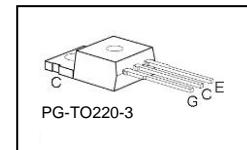
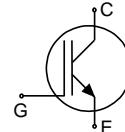


Low Loss IGBT : IGBT in TRENCHSTOP™ and Fieldstop technology


Features:

- Very low $V_{CE(sat)}$ 1.5V (typ.)
- Maximum Junction Temperature 175°C
- Short circuit withstand time 5μs
- Designed for :
 - Frequency Converters
 - Uninterrupted Power Supply
- TRENCHSTOP™ and Fieldstop technology for 600V applications offers :
 - very tight parameter distribution
 - high ruggedness, temperature stable behavior
 - very high switching speed
- Positive temperature coefficient in $V_{CE(sat)}$
- Low EMI
- Pb-free lead plating; RoHS compliant
- Qualified according to JEDEC¹ for target applications
- Complete product spectrum and PSpice Models : <http://www.infineon.com/igbt/>



Type	V_{CE}	I_C	$V_{CE(sat), T_j=25^\circ C}$	$T_{j,max}$	Marking Code	Package
IGP15N60T	600V	15A	1.5V	175°C	G15T60	PG-T0220-3

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage, $T_j \geq 25^\circ C$	V_{CE}	600	V
DC collector current, limited by $T_{j,max}$	I_C	26	A
$T_C = 25^\circ C$, value limited by bondwire		23	
$T_C = 100^\circ C$			
Pulsed collector current, t_p limited by $T_{j,max}$	I_{Cpuls}	45	
Turn off safe operating area, $V_{CE} = 600V$, $T_j = 175^\circ C$, $t_p = 1\mu s$	-	45	
Gate-emitter voltage	V_{GE}	± 20	V
Short circuit withstand time ²⁾ $V_{GE} = 15V$, $V_{CC} \leq 400V$, $T_j \leq 150^\circ C$	t_{sc}	5	μs
Power dissipation $T_C = 25^\circ C$	P_{tot}	130	W
Operating junction temperature	T_j	-40...+175	
Storage temperature	T_{stg}	-55...+150	$^\circ C$
Soldering temperature wavesoldering, 1.6 mm (0.063 in.) from case for 10s		260	

¹ J-STD-020 and JESD-022

²⁾ Allowed number of short circuits: <1000; time between short circuits: >1s.

Thermal Resistance

Parameter	Symbol	Conditions	Max. Value	Unit
Characteristic				
IGBT thermal resistance, junction – case	R_{thJC}		1.15	K/W
Thermal resistance, junction – ambient	R_{thJA}		62	

Electrical Characteristic, at $T_j = 25^\circ\text{C}$, unless otherwise specified

Parameter	Symbol	Conditions	Value			Unit
			min.	Typ.	max.	
Static Characteristic						
Collector-emitter breakdown voltage	$V_{(BR)CES}$	$V_{GE}=0\text{V}, I_C=0.2\text{mA}$	600	-	-	V
Collector-emitter saturation voltage	$V_{CE(\text{sat})}$	$V_{GE} = 15\text{V}, I_C=15\text{A}$ $T_j=25^\circ\text{C}$ $T_j=175^\circ\text{C}$	-	1.5	2.05	
Gate-emitter threshold voltage	$V_{GE(\text{th})}$	$I_C=210\mu\text{A}, V_{CE}=V_{GE}$	4.1	4.9	5.7	
Zero gate voltage collector current	I_{CES}	$V_{CE}=600\text{V}, V_{GE}=0\text{V}$ $T_j=25^\circ\text{C}$ $T_j=175^\circ\text{C}$	-	-	40	μA
Gate-emitter leakage current	I_{GES}	$V_{CE}=0\text{V}, V_{GE}=20\text{V}$	-	-	100	nA
Transconductance	g_{fs}	$V_{CE}=20\text{V}, I_C=15\text{A}$	-	8.7	-	S
Integrated gate resistor	R_{Gint}			-		Ω

Dynamic Characteristic

Input capacitance	C_{iss}	$V_{CE}=25\text{V}, V_{GE}=0\text{V}, f=1\text{MHz}$	-	860	-	pF
Output capacitance	C_{oss}		-	55	-	
Reverse transfer capacitance	C_{rss}		-	24	-	
Gate charge	Q_{Gate}	$V_{CC}=480\text{V}, I_C=15\text{A}$ $V_{GE}=15\text{V}$	-	87	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E		-	7	-	nH
Short circuit collector current ¹⁾	$I_{C(\text{SC})}$	$V_{GE}=15\text{V}, t_{SC}\leq 5\mu\text{s}$ $V_{CC} = 400\text{V}, T_j = 150^\circ\text{C}$	-	137.5	-	A

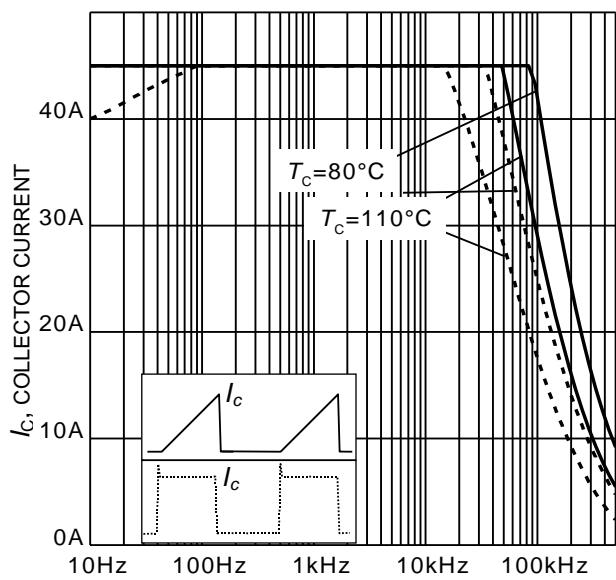
¹⁾ Allowed number of short circuits: <1000; time between short circuits: >1s.

Switching Characteristic, Inductive Load, at $T_j=25^\circ\text{C}$

Parameter	Symbol	Conditions	Value			Unit
			min.	Typ.	max.	
IGBT Characteristic						
Turn-on delay time	$t_{d(on)}$	$T_j=25^\circ\text{C}$, $V_{CC}=400\text{V}$, $I_C=15\text{A}$, $V_{GE}=0/15\text{V}$, $r_G=15\Omega$, $L_\sigma=154\text{nH}$, $C_\sigma=39\text{pF}$ L_σ , C_σ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	17	-	ns
Rise time	t_r		-	11	-	
Turn-off delay time	$t_{d(off)}$		-	188	-	
Fall time	t_f		-	50	-	
Turn-on energy	E_{on}		-	0.22	-	mJ
Turn-off energy	E_{off}		-	0.35	-	
Total switching energy	E_{ts}		-	0.57	-	

Switching Characteristic, Inductive Load, at $T_j=175^\circ\text{C}$

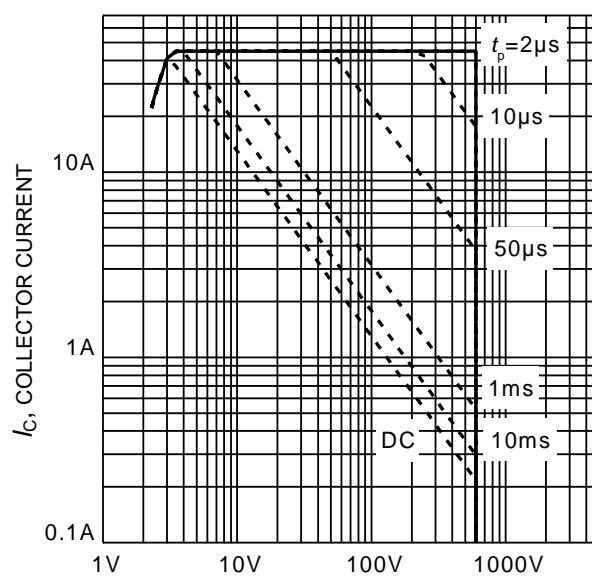
Parameter	Symbol	Conditions	Value			Unit
			min.	Typ.	max.	
IGBT Characteristic						
Turn-on delay time	$t_{d(on)}$	$T_j=175^\circ\text{C}$, $V_{CC}=400\text{V}$, $I_C=15\text{A}$, $V_{GE}=0/15\text{V}$, $r_G=15\Omega$, $L_\sigma=154\text{nH}$, $C_\sigma=39\text{pF}$ L_σ , C_σ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	17	-	ns
Rise time	t_r		-	15	-	
Turn-off delay time	$t_{d(off)}$		-	212	-	
Fall time	t_f		-	79	-	
Turn-on energy	E_{on}		-	0.34	-	mJ
Turn-off energy	E_{off}		-	0.47	-	
Total switching energy	E_{ts}		-	0.81	-	



f , SWITCHING FREQUENCY

Figure 1. Collector current as a function of switching frequency

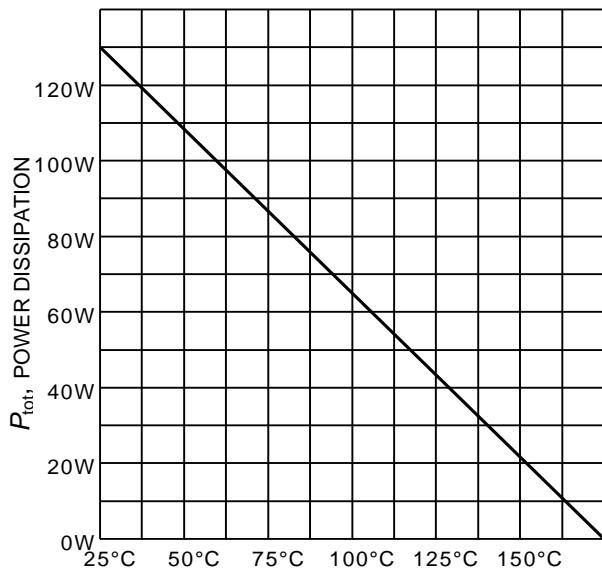
($T_j \leq 175^\circ\text{C}$, $D = 0.5$, $V_{\text{CE}} = 400\text{V}$,
 $V_{\text{GE}} = 0/15\text{V}$, $r_G = 15\Omega$)



V_{CE} , COLLECTOR-EMITTER VOLTAGE

Figure 2. Safe operating area

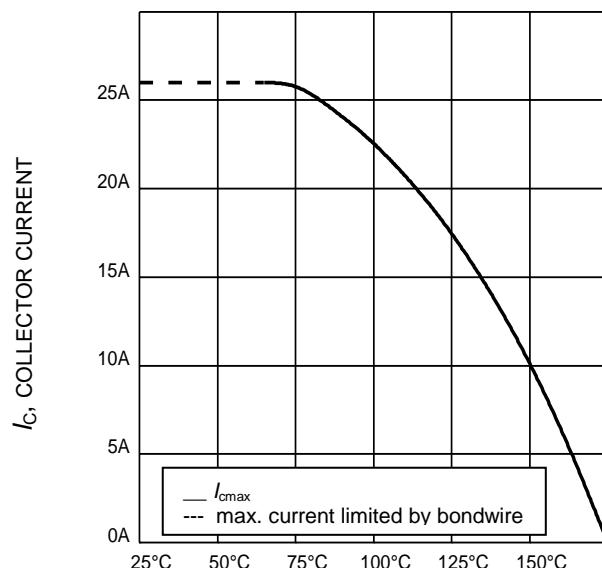
($D = 0$, $T_c = 25^\circ\text{C}$, $T_j \leq 175^\circ\text{C}$;
 $V_{\text{GE}}=0/15\text{V}$)



T_c , CASE TEMPERATURE

Figure 3. Power dissipation as a function of case temperature

($T_j \leq 175^\circ\text{C}$)



T_c , CASE TEMPERATURE

Figure 4. Collector current as a function of case temperature

($V_{\text{GE}} \geq 15\text{V}$, $T_j \leq 175^\circ\text{C}$)

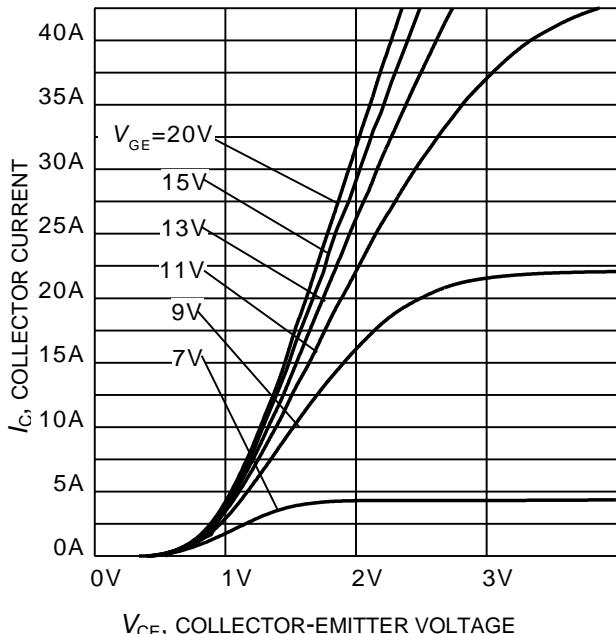


Figure 5. Typical output characteristic
($T_j = 25^\circ\text{C}$)

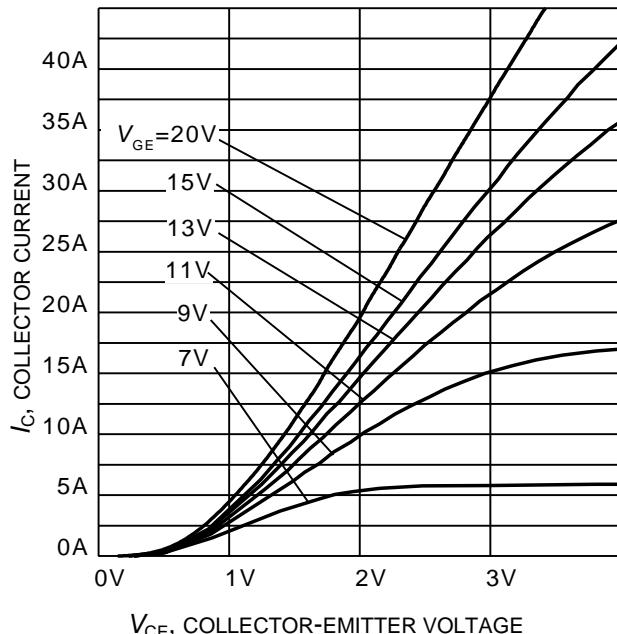


Figure 6. Typical output characteristic
($T_j = 175^\circ\text{C}$)

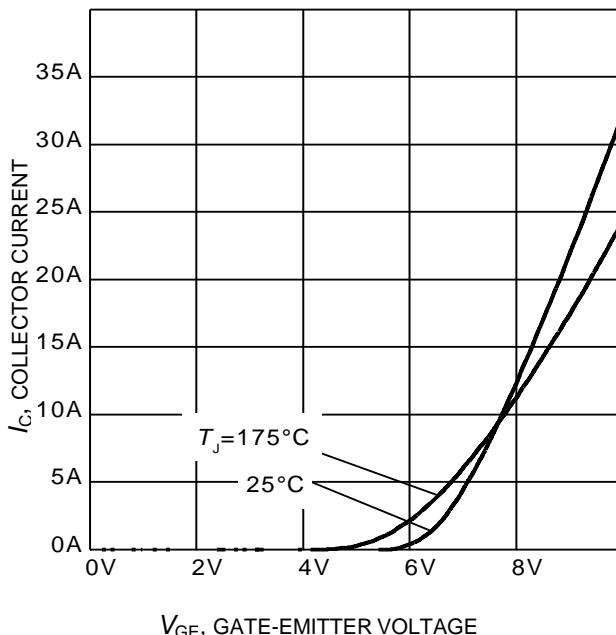


Figure 7. Typical transfer characteristic
($V_{CE}=20\text{V}$)

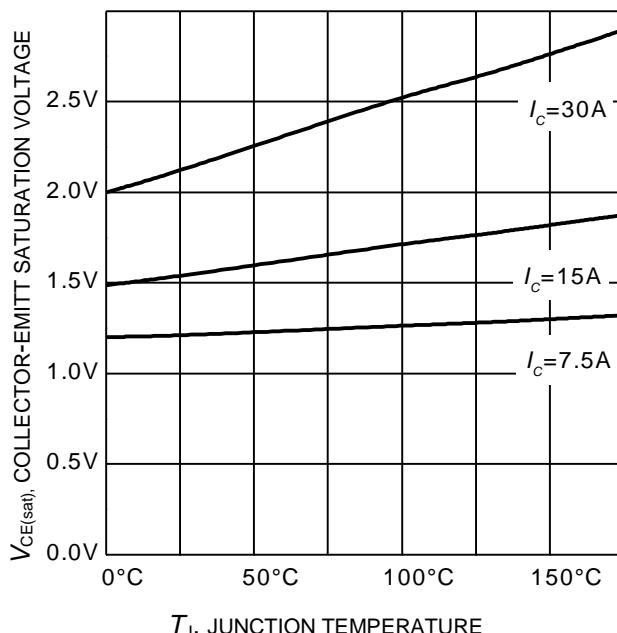


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
($V_{GE} = 15\text{V}$)

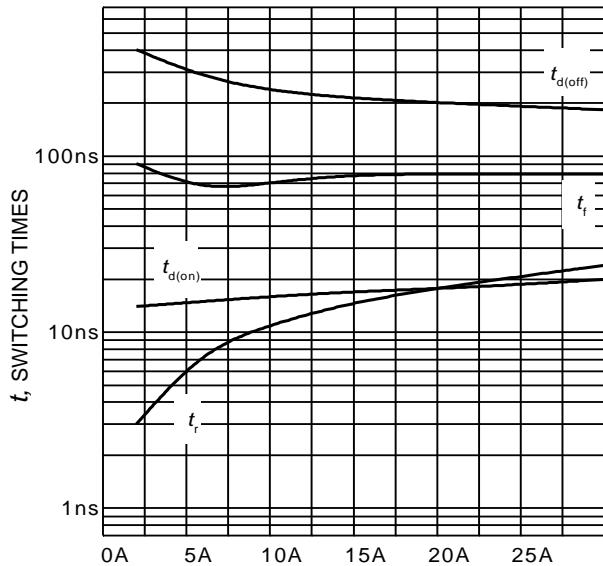

 I_C , COLLECTOR CURRENT

Figure 9. Typical switching times as a function of collector current
 (inductive load, $T_J=175^\circ\text{C}$,
 $V_{CE} = 400\text{V}$, $V_{GE} = 0/15\text{V}$, $r_G = 15\Omega$,
 Dynamic test circuit in Figure E)

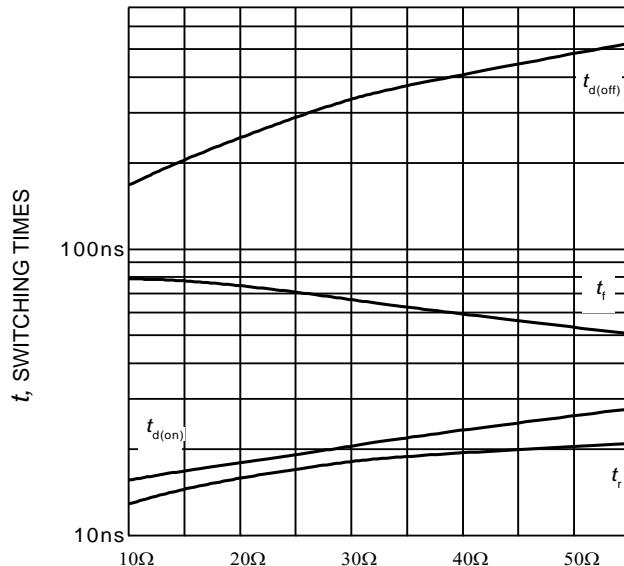

 R_G , GATE RESISTOR

Figure 10. Typical switching times as a function of gate resistor
 (inductive load, $T_J = 175^\circ\text{C}$,
 $V_{CE} = 400\text{V}$, $V_{GE} = 0/15\text{V}$, $I_C = 15\text{A}$,
 Dynamic test circuit in Figure E)

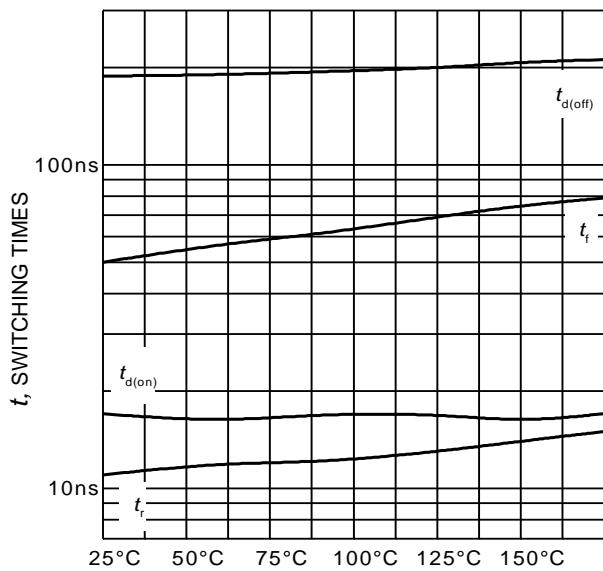

 T_J , JUNCTION TEMPERATURE

Figure 11. Typical switching times as a function of junction temperature
 (inductive load, $V_{CE} = 400\text{V}$,
 $V_{GE} = 0/15\text{V}$, $I_C = 15\text{A}$, $r_G = 15\Omega$,
 Dynamic test circuit in Figure E)

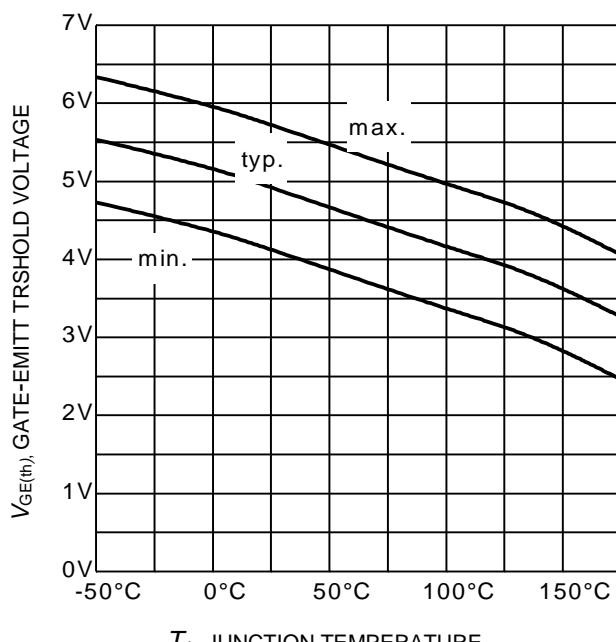

 T_J , JUNCTION TEMPERATURE

Figure 12. Gate-emitter threshold voltage as a function of junction temperature
 $(I_C = 0.21\text{mA})$

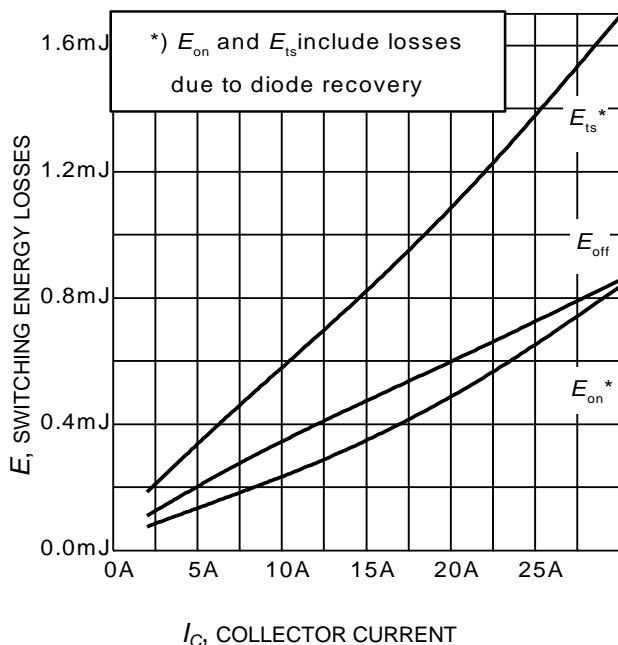
TRENCHSTOP™ Series


Figure 13. Typical switching energy losses as a function of collector current
(inductive load, $T_J = 175^\circ\text{C}$,
 $V_{CE} = 400\text{V}$, $V_{GE} = 0/15\text{V}$, $r_G = 15\Omega$,
Dynamic test circuit in Figure E)

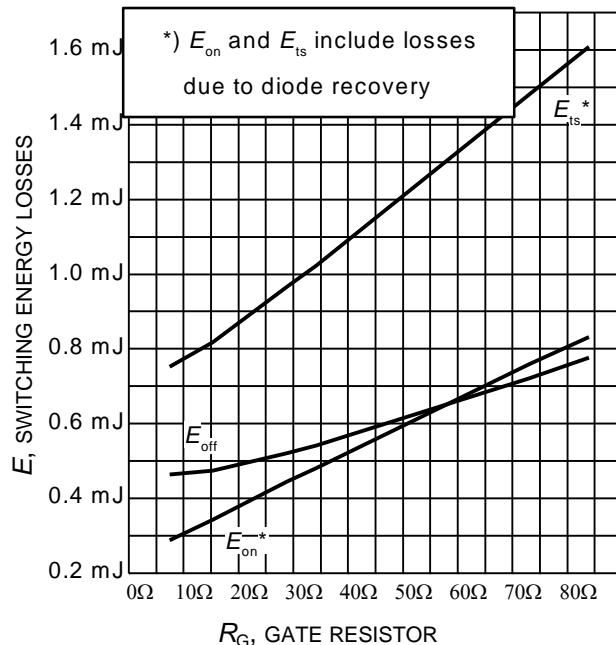


Figure 14. Typical switching energy losses as a function of gate resistor
(inductive load, $T_J = 175^\circ\text{C}$,
 $V_{CE} = 400\text{V}$, $V_{GE} = 0/15\text{V}$, $I_C = 15\text{A}$,
Dynamic test circuit in Figure E)

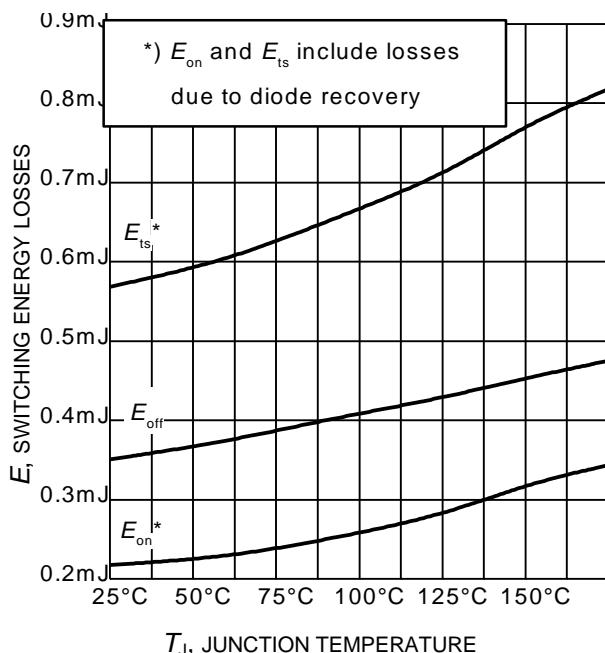


Figure 15. Typical switching energy losses as a function of junction temperature
(inductive load, $V_{CE} = 400\text{V}$,
 $V_{GE} = 0/15\text{V}$, $I_C = 15\text{A}$, $r_G = 15\Omega$,
Dynamic test circuit in Figure E)

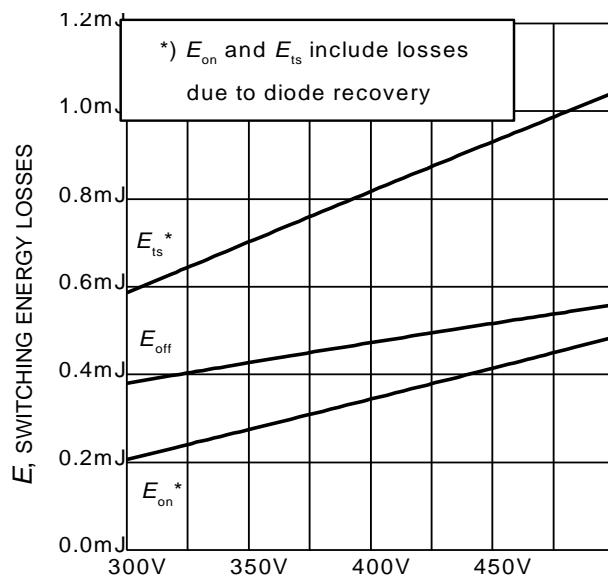


Figure 16. Typical switching energy losses as a function of collector-emitter voltage
(inductive load, $T_J = 175^\circ\text{C}$,
 $V_{GE} = 0/15\text{V}$, $I_C = 15\text{A}$, $r_G = 15\Omega$,
Dynamic test circuit in Figure E)

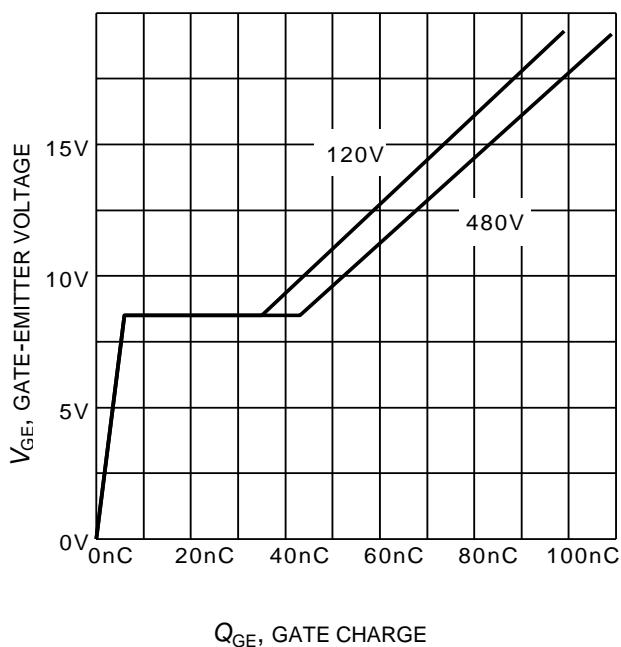


Figure 17. Typical gate charge
($I_C=15$ A)

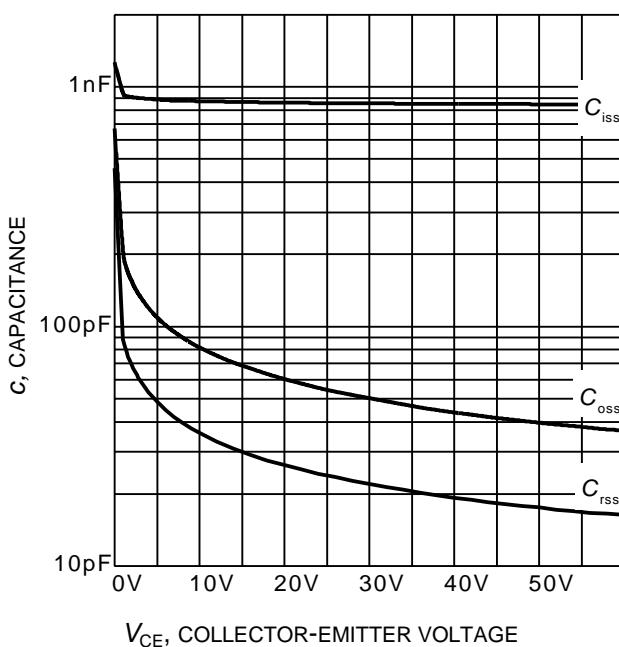


Figure 18. Typical capacitance as a function
of collector-emitter voltage
($V_{GE}=0$ V, $f = 1$ MHz)

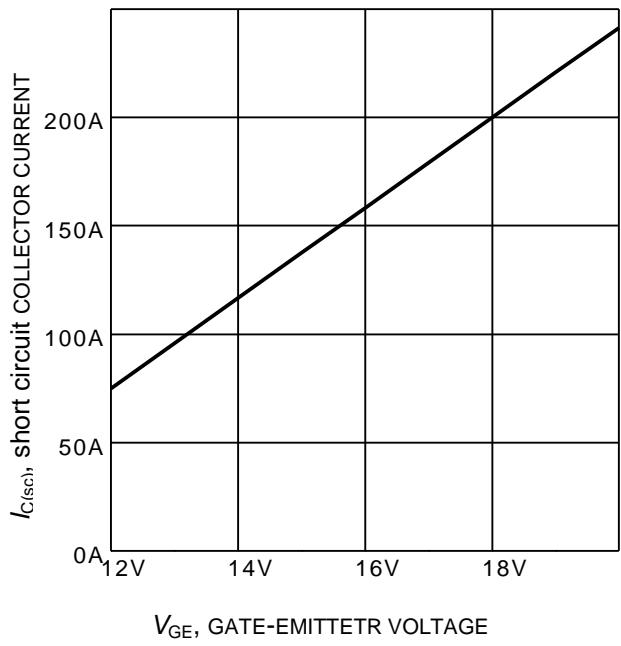


Figure 19. Typical short circuit collector
current as a function of gate-
emitter voltage
($V_{CE} \leq 400$ V, $T_j \leq 150^\circ$ C)

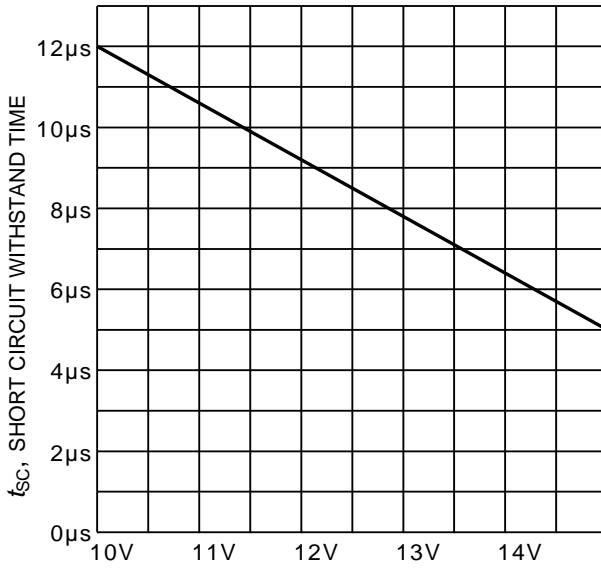


Figure 20. Short circuit withstand time as a
function of gate-emitter voltage
($V_{CE}=400$ V, start at $T_j=25^\circ$ C,
 $T_{jmax}<150^\circ$ C)

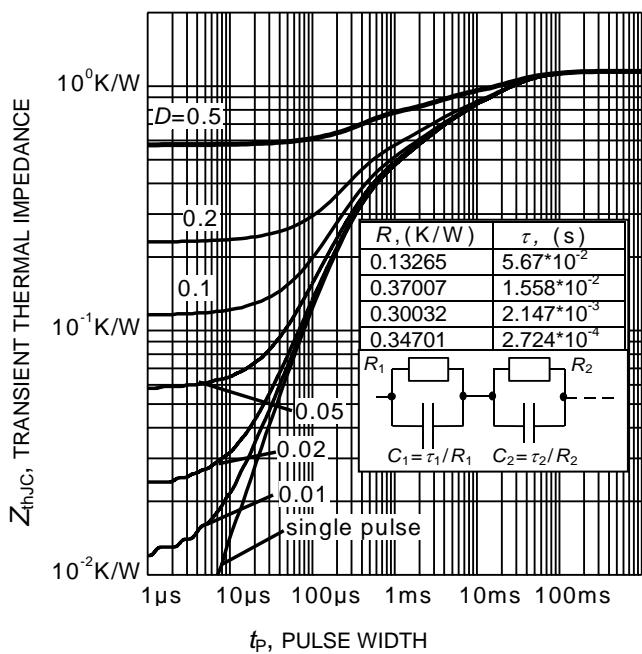
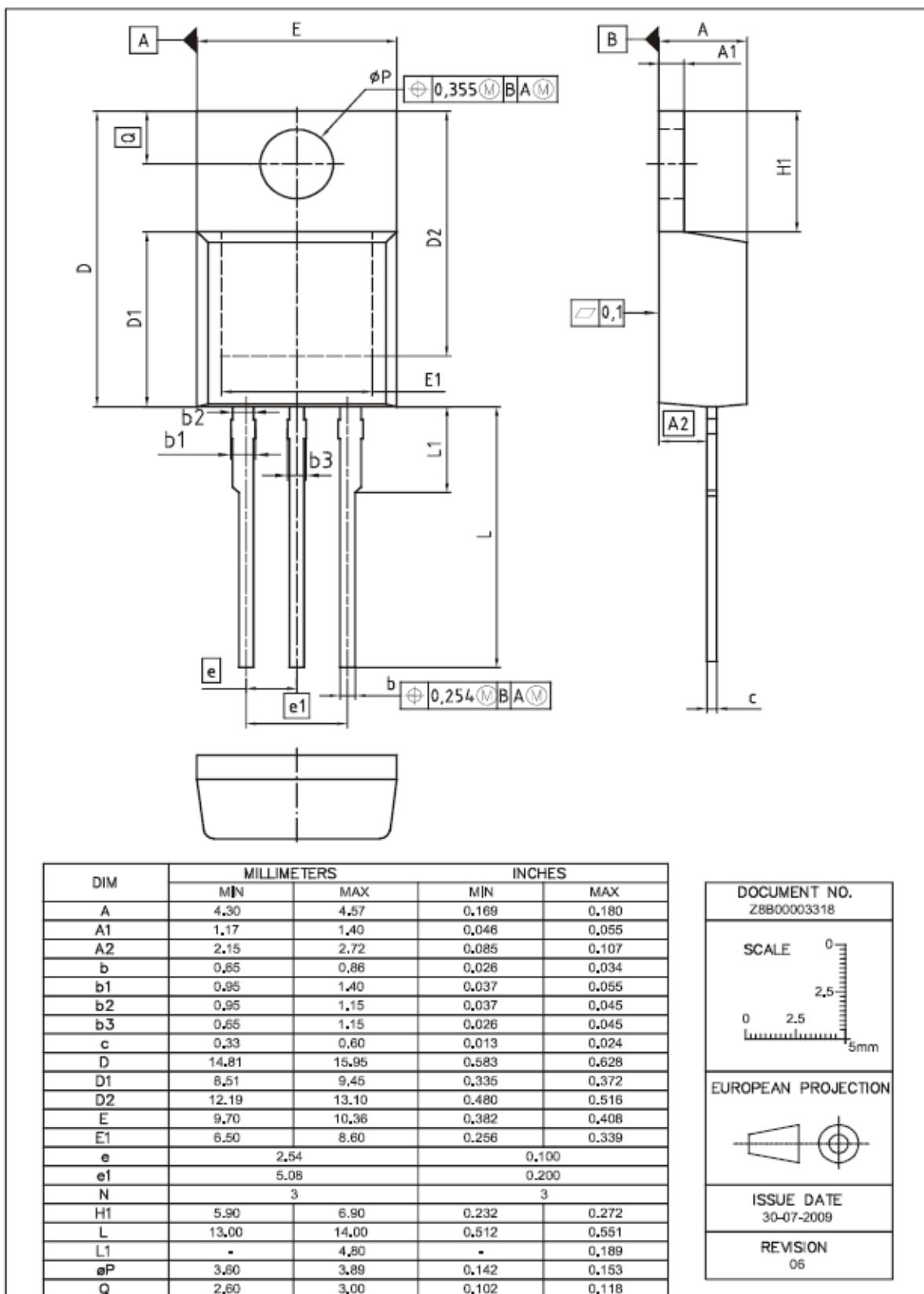


Figure 21. IGBT transient thermal impedance
 $(D = t_p / T)$

PG-T0220-3


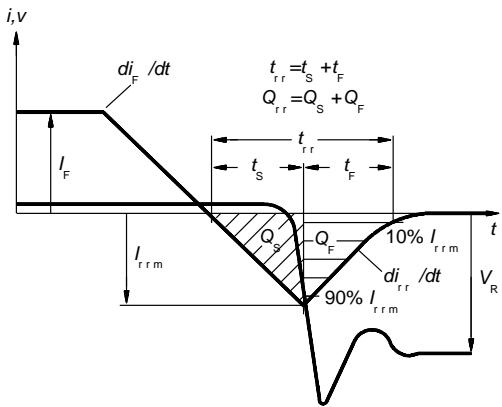
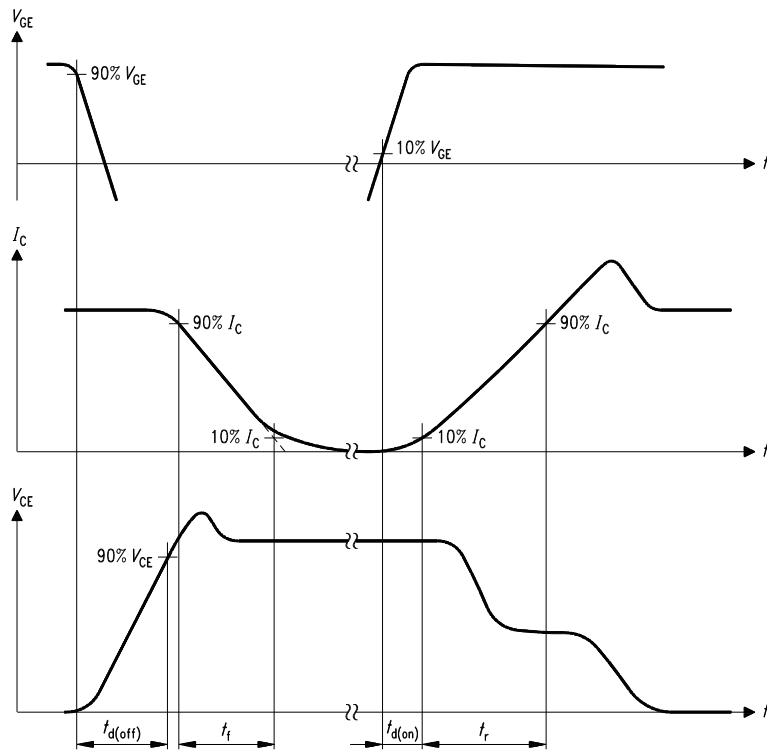


Figure C. Definition of diodes switching characteristics

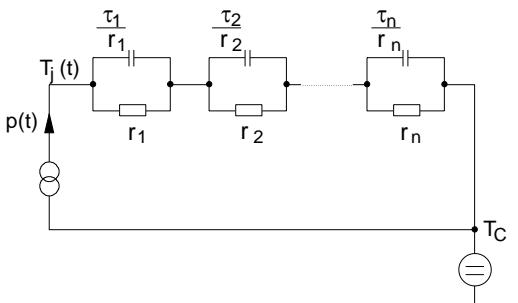


Figure D. Thermal equivalent circuit

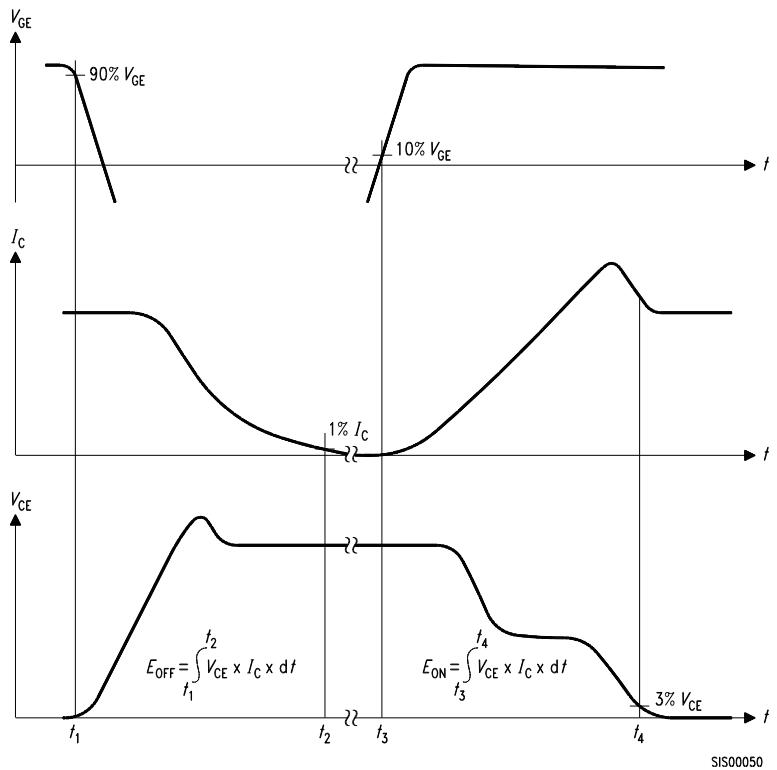
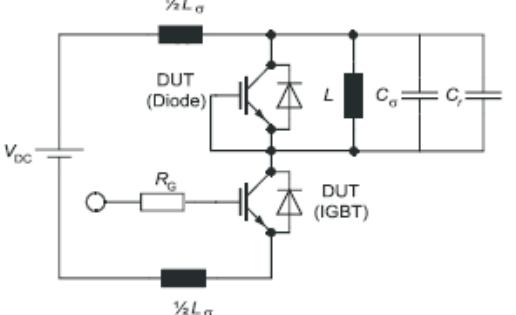


Figure E. Dynamic test circuit

Parasitic inductance L_α ,
Parasitic capacitor C_α ,
Relief capacitor C_r ,
(only for ZVT switching)



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Электрон
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