

## TRENCHSTOP™ IGBT6

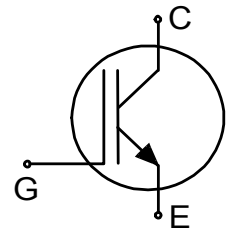
## IGBT in trench and field-stop technology

## 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](http://www.infineon.com/igbt)



## Potential Applications:

Drives

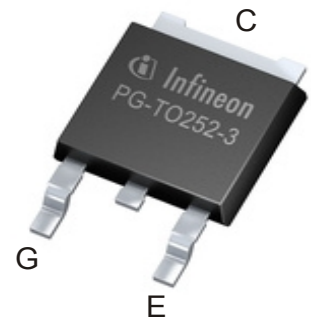
- GPD (general purpose drives)

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

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## TRENCHSTOP™ IGBT6

## 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 $T_{vjmax}$ $T_c = 25^{\circ}\text{C}$ $T_c = 100^{\circ}\text{C}$	$I_C$	23.0 14.0	A
Pulsed collector current, $t_p$ limited by $T_{vjmax}$	$I_{Cpuls}$	42.5	A
Turn off safe operating area $V_{CE} \leq 650\text{V}$ , $T_{vj} \leq 175^{\circ}\text{C}$	-	42.5	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
Short circuit withstand time $V_{GE} = 15.0\text{V}$ , $V_{CC} \leq 360\text{V}$ Allowed number of short circuits < 1000 Time between short circuits: $\geq 1.0\text{s}$ $T_{vj} = 150^{\circ}\text{C}$	$t_{SC}$	3	$\mu\text{s}$
Power dissipation $T_c = 25^{\circ}\text{C}$ Power dissipation $T_c = 100^{\circ}\text{C}$	$P_{tot}$	75.0 37.5	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	$R_{th(j-c)}$		-	-	2.00	K/W
Thermal resistance, min. footprint junction - ambient	$R_{th(j-a)}$		-	-	75	K/W
Thermal resistance, 6cm <sup>2</sup> Cu on PCB junction - ambient	$R_{th(j-a)}$		-	-	50	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 saturation voltage	$V_{CEsat}$	$V_{GE} = 15.0\text{V}$ , $I_C = 8.5\text{A}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	- - -	1.50 1.65 1.75	1.90 - -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C = 0.15\text{mA}$ , $V_{CE} = V_{GE}$	4.8	5.6	6.4	V
Zero gate voltage collector current	$I_{CES}$	$V_{CE} = 650\text{V}$ , $V_{GE} = 0\text{V}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	- -	- 360	30 -	$\mu\text{A}$
Gate-emitter leakage current	$I_{GES}$	$V_{CE} = 0\text{V}$ , $V_{GE} = 20\text{V}$	-	-	100	nA
Transconductance	$g_{fs}$	$V_{CE} = 20\text{V}$ , $I_C = 8.5\text{A}$	-	8.7	-	S

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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	$C_{ies}$	$V_{CE} = 25\text{V}, V_{GE} = 0\text{V}$ $f = 1000\text{kHz}$	-	790	-	pF
Output capacitance	$C_{oes}$		-	41	-	
Reverse transfer capacitance	$C_{res}$		-	12	-	
Gate charge	$Q_G$	$V_{CC} = 520\text{V}, I_C = 8.5\text{A},$ $V_{GE} = 15\text{V}$	-	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.	
<b>IGBT Characteristic, at <math>T_{vj} = 25^{\circ}\text{C}</math></b>						
Turn-on delay time	$t_{d(on)}$	$T_{vj} = 25^{\circ}\text{C},$ $V_{CC} = 400\text{V}, I_C = 8.5\text{A},$ $V_{GE} = 0.0/15.0\text{V},$ $R_{G(on)} = 47.0\Omega, R_{G(off)} = 47.0\Omega,$ $L_{\sigma} = 30\text{nH}, C_{\sigma} = 150\text{pF}$ $L_{\sigma}, C_{\sigma}$ 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.	
<b>IGBT Characteristic, at <math>T_{vj} = 150^{\circ}\text{C}</math></b>						
Turn-on delay time	$t_{d(on)}$	$T_{vj} = 150^{\circ}\text{C},$ $V_{CC} = 400\text{V}, I_C = 8.5\text{A},$ $V_{GE} = 0.0/15.0\text{V},$ $R_{G(on)} = 47.0\Omega, R_{G(off)} = 47.0\Omega,$ $L_{\sigma} = 30\text{nH}, C_{\sigma} = 150\text{pF}$ $L_{\sigma}, C_{\sigma}$ 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

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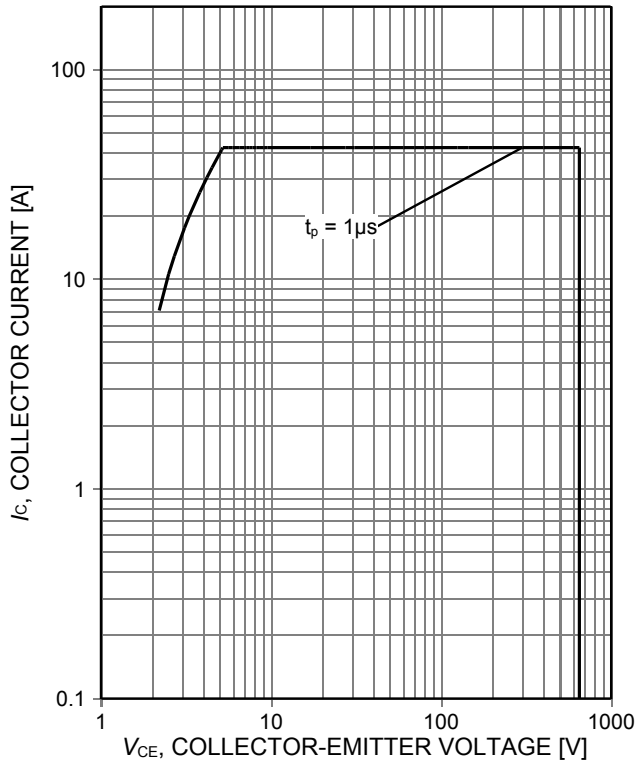


Figure 1. **Forward bias safe operating area**  
( $D=0$ ,  $T_C=25^\circ\text{C}$ ,  $T_{vj}\leq 175^\circ\text{C}$ ;  $V_{GE}=15\text{V}$ )

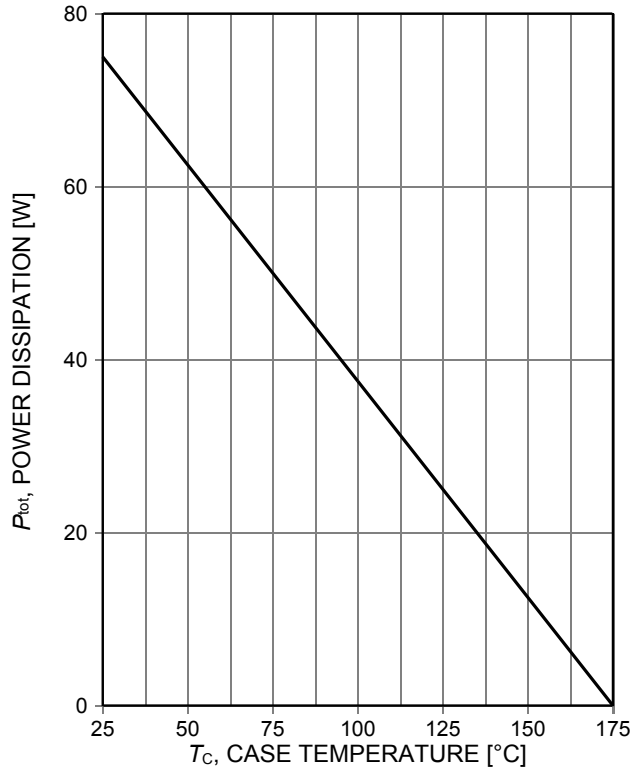


Figure 2. **Power dissipation as a function of case temperature**  
( $T_{vj}\leq 175^\circ\text{C}$ )

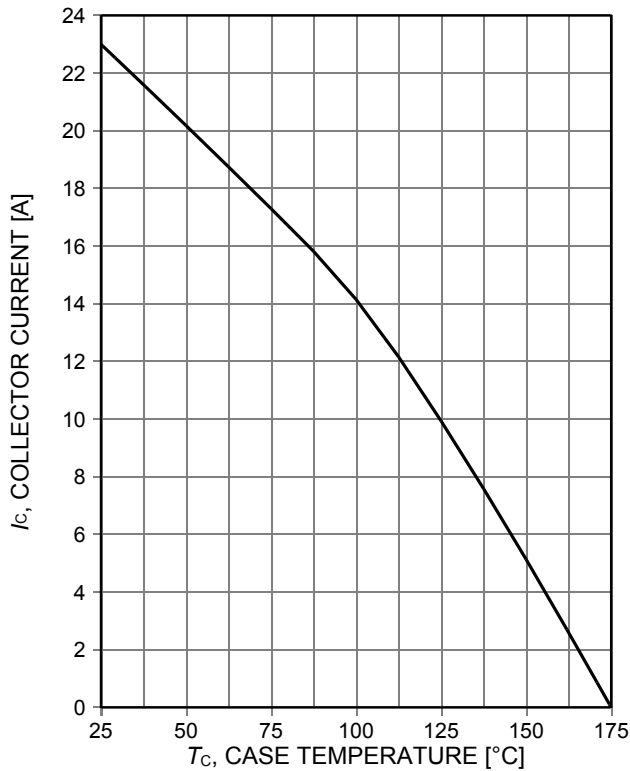


Figure 3. **Collector current as a function of case temperature**  
( $V_{GE}\geq 15\text{V}$ ,  $T_{vj}\leq 175^\circ\text{C}$ )

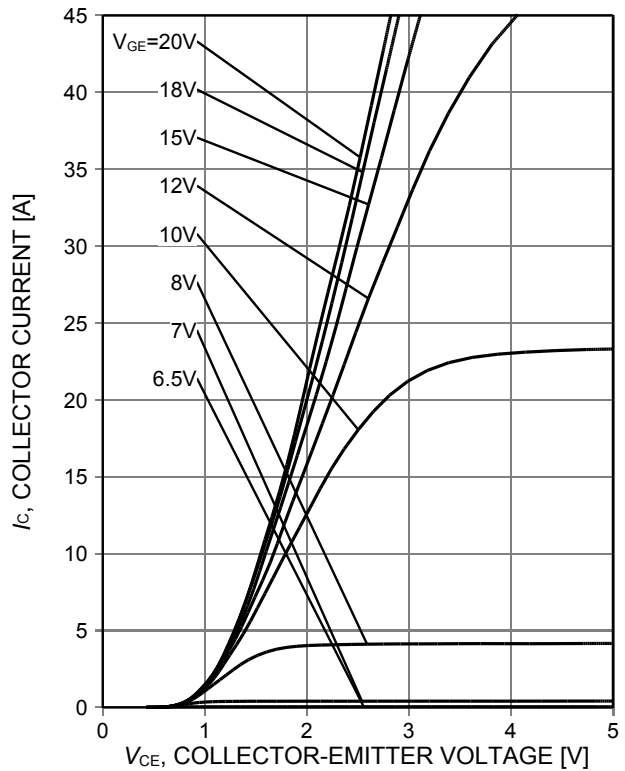


Figure 4. **Typical output characteristic**  
( $T_{vj}=25^\circ\text{C}$ )

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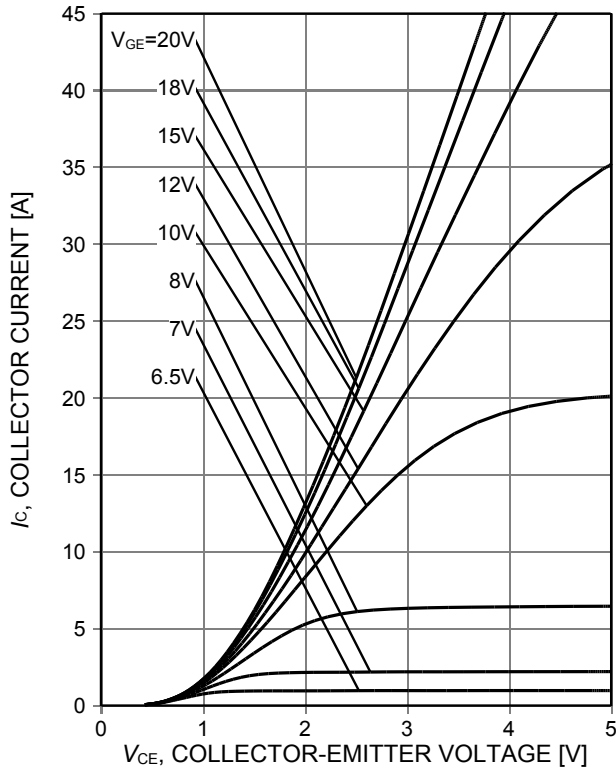


Figure 5. Typical output characteristic ( $T_{vj}=150^{\circ}\text{C}$ )

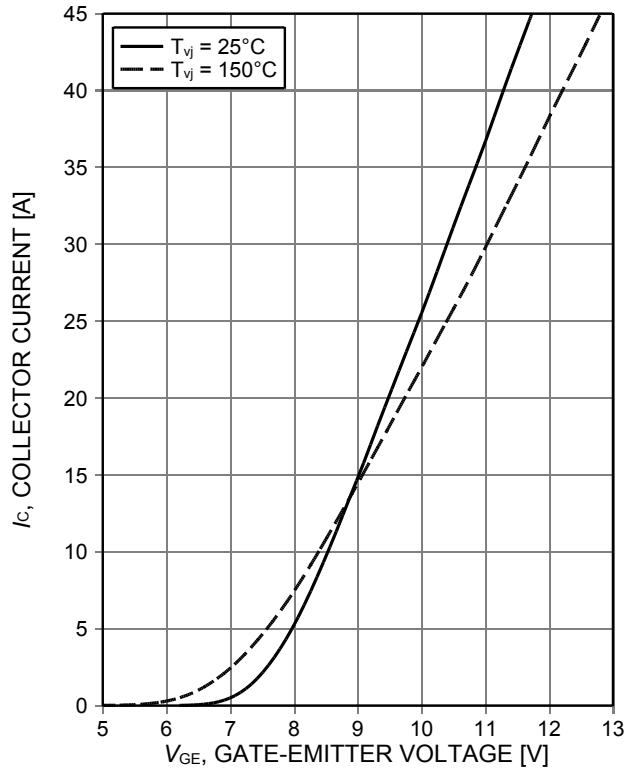


Figure 6. Typical transfer characteristic ( $V_{CE}=20\text{V}$ )

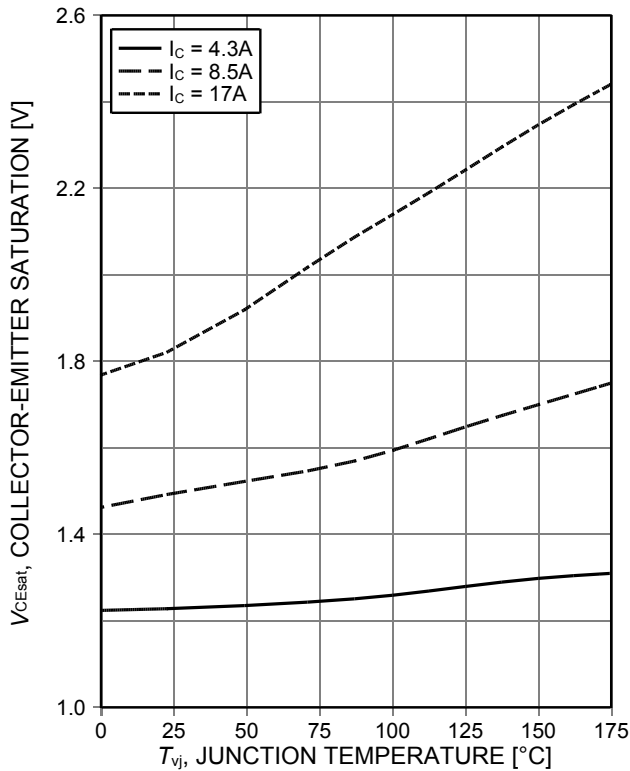


Figure 7. Typical collector-emitter saturation voltage as a function of junction temperature ( $V_{GE}=15\text{V}$ )

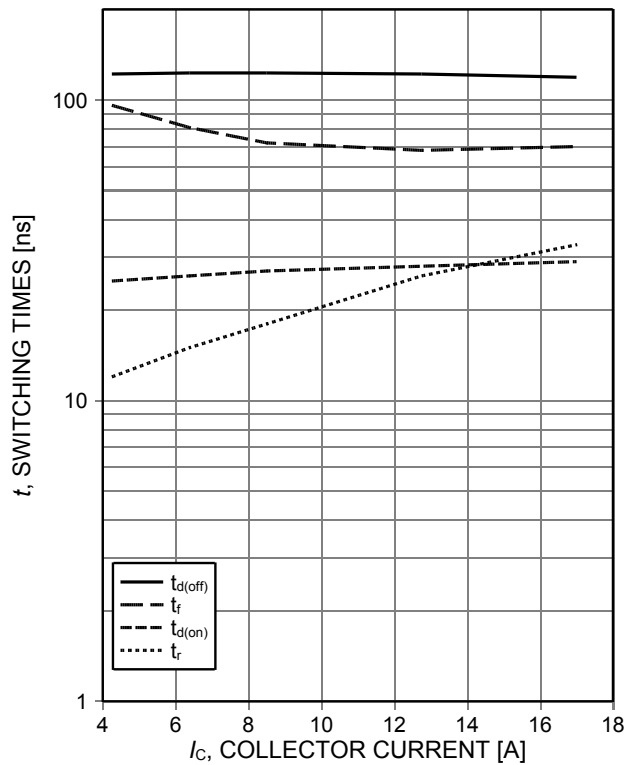


Figure 8. Typical switching times as a function of collector current (inductive load,  $T_{vj}=150^{\circ}\text{C}$ ,  $V_{CE}=400\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $r_G=47\Omega$ , Dynamic test circuit in Figure E)

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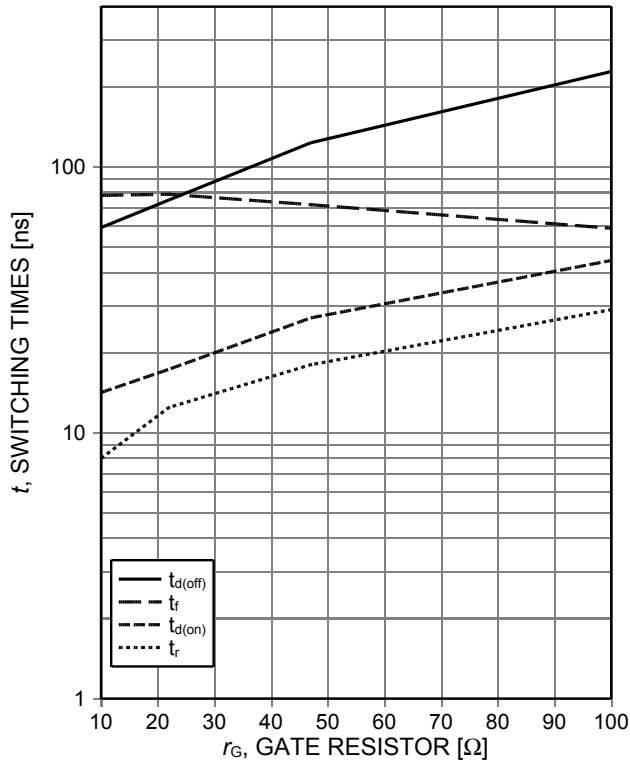


Figure 9. Typical switching times as a function of gate resistor (inductive load,  $T_{vj}=150^{\circ}\text{C}$ ,  $V_{CE}=400\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=8.5\text{A}$ , Dynamic test circuit in Figure E)

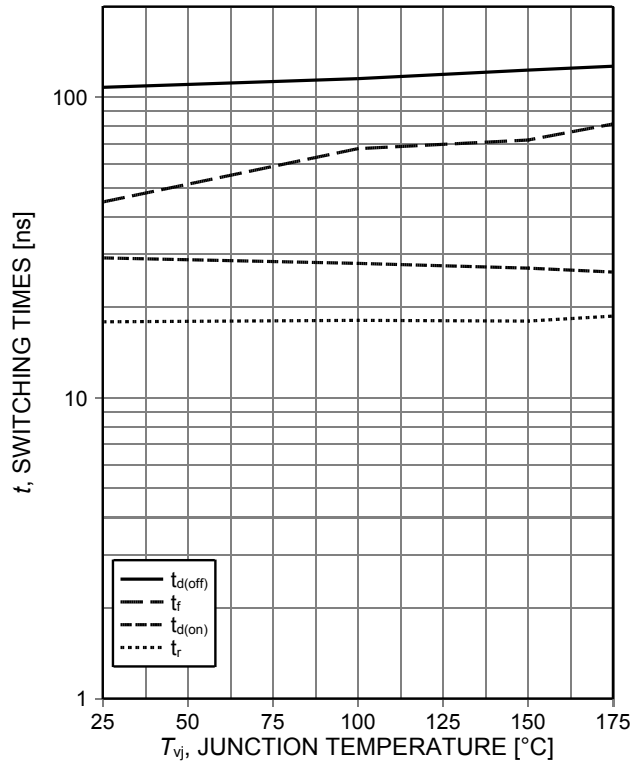


Figure 10. Typical switching times as a function of junction temperature (inductive load,  $V_{CE}=400\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=8.5\text{A}$ ,  $r_G=47\Omega$ , Dynamic test circuit in Figure E)

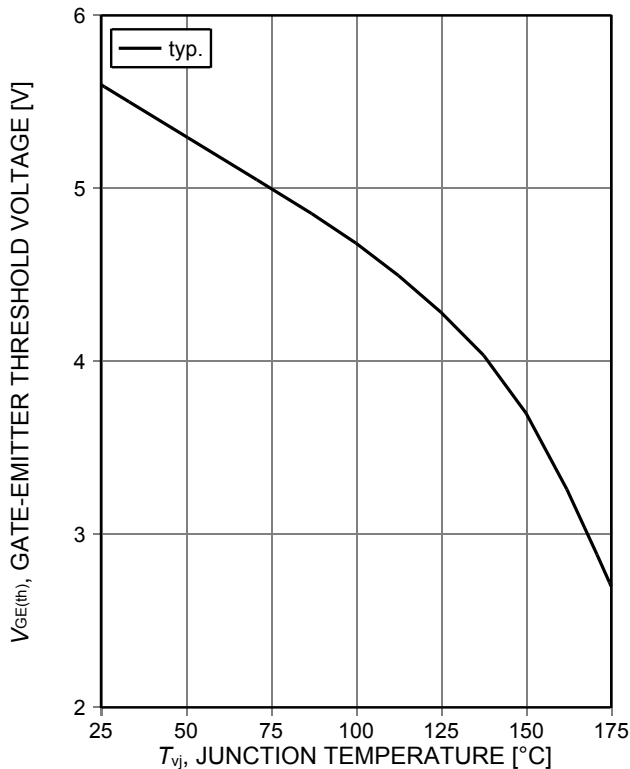


Figure 11. Gate-emitter threshold voltage as a function of junction temperature ( $I_C=0.15\text{mA}$ )

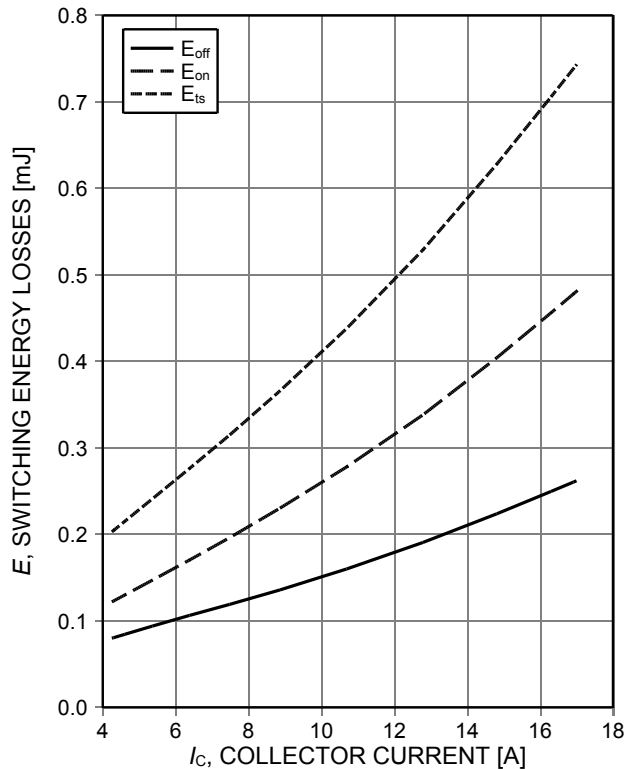


Figure 12. Typical switching energy losses as a function of collector current (inductive load,  $T_{vj}=150^{\circ}\text{C}$ ,  $V_{CE}=400\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $r_G=47\Omega$ , Dynamic test circuit in Figure E)

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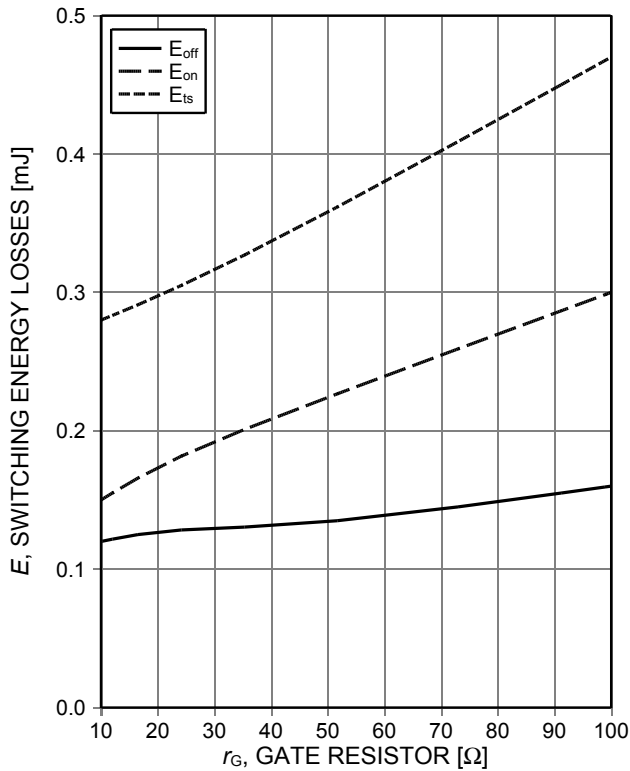


Figure 13. **Typical switching energy losses as a function of gate resistor**  
 (inductive load,  $T_{vj}=150^{\circ}\text{C}$ ,  $V_{CE}=400\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=8.5\text{A}$ , Dynamic test circuit in Figure E)

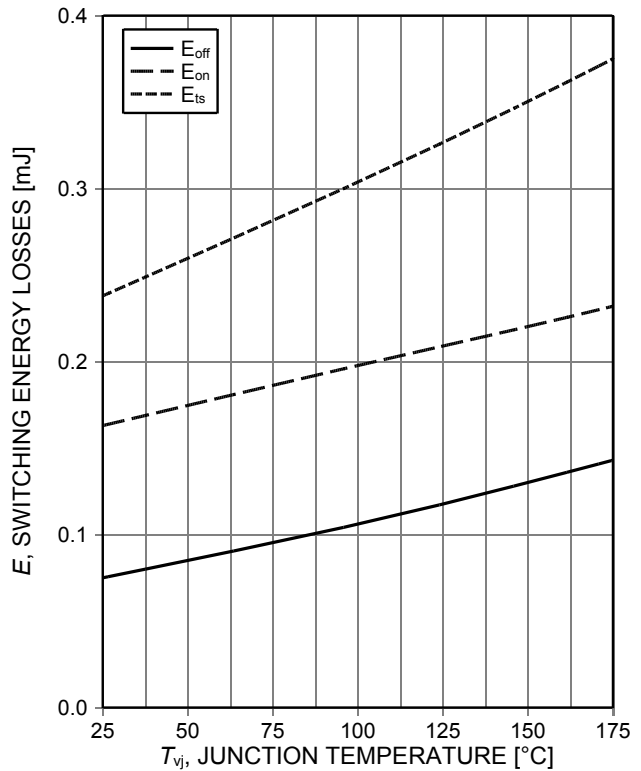


Figure 14. **Typical switching energy losses as a function of junction temperature**  
 (inductive load,  $V_{CE}=400\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=8.5\text{A}$ ,  $r_G=47\Omega$ , Dynamic test circuit in Figure E)

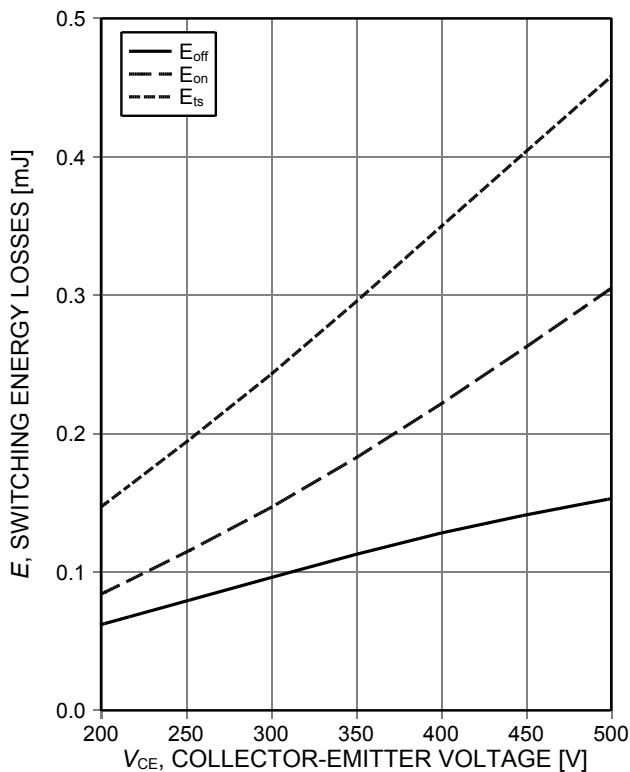


Figure 15. **Typical switching energy losses as a function of collector emitter voltage**  
 (inductive load,  $T_{vj}=150^{\circ}\text{C}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=8.5\text{A}$ ,  $r_G=47\Omega$ , Dynamic test circuit in Figure E)

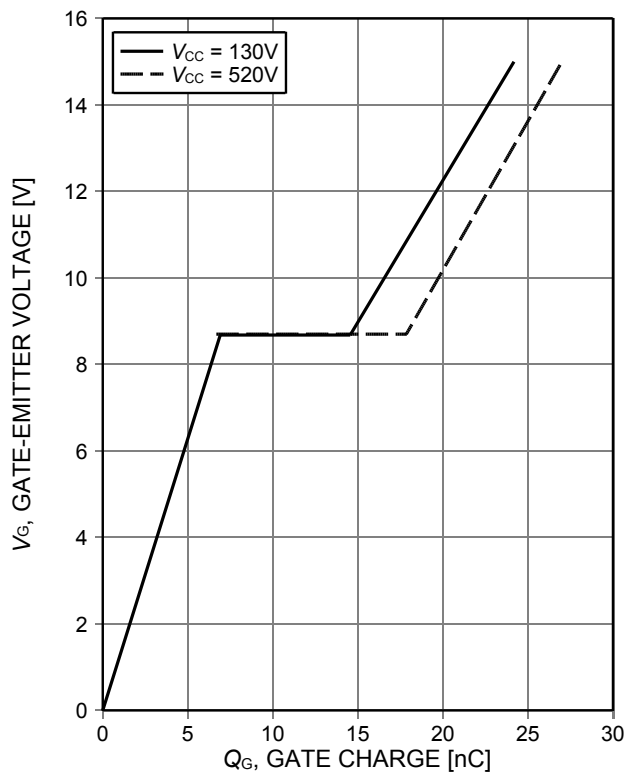


Figure 16. **Typical gate charge**  
 ( $I_C=8.5\text{A}$ )



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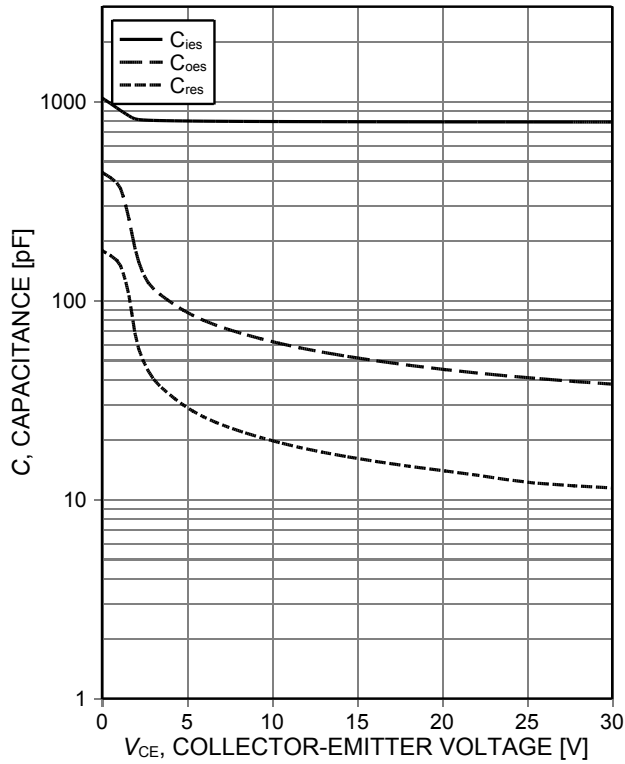


Figure 17. Typical capacitance as a function of collector-emitter voltage ( $V_{GE}=0V$ ,  $f=1MHz$ )

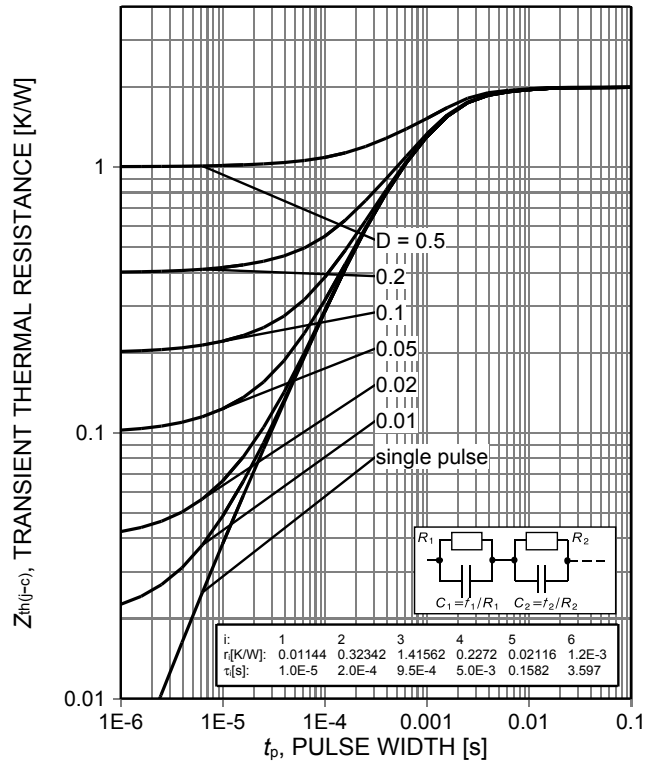
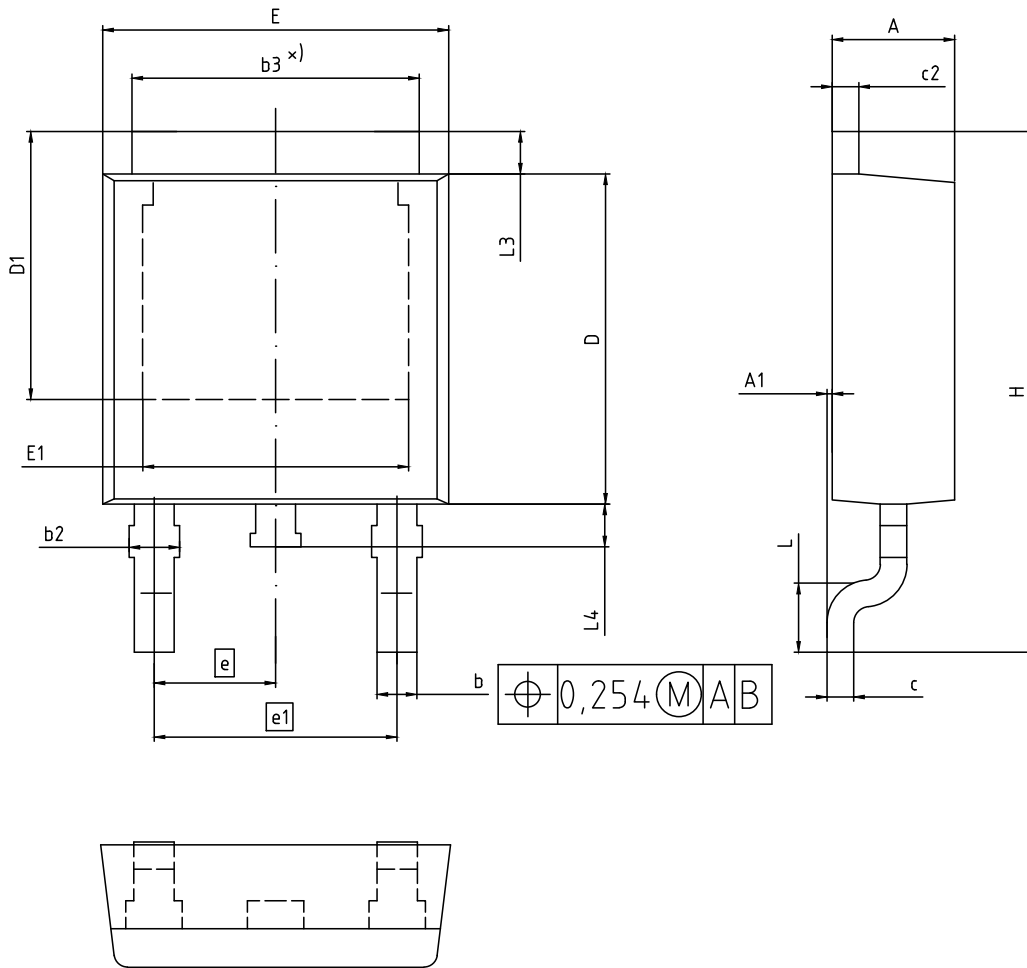


Figure 18. IGBT transient thermal resistance ( $D=t_p/T$ )

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

EUROPEAN PROJECTION

ISSUE DATE  
05-02-2016

REVISION  
06

Testing Conditions

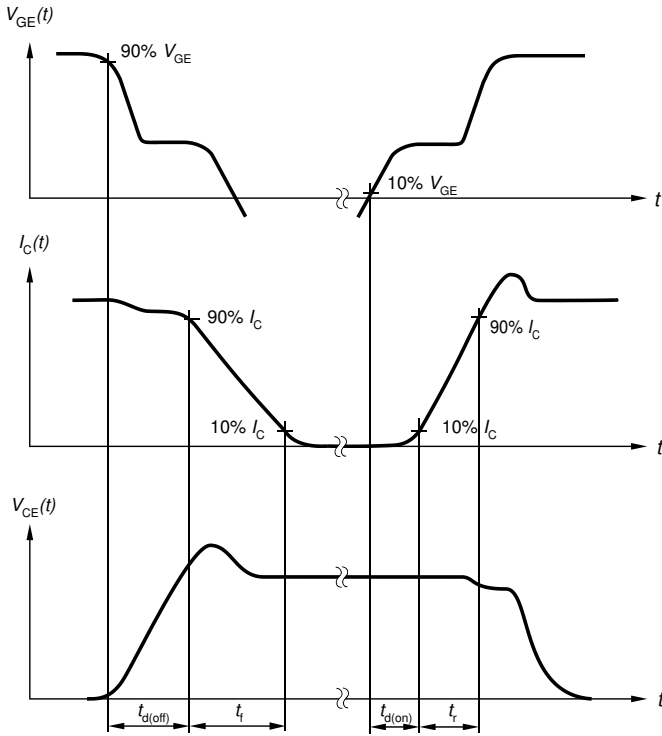


Figure A. Definition of switching times

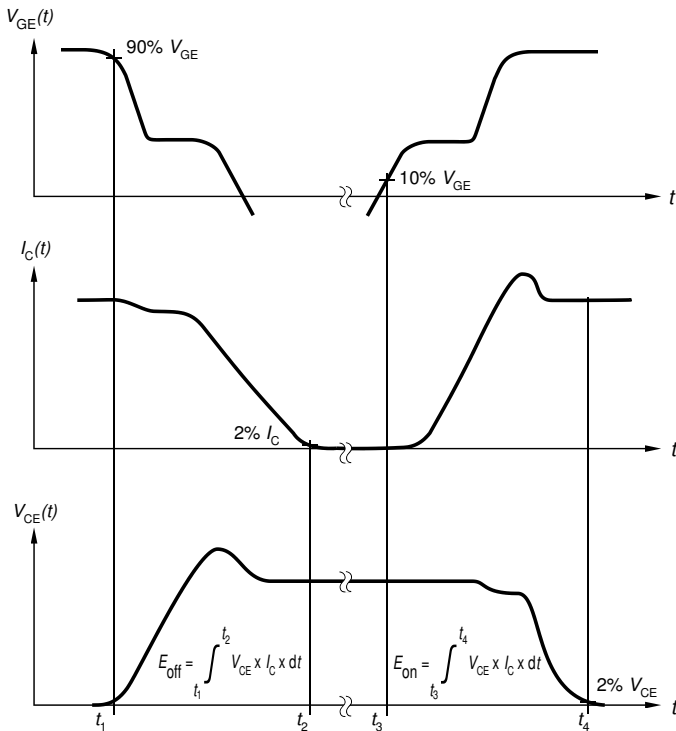


Figure B. Definition of switching losses

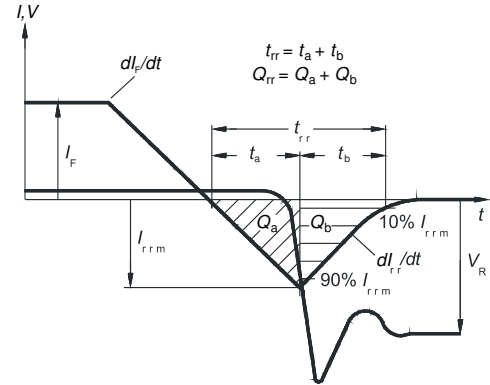


Figure C. Definition of diode switching characteristics

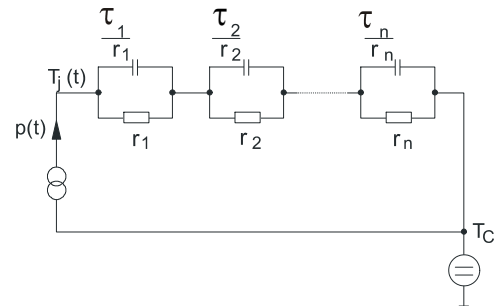


Figure D. Thermal equivalent circuit

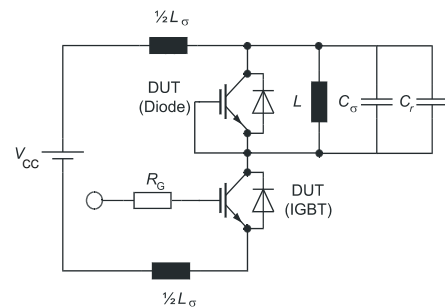


Figure E. Dynamic test circuit  
Parasitic inductance  $L_{\sigma}$ ,  
parasitic capacitor  $C_{\sigma}$ ,  
relief capacitor  $C_r$ ,  
(only for ZVT switching)

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**TRENCHSTOP™ IGBT6****Revision History**

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IGD10N65T6

**Revision: 2020-04-29, Rev. 2.3**

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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