



# IGT™ TRANSISTORS

## Insulated Gate Bipolar Transistor

**IGT8D21, E21**

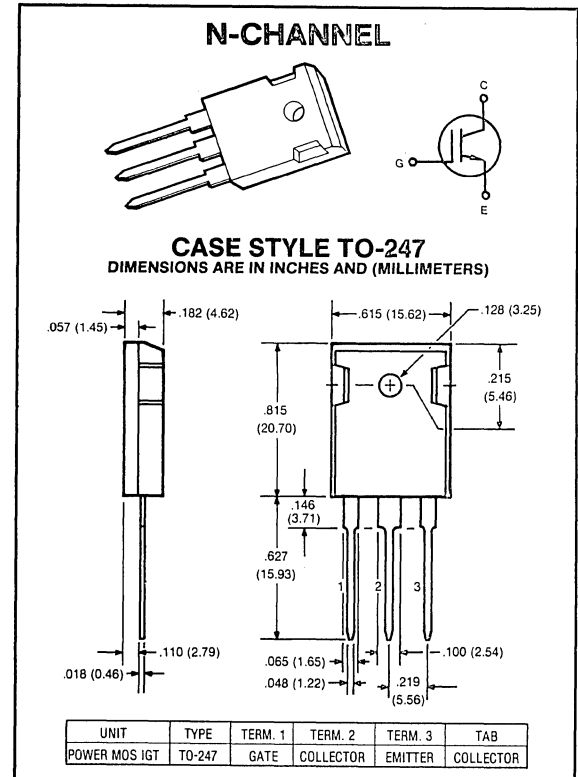
**20 AMPERES  
400, 500 VOLTS  
EQUIV. R<sub>DS(ON)</sub> = 0.145 Ω**

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<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 @ 20A
- Ultra-fast turn-on — 150 ns typical
- Polysilicon MOS gate — Voltage controlled turn on/off
- High current handling — 20 amps @ 90° C



maximum ratings ( $T_C = 25^\circ C$ ) (unless otherwise specified)

RATING	SYMBOL	IGT8D21	IGT8E21	UNITS
Collector-Emitter Voltage, $V_{GE} = 0V$	$V_{CES}$	400	500	Volts
Collector-Gate Voltage, $R_{GE} = 1M\Omega$	$V_{CGR}$	400	500	Volts
Continuous Drain Current @ $T_C = 90^\circ C$ @ $T_C = 25^\circ C$	$I_C$	20 32	20 32	A A
Pulsed Collector Current <sup>(1)</sup>	$I_{CM}$	80	80	A
Gate-Emitter Voltage	$V_{GE}$	$\pm 25$	$\pm 25$	Volts
Total Power Dissipation @ $T_C = 25^\circ C$ 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: 1/8" from Case for 5 Seconds	$T_L$	260	260	°C

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

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

CHARACTERISTIC	SYMBOL	MIN	TYP	MAX	UNIT
Collector-Emitter Breakdown Voltage ( $V_{GE} = 0\text{V}$ , $I_C = 250\mu\text{A}$ )	IGT8D21 IGT8E21 $BV_{CES}$	400 500	— —	— —	Volts
Collector Cut-off Current ( $V_{CE} = \text{Max Rating}$ , $V_{GE} = 0\text{V}$ , $T_C = 25^\circ\text{C}$ ) ( $V_{CE} = \text{Max Rating}$ , $\times 0.8$ , $V_{GE} = 0\text{V}$ , $T_C = 125^\circ\text{C}$ ) <sup>(2)</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

(2) Applies for  $3.3^\circ\text{C}$  per watt maximum thermal resistance, case to ambient.

on characteristics<sup>(3)</sup>

Gate Threshold Voltage ( $V_{CE} = V_{GE}$ , $I_C = 500\mu\text{A}$ )	$T_C = 25^\circ\text{C}$ $T_C = 150^\circ\text{C}$	$V_{GE(TH)}$	2 —	4 2	5 —	Volts
Collector-Emitter Saturation Voltage $I_C = 20\text{A}$ , $T_C = 25^\circ\text{C}$ , $V_{GE} = 15\text{V}$ $I_C = 20\text{A}$ , $T_C = 150^\circ\text{C}$ , $V_{GE} = 15\text{V}$ $I_C = 20\text{A}$ , $T_C = 25^\circ\text{C}$ , $V_{GE} = 10\text{V}$		$V_{CE(SAT)}$	— — —	2.5 2.6 3.0	2.9 — —	Volts

dynamic characteristics

Input Capacitance	$V_{GE} = 0\text{V}$	$C_{ies}$	—	2300	—	pF
Output Capacitance	$V_{CE} = 25\text{V}$	$C_{oes}$	—	700	—	pF
Reverse Transfer Capacitance	$f = 1\text{MHz}$	$C_{res}$	—	10	—	pF

switching characteristics<sup>(3)</sup> (see figures 8 & 9)

Turn-on Delay Time	Resistive Load $T_C = 125^\circ\text{C}$ $I_C = 20\text{A}$ , $V_{CE} = \text{Rated } V_{CES}$ $V_{GE} = 15\text{V}$ $R_{G(on)} = 50\Omega$ , $R_{GE} = 100\Omega$	$t_{d(on)}$	—	100	—	ns
Rise Time		$t_r$	—	150	—	ns
Turn-off Delay Time		$t_{d(off)}$	—	0.60	—	$\mu\text{s}$
Fall Time		$t_f$	—	3.0	—	$\mu\text{s}$
Turn-off Delay Time	Inductive Load, $T_C = 125^\circ\text{C}$ , $L = 550\mu\text{H}$ , $I_C = 20\text{A}$ , $V_{CE(CLAMP)} = \text{Rated } V_{CES}$	$t_{d(off)}$	—	0.8	1.4	$\mu\text{s}$
Fall Time		$t_f$	—	0.8	1.0	$\mu\text{s}$
Equivalent Fall Time		$t_{f(eq)}$	—	0.6	0.8	$\mu\text{s}$
Turn-off Switching Losses	$R_{G(on)} = 50\Omega$ , $R_{GE} = 100\Omega$	IGT8D21 IGT8E21 $E_f$	—	2.6 3.2	3.2 4.0	mJ

(3) Pulse test: Pulse widths  $\leq 300\mu\text{sec}$ , duty cycle  $\leq 2\%$ .

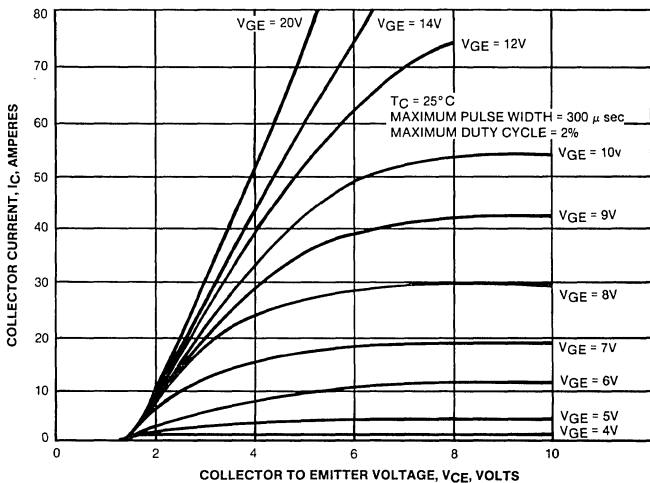


FIGURE 1. TYPICAL OUTPUT CHARACTERISTICS

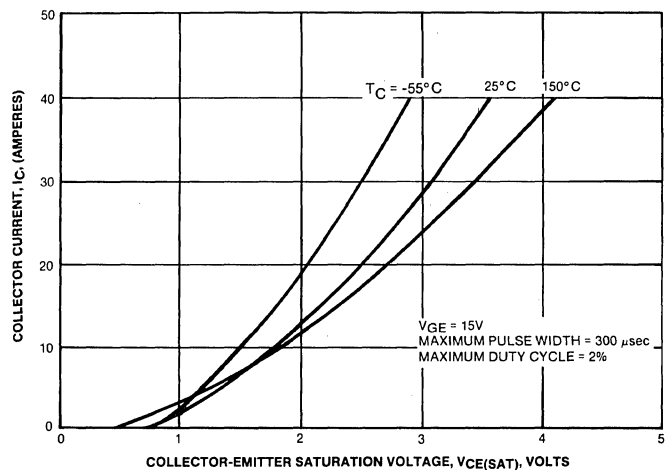
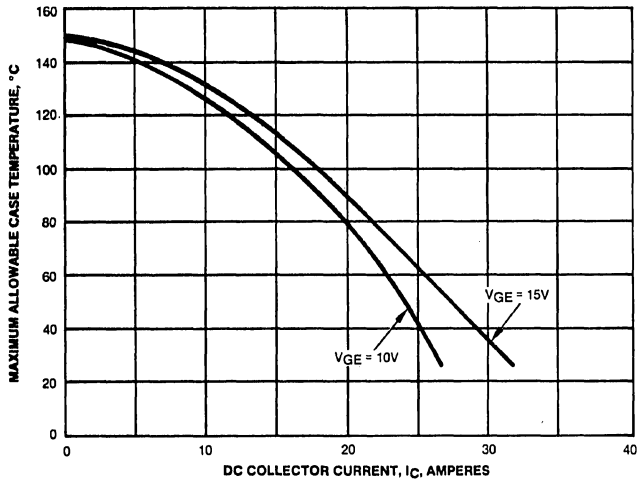
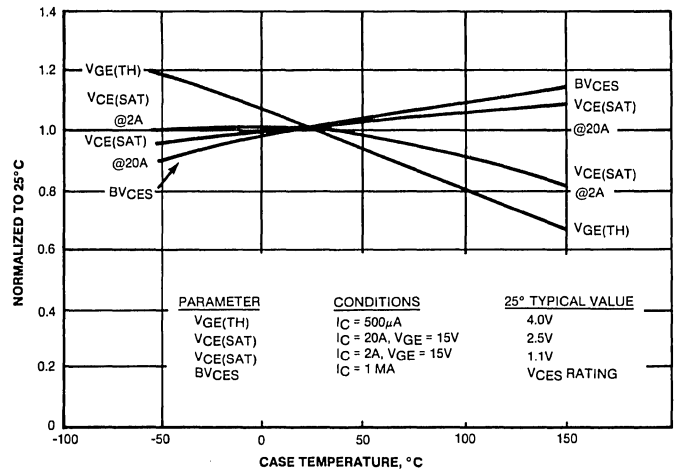


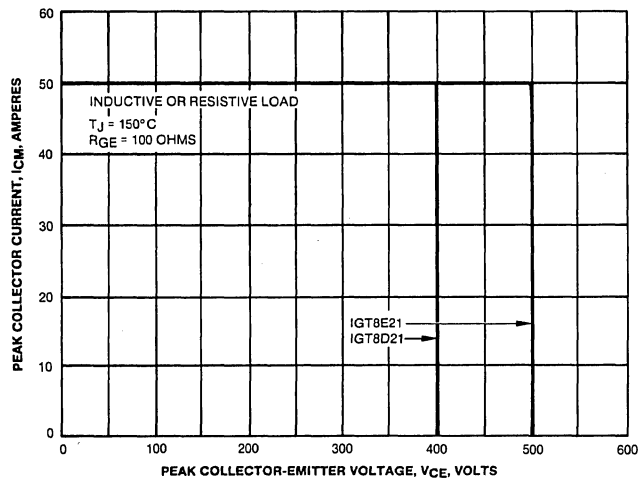
FIGURE 2. TYPICAL COLLECTOR-EMITTER SATURATION VOLTAGE



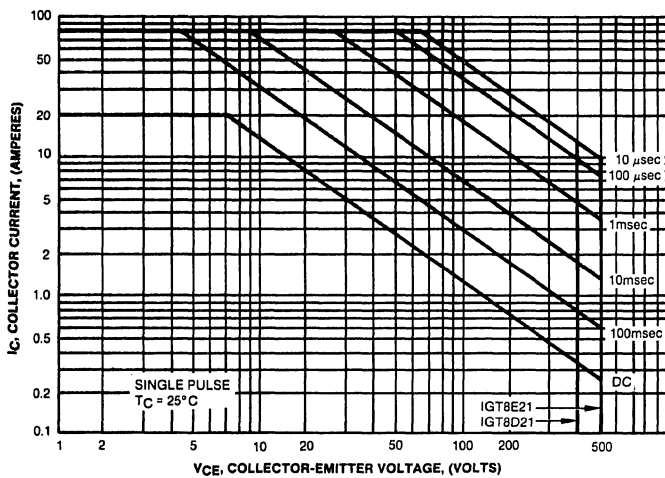
**FIGURE 3. MAXIMUM ALLOWABLE CASE TEMPERATURE VS. DC COLLECTOR CURRENT**



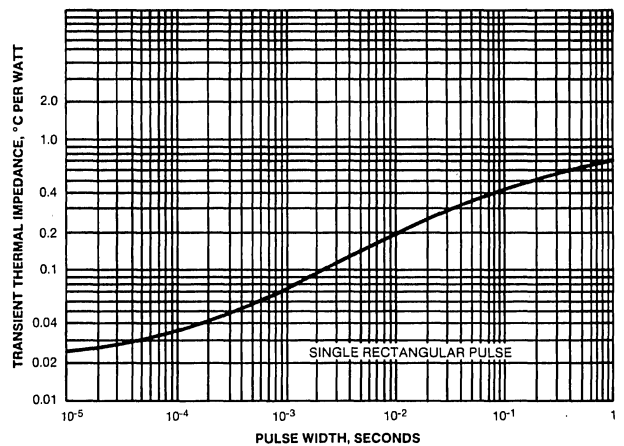
**FIGURE 4. TYPICAL TEMPERATURE DEPENDENCE OF PARAMETERS**



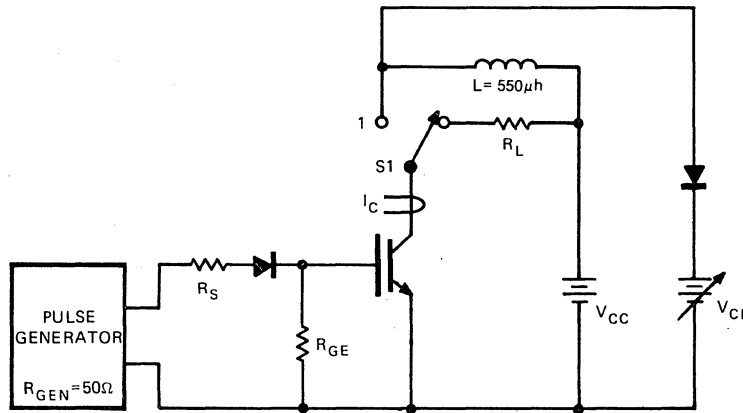
**FIGURE 5. TURN-OFF SAFE OPERATING AREA**



**FIGURE 6. TURN-ON SAFE OPERATING AREA**



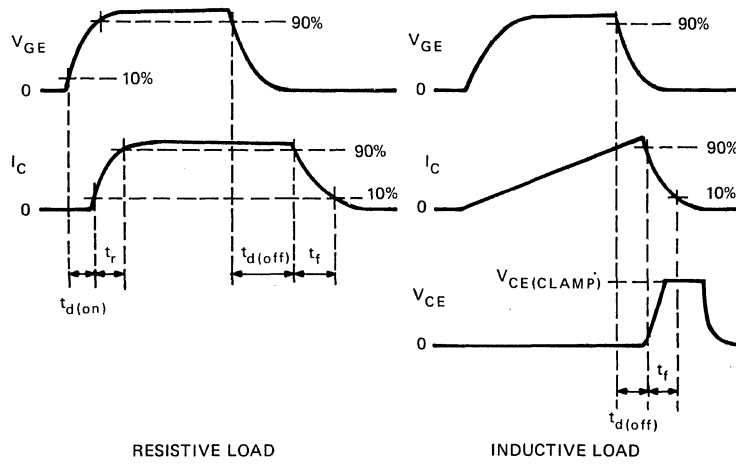
**FIGURE 7. MAXIMUM TRANSIENT THERMAL IMPEDANCE**



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

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

**FIGURE 8. BASIC SWITCHING TEST CIRCUIT**



RESISTIVE LOAD

INDUCTIVE LOAD

(WAVEFORMS NOT TO SCALE)

**FIGURE 9. SWITCHING WAVEFORMS**