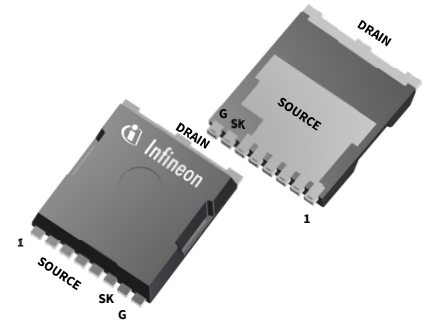


IGT60R190D1S

600V CoolGaN™ enhancement-mode Power Transistor

Features

- Enhancement mode transistor – Normally OFF switch
- Ultra fast switching
- No reverse-recovery charge
- Capable of reverse conduction
- Low gate charge, low output charge
- Superior commutation ruggedness
- Qualified for standard grade applications according to JEDEC standards



Benefits

- Improves system efficiency
- Improves power density
- Enables higher operating frequency
- System cost reduction savings
- Reduces EMI

Gate	8
Drain	drain contact
Kelvin Source	7
Source	1,2,3,4,5,6

Applications

Consumer SMPS and high density chargers based on the half-bridge topology (half-bridge topologies for hard and soft switching such as Totem pole PFC, high frequency LLC and flyback).

For other applications: review CoolGaN™ reliability white paper and contact Infineon regional support

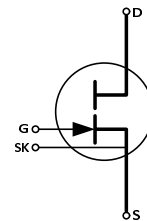


Table 1 Key Performance Parameters at T_J = 25 °C

Parameter	Value	Unit
V _{DS,max}	600	V
R _{DS(on),max}	190	mΩ
Q _{G,typ}	3.2	nC
I _{D,pulse}	23	A
Q _{oss @ 400 V}	16	nC
Q _{rr}	0	nC



Table 2 Ordering Information

Type / Ordering Code	Package	Marking	Related links
IGT60R190D1S	PG-HSOF-8-3	60S190D1	see Appendix A

Table of Contents

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Benefits	1
Applications	1
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1 Maximum ratings

at $T_j = 25\text{ }^\circ\text{C}$, unless otherwise specified. Continuous application of maximum ratings can deteriorate transistor lifetime. For further information, contact your local Infineon sales office.

Table 3 Maximum ratings

Parameter	Symbol	Values			Unit	Note/Test Condition
		Min.	Typ.	Max.		
Drain Source Voltage, continuous ¹	$V_{DS,max}$	-	-	600	V	$V_{GS} = 0\text{ V}$
Drain source destructive breakdown voltage ²	$V_{DS,bd}$	800	-	-	V	$V_{GS} = 0\text{ V}$, $I_{DS} = 4.3\text{ mA}$
Drain source voltage, pulsed ²	$V_{DS,pulse}$	-	-	750	V	$T_j = 25\text{ }^\circ\text{C}$; $V_{GS} \leq 0\text{ V}$; ≤ 1 hour of total time
		-	-	650	V	$T_j = 125\text{ }^\circ\text{C}$, $V_{GS} \leq 0\text{ V}$; ≤ 1 hour of total time
Switching surge voltage, pulsed ²	$V_{DS,surge}$	-	-	750	V	DC bus voltage = 700 V; turn off $V_{DS,pulse} = 750\text{ V}$; turn on $I_{D,pulse} = 10\text{ A}$; $T_j = 105\text{ }^\circ\text{C}$; $f \leq 100\text{ kHz}$, $t \leq 100\text{ secs}$ (10 million pulses)
Continuous current, drain source	I_D	-	-	12.5	A	$T_C = 25\text{ }^\circ\text{C}$; $T_j = T_{j,max}$
		-	-	8.0		$T_C = 100\text{ }^\circ\text{C}$; $T_j = T_{j,max}$
		-	-	5.5		$T_C = 125\text{ }^\circ\text{C}$; $T_j = T_{j,max}$
Pulsed current, drain source ^{3 4}	$I_{D,pulse}$	-	-	23	A	$T_C = 25\text{ }^\circ\text{C}$; $I_G = 9.6\text{ mA}$; See Figure 3; Figure 5;
Pulsed current, drain source ^{4 5}	$I_{D,pulse}$	-	-	13.5	A	$T_C = 125\text{ }^\circ\text{C}$; $I_G = 9.6\text{ mA}$; See Figure 4; Figure 6;
Gate current, continuous ^{4 5 6}	$I_{G,avg}$	-	-	7.7	mA	$T_j = -55\text{ }^\circ\text{C}$ to $150\text{ }^\circ\text{C}$;
Gate current, pulsed ^{4 6}	$I_{G,pulse}$	-	-	770	mA	$T_j = -55\text{ }^\circ\text{C}$ to $150\text{ }^\circ\text{C}$; $t_{PULSE} = 50\text{ ns}$, $f = 100\text{ kHz}$
Gate source voltage, continuous ⁶	V_{GS}	-10	-	-	V	$T_j = -55\text{ }^\circ\text{C}$ to $150\text{ }^\circ\text{C}$;
Gate source voltage, pulsed ⁶	$V_{GS,pulse}$	-25	-	-	V	$T_j = -55\text{ }^\circ\text{C}$ to $150\text{ }^\circ\text{C}$; $t_{PULSE} = 50\text{ ns}$, $f = 100\text{ kHz}$; open drain
Power dissipation	P_{tot}	-	-	55.5	W	$T_C = 25\text{ }^\circ\text{C}$
Operating temperature	T_j	-55	-	150	$^\circ\text{C}$	

¹ All devices are 100% tested at $I_{DS} = 4.3\text{ mA}$ to assure $V_{DS} \geq 800\text{ V}$

² Provided as measure of robustness under abnormal operating conditions and not recommended for normal operation

³ Limits derived from product characterization, parameter not measured during production

⁴ Ensure that average gate drive current, $I_{G,avg}$ is $\leq 7.7\text{ mA}$. Please see figure 27 for $I_{G,avg}$, $I_{G,pulse}$ and I_G details

⁵ Parameter is influenced by rel-requirements. Please contact the local Infineon Sales Office to get an assessment of your application

⁶ We recommend using an advanced driving technique to optimize the device performance. Please see gate drive application note for details

Storage temperature	T_{stg}	-55	-	150	°C	Max shelf life depends on storage conditions.
Drain-source voltage slew-rate	dV/dt			200	V/ns	

2 Thermal characteristics

Table 4 Thermal characteristics

Parameter	Symbol	Values			Unit	Note/Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction-case	R_{thJC}	-	-	2.25	°C/W	
Thermal resistance, junction-ambient	R_{thJA}	-	-	62	°C/W	Device on PCB, minimum footprint
Thermal resistance, junction-ambient for SMD version	R_{thJA}	-	35	45	°C/W	Device on 40mm*40mm* 1.5mm epoxy PCB FR4 with 6cm ² (one layer, 70μm thickness) copper area for drain connection and cooling. PCB is vertical without air stream cooling.
Reflow soldering temperature	T_{sold}	-	-	260	°C	MSL1

3 Electrical characteristics

at $T_j = 25\text{ °C}$, unless specified otherwise

Table 5 Static characteristics

Parameter	Symbol	Values			Unit	Note/Test Condition
		Min.	Typ.	Max.		
Gate threshold voltage	$V_{GS(th)}$	0.9 0.7	1.2 1.0	1.6 1.4	V	$I_{DS} = 0.96\text{ mA}$; $V_{DS} = 10\text{ V}$; $T_j = 25\text{ °C}$ $I_{DS} = 0.96\text{ mA}$; $V_{DS} = 10\text{ V}$; $T_j = 125\text{ °C}$
Drain-Source leakage current	I_{DSS}	- -	0.4 8	40 -	μA	$V_{DS} = 600\text{ V}$; $V_{GS} = 0\text{ V}$; $T_j = 25\text{ °C}$ $V_{DS} = 600\text{ V}$; $V_{GS} = 0\text{ V}$; $T_j = 150\text{ °C}$
Drain-Source leakage current at application conditions ¹	I_{DSSapp}	-	0.3	-	μA	$V_{DS} = 400\text{ V}$; $V_{GS} = 0\text{ V}$; $T_j = 125\text{ °C}$
Gate-Source leakage current	I_{GSS}	-1 -1	- -	- -	mA	$V_{DS} = 0\text{ V}$; $V_{GS} = -10\text{ V}$; $T_j = 25\text{ °C}$ $V_{DS} = 0\text{ V}$; $V_{GS} = -10\text{ V}$; $T_j = 125\text{ °C}$
Drain-Source on-state resistance	$R_{DS(on)}$	- -	0.14 0.26	0.19 -	Ω	$I_G = 9.6\text{ mA}$; $I_D = 5\text{ A}$; $T_j = 25\text{ °C}$ $I_G = 9.6\text{ mA}$; $I_D = 5\text{ A}$; $T_j = 150\text{ °C}$
Gate resistance	$R_{G,int}$	-	0.27	-	Ω	LCR impedance measurement; $f = f_{res}$

Table 6 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note/Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	157	-	pF	$V_{GS} = 0\text{ V}$; $V_{DS} = 400\text{ V}$; $f = 1\text{ MHz}$
Output capacitance	C_{oss}	-	28	-	pF	$V_{GS} = 0\text{ V}$; $V_{DS} = 400\text{ V}$; $f = 1\text{ MHz}$
Reverse transfer capacitance	C_{rss}	-	0.15	-	pF	$V_{GS} = 0\text{ V}$; $V_{DS} = 400\text{ V}$; $f = 1\text{ MHz}$
Effective output capacitance, energy related ²	$C_{o(er)}$	-	32.5	-	pF	$V_{DS} = 0\text{ to }400\text{ V}$
Effective output capacitance, time related ³	$C_{o(tr)}$	-	40	-	pF	$V_{GS} = 0\text{ V}$; $V_{DS} = 0\text{ to }400\text{ V}$; $I_D = \text{const}$
Output charge	Q_{oss}	-	16	-	nC	$V_{DS} = 0\text{ to }400\text{ V}$
Turn- on delay time	$t_{d(on)}$	-	11	-	ns	see Figure 23
Turn- off delay time	$t_{d(off)}$	-	12	-	ns	see Figure 23
Rise time	t_r	-	5	-	ns	see Figure 23
Fall time	t_f	-	12	-	ns	see Figure 23

¹ Parameter represents end of use leakage in applications

² $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 400 V

³ $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 400 V

Table 7 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note/Test Condition
		Min.	Typ.	Max.		
Gate charge	Q_G	-	3.2	-	nC	$I_{GS} = 0$ to 3.8 mA; $V_{DS} = 400$ V; $I_D = 5$ A

Table 8 Reverse conduction characteristics

Parameter	Symbol	Values			Unit	Note/Test Condition
		Min.	Typ.	Max.		
Source-Drain reverse voltage	V_{SD}	-	2.5	3	V	$V_{GS} = 0$ V; $I_{SD} = 5$ A
Pulsed current, reverse	$I_{S,pulse}$	-	-	23	A	$I_G = 9.6$ mA
Reverse recovery charge	Q_{rr}^1	-	0	-	nC	$I_{SD} = 5$ A, $V_{DS} = 400$ V
Reverse recovery time	t_{rr}	-	0	-	ns	
Peak reverse recovery current	I_{rrm}	-	0	-	A	

4 Electrical characteristics diagrams

at $T_j = 25\text{ }^\circ\text{C}$, unless specified otherwise

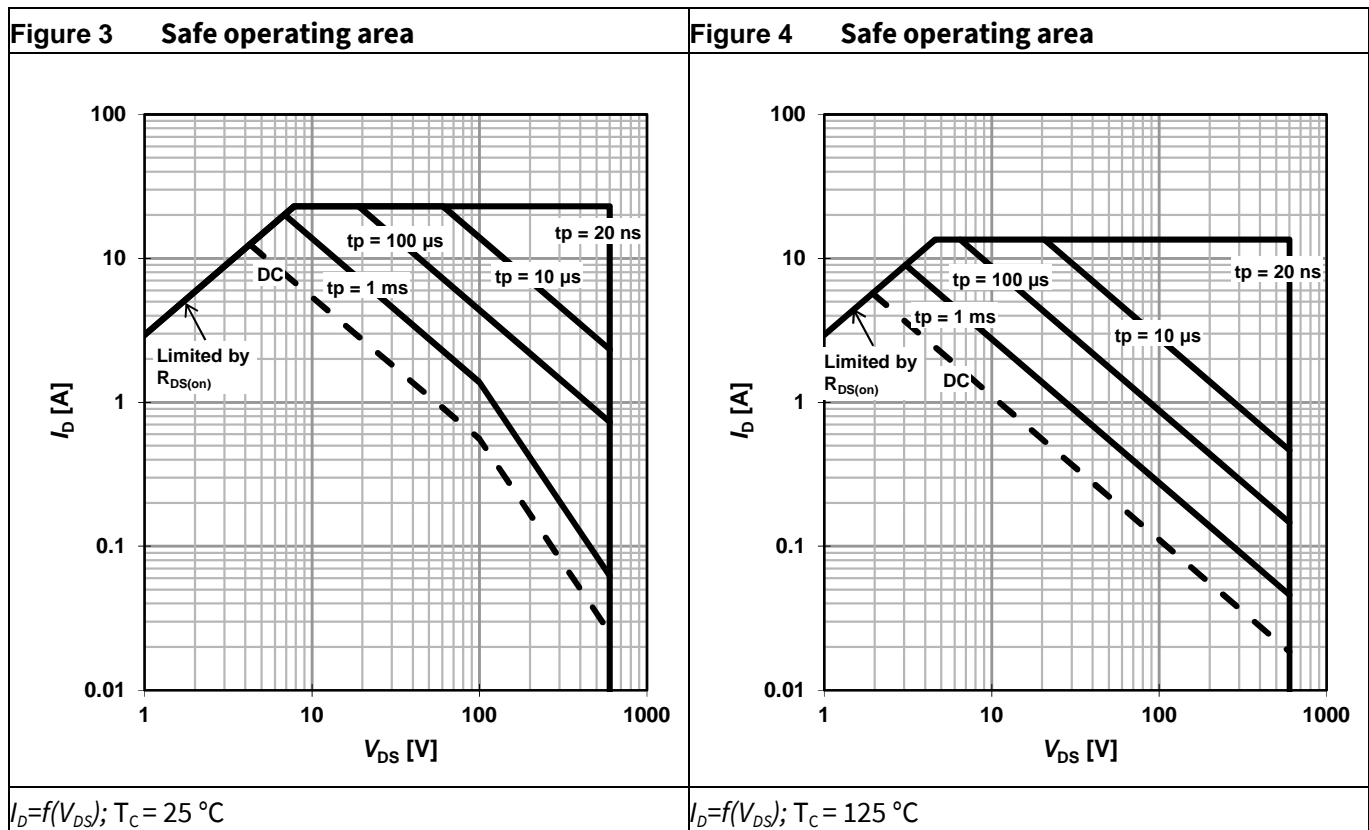
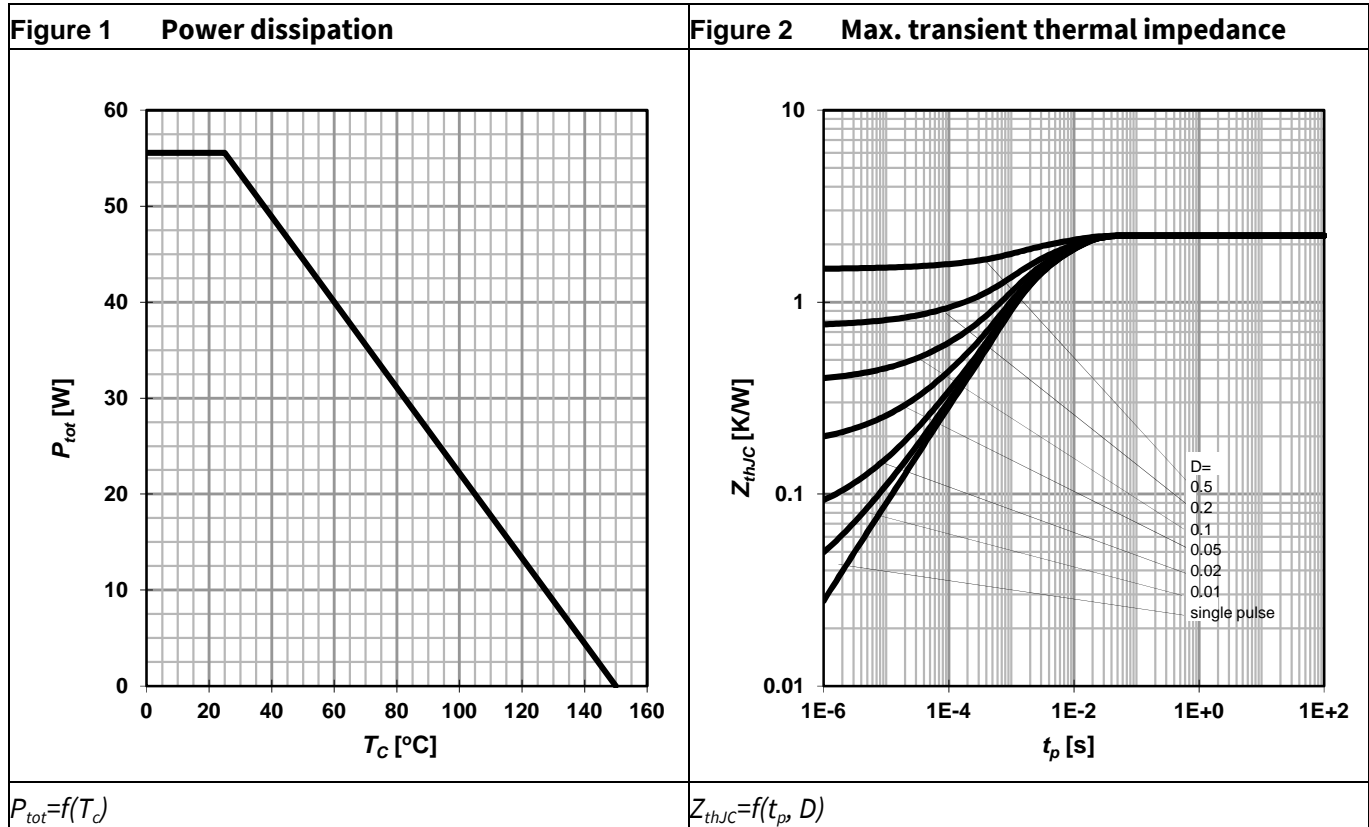
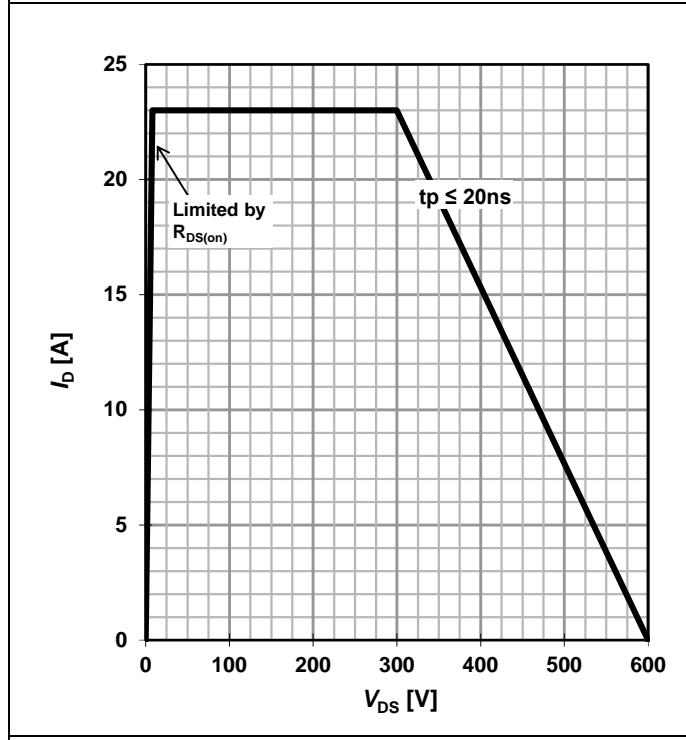
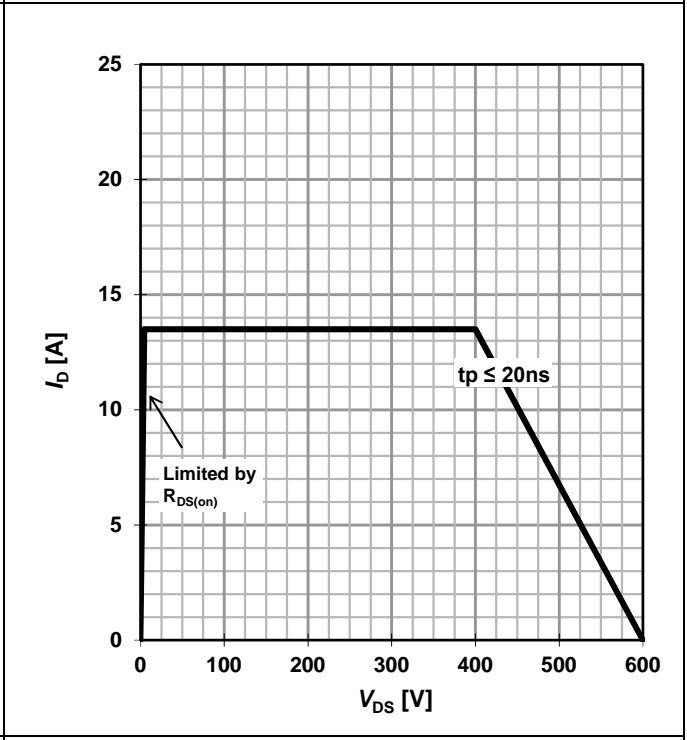


Figure 5 Repetitive safe operating area¹



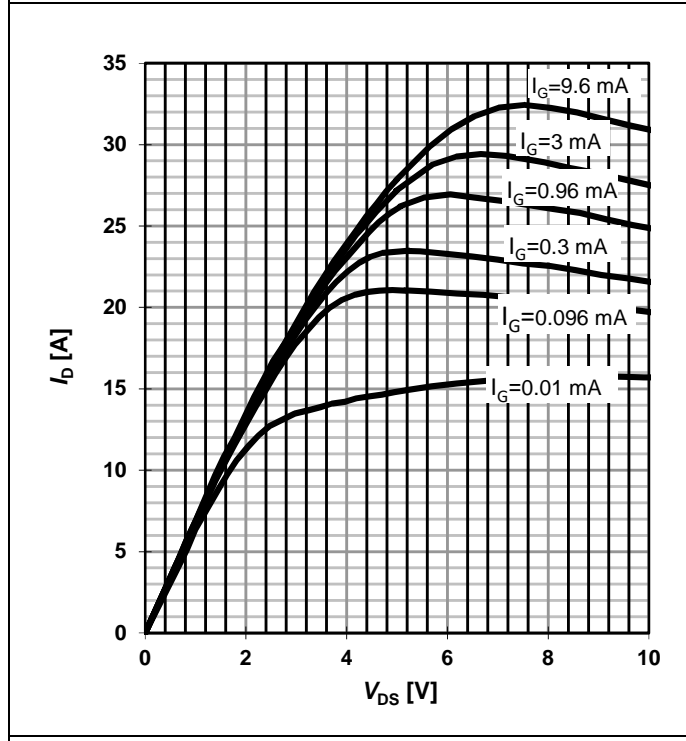
$T_c = 25\text{ °C}; T_j \leq 150\text{ °C}$

Figure 6 Repetitive safe operating area¹



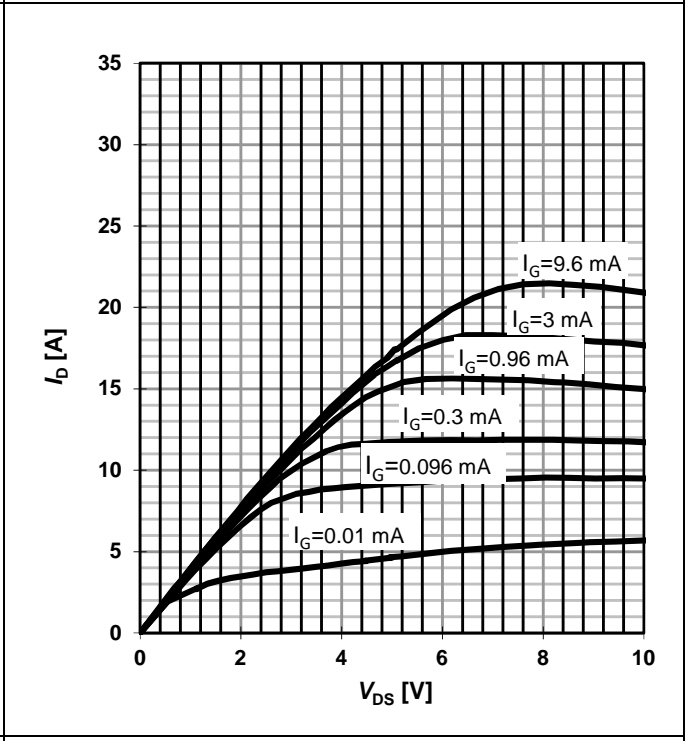
$T_c = 125\text{ °C}; T_j \leq 150\text{ °C}$

Figure 7 Typ. output characteristics



$I_D = f(V_{DS}, I_{GS}); T_j = 25\text{ °C}$

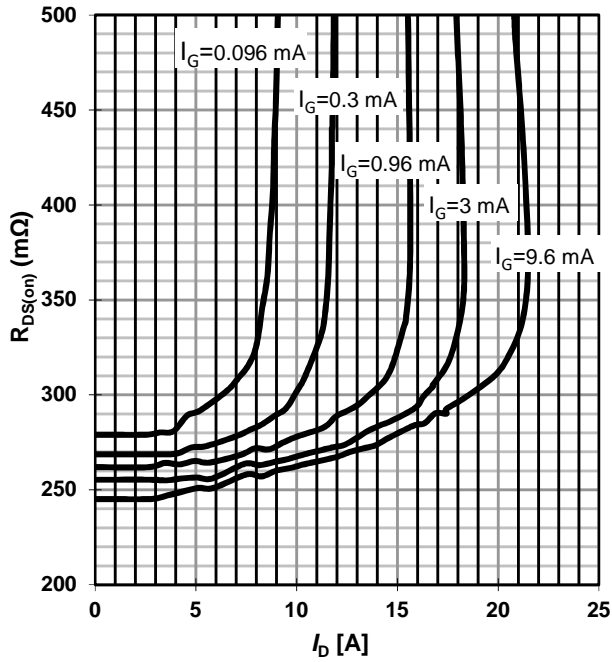
Figure 8 Typ. output characteristics



$I_D = f(V_{DS}, I_{GS}); T_j = 125\text{ °C}$

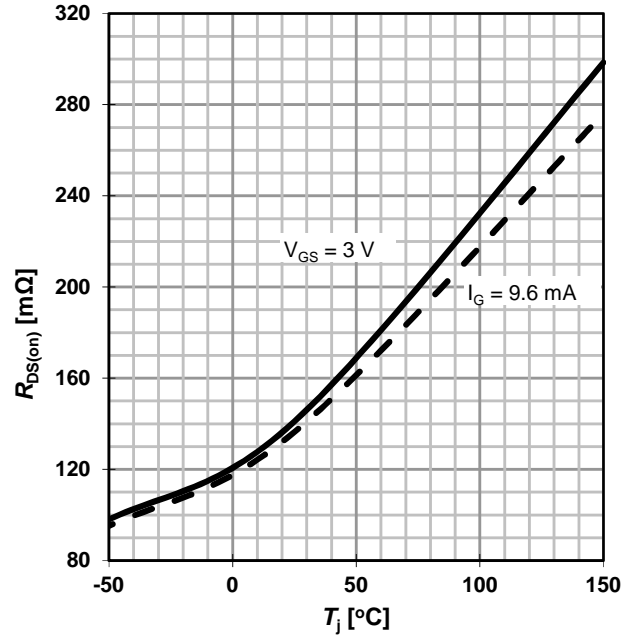
¹ Parameter is influenced by rel-requirements. This value is determined by a typical lifetime-model for consumer applications. Please contact the local Infineon Sales Office to get an assessment of your application.

Figure 9 Typ. Drain-source on-state resistance



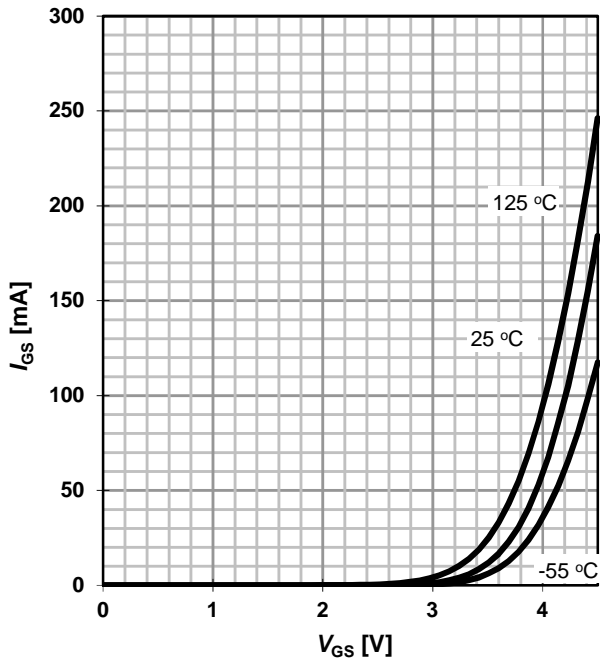
$R_{DS(on)} = f(I_D, I_G); T_j = 125^\circ\text{C}$

Figure 10 Typ. Drain-source on-state resistance



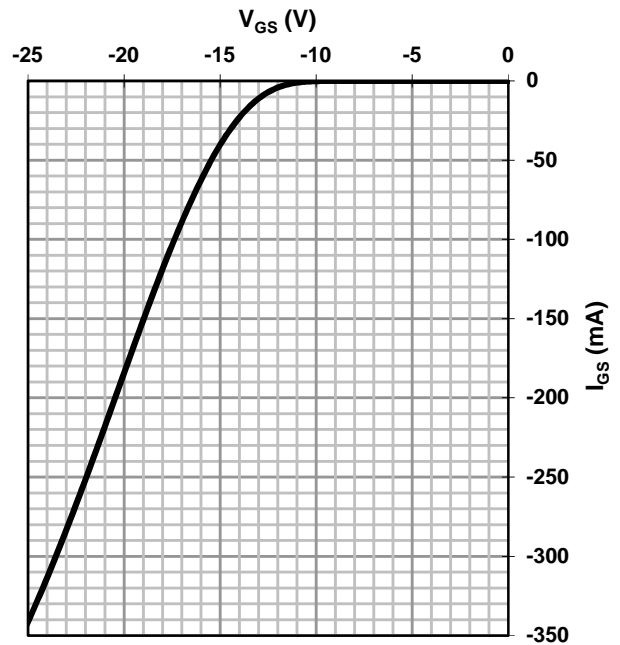
$R_{DS(on)} = f(T_j); I_D = 5\text{ A}$

Figure 11 Typ. gate characteristics forward



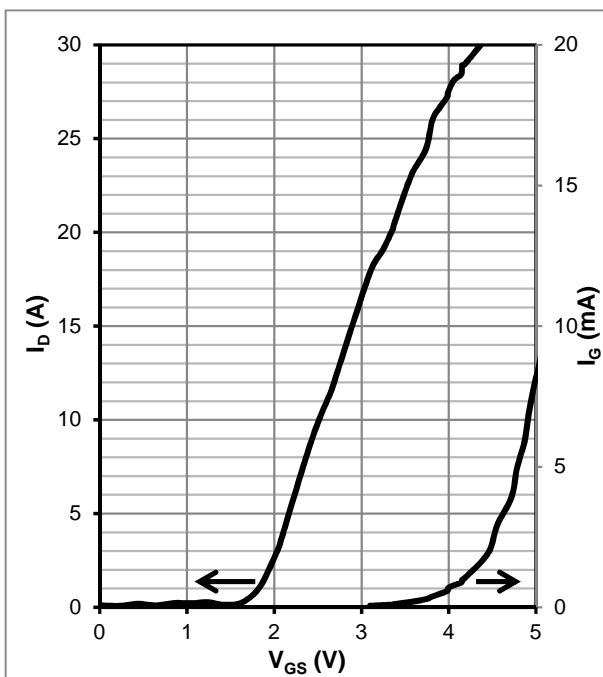
$I_{GS} = f(V_{GS}, T_j); \text{open drain}$

Figure 12 Typ. gate characteristics reverse



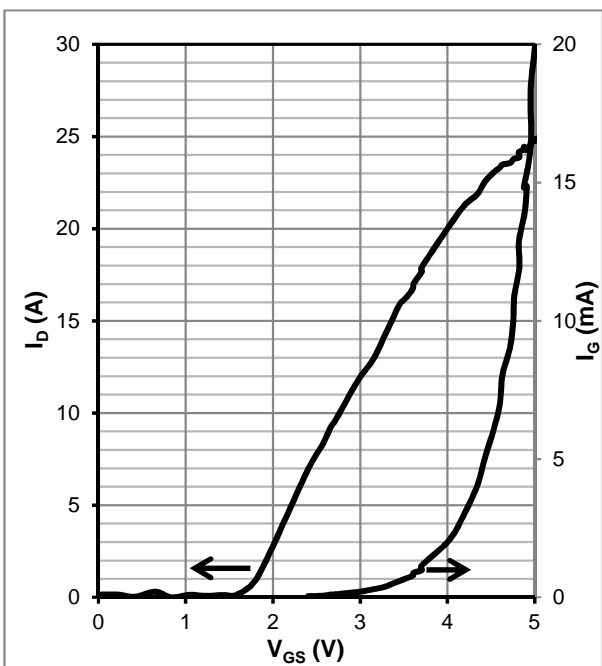
$I_{GS} = f(V_{GS}); T_j = 25^\circ\text{C}$

Figure 13 Typ. transfer characteristics



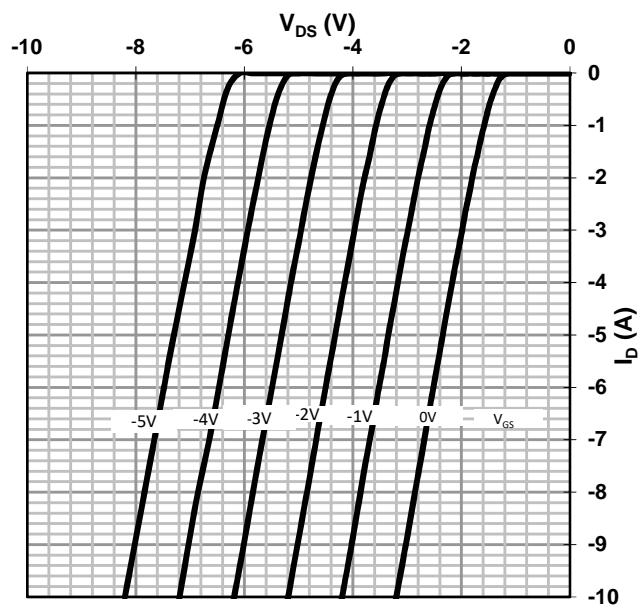
$I_D, I_G = f(V_{GS}); V_{DS} = 8\text{ V}; T_j = 25\text{ }^\circ\text{C}$

Figure 14 Typ. transfer characteristics



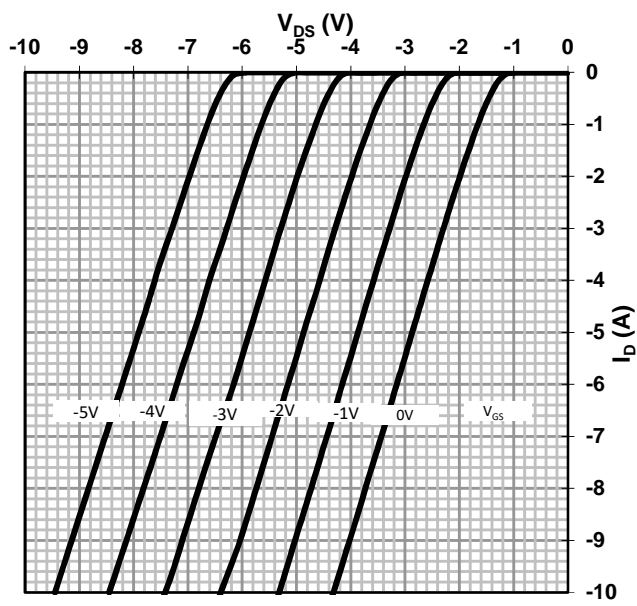
$I_D, I_G = f(V_{GS}); V_{DS} = 8\text{ V}; T_j = 125\text{ }^\circ\text{C}$

Figure 15 Typ. channel reverse characteristics



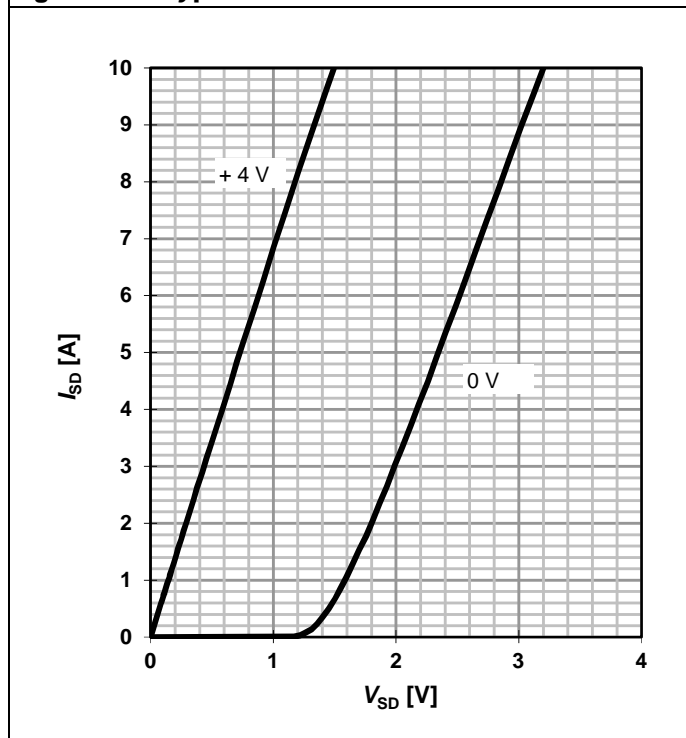
$V_{DS} = f(I_D, V_{GS}); T_j = 25\text{ }^\circ\text{C}$

Figure 16 Typ. channel reverse characteristics



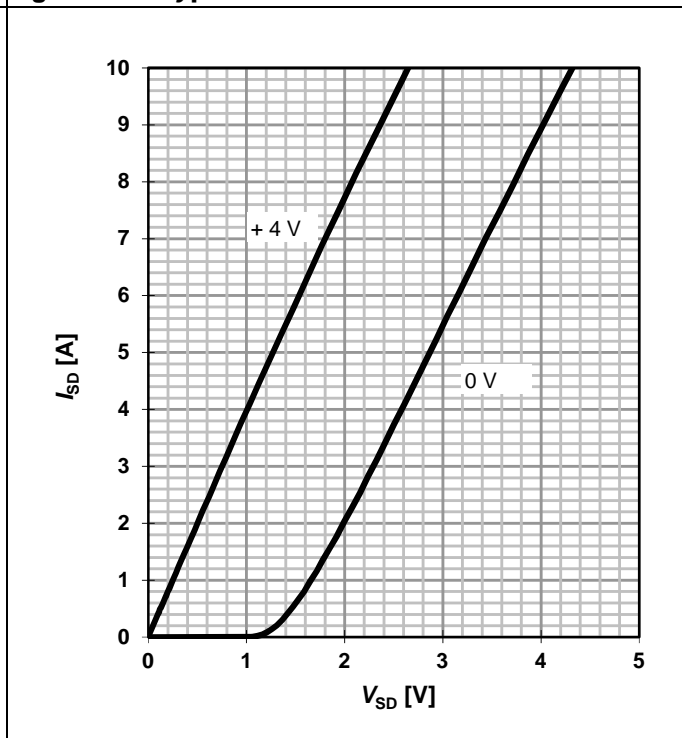
$V_{DS} = f(I_D, V_{GS}); T_j = 125\text{ }^\circ\text{C}$

Figure 17 Typ. channel reverse characteristics



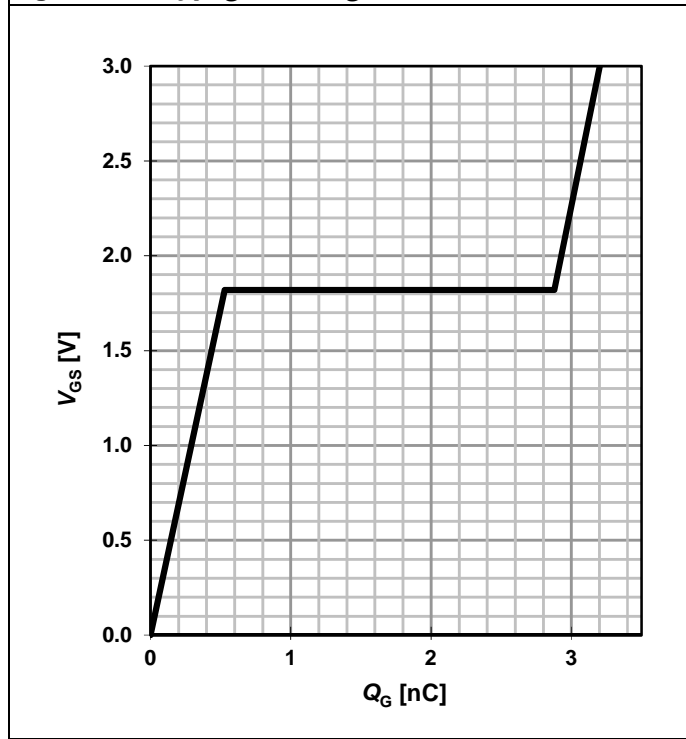
$I_D = f(V_{DS}, V_{GS}); T_j = 25\text{ °C}$

Figure 18 Typ. channel reverse characteristics



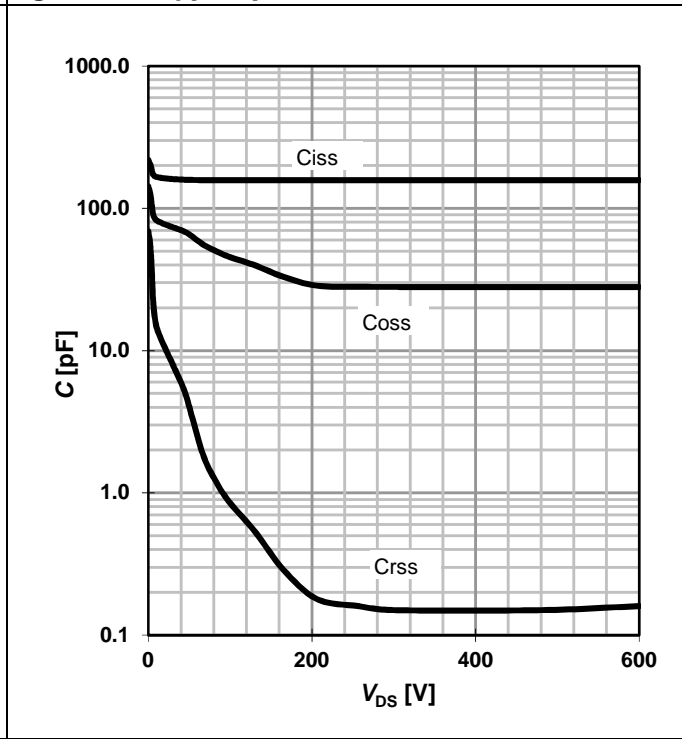
$I_D = f(V_{DS}, V_{GS}); T_j = 125\text{ °C}$

Figure 19 Typ. gate charge



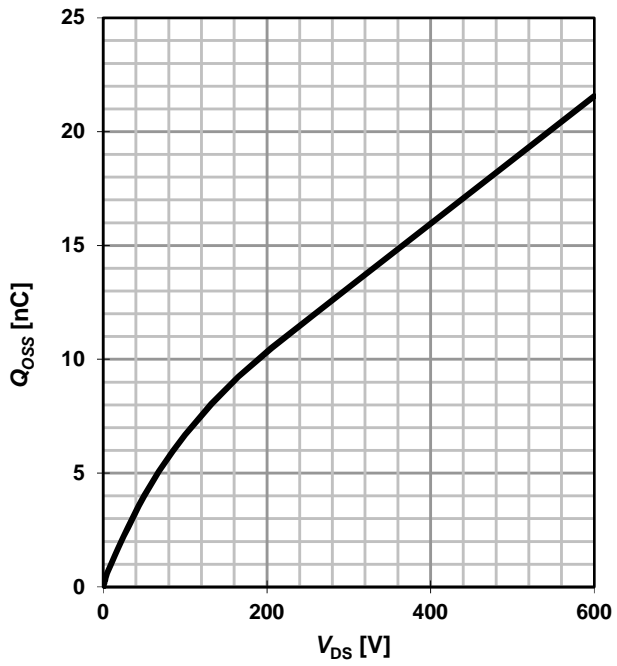
$V_{GS} = f(Q_G); V_{DCLINK} = 400\text{ V}; I_D = 5\text{ A}$

Figure 20 Typ. capacitances



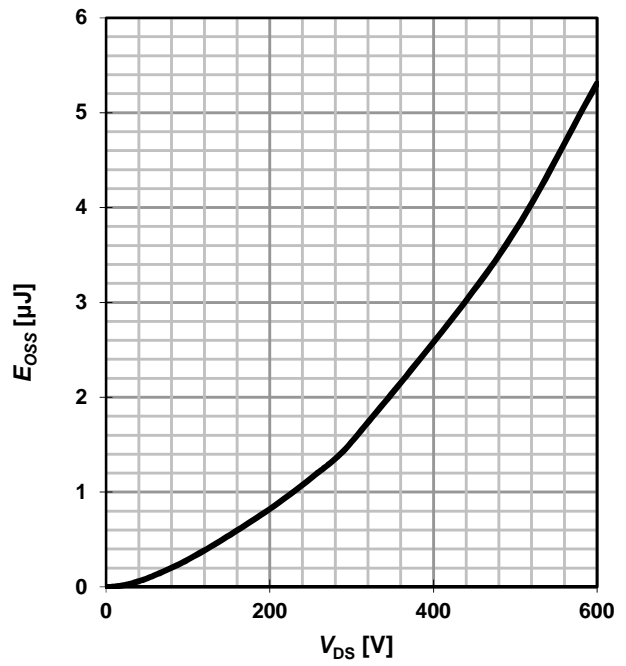
$C_{xss} = f(V_{DS})$

Figure 21 Typ. output charge



$Q_{OSS} = f(V_{DS})$

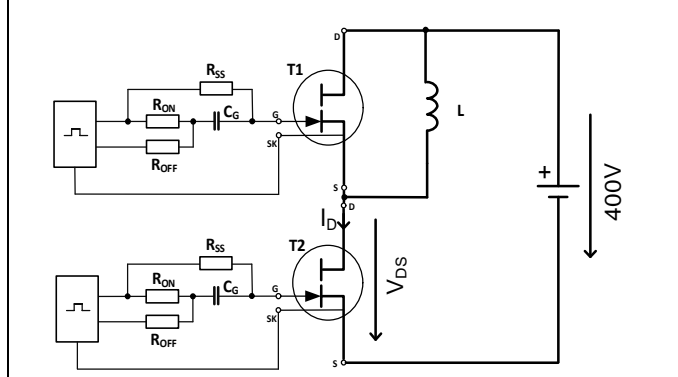
Figure 22 Typ. Coss stored Energy



$E_{OSS} = f(V_{DS})$

5 Test Circuits

Figure 23 Switching times with inductive load



$I_D=5\text{ A}$, $R_{ON}=15\ \Omega$; $R_{OFF}=4.7\ \Omega$; $R_{SS}=1500\ \Omega$;
 $C_G=0.68\text{ nF}$; $V_{DRV} = 12\text{ V}$

Figure 24 Switching times waveform

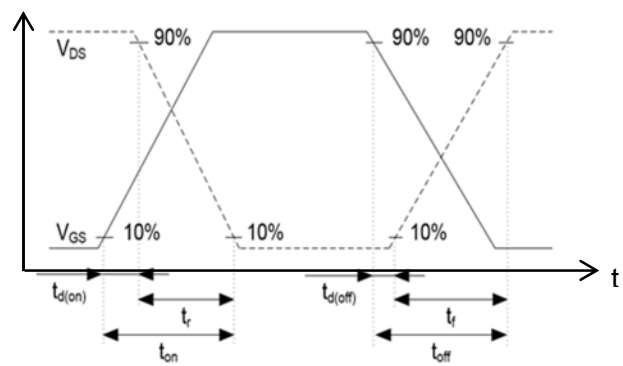
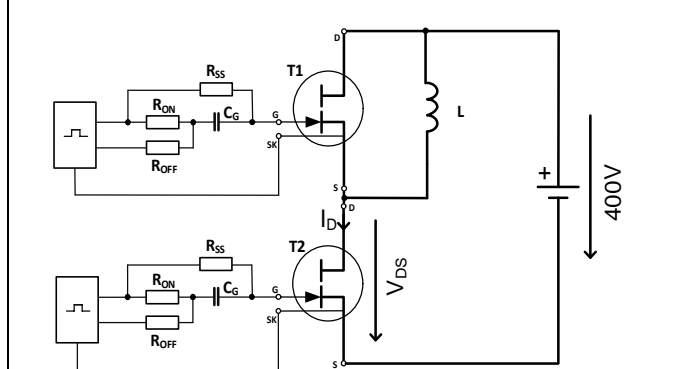
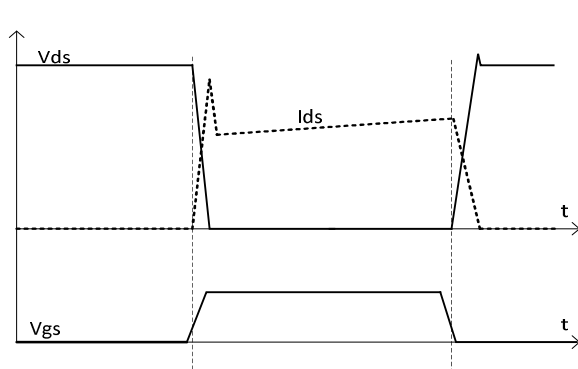


Figure 25 Reverse Channel Characteristics Test



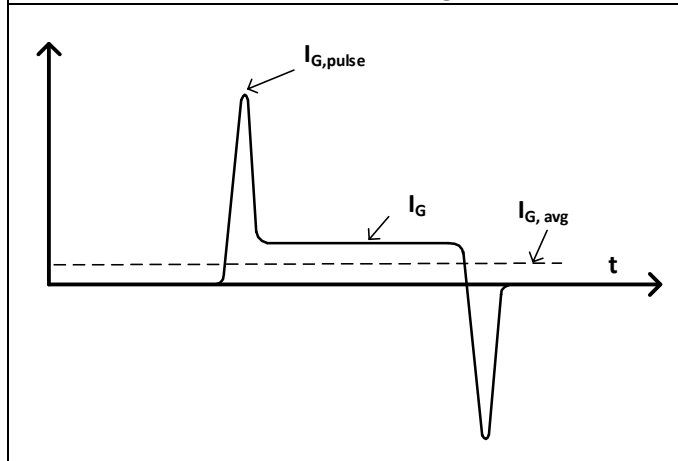
$I_D=5\text{ A}$, $R_{ON}=15\ \Omega$; $R_{OFF}=4.7\ \Omega$; $R_{SS}=1500\ \Omega$;
 $C_G=0.68\text{ nF}$; $V_{DRV} = 12\text{ V}$

Figure 26 Typical Reverse Channel Recovery



The recovery charge is Q_{OSS} only, no additional Q_{rr}

Figure 27 Gate current switching waveform



6 Package Outlines

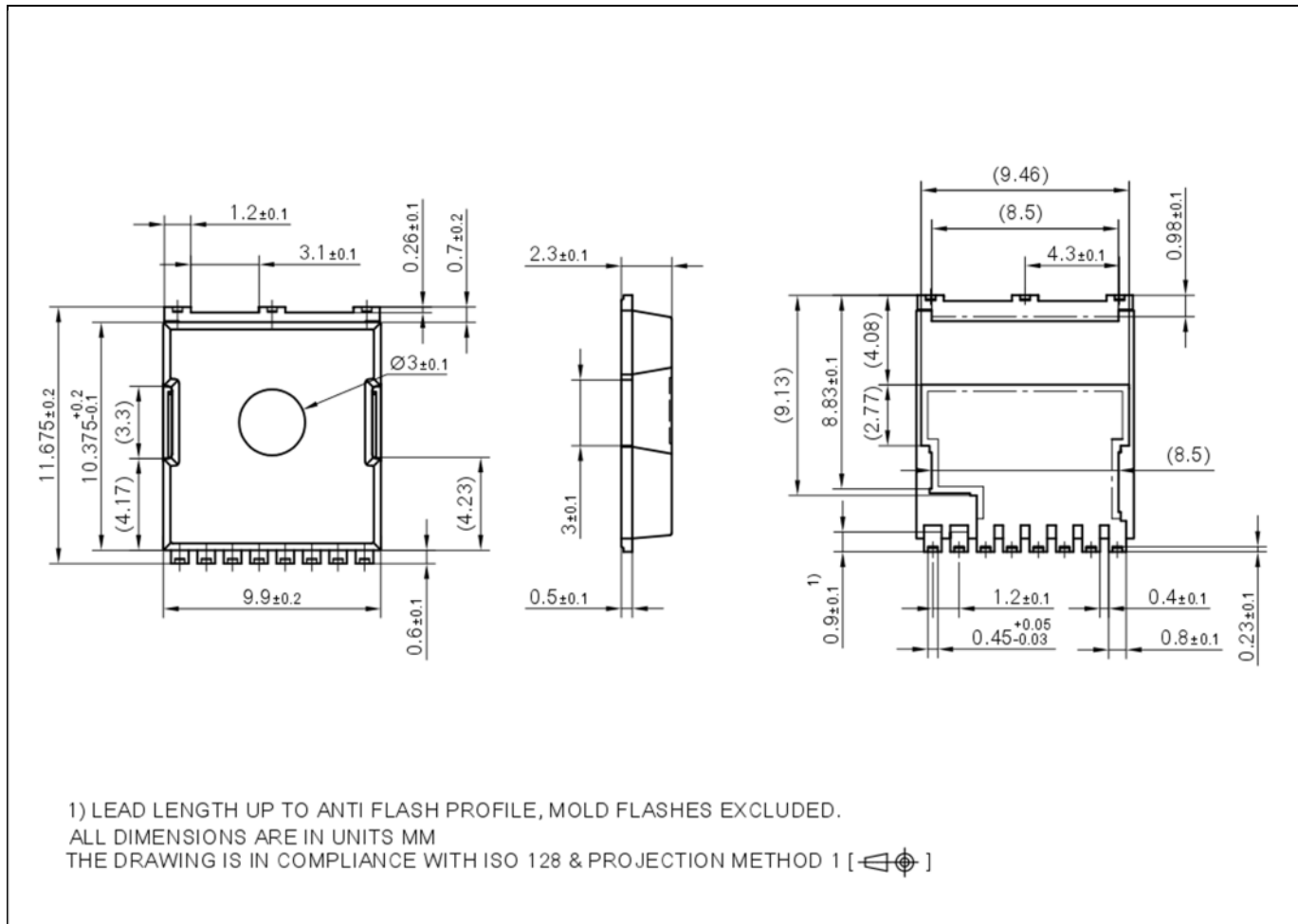


Figure 28 PG-HSOF-8-3 Package Outline, dimensions (mm)

7 Appendix A

Table 9 Related links

- IFX CoolGaN™ webpage: www.infineon.com/why-coolgan
- IFX CoolGaN™ reliability white paper: www.infineon.com/gan-reliability
- IFX CoolGaN™ gate drive application note: www.infineon.com/driving-coolgan
- IFX CoolGaN™ applications information:
 - www.infineon.com/gan-in-server-telecom
 - www.infineon.com/gan-in-wirelesscharging
 - www.infineon.com/gan-in-audio
 - www.infineon.com/gan-in-adapter-charger

8 Revision History

Major changes since the last revision

Revision	Date	Description of change
3.0	2017-04-25	Release of final version
3.1	2018-10-12	Updated application section; added Appendix A and Fig. 27; updated maximum rating table footnotes, switching times and figures.
3.11	2020-01-16	Added $V_{DS,bd}$, $V_{DS,pulse}$, $V_{DS,surge}$ specifications in maximum ratings table of page3
3.12	2020-05-29	Updated to MSL1 in table 4

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[NTE2967](#) [NTE2969](#) [NTE2976](#) [NTE6400A](#) [NTE2910](#) [NTE2916](#) [NTE2956](#) [NTE2911](#) [DMN2080UCB4-7](#) [TK10A80W,S4X\(S](#)
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