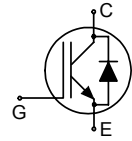


IGBT with monolithic body diode for soft switching Applications

Features:

- Powerful monolithic Body Diode
- Specified for $T_{jmax} = 175^{\circ}\text{C}$
- Trench and Fieldstop technology for 1200 V applications offers :
 - very tight parameter distribution
 - high ruggedness, temperature stable behavior
- NPT technology offers easy parallel switching capability due to positive temperature coefficient in $V_{CE(sat)}$
- Low EMI
- Qualified according to JEDEC¹ for target applications
- Pb-free lead plating; RoHS compliant



Applications:

- Inductive Cooking
- Soft Switching Applications

Type	V_{CE}	I_C	$V_{CE(sat), T_j=25^{\circ}\text{C}}$	$T_{j,max}$	Marking	Package
IHW30N120R	1200V	30A	1.55V	175°C	H30R120	PG-TO-247-3-21

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	1200	V
DC collector current $T_C = 25^{\circ}\text{C}$ $T_C = 100^{\circ}\text{C}$	I_C	60 30	A
Pulsed collector current, t_p limited by T_{jmax}	I_{Cpuls}	90	
Turn off safe operating area ($V_{CE} \leq 1200\text{V}$, $T_j \leq 175^{\circ}\text{C}$)	-	90	
Diode forward current $T_C = 25^{\circ}\text{C}$ $T_C = 100^{\circ}\text{C}$	I_F	50 25	
Diode pulsed current, t_p limited by T_{jmax}	I_{Fpuls}	75	
Diode surge non repetitive current, t_p limited by T_{jmax} $T_C = 25^{\circ}\text{C}$, $t_p = 10\text{ms}$, sine halfwave $T_C = 25^{\circ}\text{C}$, $t_p \leq 2.5\mu\text{s}$, sine halfwave $T_C = 100^{\circ}\text{C}$, $t_p \leq 2.5\mu\text{s}$, sine halfwave	I_{FSM}	50 130 120	
Gate-emitter voltage Transient Gate-emitter voltage ($t_p < 5\text{ms}$)	V_{GE}	± 20 ± 25	V
Power dissipation $T_C = 25^{\circ}\text{C}$	P_{tot}	395	W
Operating junction temperature	T_j	$-40 \dots +175$	$^{\circ}\text{C}$
Storage temperature	T_{stg}	$-55 \dots +175$	
Soldering temperature, 1.6mm (0.063 in.) from case for 10s	-	260	

¹ J-STD-020 and JESD-022

Thermal Resistance

Parameter	Symbol	Conditions	Max. Value	Unit
Characteristic				
IGBT thermal resistance, junction – case	R_{thJC}		0.38	K/W
Diode thermal resistance, junction – case	R_{thJCD}		0.37	
Thermal resistance, junction – ambient	R_{thJA}		40	

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	$V_{(BR)CES}$	$V_{GE}=0V, I_C=500\mu A$	1200	-	-	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	$V_{GE} = 15V, I_C=30A$				
		$T_j=25^{\circ}C$	-	1.55	1.75	
		$T_j=125^{\circ}C$	-	1.75	-	
		$T_j=175^{\circ}C$	-	1.85	-	
Diode forward voltage	V_F	$V_{GE}=0V, I_F=15A$				
		$T_j=25^{\circ}C$	-	1.3	1.5	
		$T_j=125^{\circ}C$	-	1.35	-	
		$T_j=175^{\circ}C$	-	1.4	-	
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C=0.7mA, V_{CE}=V_{GE}$	5.1	5.8	6.4	
Zero gate voltage collector current	I_{CES}	$V_{CE}=1200V, V_{GE}=0V$				μA
		$T_j=25^{\circ}C$	-	-	5	
		$T_j=175^{\circ}C$	-	-	2500	
Gate-emitter leakage current	I_{GES}	$V_{CE}=0V, V_{GE}=20V$	-	-	100	nA
Transconductance	g_{fs}	$V_{CE}=20V, I_C=30A$	-	26	-	S
Integrated gate resistor	R_{Gint}			None		Ω

Dynamic Characteristic

Input capacitance	C_{iss}	$V_{CE}=25V, V_{GE}=0V, f=1MHz$	-	2573	-	pF
Output capacitance	C_{oss}		-	76	-	
Reverse transfer capacitance	C_{rss}		-	17	-	
Gate charge	Q_{Gate}	$V_{CC}=960V, I_C=30A, V_{GE}=15V$	-	197	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E		-	13	-	nH

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	$t_{d(on)}$	$T_j=25^{\circ}\text{C}$, $V_{CC}=600\text{V}$, $I_C=30\text{A}$ $V_{GE}=0/15\text{V}$, $R_G=34\Omega$, $L_{\sigma}^{1)}=180\text{nH}$, $C_{\sigma}^{2)}=39\text{pF}$ Energy losses include “tail” and diode reverse recovery.	-	71	-	ns
Rise time	t_r		-	37	-	
Turn-off delay time	$t_{d(off)}$		-	1007	-	
Fall time	t_f		-	45	-	
Turn-on energy	E_{on}		-	-	-	mJ
Turn-off energy	E_{off}		-	2.9	-	
Total switching energy	E_{ts}		-	2.9	-	

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	$t_{d(on)}$	$T_j=175^{\circ}\text{C}$ $V_{CC}=600\text{V}, I_C=30\text{A},$ $V_{GE}= 0/15\text{V},$ $R_G= 34\Omega,$ $L_{\sigma^{(2)}}=180\text{nH},$ $C_{\sigma^{(2)}}=39\text{pF}$	-	67	-	ns
Rise time	t_r		-	54	-	
Turn-off delay time	$t_{d(off)}$		-	1157	-	
Fall time	t_f		-	59	-	
Turn-on energy	E_{on}	Energy losses include “tail” and diode reverse recovery ²	-	-	-	mJ
Turn-off energy	E_{off}		-	4.3	-	
Total switching energy	E_{ts}		-	4.3	-	

¹ Leakage inductance L_{σ} and Stray capacity C_{σ} due to dynamic test circuit in Figure E.

² Diode used in this test is Diode of IDP30E120

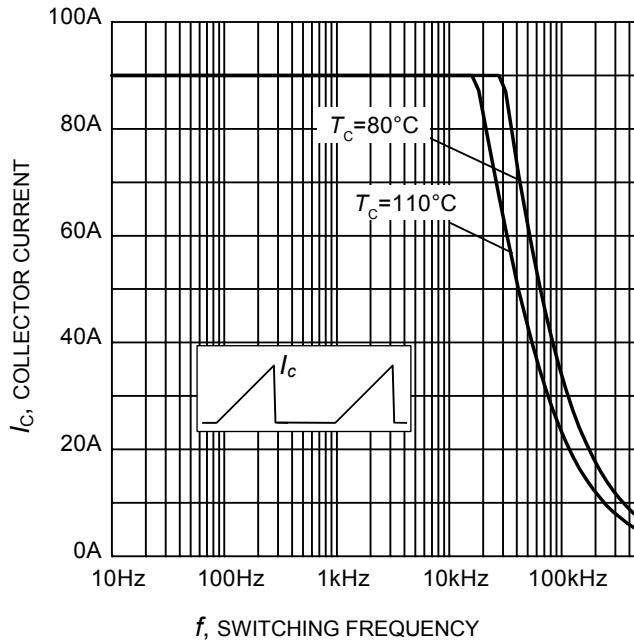


Figure 1. Collector current as a function of switching frequency for hard switching (turn-off)
 $(T_j \leq 175^\circ\text{C}, D = 0.5, V_{CE} = 600\text{V}, V_{GE} = 0/+15\text{V}, R_G = 34\Omega)$

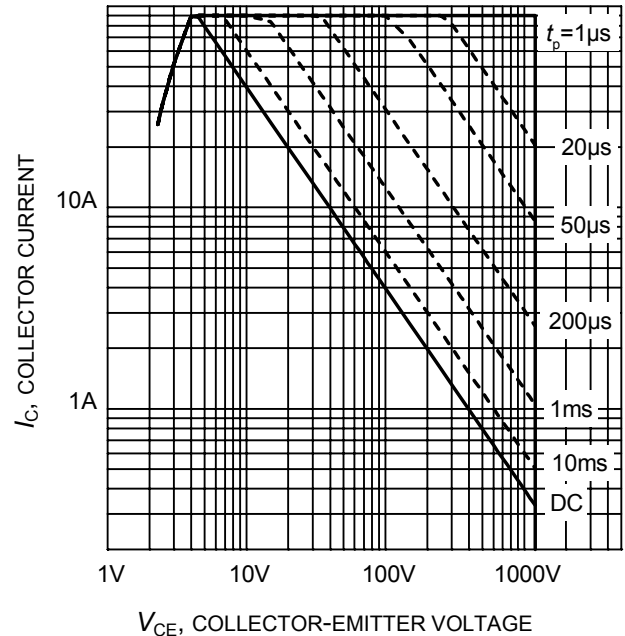


Figure 2. IGBT Safe operating area
 $(D = 0, T_C = 25^\circ\text{C}, T_j \leq 175^\circ\text{C}; V_{GE} = 15\text{V})$

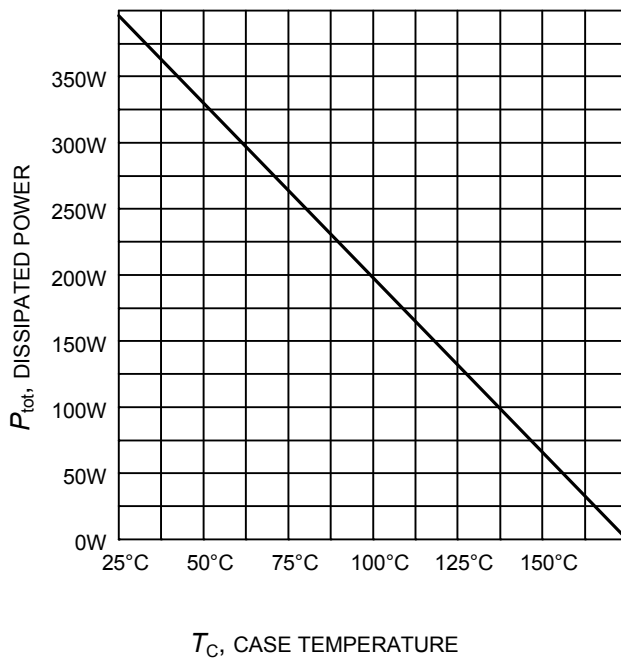


Figure 3. Power dissipation as a function of case temperature
 $(T_j \leq 175^\circ\text{C})$

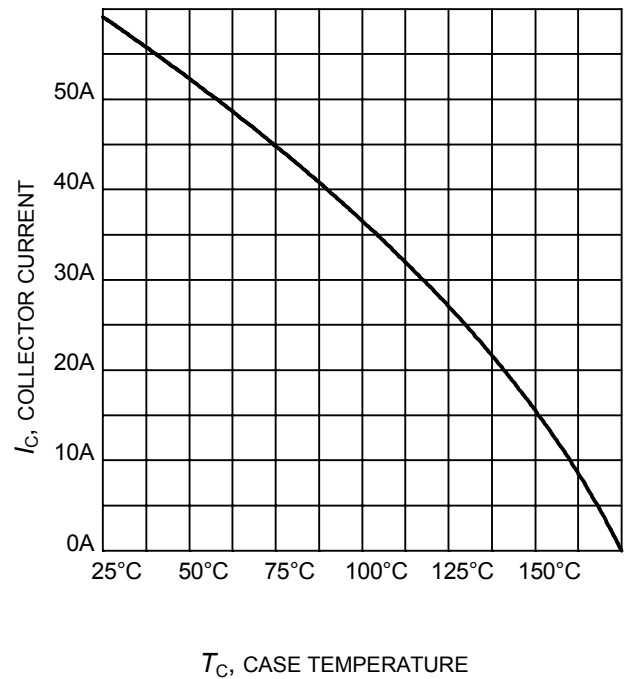


Figure 4. DC Collector current as a function of case temperature
 $(V_{GE} \geq 15\text{V}, T_j \leq 175^\circ\text{C})$

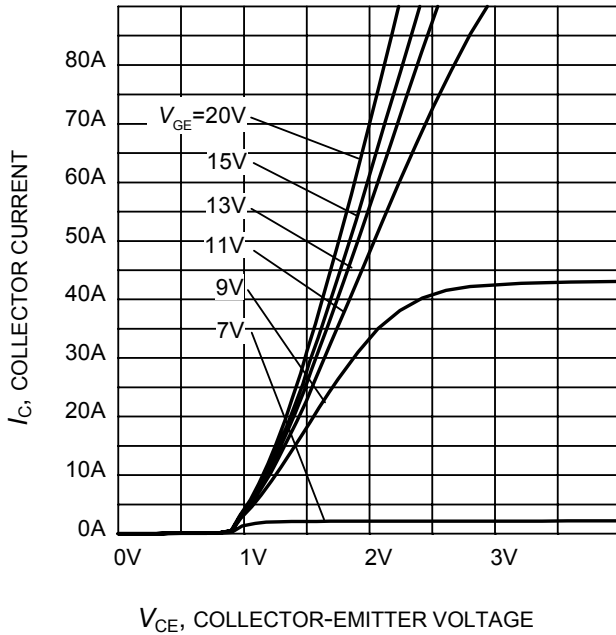


Figure 5. Typical output characteristic
($T_J = 25^\circ\text{C}$)

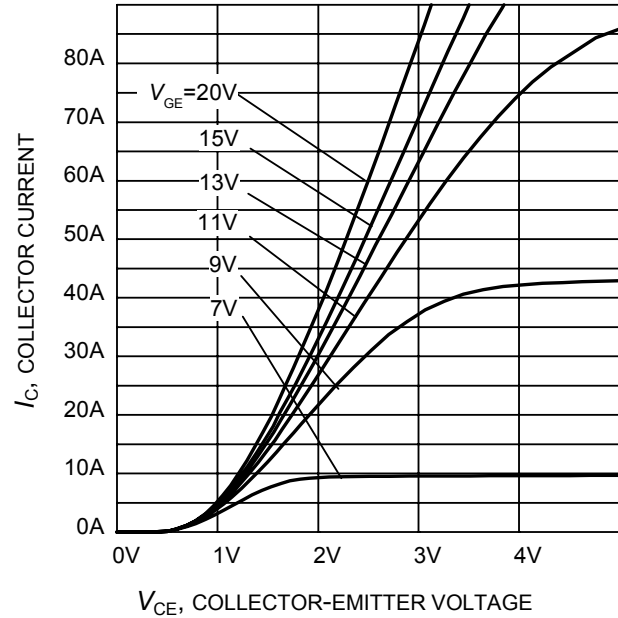


Figure 6. Typical output characteristic
($T_J = 175^\circ\text{C}$)

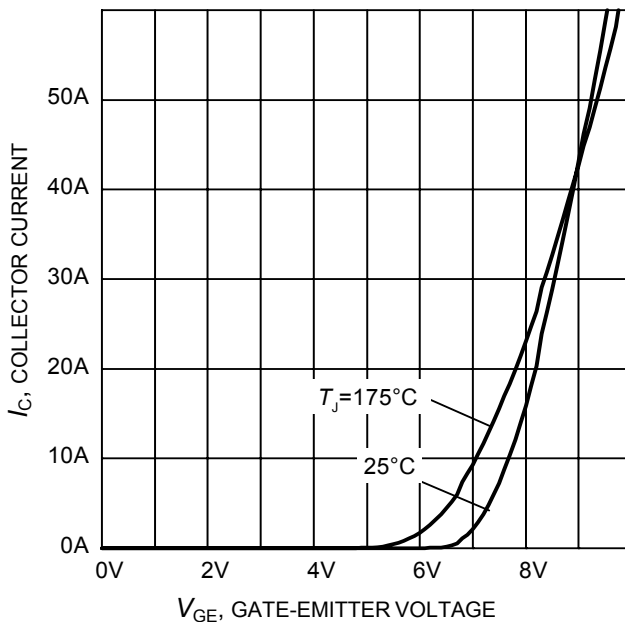


Figure 7. Typical transfer characteristic
($V_{CE} = 20\text{V}$)

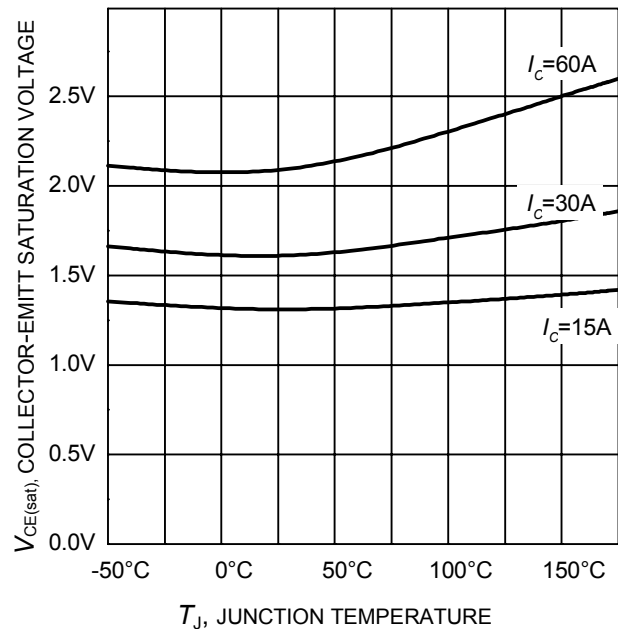


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
($V_{GE} = 15\text{V}$)

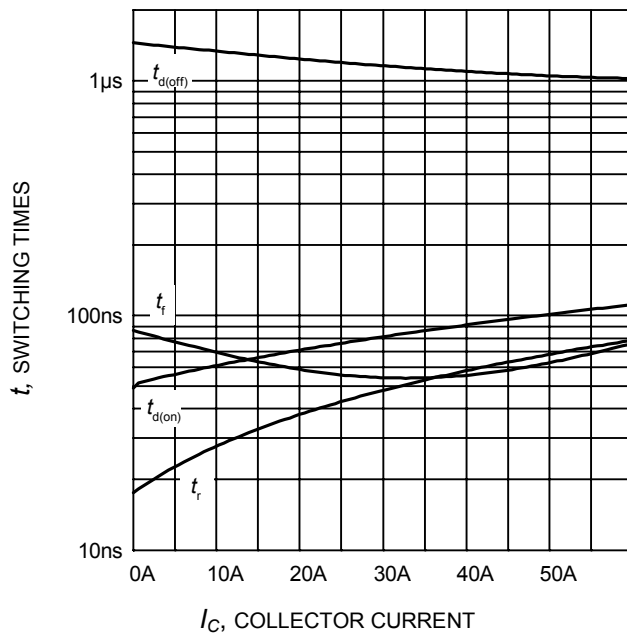


Figure 9. Typical switching times as a function of collector current
(inductive load, $T_J=175^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $R_G=34\Omega$, Dynamic test circuit in Figure E)

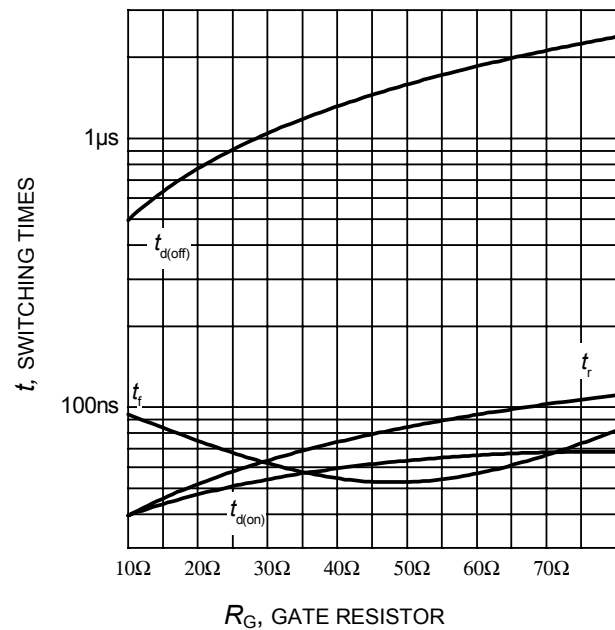


Figure 10. Typical switching times as a function of gate resistor
(inductive load, $T_J=175^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=30\text{A}$, Dynamic test circuit in Figure E)

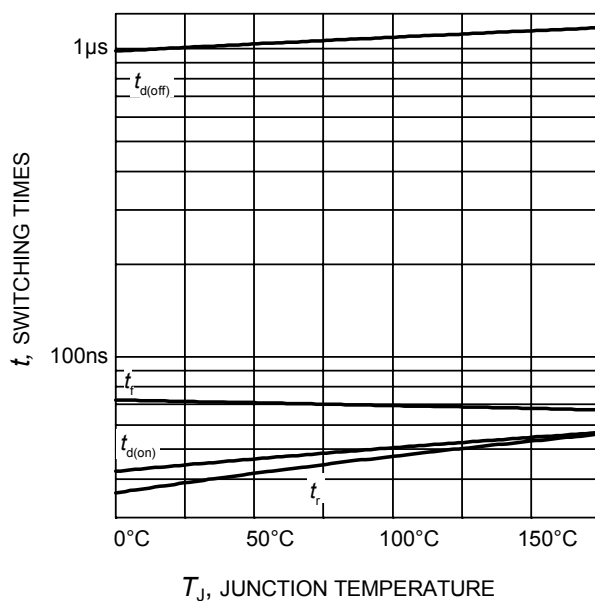


Figure 11. Typical switching times as a function of junction temperature
(inductive load, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=30\text{A}$, $R_G=34\Omega$, Dynamic test circuit in Figure E)

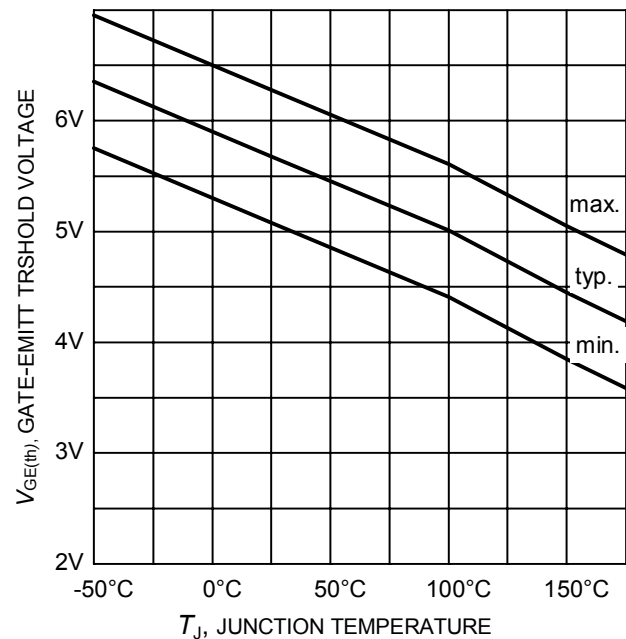


Figure 12. Gate-emitter threshold voltage as a function of junction temperature
($I_C = 0.7\text{mA}$)

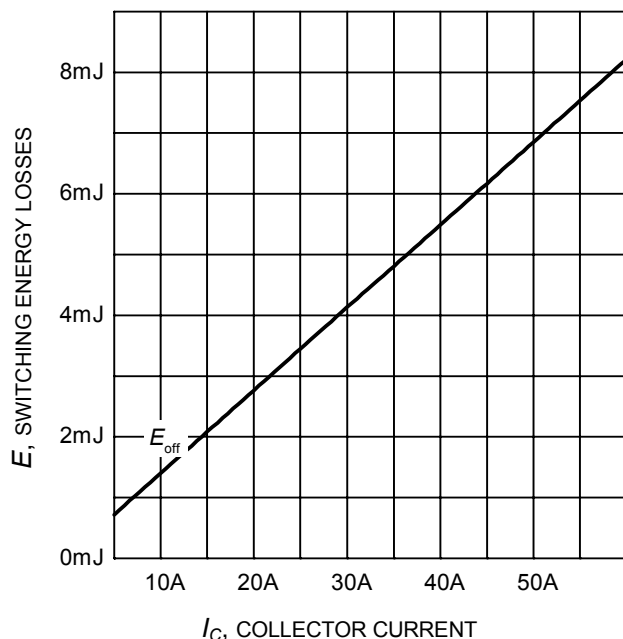


Figure 13. Typical turn-off energy as a function of collector current
(inductive load, $T_J=175^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $R_G=34\Omega$, Dynamic test circuit in Figure E)

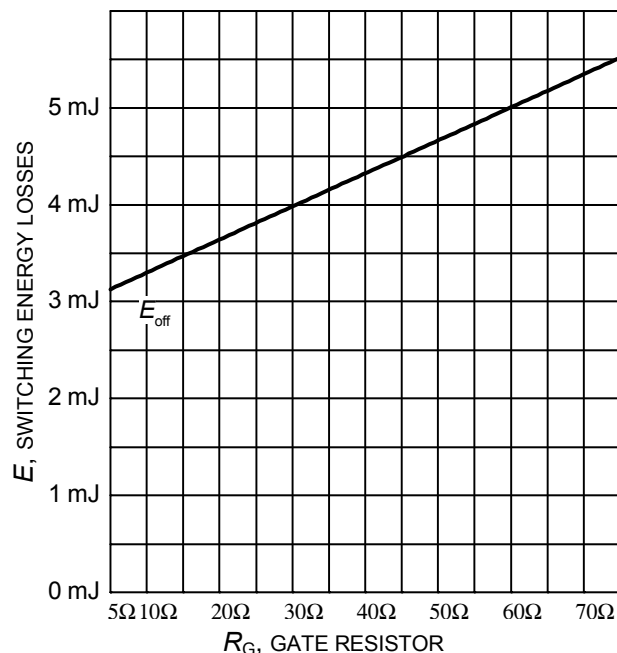


Figure 14. Typical turn-off energy as a function of gate resistor
(inductive load, $T_J=175^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=30\text{A}$, Dynamic test circuit in Figure E)

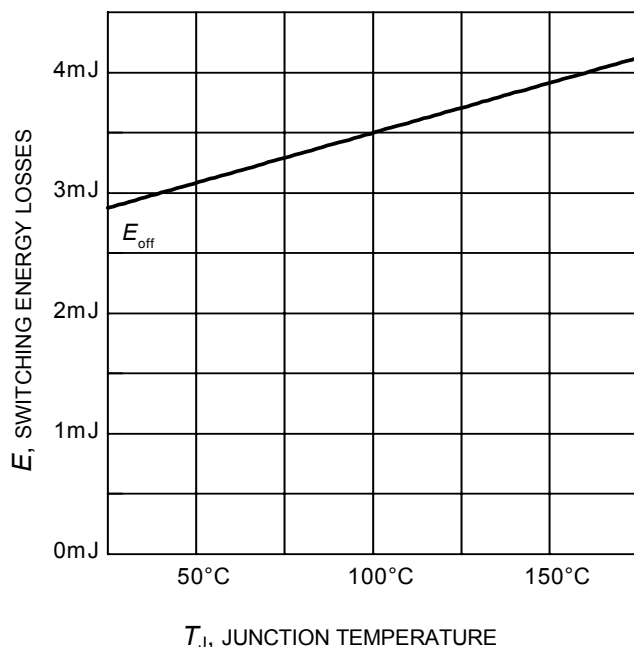


Figure 15. Typical turn-off energy as a function of junction temperature
(inductive load, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=30\text{A}$, $R_G=34\Omega$, Dynamic test circuit in Figure E)

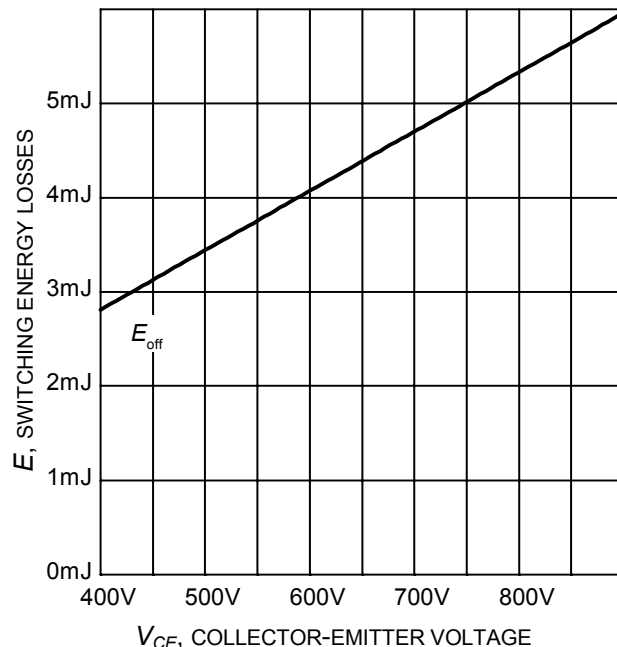


Figure 16. Typical turn-off energy as a function of collector emitter voltage
(inductive load, $T_J=175^\circ\text{C}$, $V_{GE}=0/15\text{V}$, $I_C=30\text{A}$, $R_G=34\Omega$, Dynamic test circuit in Figure E)

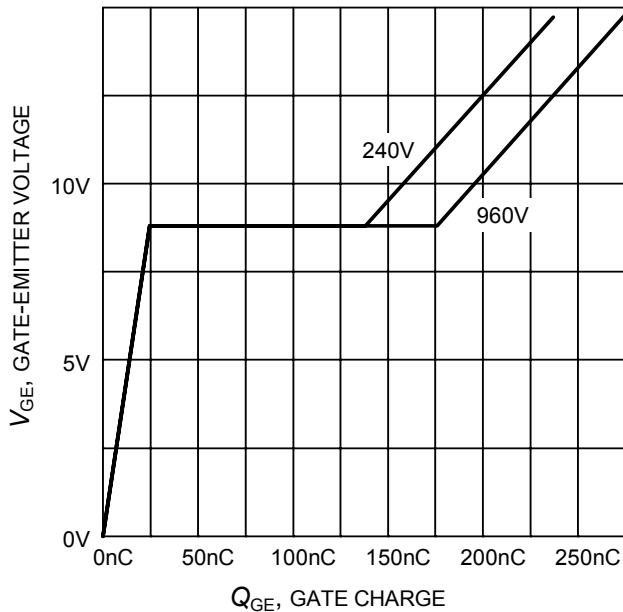


Figure 17. Typical gate charge
($I_C = 30$ A)

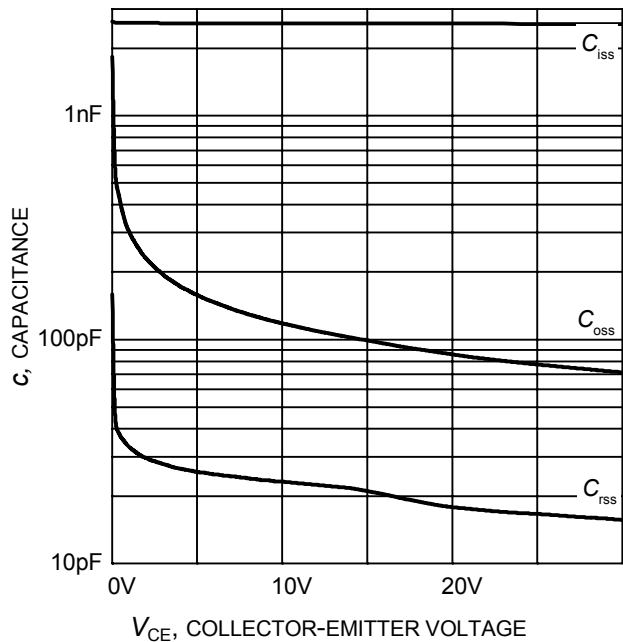


Figure 18. Typical capacitance as a function of collector-emitter voltage
($V_{GE} = 0V$, $f = 1$ MHz)

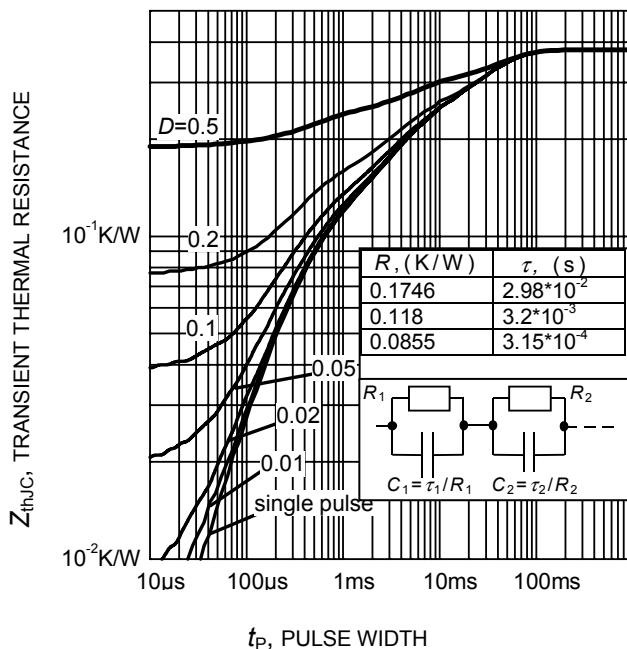


Figure 19. IGBT transient thermal resistance
($D = t_p / T$)

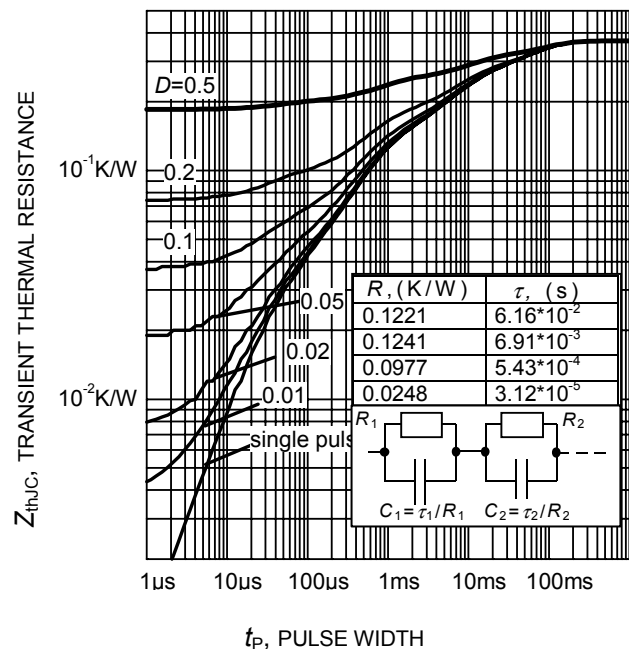


Figure 20. Typical Diode transient thermal impedance as a function of pulse width
($D = t_p / T$)

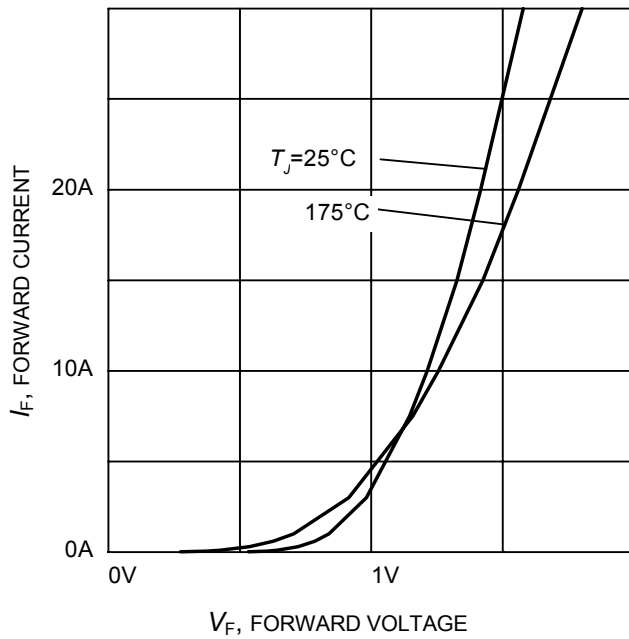


Figure 21. Typical diode forward current as a function of forward voltage

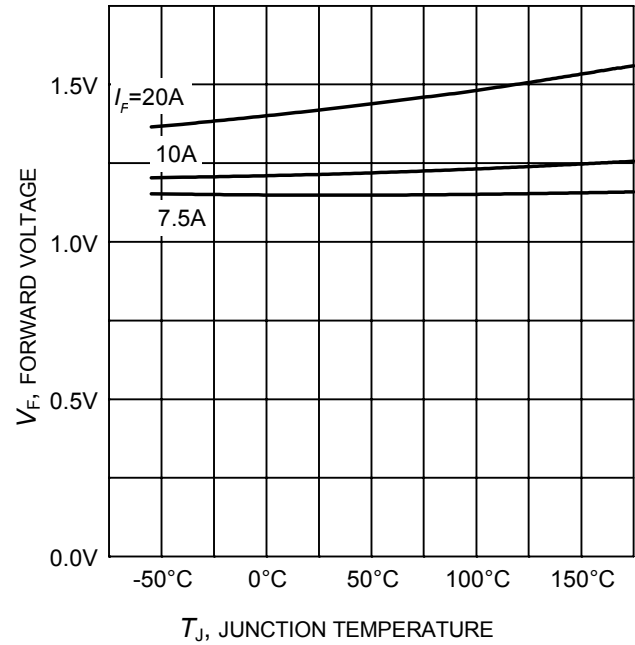
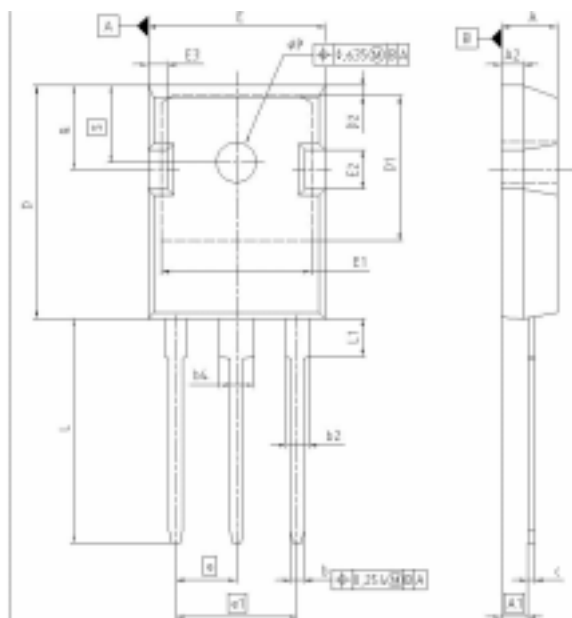


Figure 22. Typical diode forward voltage as a function of junction temperature

PG-TO247-3-21



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.905	5.157	0.193	0.203
A1	2.273	2.527	0.090	0.099
A2	1.653	2.107	0.075	0.081
b	1.073	1.327	0.047	0.052
b2	1.903	2.506	0.075	0.099
b4	2.870	3.454	0.113	0.136
c	0.549	0.752	0.024	0.030
D	29.823	24.077	0.820	0.890
D1	17.323	17.831	0.682	0.702
D2	1.093	1.317	0.042	0.052
E	15.773	16.827	0.621	0.661
E1	13.893	14.147	0.547	0.557
E2	3.683	3.907	0.145	0.155
E3	1.663	1.907	0.066	0.076
a	5.450		0.215	
a1	10.800		0.430	
N	3		3	
L	20.093	20.307	0.791	0.799
L1	4.186	4.472	0.164	0.175
aP	3.559	3.661	0.140	0.144
Q	5.490	5.747	0.216	0.228
S	6.043	6.297	0.238	0.248

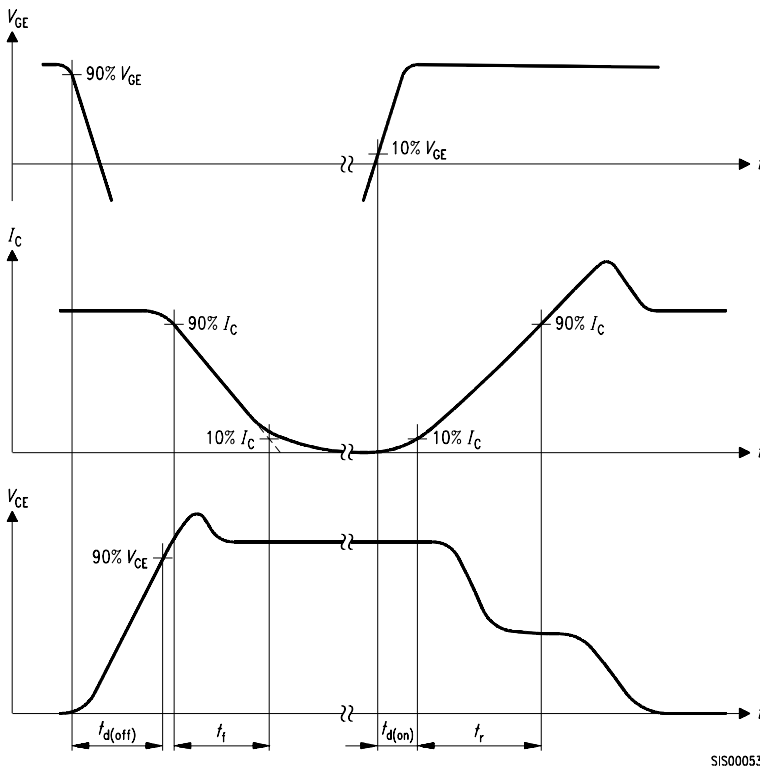


Figure A. Definition of switching times

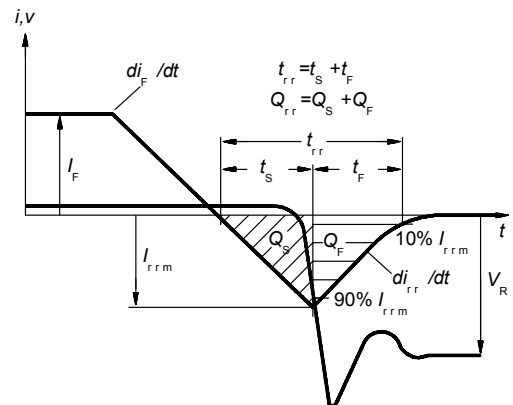


Figure C. Definition of diodes switching characteristics

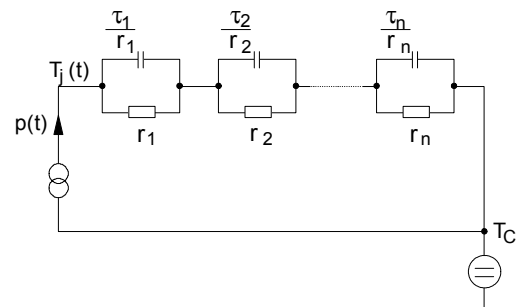


Figure D. Thermal equivalent circuit

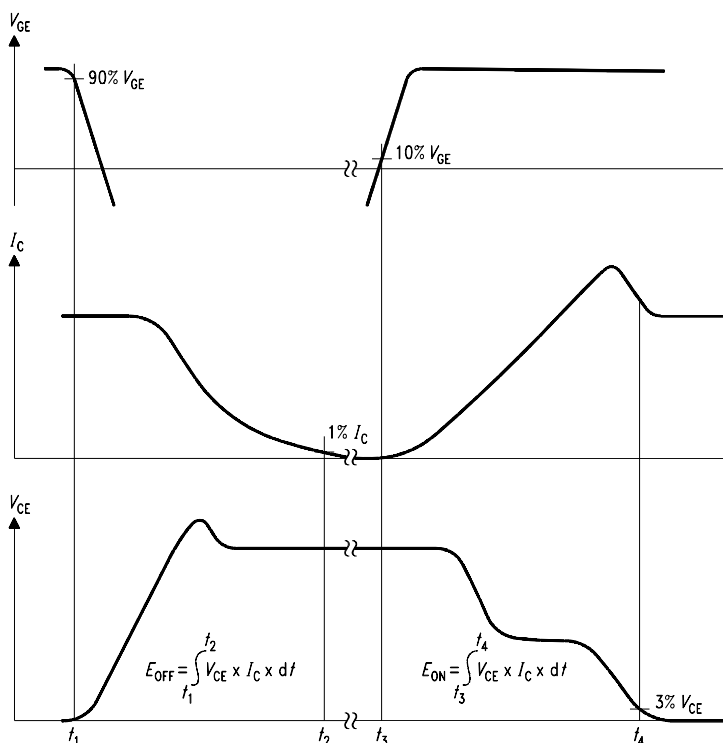


Figure B. Definition of switching losses

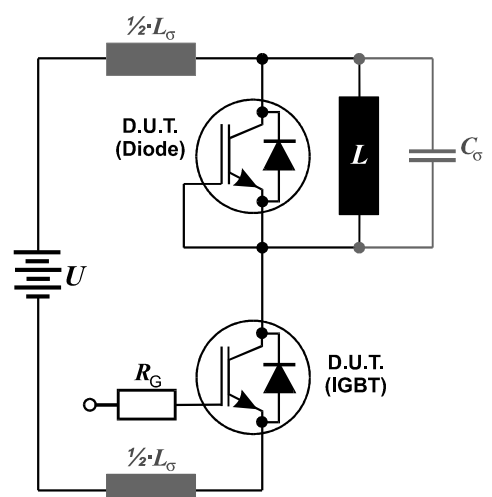


Figure E. Dynamic test circuit
Leakage inductance $L_\sigma = 180\text{nH}$
and Stray capacity $C_\sigma = 39\text{pF}$.

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