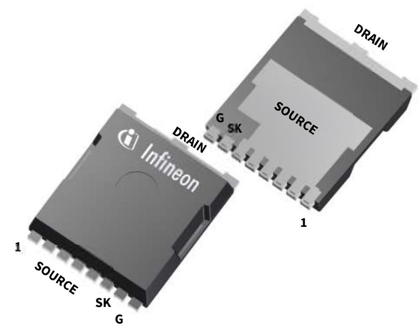
IGT60R070D1

600V CoolGaN™ enhancement-mode Power Transistor

Features

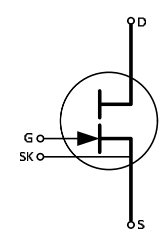
- Enhancement mode transistor – Normally OFF switch
- Ultra fast switching
- No reverse-recovery charge
- Capable of reverse conduction
- Low gate charge, low output charge
- Superior commutation ruggedness
- Qualified for industrial applications according to JEDEC Standards (JESD47 and JESD22)



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

Benefits

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



Applications

Industrial, telecom, datacenter SMPS based on the half-bridge topology (half-bridge topologies for hard and soft switching such as Totem pole PFC, high frequency LLC).
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
$R_{DS(on),max}$	70	mΩ
$Q_{G,typ}$	5.8	nC
$I_{D,pulse}$	60	A
Q_{oss} @ 400 V	41	nC
Q_{rr}	0	nC

Table 2 Ordering Information

Type / Ordering Code	Package	Marking	Related links
IGT60R070D1	PG-HSOF-8-3	60R070D1	see Appendix A

Table of Contents

1 Maximum ratings

at T_j = 25 °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 V
Drain source destructive breakdown voltage [2]	$V_{DS,bd}$	800	-	-	V	V_{GS} = 0 V, I_{DS} = 12.2 mA
Drain source voltage, pulsed [2]	$V_{DS,pulse}$	- -	- -	750 650	V V	T_j = 25 °C; V_{GS} ≤ 0 V; ≤1 hour of total time T_j = 125 °C, V_{GS} ≤ 0 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 V; turn on $I_{D,pulse}$ = 27 A; T_j = 105 °C; f ≤ 100 kHz, t ≤ 100 secs (10 million pulses)
Continuous current, drain source	I_D	- - -	- - -	31 20 14	A	T_C = 25 °C; $T_j = T_{j,max}$ T_C = 100 °C; $T_j = T_{j,max}$ T_C = 125 °C; $T_j = T_{j,max}$
Pulsed current, drain source [3 4]	$I_{D,pulse}$	-	-	60	A	T_C = 25 °C; I_G = 26.1 mA; See Figure 3;
Pulsed current, drain source [4 5]	$I_{D,pulse}$	-	-	35	A	T_C = 125 °C; I_G = 26.1 mA; See Figure 4;
Gate current, continuous [4 5 6]	$I_{G,avg}$	-	-	20	mA	T_j = -55 °C to 150 °C;
Gate current, pulsed [4 6]	$I_{G,pulse}$	-	-	2000	mA	T_j = -55 °C to 150 °C; t_{PULSE} = 50 ns, f=100 kHz
Gate source voltage, continuous [6]	V_{GS}	-10	-	-	V	T_j = -55 °C to 150 °C;
Gate source voltage, pulsed [6]	$V_{GS,pulse}$	-25	-	-	V	T_j = -55 °C to 150 °C; t_{PULSE} = 50 ns, f = 100 kHz; open drain
Power dissipation	P_{tot}	-	-	125	W	T_C = 25 °C
Operating temperature	T_j	-55	-	150	°C	

[1] All devices are 100% tested at I_{DS} = 12.2 mA to assure V_{DS} ≥ 800 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 ≤ 20 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}	-	-	1	°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 °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} = 2.6 mA; V_{DS} = 10 V; T_j =25 °C I_{DS} = 2.6 mA; V_{DS} = 10 V; T_j =125 °C
Gate-Source reverse clamping voltage	$V_{GS, clamp}$	-	-	-8	V	I_{GSS} = -1 mA
Drain-Source leakage current	I_{DSS}	- -	1 20	100 -	µA	V_{DS} = 600 V; V_{GS} = 0 V; T_j = 25 °C V_{DS} = 600 V; V_{GS} = 0 V; T_j = 150 °C
Drain-Source leakage current at application conditions[1]	I_{DSSapp}	-	60	-	µA	V_{DS} = 400 V; V_{GS} = 0 V; T_j = 125 °C
Drain-Source on-state resistance	$R_{DS(on)}$	- -	0.055 0.100	0.070 -	Ω	I_G = 26.1 mA; I_D = 8 A; T_j = 25 °C I_G = 26.1 mA; I_D = 8 A; T_j = 150 °C
Gate resistance	$R_{G,int}$	-	0.78	-	Ω	LCR impedance measurement; f = f_{res} ; open drain;

Table 6 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note/Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	380	-	pF	V_{GS} = 0 V; V_{DS} = 400 V; f = 1 MHz
Output capacitance	C_{oss}	-	72	-	pF	V_{GS} = 0 V; V_{DS} = 400 V; f = 1 MHz
Reverse Transfer capacitance	C_{rss}	-	0.3	-	pF	V_{GS} = 0 V; V_{DS} = 400 V; f = 1 MHz
Effective output capacitance, energy related [2]	$C_{o(er)}$	-	80	-	pF	V_{DS} = 0 to 400 V
Effective output capacitance, time related [3]	$C_{o(tr)}$	-	102.5	-	pF	V_{GS} = 0 V; V_{DS} = 0 to 400 V; Id = const
Output charge	Q_{oss}	-	41	-	nC	V_{DS} = 0 to 400 V
Turn- on delay time	$t_{d(on)}$	-	10	-	ns	see Figure 23
Turn- off delay time	$t_{d(off)}$	-	14	-	ns	see Figure 23
Rise time	t_r	-	8	-	ns	see Figure 23
Fall time	t_f	-	15	-	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 Coss while VDS is rising from 0 to 400 V
[3] $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as Coss while VDS 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	-	5.8	-	nC	I_{GS} = 0 to 10 mA; V_{DS} = 400 V; I_D = 8 A

Table 8 Reverse conduction characteristics

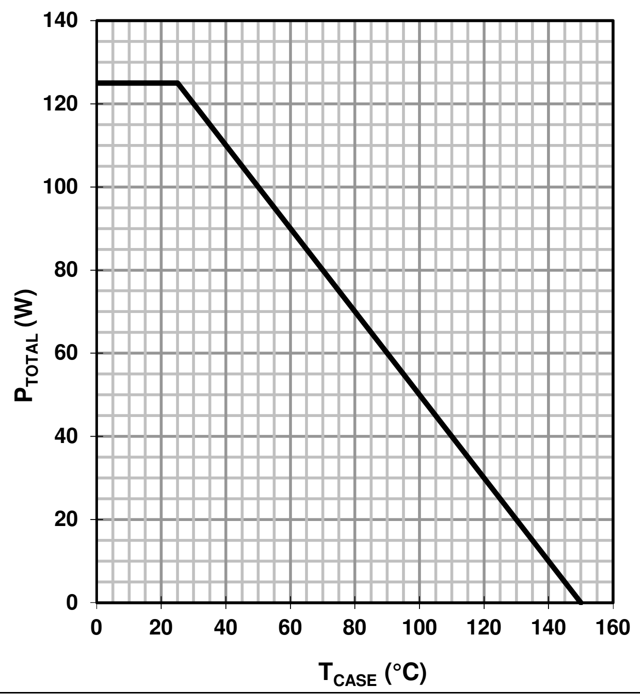
Parameter	Symbol	Values			Unit	Note/Test Condition
		Min.	Typ.	Max.		
Source-Drain reverse voltage	V_{SD}	-	2.2	2.5	V	V_{GS} = 0 V; I_{SD} = 8 A
Pulsed current, reverse	$I_{S,pulse}$	-	-	60	A	I_G = 26.1 mA
Reverse recovery charge	Q_{rr} [1]	-	0	-	nC	I_S = 8 A, V_{DS} = 400 V
Reverse recovery time	t_{rr}	-	0	-	ns	
Peak reverse recovery current	I_{rrm}	-	0	-	A	

[1] Excluding Qoss

4 Electrical characteristics diagrams

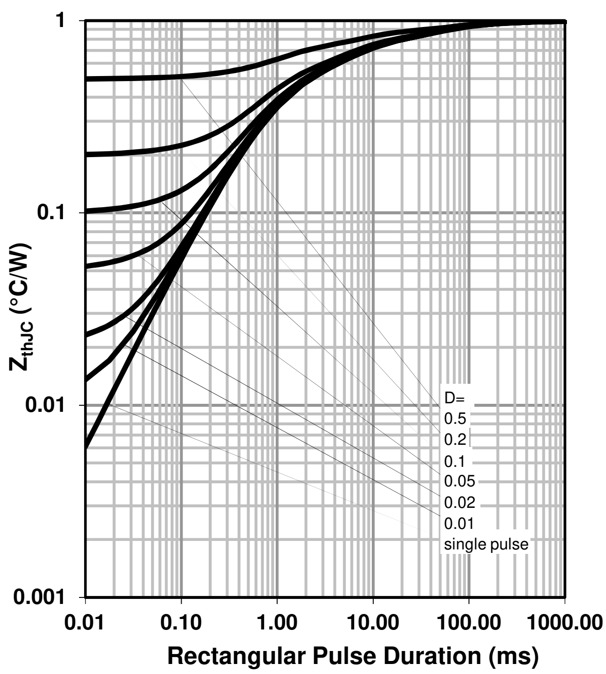
at T_j = 25 °C, unless specified otherwise

Figure 1 Power dissipation



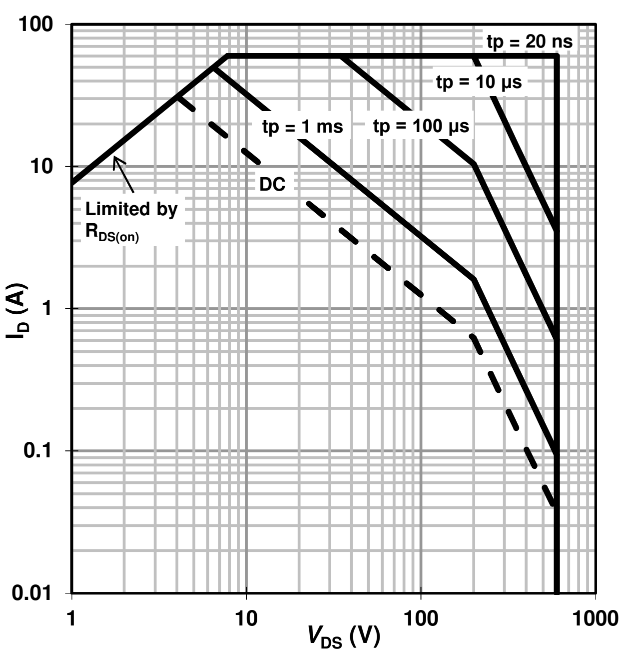
P_{tot}=f(T_c)

Figure 2 Max. transient thermal impedance



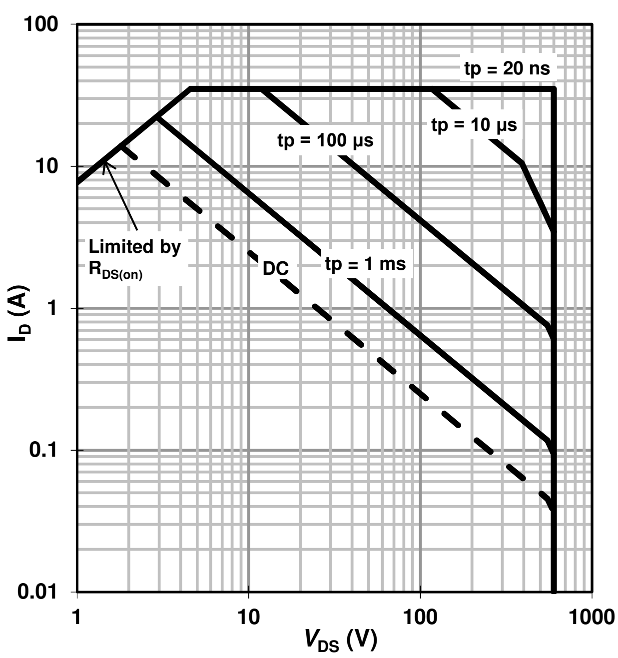
Z_{thJC}=f(t_p, D)

Figure 3 Safe operating area



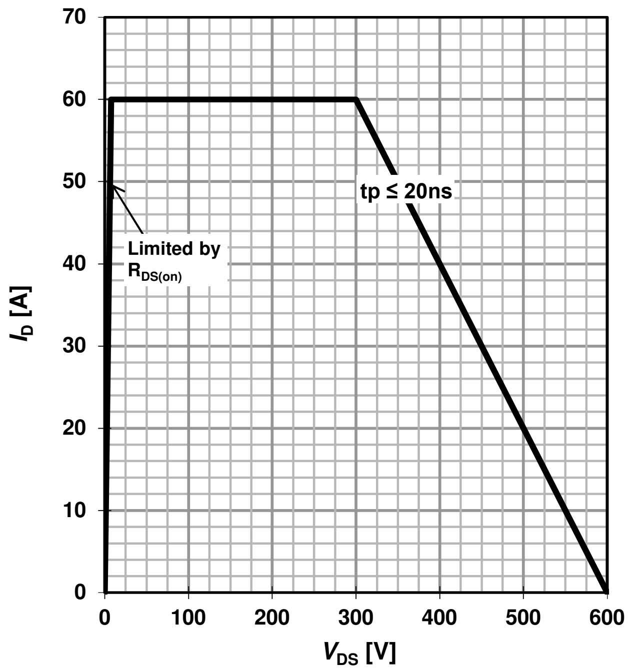
I_D=f(V_{DS}); T_C = 25 °C

Figure 4 Safe operating area



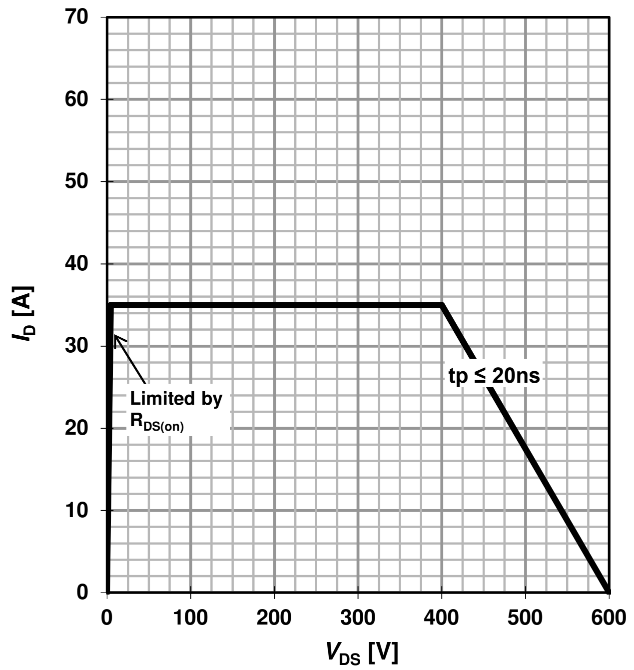
I_D=f(V_{DS}); T_C = 125 °C

Figure 5 Repetitive safe operating area[1]



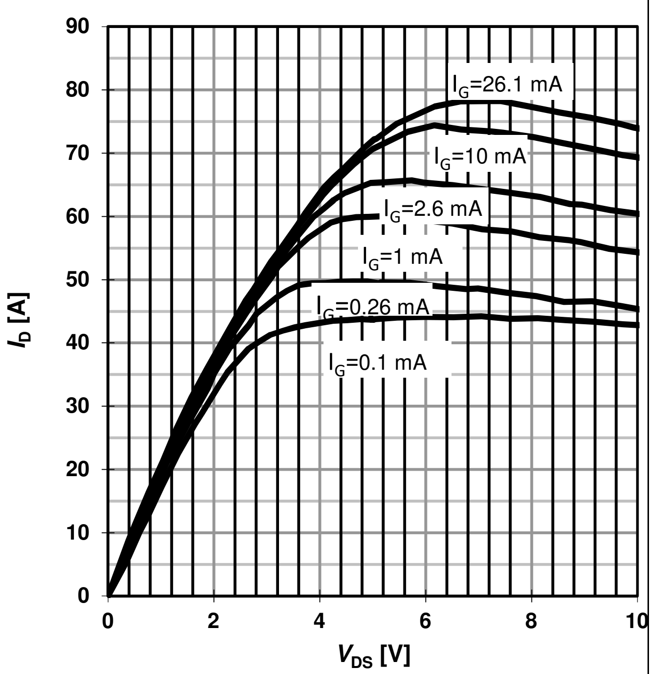
Tc = 25 °C; T_j ≤ 150 °C

Figure 6 Repetitive safe operating area[1]



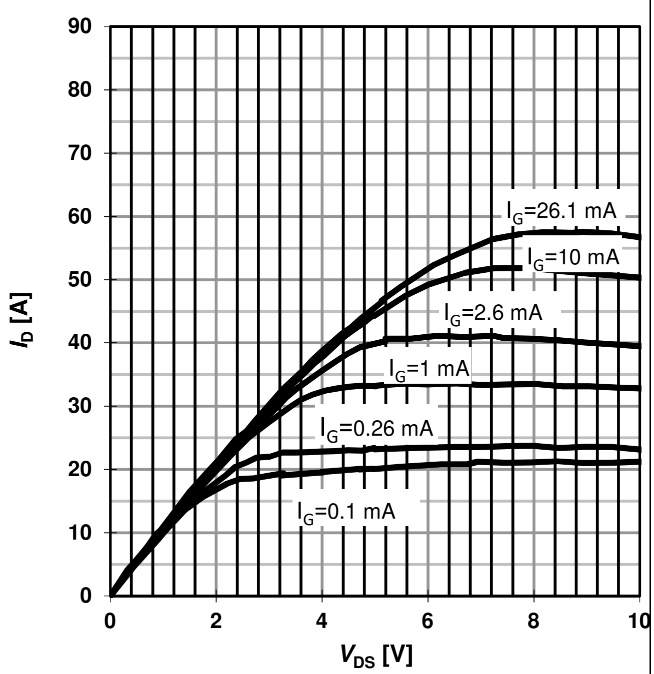
Tc = 125 °C; T_j ≤ 150 °C

Figure 7 Typ. output characteristics



$I_D=f(V_{DS},I_G)$; T_j = 25 °C

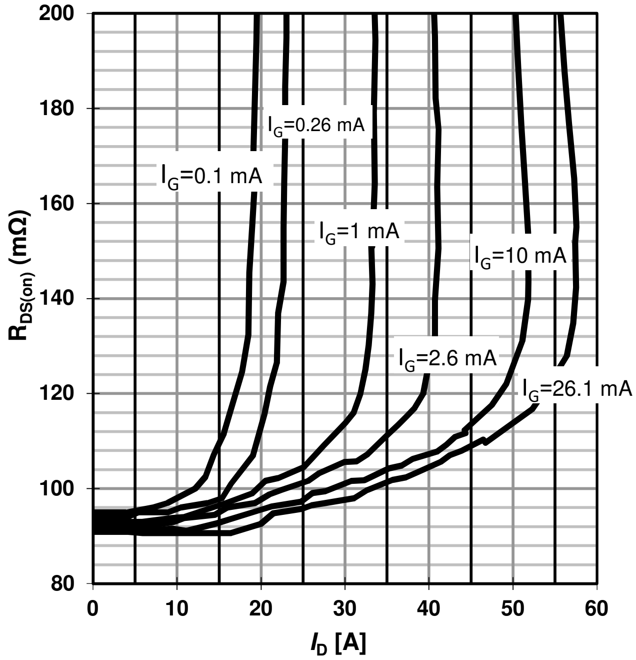
Figure 8 Typ. output characteristics



$I_D=f(V_{DS},I_G)$; T_j = 125 °C

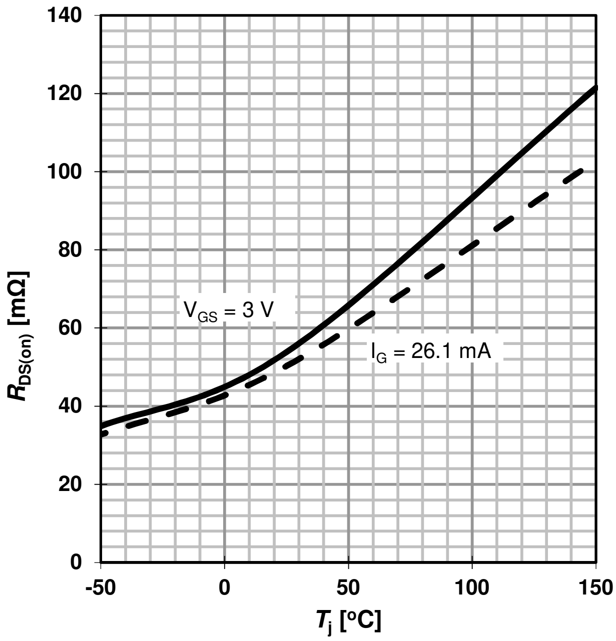
[1] Parameter is influenced by rel-requirements. Please contact the local Infineon Sales Office to get an assessment of your application.

Figure 9 Typ. Drain-source on-state resistance



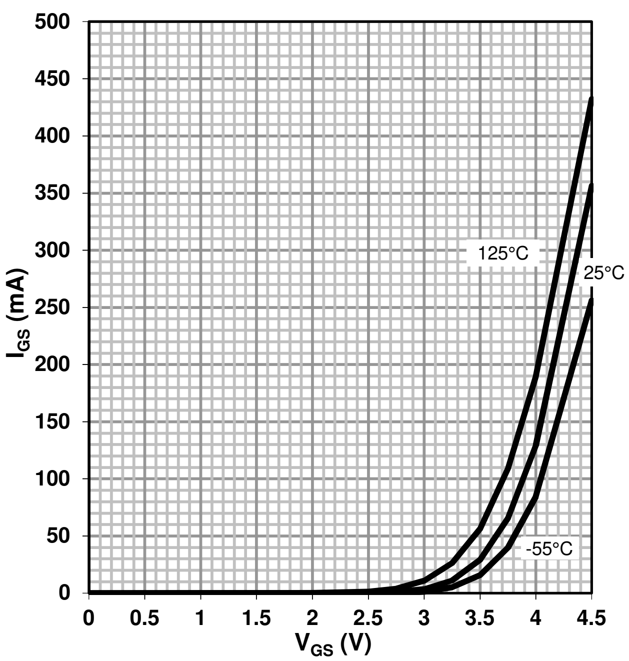
$R_{DS(on)}=f(I_D,I_G)$; T_j = 125 °C

Figure 10 Drain-source on-state resistance



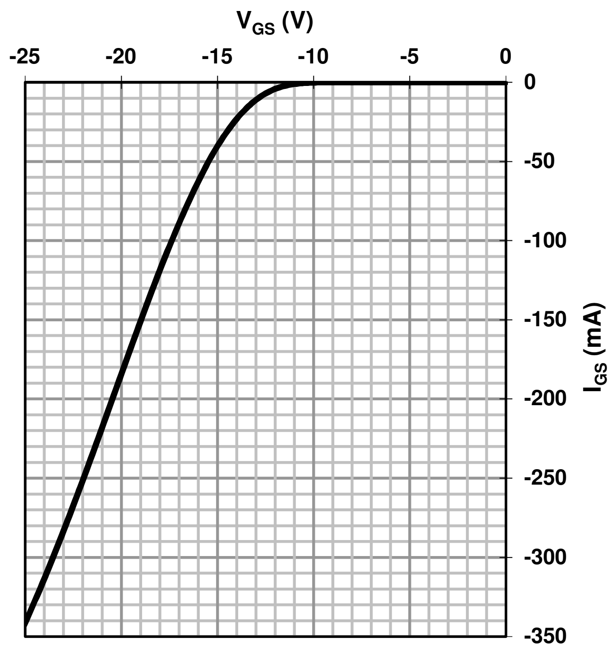
$R_{DS(on)}=f(T_j)$; I_D = 8 A

Figure 11 Typ. gate characteristics forward



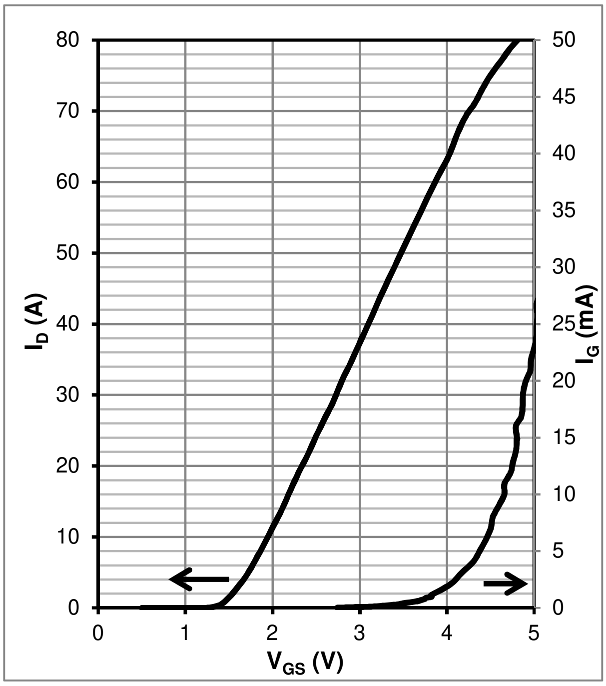
$I_{GS}=f(V_{GS},T_j)$; open drain

Figure 12 Typ. gate characteristics reverse



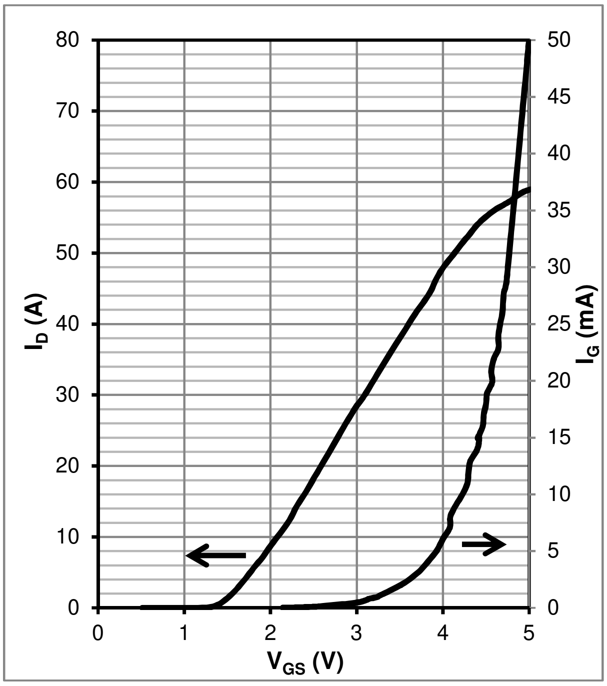
$I_{GS}=f(V_{GS})$; T_j = 25 °C

Figure 13 Typ. transfer characteristics



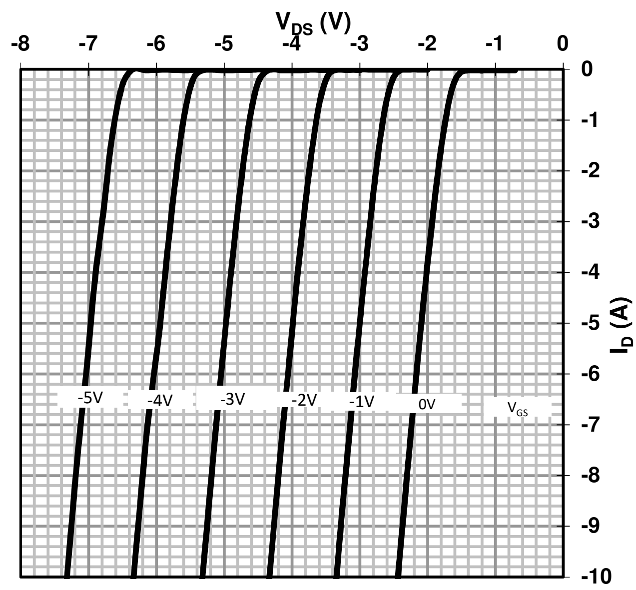
I_D, I_G = $f(V_{GS})$; V_{DS} = 8 V; T_j = 25 °C

Figure 14 Typ. transfer characteristics



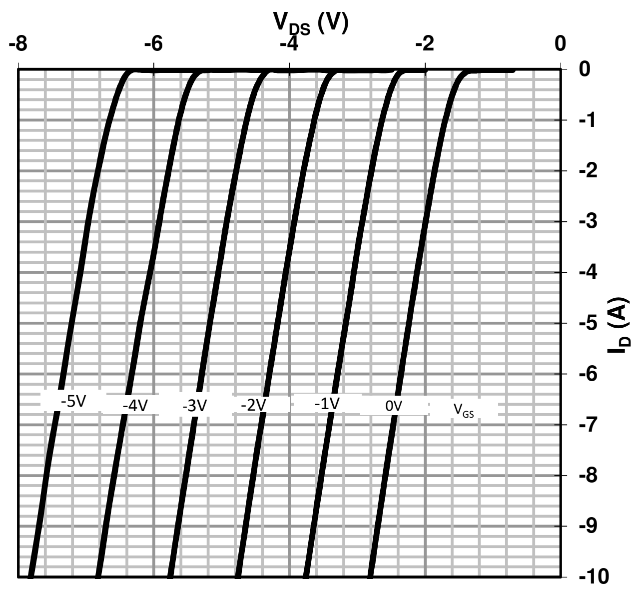
I_D, I_G = $f(V_{GS})$; V_{DS} = 8 V ; T_j = 125 °C

Figure 15 Typ. channel reverse characteristics



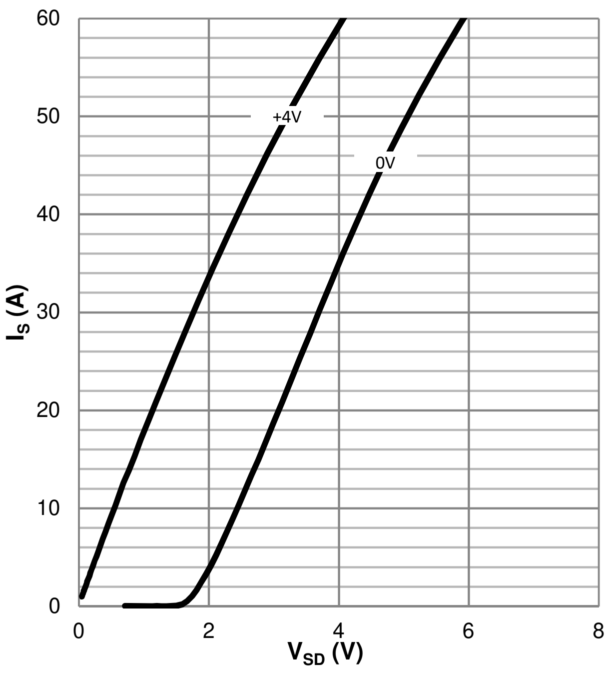
V_{DS} = $f(I_D, V_{GS})$; T_j = 25 °C

Figure 16 Typ. channel reverse characteristics



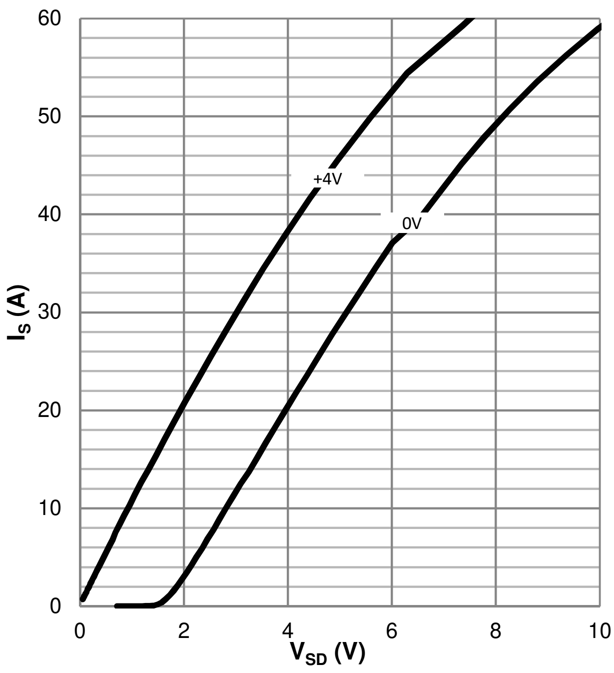
V_{DS} = $f(I_D, V_{GS})$; T_j = 125 °C

Figure 17 Typ. channel reverse characteristics



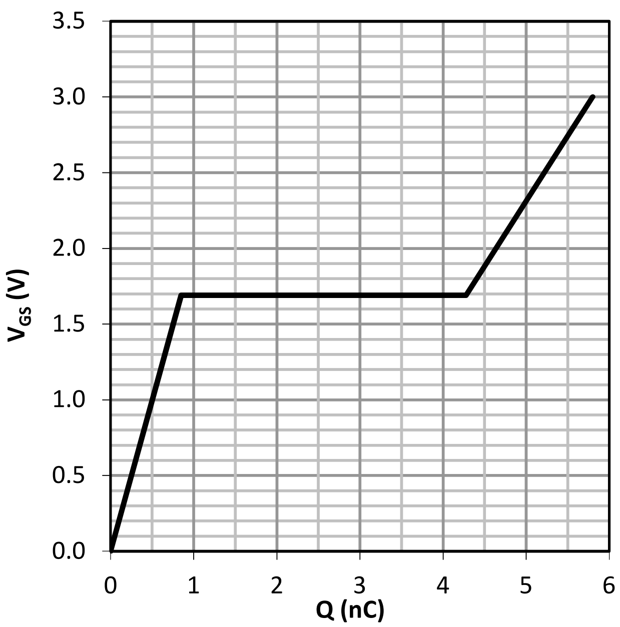
I_D=$f(V_{DS}, V_{GS})$; T_j = 25 °C

Figure 18 Typ. channel reverse characteristics



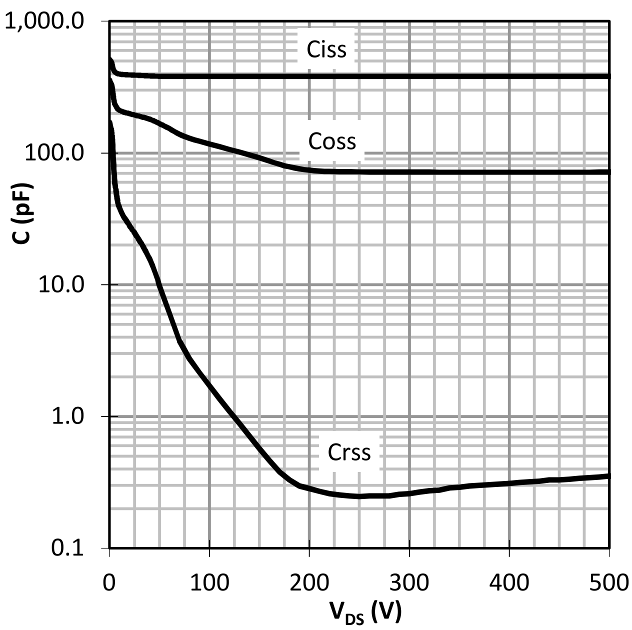
I_D=$f(V_{DS}, V_{GS})$; T_j = 125 °C

Figure 19 Typ. gate charge

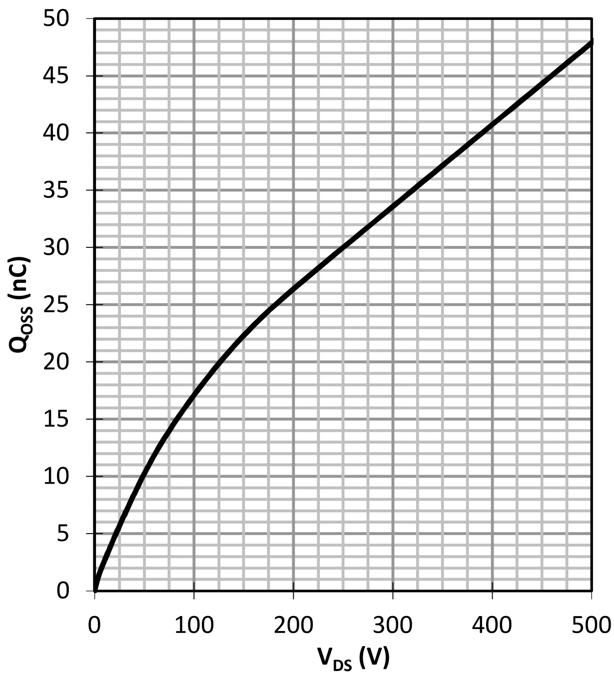
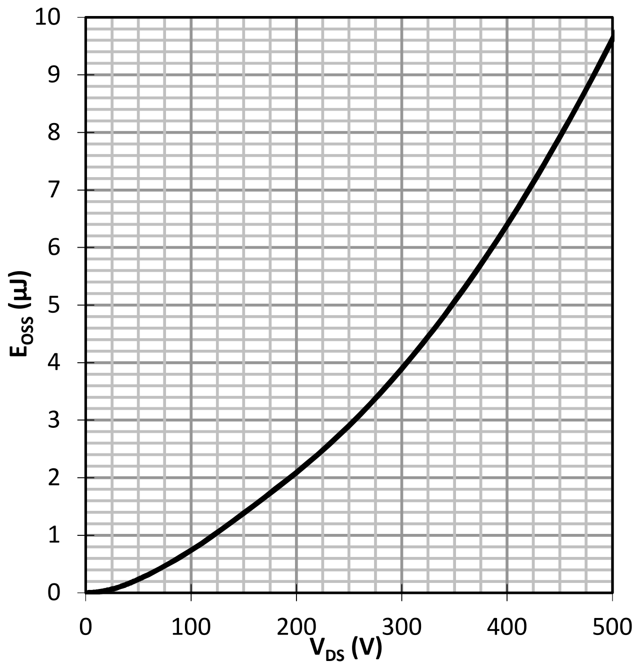


$V_{GS} = f(Q_G)$; V_{DCLINK} = 400 V; I_D = 8 A

Figure 20 Typ. capacitances

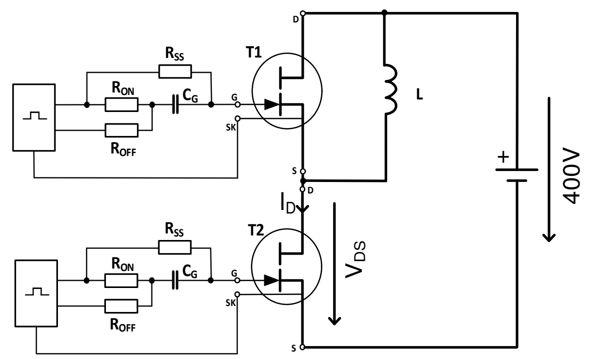


$C_{xss} = f(V_{DS})$

Figure 21 Typ. output charge	**Figure 22 Typ. Coss stored Energy**
	
$Q_{OSS} = f(V_{DS})$	$E_{OSS} = f(V_{DS})$

5 Test Circuits

Figure 23 Switching times with inductive load



I_D = 8A, R_{ON} = 5 Ω; R_{OFF} = 5 Ω; R_{SS} = 300 Ω;
C_G = 3.3 nF; V_{DRV} = 12V

Figure 24 Switching times waveform

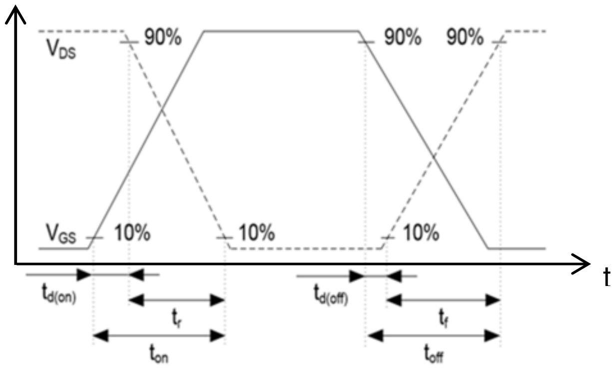
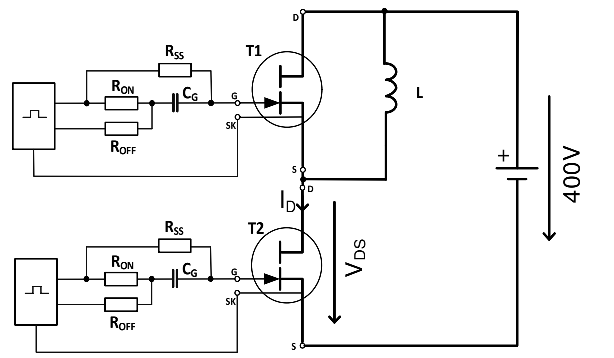
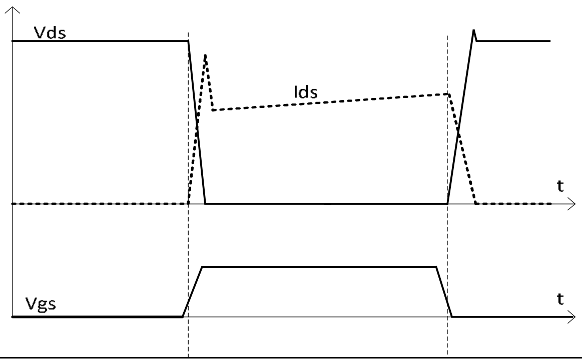


Figure 25 Reverse Channel Characteristics Test



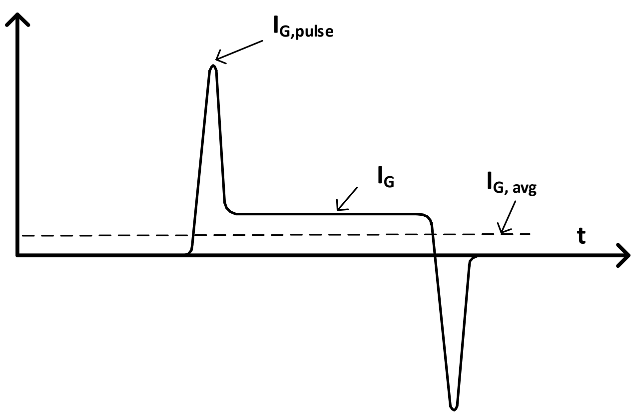
I_D = 8A, R_{ON} = 5 Ω; R_{OFF} = 5 Ω; R_{SS} = 300 Ω;
C_G = 3.3 nF; V_{DRV} = 12V

Figure 26 Typical Reverse Channel Recovery

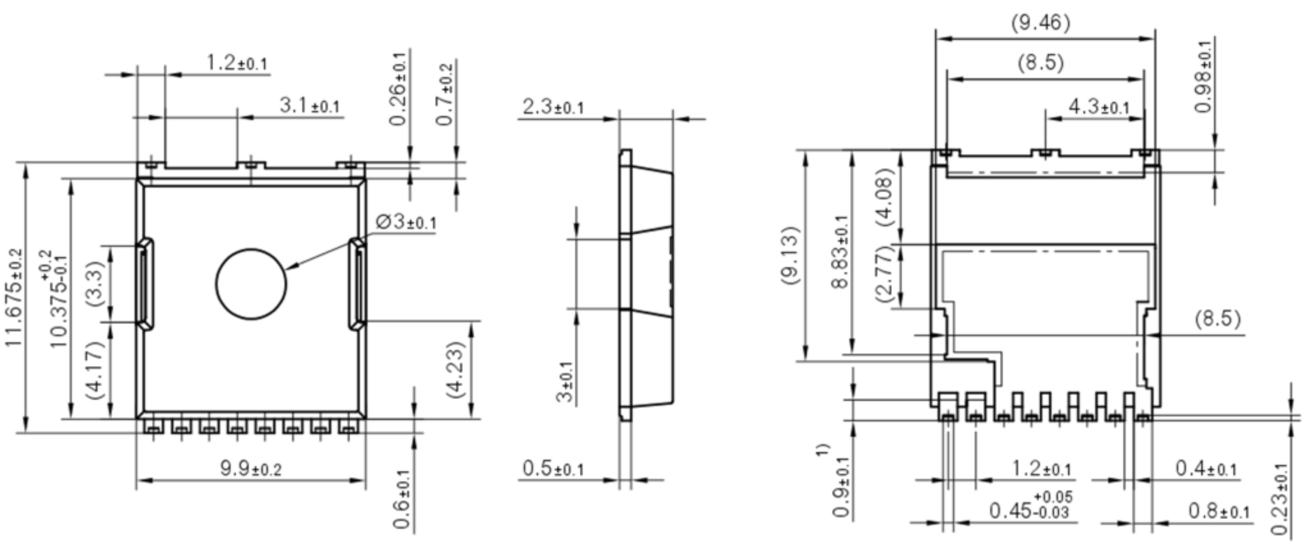


The recovery charge is Q_{OSS} only, no additional Q_{rr}

Figure 27 Gate current switching waveform



6 Package Outlines



1) LEAD LENGTH UP TO ANTI FLASH PROFILE, MOLD FLASHES EXCLUDED.
ALL DIMENSIONS ARE IN UNITS MM
THE DRAWING IS IN COMPLIANCE WITH ISO 128 & PROJECTION METHOD 1 [ ]

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
2.0	2018-04-24	Final version release
2.1	2018-10-12	Updated application section; added Appendix A and Fig. 27; updated maximum rating table footnotes, switching times and figures.
2.11	2020-01-16	Added $V_{DS,bd}$, $V_{DS,pulse}$, $V_{DS,surge}$ specifications in maximum ratings table of page3
2.12	2020-05-29	Updated to MSL1 in table 4
2.13	2021-04-27	Updated I_{GSS} specification at 125°C to -2 mA in table 5; updated switching times and related test conditions
2.14	2021-10-26	Replaced I_{GSS} specification with $V_{GS, clamp}$ in table 5

We Listen to Your Comments
Any information within this document that you feel is wrong, unclear or missing at all? Your feedback will help us to continuously improve the quality of this document. Please send your proposal (including a reference to this document) to: erratum@infineon.com

Published by
Infineon Technologies AG
81726 München, Germany

Information
For further information on technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies Office (www.infineon.com).

Warnings
Due to technical requirements, components may contain dangerous substances. For information on the types in question, please contact the nearest Infineon Technologies Office.
The Infineon Technologies component described in this Data Sheet may be used in life-support devices or systems and/or automotive, aviation and aerospace applications or systems only with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support, automotive, aviation and aerospace device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.