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High speed switching series fifth generation

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage, $T_{vj} \geq 25^{\circ}\text{C}$	V_{CE}	650	V
DC collector current, limited by T_{vjmax} $T_C = 25^{\circ}\text{C}$ value limited by bondwire $T_C = 100^{\circ}\text{C}$	I_C	80.0 53.5	A
Pulsed collector current, t_p limited by $T_{vjmax}^{1)}$	I_{Cpuls}	150.0	A
Turn off safe operating area $V_{CE} \leq 650\text{V}$, $T_{vj} \leq 175^{\circ}\text{C}$, $t_p = 1\mu\text{s}^{1)}$	-	150.0	A
Gate-emitter voltage Transient Gate-emitter voltage ($t_p \leq 10\mu\text{s}$, $D < 0.010$)	V_{GE}	± 20 ± 30	V
Power dissipation $T_C = 25^{\circ}\text{C}$ Power dissipation $T_C = 100^{\circ}\text{C}$	P_{tot}	270.0 136.0	W
Operating junction temperature	T_{vj}	$-40 \dots +175$	$^{\circ}\text{C}$
Storage temperature	T_{stg}	$-55 \dots +150$	$^{\circ}\text{C}$
Soldering temperature, ²⁾ 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)}		-	-	0.55	K/W
Thermal resistance junction - ambient	R _{th(j-a)}		-	-	40	K/W

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	$V_{(BR)CES}$	$V_{GE} = 0V, I_C = 0.20mA$	650	-	-	V
Collector-emitter saturation voltage	V_{CEsat}	$V_{GE} = 15.0V, I_C = 50.0A$ $T_{vj} = 25^{\circ}C$ $T_{vj} = 125^{\circ}C$ $T_{vj} = 175^{\circ}C$	- - -	1.66 1.90 2.03	2.10 - -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C = 0.40mA, V_{CE} = V_{GE}$	3.2	4.0	4.8	V
Zero gate voltage collector current	I_{CES}	$V_{CE} = 650V, V_{GE} = 0V$ $T_{vj} = 25^{\circ}C$ $T_{vj} = 175^{\circ}C$	- -	- 600	40 -	μA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0V, V_{GE} = 20V$	-	-	100	nA
Transconductance	g_{fs}	$V_{CE} = 20V, I_C = 50.0A$	-	62.0	-	S

¹⁾ Defined by design. Not subject to production test.²⁾ Package not recommended for surface mount applications

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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	-	2800	-	pF
Output capacitance	C _{oes}		-	51	-	
Reverse transfer capacitance	C _{res}		-	11	-	
Gate charge	Q _G	V _{CC} = 520V, I _C = 50.0A, V _{GE} = 15V	-	108.0	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L _E		-	13.0	-	nH

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	$t_{d(\text{on})}$	$T_{vj} = 25^{\circ}\text{C},$ $V_{CC} = 400\text{V}, I_C = 25.0\text{A},$ $V_{GE} = 0.0/15.0\text{V},$ $R_{G(\text{on})} = 12.0\Omega, R_{G(\text{off})} = 12.0\Omega,$ $L\sigma = 30\text{nH}, C\sigma = 30\text{pF}$ $L\sigma, C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	21	-	ns
Rise time	t_r		-	12	-	ns
Turn-off delay time	$t_{d(\text{off})}$		-	156	-	ns
Fall time	t_f		-	6	-	ns
Turn-on energy	E_{on}		-	0.49	-	mJ
Turn-off energy	E_{off}		-	0.14	-	mJ
Total switching energy	E_{ts}		-	0.63	-	mJ
Turn-on delay time	$t_{d(\text{on})}$	$T_{vj} = 25^{\circ}\text{C},$ $V_{CC} = 400\text{V}, I_C = 6.0\text{A},$ $V_{GE} = 0.0/15.0\text{V},$ $R_{G(\text{on})} = 12.0\Omega, R_{G(\text{off})} = 12.0\Omega,$ $L\sigma = 30\text{nH}, C\sigma = 30\text{pF}$ $L\sigma, C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	19	-	ns
Rise time	t_r		-	4	-	ns
Turn-off delay time	$t_{d(\text{off})}$		-	173	-	ns
Fall time	t_f		-	10	-	ns
Turn-on energy	E_{on}		-	0.10	-	mJ
Turn-off energy	E_{off}		-	0.03	-	mJ
Total switching energy	E_{ts}		-	0.13	-	mJ

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Switching Characteristic, Inductive Load

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic, at $T_{vj} = 150^{\circ}\text{C}$						
Turn-on delay time	$t_{d(\text{on})}$	$T_{vj} = 150^{\circ}\text{C}$, $V_{CC} = 400\text{V}$, $I_C = 25.0\text{A}$, $V_{GE} = 0.0/15.0\text{V}$, $R_{G(\text{on})} = 12.0\Omega$, $R_{G(\text{off})} = 12.0\Omega$, $L\sigma = 30\text{nH}$, $C\sigma = 30\text{pF}$ $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	21	-	ns
Rise time	t_r		-	14	-	ns
Turn-off delay time	$t_{d(\text{off})}$		-	191	-	ns
Fall time	t_f		-	5	-	ns
Turn-on energy	E_{on}		-	0.68	-	mJ
Turn-off energy	E_{off}		-	0.25	-	mJ
Total switching energy	E_{ts}		-	0.93	-	mJ
Turn-on delay time	$t_{d(\text{on})}$	$T_{vj} = 150^{\circ}\text{C}$, $V_{CC} = 400\text{V}$, $I_C = 6.0\text{A}$, $V_{GE} = 0.0/15.0\text{V}$, $R_{G(\text{on})} = 12.0\Omega$, $R_{G(\text{off})} = 12.0\Omega$, $L\sigma = 30\text{nH}$, $C\sigma = 30\text{pF}$ $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	18	-	ns
Rise time	t_r		-	5	-	ns
Turn-off delay time	$t_{d(\text{off})}$		-	229	-	ns
Fall time	t_f		-	12	-	ns
Turn-on energy	E_{on}		-	0.18	-	mJ
Turn-off energy	E_{off}		-	0.06	-	mJ
Total switching energy	E_{ts}		-	0.24	-	mJ

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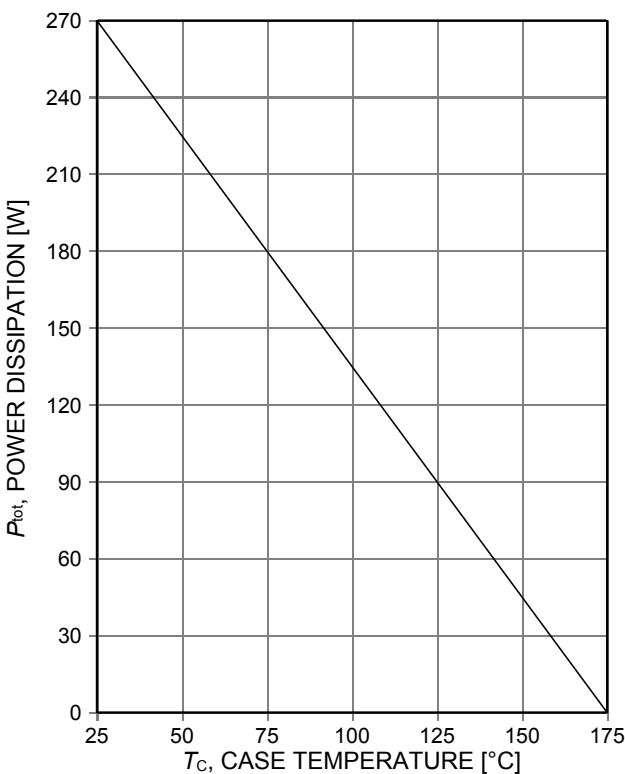


Figure 1. **Power dissipation as a function of case temperature**
($T_{vj} \leq 175^\circ\text{C}$)

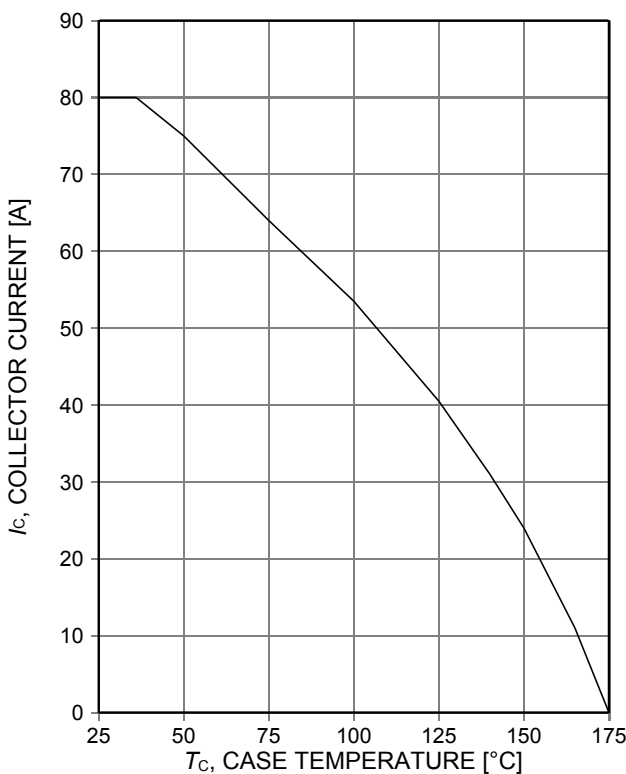


Figure 2. **Collector current as a function of case temperature**
($V_{GE} \geq 15\text{V}$, $T_{vj} \leq 175^\circ\text{C}$)

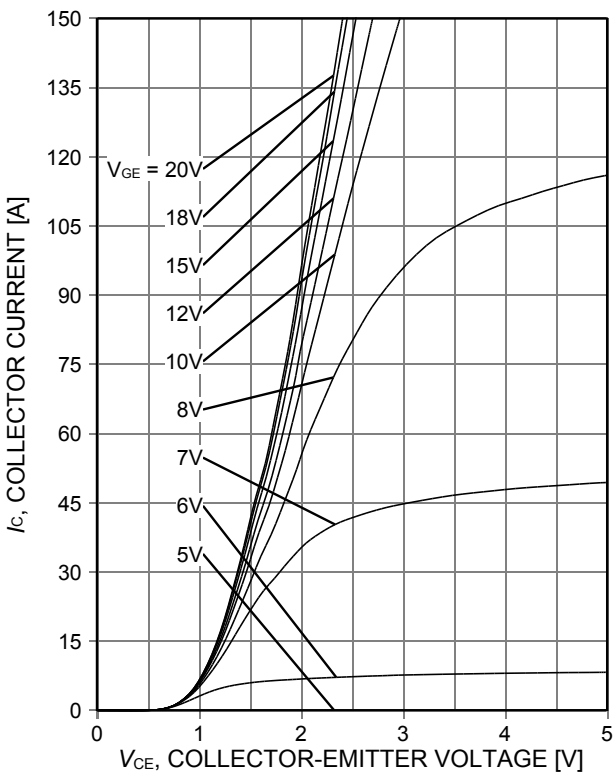


Figure 3. **Typical output characteristic**
($T_{vj} = 25^\circ\text{C}$)

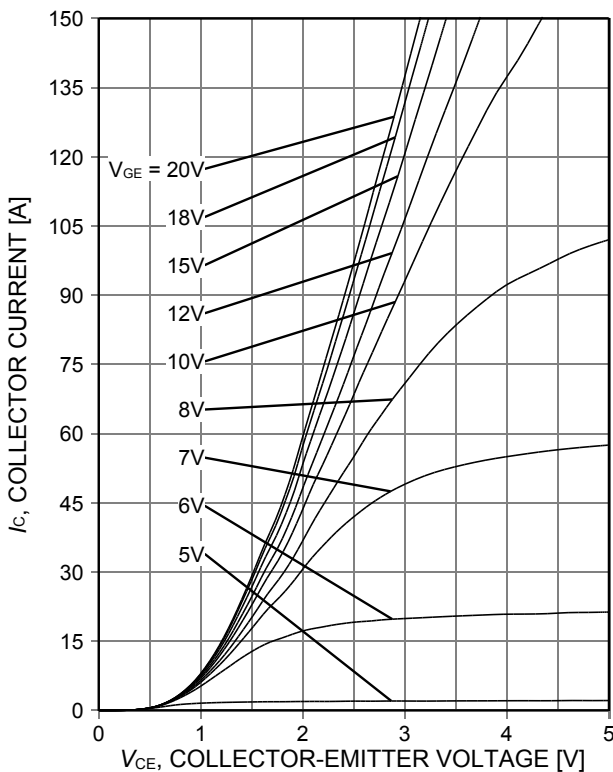


Figure 4. **Typical output characteristic**
($T_{vj} = 150^\circ\text{C}$)

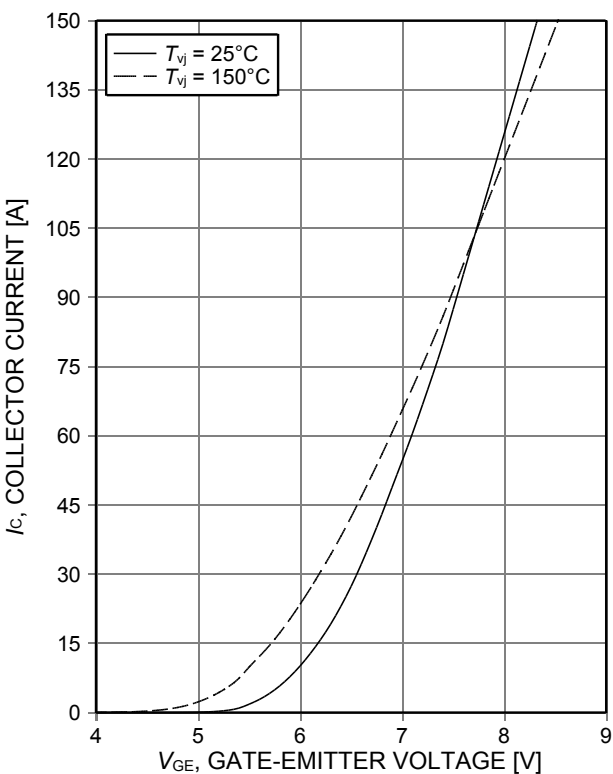


Figure 5. **Typical transfer characteristic**
($V_{CE}=20V$)

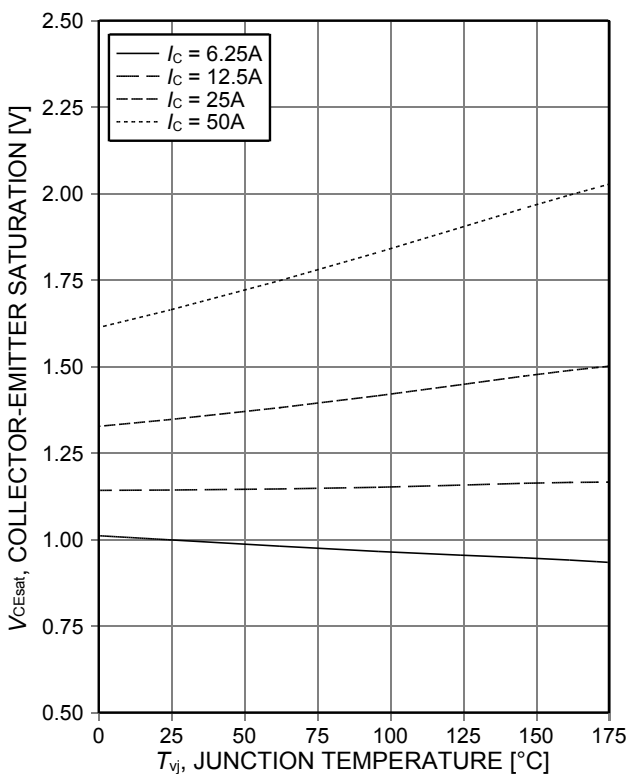


Figure 6. **Typical collector-emitter saturation voltage as a function of junction temperature**
($V_{GE}=15V$)

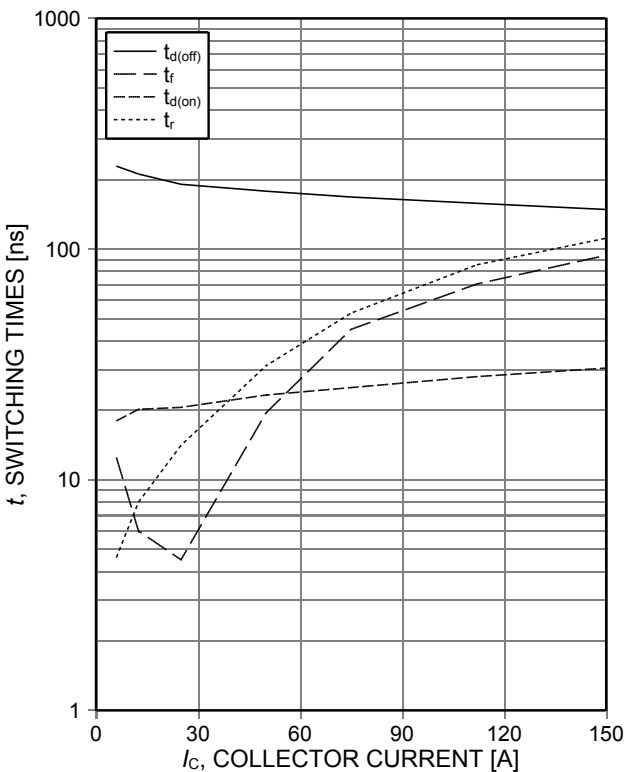


Figure 7. **Typical switching times as a function of collector current**
(inductive load, $T_{vj}=150^{\circ}C$, $V_{CE}=400V$, $V_{GE}=0/15V$, $R_{G(on)}=12\Omega$, $R_{G(off)}=12\Omega$, dynamic test circuit in Figure E)

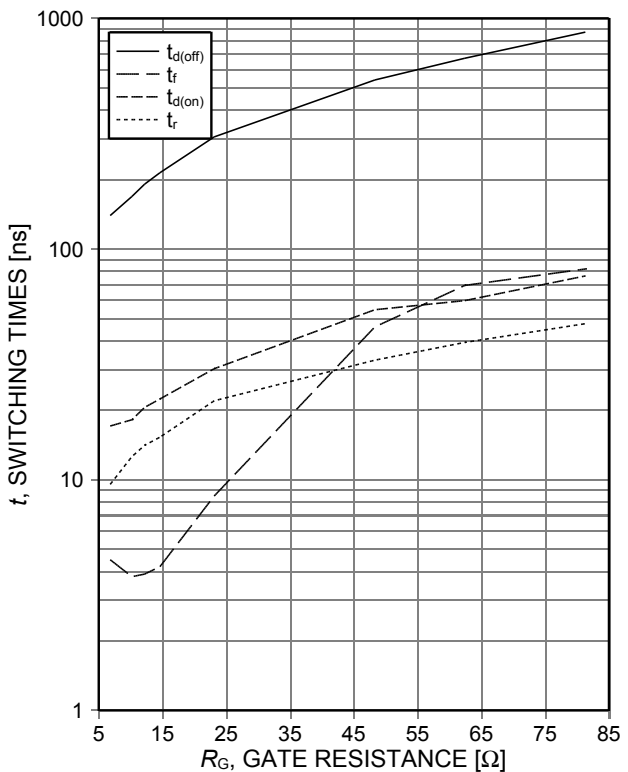


Figure 8. **Typical switching times as a function of gate resistance**
(inductive load, $T_{vj}=150^{\circ}C$, $V_{CE}=400V$, $V_{GE}=0/15V$, $I_C=25A$, dynamic test circuit in Figure E)

High speed switching series fifth generation

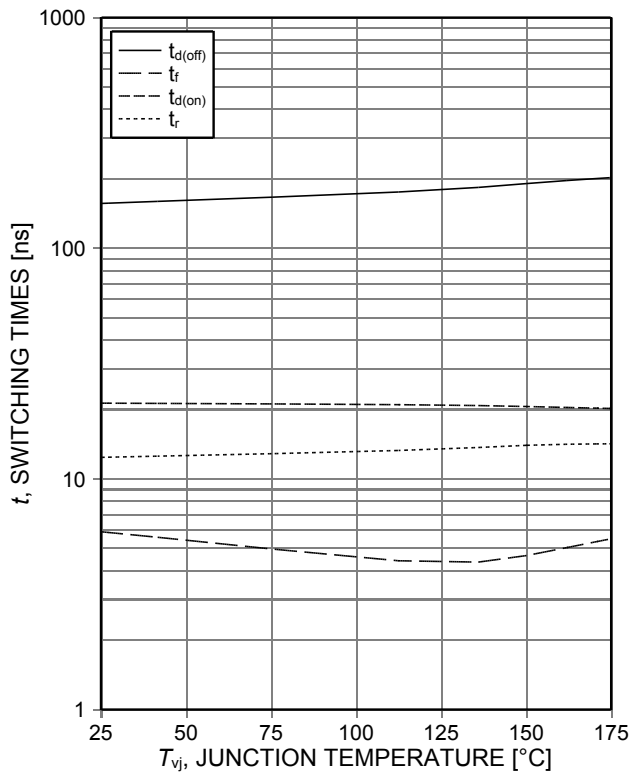


Figure 9. **Typical switching times as a function of junction temperature**
(inductive load, $V_{CE}=400V$, $V_{GE}=0/15V$, $I_C=25A$, $R_{G(on)}=12\Omega$, $R_{G(off)}=12\Omega$, dynamic test circuit in Figure E)

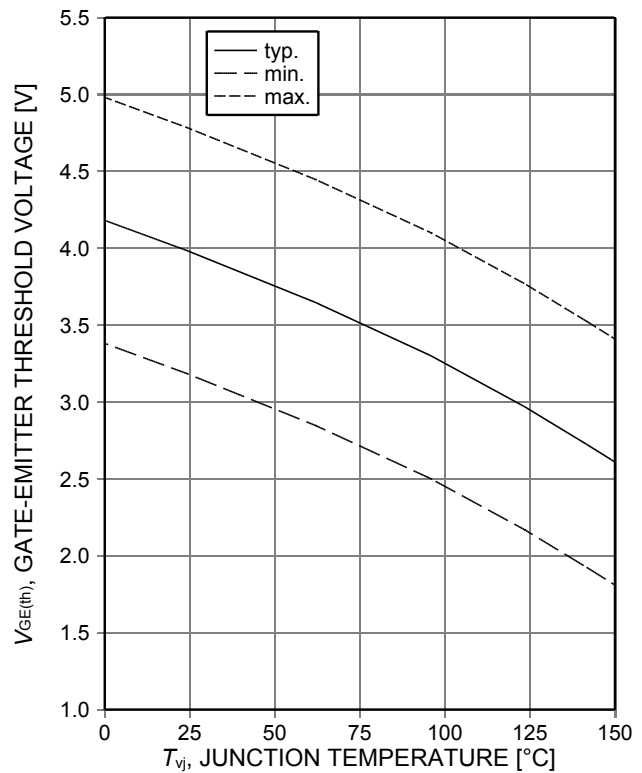


Figure 10. **Gate-emitter threshold voltage as a function of junction temperature**
($I_C=0.4mA$)

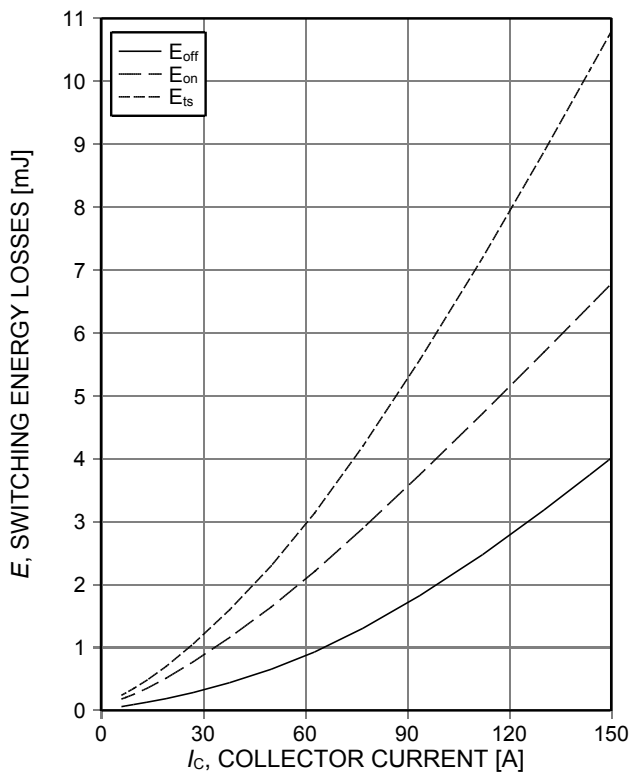


Figure 11. **Typical switching energy losses as a function of collector current**
(inductive load, $T_{vj}=150^{\circ}C$, $V_{CE}=400V$, $V_{GE}=0/15V$, $R_{G(on)}=12\Omega$, $R_{G(off)}=12\Omega$, dynamic test circuit in Figure E)

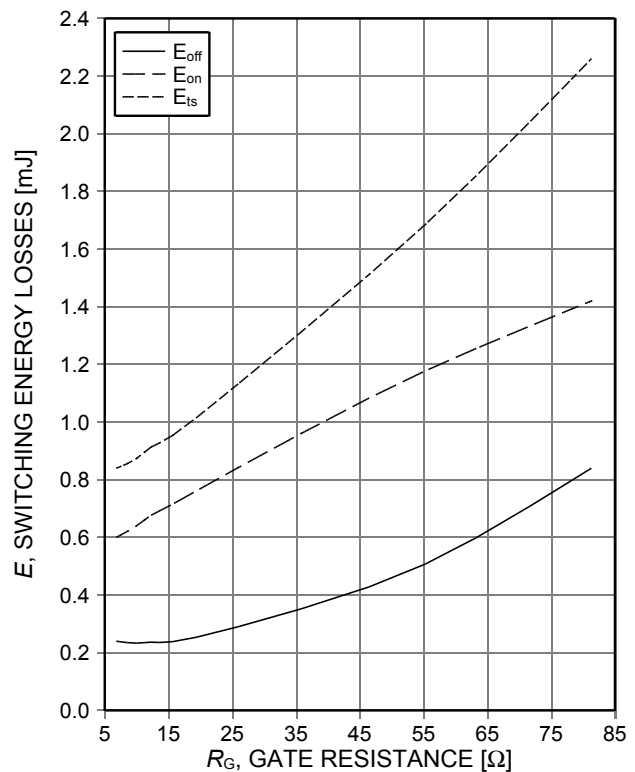


Figure 12. **Typical switching energy losses as a function of gate resistance**
(inductive load, $T_{vj}=150^{\circ}C$, $V_{CE}=400V$, $V_{GE}=0/15V$, $I_C=25A$, dynamic test circuit in Figure E)

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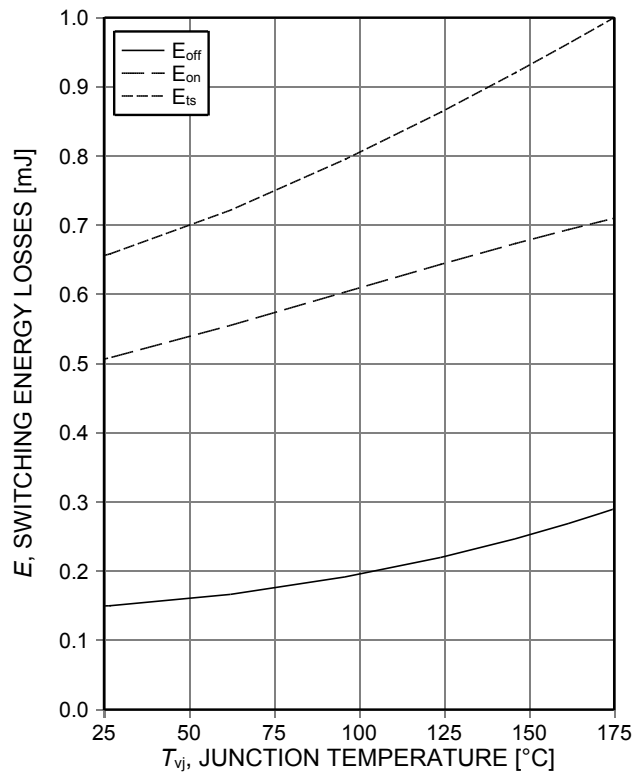


Figure 13. **Typical switching energy losses as a function of junction temperature**
(inductive load, $V_{CE}=400V$, $V_{GE}=0/15V$, $I_C=25A$, $R_{G(on)}=12\Omega$, $R_{G(off)}=12\Omega$, dynamic test circuit in Figure E)

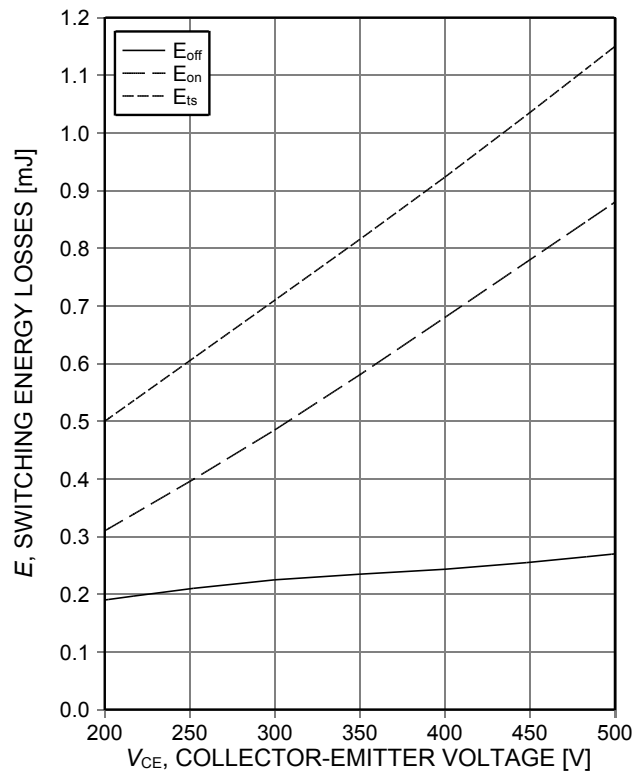


Figure 14. **Typical switching energy losses as a function of collector emitter voltage**
(inductive load, $T_{vj}=150^\circ C$, $V_{GE}=0/15V$, $I_C=25A$, $R_{G(on)}=12\Omega$, $R_{G(off)}=12\Omega$, dynamic test circuit in Figure E)

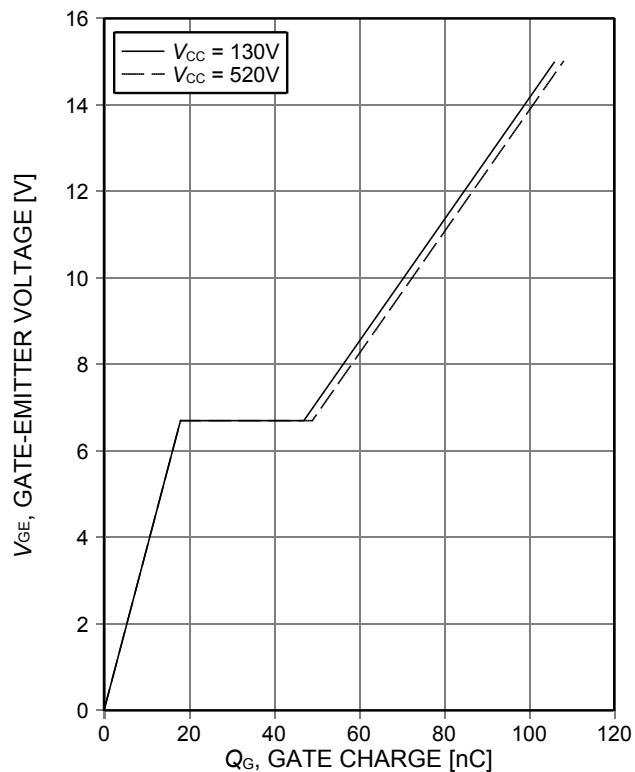


Figure 15. **Typical gate charge**
($I_C=50A$)

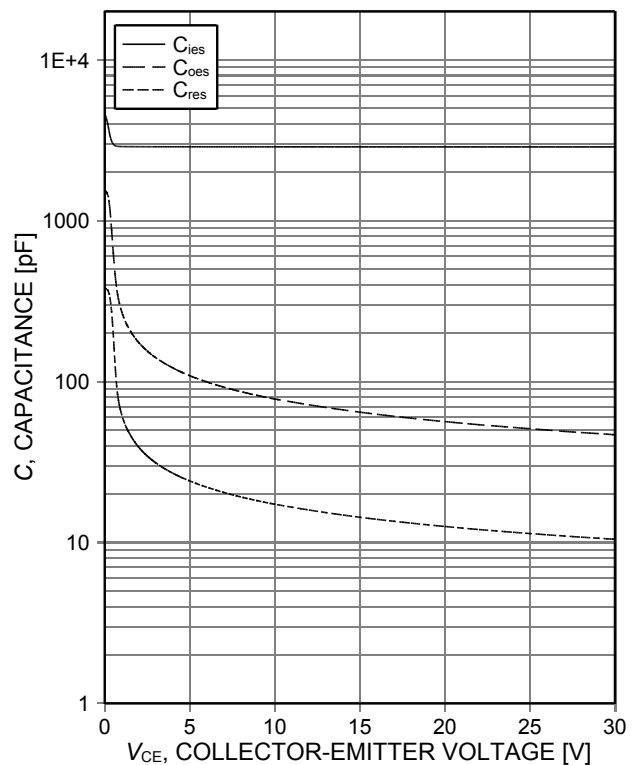


Figure 16. **Typical capacitance as a function of collector-emitter voltage**
($V_{GE}=0V$, $f=1MHz$)

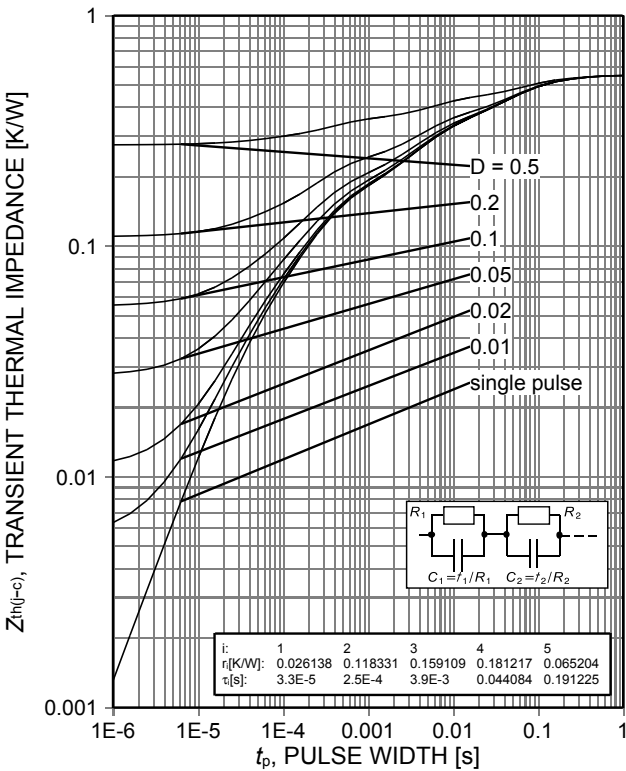
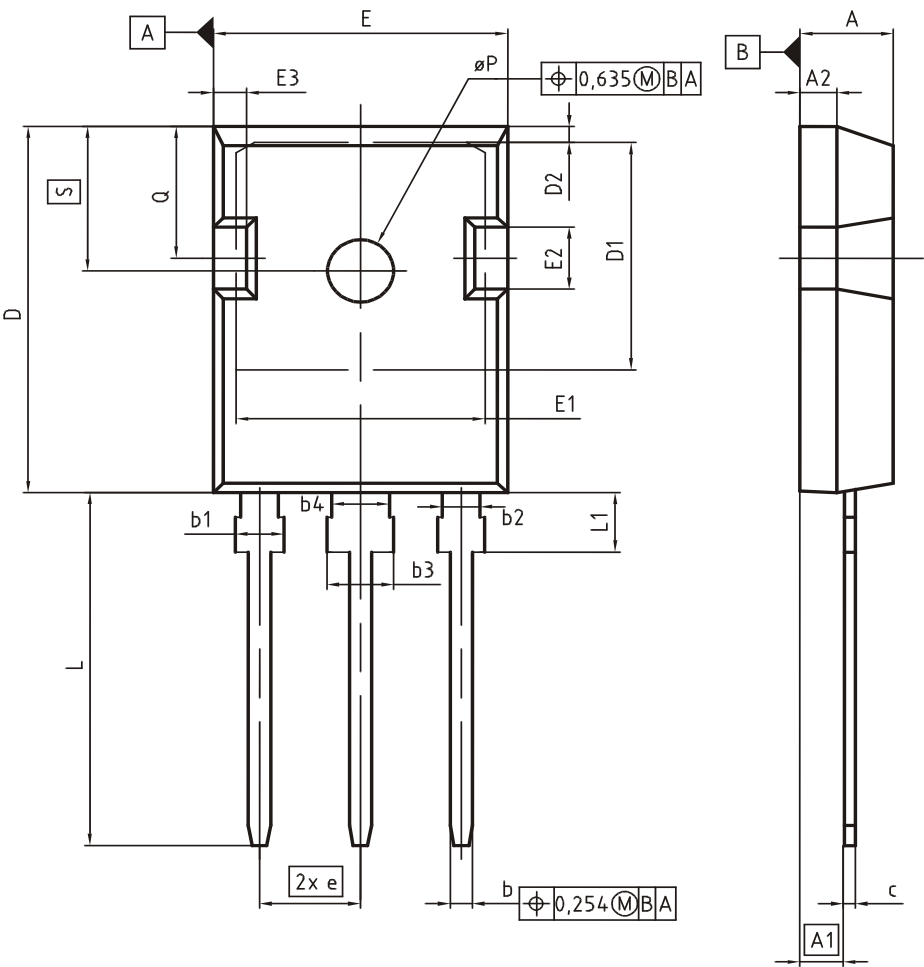


Figure 17. IGBT transient thermal impedance ($D=t_p/T$)

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

DOCUMENT NO.
Z8B00003327

SCALE

EUROPEAN PROJECTION

ISSUE DATE
09-07-2010

REVISION
05

Testing Conditions

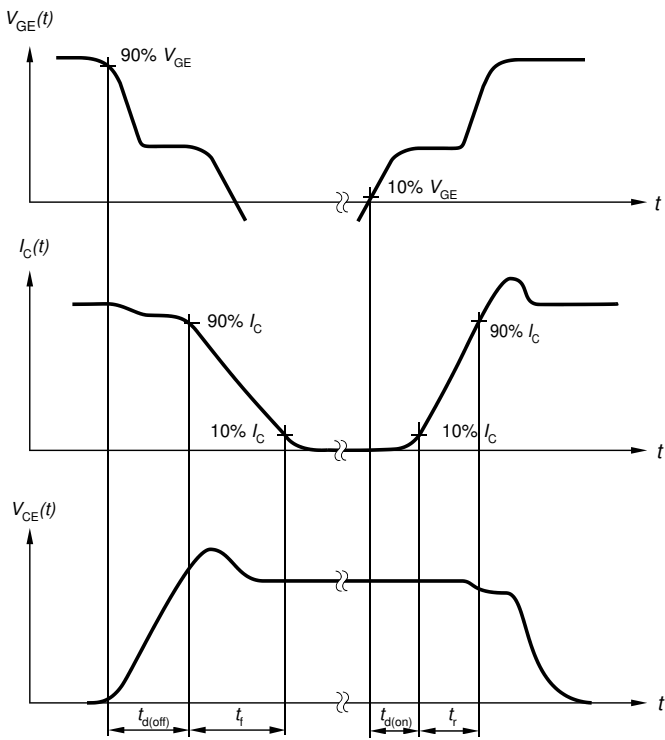


Figure A. Definition of switching times

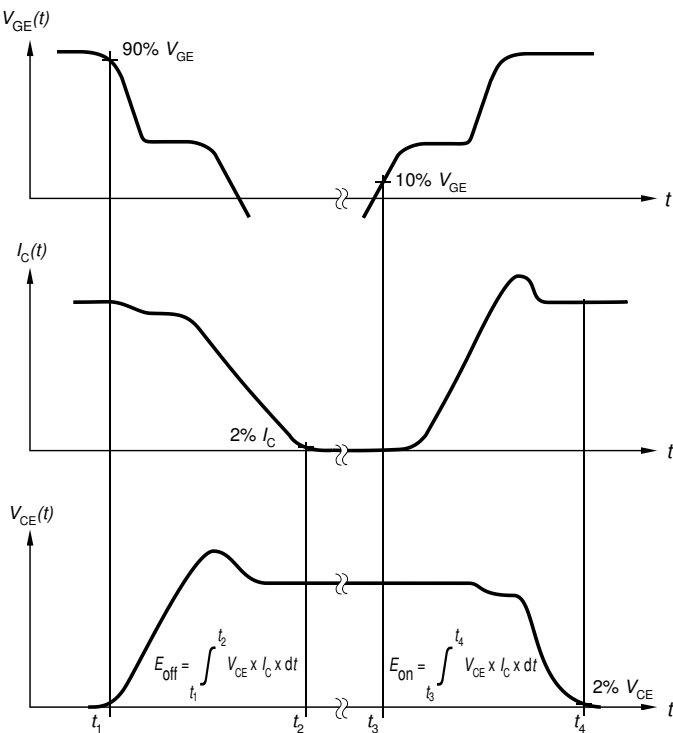


Figure B. Definition of switching losses

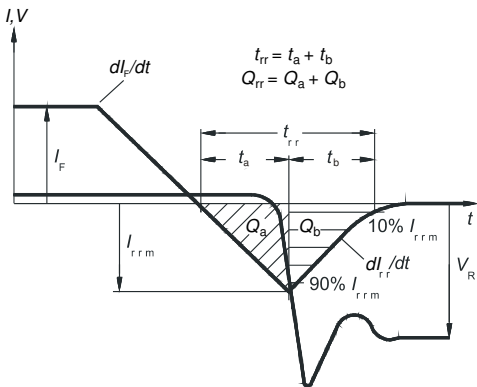


Figure C. Definition of diode switching characteristics

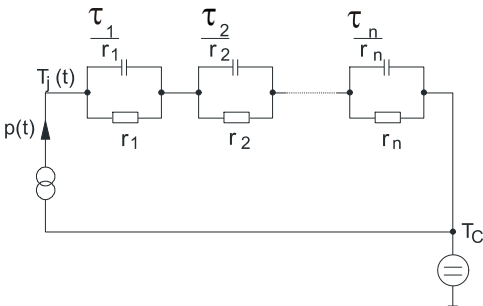


Figure D. Thermal equivalent circuit

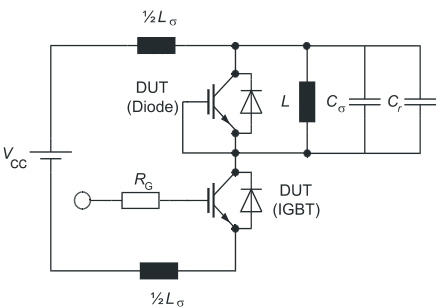


Figure E. **Dynamic test circuit**
Parasitic inductance L_{σ} ,
parasitic capacitor C_{σ} ,
relief capacitor C_r ,
(only for ZVT switching)

High speed switching series fifth generation

Revision History

AIGW50N65F5

Revision: 2017-06-27, Rev. 2.1

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.1	2017-06-27	Data sheet created

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