

Designer's™ Data Sheet

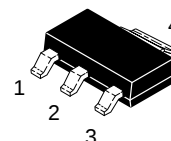
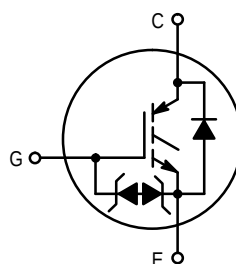
Insulated Gate Bipolar Transistor

N-Channel Enhancement-Mode Silicon Gate

MMG05N60D

IGBT
0.5 A @ 25°C
600 V

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



1 = G
2 = 4 = C
3 = E

CASE 318E-04
STYLE 13
TO-261A

MAXIMUM RATINGS ($T_J = 25^\circ C$ unless otherwise noted)

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

UNCLAMPED DRAIN-TO-SOURCE AVALANCHE CHARACTERISTICS ($T_C \leq 150^\circ C$)

Single Pulse Drain-to-Source Avalanche Energy — Starting @ $T_C = 25^\circ C$ @ $T_C = 125^\circ C$ $V_{CE} = 100 V, V_{GE} = 15 V, \text{Peak } I_L = 2.0 A, L = 3.0 mH, R_G = 25 \Omega$	E_{AS}	125 40	mJ
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(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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MMG05N60D

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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-to-Emitter Breakdown Voltage ($V_{GE} = 0\text{ Vdc}$, $I_C = 250\text{ }\mu\text{Adc}$) Temperature Coefficient (Positive)	$V_{(BR)CES}$	600 —	680 0.7	— —	Vdc V/ $^\circ\text{C}$
Zero Gate Voltage Collector Current ($V_{CE} = 600\text{ Vdc}$, $V_{GE} = 0\text{ Vdc}$, $T_C = 25^\circ\text{C}$) ($V_{CE} = 600\text{ Vdc}$, $V_{GE} = 0\text{ Vdc}$, $T_C = 125^\circ\text{C}$)	I_{CES} I_{CES}	— —	0.1 5.0	5.0 50	μAdc
Gate-Body Leakage Current ($V_{GE} = \pm 15\text{ Vdc}$, $V_{CE} = 0\text{ Vdc}$)	I_{GES}	—	10	100	μAdc

ON CHARACTERISTICS

Collector-to-Emitter On-State Voltage ($V_{GE} = 15\text{ Vdc}$, $I_C = 0.3\text{ Adc}$, $T_C = 25^\circ\text{C}$) ($V_{GE} = 15\text{ Vdc}$, $I_C = 0.3\text{ Adc}$, $T_C = 125^\circ\text{C}$)	$V_{CE(on)}$	— —	1.6 1.5	2.0 —	Vdc
Gate Threshold Voltage ($V_{CE} = V_{GE}$, $I_C = 250\text{ }\mu\text{Adc}$) Threshold Temperature Coefficient (Negative)	$V_{GE(th)}$	3.5 —	— 6.0	6.0 —	Vdc mV/ $^\circ\text{C}$
Forward Transconductance ($V_{CE} = 10\text{ Vdc}$, $I_C = 0.5\text{ Adc}$)	g_{fe}	0.3	0.42	—	Mhos

DYNAMIC CHARACTERISTICS

Input Capacitance	$(V_{CE} = 20\text{ Vdc}$, $V_{GE} = 0\text{ Vdc}$, $f = 1.0\text{ MHz})$	C_{ies}	—	75	100	pF
Output Capacitance		C_{oes}	—	11	20	
Transfer Capacitance		C_{res}	—	1.6	5.0	

DIODE CHARACTERISTICS

Diode Forward Voltage Drop ($I_{EC} = 0.3\text{ Adc}$, $T_C = 25^\circ\text{C}$) ($I_{EC} = 0.3\text{ Adc}$, $T_C = 125^\circ\text{C}$) ($I_{EC} = 0.1\text{ Adc}$, $T_C = 25^\circ\text{C}$) ($I_{EC} = 0.1\text{ Adc}$, $T_C = 125^\circ\text{C}$)	V_{FEC}	— — — —	5.0 5.2 2.3 2.3	6.0 — 3.0 —	Vdc
Reverse Recovery Time @ $T_C = 25^\circ\text{C}$ $I_F = 0.4\text{ Adc}$, $V_R = 300\text{ Vdc}$, $dI_F/dt = 10\text{ A}/\mu\text{s}$	t_{rr}	—	150	—	ns
Reverse Recovery Stored Charge $I_F = 0.4\text{ Adc}$, $V_R = 300\text{ Vdc}$, $dI_F/dt = 10\text{ A}/\mu\text{s}$	Q_{RR}	—	35	—	μC

SWITCHING CHARACTERISTICS (1)

Turn-Off Delay Time	$(V_{CC} = 300\text{ Vdc}$, $I_C = 0.4\text{ Adc}$, $V_{GE} = 15\text{ Vdc}$, $L = 3.0\text{ mH}$, $R_G = 25\text{ }\Omega$, $T_C = 25^\circ\text{C}$, $dV/dt = 1000\text{ V}/\mu\text{s}$) Energy losses include "tail"	$t_{d(off)}$	—	28	—	ns
Fall Time		t_f	—	150	—	
Turn-Off Switching Loss		E_{off}	—	3.25	4.25	
Turn-Off Delay Time	$(V_{CC} = 300\text{ Vdc}$, $I_C = 0.4\text{ Adc}$, $V_{GE} = 15\text{ Vdc}$, $L = 3.0\text{ mH}$, $R_G = 25\text{ }\Omega$, $T_C = 125^\circ\text{C}$, $dV/dt = 1000\text{ V}/\mu\text{s}$) Energy losses include "tail"	$t_{d(off)}$	—	21	—	ns
Fall Time		t_f	—	280	—	
Turn-Off Switching Loss		E_{off}	—	8.0	10	
Gate Charge	$(V_{CC} = 300\text{ Vdc}$, $I_C = 0.3\text{ Adc}$, $V_{GE} = 15\text{ Vdc})$	Q_T	—	6.4	—	nC

(1) Pulse Test: Pulse Width $\leq 300\text{ }\mu\text{s}$, Duty Cycle $\leq 2\%$.

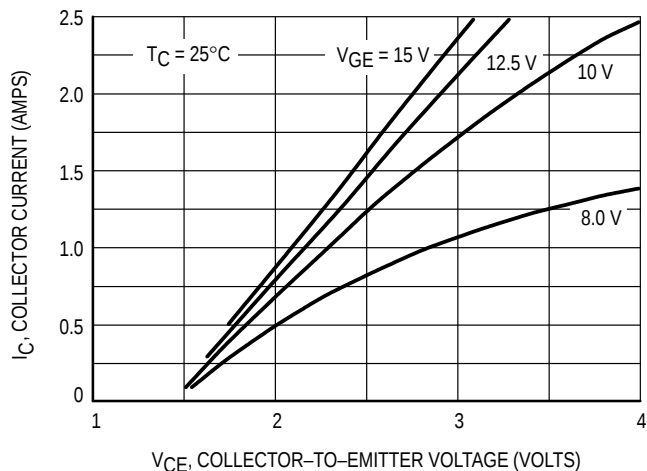


Figure 1. Saturation Characteristics

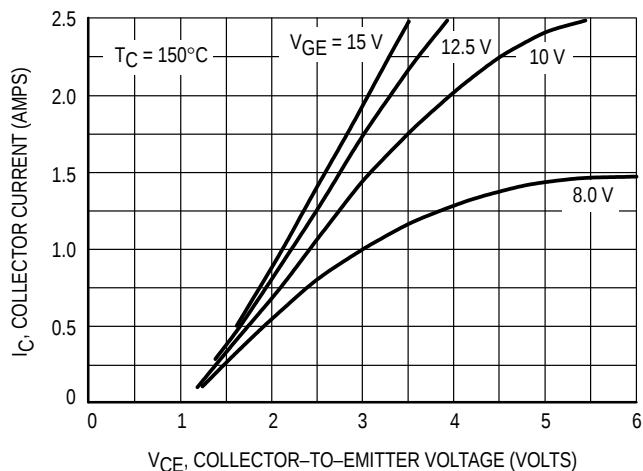


Figure 2. Saturation Characteristics

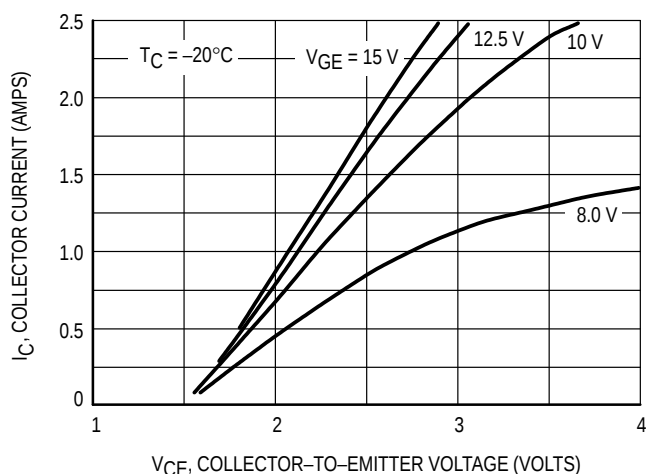


Figure 3. Saturation Characteristics

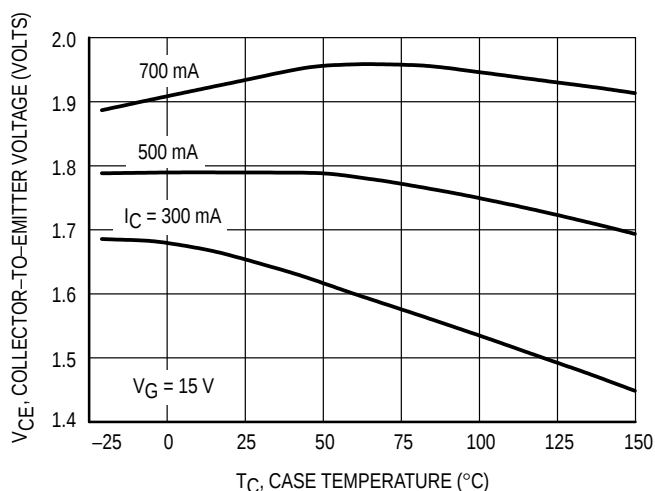


Figure 4. Collector-to-Emitter Saturation Voltage versus Case Temperature

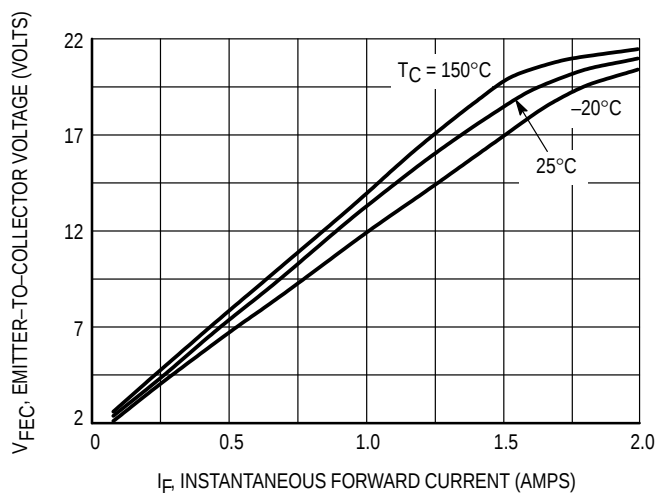


Figure 5. Diode Forward Voltage

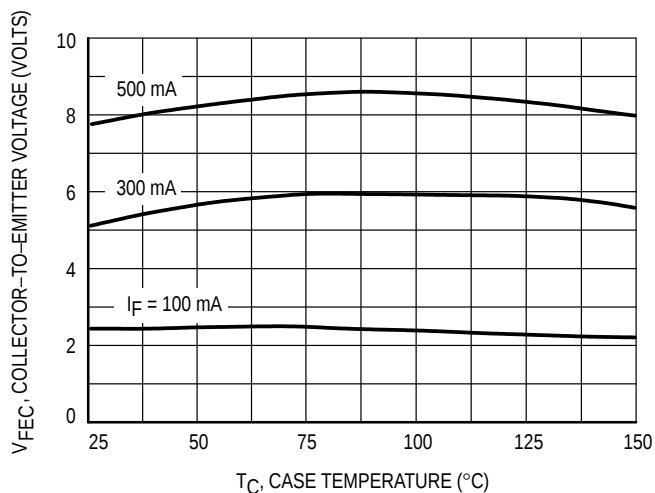
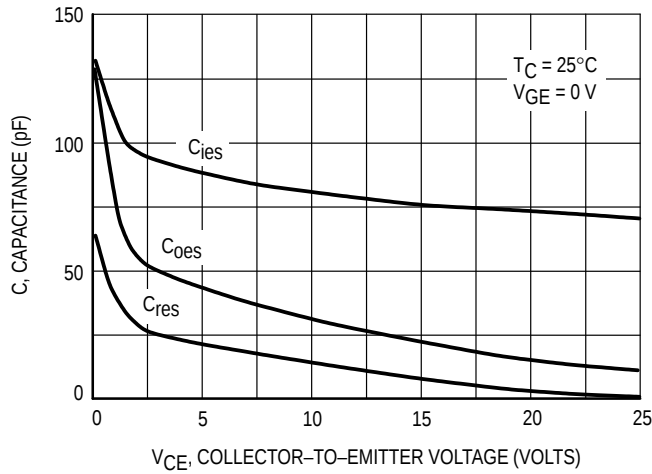
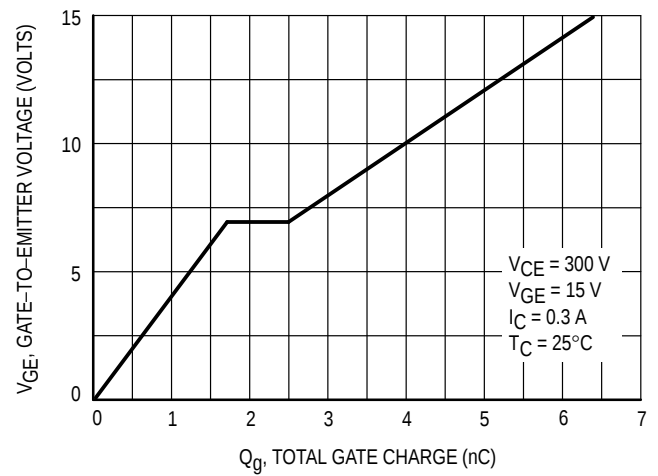
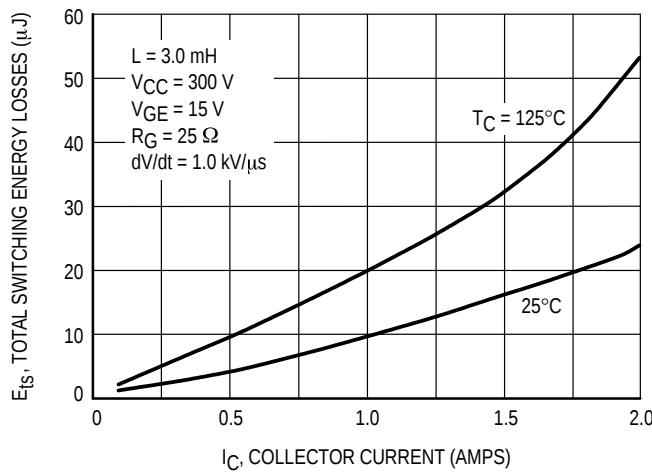
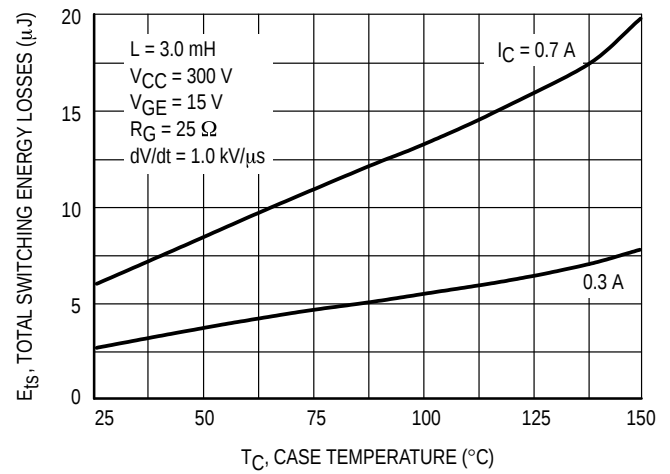
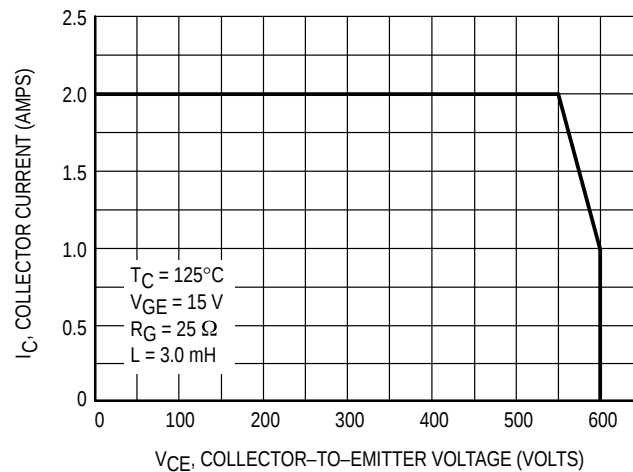


Figure 6. Diode Forward Voltage versus Case Temperature


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

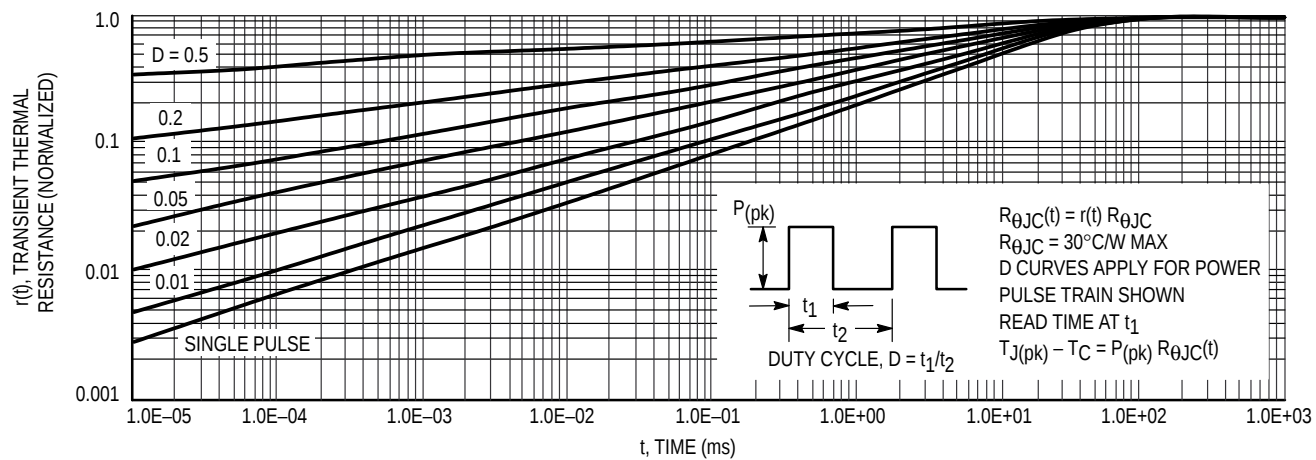
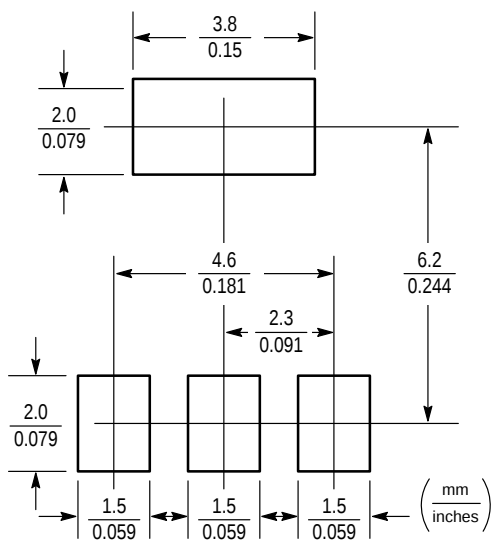
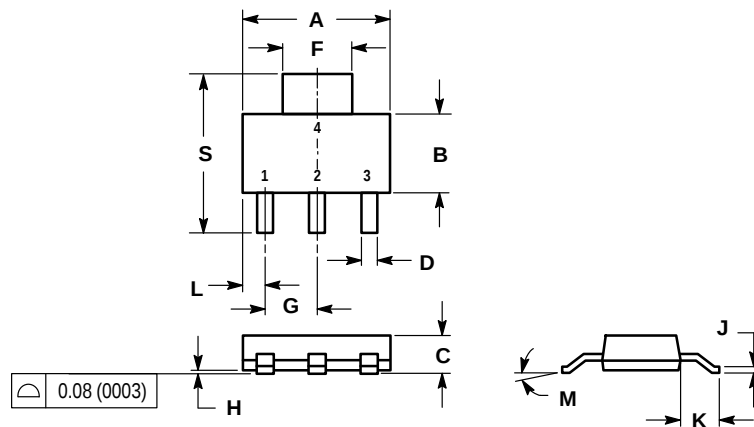


Figure 12. Typical Thermal Response



PACKAGE DIMENSIONS



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

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	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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