



# IGT™ TRANSISTORS

## Insulated Gate Bipolar Transistor

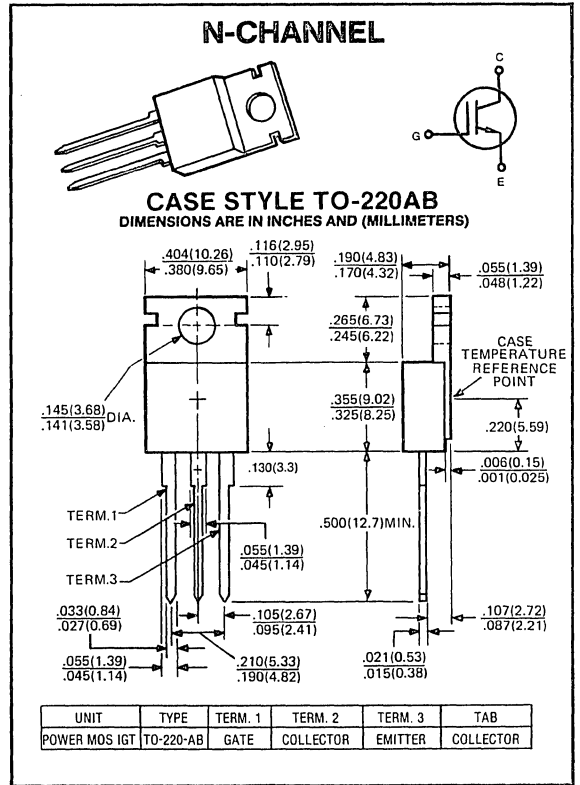
<b>IGT4D10,E10</b>
<b>10 AMPERES</b>
<b>400, 500 VOLTS</b>
<b>EQUIV. R<sub>DS(ON)</sub> = 0.27 Ω</b>

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<sub>DS(ON)</sub> 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<sub>CE(SAT)</sub> — 2.5V typ @ 10A
- Ultra-fast turn-on — 150 ns typical
- Polysilicon MOS gate — Voltage controlled turn on/off
- High current handling — 10 amps @ 100°C



maximum ratings (T<sub>C</sub> = 25°C) (unless otherwise specified)

RATING	SYMBOL	IGT4D10	IGT4E10	UNITS
Collector-Emitter Voltage, V <sub>GE</sub> = 0V	V <sub>CES</sub>	400	500	Volts
Collector-Gate Voltage, R <sub>GE</sub> = 1MΩ	V <sub>CGR</sub>	400	500	Volts
Continuous Drain Current @ T <sub>C</sub> = 100°C @ T <sub>C</sub> = 25°C	I <sub>C</sub>	10 18	10 18	A A
Pulsed Collector Current <sup>(1)</sup>	I <sub>CM</sub>	40	40	A
Gate-Emitter Voltage	V <sub>GE</sub>	±25	±25	Volts
Total Power Dissipation @ T <sub>C</sub> = 25°C Derate Above 25°C	P <sub>D</sub>	75 0.6	75 0.6	Watts W/°C
Operating and Storage Junction Temperature Range	T <sub>J</sub> , T <sub>STG</sub>	-55 to 150	-55 to 150	°C

### thermal characteristics

Thermal Resistance, Junction to Case	R <sub>θJC</sub>	1.67	1.67	°C/W
Maximum Lead Temperature for Soldering Purposes: 1/8" from Case for 5 Seconds	T <sub>L</sub>	260	260	°C

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

electrical characteristics ( $T_C = 25^\circ\text{C}$ ) (unless otherwise specified)

CHARACTERISTIC	SYMBOL	MIN	TYP	MAX	UNIT
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off characteristics

Collector-Emitter Breakdown Voltage ( $I_C = 250\mu\text{A}$ , $V_{GE} = 0\text{V}$ )	IGT4D10 IGT4E10	$BV_{CES}$	400 500	— —	— —	Volts
Collector Cut-off Current ( $V_{CE} = \text{Max Rating}$ , $V_{GE} = 0\text{V}$ , $T_C = 25^\circ\text{C}$ ) ( $V_{CE} = \text{Max Rating}$ , $\times 0.8$ , $V_{GE} = 0\text{V}$ , $T_C = 150^\circ\text{C}$ ) <sup>1</sup>		$I_{CES}$	— —	— —	250 4.0	$\mu\text{A}$ mA
Gate-Emitter Leakage Current ( $V_{GE} = \pm 20\text{V}$ )		$I_{GES}$	—	—	$\pm 500$	nA

<sup>1</sup> Applies for  $3.3^\circ\text{C}$  per watt maximum thermal resistance, case to ambient.

on characteristics\*

Gate Threshold Voltage ( $V_{CE} = V_{GE}$ , $I_C = 250\mu\text{A}$ )	$T_C = 25^\circ\text{C}$ $T_C = 150^\circ\text{C}$	$V_{GE(TH)}$	2 —	4.0 2.5	5 —	Volts
Collector-Emitter Saturation Voltage $I_C = 10\text{A}$ , $T_C = 25^\circ\text{C}$ , $V_{GE} = 15\text{V}$ $I_C = 10\text{A}$ , $T_C = 150^\circ\text{C}$ , $V_{GE} = 15\text{V}$ $I_C = 10\text{A}$ , $T_C = 25^\circ\text{C}$ , $V_{GE} = 10\text{V}$		$V_{CE(SAT)}$	— — —	2.5 2.8 2.9	2.7 — —	Volts

dynamic characteristics

Input Capacitance	$V_{GE} = 0\text{V}$	$C_{ies}$	—	1050	—	pF
Output Capacitance	$V_{CE} = 25\text{V}$	$C_{oes}$	—	340	—	pF
Reverse Transfer Capacitance	$f = 1\text{MHz}$	$C_{res}$	—	10	—	pF

switching characteristics\* (see figures 8 & 9)

Turn-on Delay Time	Resistive Load, $T_C = 150^\circ\text{C}$ $I_C = 10\text{A}$ , $V_{CE} = \text{Rated } V_{CES}$	$t_{d(on)}$	—	100	—	ns
Rise Time		$t_r$	—	150	—	ns
Turn-off Delay Time	$V_{GE} = 15\text{V}$ $R_{G(on)} = 50\Omega$ , $R_{GE} = 100\Omega$	$t_{d(off)}$	—	0.5	—	$\mu\text{s}$
Fall Time		$t_f$	—	4	—	$\mu\text{s}$
Turn-off Delay Time	Inductive Load, $T_C = 150^\circ\text{C}$ , $L = 550\mu\text{H}$ , $I_C = 10\text{A}$ , $V_{CE(CLAMP)} = \text{Rated } V_{CES}$	$t_{d(off)}$	—	1.0	1.5	$\mu\text{s}$
Fall Time		$t_f$	—	4.5	6.5	$\mu\text{s}$
Equivalent Fall Time	$V_{GE} = 15\text{V}$	$t_{f(eq)}$	—	3.5	5.0	$\mu\text{s}$
Turn-off Switching Losses	$R_{G(on)} = 50\Omega$ , $R_{GE} = 100\Omega$	IGT4D10 IGT4E10	$E_f$	—	10 12.5	mJ

\*Pulse test: Pulse width  $\leq 300\mu\text{sec}$ , duty cycle  $\leq 2\%$ .

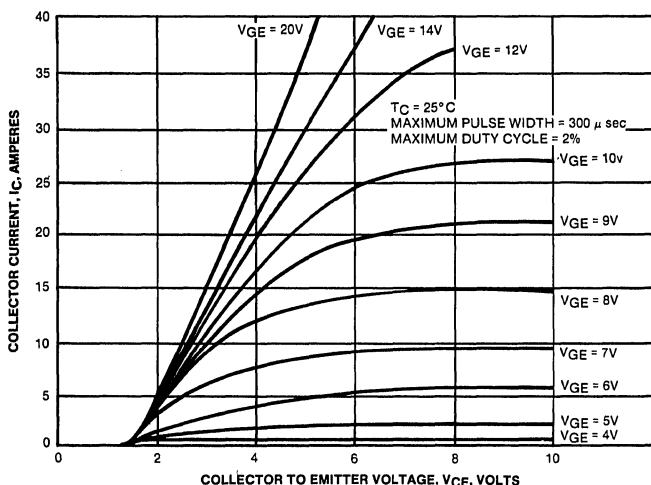


FIGURE 1. TYPICAL OUTPUT CHARACTERISTICS

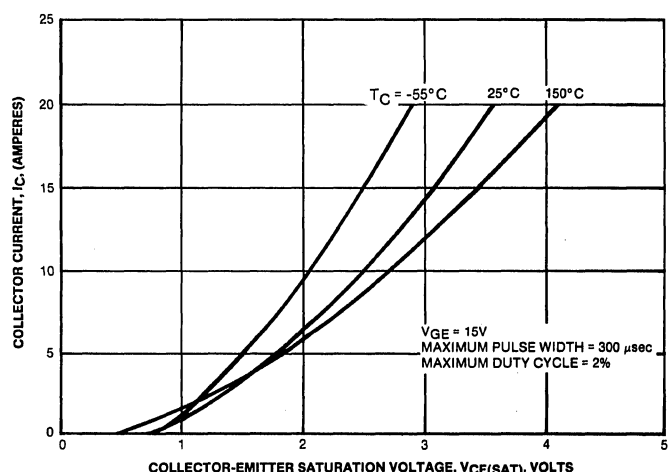


FIGURE 2. TYPICAL COLLECTOR-EMITTER SATURATION VOLTAGE

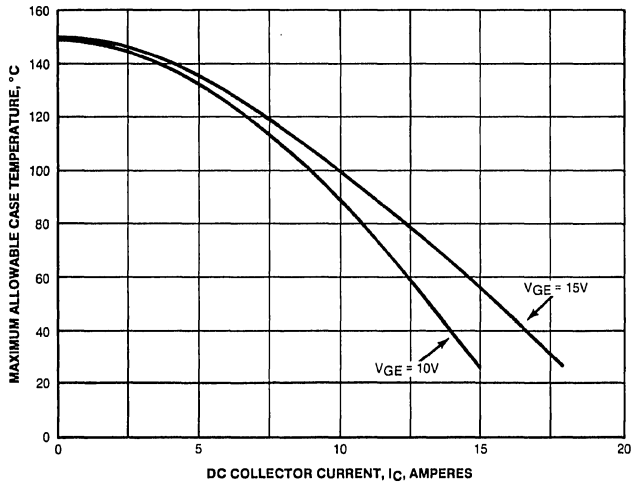


FIGURE 3. MAXIMUM ALLOWABLE CASE TEMPERATURE VS. DC COLLECTOR CURRENT

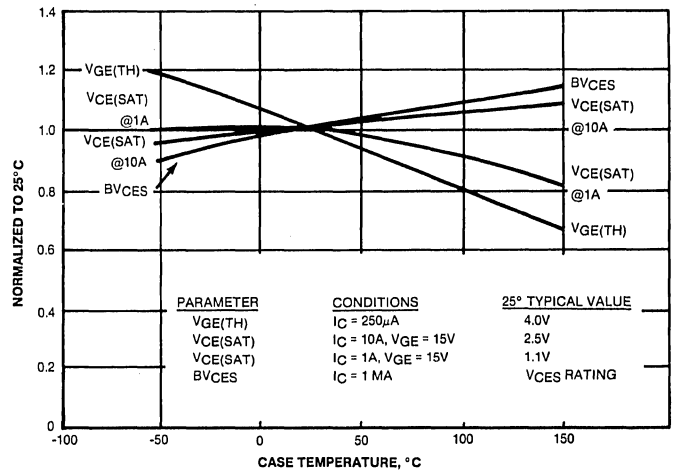


FIGURE 4. TYPICAL TEMPERATURE DEPENDENCE OF PARAMETERS

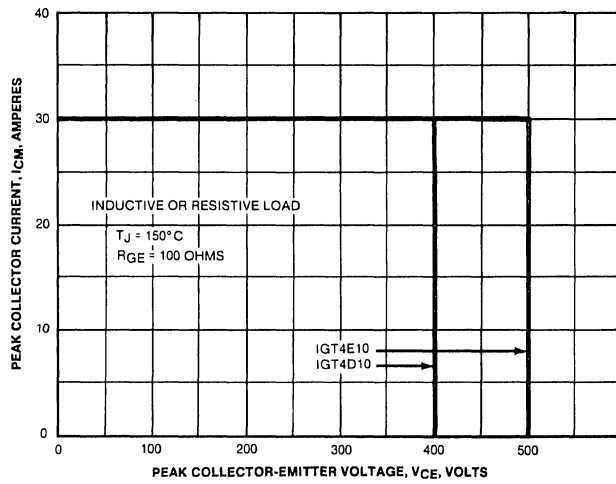


FIGURE 5. TURN-OFF SAFE OPERATING AREA

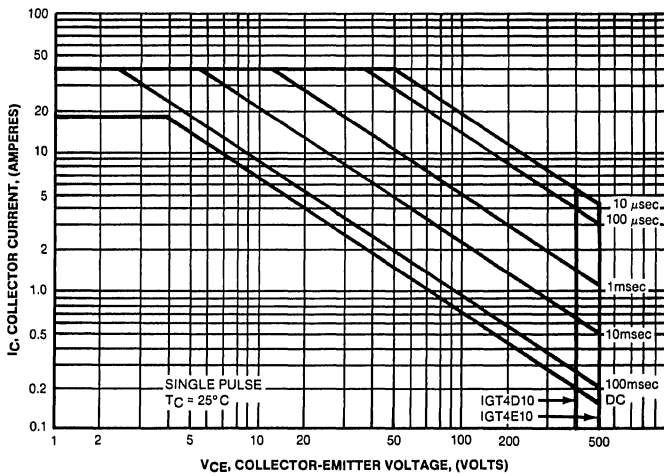


FIGURE 6. TURN-ON SAFE OPERATING AREA

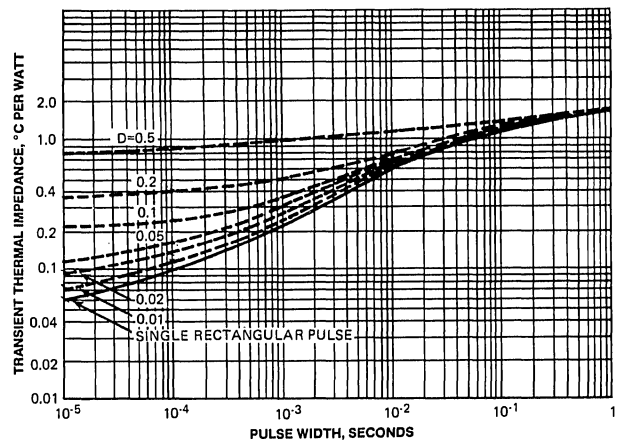
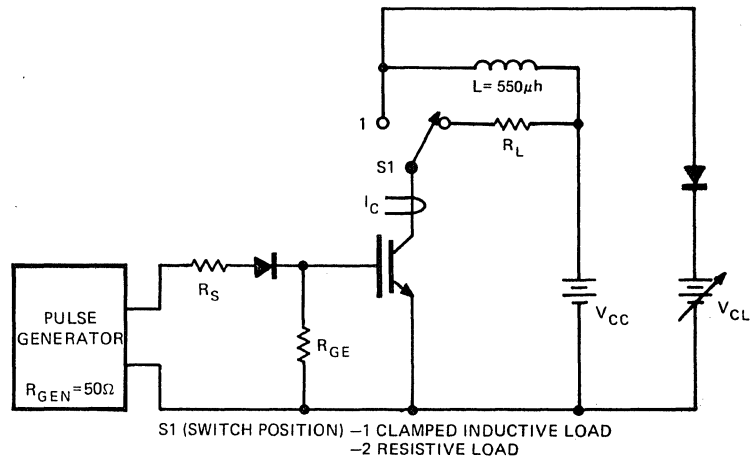
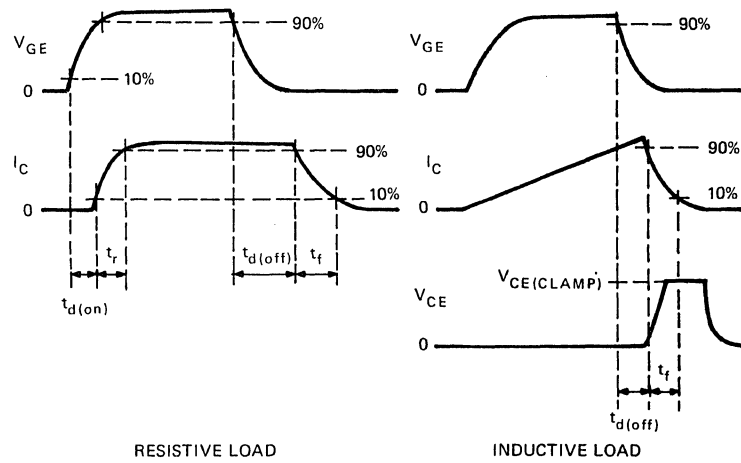


FIGURE 7. MAXIMUM TRANSIENT THERMAL IMPEDANCE



$$R_{G(ON)} = \frac{(R_{GEN} + R_S)(R_{GE})}{R_{GEN} + R_S + R_{GE}}, \text{ PULSE WIDTH} \geq 60 \mu\text{sec}, V_{CC} = \frac{L \cdot I_C (\text{MAXIMUM})}{\text{PULSE WIDTH}}$$

**FIGURE 8. BASIC SWITCHING TEST CIRCUIT**



(WAVEFORMS NOT TO SCALE)

**FIGURE 9. SWITCHING WAVEFORMS**