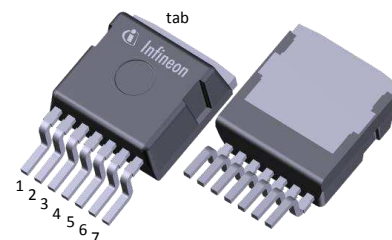
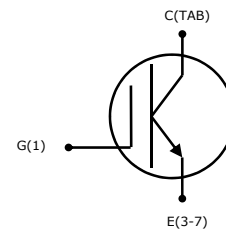


High speed switching series fifth generation

## High speed FAST IGBT in TRENCHSTOP™ 5 F5 technology

### Features and Benefits:

- Best-in-Class efficiency in hard switching and resonant topologies
- 650V breakdown voltage
- Low gate charge  $Q_G$
- Maximum junction temperature 175°C
- Dynamically stress tested
- Qualified according to AEC-Q101
- Pb-free lead plating; RoHS compliant
- Innovative high creepage D2PAK SMD package
- Complete product spectrum and PSpice Models: <http://www.infineon.com/igbt/>



### Applications:

- Off-board charger
- On-board charger
- DC/DC converter
- Power-factor correction

### Package pin definition:

- Pin 1 : Gate
- Pin 2 : No Connect
- Pin 3-7 : Emitter
- Backside : Collector



### Key Performance and Package Parameters

Type	$V_{CE}$	$I_C$	$V_{CEsat}, T_{vj}=25^{\circ}C$	$T_{vjmax}$	Marking	Package
AIGBE40N65F5	650V	40A	1.6V	175°C	AGE40EF5	PG-TO263-7-11



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## High speed switching series fifth generation

## 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, $T_{vj} \geq 25^{\circ}\text{C}$	$V_{CE}$	650	V
DC collector current, limited by $T_{vjmax}$ $T_c = 25^{\circ}\text{C}$ $T_c = 100^{\circ}\text{C}$	$I_C$	74.0 46.0	A
Pulsed collector current, $t_p$ limited by $T_{vjmax}^{1)}$	$I_{Cpuls}$	120.0	A
Turn off safe operating area $V_{CE} \leq 650\text{V}$ , $T_{vj} \leq 175^{\circ}\text{C}$ , $t_p = 1\mu\text{s}^{1)}$	-	120.0	A
Gate-emitter voltage Transient Gate-emitter voltage ( $t_p \leq 10\mu\text{s}$ , $D < 0.010$ )	$V_{GE}$	$\pm 20$ $\pm 30$	V
Power dissipation $T_c = 25^{\circ}\text{C}$ Power dissipation $T_c = 100^{\circ}\text{C}$	$P_{tot}$	250.0 125.0	W
Operating junction temperature	$T_{vj}$	-40...+175	$^{\circ}\text{C}$
Storage temperature	$T_{stg}$	-55...+150	$^{\circ}\text{C}$
Soldering temperature, reflow soldering (MSL1 according to JEDEC J-STA-020)		260	$^{\circ}\text{C}$

## Thermal Resistance

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
<b><math>R_{th}</math> Characteristics</b>						
IGBT thermal resistance, junction - case	$R_{th(j-c)}$		-	-	0.60	K/W
Thermal resistance, min. footprint junction - ambient	$R_{th(j-a)}$		-	-	65	K/W
Thermal resistance, 6cm <sup>2</sup> Cu on PCB 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.	
<b>Static Characteristic</b>						
Collector-emitter breakdown voltage	$V_{(BR)CES}$	$V_{GE} = 0\text{V}$ , $I_C = 0.20\text{mA}$	650	-	-	V
Collector-emitter saturation voltage	$V_{CEsat}$	$V_{GE} = 15.0\text{V}$ , $I_C = 40.0\text{A}$	-	1.60	2.10	V
		$T_{vj} = 25^{\circ}\text{C}$	-	1.80	-	
		$T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	-	1.90	-	
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C = 0.40\text{mA}$ , $V_{CE} = V_{GE}$	3.2	4.0	4.8	V
Zero gate voltage collector current	$I_{CES}$	$V_{CE} = 650\text{V}$ , $V_{GE} = 0\text{V}$	-	-	40	$\mu\text{A}$
		$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	-	1000	-	
Gate-emitter leakage current	$I_{GES}$	$V_{CE} = 0\text{V}$ , $V_{GE} = 20\text{V}$	-	-	100	nA
Transconductance	$g_{fs}$	$V_{CE} = 20\text{V}$ , $I_C = 40.0\text{A}$	-	40.0	-	S

<sup>1)</sup> Defined by design. Not subject to production test.

High speed switching series fifth generation

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

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
<b>Dynamic Characteristic</b>						
Input capacitance	$C_{ies}$	$V_{CE} = 25\text{V}, V_{GE} = 0\text{V}, f = 1\text{MHz}$	-	2500	-	pF
Output capacitance	$C_{oes}$		-	50	-	
Reverse transfer capacitance	$C_{res}$		-	9	-	
Gate charge	$Q_G$	$V_{CC} = 520\text{V}, I_C = 40.0\text{A}, V_{GE} = 15\text{V}$	-	90.0	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	$L_E$		-	5.5	-	nH

**Switching Characteristic, Inductive Load**

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
<b>IGBT Characteristic, at <math>T_{vj} = 25^{\circ}\text{C}</math></b>						
Turn-on delay time	$t_{d(on)}$	$T_{vj} = 25^{\circ}\text{C}, V_{CC} = 400\text{V}, I_C = 20.0\text{A}, V_{GE} = 0.0/15.0\text{V}, R_{G(on)} = 15.0\Omega, R_{G(off)} = 15.0\Omega, L_{\sigma} = 30\text{nH}, C_{\sigma} = 30\text{pF}$ Energy losses include "tail" and diode reverse recovery.	-	22	-	ns
Rise time	$t_r$		-	13	-	ns
Turn-off delay time	$t_{d(off)}$		-	166	-	ns
Fall time	$t_f$		-	6	-	ns
Turn-on energy	$E_{on}$		-	0.39	-	mJ
Turn-off energy	$E_{off}$		-	0.11	-	mJ
Total switching energy	$E_{ts}$		-	0.50	-	mJ
Turn-on delay time	$t_{d(on)}$	$T_{vj} = 25^{\circ}\text{C}, V_{CC} = 400\text{V}, I_C = 5.0\text{A}, V_{GE} = 0.0/15.0\text{V}, R_{G(on)} = 15.0\Omega, R_{G(off)} = 15.0\Omega, L_{\sigma} = 30\text{nH}, C_{\sigma} = 30\text{pF}$ Energy losses include "tail" and diode reverse recovery.	-	21	-	ns
Rise time	$t_r$		-	5	-	ns
Turn-off delay time	$t_{d(off)}$		-	183	-	ns
Fall time	$t_f$		-	11	-	ns
Turn-on energy	$E_{on}$		-	0.09	-	mJ
Turn-off energy	$E_{off}$		-	0.04	-	mJ
Total switching energy	$E_{ts}$		-	0.13	-	mJ

## High speed switching series fifth generation

## Switching Characteristic, Inductive Load

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
<b>IGBT Characteristic, at <math>T_{vj} = 150^{\circ}\text{C}</math></b>						
Turn-on delay time	$t_{d(on)}$	$T_{vj} = 150^{\circ}\text{C}$ , $V_{CC} = 400\text{V}$ , $I_C = 20.0\text{A}$ , $V_{GE} = 0.0/15.0\text{V}$ , $R_{G(on)} = 15.0\Omega$ , $R_{G(off)} = 15.0\Omega$ , $L\sigma = 30\text{nH}$ , $C\sigma = 30\text{pF}$ $L\sigma$ , $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	21	-	ns
Rise time	$t_r$		-	15	-	ns
Turn-off delay time	$t_{d(off)}$		-	203	-	ns
Fall time	$t_f$		-	4	-	ns
Turn-on energy	$E_{on}$		-	0.53	-	mJ
Turn-off energy	$E_{off}$		-	0.21	-	mJ
Total switching energy	$E_{ts}$		-	0.74	-	mJ
Turn-on delay time	$t_{d(on)}$	$T_{vj} = 150^{\circ}\text{C}$ , $V_{CC} = 400\text{V}$ , $I_C = 5.0\text{A}$ , $V_{GE} = 0.0/15.0\text{V}$ , $R_{G(on)} = 15.0\Omega$ , $R_{G(off)} = 15.0\Omega$ , $L\sigma = 30\text{nH}$ , $C\sigma = 30\text{pF}$ $L\sigma$ , $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	19	-	ns
Rise time	$t_r$		-	6	-	ns
Turn-off delay time	$t_{d(off)}$		-	243	-	ns
Fall time	$t_f$		-	20	-	ns
Turn-on energy	$E_{on}$		-	0.16	-	mJ
Turn-off energy	$E_{off}$		-	0.08	-	mJ
Total switching energy	$E_{ts}$		-	0.24	-	mJ

High speed switching series fifth generation

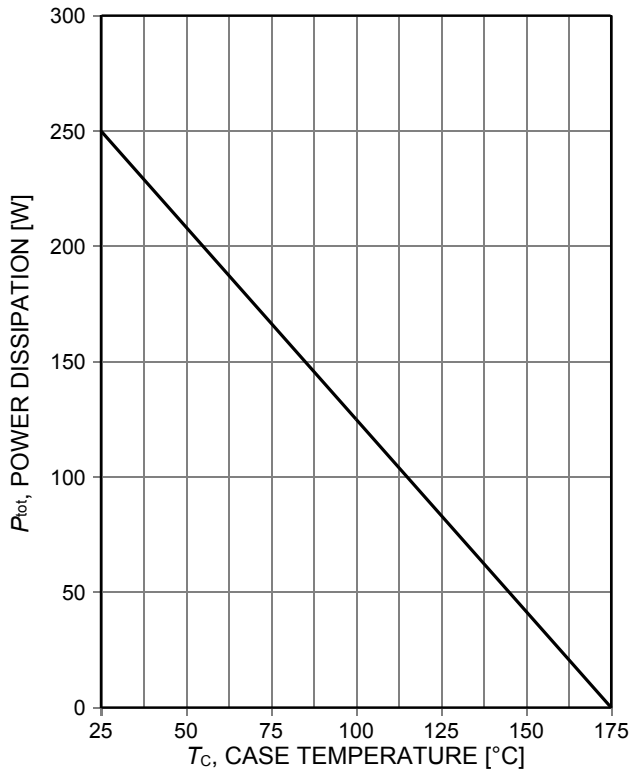


Figure 1. Power dissipation as a function of case temperature ( $T_{vj} \leq 175^\circ\text{C}$ )

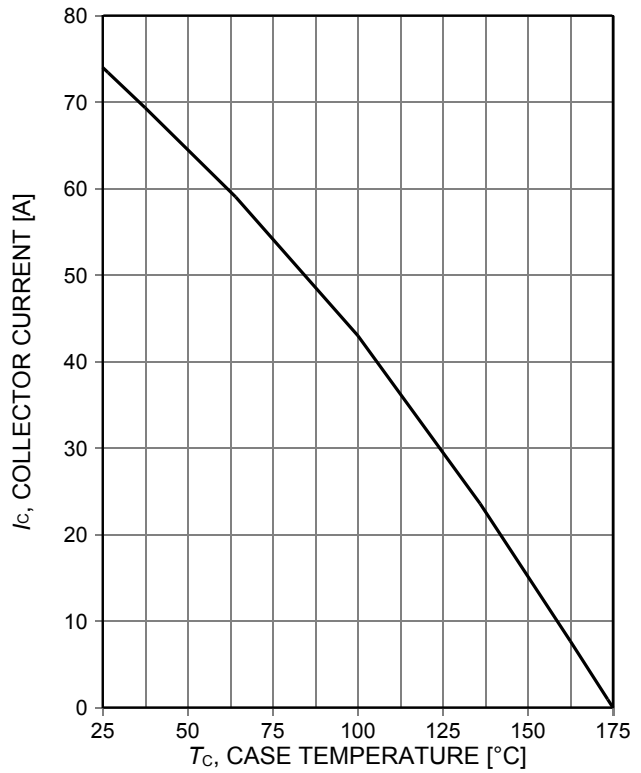


Figure 2. Collector current as a function of case temperature ( $V_{GE} \geq 15\text{V}$ ,  $T_{vj} \leq 175^\circ\text{C}$ )

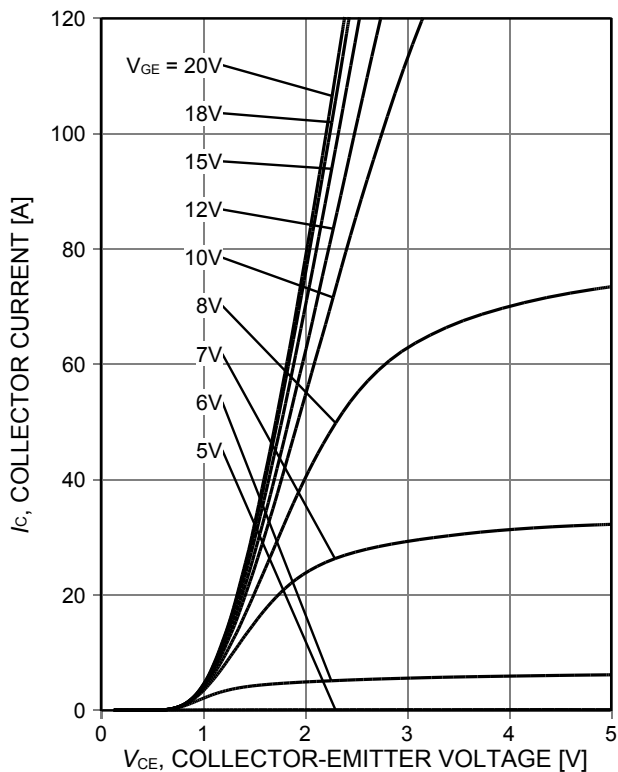


Figure 3. Typical output characteristic ( $T_{vj} = 25^\circ\text{C}$ )

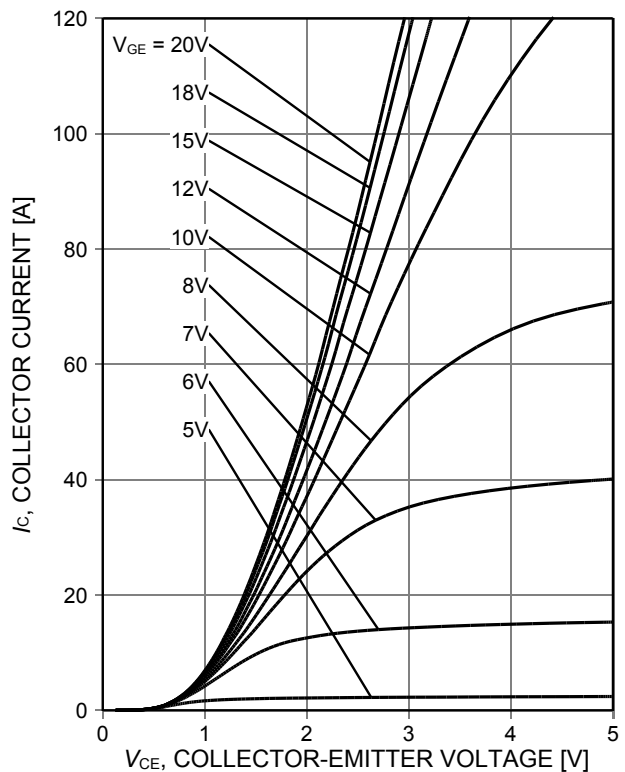


Figure 4. Typical output characteristic ( $T_{vj} = 150^\circ\text{C}$ )

High speed switching series fifth generation

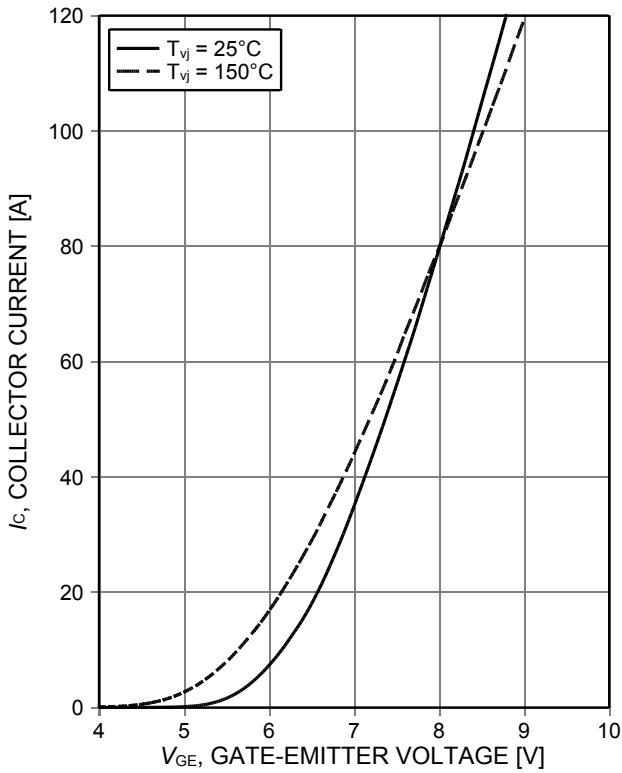


Figure 5. Typical transfer characteristic (V<sub>CE</sub>=20V)

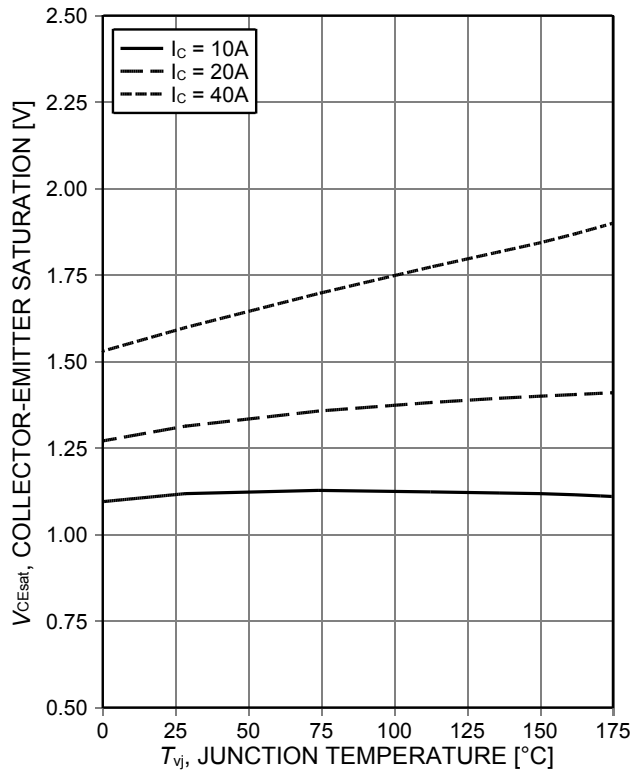


Figure 6. Typical collector-emitter saturation voltage as a function of junction temperature (V<sub>GE</sub>=15V)

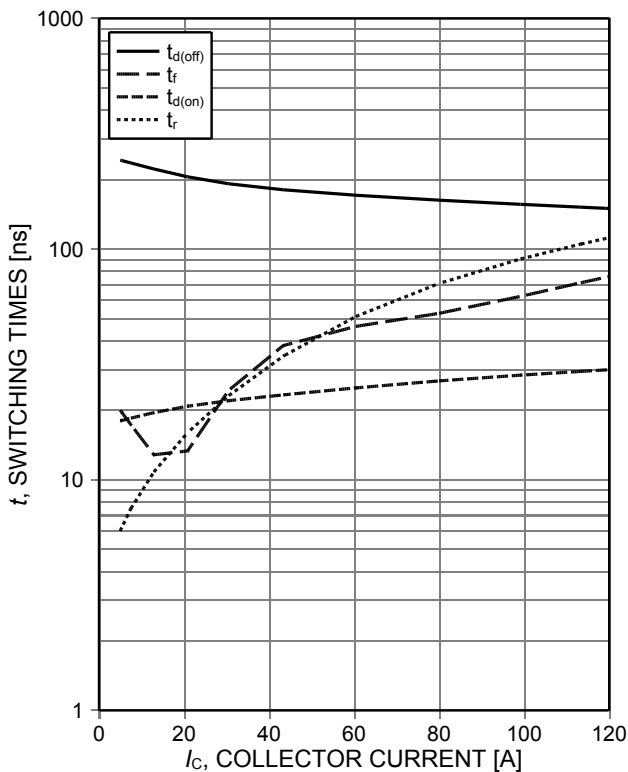


Figure 7. Typical switching times as a function of collector current (inductive load, T<sub>vj</sub>=150°C, V<sub>CE</sub>=400V, V<sub>GE</sub>=15/0V, r<sub>G</sub>=15Ω, Dynamic test circuit in Figure E)

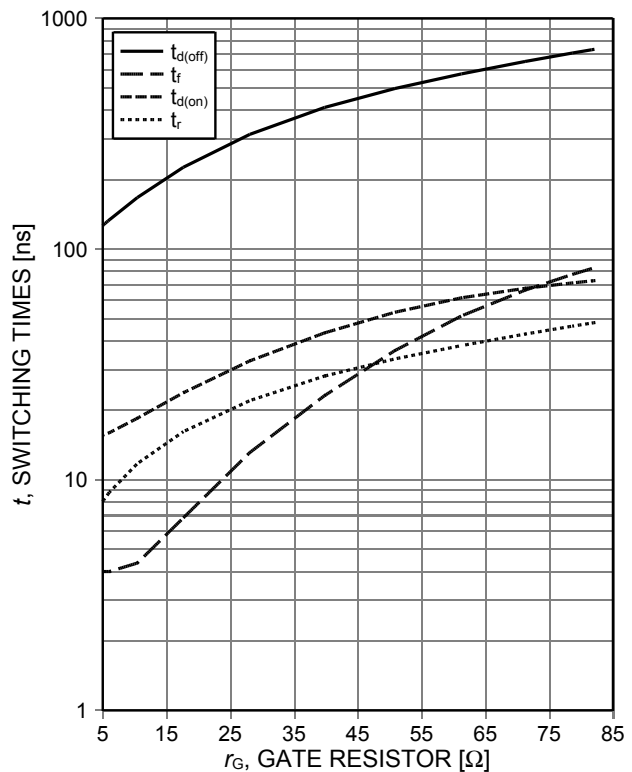


Figure 8. Typical switching times as a function of gate resistor (inductive load, T<sub>vj</sub>=150°C, V<sub>CE</sub>=400V, V<sub>GE</sub>=15/0V, I<sub>C</sub>=20A, Dynamic test circuit in Figure E)

High speed switching series fifth generation

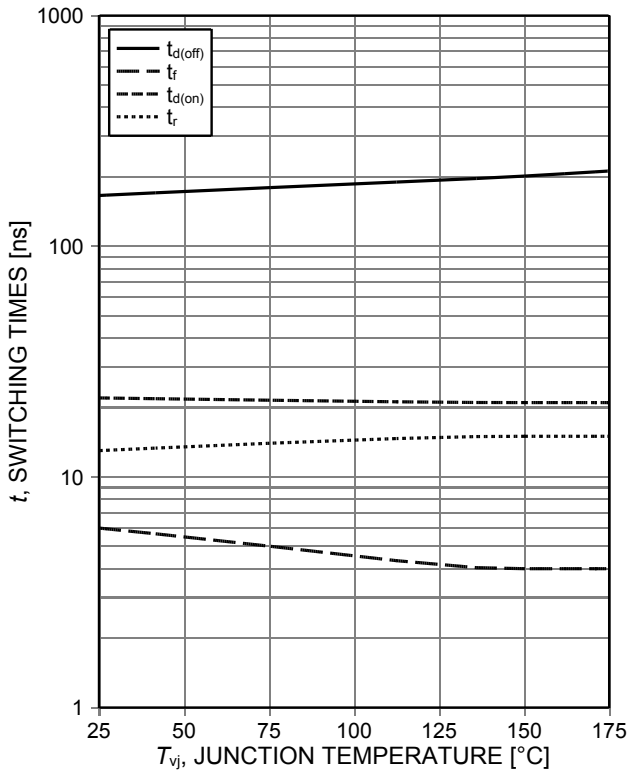


Figure 9. Typical switching times as a function of junction temperature (inductive load,  $V_{CE}=400V$ ,  $V_{GE}=15/0V$ ,  $I_C=20A$ ,  $r_G=15\Omega$ , Dynamic test circuit in Figure E)

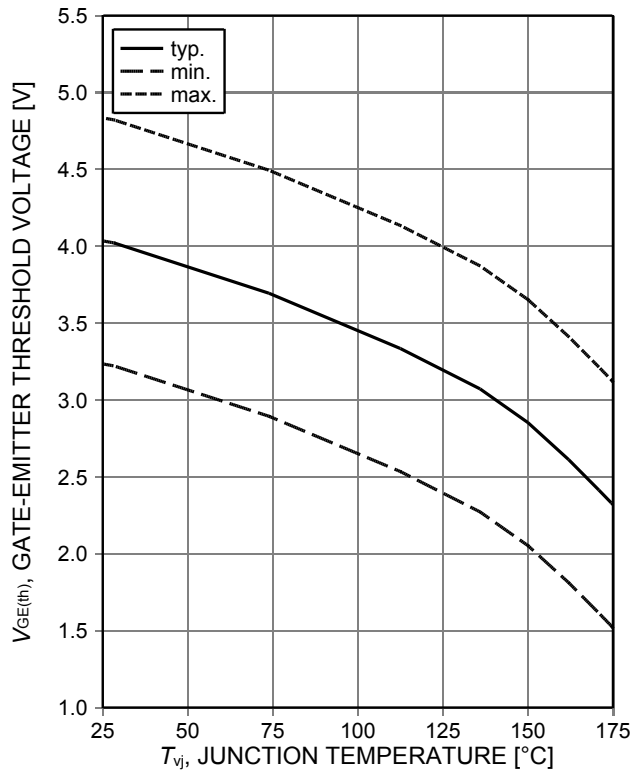


Figure 10. Gate-emitter threshold voltage as a function of junction temperature ( $I_C=0.4mA$ )

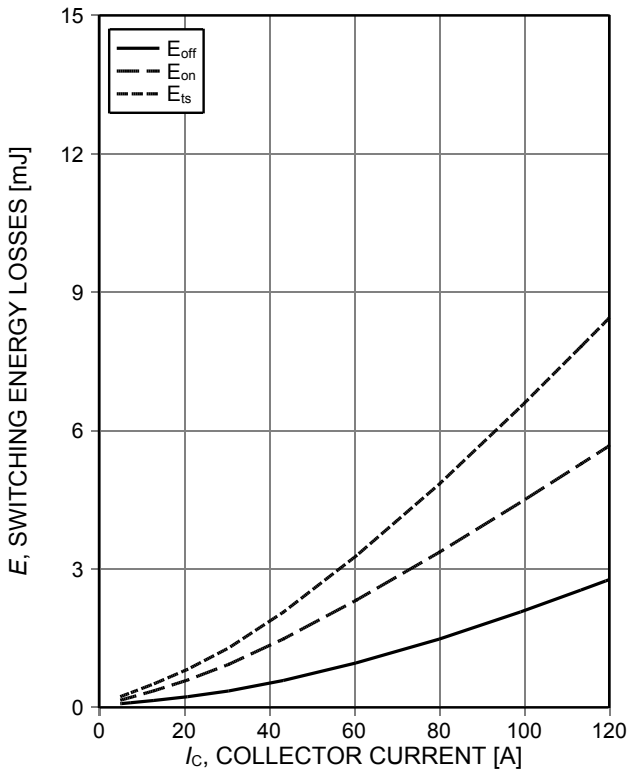


Figure 11. Typical switching energy losses as a function of collector current (inductive load,  $T_{vj}=150^\circ C$ ,  $V_{CE}=400V$ ,  $V_{GE}=15/0V$ ,  $r_G=15\Omega$ , Dynamic test circuit in Figure E)

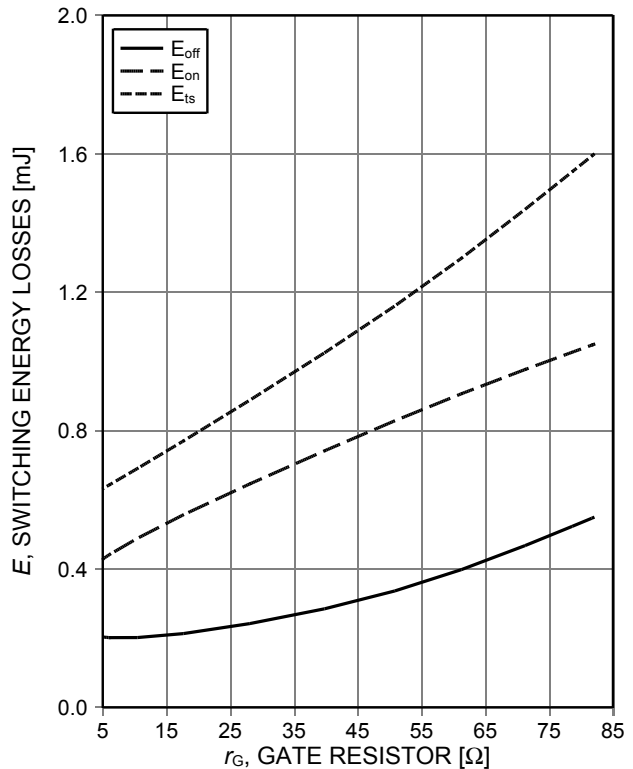


Figure 12. Typical switching energy losses as a function of gate resistor (inductive load,  $T_{vj}=150^\circ C$ ,  $V_{CE}=400V$ ,  $V_{GE}=15/0V$ ,  $I_C=20A$ , Dynamic test circuit in Figure E)



High speed switching series fifth generation

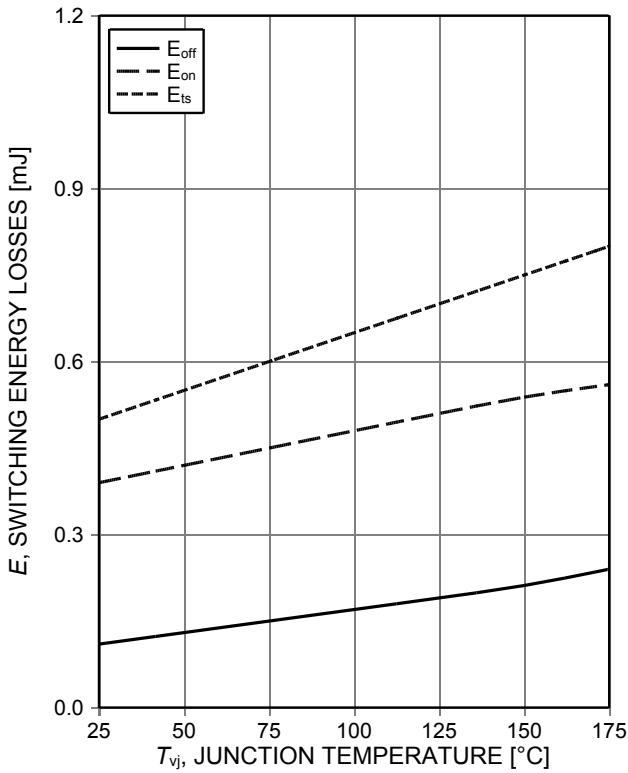


Figure 13. **Typical switching energy losses as a function of junction temperature** (inductive load,  $V_{CE}=400V$ ,  $V_{GE}=15/0V$ ,  $I_C=20A$ ,  $r_G=15\Omega$ , Dynamic test circuit in Figure E)

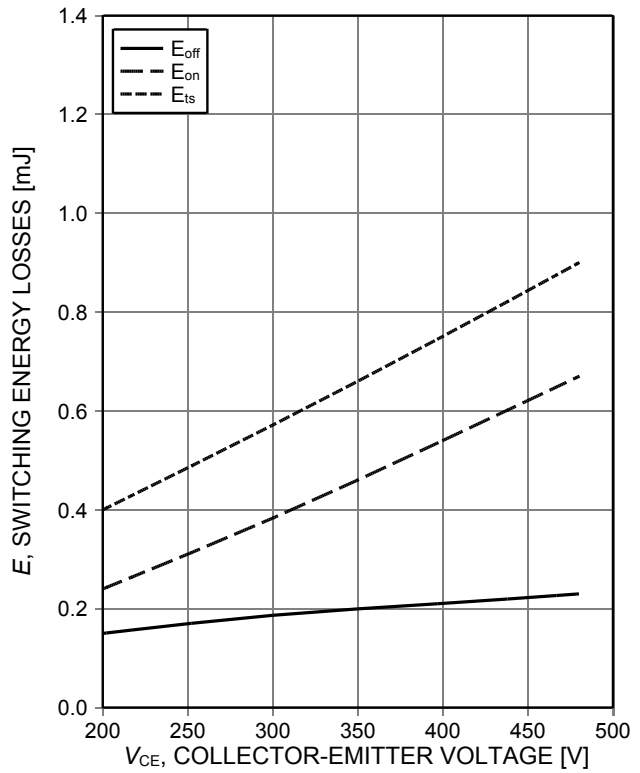


Figure 14. **Typical switching energy losses as a function of collector emitter voltage** (inductive load,  $T_{vj}=150^\circ C$ ,  $V_{GE}=15/0V$ ,  $I_C=20A$ ,  $r_G=15\Omega$ , Dynamic test circuit in Figure E)

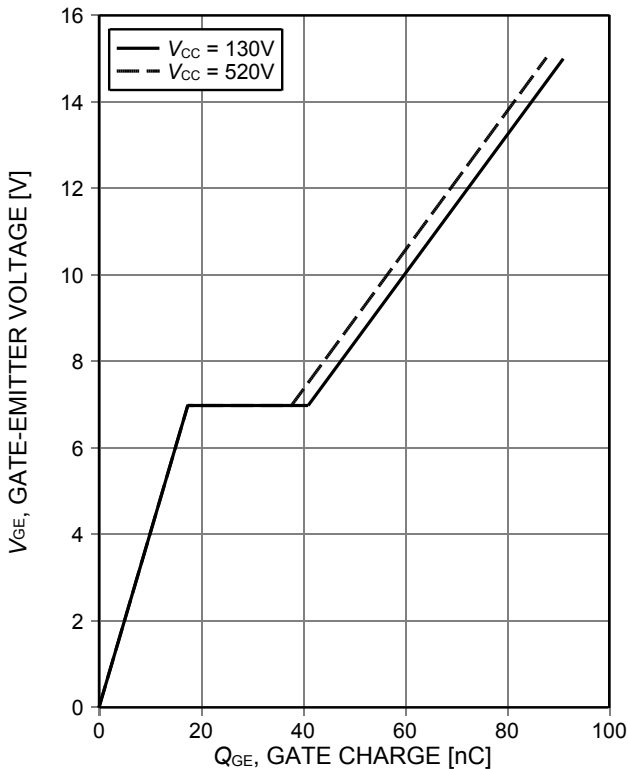


Figure 15. **Typical gate charge** ( $I_C=40A$ )

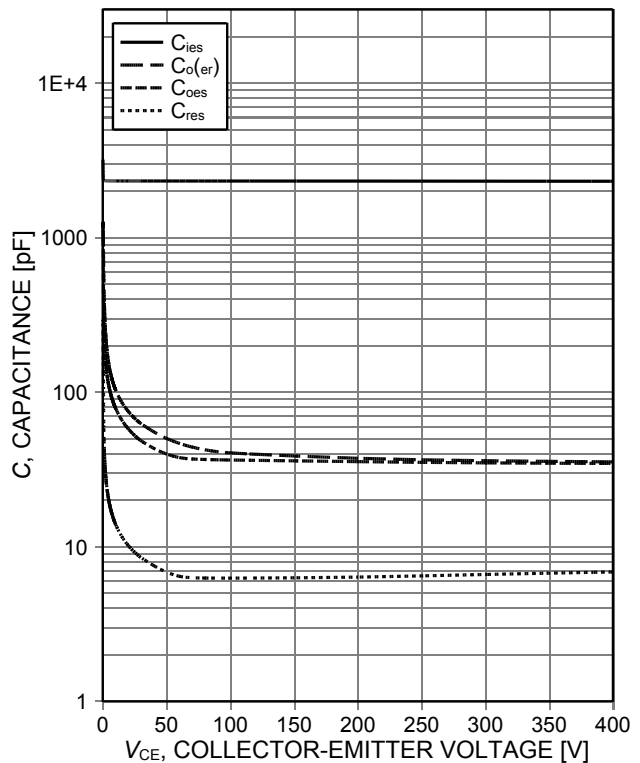


Figure 16. **Typical capacitance as a function of collector-emitter voltage** ( $V_{GE}=0V$ ,  $f=1MHz$ )

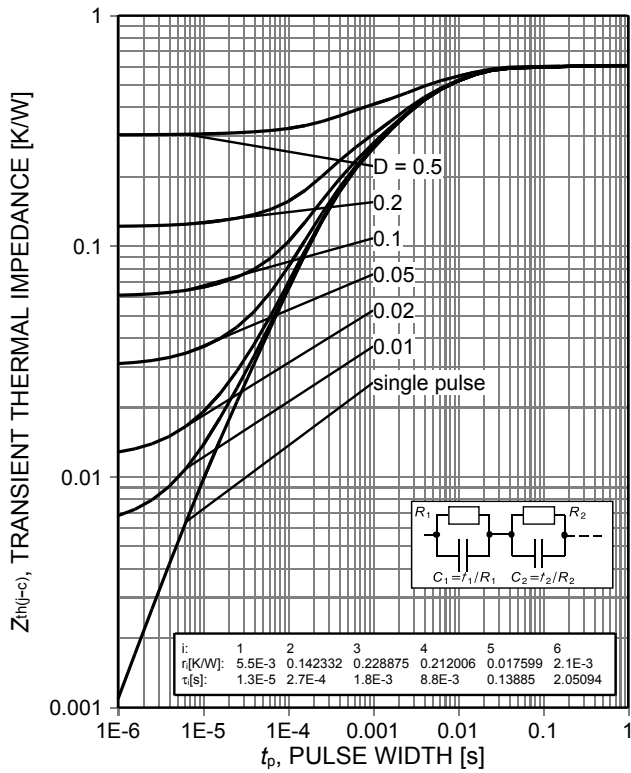
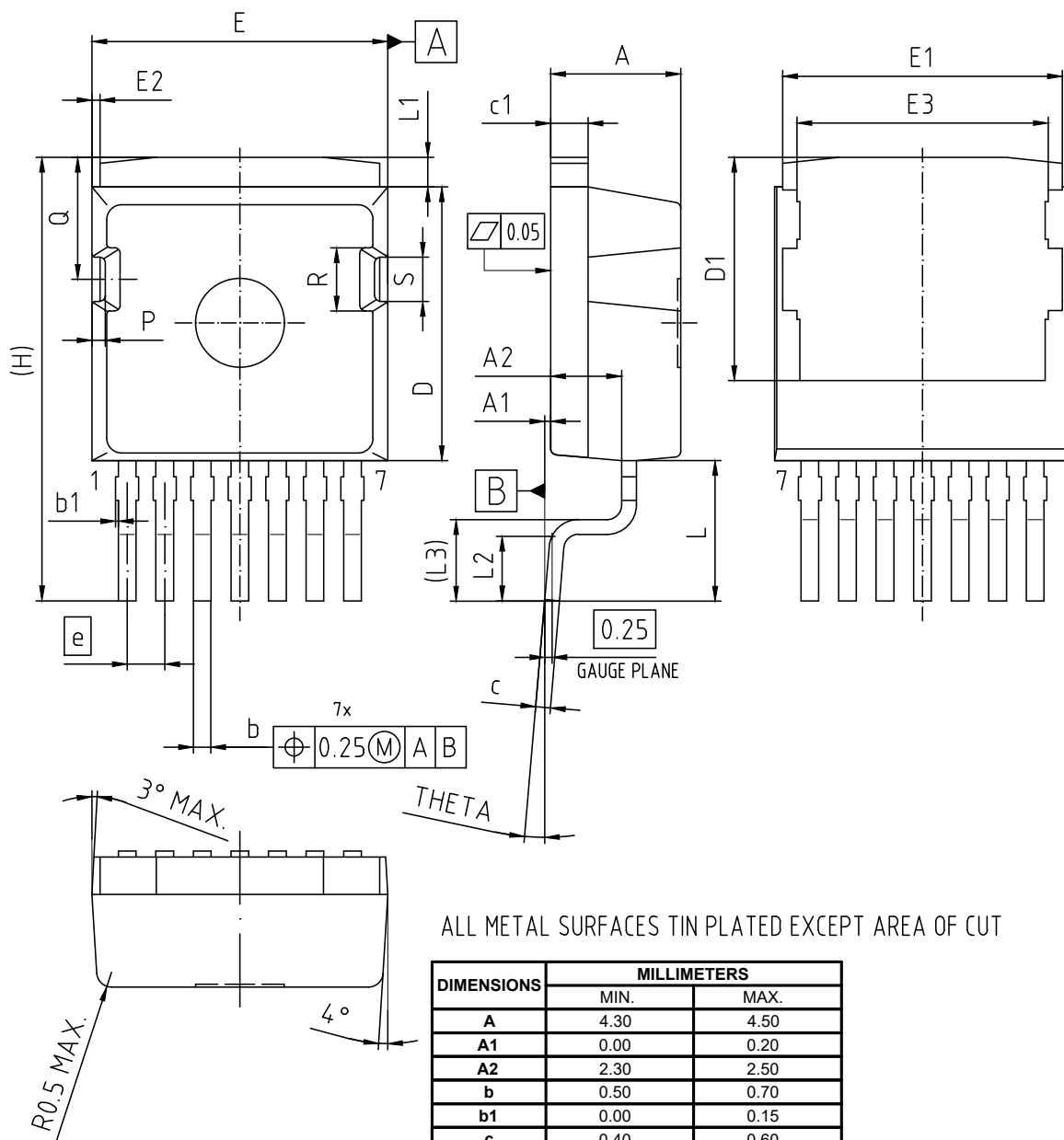


Figure 17. IGBT transient thermal impedance ( $D=t_p/T$ )

PG-TO263-7-11



ALL METAL SURFACES TIN PLATED EXCEPT AREA OF CUT

DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	4.30	4.50
A1	0.00	0.20
A2	2.30	2.50
b	0.50	0.70
b1	0.00	0.15
c	0.40	0.60
c1	1.17	1.37
D	9.05	9.45
D1	7.30	7.50
E	9.80	10.20
E1	9.36	9.56
E2	0.00	0.30
E3	8.40	8.60
e	1.27	
H	15.00	
L	4.20	5.20
L1	0.70	1.30
L2	1.70	2.30
L3	2.70	
P	0.35	0.55
Q	4.02	4.22
R	2.03	2.23
S	1.40	1.60
THETA	0.00°	8.00°

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<b>REVISION</b> 01
<b>SCALE 5:1</b> 0 1 2 3 4 5mm
<b>EUROPEAN PROJECTION</b> 
<b>ISSUE DATE</b> 20.09.2018

Testing Conditions



Figure A. Definition of switching times

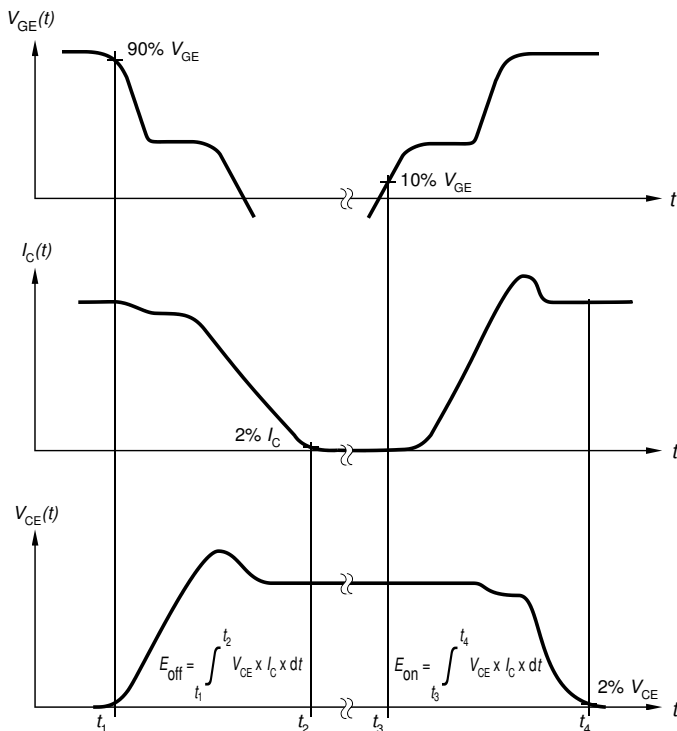


Figure B. Definition of switching losses



Figure C. Definition of diode switching characteristics



Figure D. Thermal equivalent circuit

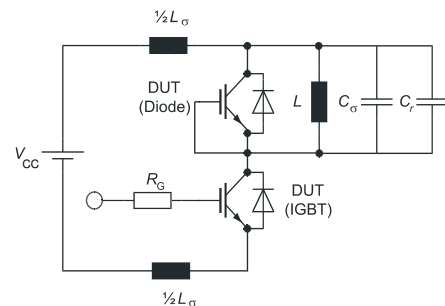


Figure E. Dynamic test circuit  
Parasitic inductance  $L_{\sigma}$ ,  
parasitic capacitor  $C_{\sigma}$ ,  
relief capacitor  $C_r$ ,  
(only for ZVT switching)

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High speed switching series fifth generation

## Revision History

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AIGBE40N65F5

**Revision: 2019-08-26, Rev. 2.1**

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Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.1	2019-08-26	Final Datasheet

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