

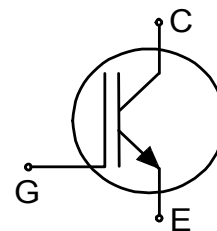
High speed switching series fifth generation

TRENCHSTOP™ 5 high speed soft switching IGBT

Features and Benefits:

High speed S5 technology offering

- High speed smooth switching device for hard & soft switching
- Very Low V_{CEsat} , 1.35V at nominal current
- Plug and play replacement of previous generation IGBTs
- 650V breakdown voltage
- Low gate charge Q_G
- Maximum junction temperature 175°C
- Pb-free lead plating; RoHS compliant
- Complete product spectrum and PSpice Models:
<http://www.infineon.com/igbt/>

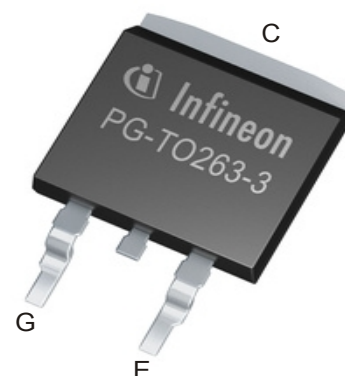


Applications:

- Industrial SMPS
- Industrial UPS
- Welding
- Chargers

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
IGB15N65S5	650V	15A	1.35V	175°C	G15ES5	PG-TO263-3

Table of Contents

Description	1
Table of Contents	2
Maximum Ratings	3
Thermal Resistance	3
Electrical Characteristics	3
Electrical Characteristics Diagrams	6
Package Drawing	11
Testing Conditions	12
Revision History	13
Disclaimer	14

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	35.0 23.0	A
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}	60.0	A
Turn off safe operating area $V_{CE} \leq 650\text{V}$, $T_{vj} \leq 175^{\circ}\text{C}$, $t_p = 1\mu\text{s}$	-	60.0	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}	105.0 52.5	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.	

 R_{th} Characteristics

IGBT thermal resistance, junction - case	$R_{th(j-c)}$		-	-	1.40	K/W
Thermal resistance, min. footprint junction - ambient	$R_{th(j-a)}$		-	-	65	K/W
Thermal resistance, 6cm ² 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.	

Static Characteristic

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}	$V_{GE} = 15.0\text{V}$, $I_C = 15.0\text{A}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	-	1.35 1.50 1.60	1.70 - -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C = 0.15\text{mA}$, $V_{CE} = V_{GE}$	3.2	4.0	4.8	V
Zero gate voltage collector current	I_{CES}	$V_{CE} = 650\text{V}$, $V_{GE} = 0\text{V}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	-	- 1400	50 -	μA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0\text{V}$, $V_{GE} = 20\text{V}$	-	-	100	nA
Transconductance	g_{fs}	$V_{CE} = 20\text{V}$, $I_C = 15.0\text{A}$	-	25.0	-	S

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.	
Dynamic Characteristic						
Input capacitance	C_{ies}	$V_{CE} = 25\text{V}, V_{GE} = 0\text{V}, f = 1\text{MHz}$	-	930	-	pF
Output capacitance	C_{oes}		-	20	-	
Reverse transfer capacitance	C_{res}		-	4	-	
Gate charge	Q_G	$V_{CC} = 520\text{V}, I_C = 15.0\text{A}, V_{GE} = 15\text{V}$	-	38.0	-	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 $T_{vj} = 25^{\circ}\text{C}$						
Turn-on delay time	$t_{d(on)}$	$T_{vj} = 25^{\circ}\text{C}, V_{CC} = 400\text{V}, I_C = 15.0\text{A}, V_{GE} = 0.0/15.0\text{V}, R_{G(on)} = 25.0\Omega, R_{G(off)} = 25.0\Omega, L_{\sigma} = 30\text{nH}, C_{\sigma} = 30\text{pF}$ Energy losses include "tail" and diode reverse recovery.	-	12	-	ns
Rise time	t_r		-	14	-	ns
Turn-off delay time	$t_{d(off)}$		-	117	-	ns
Fall time	t_f		-	30	-	ns
Turn-on energy	E_{on}		-	0.25	-	mJ
Turn-off energy	E_{off}		-	0.14	-	mJ
Total switching energy	E_{ts}		-	0.39	-	mJ
Turn-on delay time	$t_{d(on)}$	$T_{vj} = 25^{\circ}\text{C}, V_{CC} = 400\text{V}, I_C = 7.5\text{A}, V_{GE} = 0.0/15.0\text{V}, R_{G(on)} = 25.0\Omega, R_{G(off)} = 25.0\Omega, L_{\sigma} = 30\text{nH}, C_{\sigma} = 30\text{pF}$ Energy losses include "tail" and diode reverse recovery.	-	11	-	ns
Rise time	t_r		-	8	-	ns
Turn-off delay time	$t_{d(off)}$		-	130	-	ns
Fall time	t_f		-	32	-	ns
Turn-on energy	E_{on}		-	0.13	-	mJ
Turn-off energy	E_{off}		-	0.07	-	mJ
Total switching energy	E_{ts}		-	0.20	-	mJ

High speed switching series fifth generation

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	$t_{d(on)}$	$T_{vj} = 150^{\circ}\text{C}$, $V_{CC} = 400\text{V}$, $I_C = 15.0\text{A}$, $V_{GE} = 0.0/15.0\text{V}$, $R_{G(on)} = 25.0\Omega$, $R_{G(off)} = 25.0\Omega$, $L\sigma = 30\text{nH}$, $C\sigma = 30\text{pF}$ $L\sigma$, $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	12	-	ns
Rise time	t_r		-	15	-	ns
Turn-off delay time	$t_{d(off)}$		-	140	-	ns
Fall time	t_f		-	47	-	ns
Turn-on energy	E_{on}		-	0.32	-	mJ
Turn-off energy	E_{off}		-	0.21	-	mJ
Total switching energy	E_{ts}		-	0.53	-	mJ
Turn-on delay time	$t_{d(on)}$	$T_{vj} = 150^{\circ}\text{C}$, $V_{CC} = 400\text{V}$, $I_C = 7.5\text{A}$, $V_{GE} = 0.0/15.0\text{V}$, $R_{G(on)} = 25.0\Omega$, $R_{G(off)} = 25.0\Omega$, $L\sigma = 30\text{nH}$, $C\sigma = 30\text{pF}$ $L\sigma$, $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	11	-	ns
Rise time	t_r		-	9	-	ns
Turn-off delay time	$t_{d(off)}$		-	155	-	ns
Fall time	t_f		-	53	-	ns
Turn-on energy	E_{on}		-	0.18	-	mJ
Turn-off energy	E_{off}		-	0.11	-	mJ
Total switching energy	E_{ts}		-	0.29	-	mJ

High speed switching series fifth generation

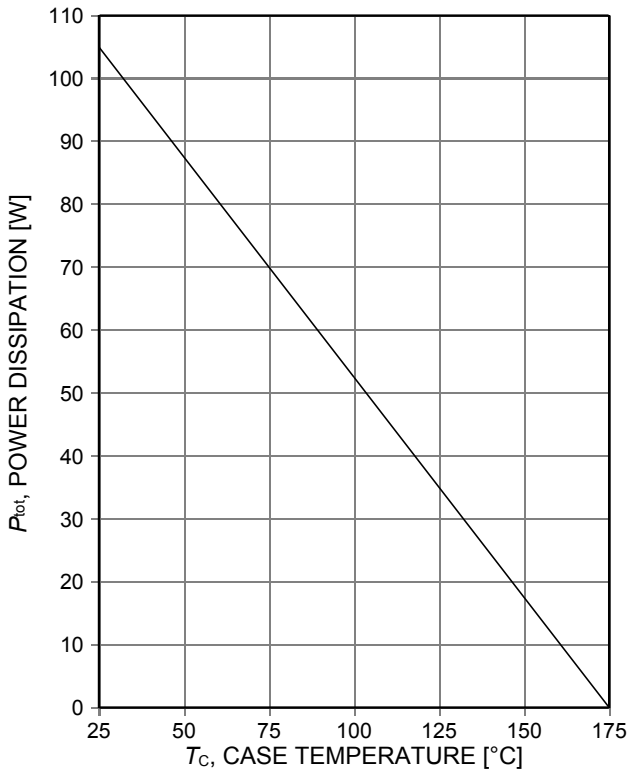


Figure 1. Power dissipation as a function of case temperature ($T_{vj} \leq 175^\circ\text{C}$)

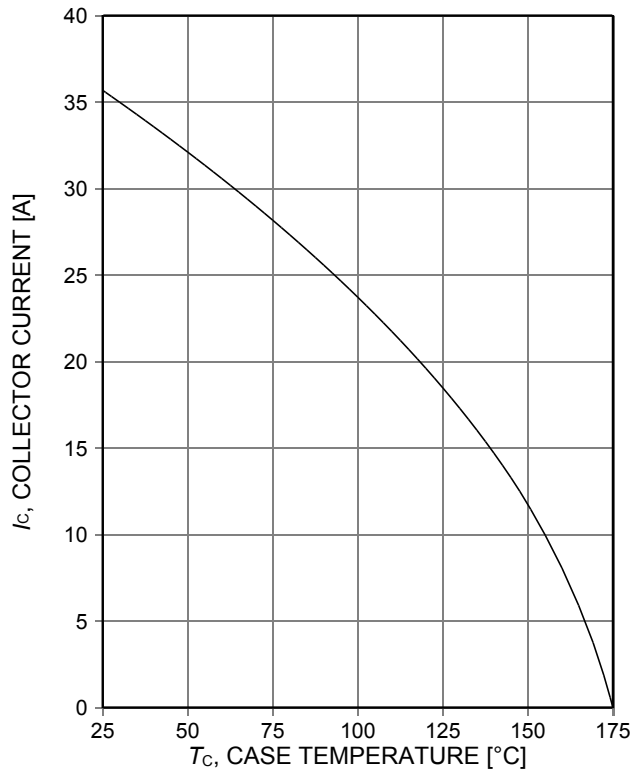


Figure 2. Collector current as a function of case temperature ($V_{GE} \geq 15\text{V}$, $T_{vj} \leq 175^\circ\text{C}$)

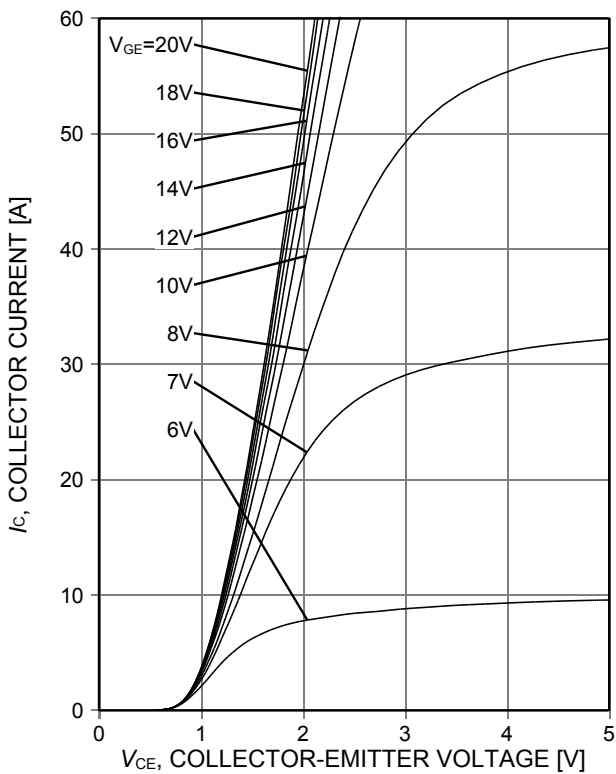


Figure 3. Typical output characteristic ($T_{vj} = 25^\circ\text{C}$)

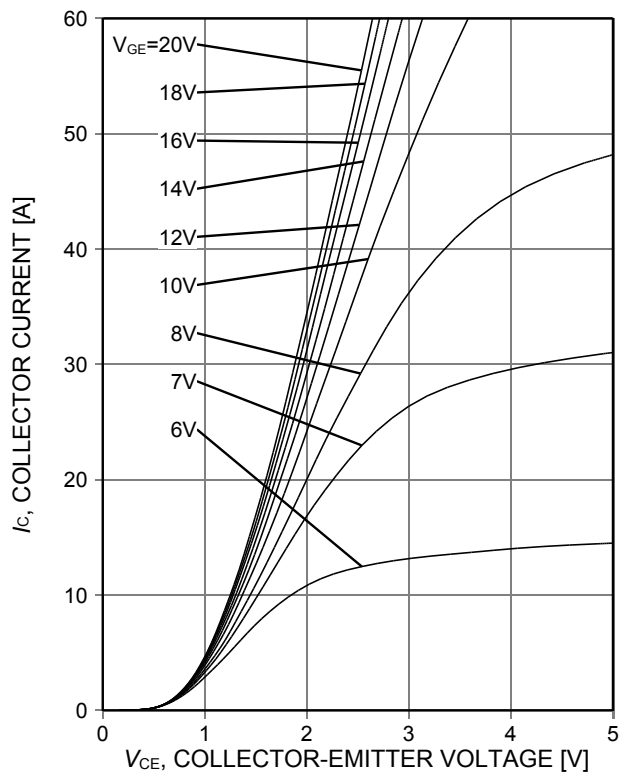


Figure 4. Typical output characteristic ($T_{vj} = 175^\circ\text{C}$)

High speed switching series fifth generation

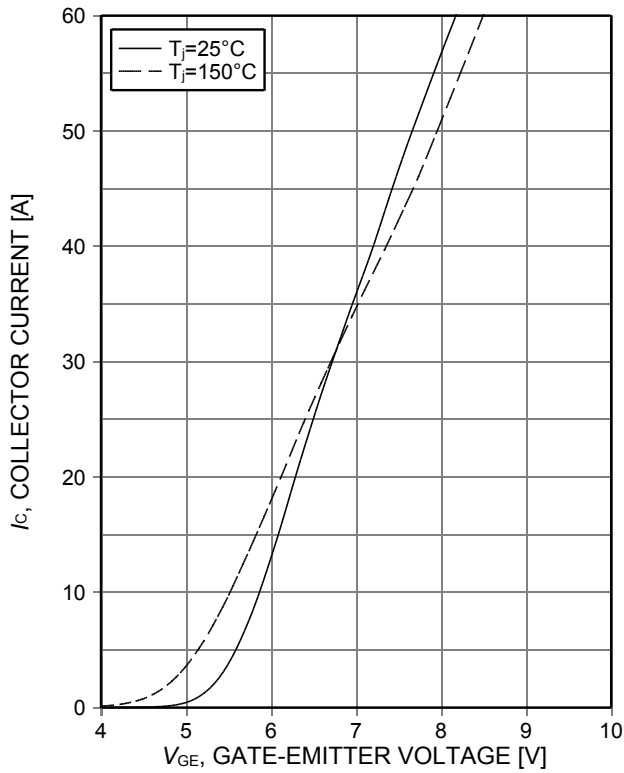


Figure 5. Typical transfer characteristic ($V_{CE}=20\text{V}$)

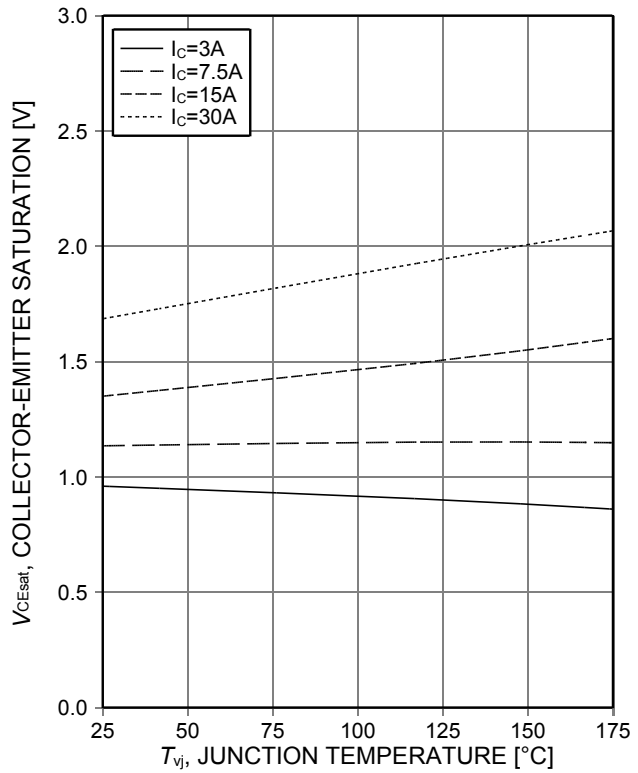


Figure 6. Typical collector-emitter saturation voltage as a function of junction temperature ($V_{GE}=15\text{V}$)

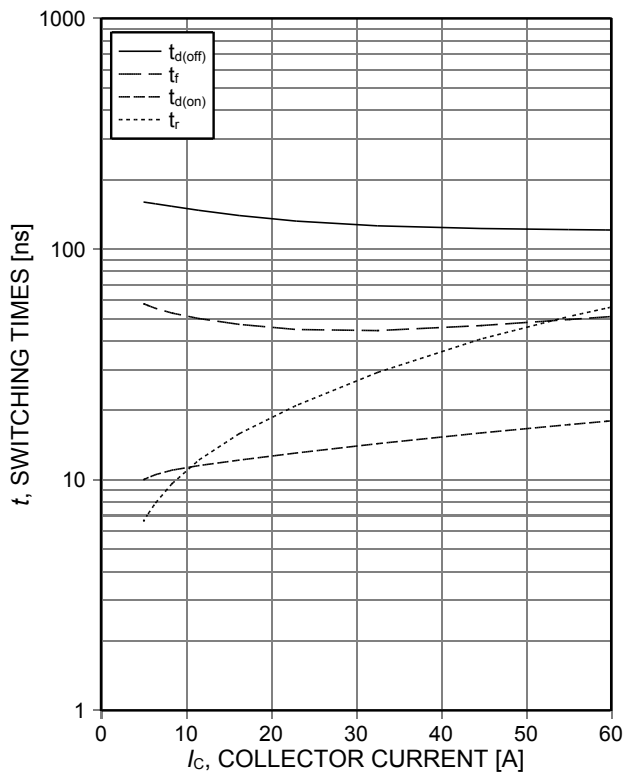


Figure 7. Typical switching times as a function of collector current (inductive load, $T_{vj}=150^\circ\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $R_G=25\Omega$, Dynamic test circuit in Figure E)

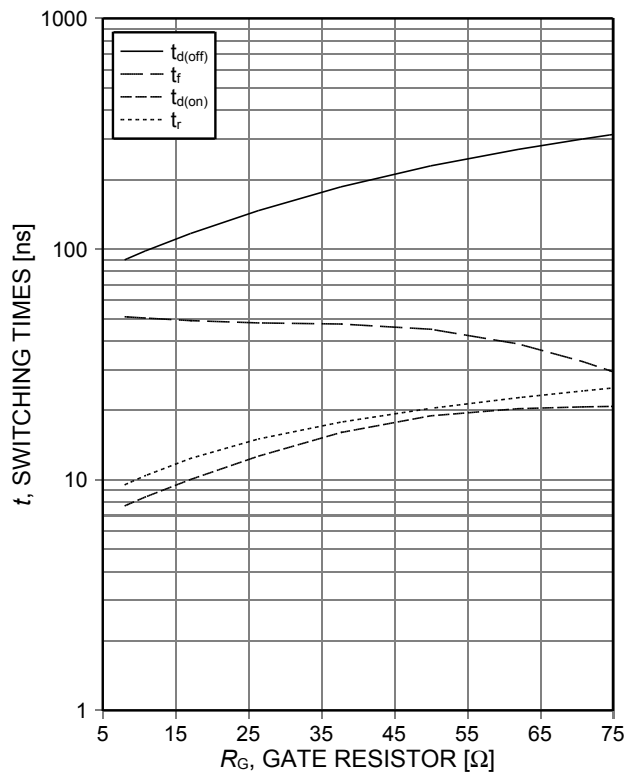


Figure 8. Typical switching times as a function of gate resistor (inductive load, $T_{vj}=150^\circ\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $I_c=15\text{A}$, Dynamic test circuit in Figure E)

High speed switching series fifth generation

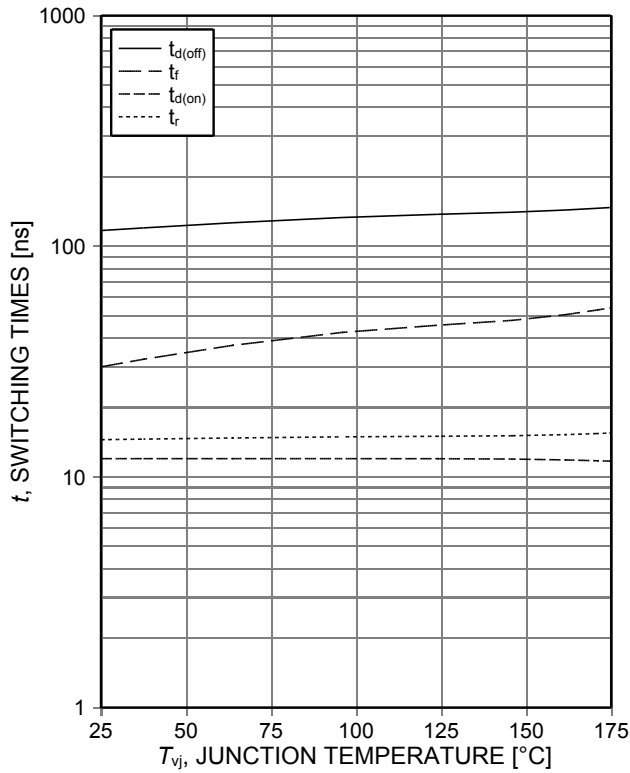


Figure 9. **Typical switching times as a function of junction temperature**
 (inductive load, $V_{CE}=400V$, $V_{GE}=0/15V$, $I_C=15A$, $R_G=25\Omega$, Dynamic test circuit in Figure E)

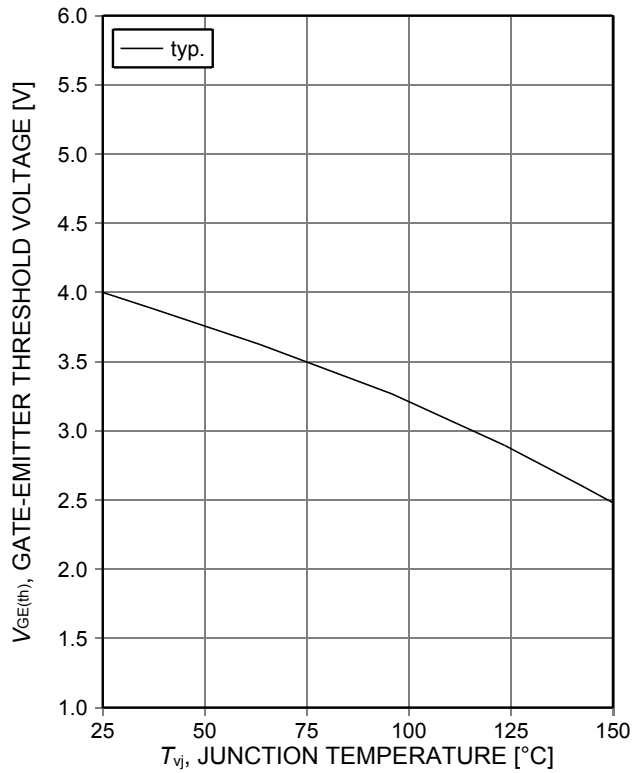


Figure 10. **Gate-emitter threshold voltage as a function of junction temperature**
 ($I_C=0.15mA$)

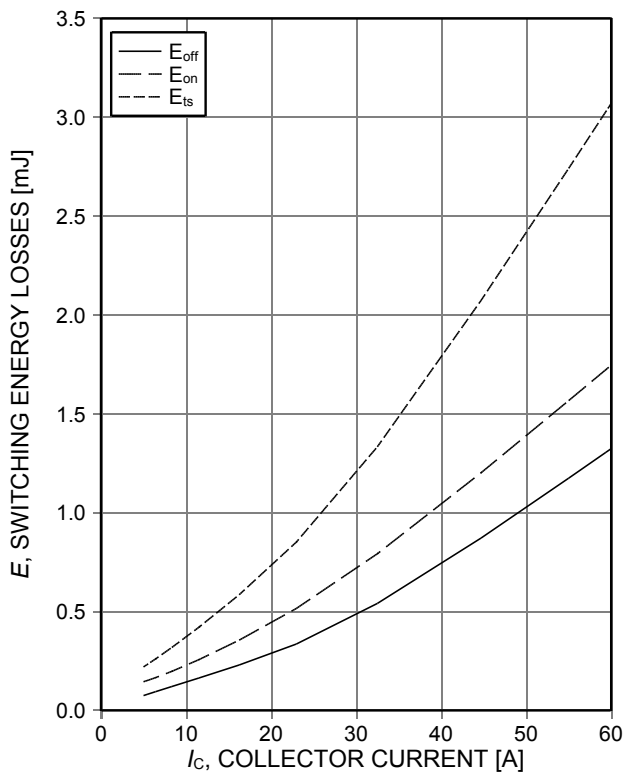


Figure 11. **Typical switching energy losses as a function of collector current**
 (inductive load, $T_{vj}=150^\circ C$, $V_{CE}=400V$, $V_{GE}=0/15V$, $R_G=25\Omega$, Dynamic test circuit in Figure E)

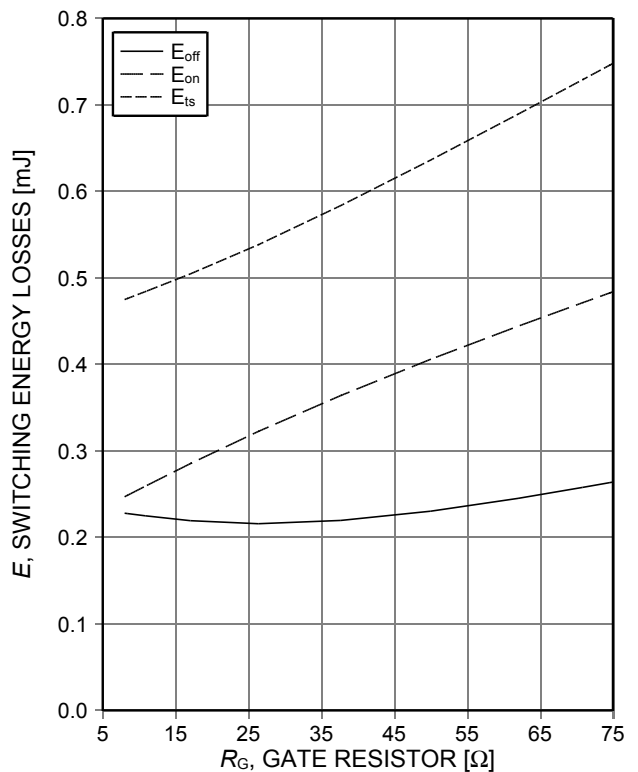


Figure 12. **Typical switching energy losses as a function of gate resistor**
 (inductive load, $T_{vj}=150^\circ C$, $V_{CE}=400V$, $V_{GE}=0/15V$, $I_C=15A$, Dynamic test circuit in Figure E)

High speed switching series fifth generation

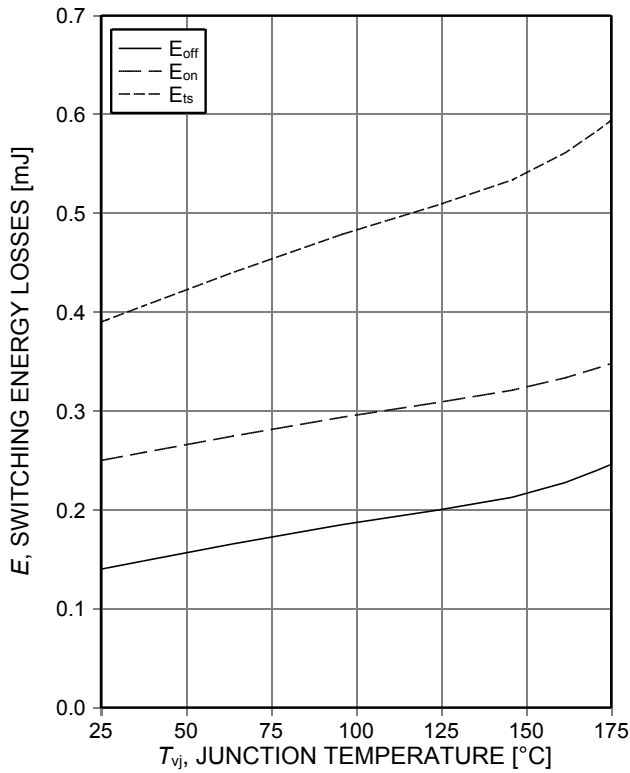


Figure 13. **Typical switching energy losses as a function of junction temperature** (inductive load, $V_{CE}=400V$, $V_{GE}=0/15V$, $I_C=15A$, $R_G=25\Omega$, Dynamic test circuit in Figure E)

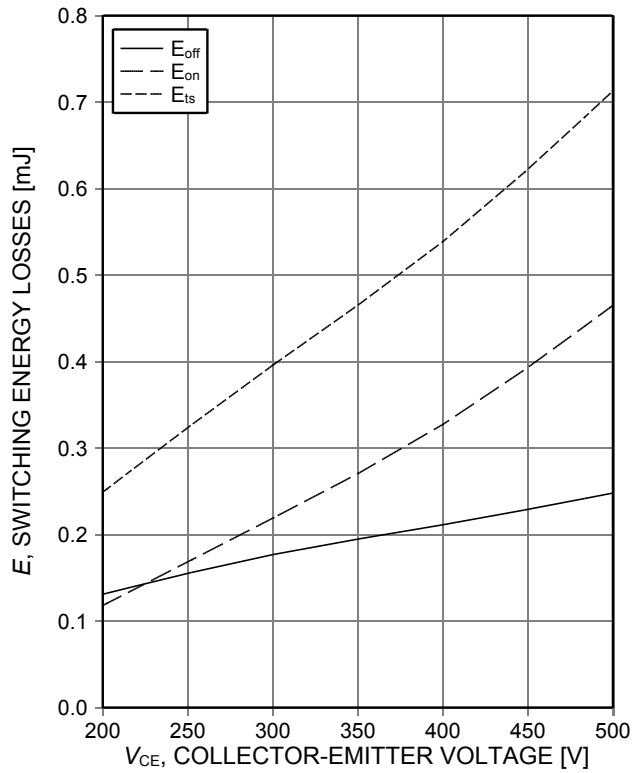


Figure 14. **Typical switching energy losses as a function of collector emitter voltage** (inductive load, $T_{vj}=150^\circ C$, $V_{GE}=0/15V$, $I_C=15A$, $R_G=25\Omega$, Dynamic test circuit in Figure E)

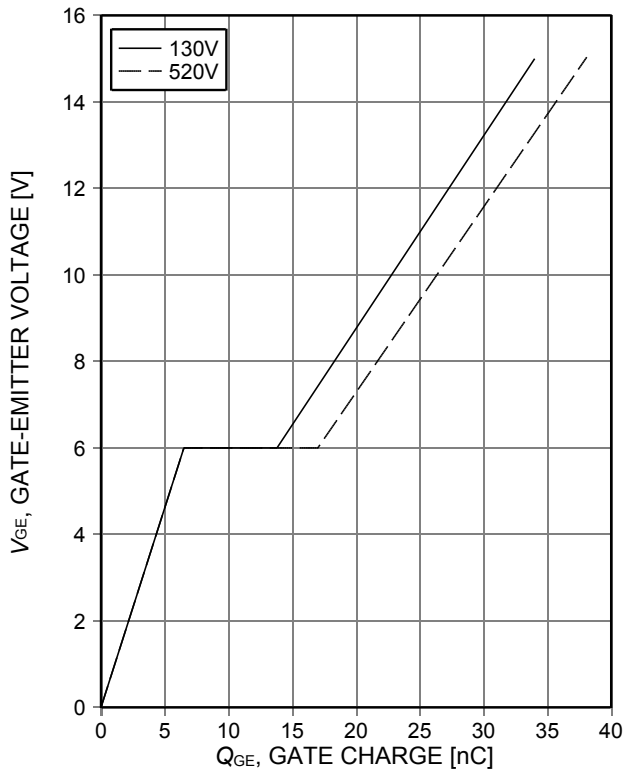


Figure 15. **Typical gate charge** ($I_C=15A$)

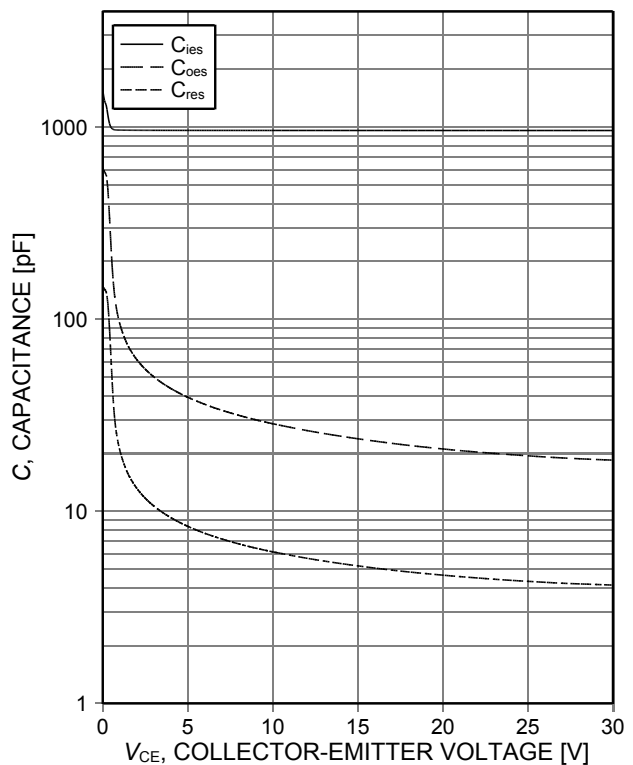


Figure 16. **Typical capacitance as a function of collector-emitter voltage** ($V_{GE}=0V$, $f=1MHz$)

High speed switching series fifth generation

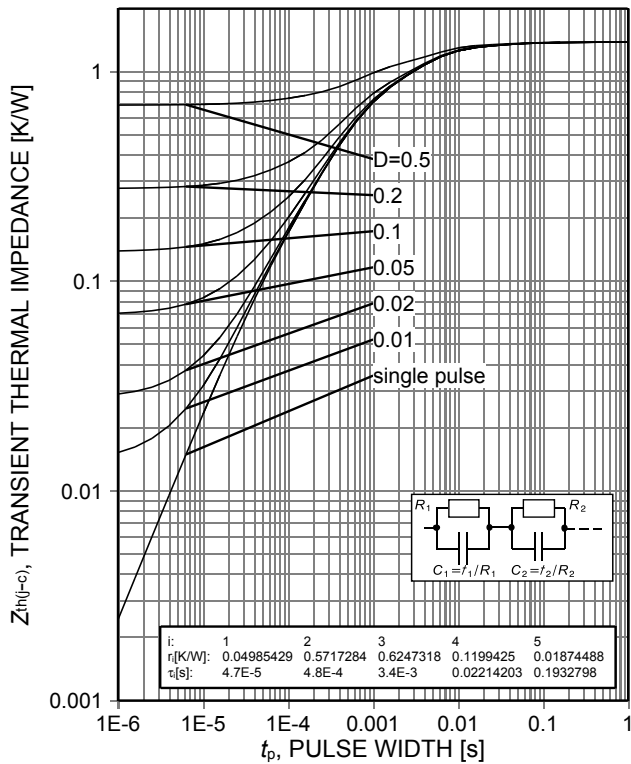
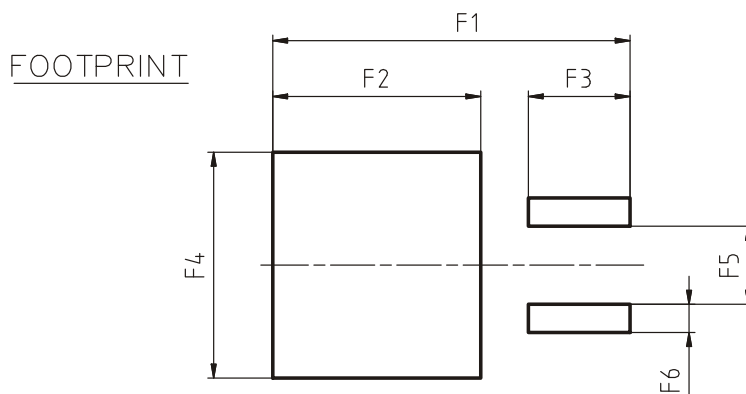
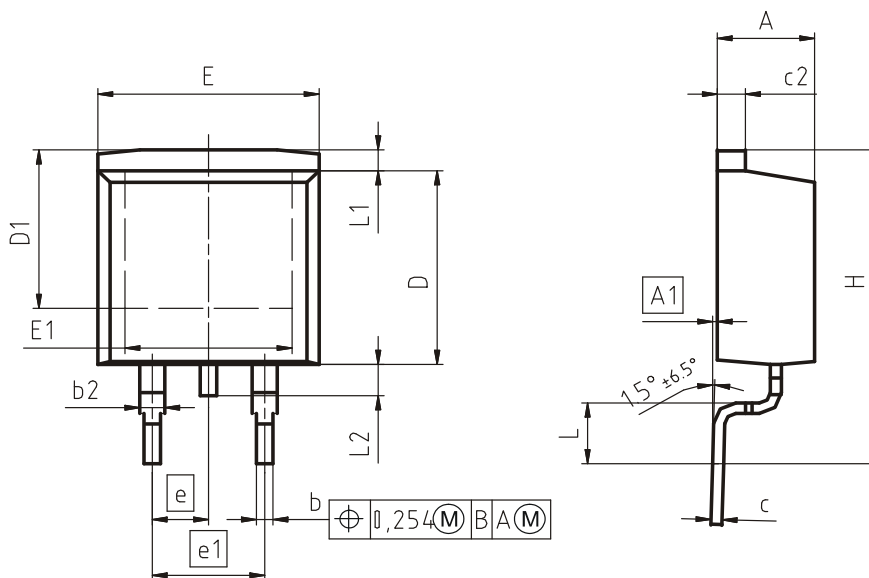


Figure 17. IGBT transient thermal impedance ($D=t_p/T$)

Package Drawing PG-TO263-3



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.30	4.57	0.169	0.180
A1	0.00	0.25	0.000	0.010
b	0.65	0.85	0.026	0.033
b2	0.95	1.15	0.037	0.045
c	0.33	0.65	0.013	0.026
c2	1.17	1.40	0.046	0.055
D	8.51	9.45	0.335	0.372
D1	7.10	7.90	0.280	0.311
E	9.80	10.31	0.386	0.406
E1	6.50	8.60	0.256	0.339
e	2.54		0.100	
e1	5.08		0.200	
N	2		2	
H	14.61	15.88	0.575	0.625
L	2.29	3.00	0.090	0.118
L1	0.70	1.60	0.028	0.063
L2	1.00	1.78	0.039	0.070
F1	16.05	16.25	0.632	0.640
F2	9.30	9.50	0.366	0.374
F3	4.50	4.70	0.177	0.185
F4	10.70	10.90	0.421	0.429
F5	3.65	3.85	0.144	0.152
F6	1.25	1.45	0.049	0.057

DOCUMENT NO.
Z8B00003324

SCALE

7.5mm

EUROPEAN PROJECTION

ISSUE DATE
30-08-2007

REVISION
01

Testing Conditions

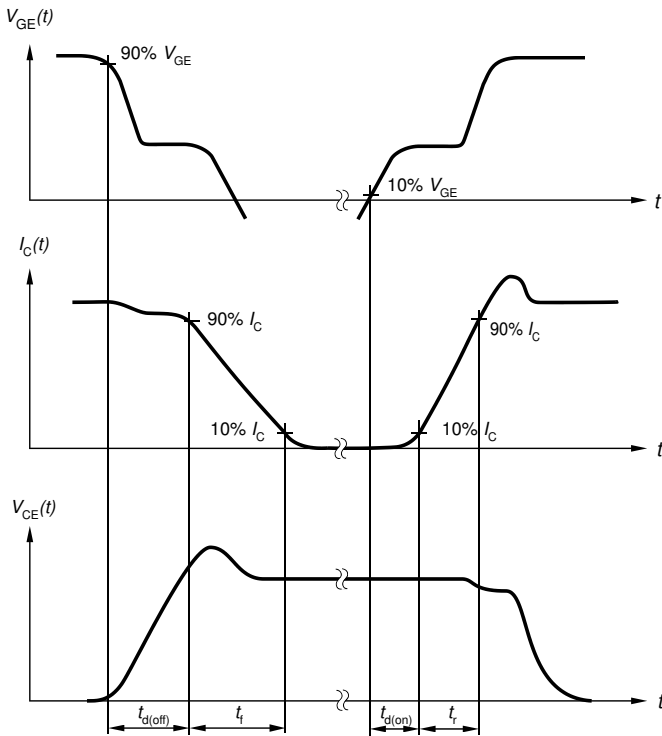


Figure A. Definition of switching times

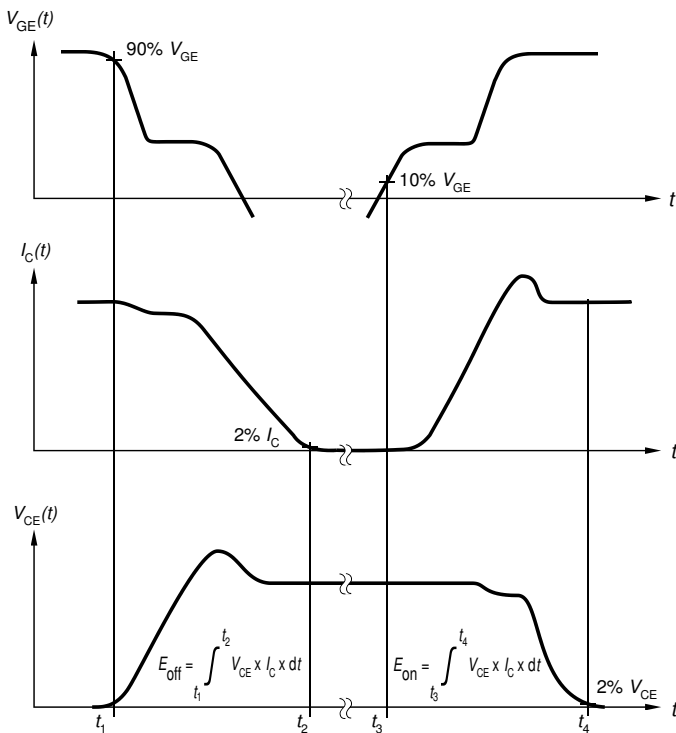


Figure B. Definition of switching losses

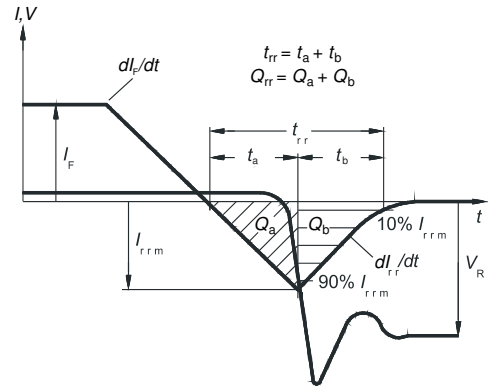


Figure C. Definition of diode switching characteristics

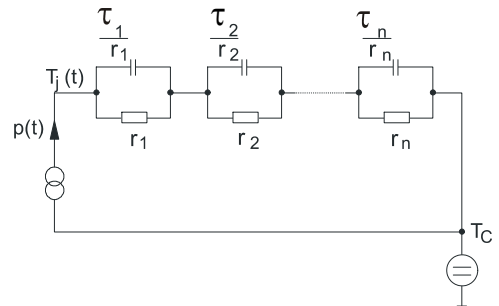


Figure D. Thermal equivalent circuit

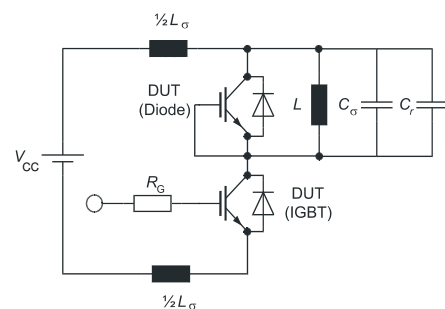


Figure E. Dynamic test circuit
Parasitic inductance L_{σ} ,
parasitic capacitor C_{σ} ,
relief capacitor C_r ,
(only for ZVT switching)

High speed switching series fifth generation

Revision History

IGB15N65S5

Revision: 2017-05-19, Rev. 2.1

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.1	2017-05-19	Final data sheet

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