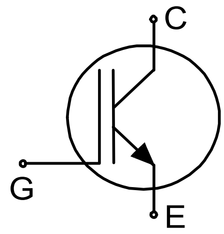
IGBT in trench and field-stop technology

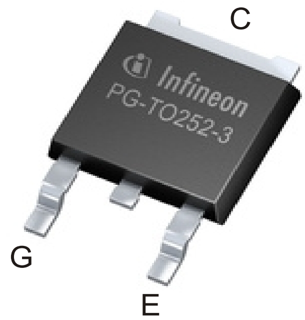
Features and Benefits:



- Very low $V_{CE(sat)}$ 1.5V (typ.)
- Maximum junction temperature 175°C
- Short circuit withstand time 3µs

Trench and field-stop technology for 650V applications offers :
  - very tight parameter distribution
  - high ruggedness, temperature stable behavior
  - low V_{CEsat} and positive temperature coefficient
- Low gate charge Q_G
- Pb-free lead plating; RoHS compliant
- Complete product spectrum and PLECS Models:

www.infineon.com/igbt



Potential Applications:

Drives
  - GPD (general purpose drives)

Major home appliances
  - Air conditioning
  - Other major home appliances

Small home appliances
  - Other small home appliances

Product Validation:

Qualified for industrial applications according to the relevant tests of JEDEC47/20/22

Key Performance and Package Parameters

Type	V_{CE}	I_C	V_{CEsat}, T_{vj}=25°C	T_{vjmax}	Marking	Package
IGD10N65T6	650V	10A	1.5V	175°C	G10ET6	PG-TO252-3

Table of Contents

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, $T_{vj} \geq 25°C$	V_{CE}	650	V
DC collector current, limited by T_{vjmax} $T_c = 25°C$ $T_c = 100°C$	I_C	 23.0 14.0	A
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}	42.5	A
Turn off safe operating area $V_{CE} \leq 650V$, $T_{vj} \leq 175°C$	-	42.5	A
Gate-emitter voltage Transient Gate-emitter voltage ($t_p \leq 10\mu s$, $D < 0.010$)	V_{GE}	±20 ±30	V
Short circuit withstand time $V_{GE} = 15.0V$, $V_{CC} \leq 360V$ Allowed number of short circuits < 1000 Time between short circuits: ≥ 1.0s $T_{vj} = 150°C$	t_{SC}	 3	µs
Power dissipation $T_c = 25°C$ Power dissipation $T_c = 100°C$	P_{tot}	75.0 37.5	W
Operating junction temperature	T_{vj}	-40...+175	°C
Storage temperature	T_{stg}	-55...+150	°C
Soldering temperature, reflow soldering (MSL1 according to JEDEC J-STA-020)		 260	°C

Thermal Resistance

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
R_{th} Characteristics						
IGBT thermal resistance, junction - case	$R_{th(j-c)}$		-	-	2.00	K/W
Thermal resistance, min. footprint junction - ambient	$R_{th(j-a)}$		-	-	75	K/W
Thermal resistance, 6cm² Cu on PCB junction - ambient	$R_{th(j-a)}$		-	-	50	K/W

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

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
Static Characteristic						
Collector-emitter saturation voltage	V_{CEsat}	$V_{GE} = 15.0V$, $I_C = 8.5A$ $T_{vj} = 25°C$ $T_{vj} = 125°C$ $T_{vj} = 150°C$	 - - -	 1.50 1.65 1.75	 1.90 - -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C = 0.15mA$, $V_{CE} = V_{GE}$	4.8	5.6	6.4	V
Zero gate voltage collector current	I_{CES}	$V_{CE} = 650V$, $V_{GE} = 0V$ $T_{vj} = 25°C$ $T_{vj} = 150°C$	 - -	 - 360	 30 -	µA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0V$, $V_{GE} = 20V$	-	-	100	nA
Transconductance	g_{fs}	$V_{CE} = 20V$, $I_C = 8.5A$	-	8.7	-	S

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 = 1000kHz	-	790	-	pF
Output capacitance	C_{oes}		-	41	-	
Reverse transfer capacitance	C_{res}		-	12	-	
Gate charge	Q_G	V_{CC} = 520V, I_C = 8.5A, V_{GE} = 15V	-	27.0	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E		-	7.0	-	nH

Switching Characteristic, Inductive Load

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic, at T_{vj} = 25°C						
Turn-on delay time	$t_{d(on)}$	T_{vj} = 25°C, V_{CC} = 400V, I_C = 8.5A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 47.0Ω, $R_{G(off)}$ = 47.0Ω, $L\sigma$ = 30nH, $C\sigma$ = 150pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	30	-	ns
Rise time	t_r		-	18	-	ns
Turn-off delay time	$t_{d(off)}$		-	106	-	ns
Fall time	t_f		-	46	-	ns
Turn-on energy	E_{on}		-	0.20	-	mJ
Turn-off energy	E_{off}		-	0.07	-	mJ
Total switching energy	E_{ts}		-	0.27	-	mJ

Switching Characteristic, Inductive Load

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic, at T_{vj} = 150°C						
Turn-on delay time	$t_{d(on)}$	T_{vj} = 150°C, V_{CC} = 400V, I_C = 8.5A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 47.0Ω, $R_{G(off)}$ = 47.0Ω, $L\sigma$ = 30nH, $C\sigma$ = 150pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	27	-	ns
Rise time	t_r		-	18	-	ns
Turn-off delay time	$t_{d(off)}$		-	123	-	ns
Fall time	t_f		-	72	-	ns
Turn-on energy	E_{on}		-	0.22	-	mJ
Turn-off energy	E_{off}		-	0.13	-	mJ
Total switching energy	E_{ts}		-	0.35	-	mJ

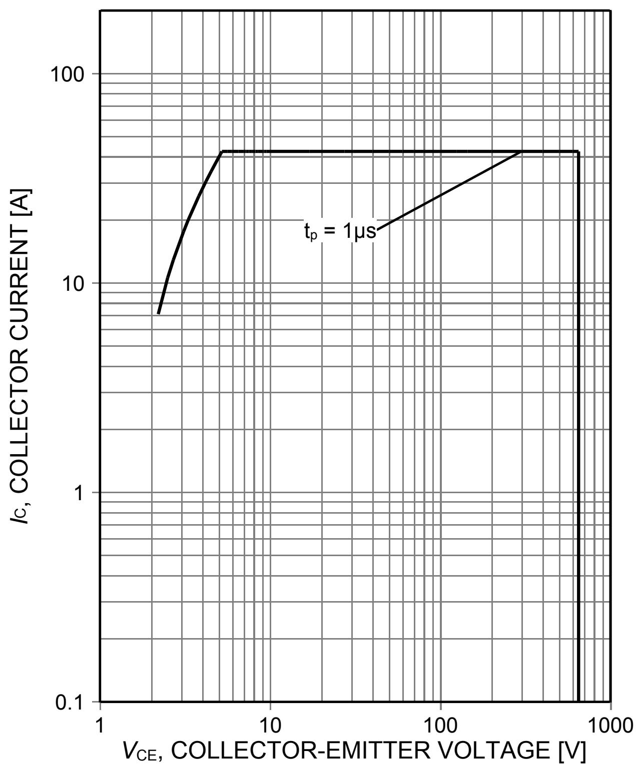


Figure 1. **Forward bias safe operating area**
(D=0, T_C=25°C, T_{vj}≤175°C; V_{GE}=15V)

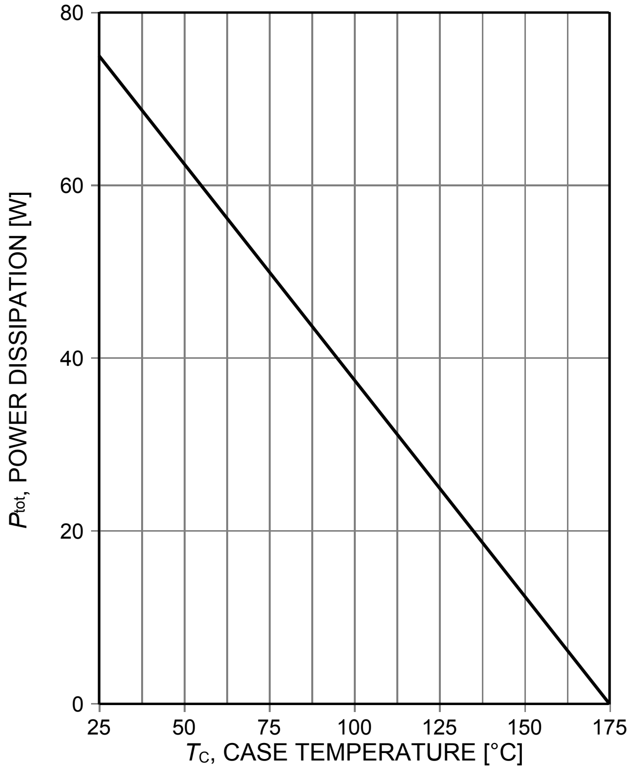


Figure 2. **Power dissipation as a function of case temperature**
(T_{vj}≤175°C)

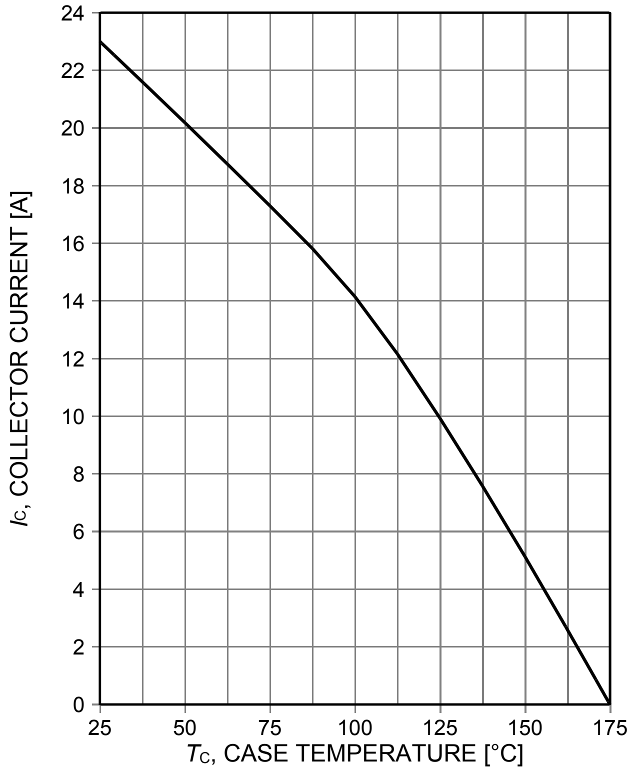


Figure 3. **Collector current as a function of case temperature**
(V_{GE}≥15V, T_{vj}≤175°C)

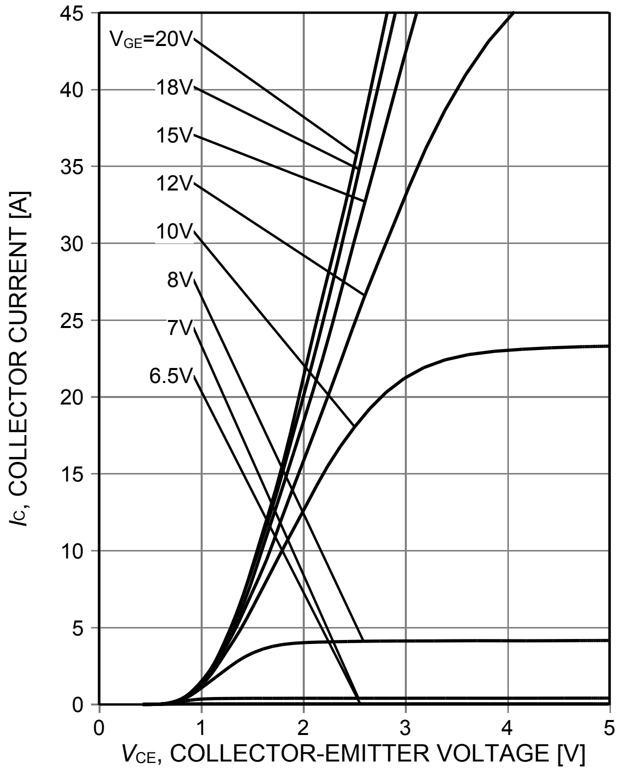


Figure 4. **Typical output characteristic**
(T_{vj}=25°C)

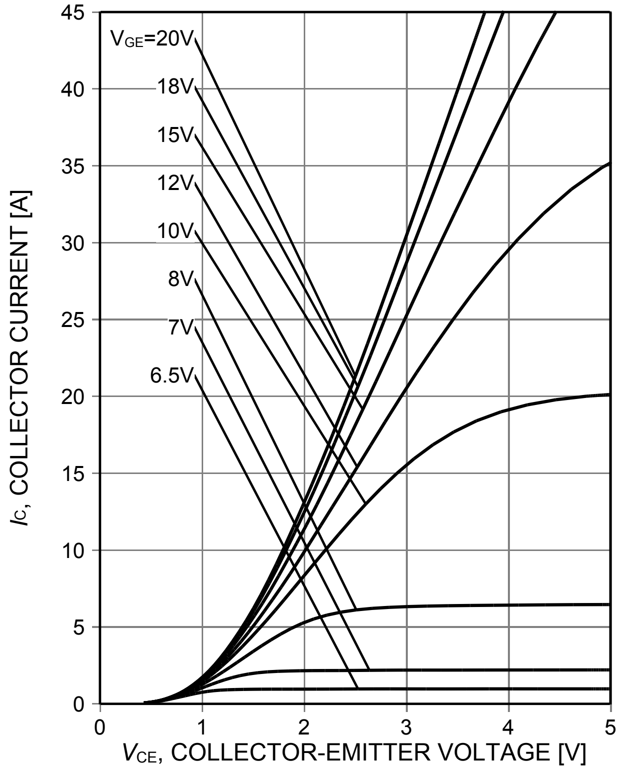


Figure 5. **Typical output characteristic**
(T_{vj}=150°C)

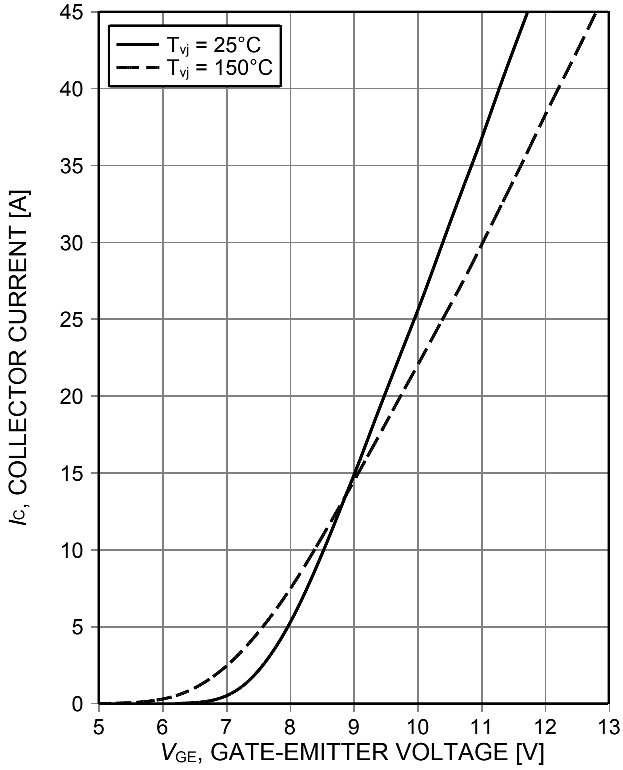


Figure 6. **Typical transfer characteristic**
(V_{CE}=20V)

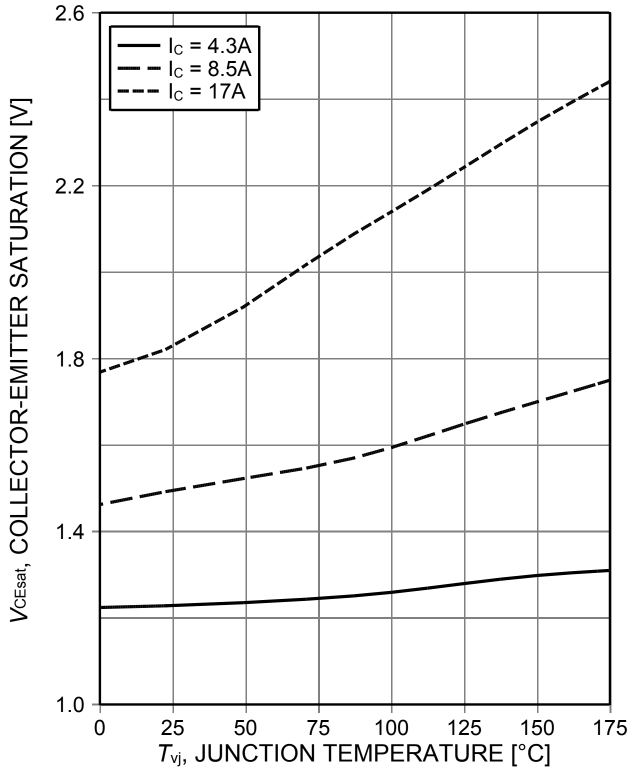


Figure 7. **Typical collector-emitter saturation voltage as a function of junction temperature**
(V_{GE}=15V)

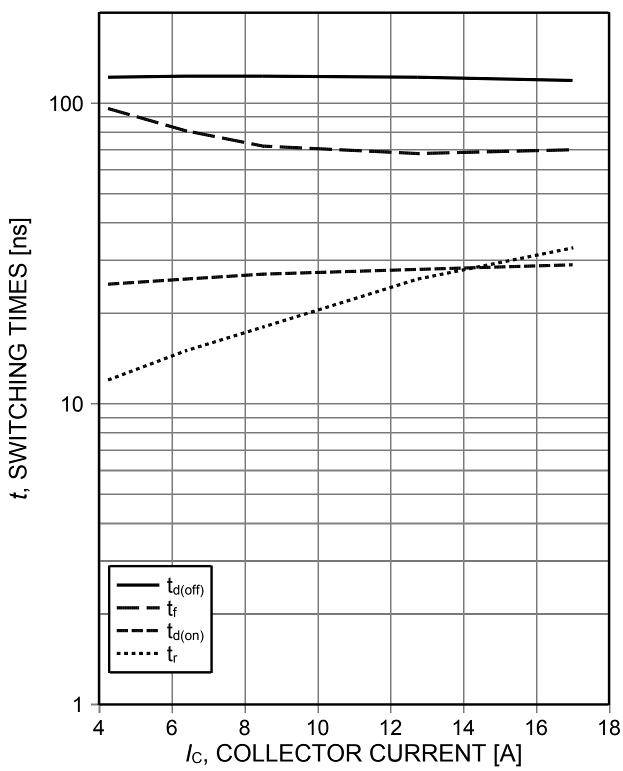


Figure 8. **Typical switching times as a function of collector current**
(inductive load, T_{vj}=150°C, V_{CE}=400V, V_{GE}=0/15V, r_G=47Ω, Dynamic test circuit in Figure E)

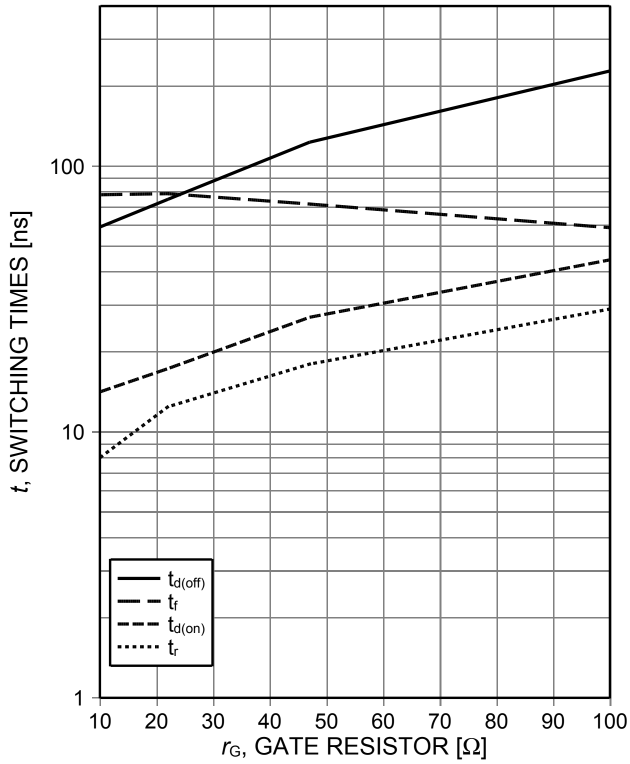


Figure 9. **Typical switching times as a function of gate resistor**
(inductive load, T_{vj}=150°C, V_{CE}=400V, V_{GE}=0/15V, I_C=8.5A,Dynamic test circuit in Figure E)

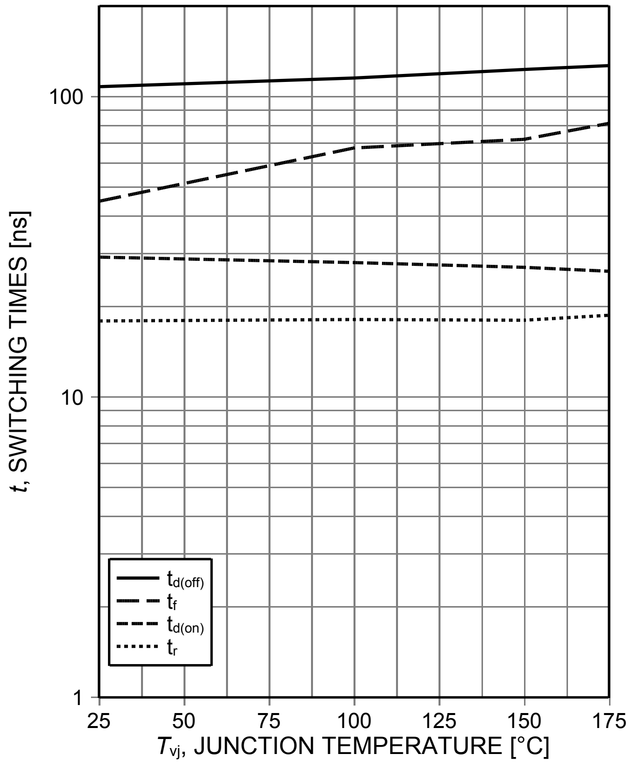


Figure 10. **Typical switching times as a function of junction temperature**
(inductive load, V_{CE}=400V, V_{GE}=0/15V, I_C=8.5A, r_G=47Ω,Dynamic test circuit in Figure E)

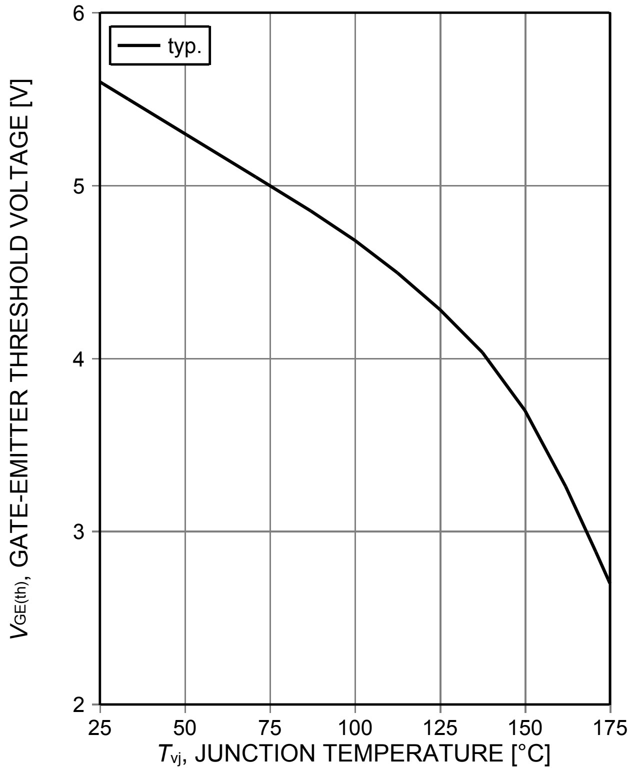


Figure 11. **Gate-emitter threshold voltage as a function of junction temperature**
(I_C=0.15mA)

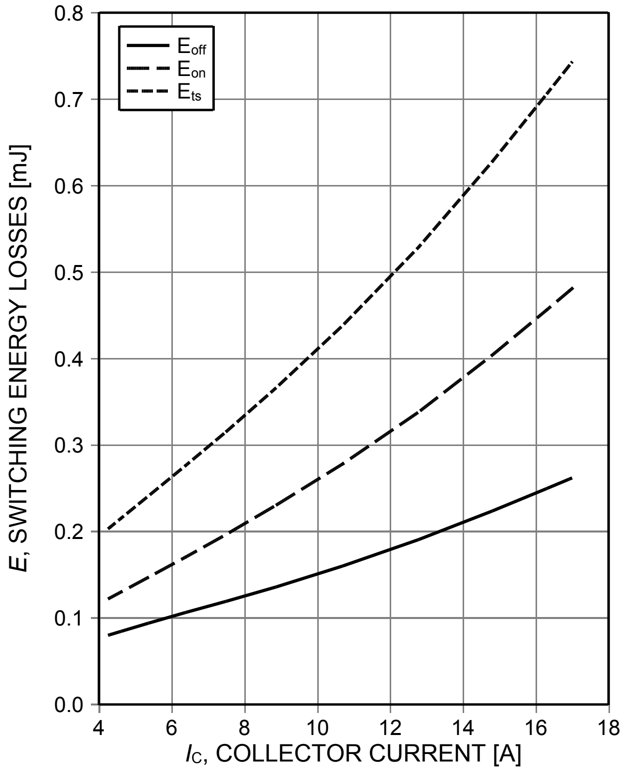


Figure 12. **Typical switching energy losses as a function of collector current**
(inductive load, T_{vj}=150°C, V_{CE}=400V, V_{GE}=0/15V, r_G=47Ω,Dynamic test circuit in Figure E)

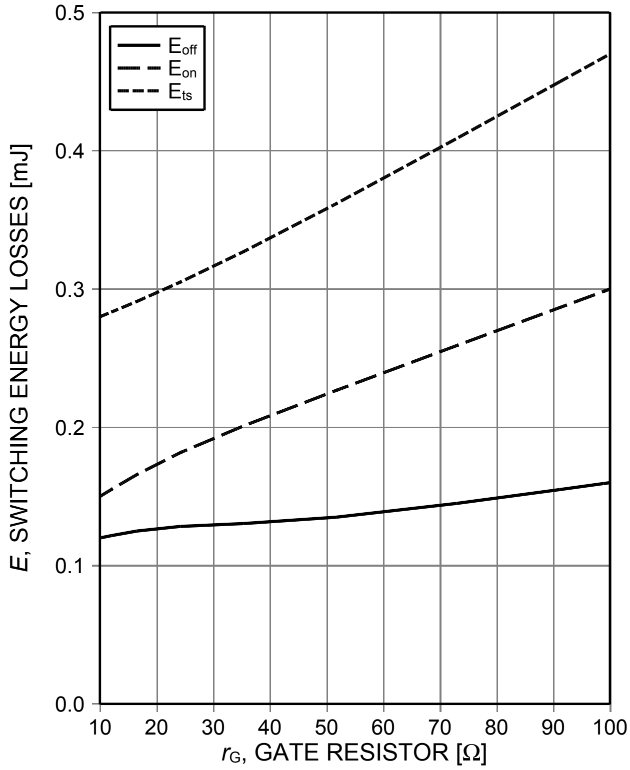


Figure 13. **Typical switching energy losses as a function of gate resistor**
(inductive load, T_{vj}=150°C, V_{CE}=400V, V_{GE}=0/15V, I_C=8.5A, Dynamic test circuit in Figure E)

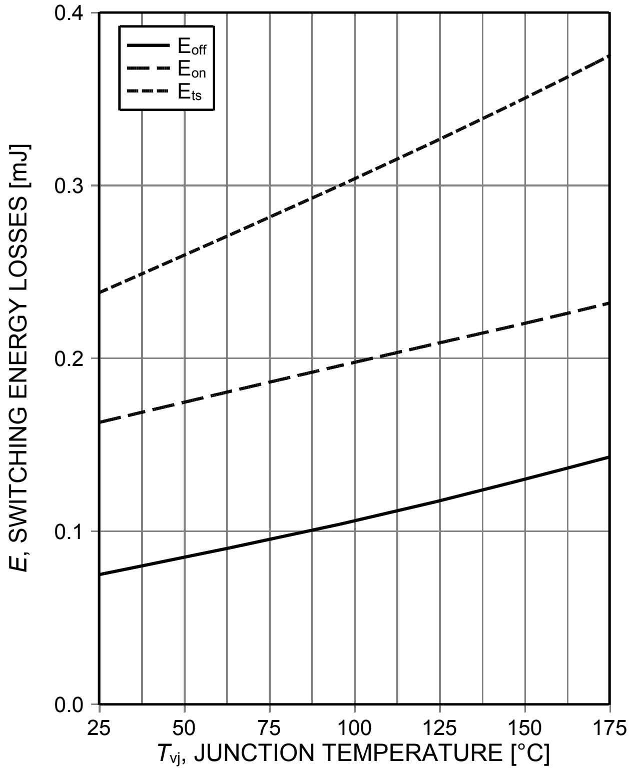


Figure 14. **Typical switching energy losses as a function of junction temperature**
(inductive load, V_{CE}=400V, V_{GE}=0/15V, I_C=8.5A, r_G=47Ω,Dynamic test circuit in Figure E)

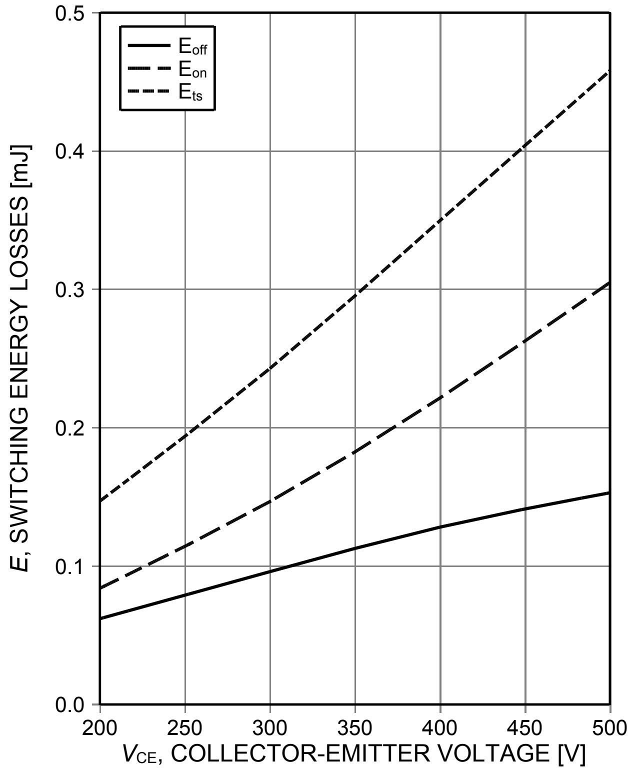


Figure 15. **Typical switching energy losses as a function of collector emitter voltage**
(inductive load, T_{vj}=150°C, V_{GE}=0/15V, I_C=8.5A, r_G=47Ω,Dynamic test circuit in Figure E)

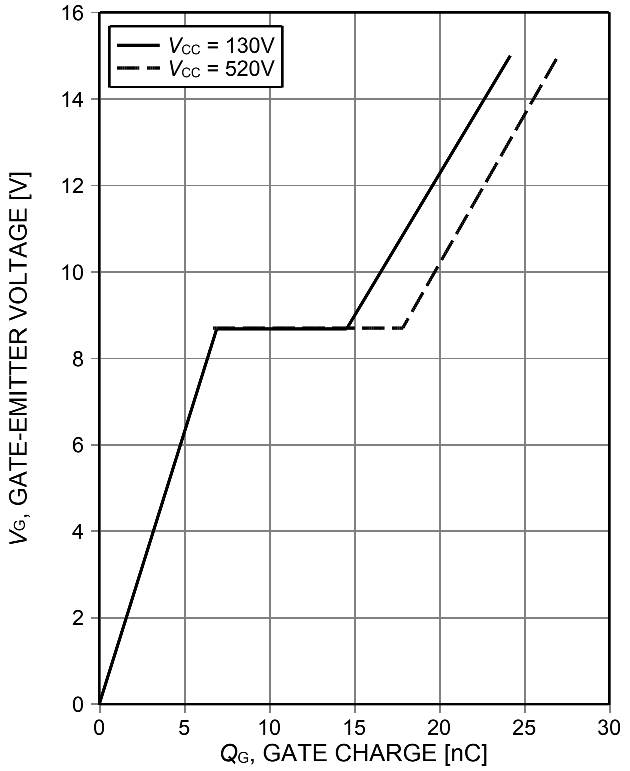


Figure 16. **Typical gate charge**
(I_C=8.5A)

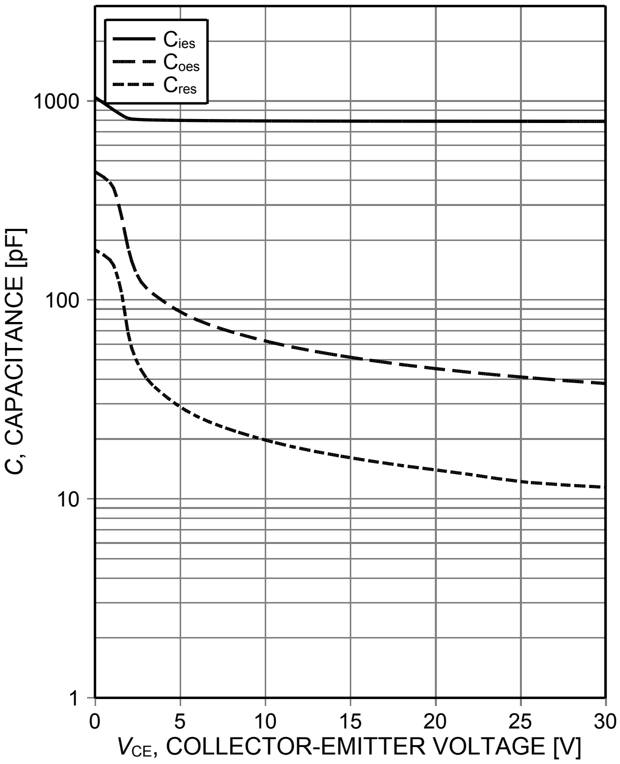


Figure 17. **Typical capacitance as a function of collector-emitter voltage**
(V_{GE}=0V, f=1MHz)

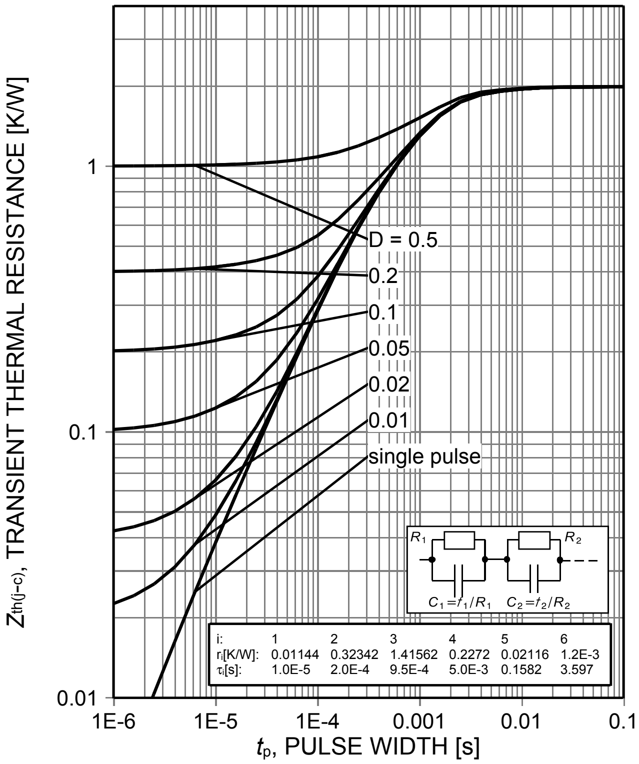
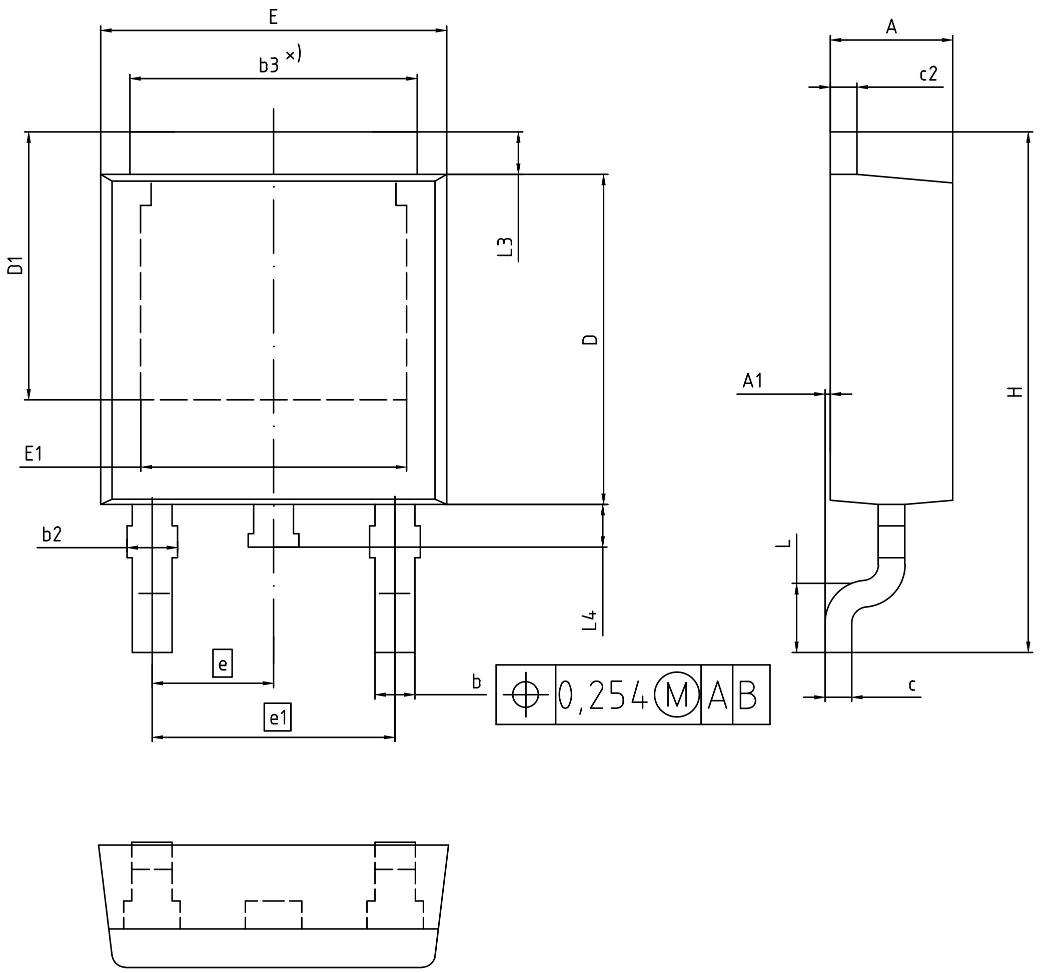


Figure 18. **IGBT transient thermal resistance**
(D=t_p/T)

Package Drawing PG-TO252-3



NOTES:
1. ALL DIMENSIONS REFER TO JEDEC STANDARD TO-252 DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.

DIM	MILLIMETERS	
	MIN	MAX
A	2.16	2.41
A1	0.00	0.15
b	0.64	0.89
b2	0.65	1.15
b3	4,95	5.50
c	0.46	0.61
c2	0.40	0.98
D	5.97	6.22
D1	5.02	5.84
E	6.35	6.73
E1	4.32	5.21
e	2.29 (BSC)	
e1	4.57 (BSC)	
N	3	
H	9.40	10.48
L	1.18	1.78
L3	0.89	1.27
L4	0.51	1.02

DOCUMENT NO.
Z8B00003328

SCALE 0 2.5 5mm

EUROPEAN PROJECTION

ISSUE DATE
05-02-2016

REVISION
06

Testing Conditions

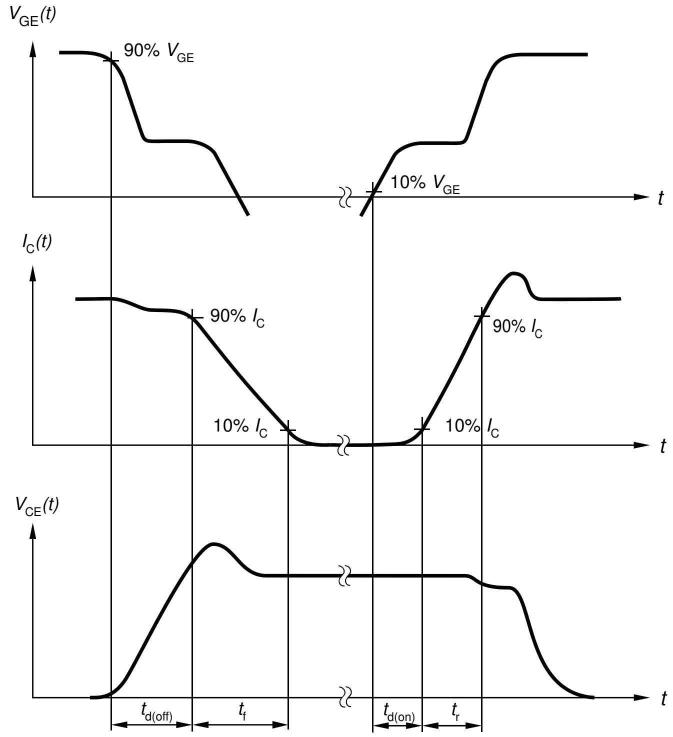


Figure A. **Definition of switching times**

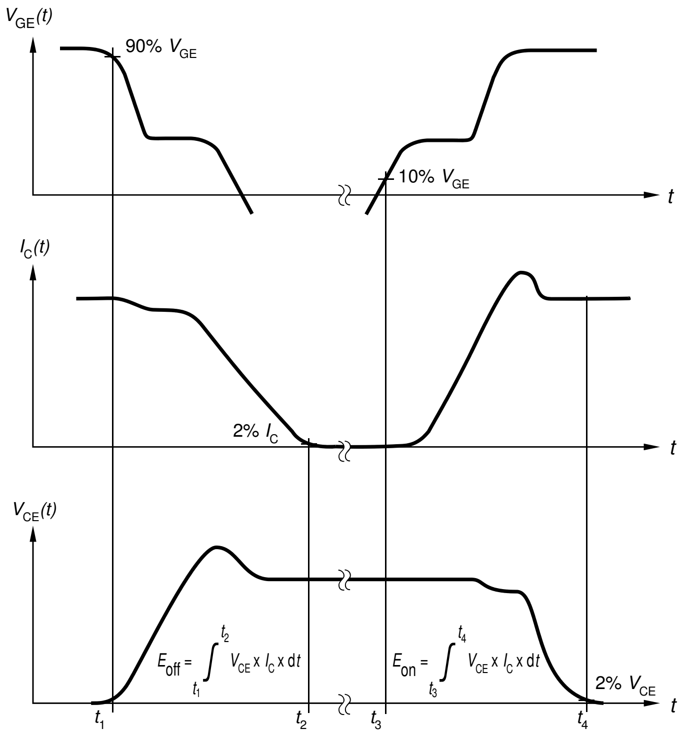


Figure B. **Definition of switching losses**

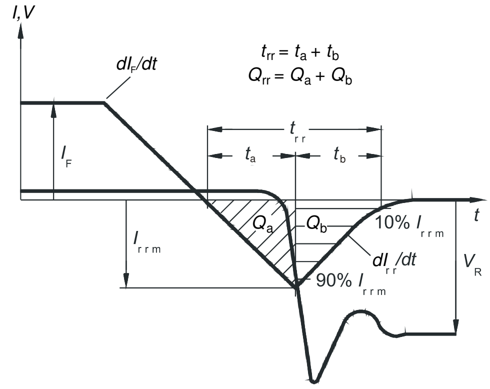


Figure C. **Definition of diode switching characteristics**

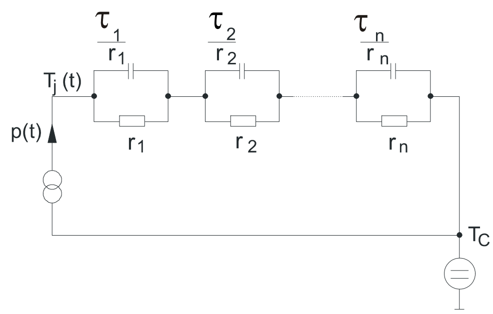


Figure D. **Thermal equivalent circuit**

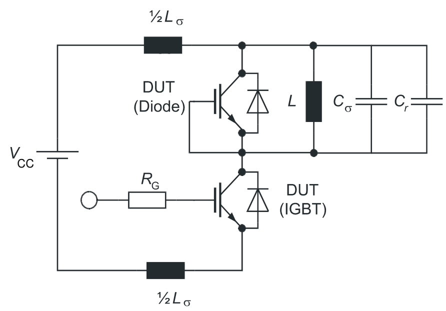


Figure E. **Dynamic test circuit**
Parasitic inductance L_σ,
parasitic capacitor C_σ,
relief capacitor C_r,
(only for ZVT switching)

Revision History

IGD10N65T6

Revision: 2020-04-29, Rev. 2.3

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.1	2020-03-16	Final Data sheet
2.2	2020-04-20	Final
2.3	2020-04-29	Final

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Published by
Infineon Technologies AG
81726 München, Germany

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