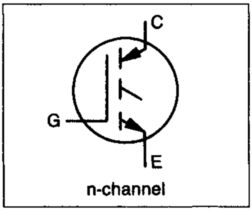
International
IOR Rectifier

PD-9.716A

IRGMC40F

INSULATED GATE BIPOLAR TRANSISTOR

Fast Speed IGBT



Description

Insulated Gate Bipolar Transistors (IGBTs) from International Rectifier have higher current densities than comparable bipolar transistors, while at the same time having simpler gate-drive requirements of the familiar power MOSFET. They provide substantial benefits to a host of higher-voltage, higher-current applications.

The performance of various IGBTs varies greatly with frequency. Note that IR now provides the designer with a speed benchmark ($f_{IC/2}$, or the "half-current frequency"), as well as an indication of the current handling capability of the device. Refer to Figure 14.

Product Summary

Part Number	$V_{(BR)CES}$	$V_{CE(on)}$	I_C	E_{ts}
IRGMC40F	600V	2.0V	35A*	9.0 mJ

Features:

- Electronically Isolated and Hermetically Sealed
- Simple Drive Requirements
- Latch-proof
- Fast Speed operation 3 kHz ~ 8 kHz
- Switching-Loss Rating includes all "tail" losses
- Ceramic Eyelets

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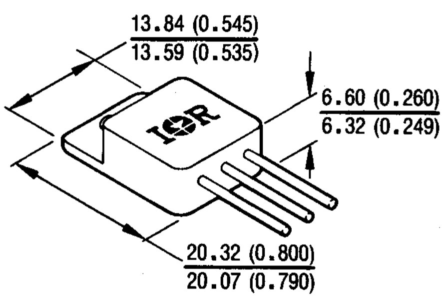
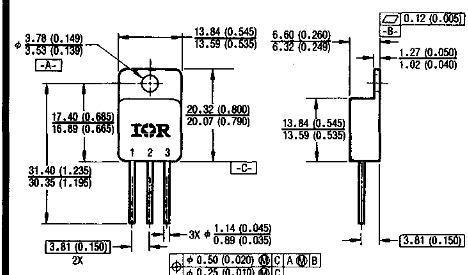
CASE STYLE AND DIMENSIONS



CAUTION

BERYLLIA WARNING PER MIL-S-19500
SEE PAGE G-81



LEGEND
1 COLLECTOR
2 EMITTER
3 GATE

NOTES:
1 DIMENSIONING & TOLERANCING PER ANSI Y14.5M - 1982.
2 ALL DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES).

**For leadform configuration see page G-81, fig. 15

Conforms to JEDEC Outline TO-254AA**
Dimensions in Millimeters and (Inches)

*I_C current limited by pin diameter

Absolute Maximum Ratings

	Parameter	Max.	Units
I_C @ T_C = 25°C	Continuous Collector Current	35*	A
I_C @ T_C = 100°C	Continuous Collector Current	20	
I_{CM}	Pulsed Collector Current ①	152	
V_{CE}	Collector-to-Emitter Breakdown Voltage	600	V
V_{GE}	Gate-to-Emitter Voltage	±20	
I_{LM}	Clamped Inductive Load Current ②	152	A
P_D @ T_C = 25°C	Maximum Power Dissipation	125	W
P_D @ T_C = 100°C	Maximum Power Dissipation	50	
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to +150	°C
	Lead Temperature, for 10 sec.	300 (0.063 in. (1.6mm) from case)	
	Weight	9.3 (typical)	g

*I_C current limited by pin diameter

Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	—	1.0	K/W ⑤
$R_{\theta CS}$	Case-to-Sink, flat, greased surface	—	0.21	—	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	—	—	48	

Electrical Characteristic @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Test Conditions
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	600	—	—	V	V_{GE} = 0V, I_C = 1.0 mA
$V_{(BR)ECS}$	Emitter-to-Collector Breakdown Volt. ③	24	—	—		V_{GE} = 0V, I_C = 1.0A
$\Delta V_{(BR)CES}/\Delta T_J$	Temp. Coeff. of Breakdown Voltage	—	0.70	—	V/°C	V_{GE} = 0V, I_C = 1.0 mA
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	—	2.0	V	V_{GE} = 15V, I_C = 20A See Fig. 4
		—	2.2	—		V_{GE} = 15V, I_C = 35A
		—	1.9	—		V_{CE} = 15V, I_C = 20A, T_J = 125°C
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	5.5		V_{CE} = V_{GE}, I_C = 250 μA
$\Delta V_{GE(th)}/\Delta T_J$	Temp. Coeff. of Threshold Voltage	—	-12	—	mV/°C	V_{CE} = V_{GE}, I_C = 250 μA
g_{fe}	Forward Transconductance ④	9.2	—	—	S	V_{CE} ≥ 15V, I_C = 20A
I_{CES}	Zero Gate Voltage Collector Current	—	—	50	μA	V_{GE} = 0V, V_{CE} = 480V, T_J = 25°C
		—	—	1000		V_{GE} = 0V, V_{CE} = 480V, T_J = 125°C
I_{GES}	Gate-to-Emitter Leakage Current	—	—	±100	nA	V_{GE} = ±20V

Notes:

① Repetitive rating; V_{GE} = 20V, pulse width limited by max. junction temperature (See figure 12b).

② V_{CC} = 80% (BV_{CES}), V_{GE} = 20V, L ≥ 10 μH, R_G = 10Ω, (See figure 12a)

③ Pulse width ≤ 80 μs; duty factor ≤ 0.1%.

④ Pulse width ≤ 5 μs, single shot

⑤ K/W equivalent to °C/W

Switching Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Q_G	Total Gate Charge (turn-on)	—	58	116	nC	I_C = 20A, V_{CC} = 300V
Q_{GE}	Gate - Emitter Charge (turn-on)	—	8	16		See Figure 6.
Q_{GC}	Gate - Collector Charge (turn-on)	—	30	60		V_{GE} = 15V
$t_{d(on)}$	Turn-On Delay Time	—	—	52	ns	See test circuit, figure 13.
t_r	Rise Time	—	—	74		I_C = 20A, V_{CC} = 480V
$t_{d(off)}$	Turn-Off Delay Time	—	—	410		T_J = 25°C
t_f	Fall Time	—	—	420		V_{GE} = 15V, R_G = 9.1Ω
E_{on}	Turn-On Switching Loss	—	0.60	—	mJ	Energy losses include "tail".
E_{off}	Turn-Off Switching Loss	—	3.8	—		Also see figures 9, 10, & 11.
E_{ts}	Total Switching Loss	—	4.4	9.0		
$t_{d(on)}$	Turn-On Delay Time	—	28	—	ns	I_C = 20A, V_{CC} = 480V
t_r	Rise Time	—	37	—		T_J = 125°C
$t_{d(off)}$	Turn-Off Delay Time	—	380	—		V_{GE} = 15V
t_f	Fall Time	—	460	—		R_G = 9.1Ω
E_{ts}	Total Switching Loss	—	7.0	—	mJ	
L_E	Internal Emitter Inductance	—	8.7	—	nH	Measured 5mm from package.
C_{ies}	Input Capacitance	—	1500	—	pF	V_{GE} = 0V
C_{oes}	Output Capacitance	—	190	—		V_{CC} = 30V See fig 5.
C_{res}	Reverse Transfer Capacitance	—	20	—		f = 1.0 MHz
C_{CC}	Case-to-Drain Capacitance	—	12	—		

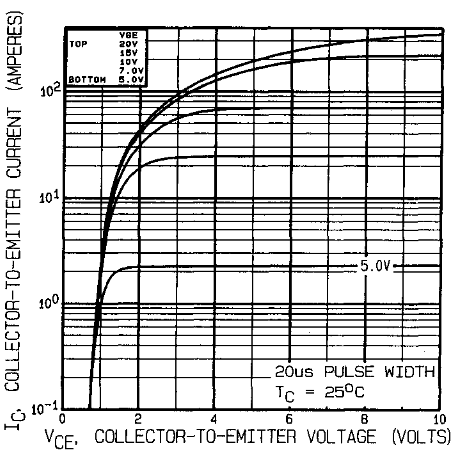


Fig. 1 — Typical Output Characteristics, T_C = 25°C

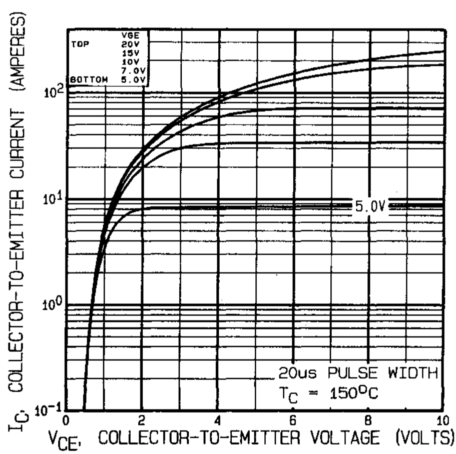


Fig. 2 — Typical Output Characteristics, T_C = 150°C

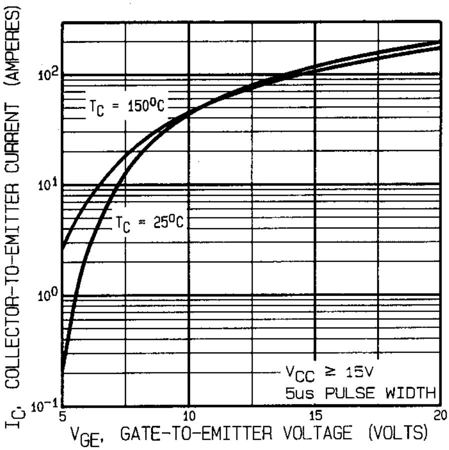


Fig. 3 — Typical Transfer Characteristics

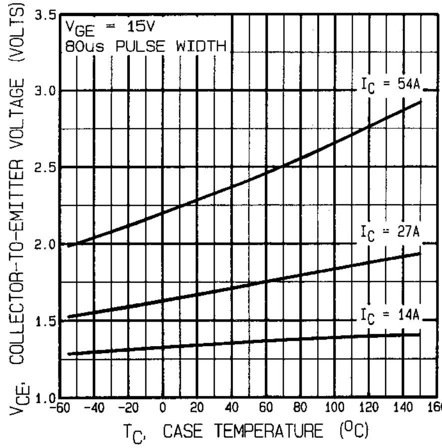


Fig. 4 — Collector-to-Emitter Saturation Voltage vs. Case Temperature

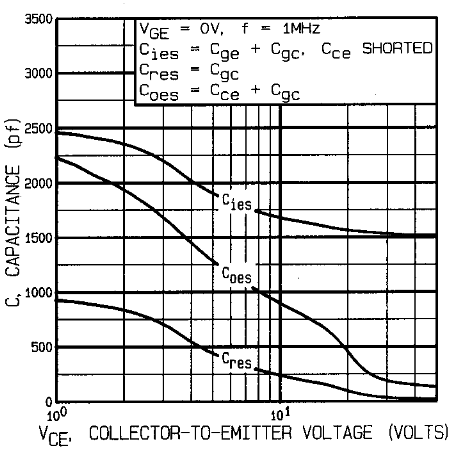


Fig. 5 — Typical Capacitance vs. Collector-to-Emitter Voltage

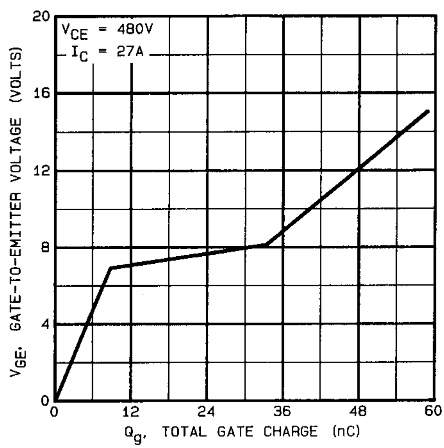


Fig. 6 — Typical Gate Charge vs. Gate-to-Emitter Voltage

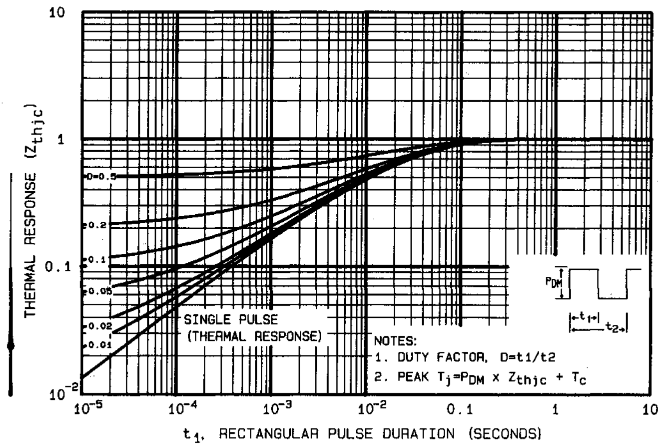


Fig. 7 — Maximum Effective Transient Thermal Impedance, Junction-to-Case

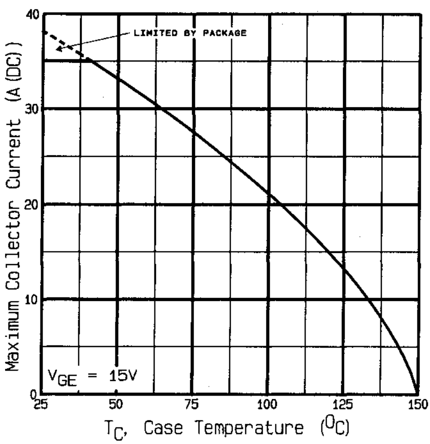


Fig. 8 — Maximum Collector Current vs. Case Temperature

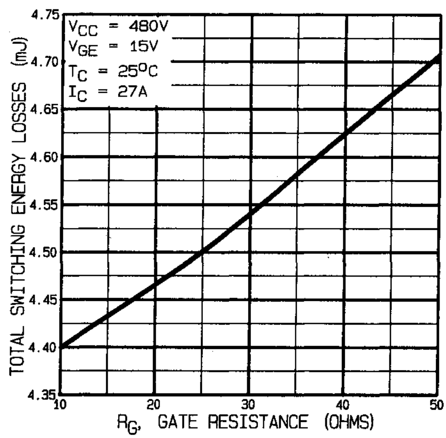


Fig. 9 — Typical Switching Losses vs. Gate Resistance

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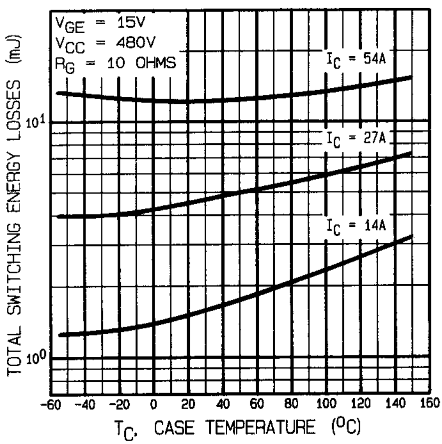


Fig. 10 — Typical Switching Losses vs. Case Temperature

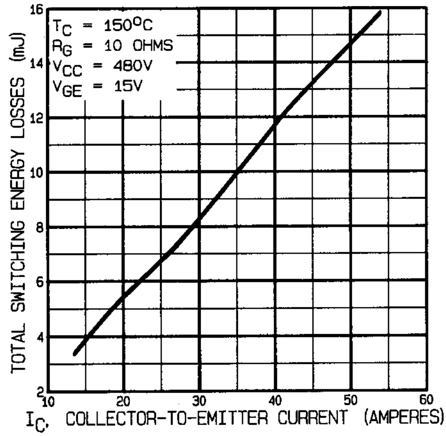


Fig. 11 — Typical Switching Losses vs. Collector-to-Emitter Current

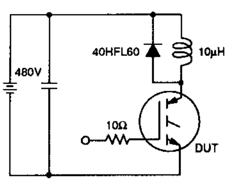


Fig 12a. Clamped Inductive Load Test Circuit

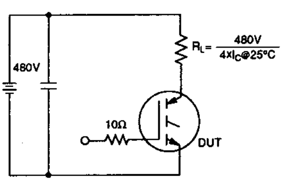


Fig 12b. Pulsed Collector Current Test Circuit

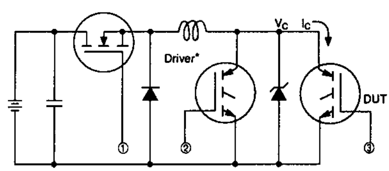


Fig 13a. Switching Loss Test Circuit

* Driver same type as DUT, V_C = 480V

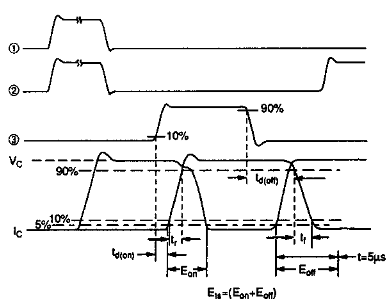


Fig 13b. Switching Loss Waveforms

For both, power dissipation = 29W

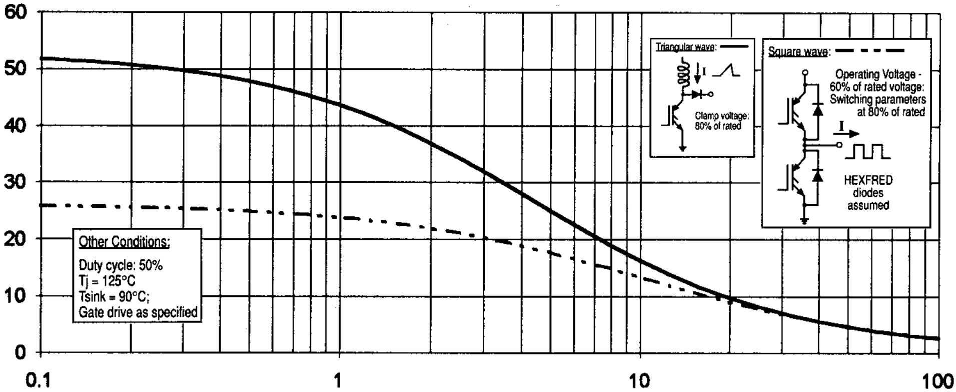
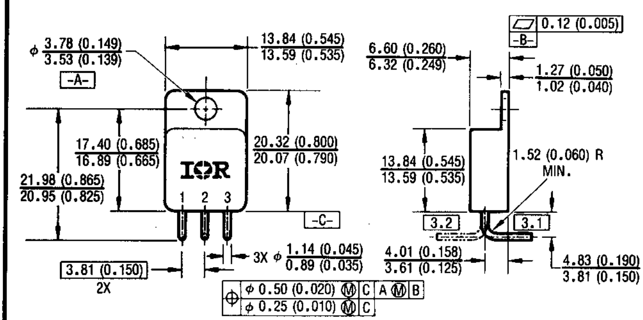


Fig. 14 — Typical Load Current vs. Frequency
(For square wave, $I = I_{RMS}$ of fundamental; for triangular wave, $I = I_{PK}$)



NOTES:
1. DIMENSIONING & TOLERANCING PER ANSI Y14.5M - 1982.
2. ALL DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES).
3. LEADFORM IS AVAILABLE IN EITHER ORIENTATION:
   - 3.1 EXAMPLE: IRGMC40FD
   - 3.2 EXAMPLE: IRGMC40FU

LEGEND
1. COLLECTOR
2. EMITTER
3. GATE

BERYLLIA WARNING PER MIL-S-19500
Packages containing beryllia shall not be ground, sandblasted, machined, or have other operations performed on them which will produce beryllia or beryllium dust. Furthermore, beryllium oxide packages shall not be placed in acids that will produce fumes containing beryllium.

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Fig. 15 – Optional Leadforms for Outline TO-254