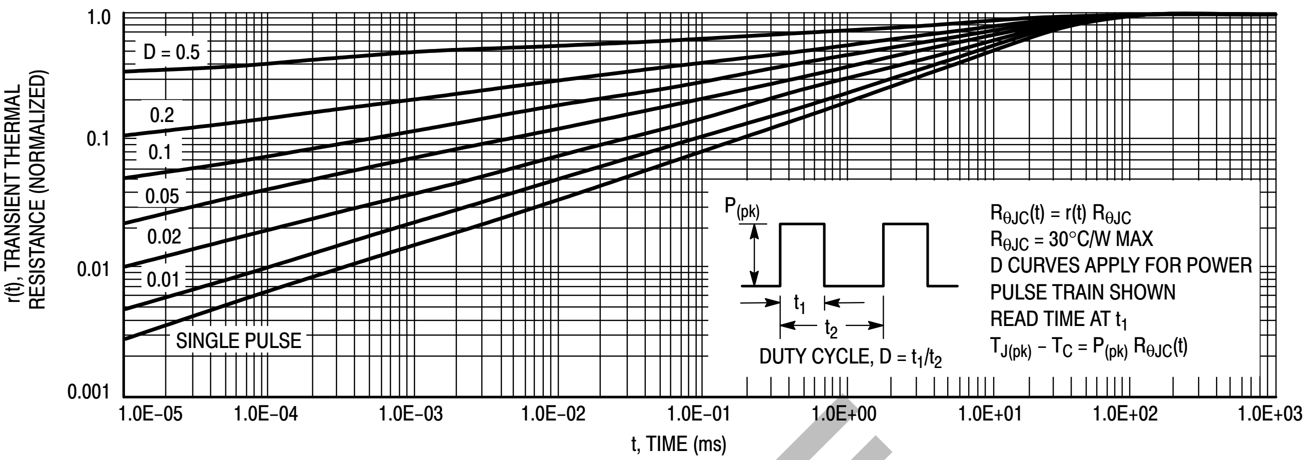
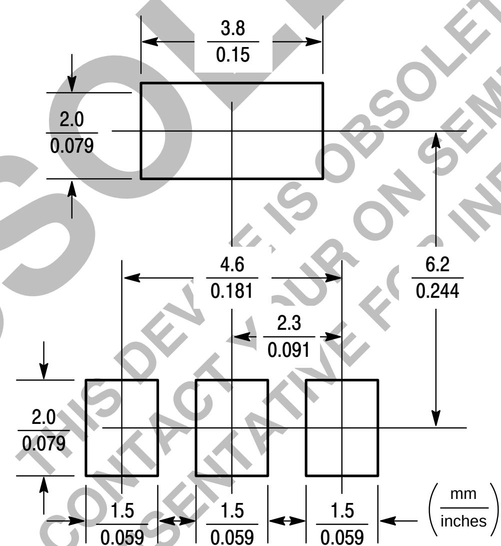
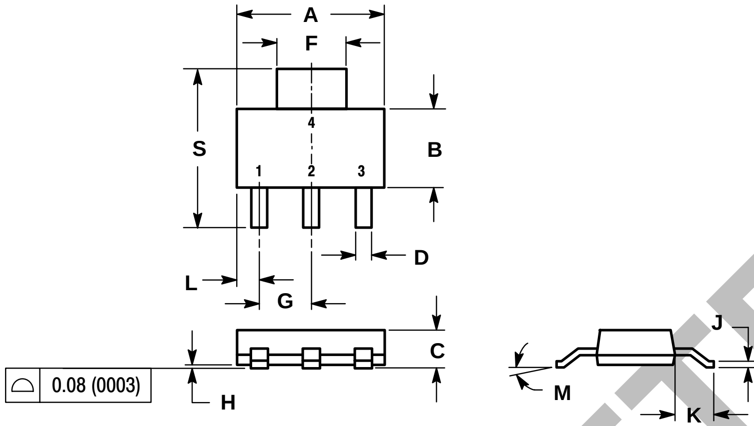


Figure 12. Typical Thermal Response



PACKAGE DIMENSIONS



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

DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX
A	0.249	0.263	6.30	6.70
B	0.130	0.145	3.30	3.70
C	0.060	0.068	1.50	1.75
D	0.024	0.035	0.60	0.89
F	0.115	0.126	2.90	3.20
G	0.087	0.094	2.20	2.40
H	0.0008	0.0040	0.020	0.100
J	0.009	0.014	0.24	0.35
K	0.060	0.078	1.50	2.00
L	0.033	0.041	0.85	1.05
M	0 °	10 °	0 °	10 °
S	0.264	0.287	6.70	7.30

STYLE 13:
PIN 1. GATE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

CASE 318E−04
TO−261A
ISSUE H

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