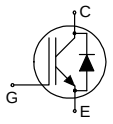
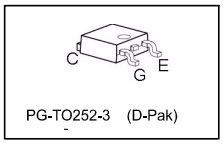
Reverse conducting IGBT with monolithic body diode

- 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_{CEsat}
  - easy parallel switching capability due to positive temperature coefficient in V_{CEsat}
- Low EMI
- Qualified according to JEDEC for target applications
- Pb-free lead plating; RoHS compliant; solder temperature 260°C, MSL3
- Complete product spectrum and PSpice Models: http://www.infineon.com/igbt/





Type	V_{CE}	I_C	$V_{CE(sat)}$ T_j=25°C	T_{jmax}	Marking	Package
IHD06N60RA	600V	6A	1.6V	175°C	H06N60RA	PG-TO252-3

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	 12.0 6.0	A
Pulsed collector current, t_p limited by T_{jmax}	I_{Cpuls}	18.0	A
Turn off safe operating area V_{CE} = 600V, T_j= 175°C	-	18.0	A
Diode forward current, limited by T_{jmax} T_C = 25°C T_C = 100°C	I_F	 12.0 6.0	A
Diode pulsed current, t_p limited by T_{jmax}	I_{Fpuls}	18.0	A
Gate-emitter voltage	V_{GE}	±20	V
Short circuit withstand time V_{GE} = 15.0V, V_{CC} ≤ 250V, T_j ≤ 125°C Allowed number of short circuits < 1000 Time between short circuits: ≥ 1.0s	t_{SC}	10	µs
Power dissipation T_C = 25°C	P_{tot}	88.0	W
Operating junction temperature	T_j	-40...+175	°C
Storage temperature	T_{stg}	-40...+175	°C
Soldering temperature, for 10 s (according to JEDEC J-STA-020A)	PG-TO252-3	260	°C

Thermal Resistance

Parameter	Symbol	Conditions	Max. Value	Unit
Characteristic				
IGBT thermal resistance, junction - case	R_{thJC}		1.70	K/W
Diode thermal resistance, junction - case	R_{thJCD}		1.70	K/W
Thermal resistance, min. footprint junction - ambient	R_{thJA}	PG-TO252-3	75	K/W
Thermal resistance, 6cm² Cu on PCB junction - ambient	R_{thJA}	PG-TO252-3	50	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 = 0.20mA	600	-	-	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	V_{GE} = 15.0V, I_C = 6.0A T_j = 25°C T_j = 150°C T_j = 175°C	 - - -	 1.45 1.70 1.75	 1.90 - -	V
Diode forward voltage	V_F	V_{GE} = 0V, I_F = 6.0A T_j = 25°C T_j = 150°C T_j = 175°C	 - - -	 1.55 1.65 1.65	 1.90 - 	V
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C = 0.18mA, 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	 - -	 - -	 40.0 600.0	µA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0V, V_{GE} = 20V	-	-	100	nA
Transconductance	g_{fs}	V_{CE} = 20V, I_C = 6.0A	-	3.7	-	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	-	370	-	pF
Output capacitance	C_{oss}		-	28	-	
Reverse transfer capacitance	C_{rss}		-	11	-	
Gate charge	Q_{Gate}	V_{CC} = 480V, I_C = 6.0A, V_{GE} = 15V	-	42.0	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E	PG-TO252-3	-	7.0	-	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 = 6.0A, V_{GE} = 0.0/15.0V, R_G = 14.7Ω, L_σ = 60nH, C_σ = 40pF L_σ, C_σ from Fig. E	-	125	-	ns
Fall time	t_f		-	145	-	ns
Turn-off energy	E_{off}		-	0.15	-	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 = 6.0A, V_{GE} = 0.0/15.0V, R_G = 14.7Ω, L_σ = 60nH, C_σ = 40pF L_σ, C_σ from Fig. E	-	165	-	ns
Fall time	t_f		-	160	-	ns
Turn-off energy	E_{off}		-	0.25	-	mJ

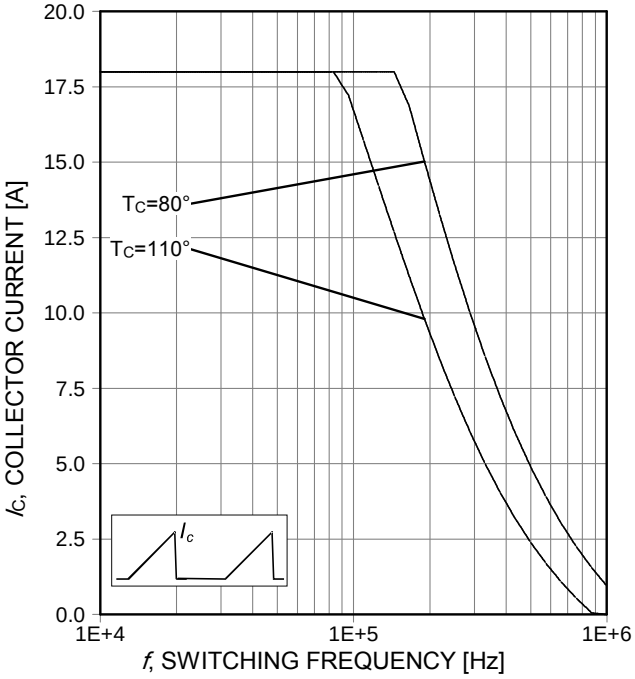


Figure 1. Collector current as a function of switching frequency
(T_j≤175°C, D=0.5, V_{CE}=400V, V_{GE}=15/0V, R_G=14.7Ω)

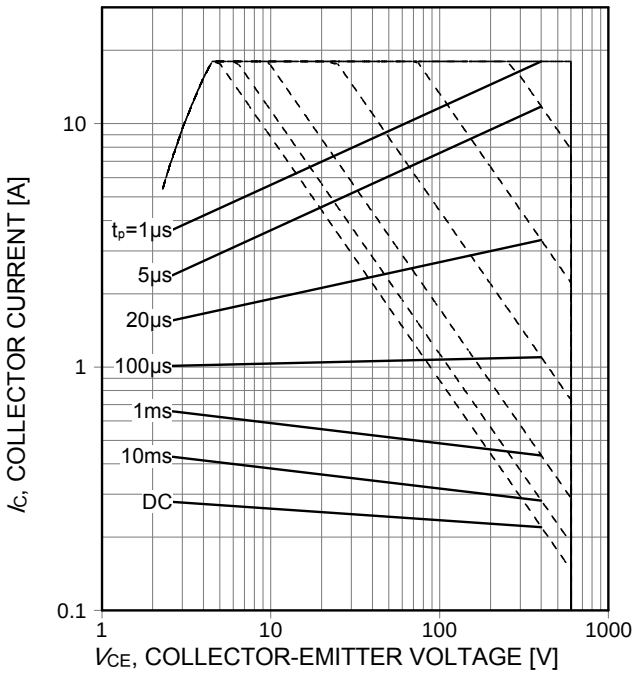


Figure 2. Forward bias safe operating area
(D=0, T_C=25°C, T_j≤175°C; V_{GE}=15V)

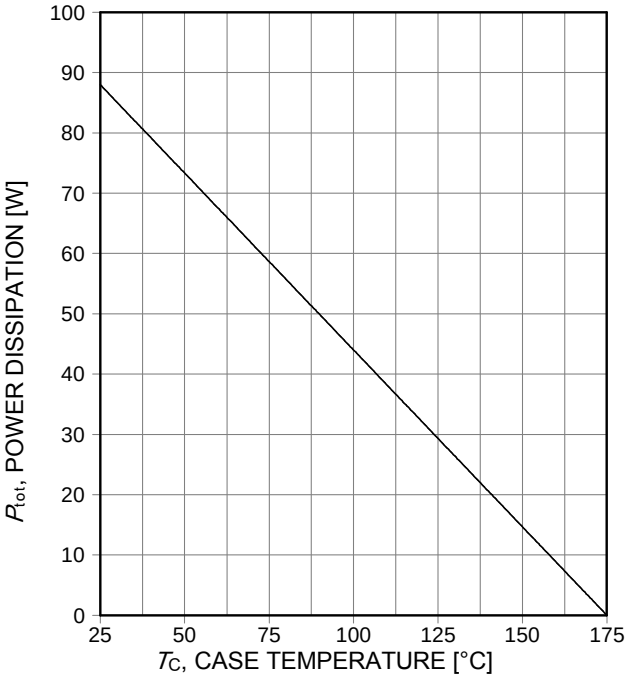


Figure 3. Power dissipation as a function of case temperature
(T_j≤175°C)

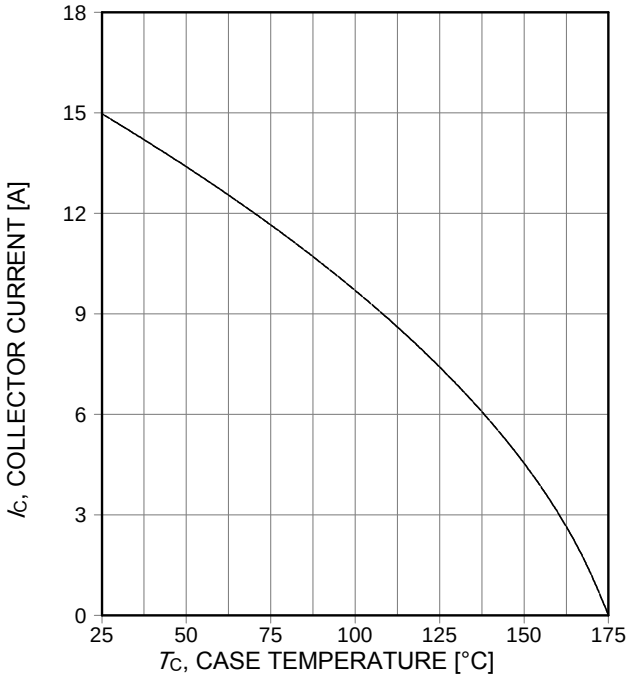


Figure 4. Collector current as a function of case temperature
(V_{GE}≥15V, T_j≤175°C)

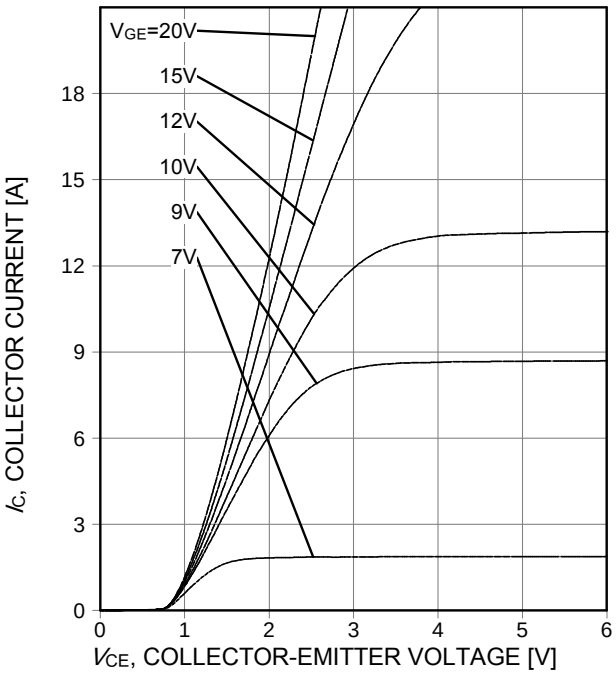


Figure 5. Typical output characteristic
(T_j=25°C)

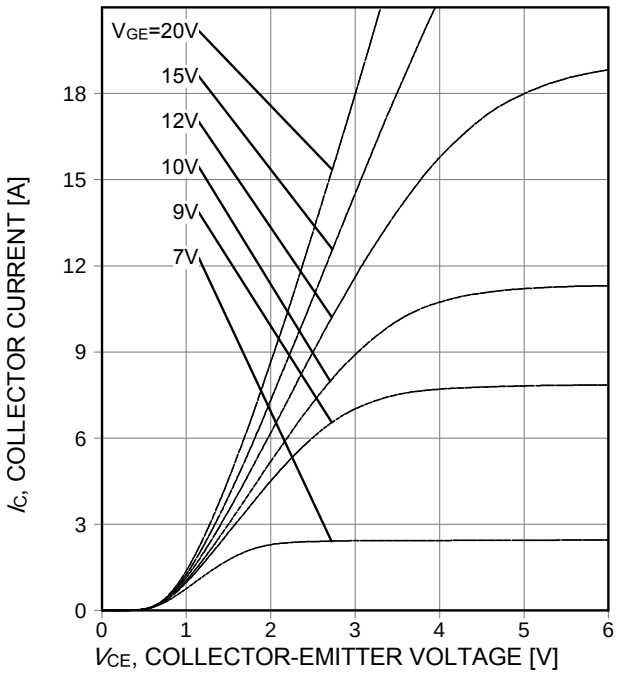


Figure 6. Typical output characteristic
(T_j=175°C)

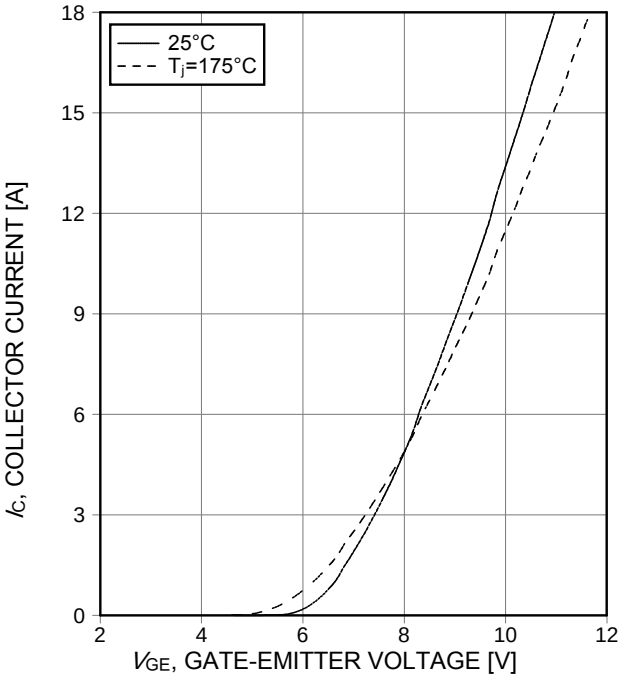


Figure 7. Typical transfer characteristic
(V_{CE}=20V)

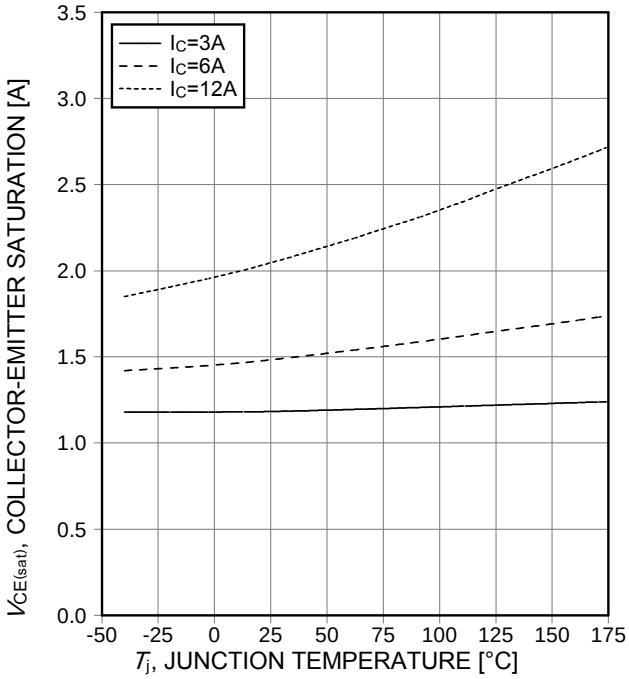


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
(V_{GE}=15V)

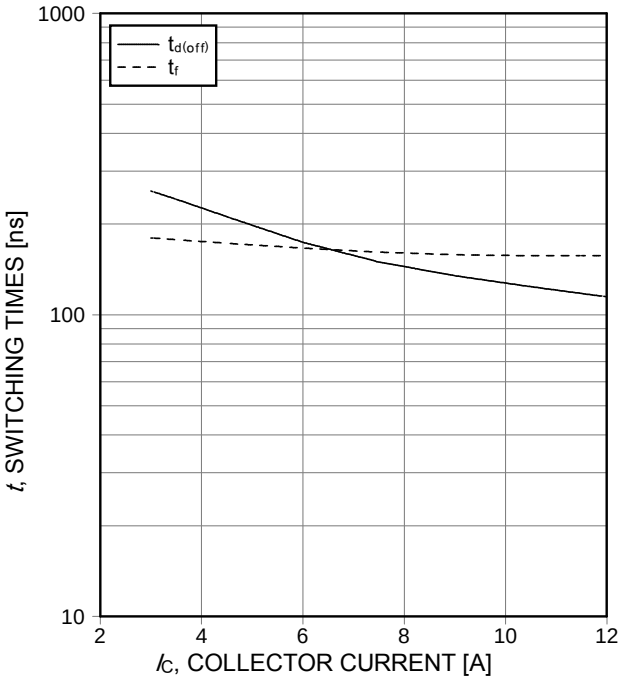


Figure 9. Typical switching times as a function of collector current
(inductive load, T_j=175°C, V_{CE}=400V, V_{GE}=15/0V, R_G=14.7Ω,Dynamic test circuit in Figure E)

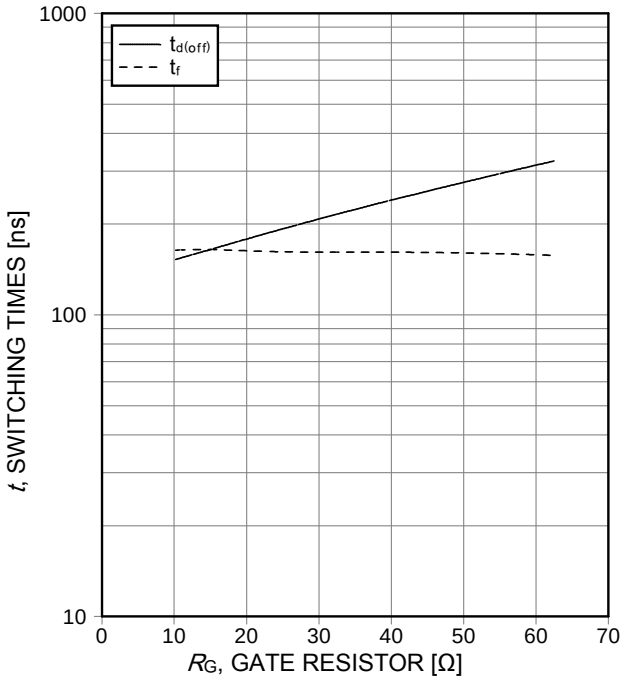


Figure 10. Typical switching times as a function of gate resistor
(inductive load, T_j=175°C, V_{CE}=400V, V_{GE}=15/0V, I_C=6A,Dynamic test circuit in Figure E)

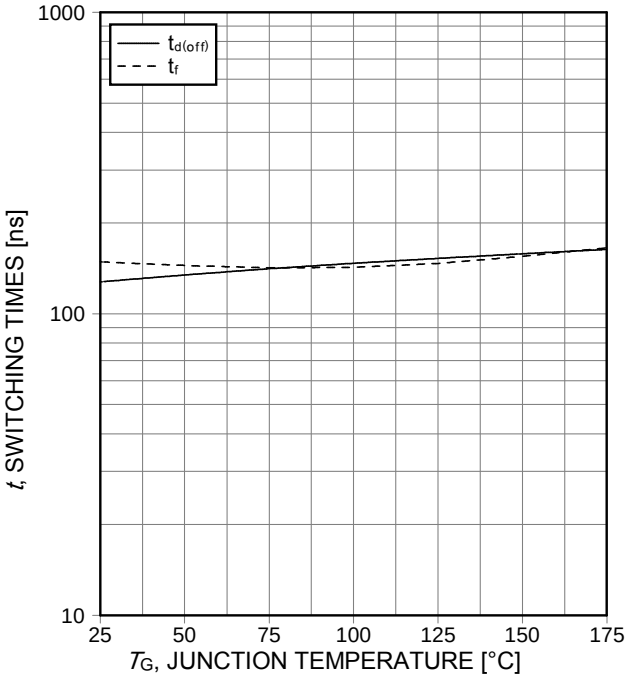


Figure 11. Typical switching times as a function of junction temperature
(inductive load, V_{CE}=400V, V_{GE}=15/0V, I_C=6A, R_G=14.7Ω,Dynamic test circuit in Figure E)

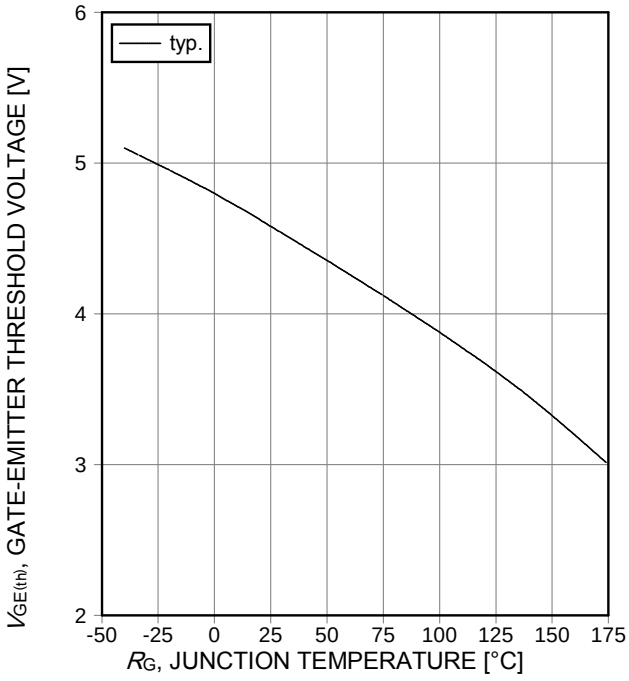


Figure 12. Gate-emitter threshold voltage as a function of junction temperature
(I_C=0.18mA)

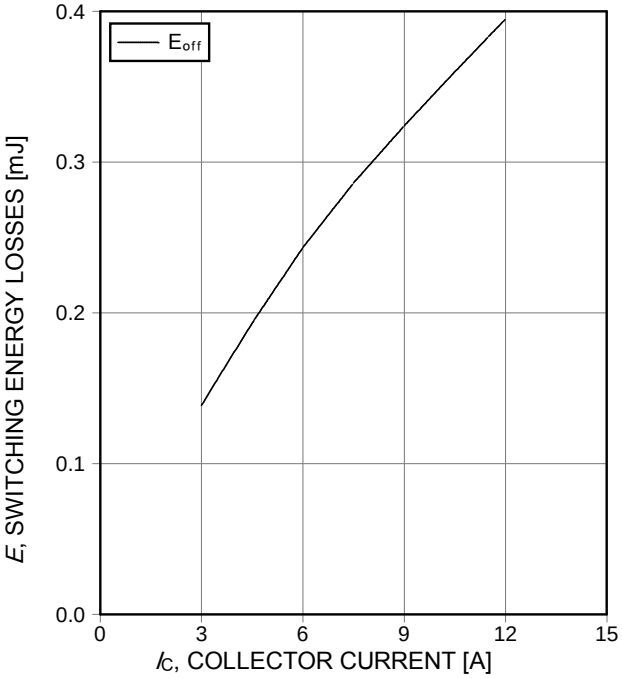


Figure 13. Typical switching energy losses as a function of collector current
(inductive load, T_j=175°C, V_{CE}=400V, V_{GE}=15/0V, R_G=14.7Ω,Dynamic test circuit in Figure E)

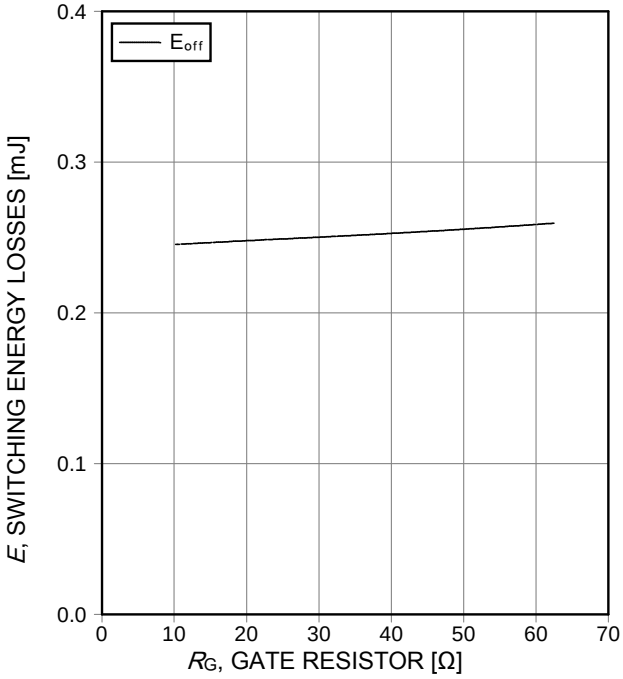


Figure 14. Typical switching energy losses as a function of gate resistor
(inductive load, T_j=175°C, V_{CE}=400V, V_{GE}=15/0V, R_G=14.7Ω,Dynamic test circuit in Figure E)

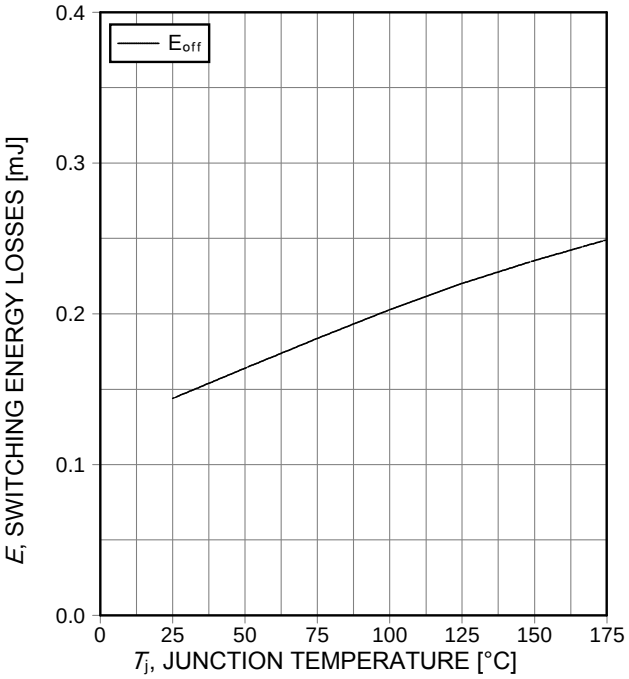


Figure 15. Typical switching energy losses as a function of junction temperature
(inductive load, V_{CE}=400V, V_{GE}=15/0V, I_C=6A, R_G=14.7Ω,Dynamic test circuit in Figure E)

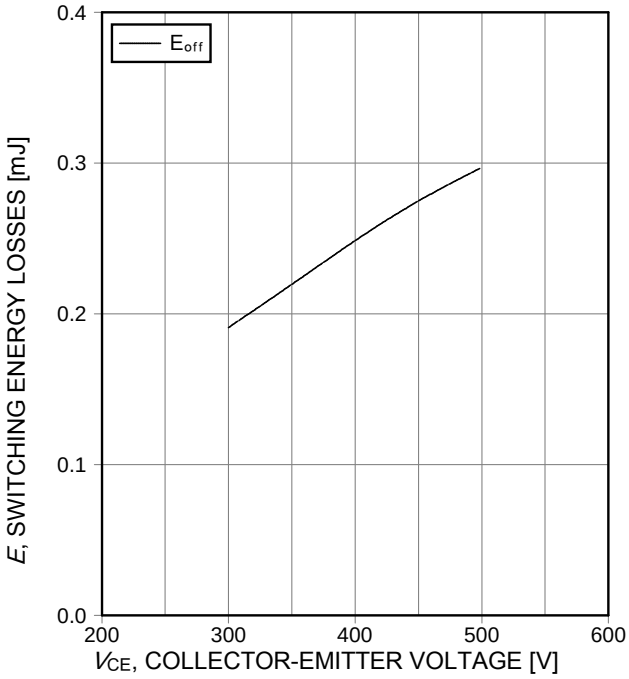


Figure 16. Typical switching energy losses as a function of collector emitter voltage
(inductive load, T_j=175°C, V_{GE}=15/0V, I_C=6A, R_G=14.7Ω,Dynamic test circuit in Figure E)

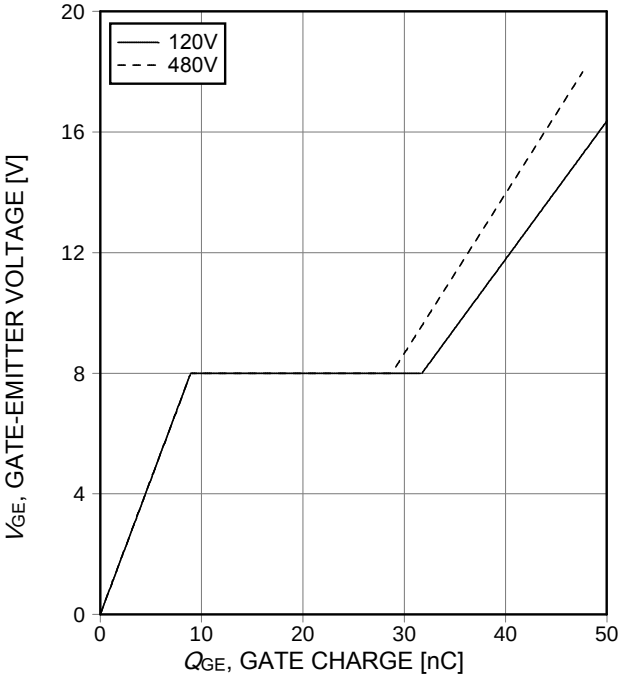


Figure 17. Typical gate charge
(I_C=6A)

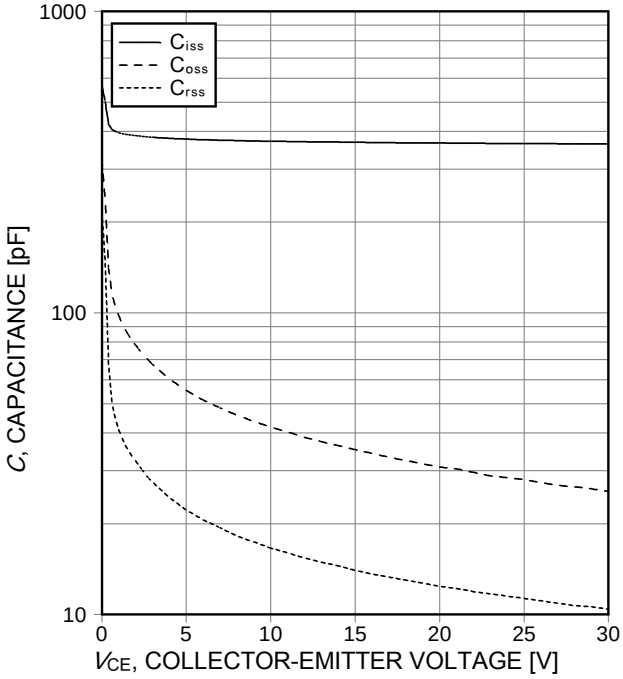


Figure 18. Typical capacitance as a function of collector-emitter voltage
(V_{GE}=0V, f=1MHz)

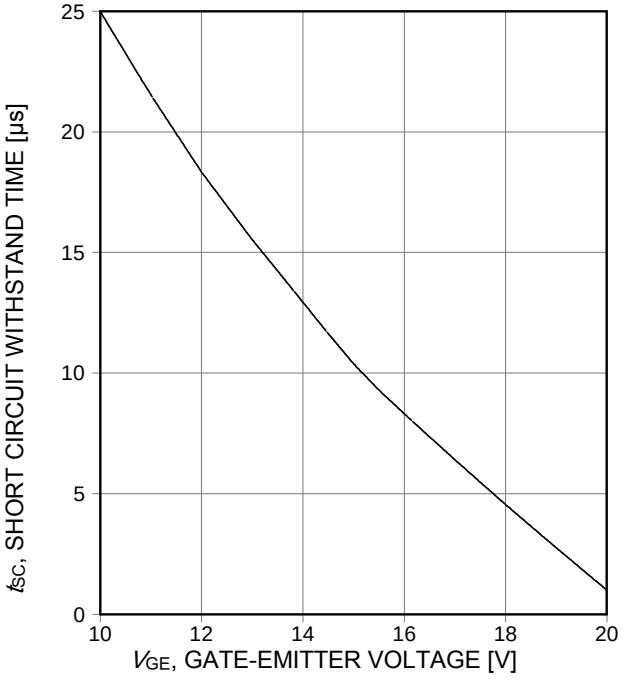


Figure 19. Short circuit withstand time as a function of gate-emitter voltage
(V_{CE}≤250V, start at T_j≤125°C)

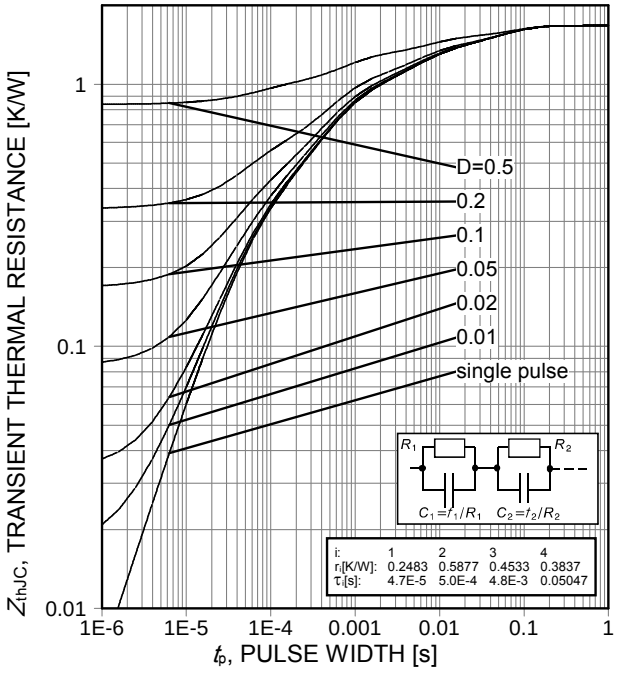


Figure 20. IGBT transient thermal resistance
($D=t_p/T$)

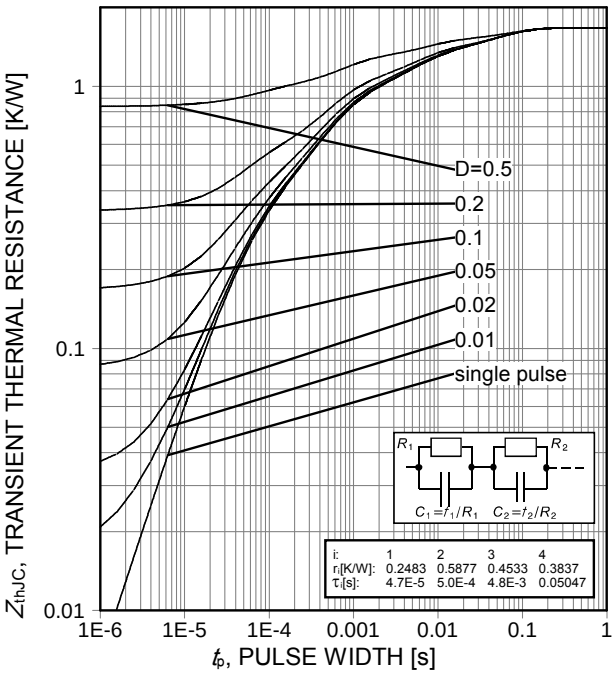


Figure 21. Diode transient thermal impedance as a function of pulse width
($D=t_p/T$)

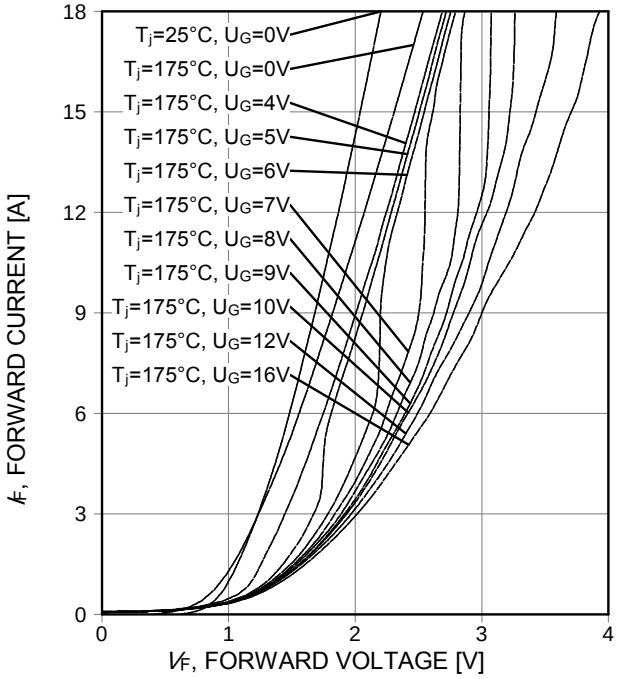


Figure 22. Typical diode forward current as a function of forward voltage

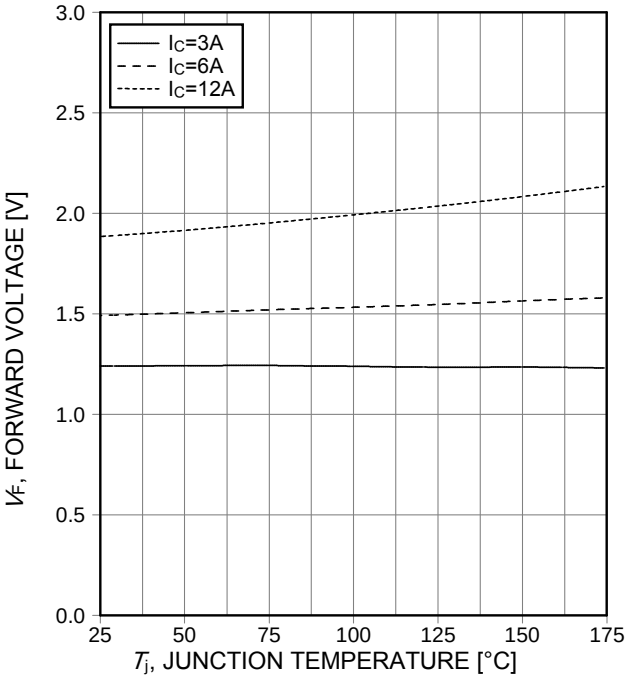
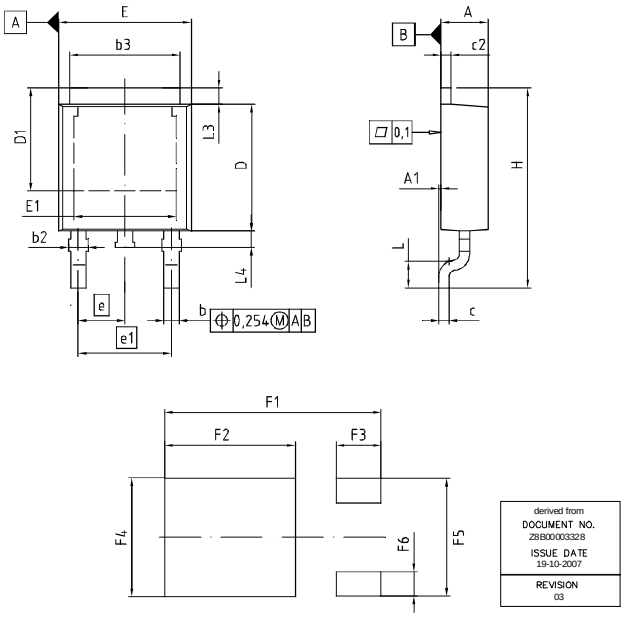


Figure 23. Typical diode forward voltage as a function of junction temperature



PG- TO252-3-1 /-11 /-21 /-311 /-341

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.16	2.41	0.085	0.095
A1	0.00	0.15	0.000	0.006
b	0.64	0.89	0.025	0.035
b2	0.65	1.15	0.026	0.045
b3	5.00	5.50	0.197	0.217
c	0.46	0.60	0.018	0.024
c2	0.46	0.98	0.018	0.039
D	5.97	6.22	0.235	0.245
D1	5.02	5.84	0.198	0.230
E	6.40	6.73	0.252	0.265
E1	4.70	5.21	0.185	0.205
e	2.29		0.090	
e1	4.57		0.180	
N	3		3	
H	9.40	10.48	0.370	0.413
L	1.18	1.70	0.046	0.067
L3	0.90	1.25	0.035	0.049
L4	0.51	1.00	0.020	0.039
F1	10.50	10.70	0.413	0.421
F2	6.30	6.50	0.248	0.256
F3	2.10	2.30	0.083	0.091
F4	5.70	5.90	0.224	0.232
F5	5.66	5.86	0.223	0.231
F6	1.10	1.30	0.043	0.051

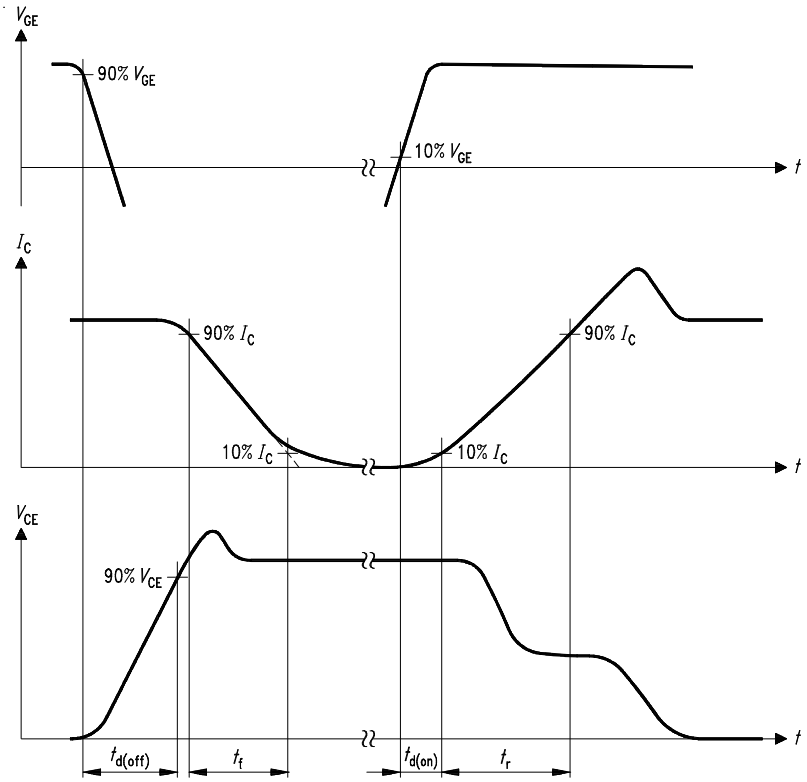


Figure A. Definition of switching times

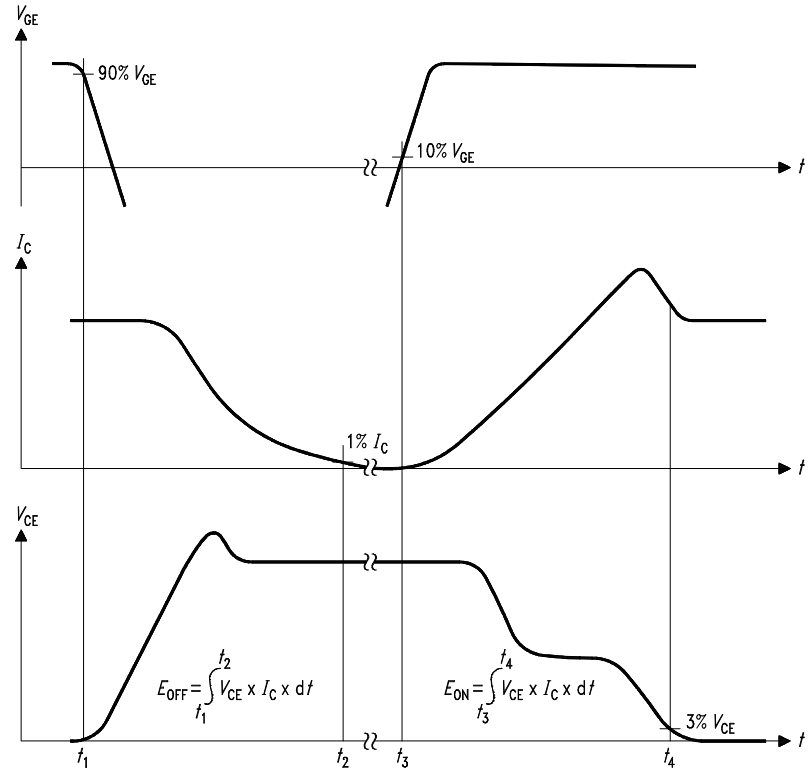


Figure B. Definition of switching losses

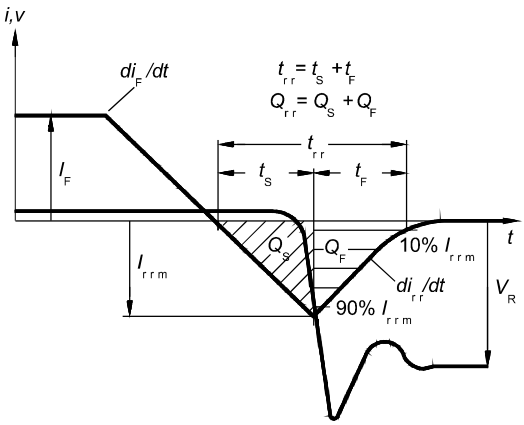


Figure C. Definition of diodes switching characteristics

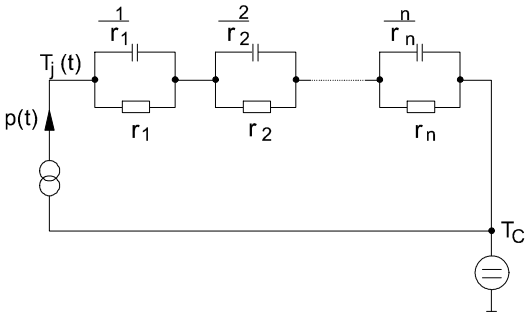


Figure D. Thermal equivalent circuit

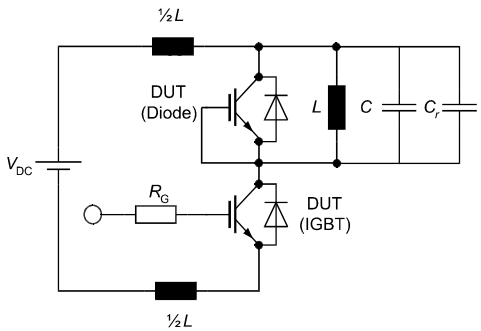


Figure E. Dynamic test circuit
Leakage inductance L= 180nH,
Stray capacitor C_σ = 40pF,
Relief capacitor C_r = 1nF
(only for ZVT switching)

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