

IGBT

TRENCHSTOP™ Performance technology

IGW40N60DTP

600V IGBT TRENCHSTOP™ Performance series

Data sheet

Industrial Power Control

600V DuoPack IGBT TRENCHSTOP™ Performance series

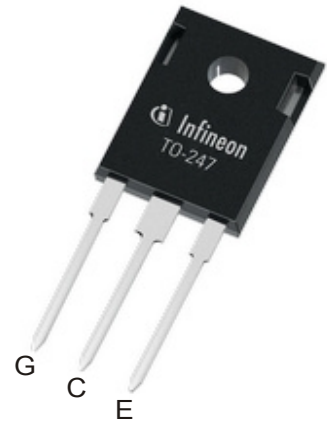
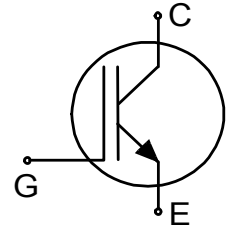
Features:

TRENCHSTOP™ technology offering

- very low V_{CEsat}
- low turn-off losses
- short tail current
- low EMI
- maximum junction temperature 175°C
- qualified according to JEDEC for target applications
- Pb-free lead plating; RoHS compliant
- complete product spectrum and PSpice Models:
<http://www.infineon.com/igbt/>

Applications:

- drives
- solar inverters
- uninterruptible power supplies
- converters with medium switching frequency



Key Performance and Package Parameters

Type	V_{CE}	I_C	$V_{CEsat}, T_{vj}=25^{\circ}C$	T_{vjmax}	Marking	Package
IGW40N60TP	600V	40A	1.6V	175°C	G40DTP	PG-TO247-3

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Maximum Ratings

For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.

Parameter	Symbol	Value	Unit
Collector-emitter voltage, $T_{vj} \geq 25^{\circ}\text{C}$	V_{CE}	600	V
DC collector current, limited by T_{vjmax} $T_C = 25^{\circ}\text{C}$ $T_C = 100^{\circ}\text{C}$	I_C	67.0 48.0	A
Pulsed collector current, t_p limited by $T_{vjmax}^{1)}$	I_{Cpuls}	120.0	A
Turn off safe operating area $V_{CE} \leq 600\text{V}$, $T_{vj} \leq 175^{\circ}\text{C}$, $t_p = 1\mu\text{s}^{1)}$	-	120.0	A
Gate-emitter voltage	V_{GE}	± 20	V
Short circuit withstand time $V_{GE} = 15.0\text{V}$, $V_{CC} \leq 400\text{V}$ Allowed number of short circuits < 1000 Time between short circuits: $\geq 1.0\text{s}$ $T_{vj} = 150^{\circ}\text{C}$	t_{SC}	5	μs
Power dissipation $T_C = 25^{\circ}\text{C}$ Power dissipation $T_C = 100^{\circ}\text{C}$	P_{tot}	246.0 123.0	W
Operating junction temperature	T_{vj}	$-40 \dots +175$	$^{\circ}\text{C}$
Storage temperature	T_{stg}	$-55 \dots +150$	$^{\circ}\text{C}$
Soldering temperature, wave soldering 1.6mm (0.063in.) from case for 10s		260	$^{\circ}\text{C}$
Mounting torque, M3 screw Maximum of mounting processes: 3	M	0.6	Nm

Thermal Resistance

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
R _{th} Characteristics						
IGBT thermal resistance, junction - case	R _{th(j-c)}		-	0.41	0.61	K/W

¹⁾ Defined by design. Not subject to production test.

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

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
Static Characteristic						
Collector-emitter breakdown voltage	$V_{(BR)CES}$	$V_{GE} = 0V, I_C = 2.00mA$	600	-	-	V
Collector-emitter saturation voltage	V_{CEsat}	$V_{GE} = 15.0V, I_C = 40.0A$ $T_{vj} = 25^{\circ}C$ $T_{vj} = 175^{\circ}C$	- -	1.60 1.94	1.80 -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C = 0.64mA, V_{CE} = V_{GE}$	4.1	5.1	5.7	V
Zero gate voltage collector current	I_{CES}	$V_{CE} = 600V, V_{GE} = 0V$ $T_{vj} = 25^{\circ}C$ $T_{vj} = 175^{\circ}C$	- -	- -	40 -	μA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0V, V_{GE} = 20V$	-	-	100	nA
Transconductance	g_{fs}	$V_{CE} = 20V, I_C = 40.0A$	-	40.0	-	S

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

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
Dynamic Characteristic						
Input capacitance	C_{ies}	$V_{CE} = 25V, V_{GE} = 0V, f = 1MHz$	-	1400	-	pF
Output capacitance	C_{oes}		-	60	-	
Reverse transfer capacitance	C_{res}		-	48	-	
Gate charge	Q_G	$V_{CC} = 480V, I_C = 40.0A,$ $V_{GE} = 15V$	-	177.0	-	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: $\geq 1.0s$	$I_{C(SC)}$	$V_{GE} = 15.0V, V_{CC} \leq 400V,$ $t_{SC} \leq 5\mu s$ $T_{vj} = 150^{\circ}C$	-	183	-	A

Switching Characteristic, Inductive Load

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic, at $T_{vj} = 25^{\circ}\text{C}$						
Turn-on delay time	$t_{d(\text{on})}$	$T_{vj} = 25^{\circ}\text{C},$ $V_{CC} = 400\text{V}, I_C = 40.0\text{A},$ $V_{GE} = 0.0/15.0\text{V},$ $R_{G(\text{on})} = 10.1\Omega, R_{G(\text{off})} = 10.1\Omega,$ $L\sigma = 32\text{nH}, C\sigma = 60\text{pF}$ $L\sigma, C\sigma$ from Fig. E Energy losses include “tail” and diode (IKW40N60DTP) reverse recovery.	-	18	-	ns
Rise time	t_r		-	30	-	ns
Turn-off delay time	$t_{d(\text{off})}$		-	222	-	ns
Fall time	t_f		-	18	-	ns
Turn-on energy	E_{on}		-	1.06	-	mJ
Turn-off energy	E_{off}		-	0.61	-	mJ
Total switching energy	E_{ts}		-	1.67	-	mJ

Switching Characteristic, Inductive Load

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic, at $T_{vj} = 175^{\circ}\text{C}$						
Turn-on delay time	$t_{d(\text{on})}$	$T_{vj} = 175^{\circ}\text{C}$, $V_{CC} = 400\text{V}$, $I_C = 40.0\text{A}$, $V_{GE} = 0.0/15.0\text{V}$, $R_{G(\text{on})} = 10.1\Omega$, $R_{G(\text{off})} = 10.1\Omega$, $L\sigma = 32\text{nH}$, $C\sigma = 60\text{pF}$ $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode (IKW40N60DTP) reverse recovery.	-	19	-	ns
Rise time	t_r		-	30	-	ns
Turn-off delay time	$t_{d(\text{off})}$		-	273	-	ns
Fall time	t_f		-	47	-	ns
Turn-on energy	E_{on}		-	1.63	-	mJ
Turn-off energy	E_{off}		-	1.05	-	mJ
Total switching energy	E_{ts}		-	2.68	-	mJ

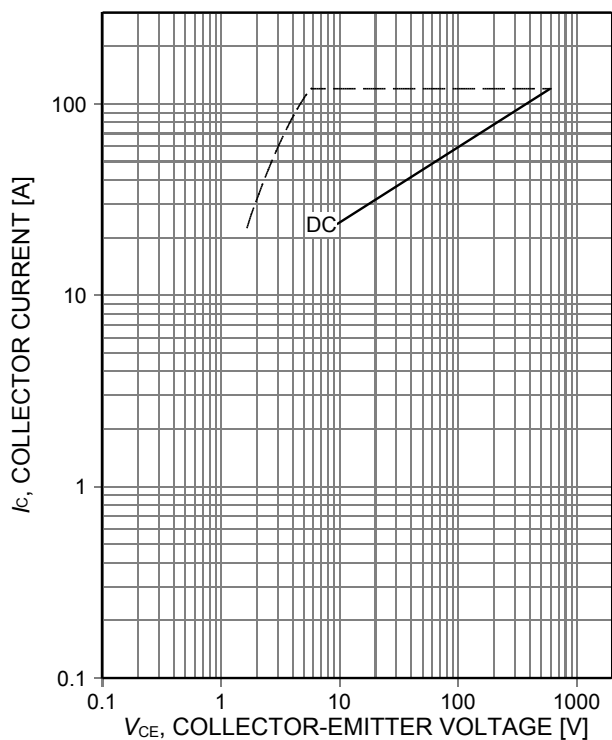


Figure 1. **Forward bias safe operating area**
($D=0$, $T_C=25^\circ\text{C}$, $T_J\leq 175^\circ\text{C}$; $V_{GE}=15\text{V}$)

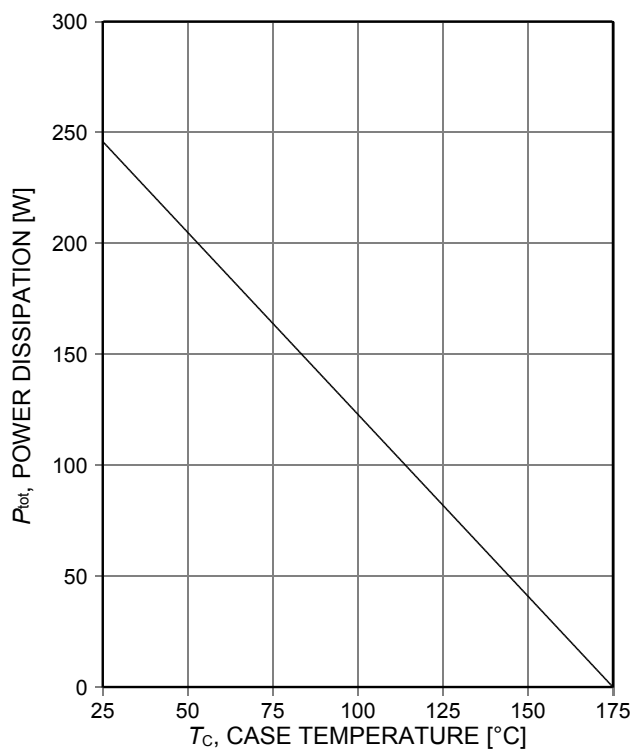


Figure 2. **Power dissipation as a function of case temperature**
($T_J\leq 175^\circ\text{C}$)

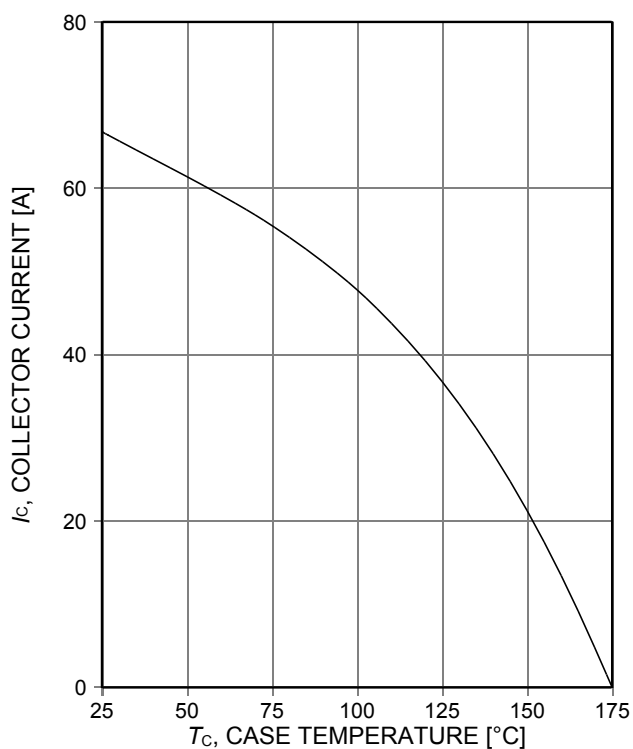


Figure 3. **Collector current as a function of case temperature**
($V_{GE}\geq 15\text{V}$, $T_J\leq 175^\circ\text{C}$)

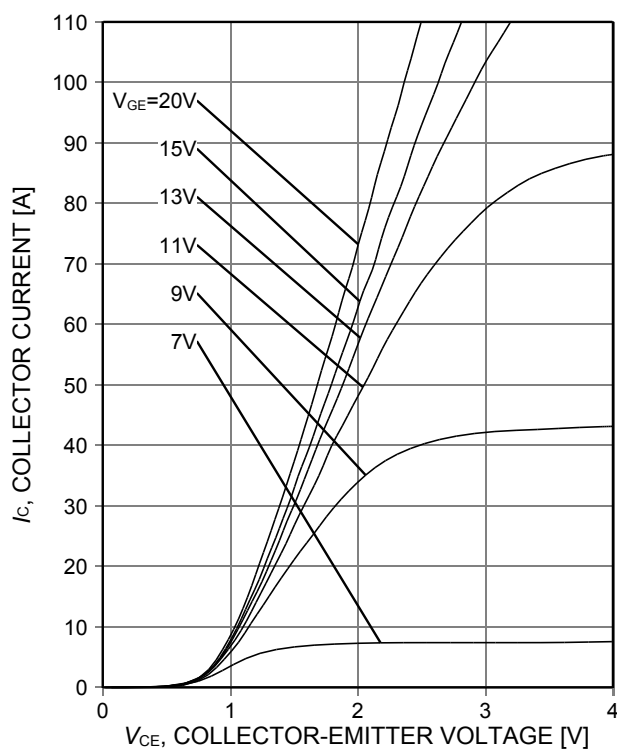


Figure 4. **Typical output characteristic**
($T_J=25^\circ\text{C}$)

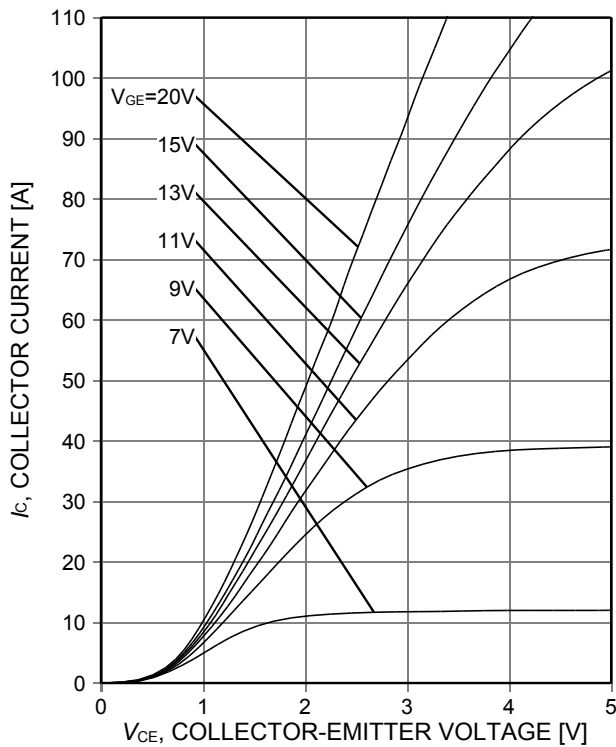


Figure 5. **Typical output characteristic**
($T_j=175^\circ\text{C}$)

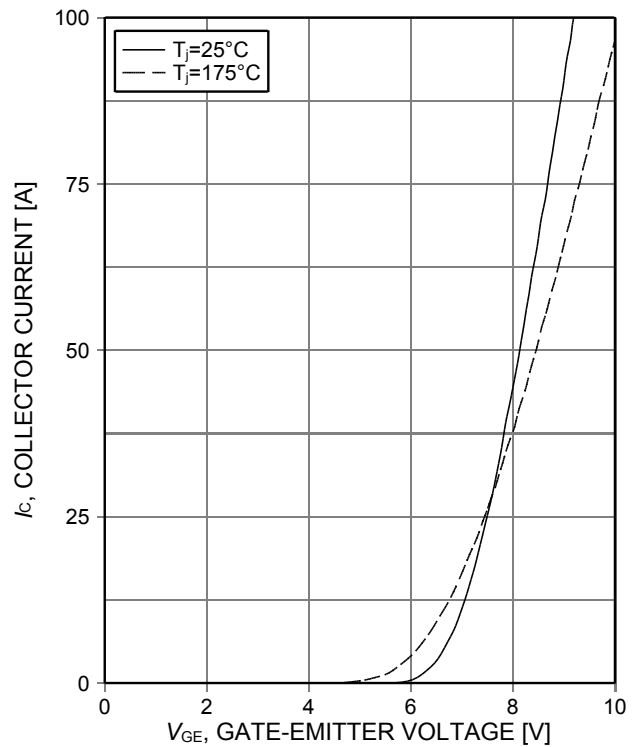


Figure 6. **Typical transfer characteristic**
($V_{CE}=20\text{V}$)

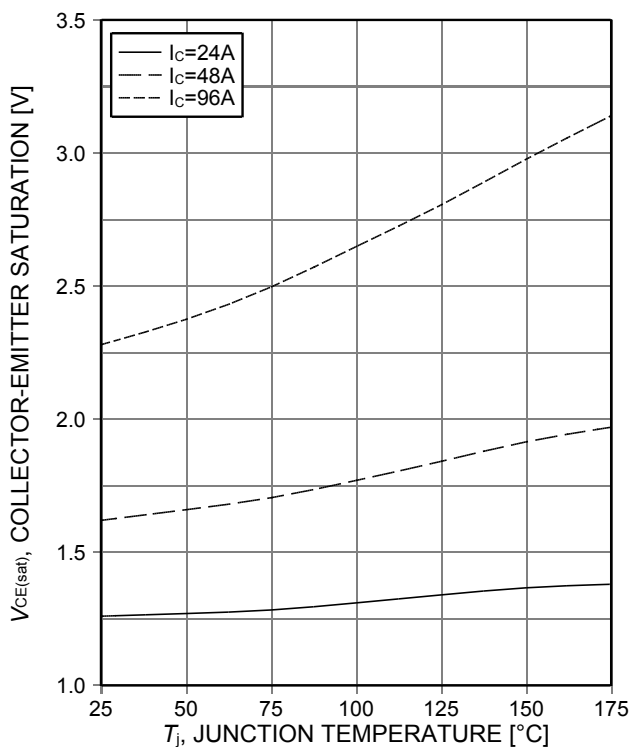


Figure 7. **Typical collector-emitter saturation voltage as a function of junction temperature**
($V_{GE}=15\text{V}$)

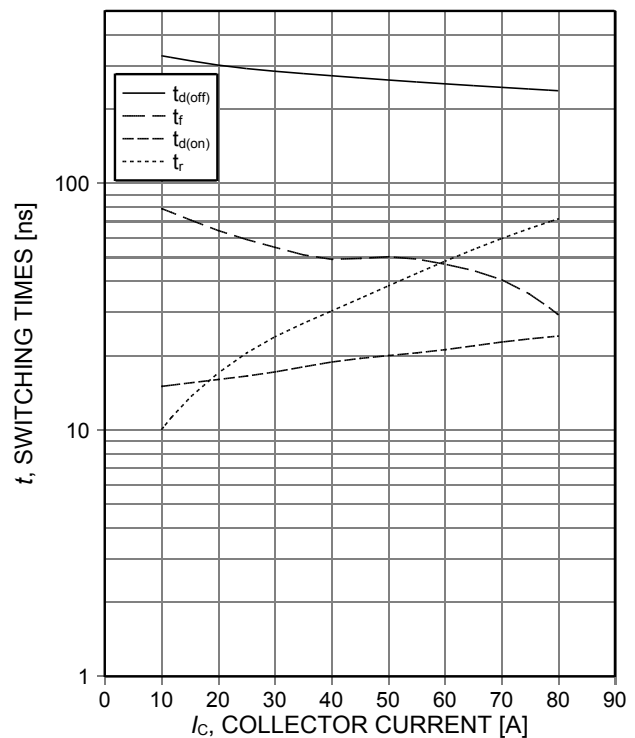


Figure 8. **Typical switching times as a function of collector current**
(ind. load, $T_j=175^\circ\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $r_G=10,1\Omega$, test circuit in Fig. E)

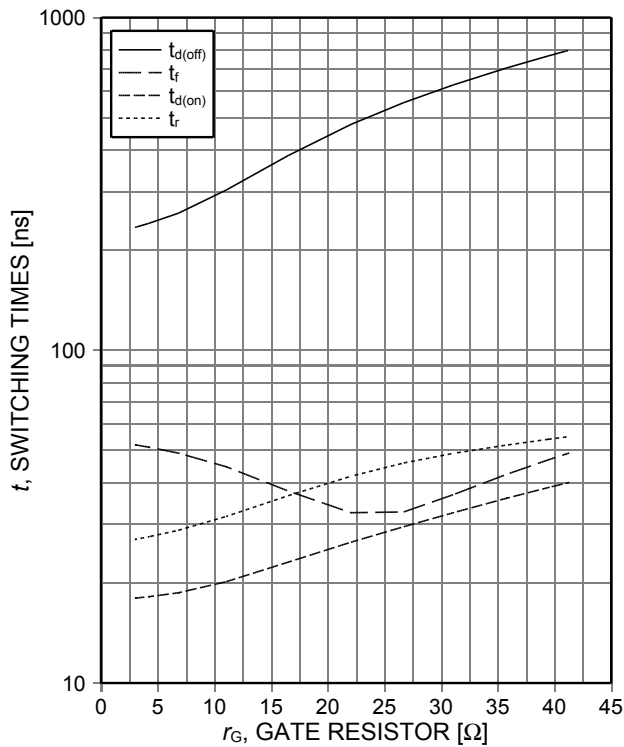


Figure 9. **Typical switching times as a function of gate resistor**
(ind. load, $T_j=175^\circ\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $I_C=40\text{A}$, test circuit in Fig. E)

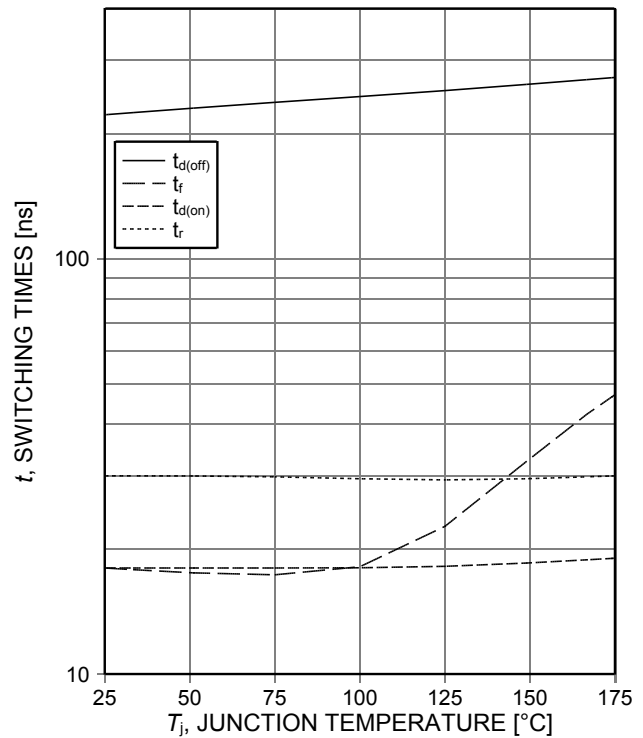


Figure 10. **Typical switching times as a function of junction temperature**
(ind. load, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $I_C=40\text{A}$, $r_G=10,1\Omega$, test circuit in Fig. E)

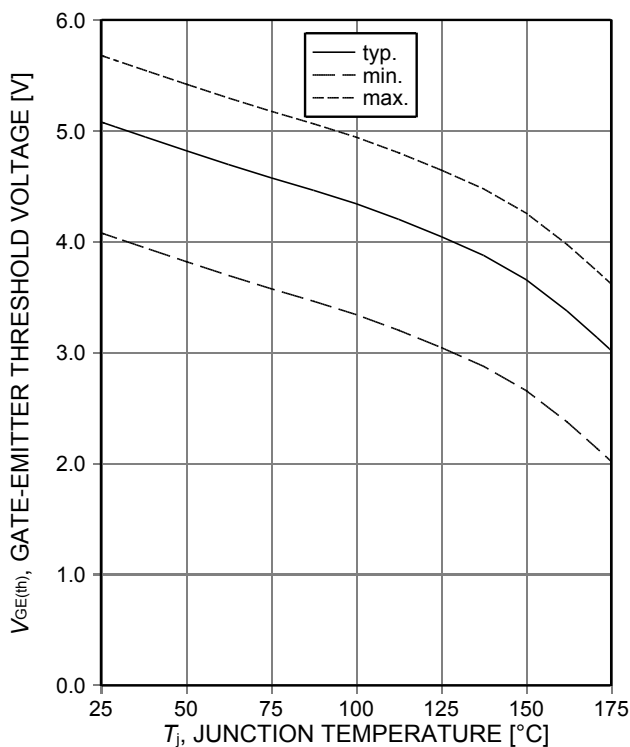


Figure 11. **Gate-emitter threshold voltage as a function of junction temperature**
($I_C=0,64\text{mA}$)

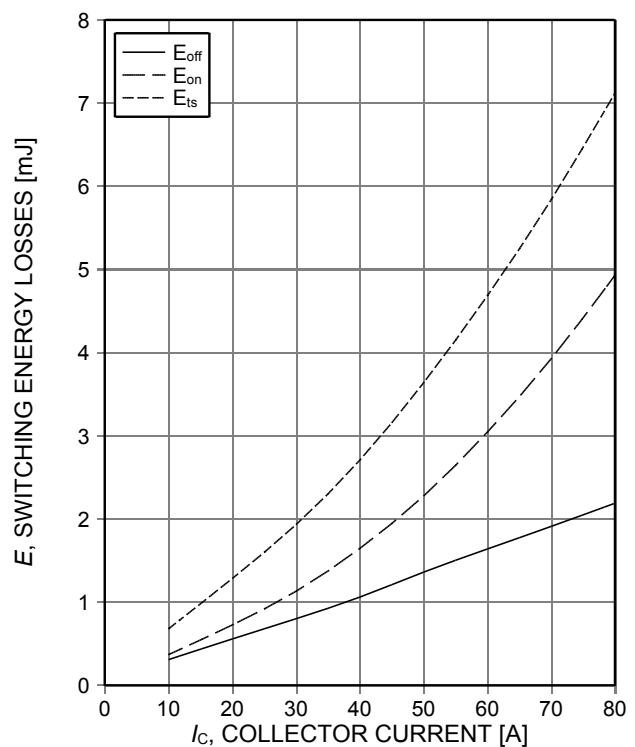


Figure 12. **Typical switching energy losses as a function of collector current**
(ind. load, $T_j=175^\circ\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $r_G=10,1\Omega$, test circuit in Fig. E)

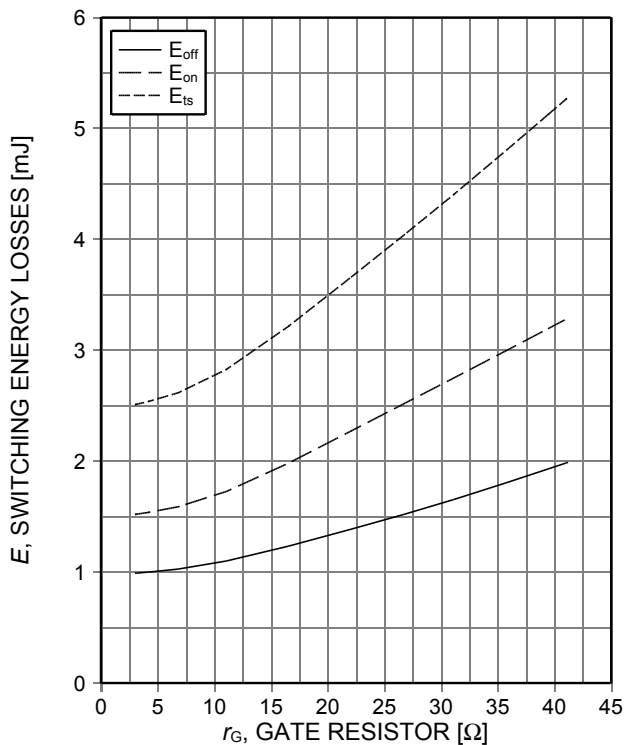


Figure 13. **Typical switching energy losses as a function of gate resistor**
(ind. load, $T_J=175^\circ\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $I_C=40\text{A}$, test circuit in Fig. E)

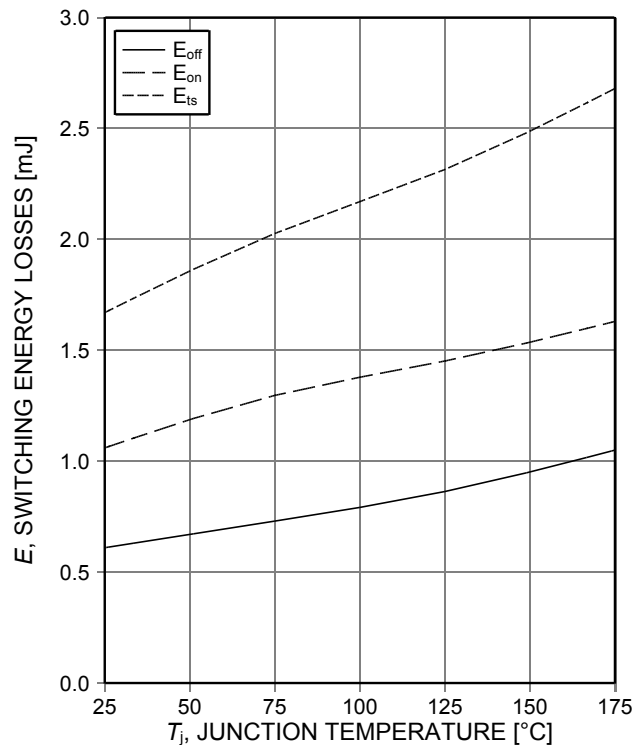


Figure 14. **Typical switching energy losses as a function of junction temperature**
(ind load, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $I_C=40\text{A}$, $r_G=10,1\Omega$, test circuit in Fig. E)

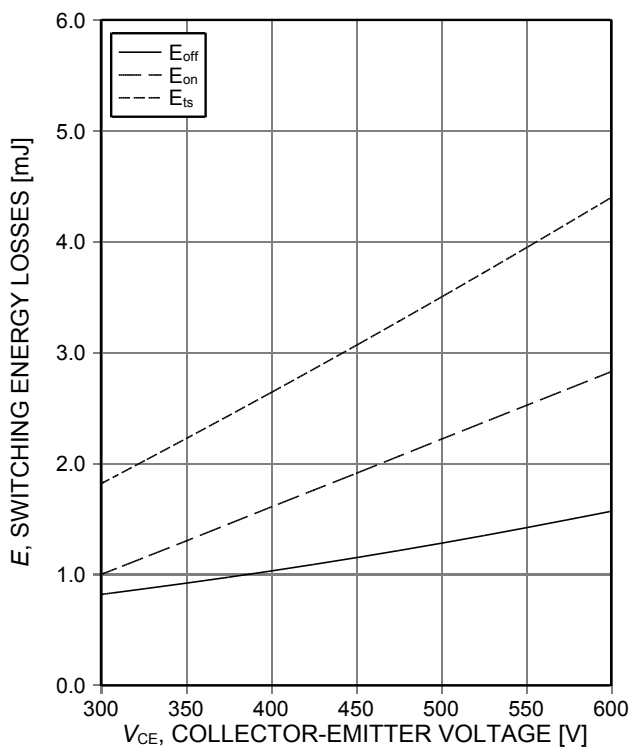


Figure 15. **Typical switching energy losses as a function of collector emitter voltage**
(ind. load, $T_J=175^\circ\text{C}$, $V_{GE}=15/0\text{V}$, $I_C=40\text{A}$, $r_G=10,1\Omega$, test circuit in Fig. E)

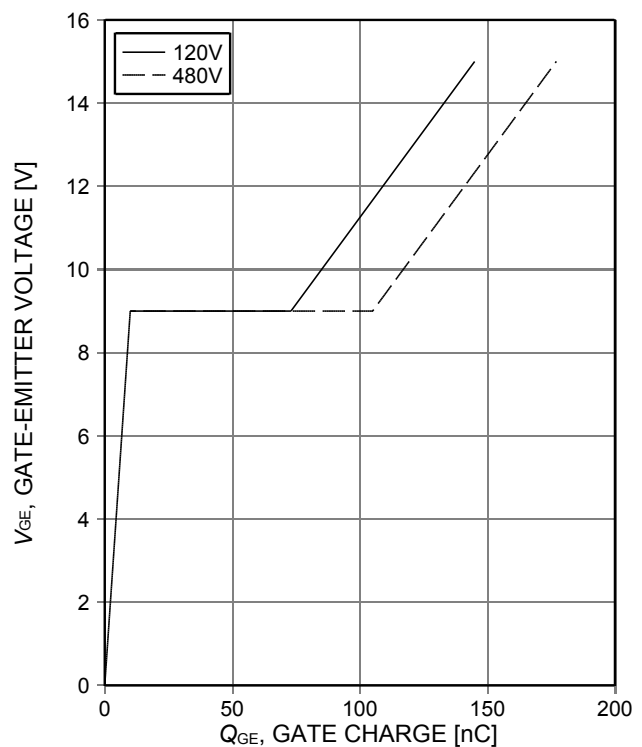


Figure 16. **Typical gate charge**
($I_C=40\text{A}$)

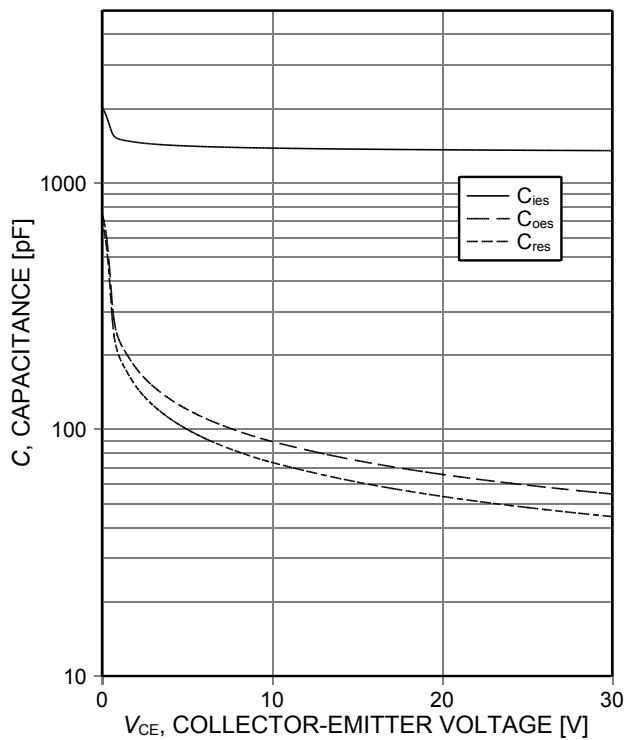


Figure 17. **Typical capacitance as a function of collector-emitter voltage**
($V_{GE}=0V$, $f=1MHz$)

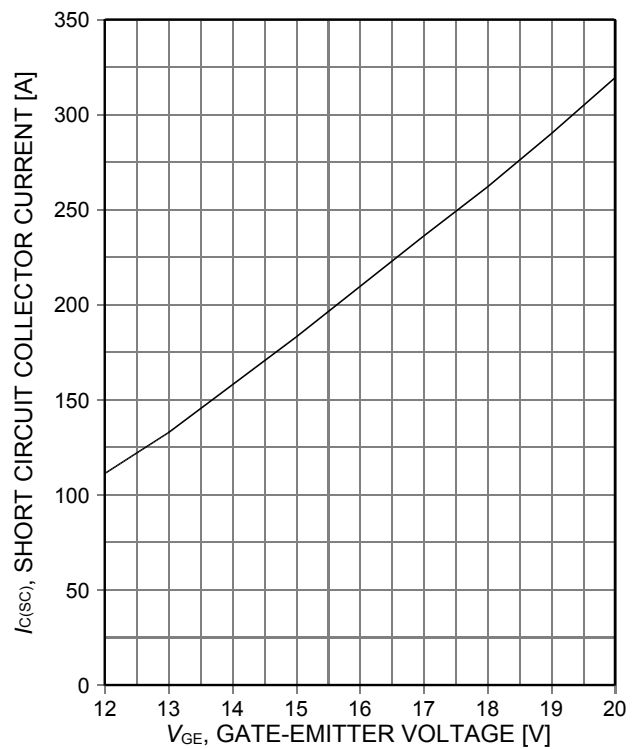


Figure 18. **Typical short circuit collector current as a function of gate-emitter voltage**
($V_{CE}\leq 400V$, start at $T_J=25^\circ C$)

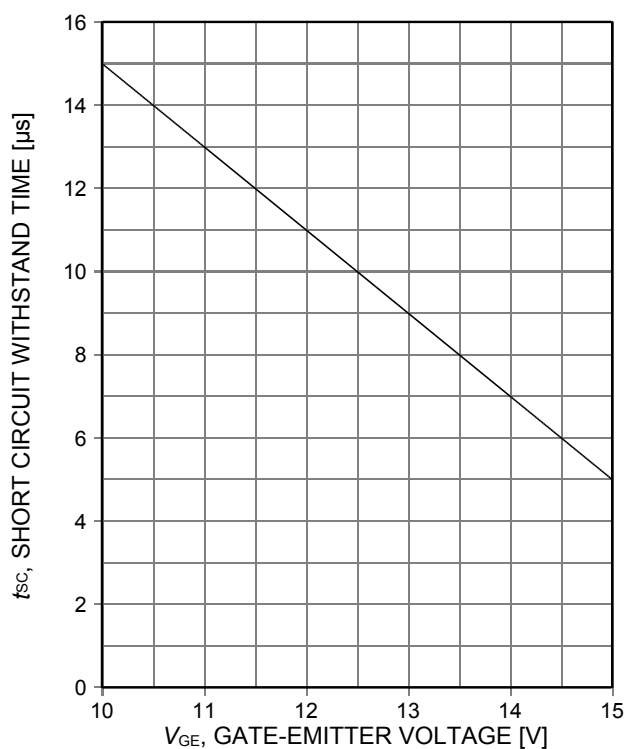


Figure 19. **Short circuit withstand time as a function of gate-emitter voltage**
($V_{CE}\leq 400V$, start at $T_J\leq 150^\circ C$)

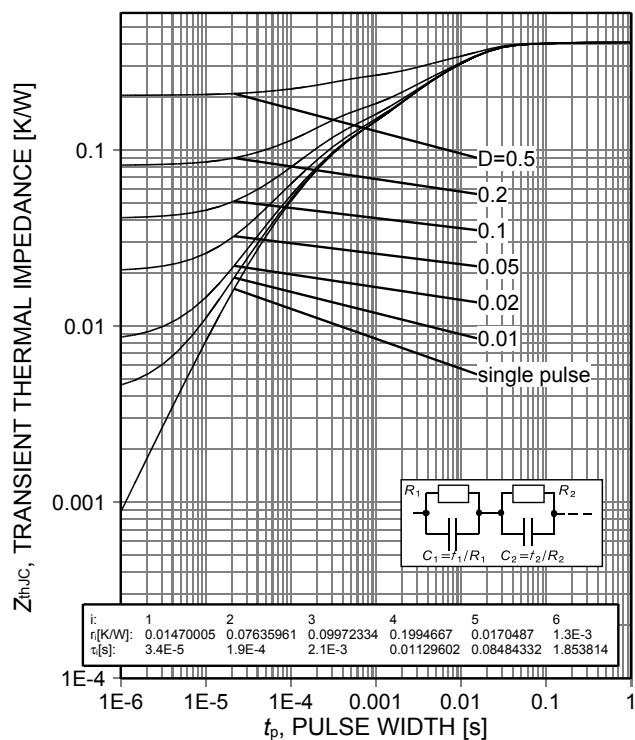
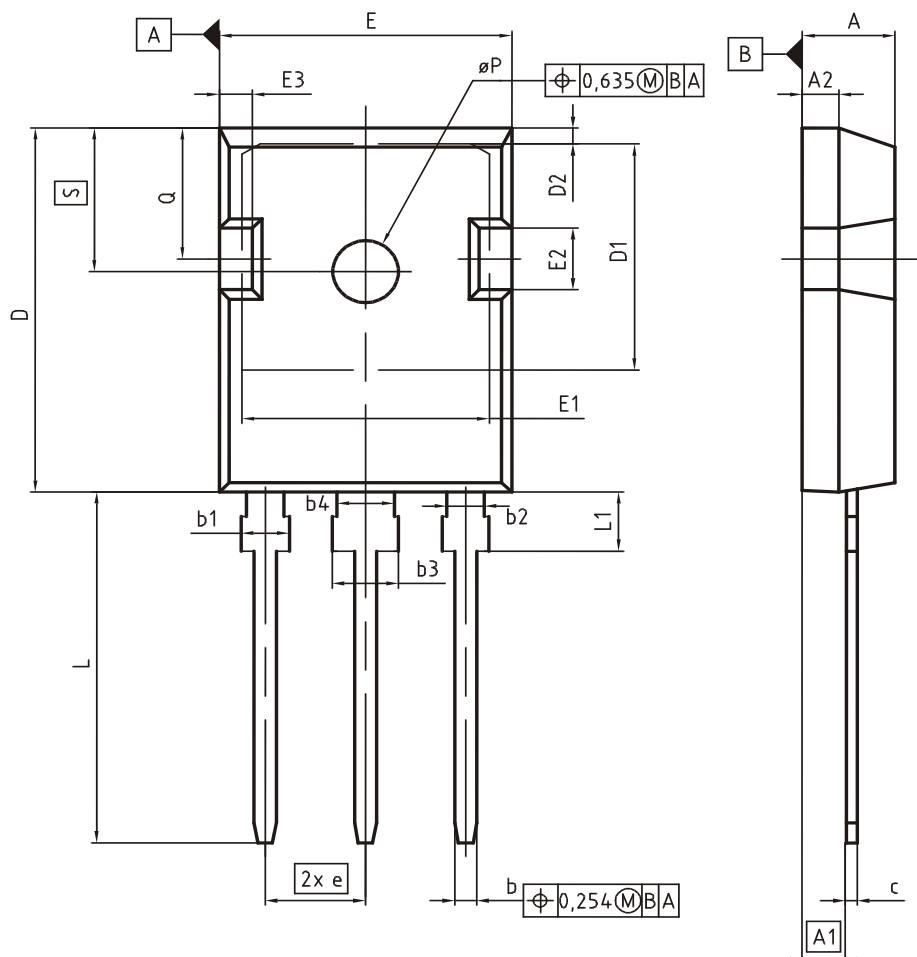
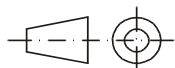


Figure 20. **Typical IGBT transient thermal impedance**
($D=t_p/T$)

Package Drawing 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 (BSC)		0.214 (BSC)	
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

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EUROPEAN PROJECTION 
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REVISION 05

Testing Conditions

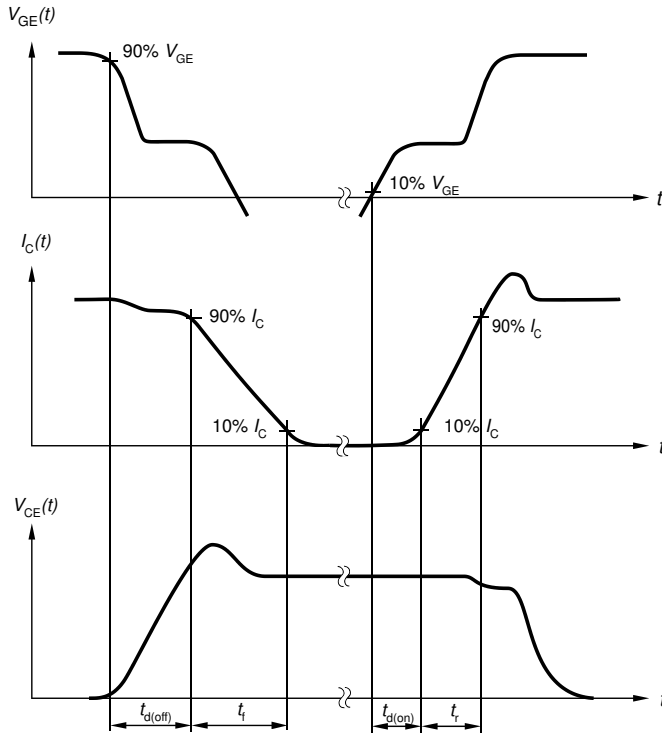


Figure A. Definition of switching times

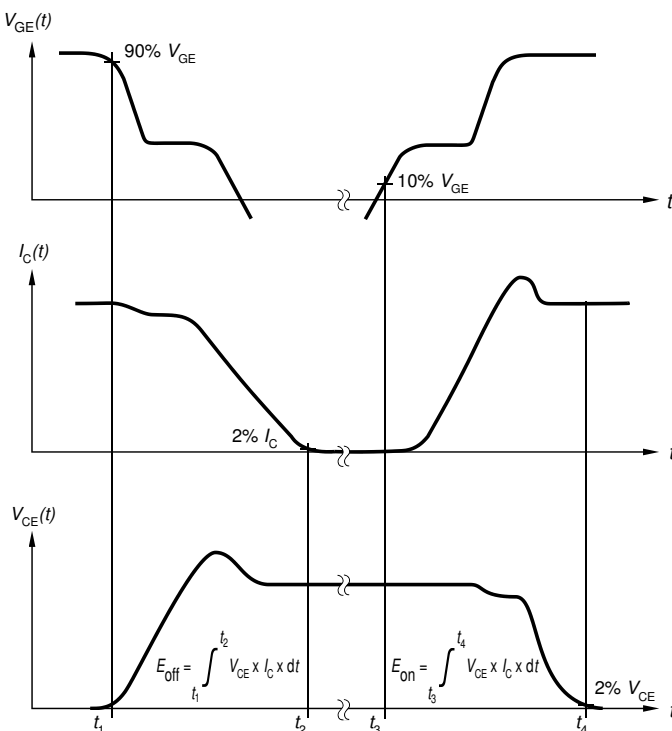


Figure B. Definition of switching losses

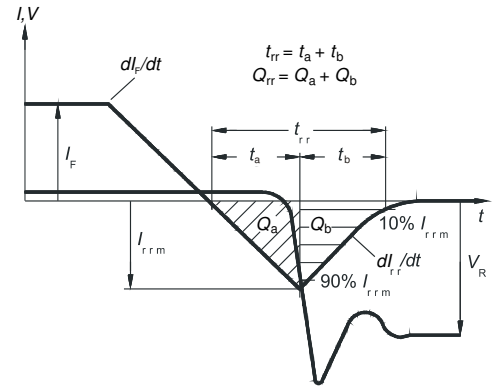


Figure C. Definition of diode switching characteristics

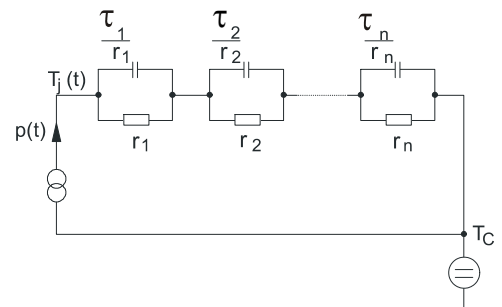


Figure D. Thermal equivalent circuit

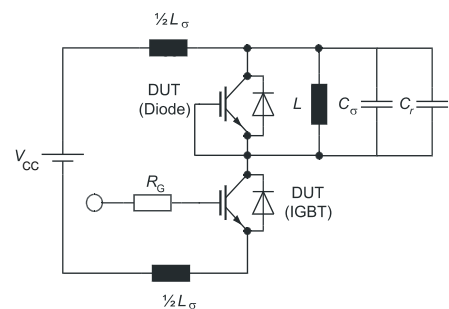


Figure E. Dynamic test circuit
Parasitic inductance L_{σ} ,
parasitic capacitor C_{σ} ,
relief capacitor C_r ,
(only for ZVT switching)

Revision History

IGW40N60TP

Revision: 2016-02-05, Rev. 2.1

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.1	-	Release final datasheet

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