IGT™ TRANSISTORS

Insulated Gate Bipolar Transistor

IGT6D20,E20

20 AMPERES
400, 500 VOLTS
EQUIV. $R_{DS(ON)}$ = 0.12 Ω

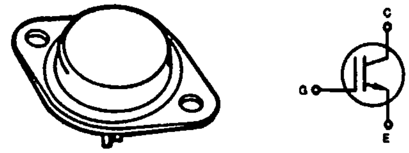
This IGT™ Transistor (Insulated Gate Bipolar Transistor) is a new type of MOS-gate turn on/off power switching device combining the best advantages of power MOSFETS and bipolar transistors. The result is a device that has the high input impedance of MOSFETS and the low on-state conduction losses similar to bipolar transistors. The device design and gate characteristics of the IGT™ Transistor are also similar to power MOSFETS. An important difference is the equivalent $R_{DS(ON)}$ drain resistance which is modulated to a low value (10 times lower) when the gate is turned on. The much lower on-state voltage drop also varies only moderately between 25°C and 150°C offering extended power handling capability.

The IGT™ Transistor is ideal for many high voltage switching applications operating at low frequencies and where low conduction losses are essential, such as; AC and DC motor controls, power supplies and drivers for solenoids, relays and contactors.

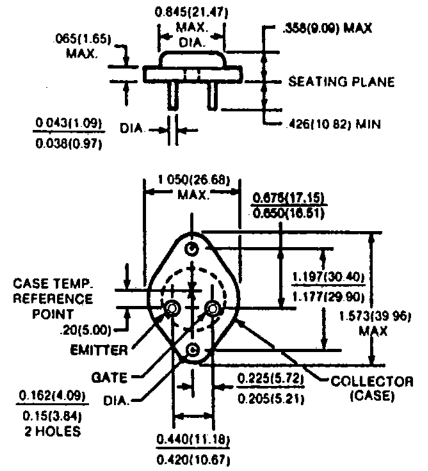
Features:

- Low $V_{CE(SAT)}$ — 2.3V typ @ 20A
- Ultra-fast turn-on — 200 ns typical
- Polysilicon MOS gate — Voltage controlled turn on/off
- High current handling — 20 amps @ 100°C

N-CHANNEL



CASE STYLE TO-204AA (TO-3)
DIMENSIONS ARE IN INCHES AND (MILLIMETERS)



maximum ratings (T_C = 25°C) (unless otherwise specified)

RATING	SYMBOL	IGT6D20	IGT6E20	UNITS
Collector-Emitter Voltage, V_{GE} = 0V	V_{CES}	400	500	Volts
Collector-Gate Voltage, R_{GE} = 1MΩ	V_{CGR}	400	500	Volts
Continuous Drain Current @ T_C = 100°C @ T_C = 25°C	I_C	20 32	20 32	A A
Pulsed Collector Current(1)	I_{CM}	80	80	A
Gate-Emitter Voltage	V_{GE}	±25	±25	Volts
Total Power Dissipation @ T_C = 25°C Derate Above 25°C	P_D	125 1.0	125 1.0	Watts W/°C
Operating and Storage Junction Temperature Range	T_J, T_{STG}	-55 to 150	-55 to 150	°C

thermal characteristics

Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.0	1.0	°C/W
Maximum Lead Temperature for Soldering Purposes: ⅛" from Case for 5 Seconds	T_L	260	260	°C

(1) Repetitive Rating: Pulse width limited by max. junction temperature.

electrical characteristics (T_C = 25° C) (unless otherwise specified)

CHARACTERISTIC		SYMBOL	MIN	TYP	MAX	UNIT

off characteristics

CHARACTERISTIC		SYMBOL	MIN	TYP	MAX	UNIT
Collector-Emitter Breakdown Voltage (V_{GE} = 0V, I_C = 250μA)	IGT6D20 IGT6E20	BV_{CES}	400 500	— —	— —	Volts
Collector Cut-off Current (V_{CE} = Max Rating, V_{GE} = 0V, T_C = 25°C) (V_{CE} = Max Rating, × 0.8, V_{GE} = 0V, T_C = 125°C)(2)		I_{CES}	— —	— —	250 4.0	μA mA
Gate-Emitter Leakage Current (V_{GE} = ±20V)		I_{GES}	—	—	±500	nA

(2) Applies for 4° C per watt maximum thermal resistance, case to ambient.

on characteristics(3)

CHARACTERISTIC		SYMBOL	MIN	TYP	MAX	UNIT
Gate Threshold Voltage (V_{CE} = V_{GE}, I_C = 500μA)	T_C = 25°C T_C = 150°C	$V_{GE(TH)}$	2 —	4 2	5 —	Volts
Collector-Emitter Saturation Voltage I_C = 20 A, T_C = 25°C, V_{GE} = 15V I_C = 20 A, T_C = 150°C, V_{GE} = 15V I_C = 20 A, T_C = 25°C, V_{GE} = 10V		$V_{CE(SAT)}$	— — —	2.3 2.4 2.8	2.4 — —	Volts

dynamic characteristics

CHARACTERISTIC		SYMBOL	MIN	TYP	MAX	UNIT
Input Capacitance	V_{GE} = 0V	C_{ies}	—	2300	—	pF
Output Capacitance	V_{CE} = 25V	C_{oes}	—	700	—	pF
Reverse Transfer Capacitance	f = 1 MHz	C_{res}	—	10	—	pF

switching characteristics(3) (see figures 8 & 9)

CHARACTERISTIC		SYMBOL	MIN	TYP	MAX	UNIT
Turn-on Delay Time	Resistive Load; T_C = 150°C	$t_{d(on)}$	—	100	—	ns
Rise Time	I_C = 20A, V_{CE} = Rated V_{CES}	t_r	—	200	—	ns
Turn-off Delay Time	V_{GE} = 15V	$t_{d(off)}$	—	0.65	—	μs
Fall Time	$R_{G(on)}$ = 50Ω, R_{GE} = 100Ω	t_f	—	5.0	—	μs
Turn-off Delay Time	Inductive Load, T_C = 150°C, L = 550μH, I_C = 20A,	$t_{d(off)}$	—	1.0	1.5	μs
Fall Time	$V_{CE(CLAMP)}$ = Rated V_{CES}	t_f	—	4.5	6.5	μs
Equivalent Fall Time	V_{GE} = 15V	$t_{f(eq)}$	—	3.5	5.0	μs
Turn-off Switching Losses	$R_{G(on)}$ = 50Ω, R_{GE} = 100Ω IGT6D20 IGT6E20	E_f	—	14 17.5	20 25	mJ

(3) Pulse test; Pulse widths ≤ 300 μsec, duty cycle ≤ 2%.

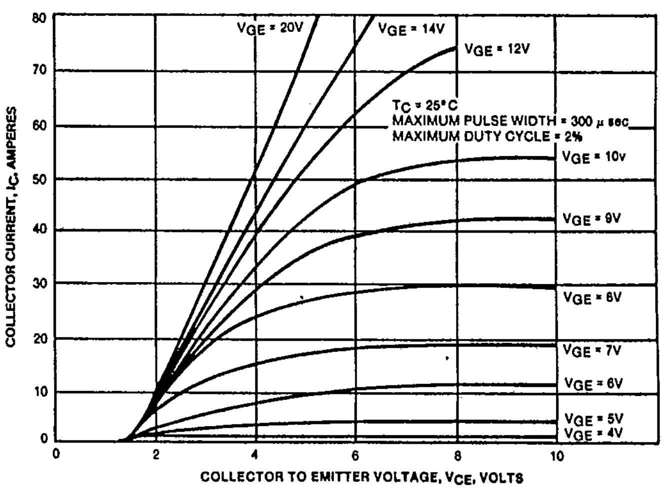


FIGURE 1. TYPICAL OUTPUT CHARACTERISTICS

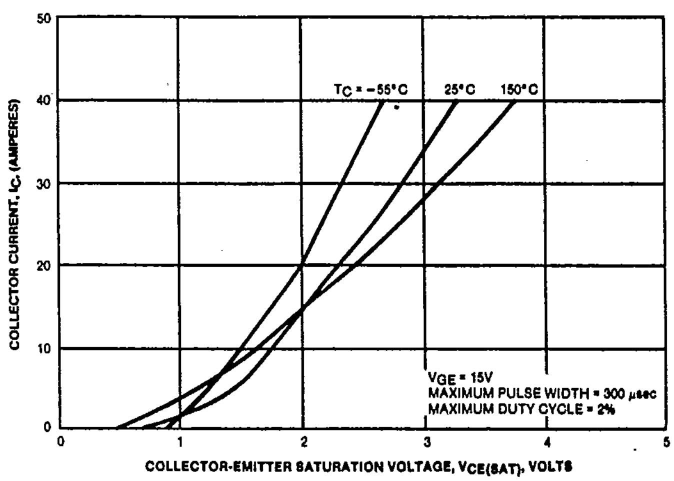


FIGURE 2. TYPICAL COLLECTOR-EMITTER SATURATION VOLTAGE

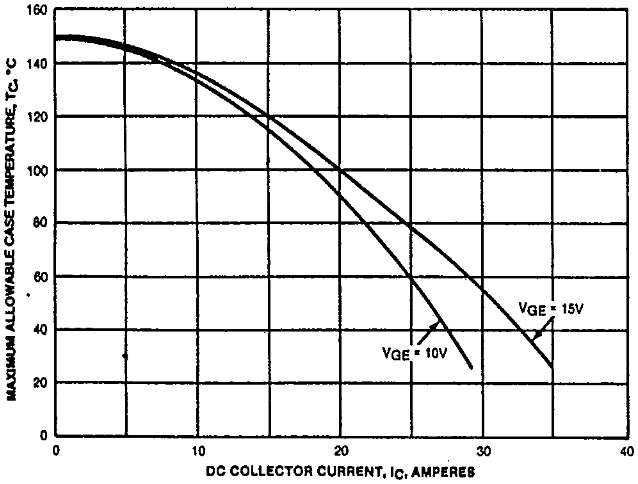


FIGURE 3. MAXIMUM ALLOWABLE CASE TEMPERATURE VS. DC COLLECTOR CURRENT

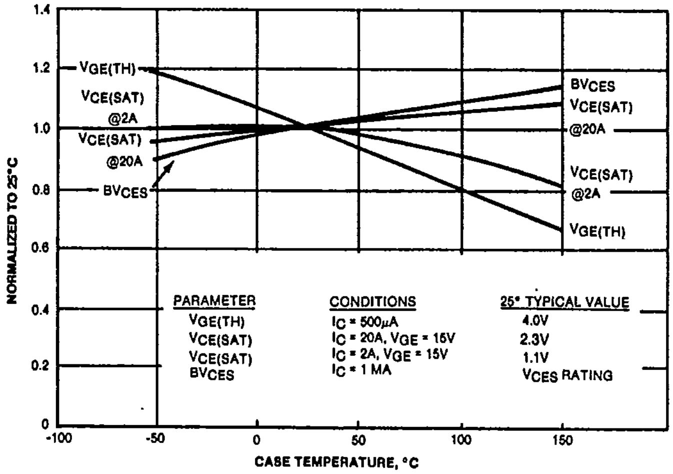


FIGURE 4. TYPICAL TEMPERATURE DEPENDENCE OF PARAMETERS

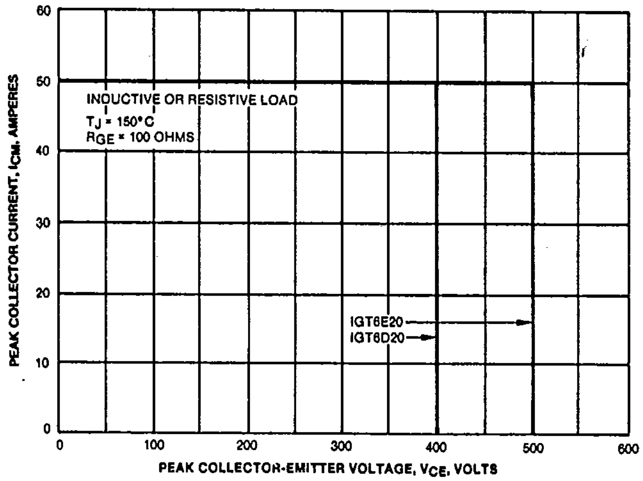


FIGURE 5. TURN-OFF SAFE OPERATING AREA

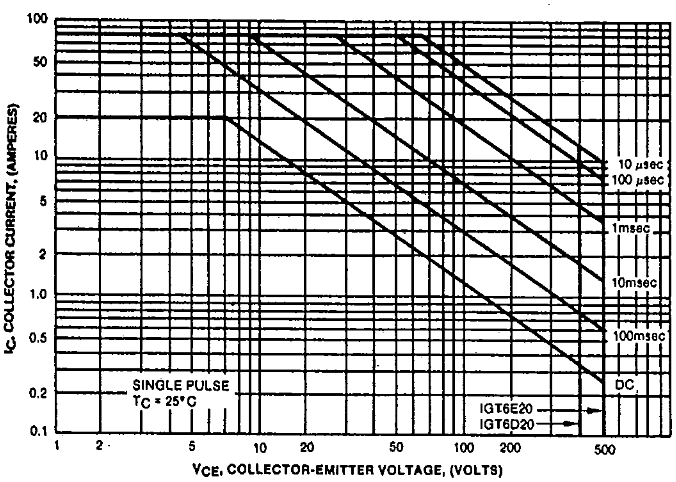


FIGURE 6. TURN-ON SAFE OPERATING AREA

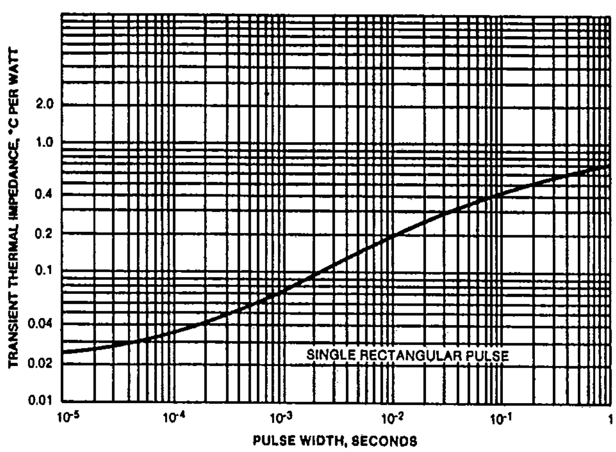
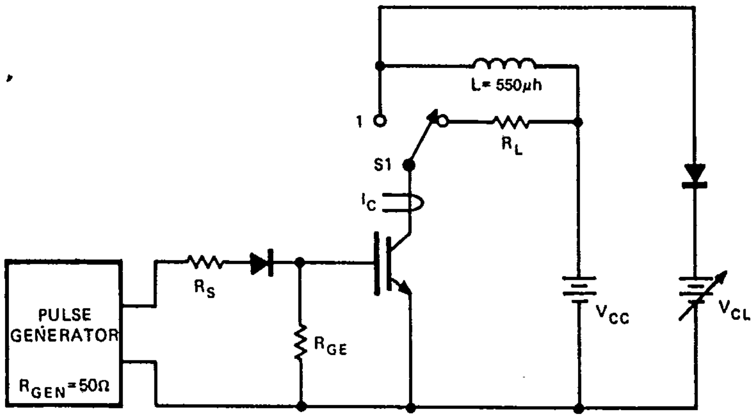


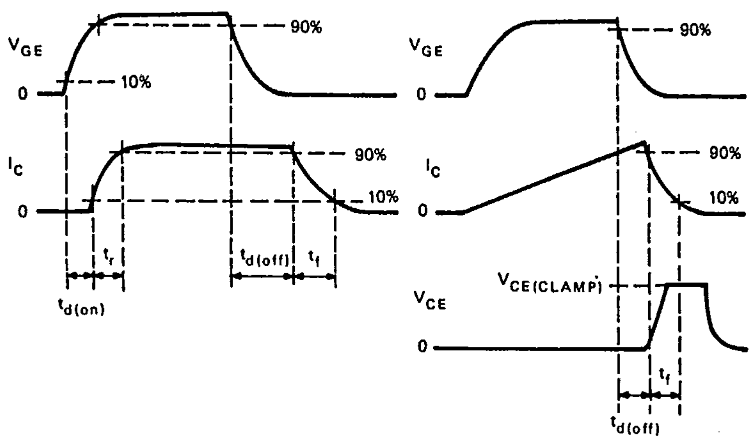
FIGURE 7. MAXIMUM TRANSIENT THERMAL IMPEDANCE



S1 (SWITCH POSITION) –1 CLAMPED INDUCTIVE LOAD
–2 RESISTIVE LOAD

$R_{G(ON)} = \frac{(R_{GEN}+R_S)(R_{GE})}{R_{GEN}+R_S+R_{GE}}$, PULSE WIDTH ≥ 60μsec, $V_{CC} = \frac{L \cdot I_{C\,(MAXIMUM)}}{\text{PULSE WIDTH}}$

FIGURE 8. BASIC SWITCHING TEST CIRCUIT



RESISTIVE LOAD INDUCTIVE LOAD

(WAVEFORMS NOT TO SCALE)

FIGURE 9. SWITCHING WAVEFORMS