Designer's™ Data Sheet

Insulated Gate Bipolar Transistor

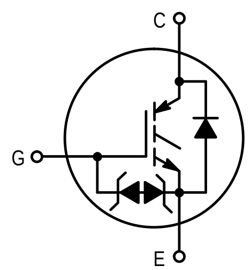
N–Channel Enhancement–Mode Silicon Gate

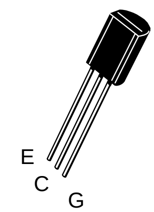
MGS05N60D

This IGBT contains a built–in free wheeling diode and a gate protection zener 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 Diodes
- 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

IGBT
0.5 A @ 25°C
600 V





CASE 029–05
STYLE 35
TO–226AE

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	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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REV 2

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) Temperature Coefficient (Positive)	$V_{(BR)CES}$	 600 —	 680 0.7	 — —	Vdc V/°C
Zero Gate Voltage Collector Current (V_{CE} = 600 Vdc, V_{GE} = 0 Vdc) (V_{CE} = 600 Vdc, V_{GE} = 0 Vdc, T_C = 125°C)	 I_{CES} I_{CES}	 — —	 0.1 5.0	 5.0 50	μAdc
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) (V_{GE} = 15 Vdc, I_C = 0.3 Adc, T_C = 125°C)	$V_{CE(on)}$	 — —	 1.6 1.5	 2.0 —	Vdc
Gate Threshold Voltage (V_{CE} = V_{GE}, I_C = 250 μAdc) Threshold Temperature Coefficient (Negative)	$V_{GE(th)}$	 3.5 —	 — 6.0	 6.0 —	Vdc 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 (V_{CE} = 20 Vdc, V_{GE} = 0 Vdc, f = 1.0 MHz)	C_{oes}	—	11	20	pF
Transfer Capacitance (V_{CE} = 20 Vdc, V_{GE} = 0 Vdc, f = 1.0 MHz)	C_{res}	—	1.6	5.0	pF
DIODE CHARACTERISTICS					
Diode Forward Voltage Drop (I_{EC} = 0.3 Adc) (I_{EC} = 0.3 Adc, T_C = 125°C) (I_{EC} = 0.1 Adc) (I_{EC} = 0.1 Adc, T_C = 125°C)	V_{FEC}	 — — — —	 5.0 5.2 2.3 2.3	 6.0 — 3.0 —	Vdc
Reverse Recovery Time (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, dV/dt = 1000 V/μs) Energy losses include “tail”	$t_{d(off)}$	—	28	—	ns
Fall Time	t_f	—	150	—	ns
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	—	ns
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%.

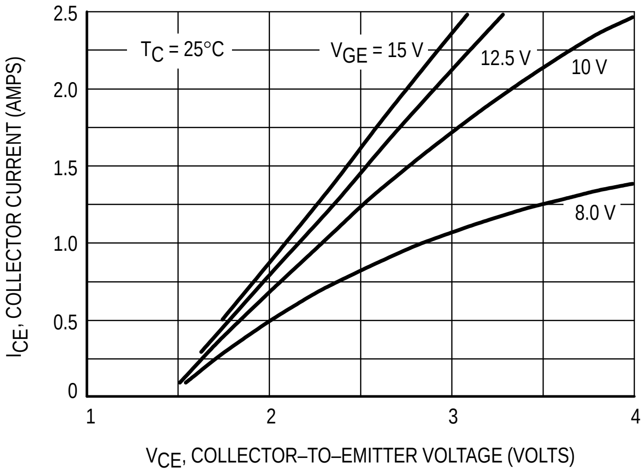


Figure 1. Saturation Characteristics

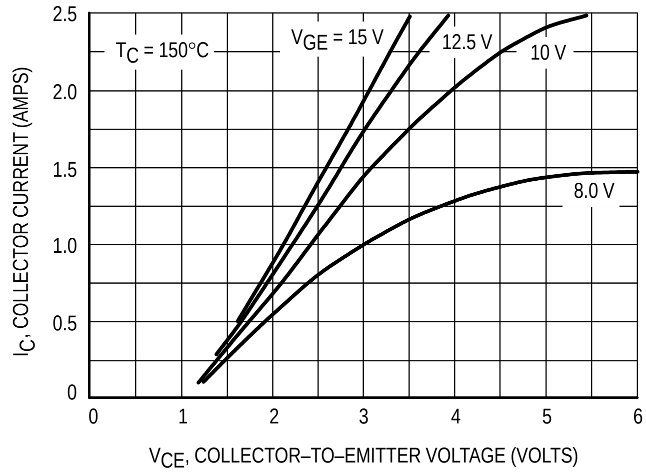


Figure 2. Saturation Characteristics

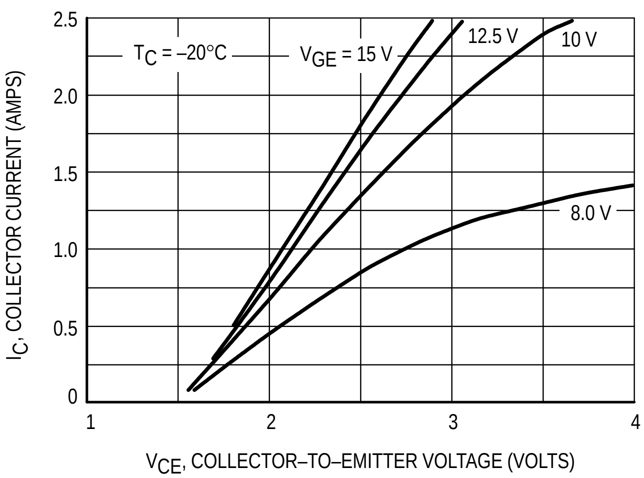


Figure 3. Saturation Characteristics

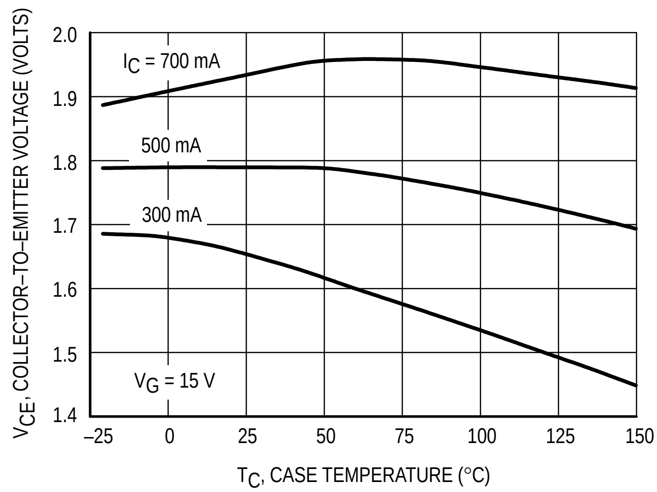


Figure 4. Collector–To–Emitter Saturation Voltage versus Case Temperature

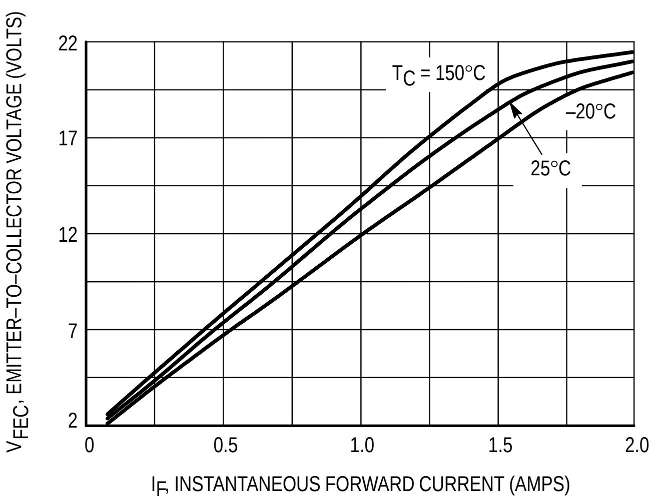


Figure 5. Diode Forward Voltage Drop

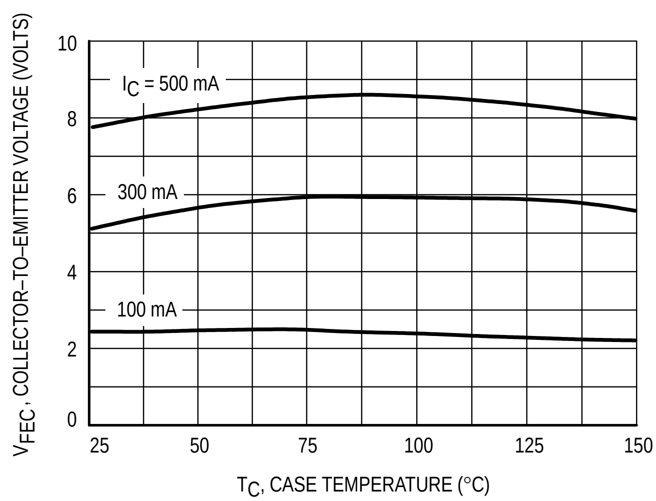


Figure 6. Diode Forward Voltage versus Case Temperature

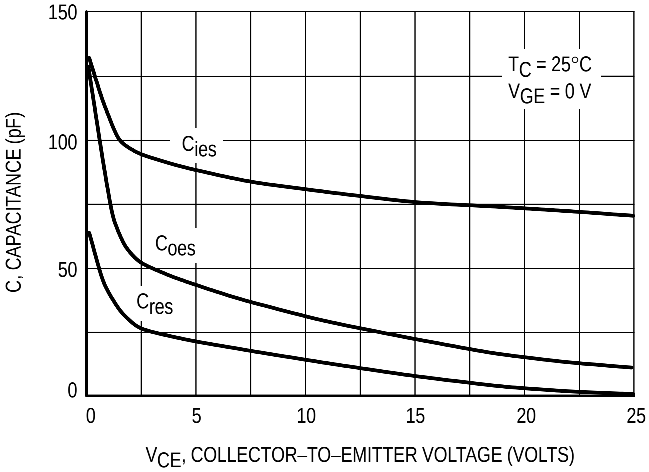


Figure 7. Capacitance Variation

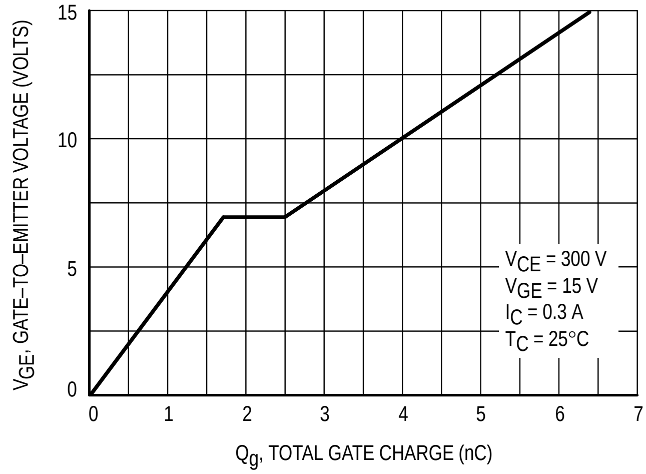


Figure 8. Gate–To–Emitter Voltage versus Total Charge

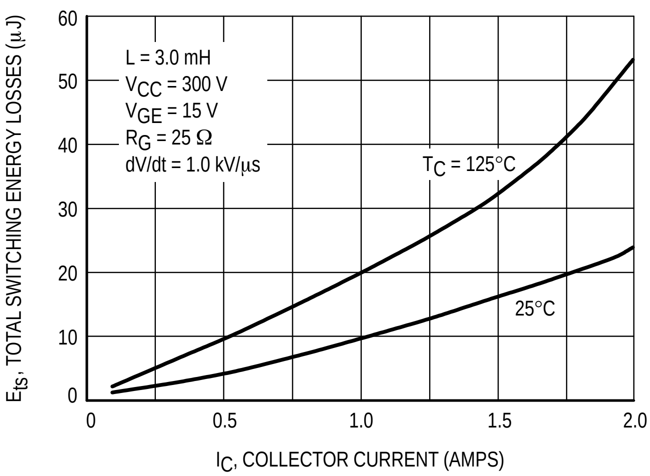


Figure 9. Total Switching Losses versus Collector Current

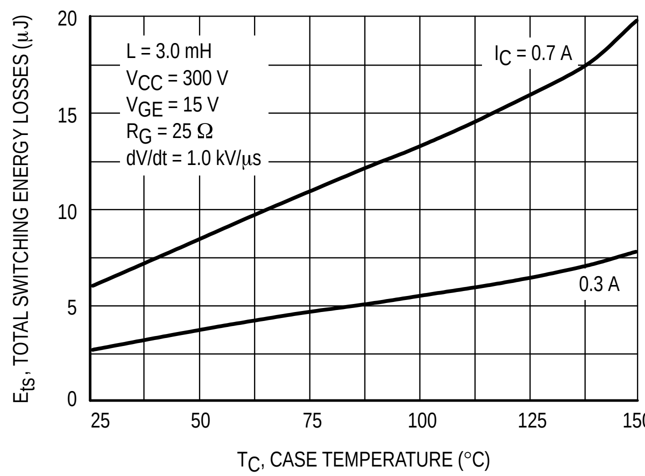


Figure 10. Total Switching Losses versus Case Temperature

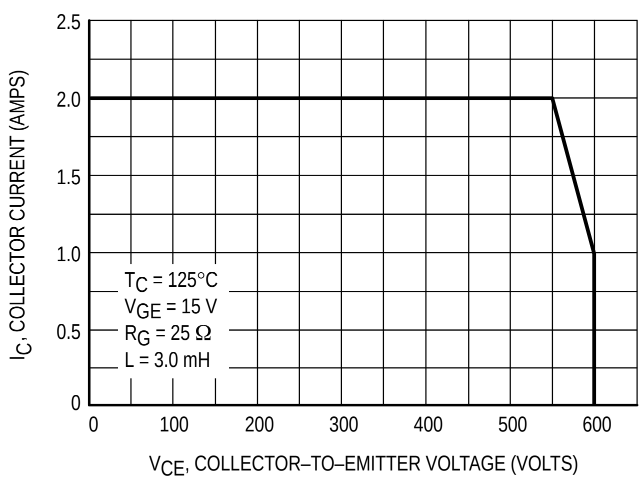


Figure 11. Minimum Turn–Off Safe Operating Area

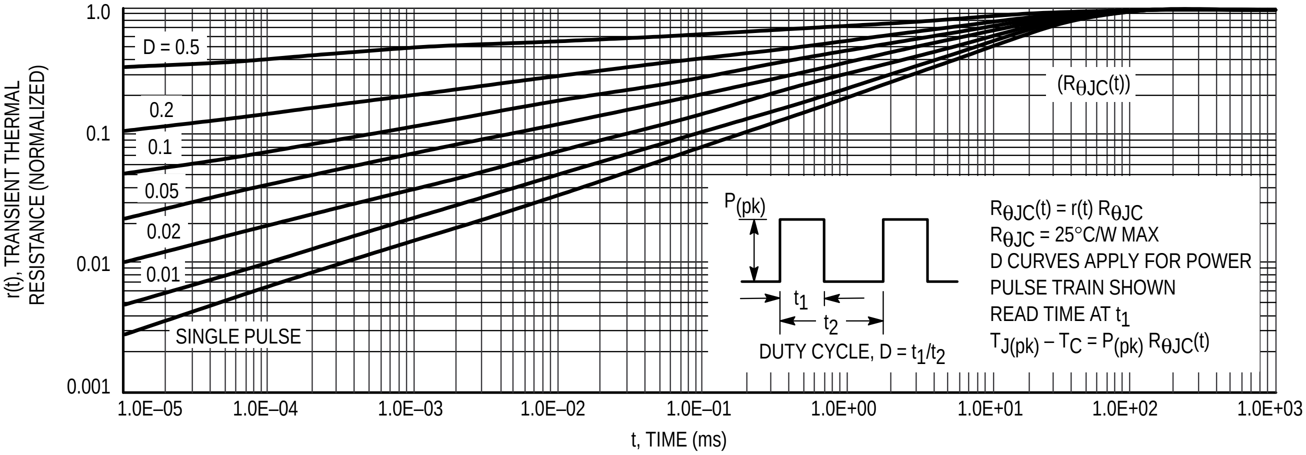
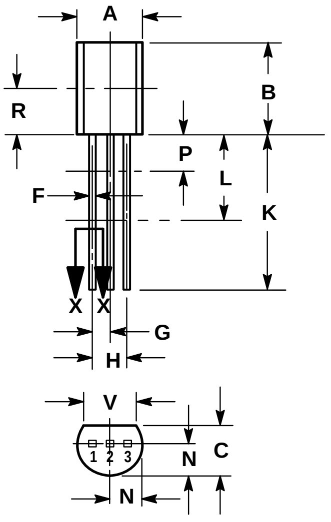
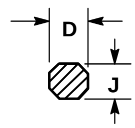


Figure 12. Typical Thermal Response

PACKAGE DIMENSIONS





SECTION X–X

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.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	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 35:
PIN 1. GATE
2. COLLECTOR
3. EMITTER

CASE 029–05
TO–226AE
ISSUE AD

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