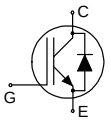
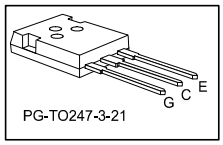
Reverse conducting IGBT





Features:
- Powerful monolithic body diode with low forward voltage designed for soft commutation only
- TrenchStop® technology applications offers:
  - very tight parameter distribution
  - high ruggedness, temperature stable behavior
  - low $V_{CE(sat)}$
  - easy parallel switching capability due to positive temperature coefficient in $V_{CE(sat)}$
- Low EMI
- Qualified according to JEDEC J-STD-020 and JESD-022 for target applications
- Pb-free lead plating; RoHS compliant
- Complete product spectrum and PSpice Models: http://www.infineon.com/igbt/

Applications:
- Inductive cooking

Type	V_{CE}	I_C	$V_{CE(sat)}$ T_j=25°C	T_{jmax}	Marking	Package
IHW40N60R	600V	40A	1.65V	175°C	H40R60	PG-TO247-3-21

Maximum ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	600	V
DC collector current, limited by T_{jmax} T_C = 25°C T_C = 100°C	I_C	 80.0 40.0	A
Pulsed collector current, t_p limited by T_{jmax}	I_{Cpuls}	120.0	A
Turn off safe operating area V_{CE} = 600V, T_j= 175°C	-	120.0	A
Diode forward current, limited by T_{jmax} T_C = 25°C T_C = 100°C	I_F	 80.0 40.0	A
Diode pulsed current, t_p limited by T_{jmax}	I_{Fpuls}	120.0	A
Gate-emitter voltage	V_{GE}	±20	V
Power dissipation T_C = 25°C Power dissipation T_C = 100°C	P_{tot}	305.0 152.5	W
Operating junction temperature	T_j	-40...+175	°C
Storage temperature	T_{stg}	-55...+175	°C
Soldering temperature, wavesoldering 1.6 mm (0.063 in.) from case for 10s	PG-TO247-3-21	260	°C
Mounting torque, M3 screw Maximum of mounting processes: 3	M	0.6	Nm

Thermal Resistance

Parameter	Symbol	Conditions	Max. Value	Unit
Characteristic				
IGBT thermal resistance, junction - case	R_{thJC}		0.49	K/W
Diode thermal resistance, junction - case	R_{thJCD}		0.49	K/W
Thermal resistance junction - ambient	R_{thJA}	PG-TO247-3-21	40	K/W

Electrical Characteristic, at T_j = 25°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 = 0.50mA	600	-	-	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	V_{GE} = 15.0V, I_C = 40.0A T_j = 25°C T_j = 175°C	- -	1.65 2.10	2.05 -	V
Diode forward voltage	V_F	V_{GE} = 0V, I_F = 40.0A T_j = 25°C T_j = 175°C	- -	1.65 1.90	2.05	V
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C = 0.58mA, V_{CE} = V_{GE}	4.1	4.9	5.7	V
Zero gate voltage collector current	I_{CES}	V_{CE} = 600V, V_{GE} = 0V T_j = 25°C T_j = 175°C	- -	- -	40.0 1000.0	µA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0V, V_{GE} = 20V	-	-	100	nA
Transconductance	g_{fs}	V_{CE} = 20V, I_C = 40.0A	-	19.0	-	S
Integrated gate resistor	R_{Gint}			none		Ω

Electrical Characteristic, at T_j = 25°C, unless otherwise specified

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
Dynamic Characteristic						
Input capacitance	C_{iss}	V_{CE} = 25V, V_{GE} = 0V, f = 1MHz	-	2370	-	pF
Output capacitance	C_{oss}		-	81	-	
Reverse transfer capacitance	C_{rss}		-	63	-	
Gate charge	Q_{Gate}	V_{CC} = 480V, I_C = 40.0A, V_{GE} = 15V	-	223.0	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E	PG-TO247-3-21	-	13.0	-	nH

Switching Characteristic, Inductive Load, at T_j = 25°C

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic						
Turn-off delay time	$t_{d(off)}$	T_j = 25°C, V_{CC} = 400V, I_C = 40.0A, V_{GE} = 0.0/15.0V, R_G = 5.6Ω, L_σ = 90nH, C_σ = 67pF L_σ, C_σ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	193	-	ns
Fall time	t_f		-	24	-	ns
Turn-off energy	E_{off}		-	0.75	-	mJ

Switching Characteristic, Inductive Load, at T_j = 175°C

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic						
Turn-off delay time	$t_{d(off)}$	T_j = 175°C, V_{CC} = 400V, I_C = 40.0A, V_{GE} = 0.0/15.0V, R_G = 5.6Ω, L_σ = 90nH, C_σ = 67pF L_σ, C_σ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	227	-	ns
Fall time	t_f		-	37	-	ns
Turn-off energy	E_{off}		-	1.22	-	mJ

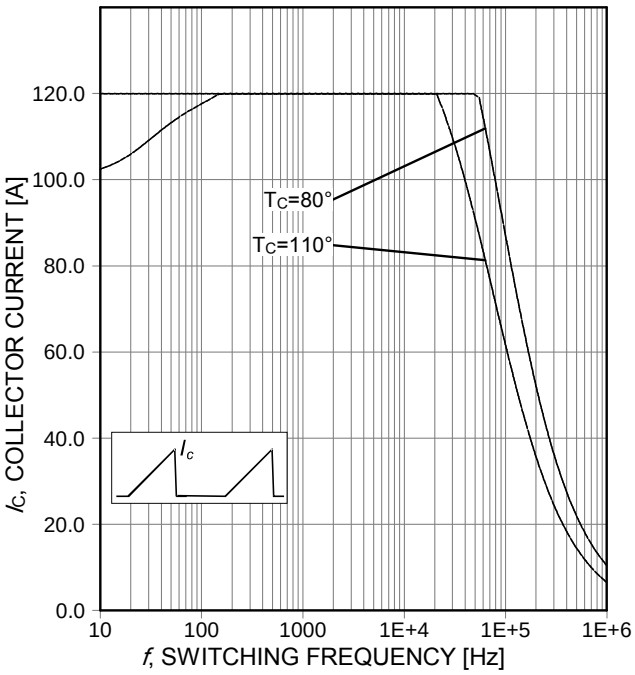


Figure 1. Collector current as a function of switching frequency
(T_j≤175°C, D=0.5, V_{CE}=400V, V_{GE}=15/0V, R_G=5.6Ω)

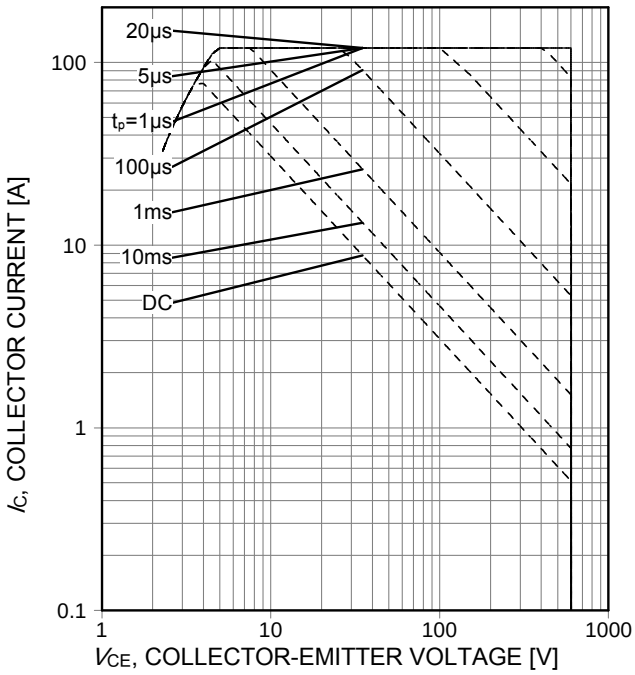


Figure 2. Forward bias safe operating area
(D=0, T_C=25°C, T_j≤175°C; V_{GE}=15V)

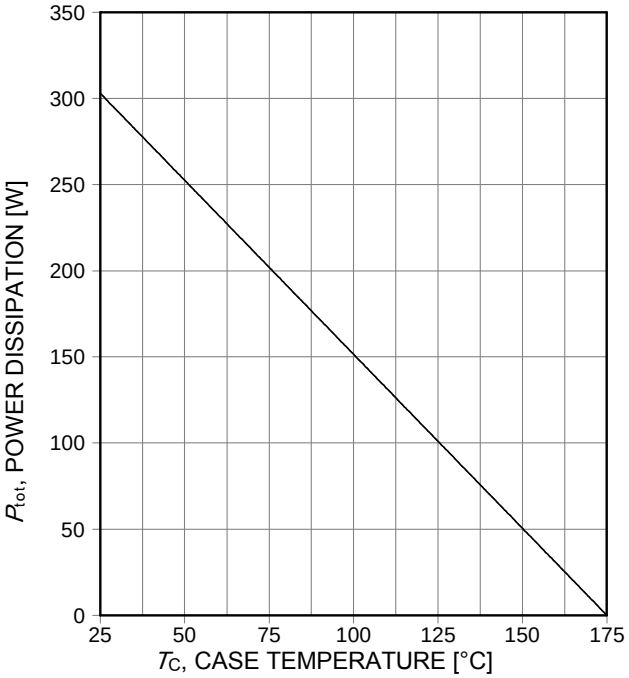


Figure 3. Power dissipation as a function of case temperature
(T_j≤175°C)

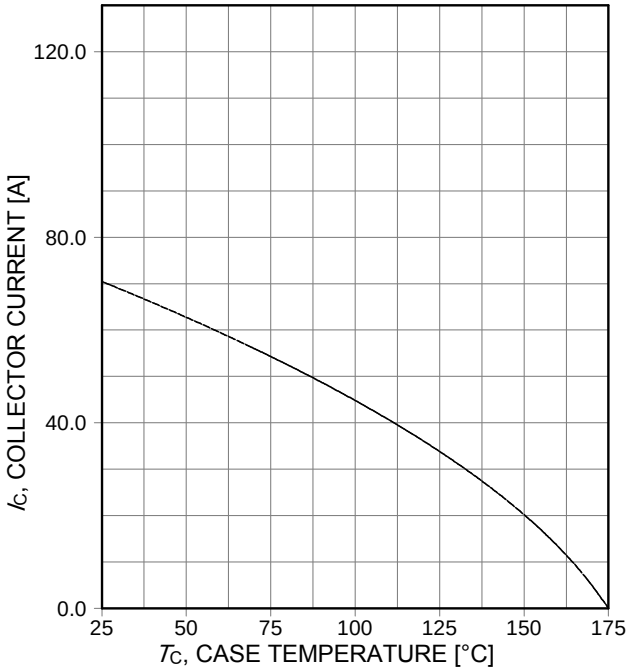


Figure 4. Collector current as a function of case temperature
(V_{GE}≥15V, T_j≤175°C)

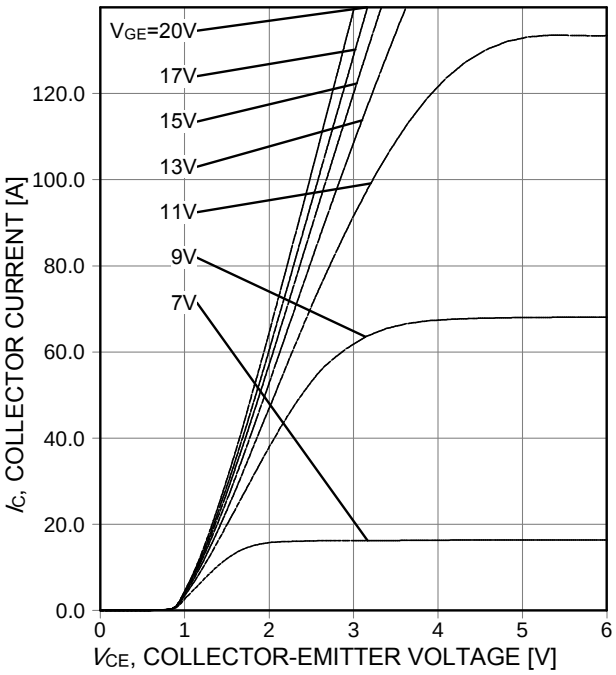


Figure 5. Typical output characteristic
(T_j=25°C)

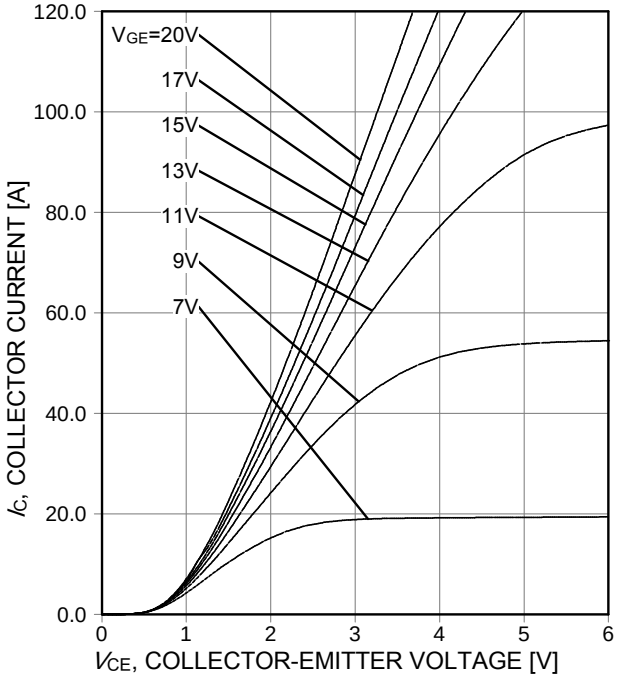


Figure 6. Typical output characteristic
(T_j=175°C)

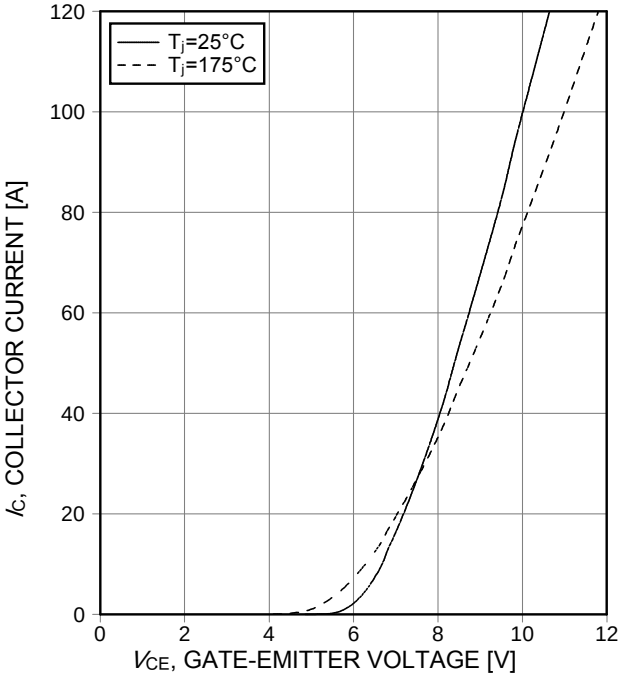


Figure 7. Typical transfer characteristic
(V_{CE}=20V)

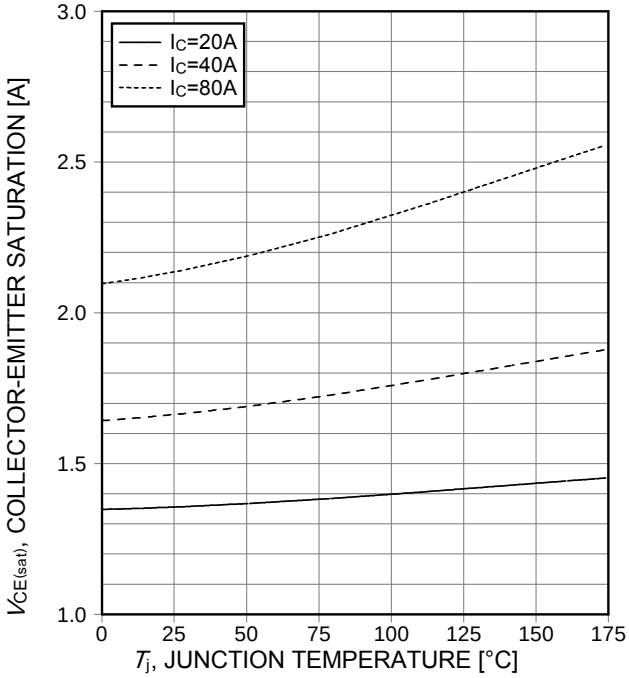


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
(V_{GE}=15V)

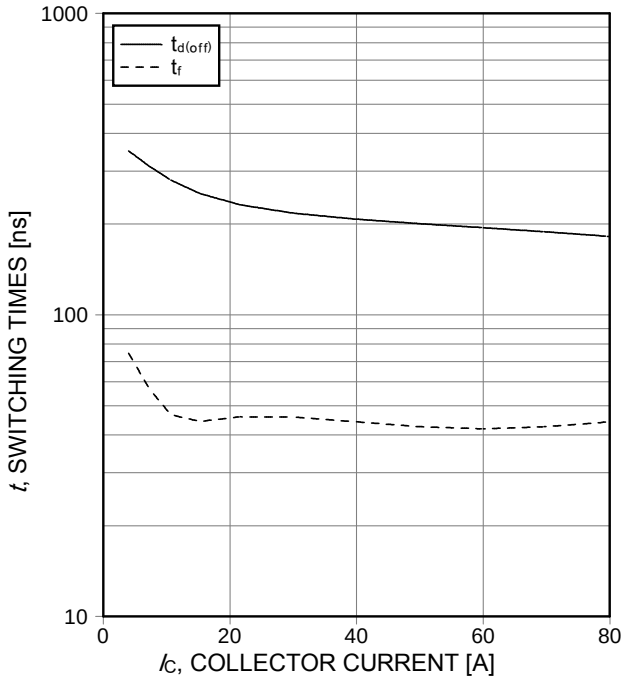


Figure 9. Typical switching times as a function of collector current
(inductive load, T_j=175°C, V_{CE}=400V, V_{GE}=15/0V, R_G=5.6Ω,Dynamic test circuit in Figure E)

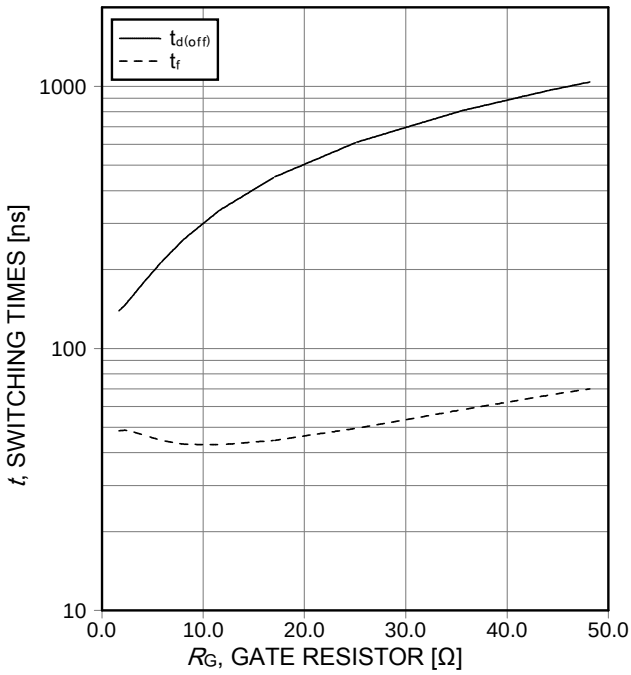


Figure 10. Typical switching times as a function of gate resistor
(inductive load, T_j=175°C, V_{CE}=400V, V_{GE}=15/0V, I_C=40A,Dynamic test circuit in Figure E)

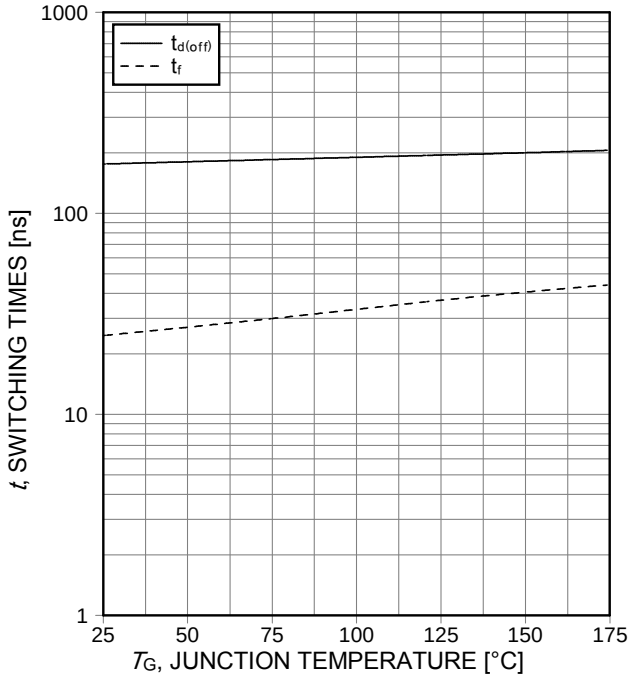


Figure 11. Typical switching times as a function of junction temperature
(inductive load, V_{CE}=400V, V_{GE}=15/0V, I_C=40A, R_G=5.6Ω,Dynamic test circuit in Figure E)

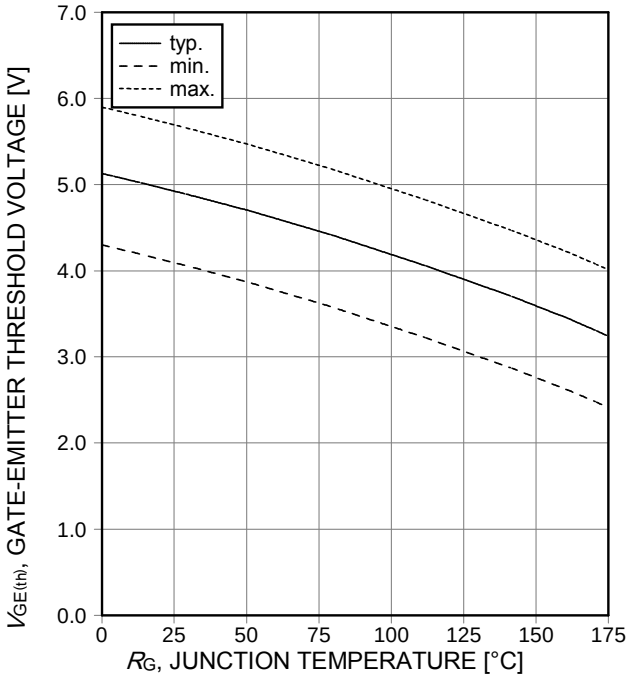


Figure 12. Gate-emitter threshold voltage as a function of junction temperature
(I_C=0.6mA)

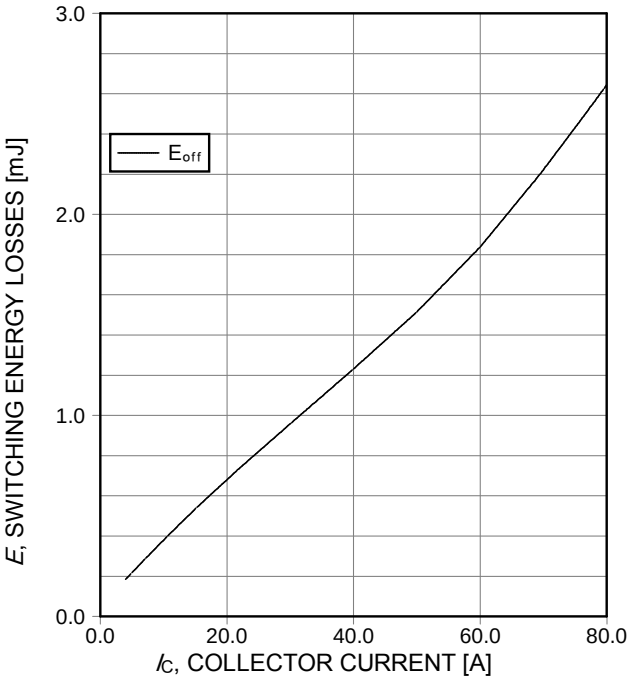


Figure 13. Typical switching energy losses as a function of collector current
(inductive load, T_j=175°C, V_{CE}=400V, V_{GE}=15/0V, R_G=5.6Ω,Dynamic test circuit in Figure E)

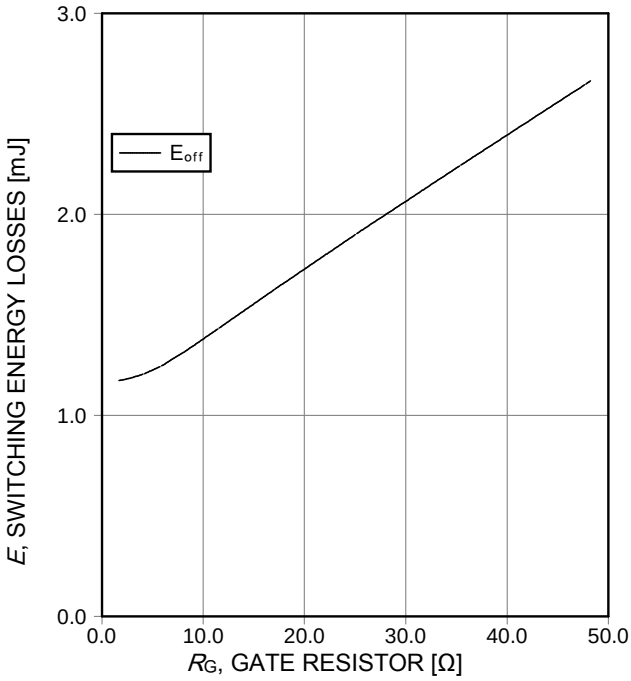


Figure 14. Typical switching energy losses as a function of gate resistor
(inductive load, T_j=175°C, V_{CE}=400V, V_{GE}=15/0V, R_G=5.6Ω,Dynamic test circuit in Figure E)

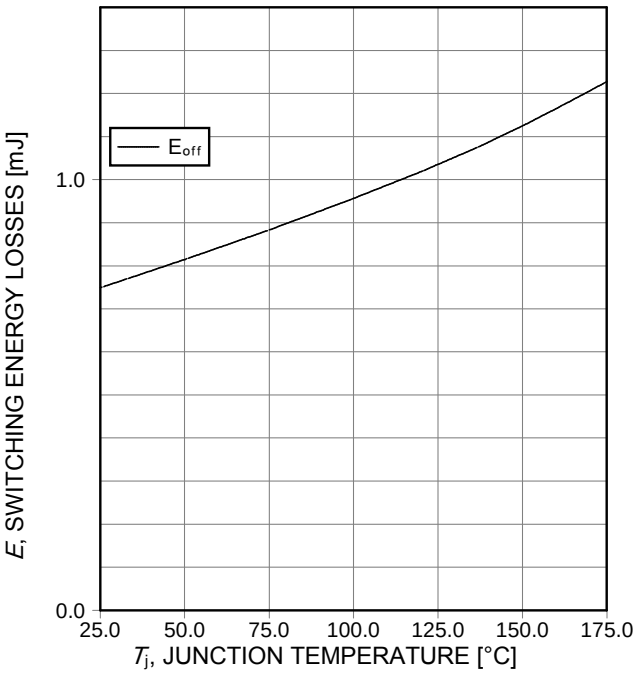


Figure 15. Typical switching energy losses as a function of junction temperature
(inductive load, V_{CE}=400V, V_{GE}=15/0V, I_C=40A, R_G=5.6Ω,Dynamic test circuit in Figure E)

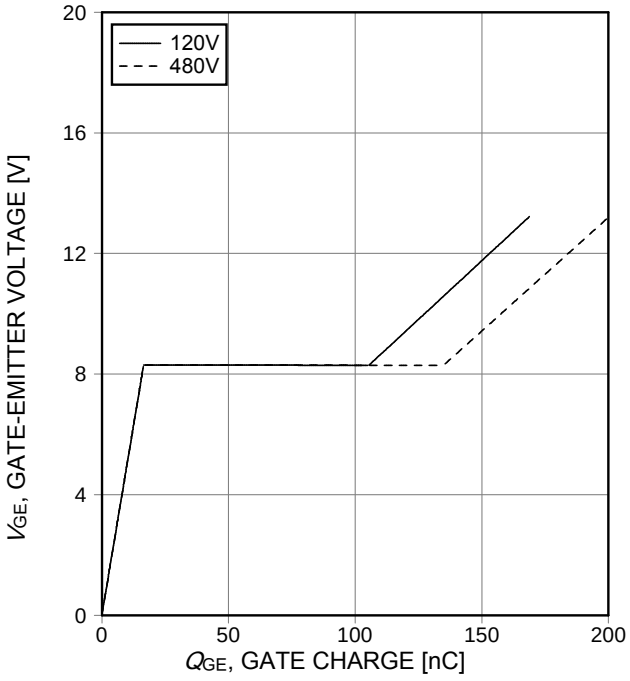


Figure 16. Typical gate charge
(I_C=40A)

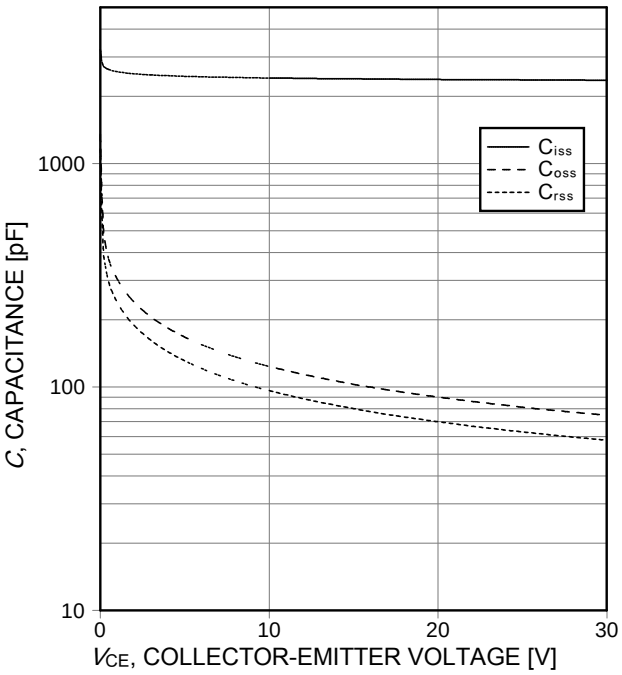


Figure 17. Typical capacitance as a function of collector-emitter voltage
(V_{GE}=0V, f=1MHz)

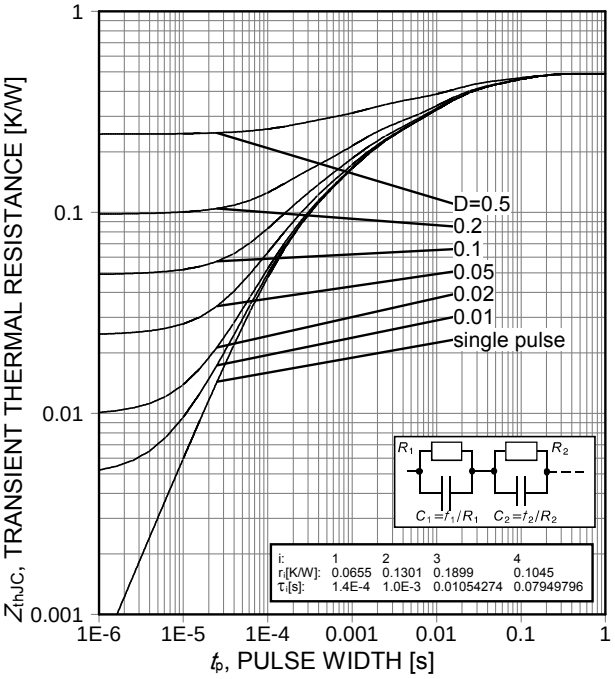


Figure 18. IGBT transient thermal resistance
($D=t_p/T$)

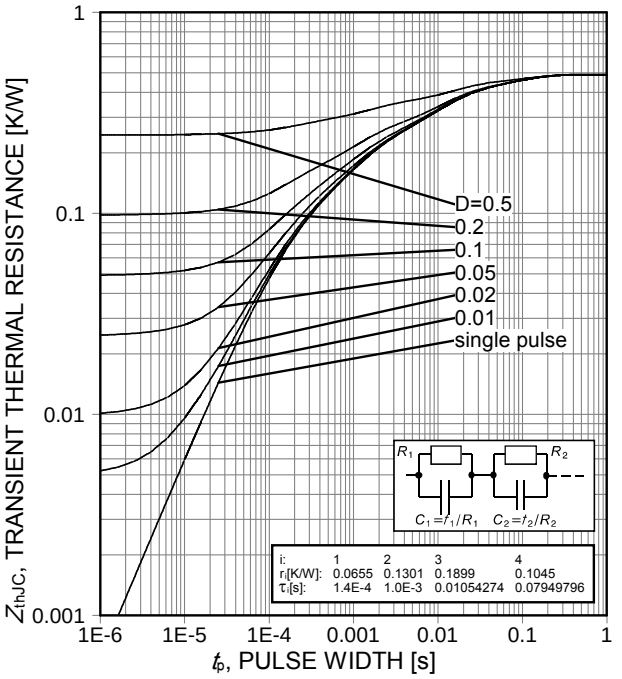


Figure 19. Diode transient thermal impedance as a function of pulse width
($D=t_p/T$)

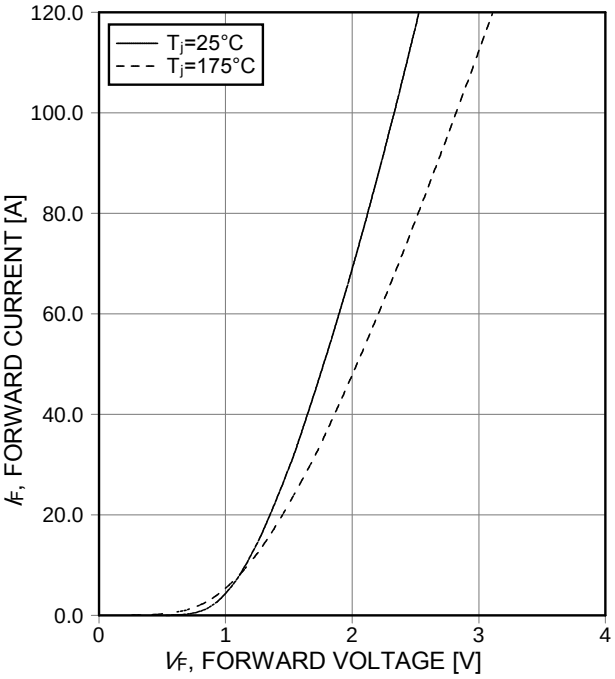


Figure 20. Typical diode forward current as a function of forward voltage

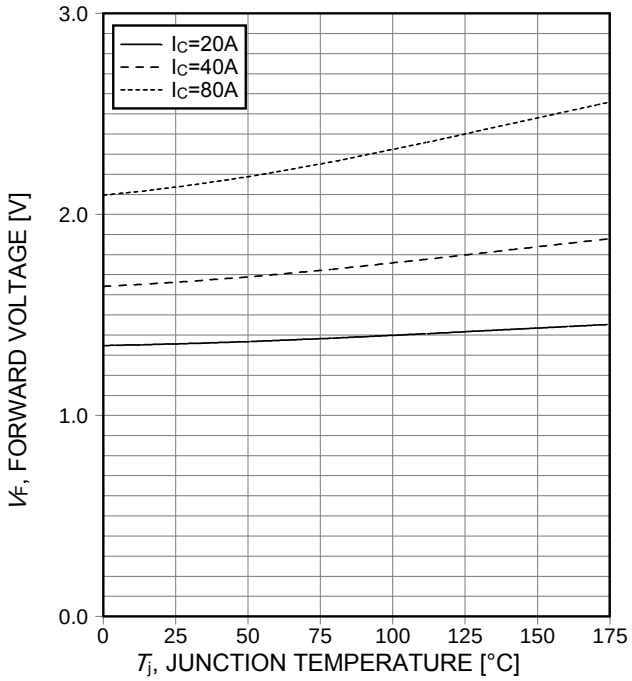
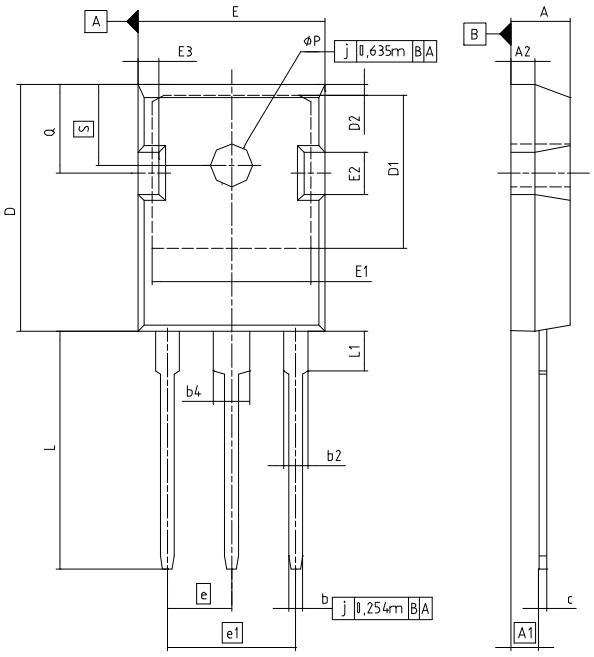


Figure 21. Typical diode forward voltage as a function of junction temperature



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DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.90	5.16	0.193	0.203
A1	2.27	2.53	0.089	0.099
A2	1.85	2.11	0.073	0.083
b	1.07	1.33	0.042	0.052
b2	1.90	2.39	0.075	0.094
b4	2.87	3.45	0.113	0.136
c	0.55	0.75	0.022	0.030
D	20.82	21.10	0.820	0.831
D1	16.25	17.83	0.640	0.702
D2	1.05	1.35	0.041	0.053
E	15.70	16.03	0.618	0.631
E1	13.10	14.15	0.516	0.557
E2	3.68	5.10	0.145	0.201
E3	1.68	2.60	0.066	0.102
e	5.44		0.214	
e1	10.90		0.429	
N	3		3	
L	19.80	20.31	0.780	0.799
L1	4.17	4.47	0.164	0.176
øP	3.50	3.70	0.138	0.146
Q	5.49	6.00	0.216	0.236
S	6.04	6.30	0.238	0.248

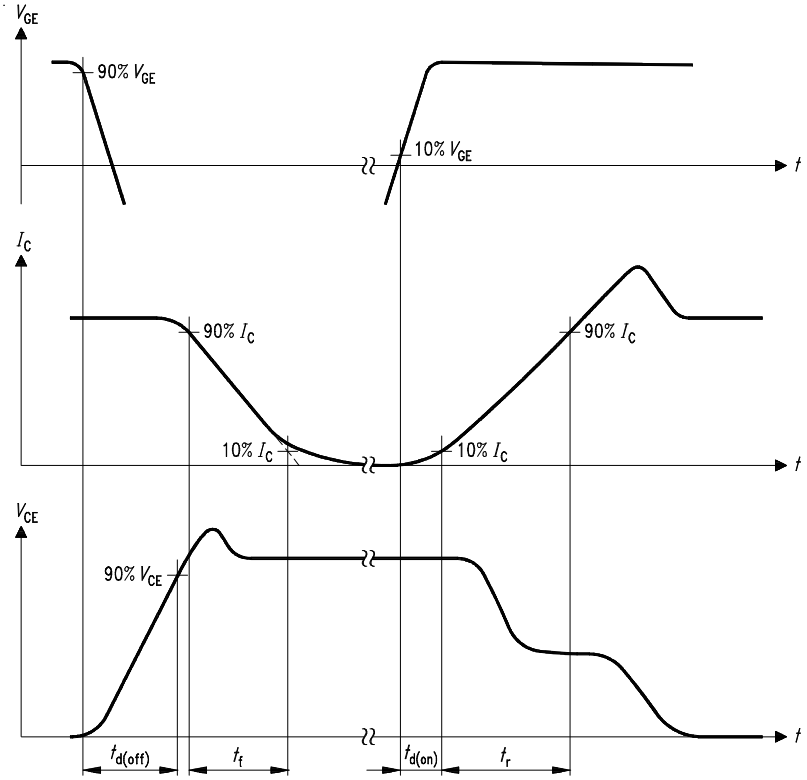

Figure A. Definition of switching times

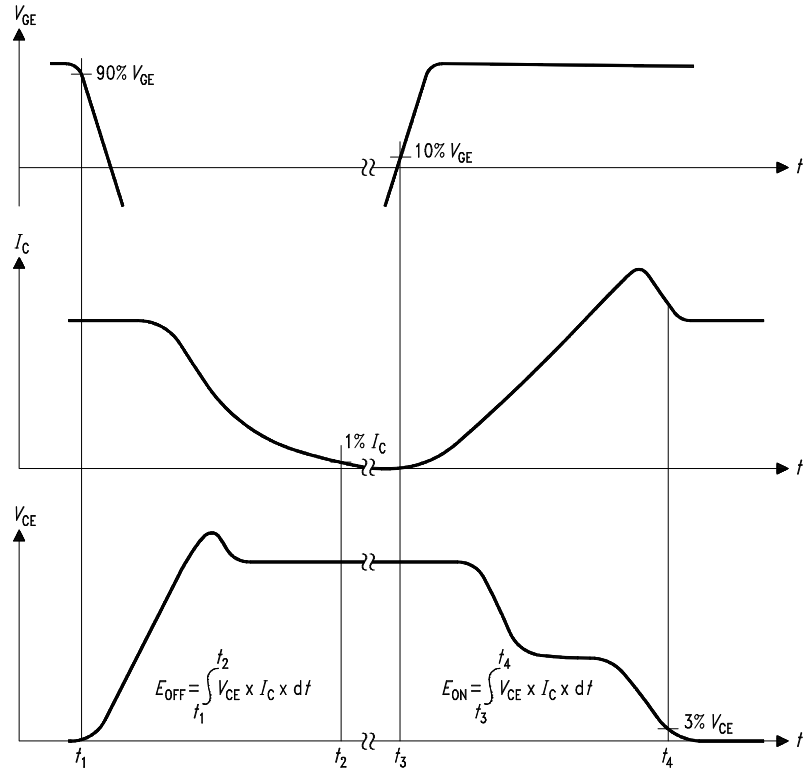

Figure B. Definition of switching losses

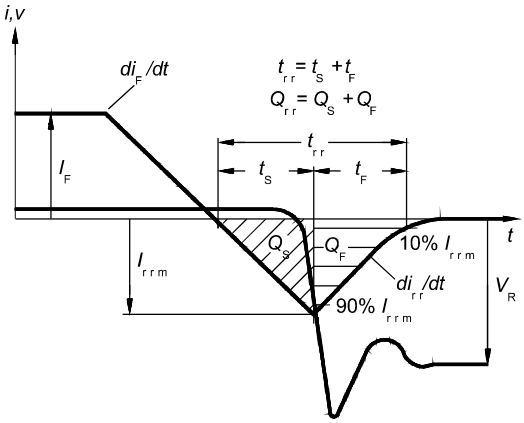

Figure C. Definition of diodes switching characteristics

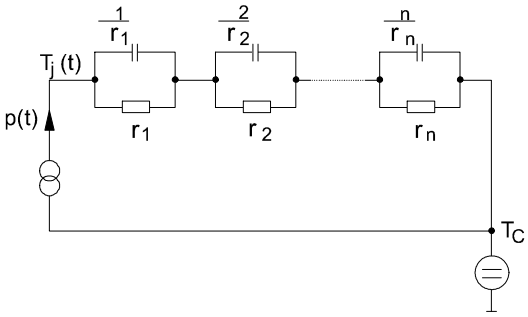

Figure D. Thermal equivalent circuit

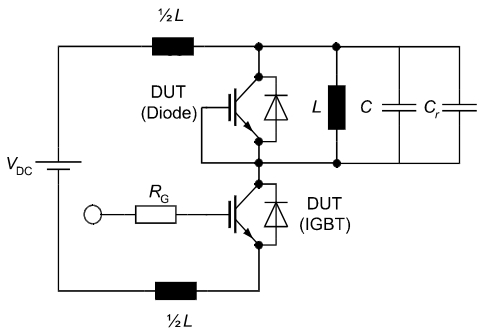

Figure E. Dynamic test circuit
Leakage inductance L= 180nH,
Stray capacitor C_σ = 40pF,
Relief capacitor C_r = 1nF
(only for ZVT switching)

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