Designer's™ Data Sheet

Insulated Gate Bipolar Transistor

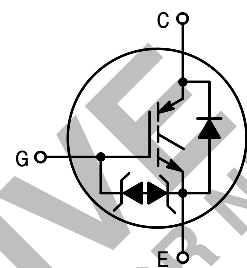
N–Channel Enhancement–Mode Silicon Gate

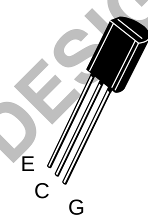
MGS13002D

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 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





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 @ 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 Thermal Resistance — 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.

Designer's is a trademark of Motorola, Inc.

REV 3

ELECTRICAL CHARACTERISTICS (T_C = 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 = 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}	 — —	 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		C_{oes}	—	11	20	
Transfer Capacitance		C_{res}	—	1.6	5.0	
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		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	—	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	—	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%.

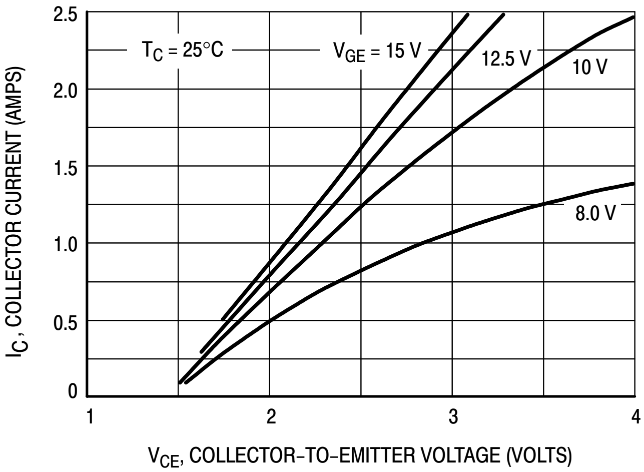


Figure 1. Saturation Characteristics

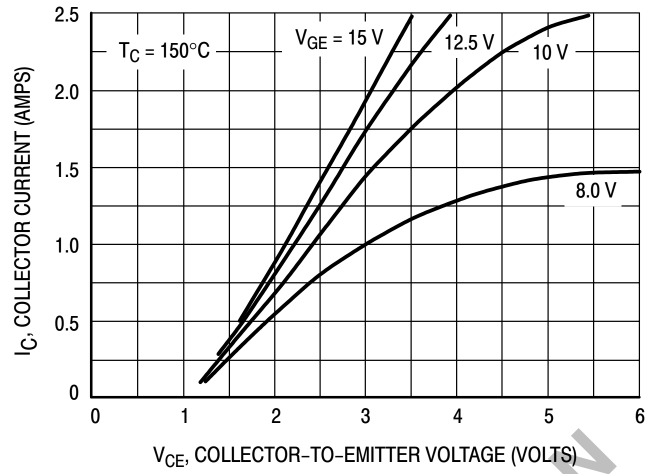


Figure 2. Saturation Characteristics

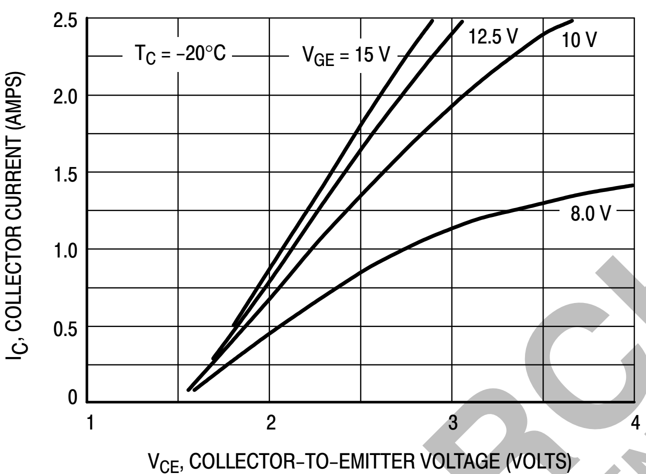


Figure 3. Saturation Characteristics

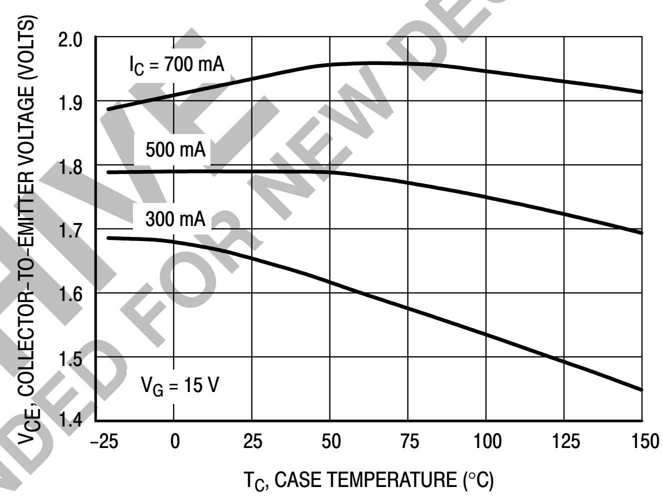


Figure 4. Collector–To–Emitter Saturation Voltage versus Case Temperature

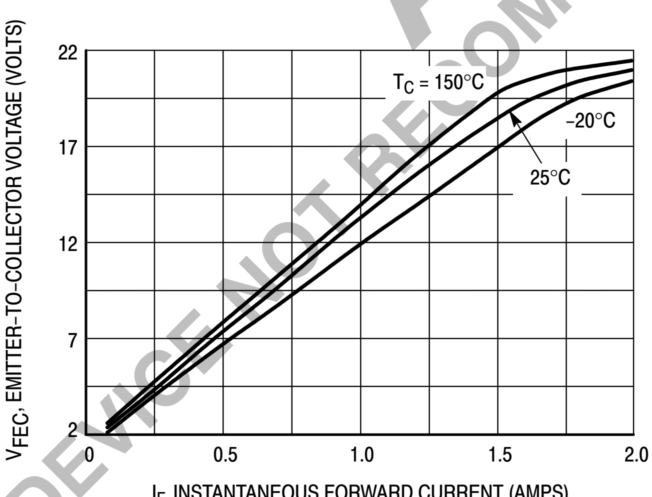


Figure 5. Diode Forward Voltage Drop

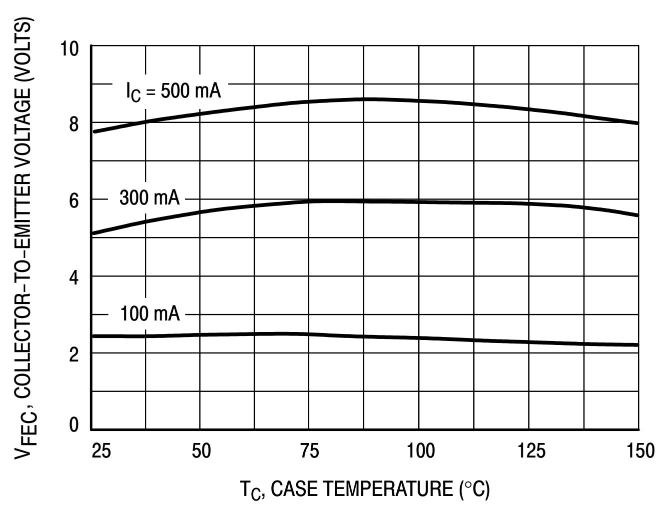


Figure 6. Diode Forward Voltage versus Case Temperature

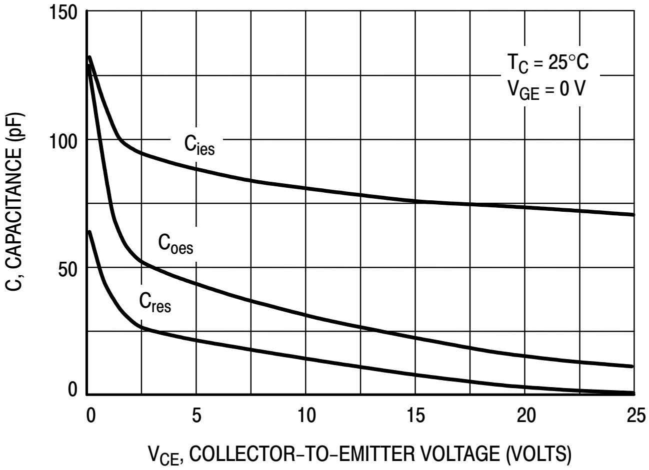


Figure 7. Capacitance Variation

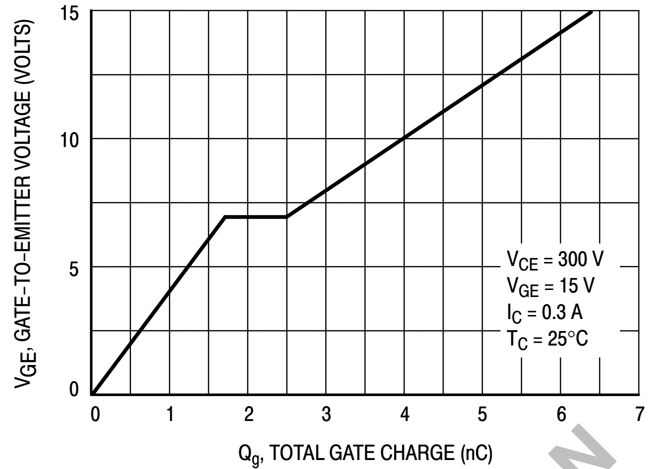


Figure 8. Gate–To–Emitter Voltage versus Total Charge

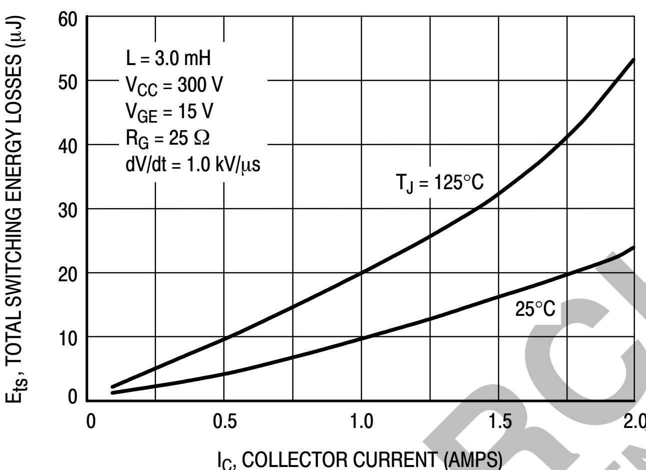


Figure 9. Total Switching Losses versus Collector Current

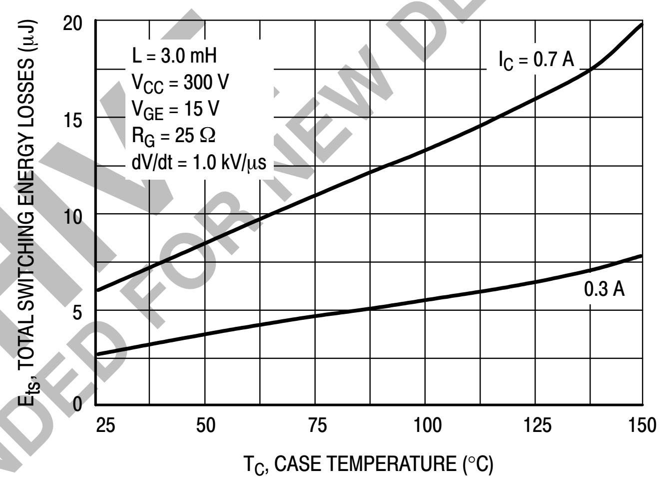


Figure 10. Total Switching Losses versus Case Temperature

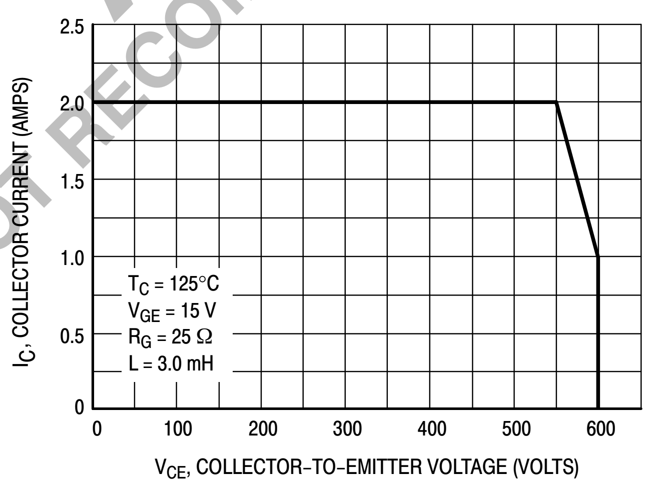


Figure 11. Minimum Turn–Off Safe Operating Area

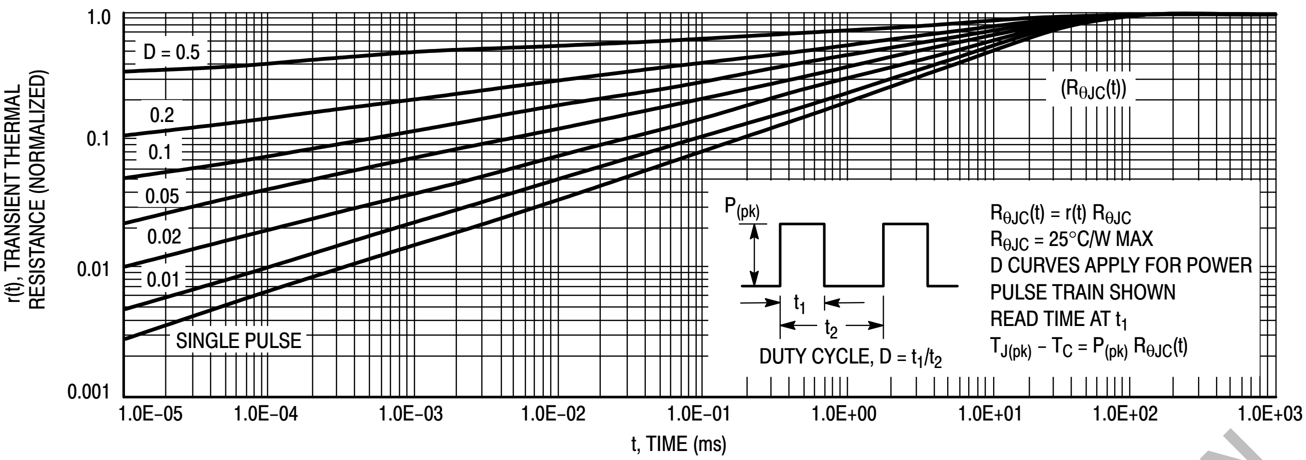
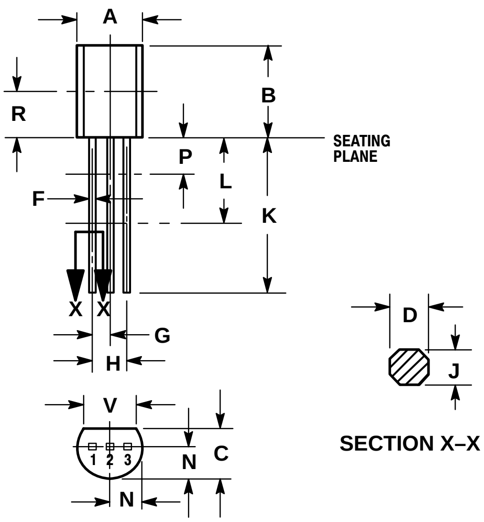


Figure 12. Typical Thermal Response

PACKAGE DIMENSIONS



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

How to reach us:
USA/EUROPE/Locations Not Listed: Motorola Literature Distribution;
P.O. Box 5405, Denver, Colorado 80217. 1–303–675–2140 or 1–800–441–2447

JAPAN: Nippon Motorola Ltd.: SPD, Strategic Planning Office, 141,
4–32–1 Nishi–Gotanda, Shagawa–ku, Tokyo, Japan. 03–5487–8488

Customer Focus Center: 1–800–521–6274

Mfax™: RMFAX0@email.sps.mot.com – TOUCHTONE 1–602–244–6609
Motorola Fax Back System – US & Canada ONLY 1–800–774–1848
– http://sps.motorola.com/mfax/

ASIA/PACIFIC: Motorola Semiconductors H.K. Ltd.; 8B Tai Ping Industrial Park,
51 Ting Kok Road, Tai Po, N.T., Hong Kong. 852–26629298

HOME PAGE: http://motorola.com/sps/