MOTOROLA
SEMICONDUCTOR TECHNICAL DATA

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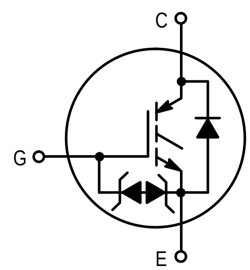
Designer's™ Data Sheet
Insulated Gate Bipolar Transistor
N–Channel Enhancement–Mode Silicon Gate

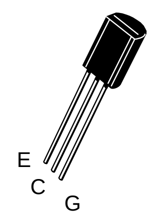
MGS05N60D

This IGBT contains a built–in free wheeling diode and a gate protection zener. Fast switching characteristics result in efficient operation at higher frequencies.

- Built–In Free Wheeling Diode
- Built–In Gate Protection Zener Diode
- Industry Standard Package (TO92 — 1.0 Watt)
- 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

POWERLUX
IGBT
0.5 A @ 25°C
600 V





CASE 029–05
TO–226AE
TO92 (1.0 WATT)

MAXIMUM RATINGS (T_C = 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_{GES}	±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 Power 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 CHARACTERISTICS

Thermal Resistance — Junction to Case – IGBT — Junction to Ambient	$R_{\theta JC}$ $R_{\theta JA}$	25 125	°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_C = 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)		B_{VCES}	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						
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						
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)						
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%.

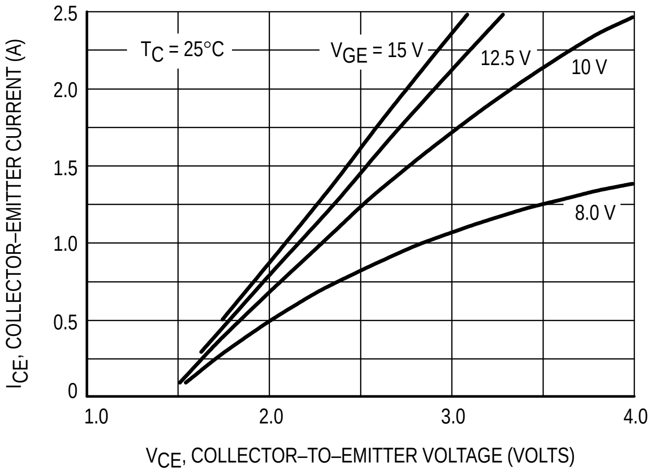


Figure 1. Saturation Characteristics

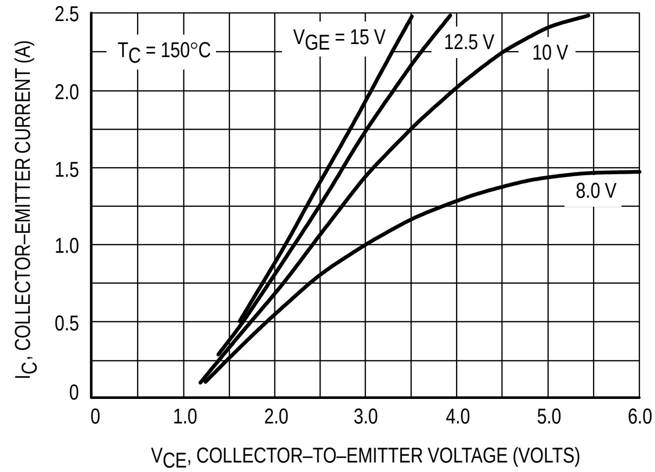


Figure 2. Saturation Characteristics

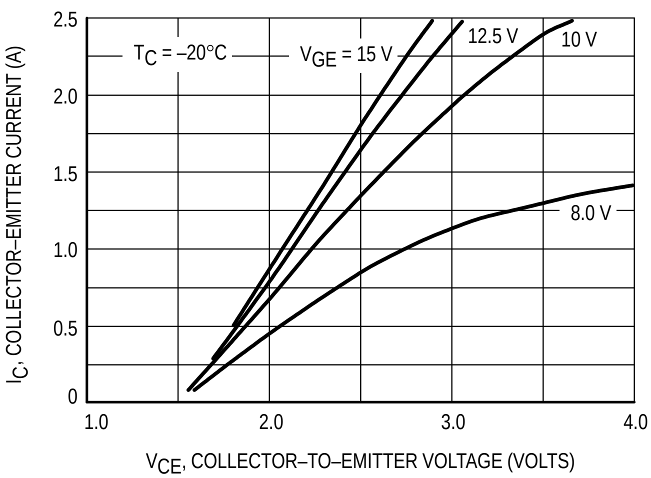


Figure 3. Saturation Characteristics

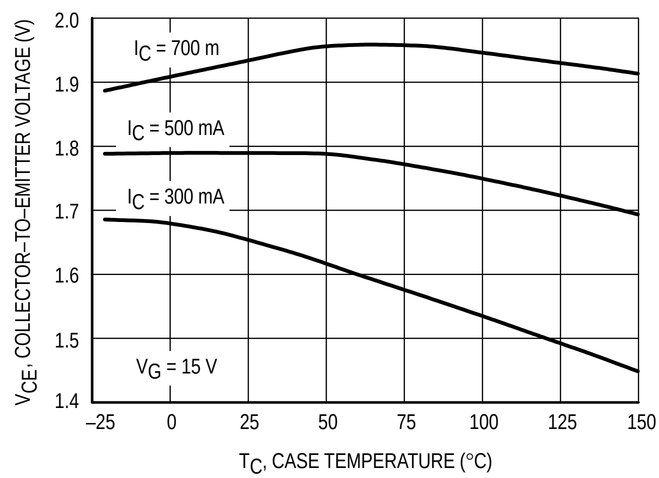


Figure 4. Collector–To–Emitter Saturation Voltage versus Case Temperature

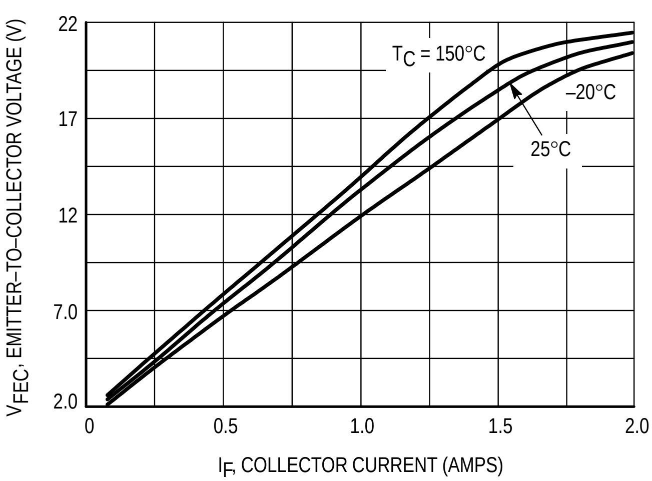


Figure 5. Diode Forward Voltage

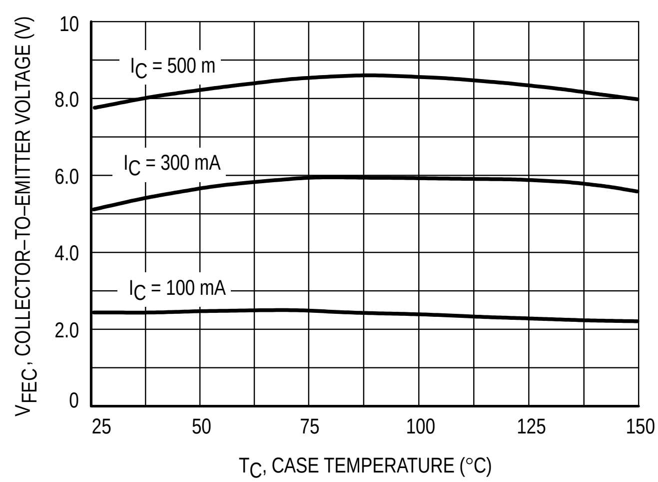


Figure 6. Diode Forward Voltage versus Case Temperature

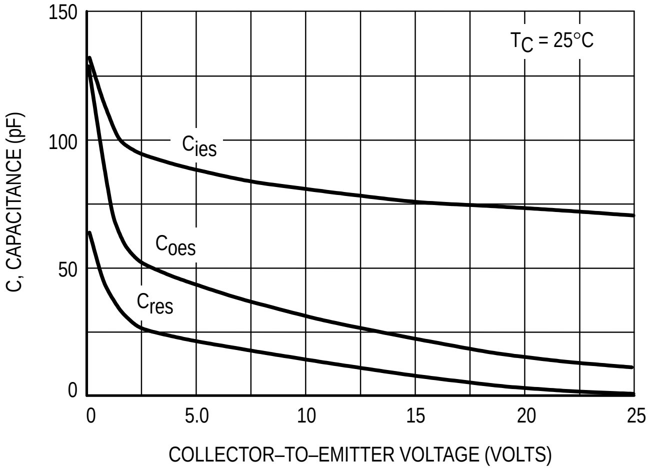


Figure 7. Capacitance Variation

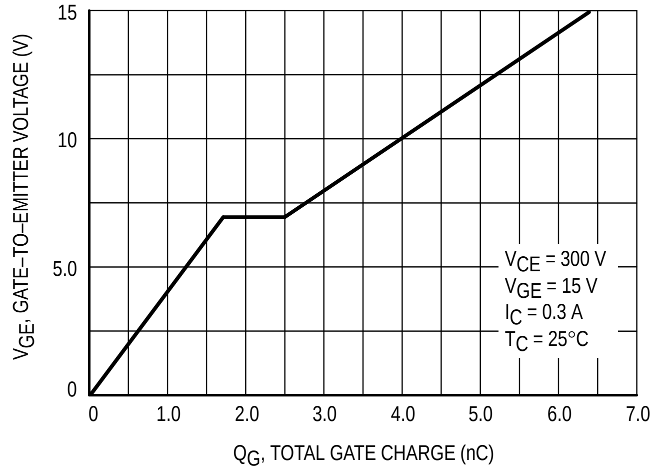


Figure 8. Gate–To–Emitter Voltage versus Total Charge

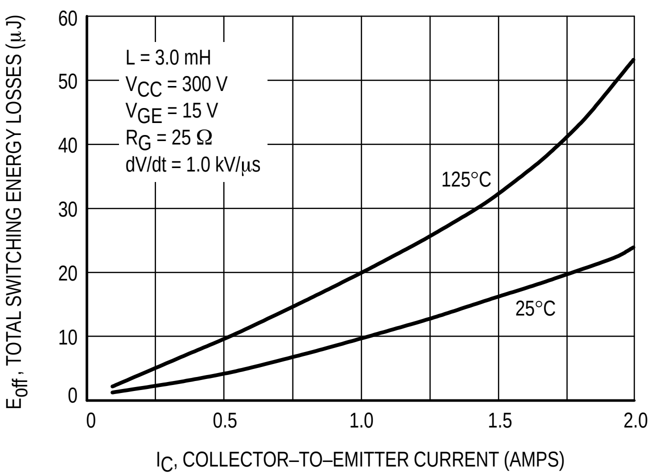


Figure 9. Total Switching Losses versus Collector–To–Emitter Current

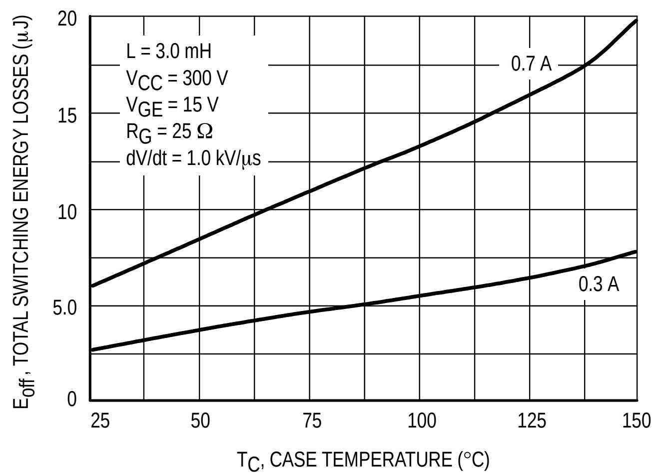


Figure 10. Total Switching Losses versus Case Temperature

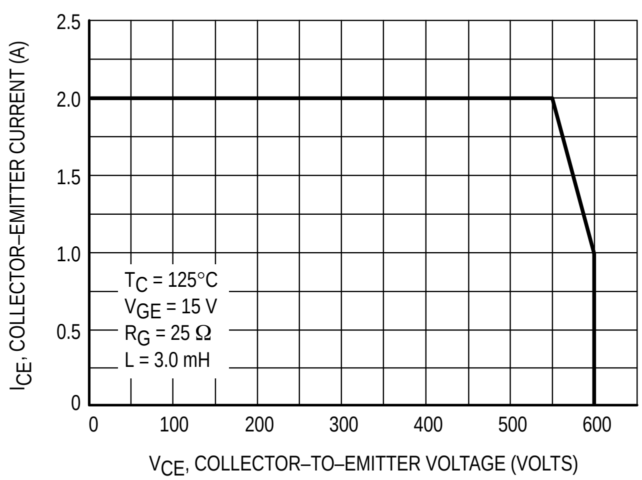


Figure 11. Minimum Turn–Off Safe Operating Area

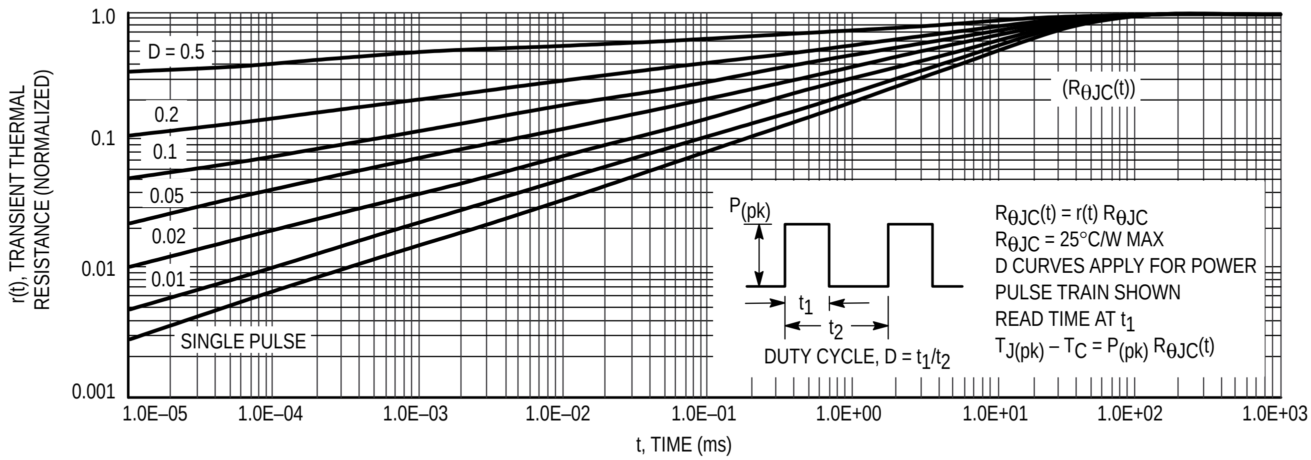
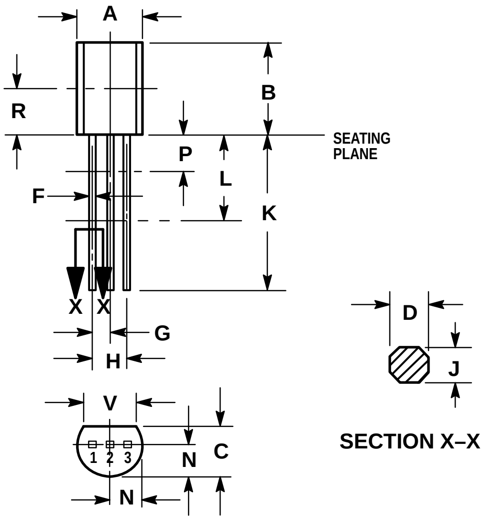


Figure 12. Typical Thermal Response

PACKAGE DIMENSIONS



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. DIMENSION F APPLIES BETWEEN P AND L. DIMENSIONS D AND J APPLY BETWEEN L AND K MIMIMUM. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX
A	0.175	0.205	4.44	5.21
B	0.290	0.310	7.37	7.87
C	0.125	0.165	3.18	4.19
D	0.018	0.022	0.46	0.56
F	0.016	0.019	0.41	0.48
G	0.045	0.055	1.15	1.39
H	0.095	0.105	2.42	2.66
J	0.018	0.024	0.46	0.61
K	0.500	—	12.70	—
L	0.250	—	6.35	—
N	0.080	0.105	2.04	2.66
P	—	0.100	—	2.54
R	0.135	—	3.43	—
V	0.135	—	3.43	—

STYLE 31:
PIN 1. GATE
2. DRAIN
3. SOURCE

CASE 029–05
TO–226AE
ISSUE AD

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