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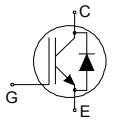
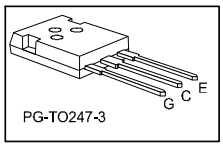
Reverse conducting IGBT





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_{CEsat}
- 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
- Soft switching applications

Type	V_{CE}	I_C	V_{CEsat}, T_{vj}=25°C	T_{vjmax}	Marking	Package
IHW40N60RF	600V	40A	1.85V	175°C	H40RF60	PG-TO247-3

Maximum ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	600	V
DC collector current, limited by T_{vjmax} T_C = 25°C T_C = 100°C	I_C	 80.0 40.0	A
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}	120.0	A
Turn off safe operating area $V_{CE} \le 600V$, $T_{vj} \le 175°C$	-	120.0	A
Diode forward current, limited by T_{vjmax} T_C = 25°C T_C = 100°C	I_F	 80.0 40.0	A
Diode pulsed current, t_p limited by T_{vjmax}	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_{vj}	-40...+175	°C
Storage temperature	T_{stg}	-55...+175	°C
Soldering temperature, wavesoldering 1.6 mm (0.063 in.) from case for 10s		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	$R_{th(j-c)}$		0.49	K/W
Diode thermal resistance, junction - case	$R_{th(j-c)}$		0.49	K/W
Thermal resistance junction - ambient	$R_{th(j-a)}$		40	K/W

Electrical Characteristic, at T_{vj} = 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_{CEsat}	V_{GE} = 15.0V, I_C = 40.0A T_{vj} = 25°C T_{vj} = 175°C	- -	1.85 2.30	2.40 -	V
Diode forward voltage	V_F	V_{GE} = 0V, I_F = 40.0A T_{vj} = 25°C T_{vj} = 175°C	- -	1.75 2.00	2.20	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_{vj} = 25°C T_{vj} = 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	-	24.0	-	S
Integrated gate resistor	r_G			none		Ω

Electrical Characteristic, at T_{vj} = 25°C, unless otherwise specified

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
Dynamic Characteristic						
Input capacitance	C_{ies}	V_{CE} = 25V, V_{GE} = 0V, f = 1MHz	-	2400	-	pF
Output capacitance	C_{oes}		-	88	-	
Reverse transfer capacitance	C_{res}		-	68	-	
Gate charge	Q_G	V_{CC} = 480V, I_C = 40.0A, V_{GE} = 15V	-	220.0	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E		-	13.0	-	nH
Short circuit collector current Max. 1000 short circuits Time between short circuits: ≥ 1.0s	$I_{C(SC)}$	V_{GE} = 15.0V, V_{CC} ≤ 400V	-		-	A

Switching Characteristic, Inductive Load, at T_{vj} = 25°C

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic						
Turn-off delay time	$t_{d(off)}$	T_{vj} = 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.	-	175	-	ns
Fall time	t_f		-	14	-	ns
Turn-off energy	E_{off}		-	0.56	-	mJ

Switching Characteristic, Inductive Load, at T_{vj} = 125°C

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic						
Turn-off delay time	$t_{d(off)}$	T_{vj} = 125°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.	-	205	-	ns
Fall time	t_f		-	23	-	ns
Turn-off energy	E_{off}		-	0.79	-	mJ

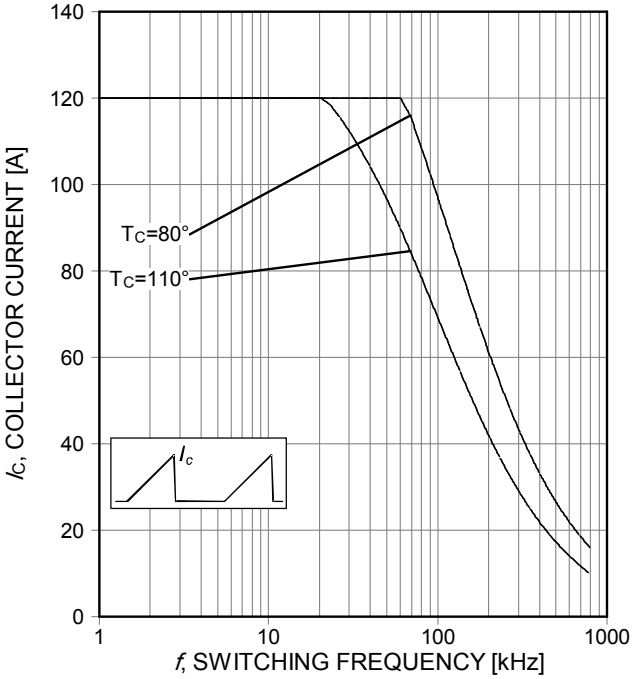


Figure 1. Collector current as a function of switching frequency
(T_{vj}≤175°C, D=0.5, V_{CE}=400V, V_{GE}=15/0V, r_G=5.6Ω)

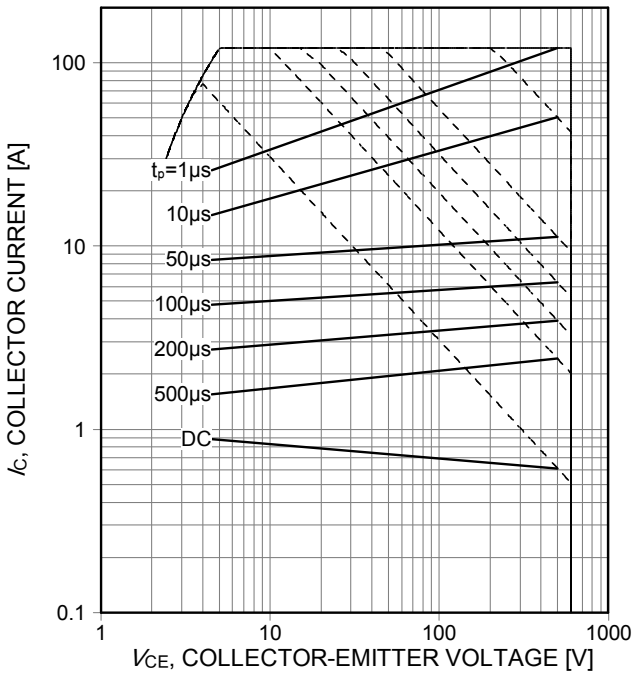


Figure 2. Forward bias safe operating area
(D=0, T_C=25°C, T_{vj}≤175°C; V_{GE}=15V)

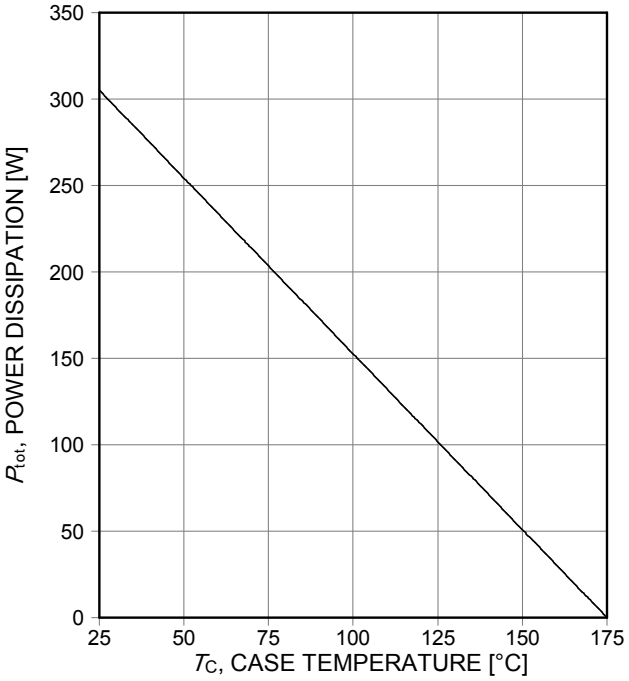


Figure 3. Power dissipation as a function of case temperature
(T_{vj}≤175°C)

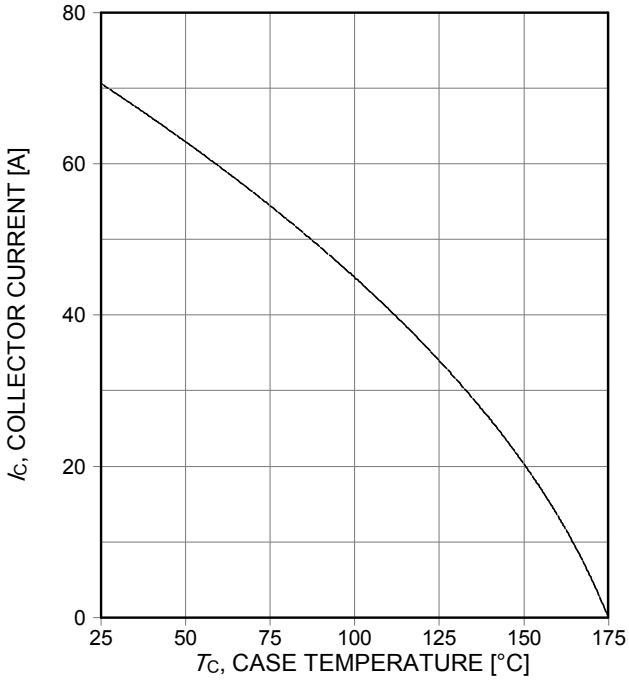


Figure 4. Collector current as a function of case temperature
(V_{GE}≥15V, T_{vj}≤175°C)

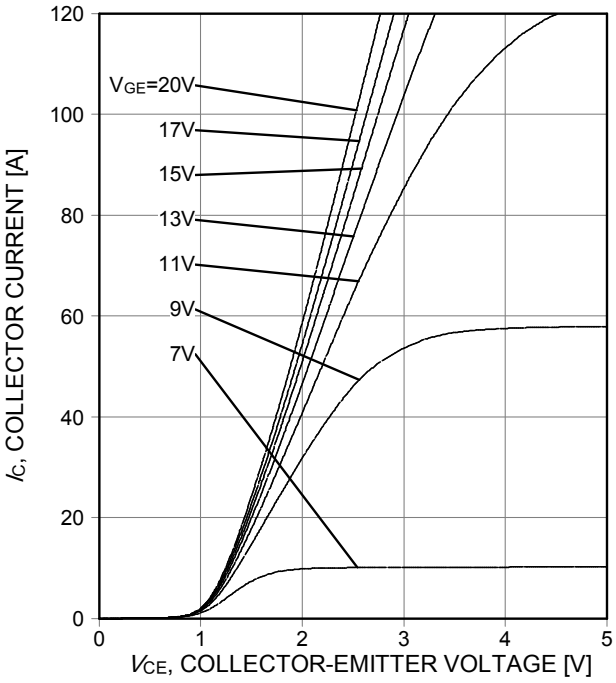


Figure 5. Typical output characteristic
(T_{vj}=25°C)

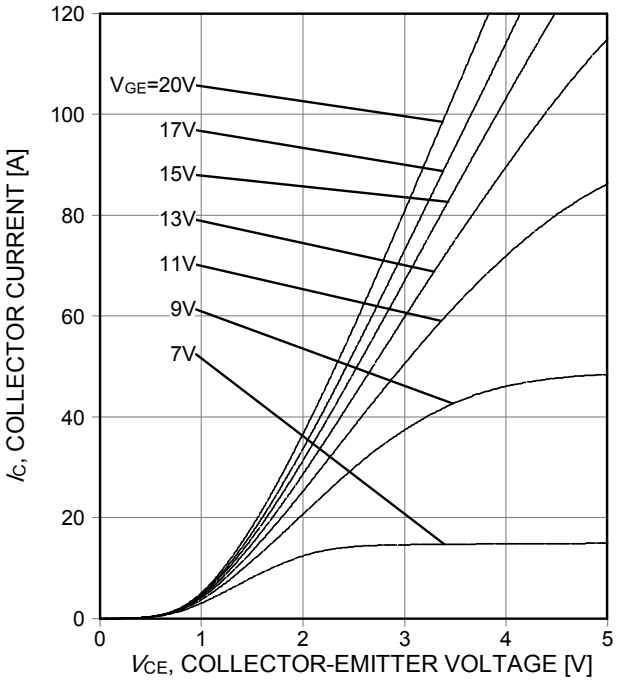


Figure 6. Typical output characteristic
(T_{vj}=175°C)

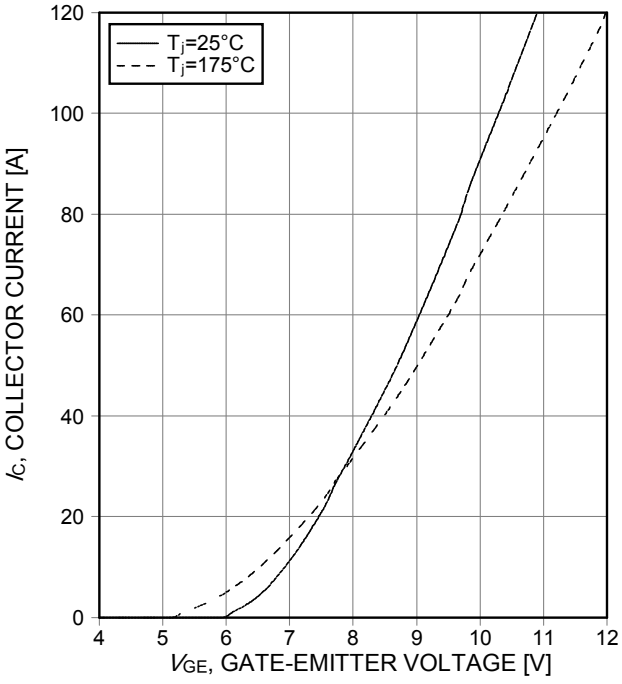


Figure 7. Typical transfer characteristic
(V_{CE}=20V)

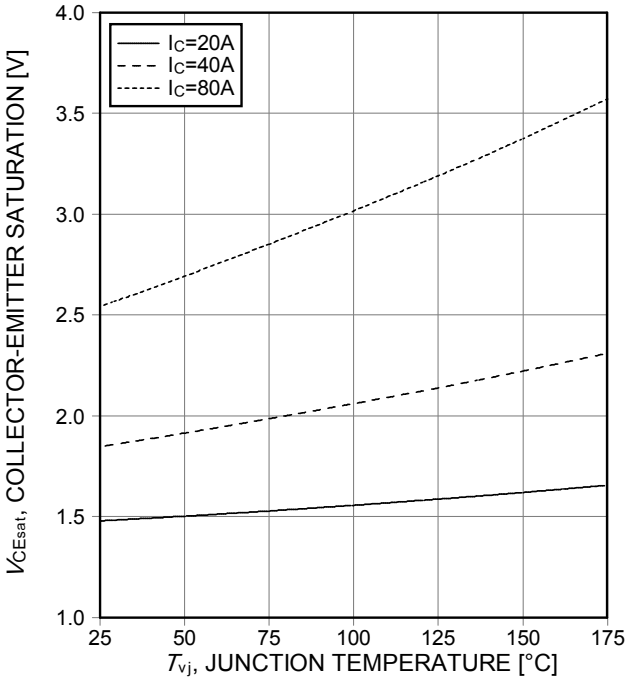


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
(V_{GE}=15V)

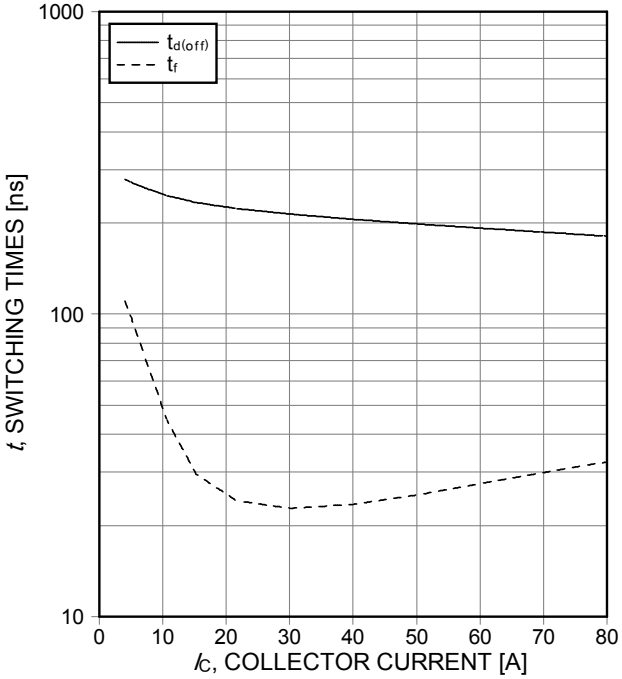


Figure 9. Typical switching times as a function of collector current
(inductive load, T_{vj}=175°C, V_{CE}=400V, V_{GE}=15/0V, r_G=5.6Ω, Dynamic test circuit in Figure E)

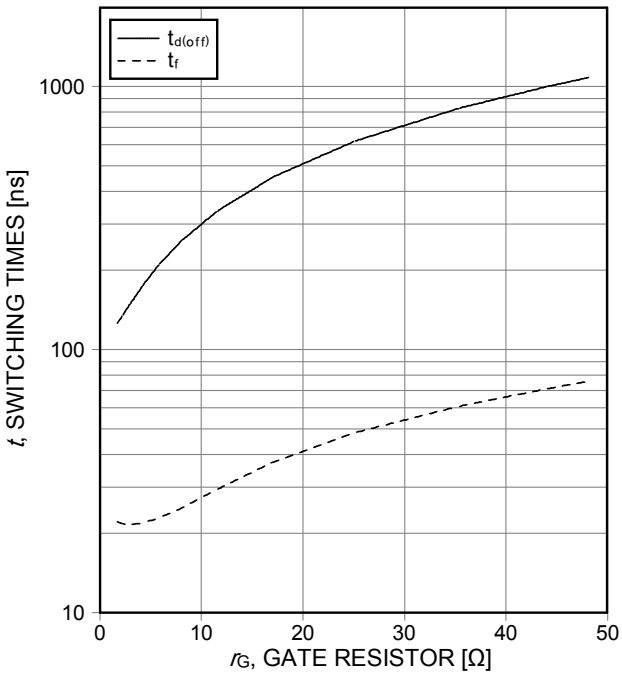


Figure 10. Typical switching times as a function of gate resistor
(inductive load, T_{vj}=175°C, V_{CE}=400V, V_{GE}=15/0V, I_C=40A, Dynamic test circuit in Figure E)

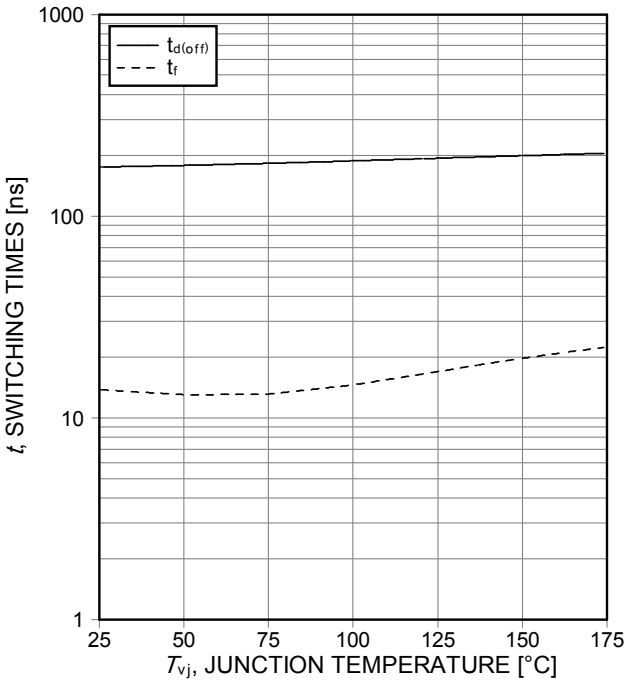


Figure 11. Typical switching times as a function of junction temperature
(inductive load, V_{CE}=400V, V_{GE}=15/0V, I_C=40A, r_G=5.6Ω,Dynamic test circuit in Figure E)

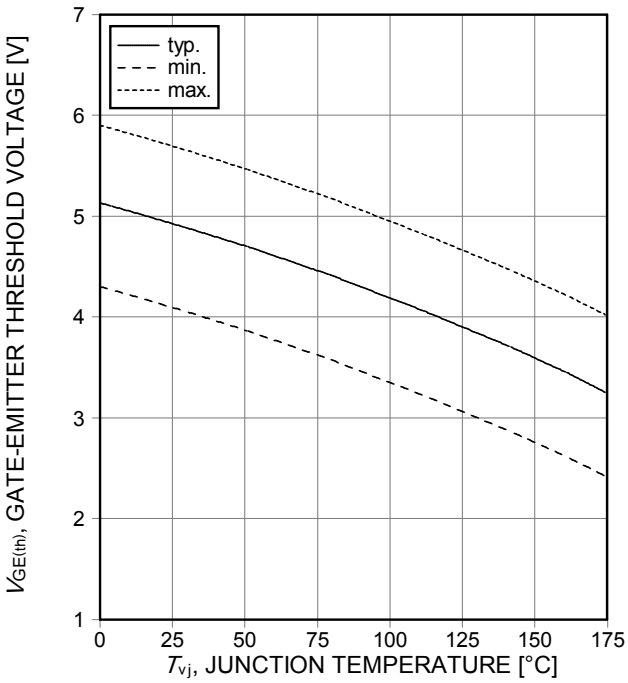


Figure 12. Gate-emitter threshold voltage as a function of junction temperature
(I_C=0.58mA)

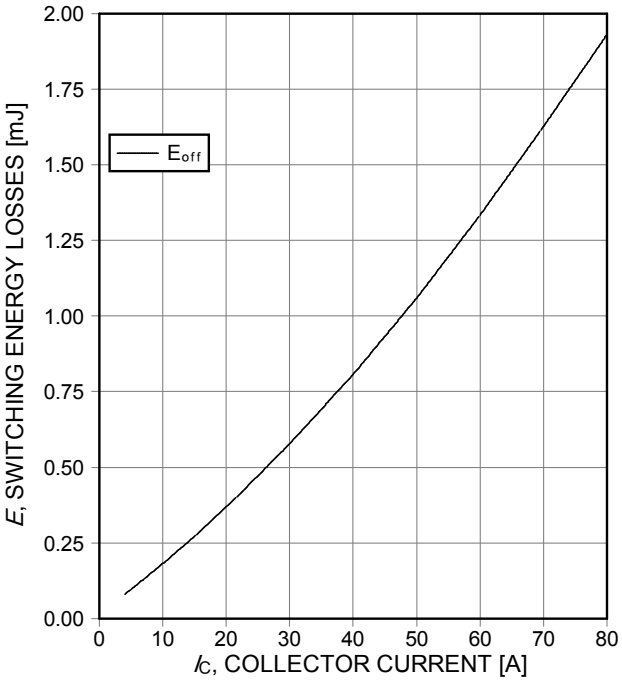


Figure 13. Typical switching energy losses as a function of collector current
(inductive load, T_{vj}=175°C, V_{CE}=400V, V_{GE}=15/0V, r_G=5.6Ω,Dynamic test circuit in Figure E)

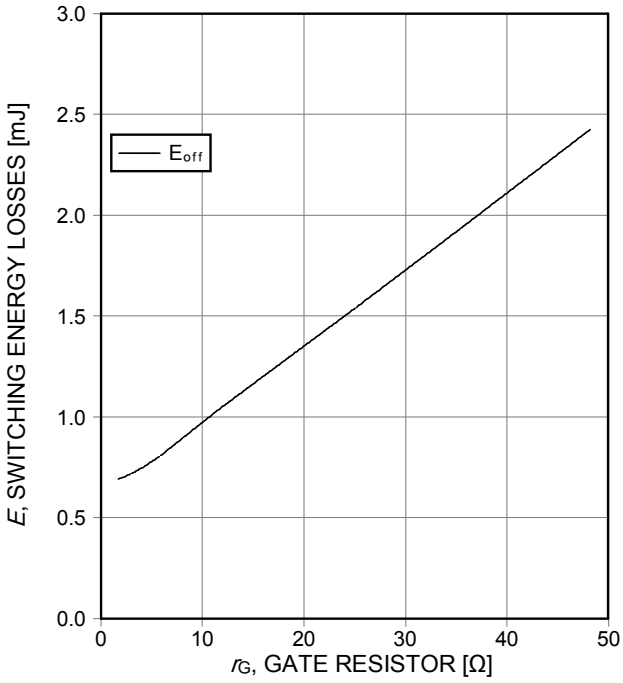


Figure 14. Typical switching energy losses as a function of gate resistor
(inductive load, T_{vj}=175°C, V_{CE}=400V, V_{GE}=15/0V, I_C=40A, Dynamic test circuit in Figure E)

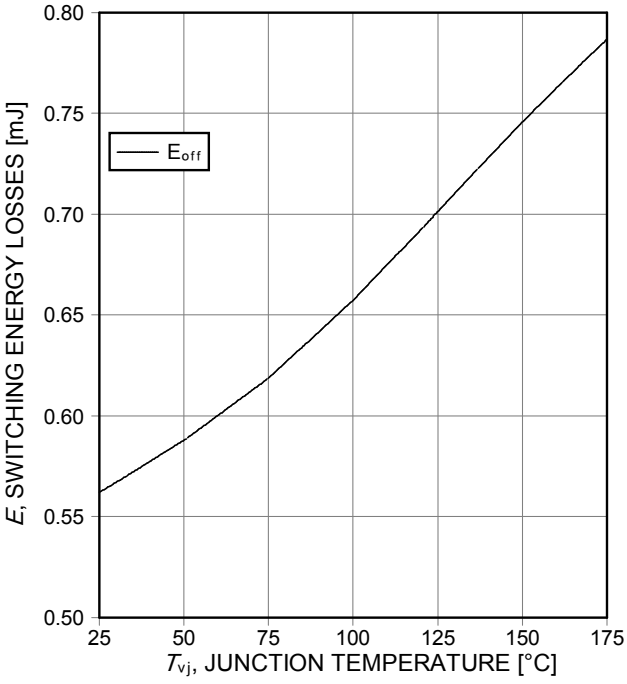


Figure 15. Typical switching energy losses as a function of junction temperature
(inductive load, V_{CE}=400V, V_{GE}=15/0V, I_C=40A, r_G=5.6Ω,Dynamic test circuit in Figure E)

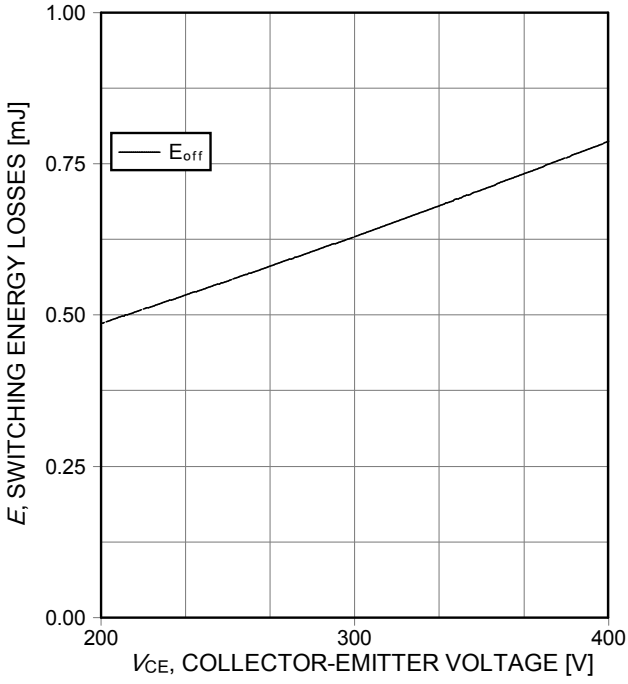


Figure 16. Typical switching energy losses as a function of collector emitter voltage
(inductive load, T_{vj}=175°C, V_{GE}=15/0V, I_C=40A, r_G=5.6Ω,Dynamic test circuit in Figure E)

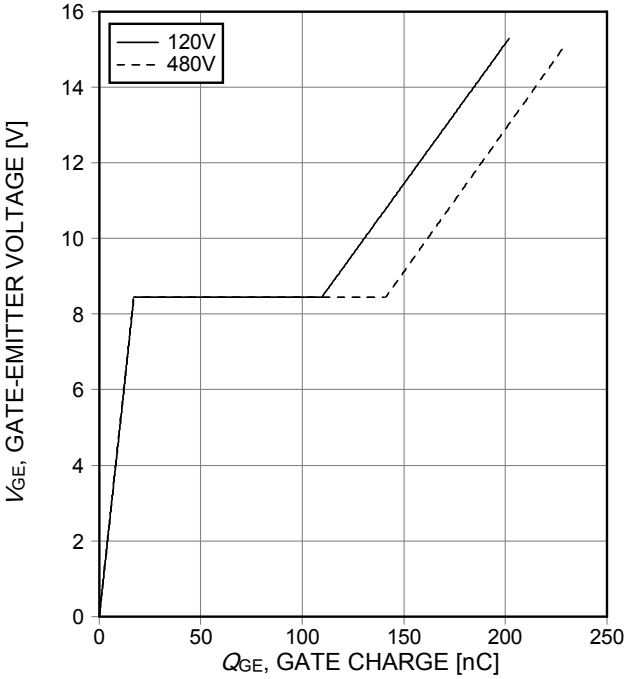


Figure 17. Typical gate charge
(I_C=40A)

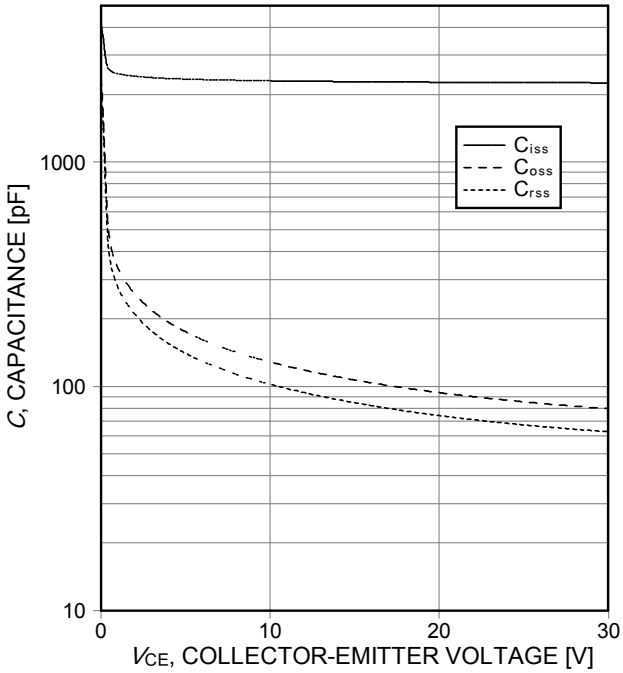


Figure 18. Typical capacitance as a function of collector-emitter voltage
(V_{GE}=0V, f=1MHz)

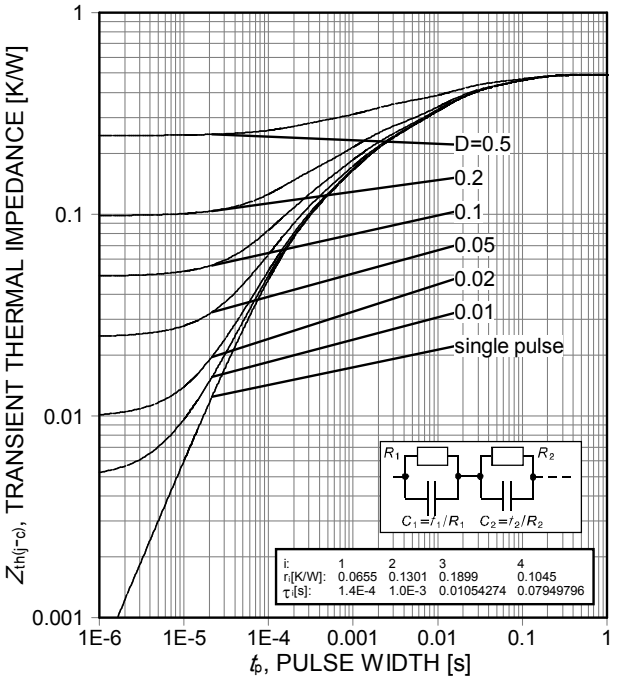


Figure 19. IGBT transient thermal impedance
($D=t_p/T$)

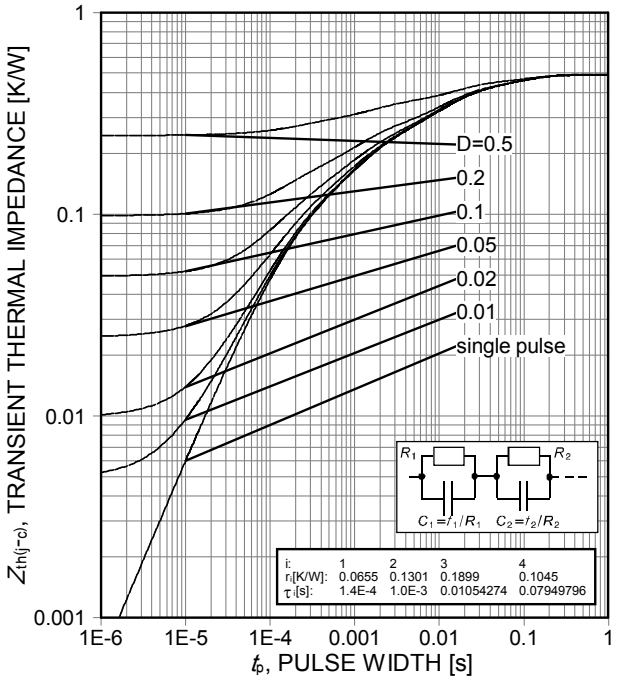


Figure 20. Diode transient thermal impedance as a function of pulse width
($D=t_p/T$)

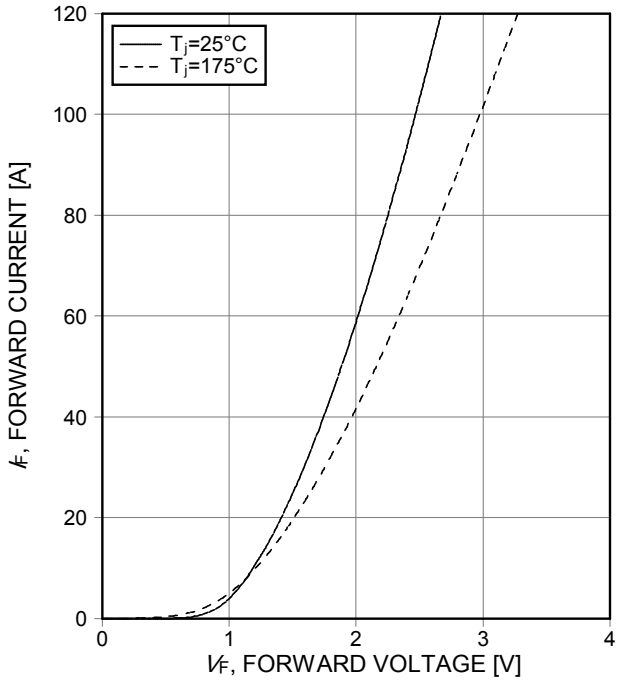


Figure 21. Typical diode forward current as a function of forward voltage

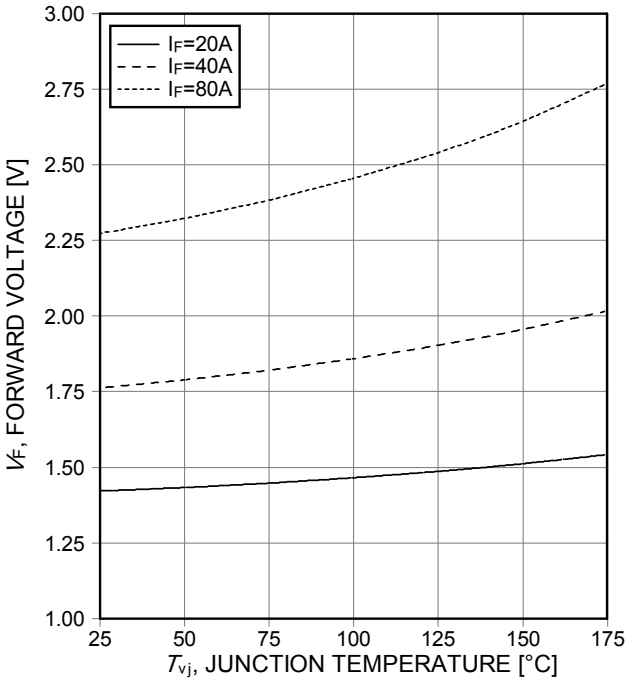
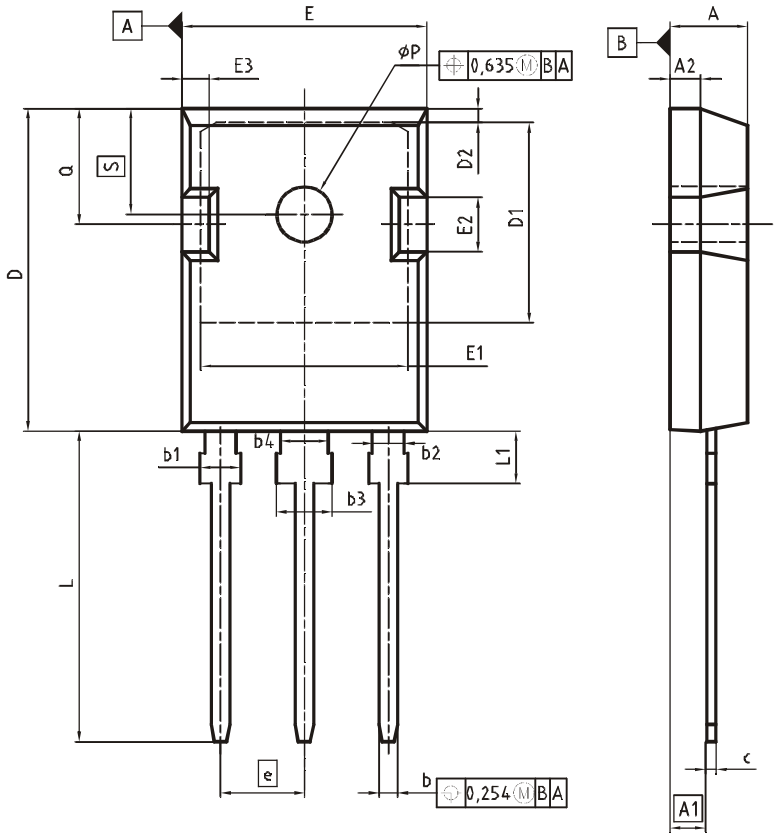
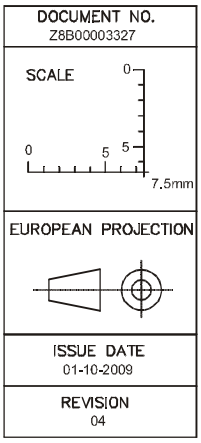


Figure 22. Typical diode forward voltage as a function of junction temperature

PG-TO247-3



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.83	5.21	0.190	0.205
A1	2.27	2.54	0.089	0.100
A2	1.85	2.16	0.073	0.085
b	1.07	1.33	0.042	0.052
b1	1.90	2.41	0.075	0.095
b2	1.90	2.16	0.075	0.085
b3	2.87	3.38	0.113	0.133
b4	2.87	3.13	0.113	0.123
c	0.55	0.68	0.022	0.027
D	20.80	21.10	0.819	0.831
D1	16.25	17.65	0.640	0.695
D2	0.95	1.35	0.037	0.053
E	15.70	16.13	0.618	0.635
E1	13.10	14.15	0.516	0.557
E2	3.68	5.10	0.145	0.201
E3	1.00	2.60	0.039	0.102
e	5.44		0.214	
N	3		3	
L	19.80	20.32	0.780	0.800
L1	4.10	4.47	0.161	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



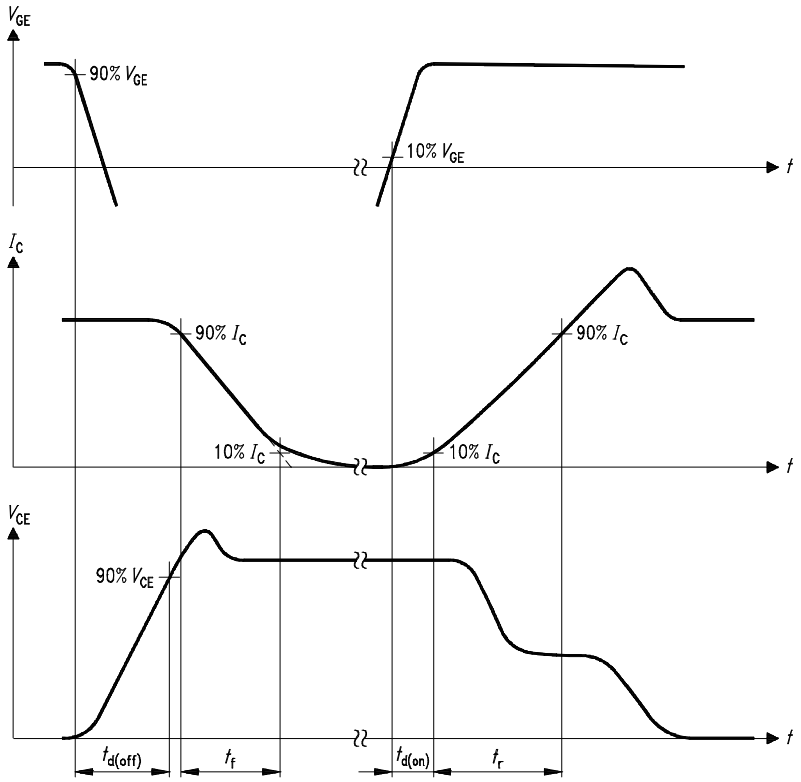


Figure A. Definition of switching times

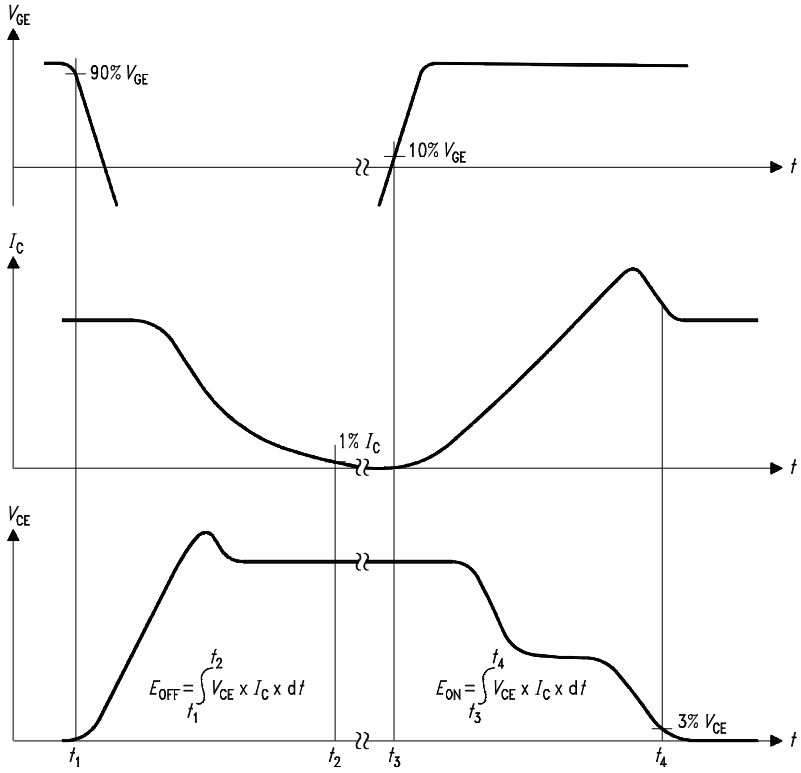


Figure B. Definition of switching losses

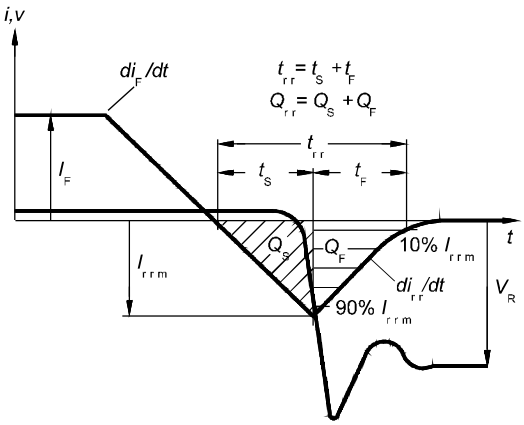


Figure C. Definition of diodes switching characteristics

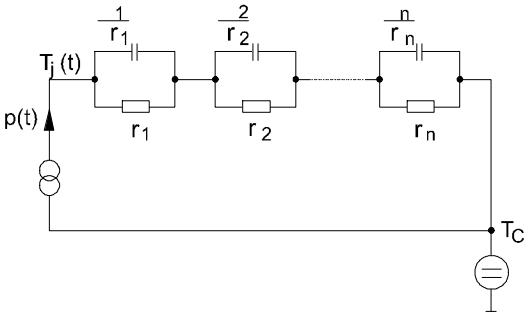


Figure D. Thermal equivalent circuit

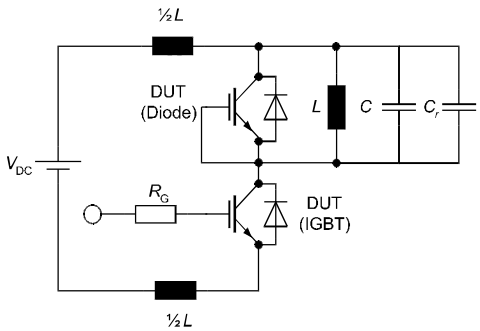


Figure E. Dynamic test circuit
Leakage inductance L= 180nH,
Stray capacitor C_σ = 40pF,
Relief capacitor C_r = 1nF
(only for ZVT switching)

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