

CoolGaN™ BDS 650 V G5

TOLT

CoolGaN™ Bi-directional switch, enhancement-mode

Infineon's CoolGaN™ Bi-Directional Switch (BDS) is an innovative solution in gallium nitride (GaN) transistor technology. The CoolGaN™ BDS 650 V G5 enables efficient voltage blocking in both directions, making it a versatile option for a wide range of applications. The CoolGaN™ BDS monolithically integrates a substrate voltage control circuit, thanks to Infineon's proprietary technology: this reduces design complexity. IGLT65R055B2 is offered in Infineon's TOLT, top-side cooling package specially designed to enable the highest power densities for power-demanding industrial applications.

Features

- 650 V CoolGaN™ technology with 850 V_{SS} surge immunity
- Superior rugged Gate Injection Transistor (GIT) structure
- Dual-gate for independent bi-directional functionality
- Superior performance of R_{SS(on)} over operating frequency
- Reliable Thermal Cycling on-Board (TCOB) performance
- Optimized for soft switching operation
- 2 kV HBM ESD standard

Benefits

- Effective replacement of back-to-back uni-directional products
- Improves system efficiency and power density
- Enables higher switching frequency
- System cost reduction
- Enables new single stage isolated topologies

Potential applications

- Cycloconverter in solar μ-inverter
- Vienna type rectifier in industrial/server SMPS and UPS
- T-type PFC, inverter in motor drives
- HERIC Inverter in string solar inverter

Product validation

Fully qualified according to JEDEC for Industrial Applications

Please note: Preliminary Datasheet to change without further notice.

Please note: The substrate thermal pad is for thermal coupling only, it should be electrically isolated from any electrical node in the system via isolation material.

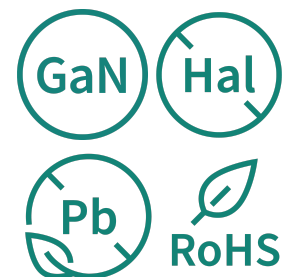
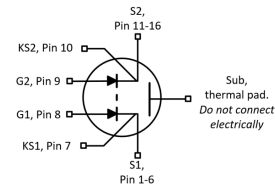
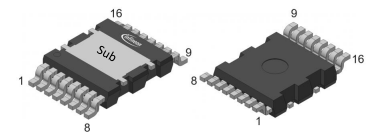


Table 1 Key performance parameters

Parameter	Value	Unit
V _{SS,cont}	340	V _{AC}
R _{SS(on),typ}	55	mΩ
Q _{GxSx,diode}	5.4	nC
I _{SS,pulse}	±73	A
Q _{oss} @ 400 V _{SS} (switch)	72	nC

Part number	Package	Marking	Related links
IGLT65R055B2	PG-HDSOP-16	65R055B2	see Appendix A

Table of contents

Description	1
Maximum ratings	3
Thermal characteristics	4
Electrical characteristics	5
Electrical characteristics diagrams	7
Test circuits	12
Modes of operation	13
Package outlines	14
Appendix A	16
Revision history	17
Trademarks	17
Disclaimer	17

1 Maximum ratings

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

Table 2 Maximum ratings

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Source-to-source voltage, continuous	$V_{SS,cont}$	-	-	340	V_{AC}	$V_{GS}=0\text{ V}$
Source-to-source voltage, transient	$V_{SS,trans}$	-	-	650	V	$t_{TRANS}=5\text{ ms}$; $V_{GS}=0\text{ V}$
Source-to-source voltage, surge	$V_{SS,surge}$	-	-	850	V	$t_{SURGE}=1\text{ }\mu\text{s}$; $V_{GS}=0\text{ V}$
Source-to-source AC line frequency	f_{SS}	TBD	-	-	Hz	$V_{SS}=305\text{ V}_{AC}$; $\pm 431\text{ V}_{pk}$
RMS current, source-to-source	$I_{SS,RMS}$	-21.8 -14	-	21.8 14	A	$T_C=25^\circ\text{C}$; $T_C=125^\circ\text{C}$; $T_j=T_{j,max}$
Pulsed current, source-to-source	$I_{SS,pulse}$	-73.6 -45	-	73.6 45	A	$T_j=25^\circ\text{C}$; $I_{GS}=30.0\text{ mA}$ $T_j=125^\circ\text{C}$; $I_{GS}=30.0\text{ mA}$
Gate current, steady state (single gate)	$I_{G,ss}$	-	-	30.0	mA	$T_j=-40^\circ\text{C}$ to $T_j=150^\circ\text{C}$; see Table 8
Gate current, pulsed (single gate) ¹⁾	$I_{G,pulse}$	-	-	3000	mA	$T_j=-40^\circ\text{C}$ to $T_j=150^\circ\text{C}$; $t_{PULSE}=50\text{ ns}$, $f=100\text{ kHz}$; see Table 8
Gate source voltage, continuous ¹⁾	V_{GS}	-10	-	-	V	$T_j=-40^\circ\text{C}$ to $T_j=150^\circ\text{C}$; see Table 8
Gate source voltage, pulsed ¹⁾	$V_{GxSx,pulse}$	-25	-	-	V	$T_j=-40^\circ\text{C}$ to $T_j=150^\circ\text{C}$; $t_{PULSE}=50\text{ ns}$, $f=100\text{ kHz}$; open source
Power dissipation	P_{tot}	-	-	135	W	$T_C=25^\circ\text{C}$
Operating junction temperature	T_j	-40	-	150	$^\circ\text{C}$	$T_j=125^\circ\text{C}$; $V_{GySy}=3\text{ V}$; see Diagram 5, 6
Storage temperature	T_{stg}	-40	-	150	$^\circ\text{C}$	Max shelf life depends on storage conditions
Source-to-source voltage slew-rate	dv/dt	-	-	20	V/ns	-

¹⁾ We recommend using an advanced driving technique to optimize the device performance. Please see gate drive application note for more details.

2 Thermal characteristics

Table 3 Thermal characteristics

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}	-	-	0.92	°C/W	-
Thermal resistance, junction - ambient	R_{thJA}	-	-	TBD	°C/W	Device on PCB, minimum footprint
Thermal resistance, junction - ambient for SMD version	R_{thJA}	-	-	TBD	°C/W	Device on 40 mm*40 mm*1.5 mm epoxy PCB FR4 with 6 cm ² (one layer, 70 μm thickness) copper area. PCB is vertical without air stream cooling.
Reflow soldering temperature	T_{sold}	-	-	260	°C	reflow MSL3

3 Electrical characteristics

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

Table 4 Gate characteristics

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Gate threshold voltage: switch mode (OFF) to diode mode	$V_{GxSx(th), diode}$	0.8 TBD	1.15 0.95	1.6 TBD	V	$I_{SS}=3.0\text{ mA}$; $V_{GySy}=0\text{ V}$; $V_{SS}=10\text{ V}$; $T_j=25^\circ\text{C}$; $I_{SS}=3.0\text{ mA}$; $V_{GySy}=0\text{ V}$; $V_{SS}=10\text{ V}$; $T_j=125^\circ\text{C}$; see Table 9
Gate threshold voltage: diode mode to switch mode (ON)	$V_{GxSx(th), switch}$	0.7 TBD	1.00 0.83	1.5 TBD	V	$I_{SS}=3.0\text{ mA}$; $I_{GySy}=5\text{ mA}$; $V_{SS}=10\text{ V}$; $T_j=25^\circ\text{C}$; $I_{SS}=3.0\text{ mA}$; $I_{GySy}=5\text{ mA}$; $V_{SS}=10\text{ V}$; $T_j=125^\circ\text{C}$; see Table 9
Gate-Source reverse clamping voltage	$V_{GS, clamp}$	-8	-	-	V	$I_{GS,ss}=-1\text{ mA}$
Gate charge: diode mode to switch mode (ON)	$Q_{GxSx, switch}$	-	5.4	-	nC	$V_{GxSx}=0\text{ to }3\text{ V}$; $I_{GySy}=5\text{ mA}$; $V_{SS}=400\text{ V}$, $I_{SS}=9\text{ A}$
Gate resistance	$R_{GS, int}$	-	1	-	Ω	LCR impedance measurement; $f=f_{res}$

Table 5 On-state characteristics

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Source-to-source on-state resistance	$R_{SS(on)}$	-	55 103	70 -	m Ω	$I_{GS}=30.0\text{ mA}$; $I_{SS}=9\text{ A}$; $T_j=25^\circ\text{C}$ $I_{GS}=30.0\text{ mA}$; $I_{SS}=9\text{ A}$; $T_j=150^\circ\text{C}$

Table 6 Dynamic characteristics - switch mode, see Table 10

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Input capacitance: switch mode	$C_{iss, switch}$	-	346	-	pF	$V_{GS}=0\text{ V}$; $V_{SS}=400\text{ V}$; $f=1\text{ MHz}$
Output capacitance: switch mode	$C_{oss, switch}$	-	147	-	pF	
Reverse Transfer capacitance: switch mode	$C_{rss, switch}$	-	3	-	pF	
Effective output capacitance, energy related: switch mode ²⁾	$C_{o(er), switch}$	-	166	-	pF	$V_{GS}=0\text{ V}$; $V_{SS}=400\text{ V}$
Effective output capacitance, time related: switch mode ³⁾	$C_{o(tr), switch}$	-	180	-	pF	$V_{GS}=0\text{ V}$; $V_{SS}=0\text{ to }400\text{ V}$; $I_{SS}=\text{const}$
Output charge: switch mode	$Q_{oss, switch}$	-	72	-	nC	$V_{GS}=0\text{ V}$; $V_{SS}=400\text{ V}$

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

Table 7 Dynamic characteristics - diode mode, see Table 11

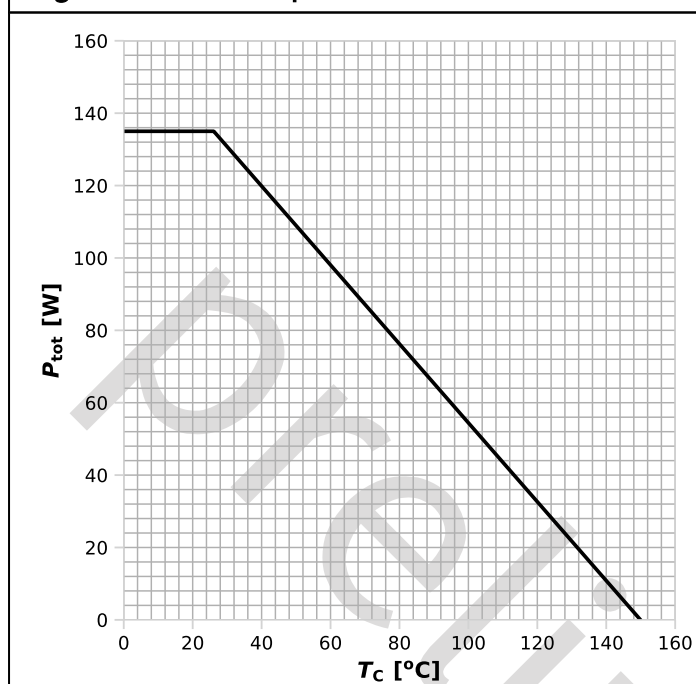
Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Input capacitance: diode mode	$C_{iss,diode}$	-	351	-	pF	$V_{GxSx}=0\text{ V}; V_{GySy}=3\text{ V}; V_{SySx}=400\text{ V};$ $f=1\text{ MHz}$
Output capacitance: diode mode	$C_{oss,diode}$	-	172	-	pF	
Reverse Transfer capacitance: diode mode	$C_{rss,diode}$	-	4	-	pF	
Effective output capacitance, energy related: diode mode ⁴⁾	$C_{o(er),diode}$	-	198	-	pF	$V_{GxSx}=0\text{ V}; V_{GySy}=3\text{ V}; V_{SySx}=400\text{ V}$
Effective output capacitance, time related: diode mode ⁵⁾	$C_{o(tr),diode}$	-	224	-	pF	$V_{GxSx}=0\text{ V}; V_{GySy}=3\text{ V};$ $V_{SySx}=0\text{ to }400\text{ V}; I_{SS}=\text{const}$
Output charge: diode mode	$Q_{oss,diode}$	-	90	-	nC	$V_{GxSx}=0\text{ V}; V_{GySy}=3\text{ V}; V_{SySx}=400\text{ V}$

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

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

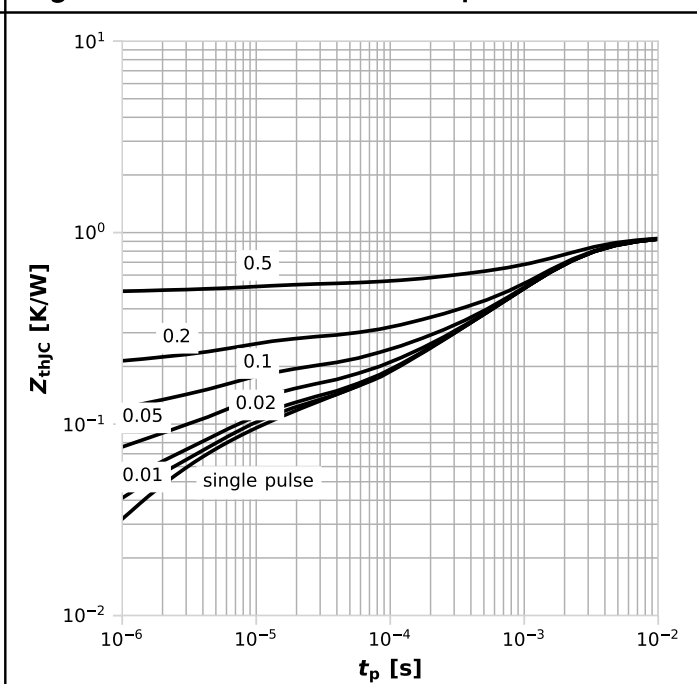
4 Electrical characteristics diagrams

Diagram 1: Power dissipation



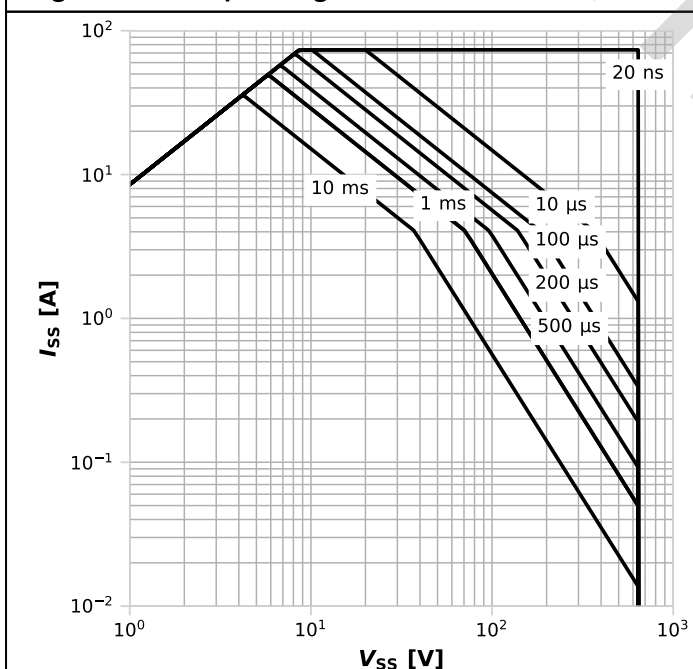
$$P_{\text{tot}} = f(T_c)$$

Diagram 2: Max. transient thermal impedance



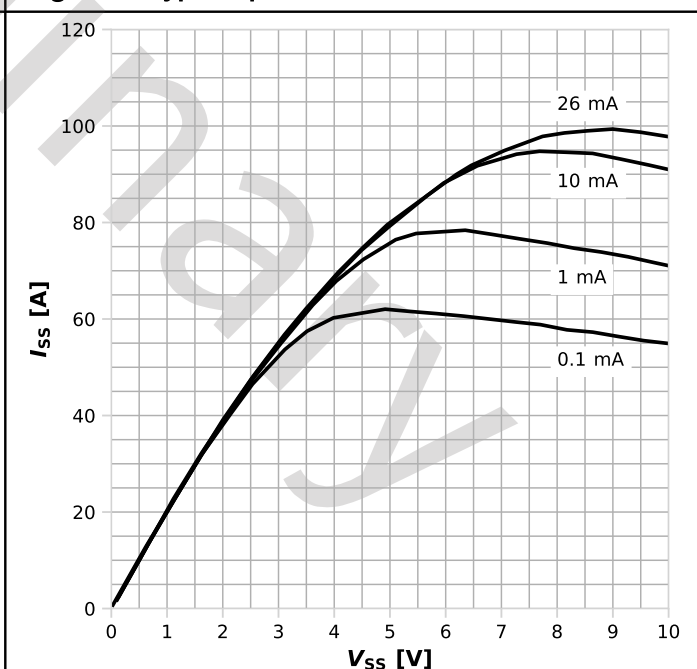
$$Z_{\text{thJC}} = f(t_p); \text{ parameter: } D = t_p / T$$

Diagram 3: Safe operating area



$$I_{\text{SS}} = f(V_{\text{SS}}); T_c = 25^\circ\text{C}; D = 0; \text{ parameter: } t_p$$

Diagram 4: Typ. output characteristics



$$I_{\text{SS}} = f(V_{\text{SS}}); V_{\text{GSy}} = 3 \text{ V}; T_j = 25^\circ\text{C}; \text{ parameter: } I_{\text{GxSx}}$$

Diagram 5: Typ. output characteristics

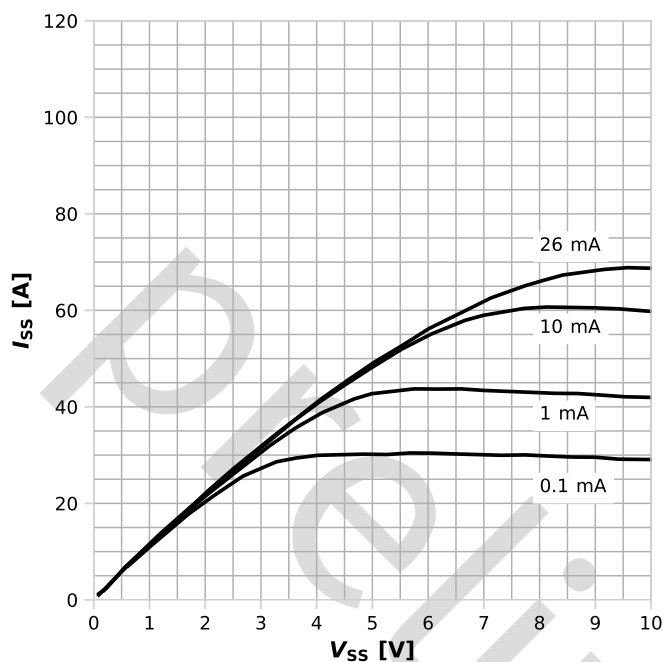

 $I_{SS}=f(V_{SS}); V_{GSy}=3\text{ V}; T_j=125^\circ\text{C}; \text{parameter: } I_{GxSx}$

Diagram 6: Typ. source on-state resistance

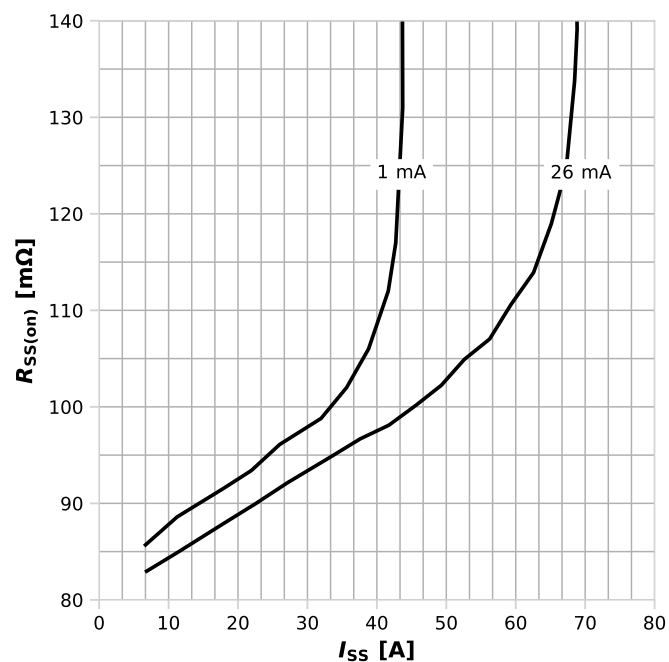

 $R_{SS(on)}=f(I_{SS}); V_{GSy}=3\text{ V}; T_j=125^\circ\text{C}; \text{parameter: } I_{GxSx}$

Diagram 7: Typ. source-source on-state resistance

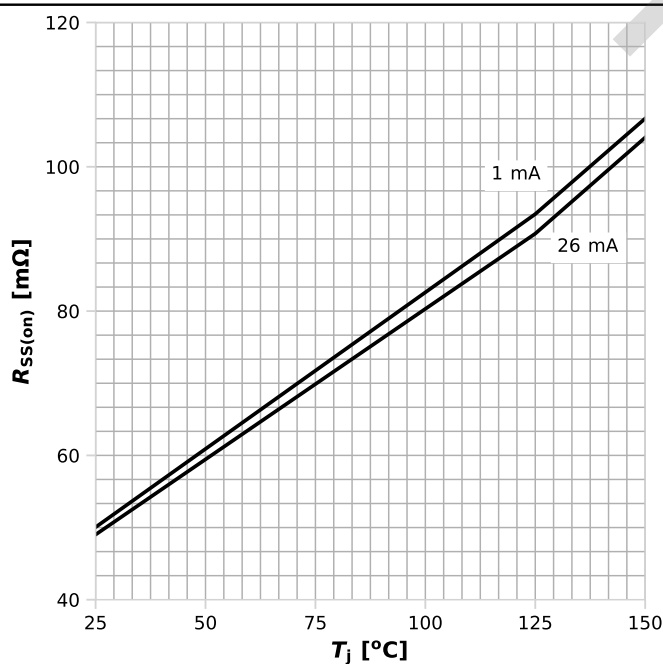

 $R_{SS(on)}=f(T_j); V_{GSy}=3\text{ V}; I_{SS}=20\text{ A}; \text{parameter: } I_{GxSx}$

Diagram 8: Typ. gate characteristics forward

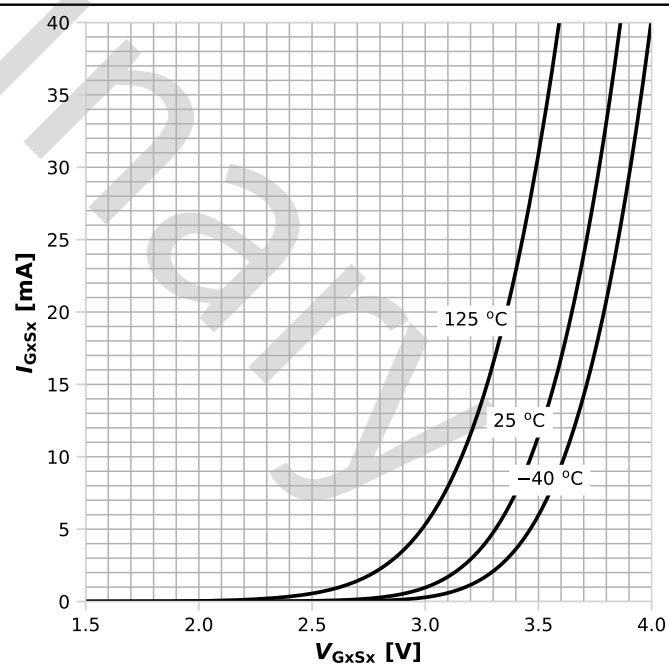
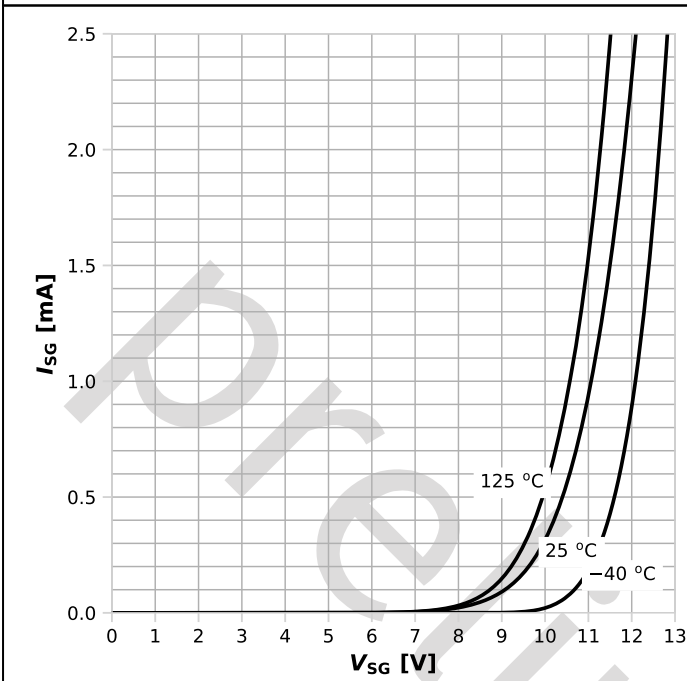
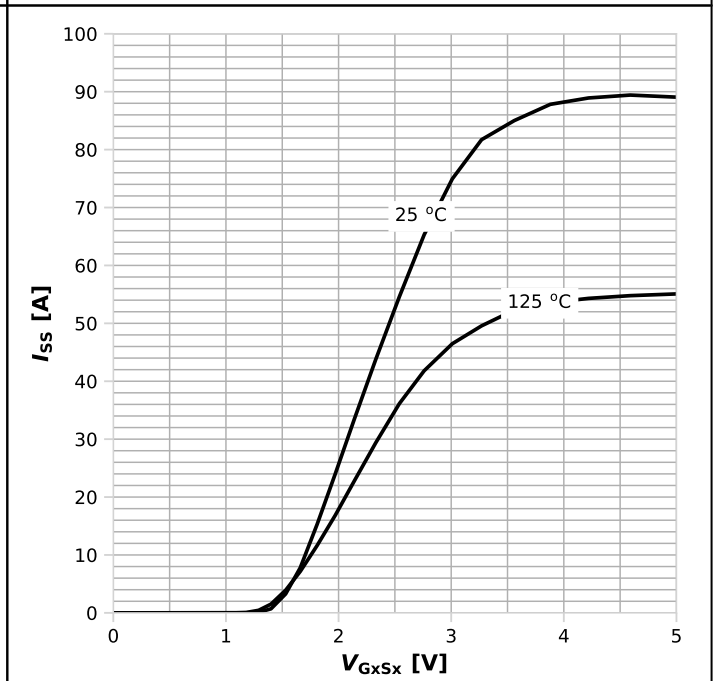

 $I_{GS}=f(V_{GxSx}); \text{open } S_y, G_y; \text{parameter: } T_j$

Diagram 9: Typ. gate characteristics reverse



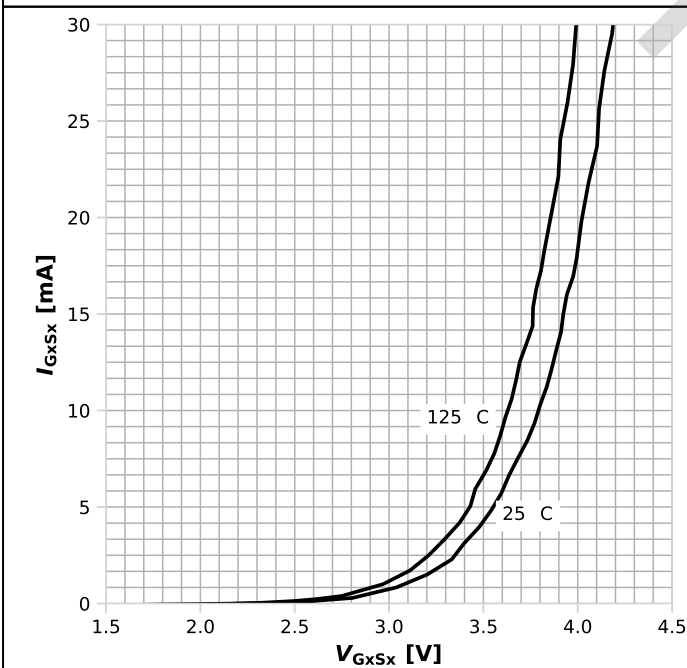
$I_{SG}=f(V_{SG})$; parameter: T_j

Diagram 10: Typ. transfer characteristics



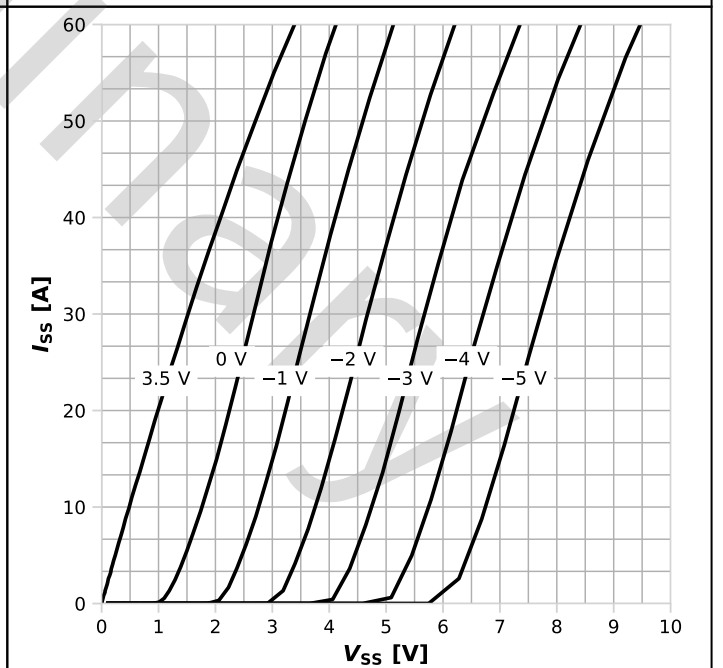
$I_{SS}=f(V_{GxSx})$; $V_{GySy}=3\text{ V}$; $V_{SS}=8\text{ V}$; parameter: T_j

Diagram 11: Typ. transfer gate current characteristics



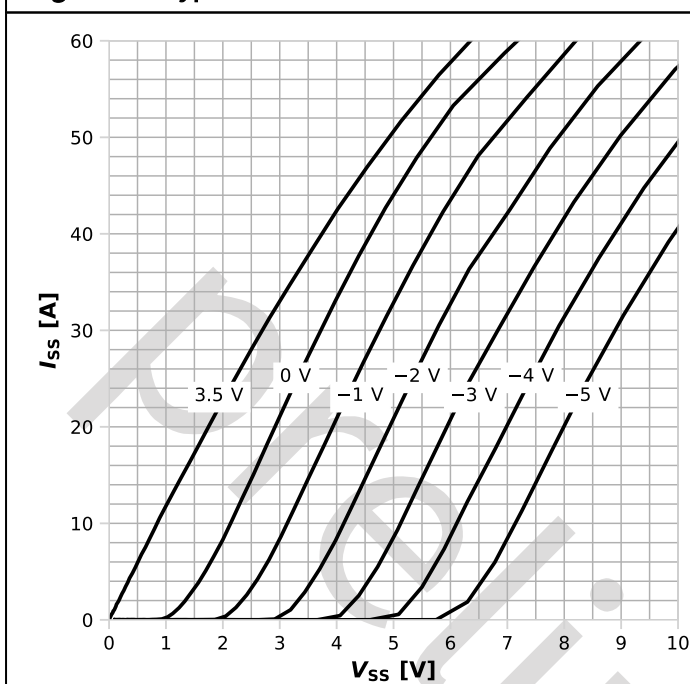
$I_{GxSx}=f(V_{GxSx})$; $V_{GySy}=3\text{ V}$; $V_{SS}=8\text{ V}$; parameter: T_j

Diagram 12: Typ. channel reverse characteristics



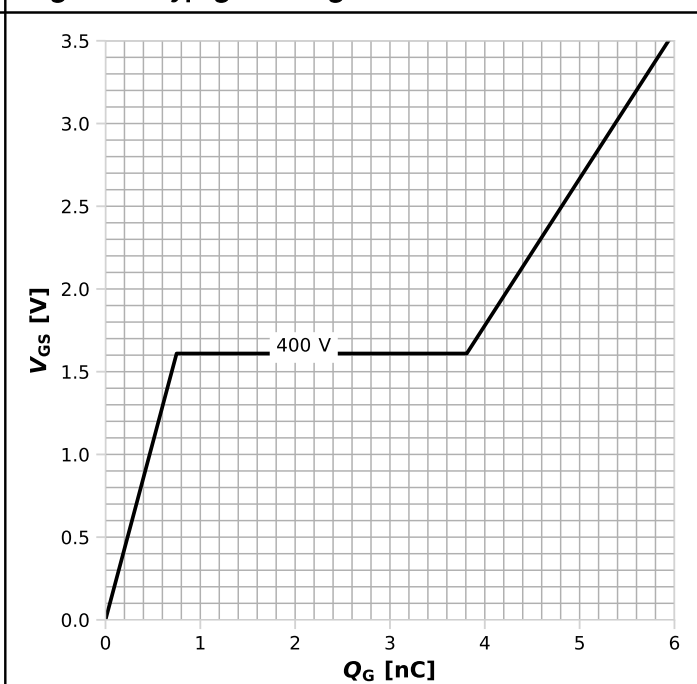
$I_{SS}=f(V_{SS})$; $I_{GySy}=37\text{ mA}$; $T_j=25^\circ\text{C}$; parameter: V_{GxSx}

Diagram 13: Typ. channel reverse characteristics



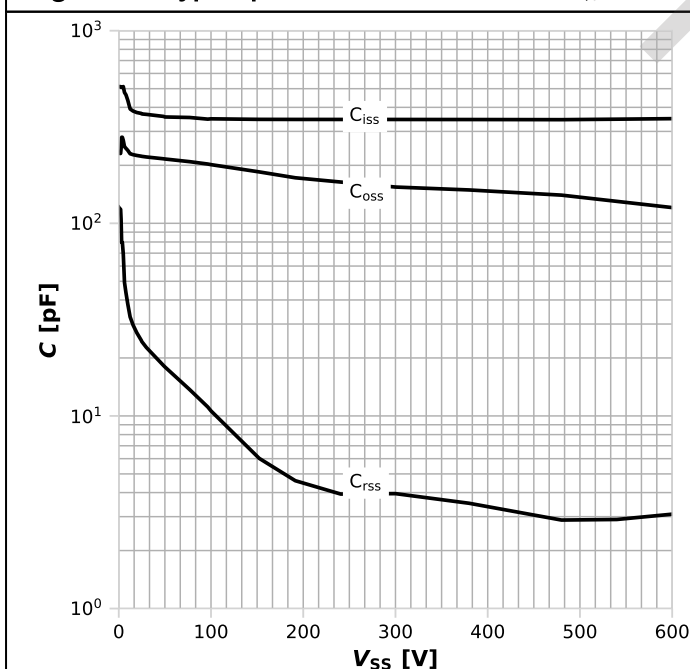
$I_{SS}=f(V_{SS})$; $I_{GySy}=37\text{ mA}$; $T_j=125^\circ\text{C}$; parameter: V_{GxSx}

Diagram 14 Typ. gate charge



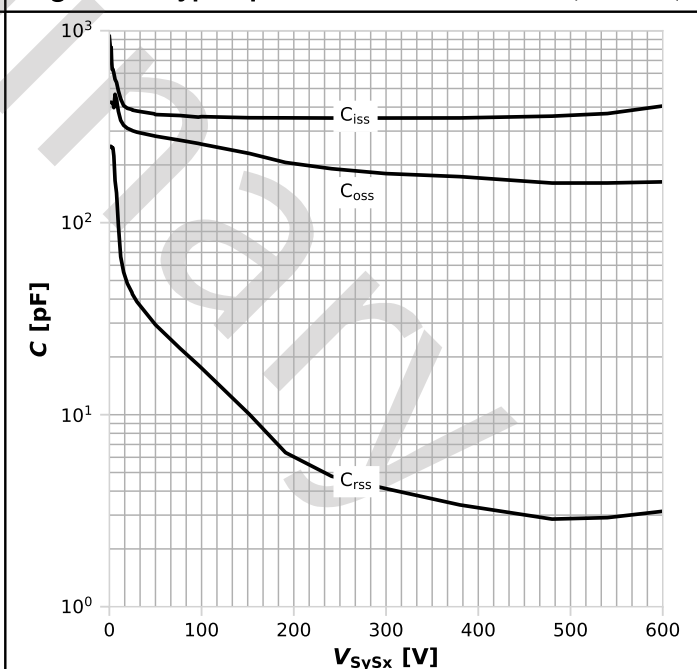
$V_{GxSx}=f(Q_G)$; $V_{GySy}=3\text{ V}$; $I_{SS}=9.3\text{ A}$ pulsed; parameter: V_{SS}

Diagram 15: Typ. capacitances in switch mode (OFF-OFF)



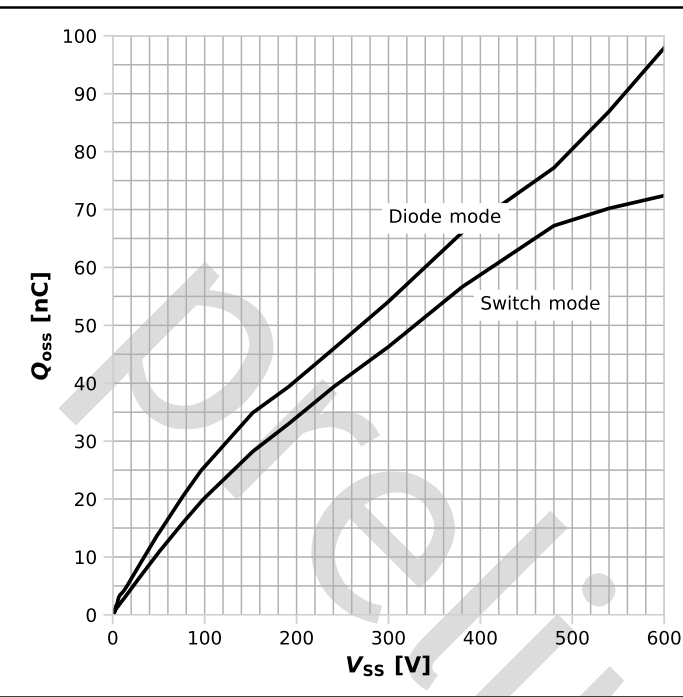
$C_{zss}=f(V_{SS})$; $V_{GS}=0\text{ V}$

Diagram 16: Typ. capacitances in diode mode (ON-OFF)



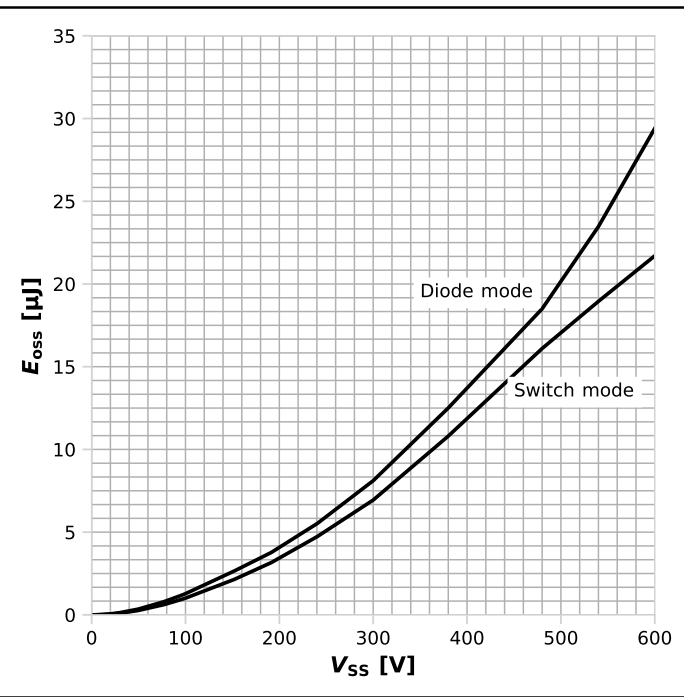
$C_{zss}=f(V_{SySx})$; $V_{GySy}=3\text{ V}$; $V_{GxSx}=0\text{ V}$

Diagram 17: Typ. output charge



$Q_{oss}=f(V_{ss})$; parameter: modes

Diagram 18: Typ. Coss stored Energy



$E_{oss}=f(V_{ss})$; parameter: modes

5 Test circuits

Table 8 Gate current switching waveform

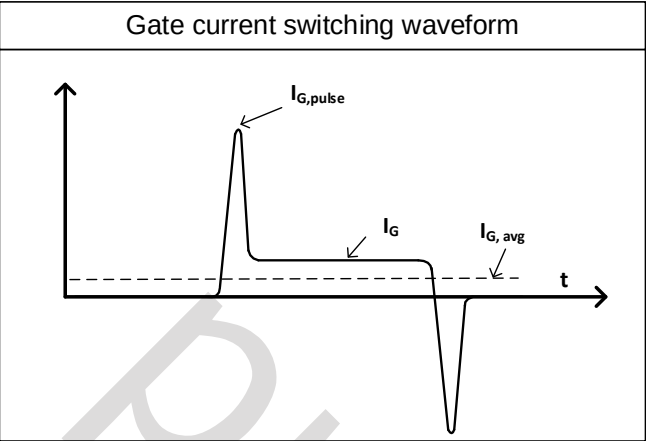
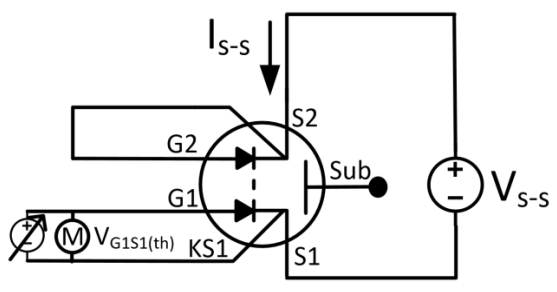
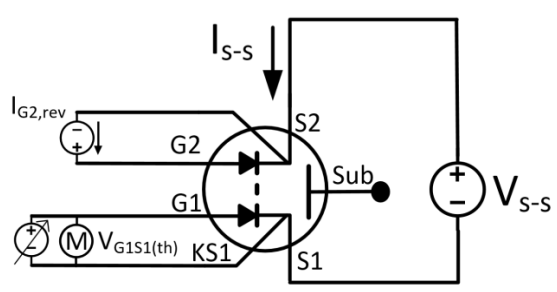


Table 9 Test condition

$V_{GXSX(th)}$ test condition (diode mode)	$V_{GXSX(th)}$ test condition (switch mode)
 The diagram shows a CoolGaN device in diode mode. The source (S1) is connected to ground, and the drain (S2) is connected to a positive voltage source V_{S-S}. A current I_{S-S} flows from the drain to the source. The gate (G1) is connected to a voltage source $V_{G1S1(th)}$ through a meter M and a switch $KS1$. The gate (G2) is connected to the drain (S2) through a resistor.	 The diagram shows the CoolGaN device in switch mode. The source (S1) is connected to ground, and the drain (S2) is connected to a positive voltage source V_{S-S}. A current I_{S-S} flows from the drain to the source. The gate (G1) is connected to a voltage source $V_{G1S1(th)}$ through a meter M and a switch $KS1$. The gate (G2) is connected to the drain (S2) through a resistor, and a reverse gate current $I_{G2,rev}$ is indicated flowing from the gate to the drain.

6 Modes of operation

Table 10 Switch mode

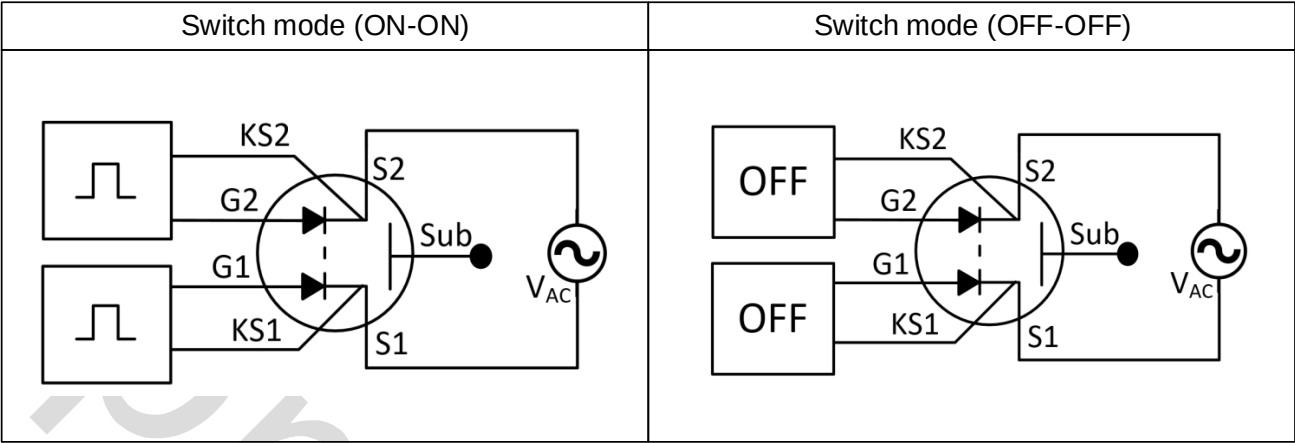
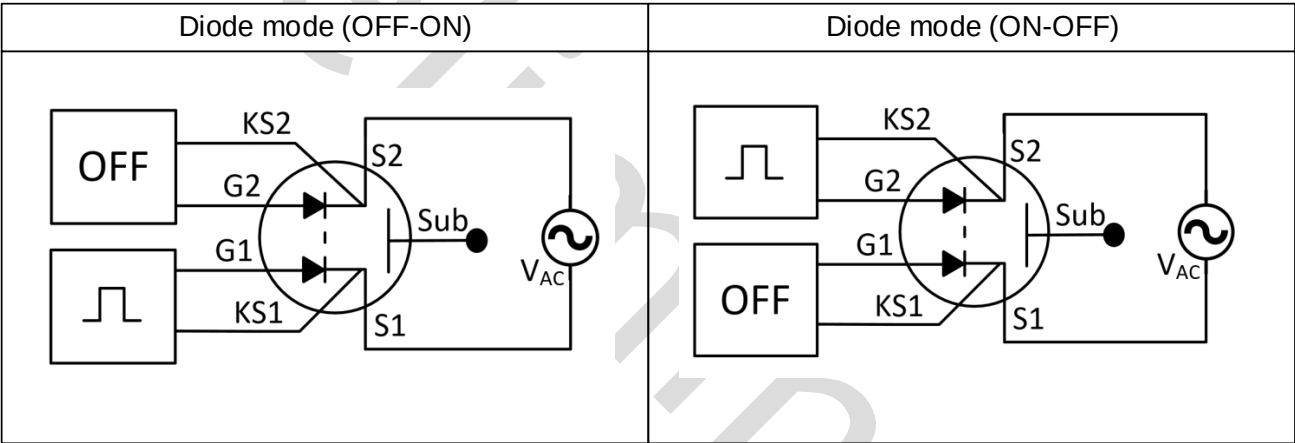
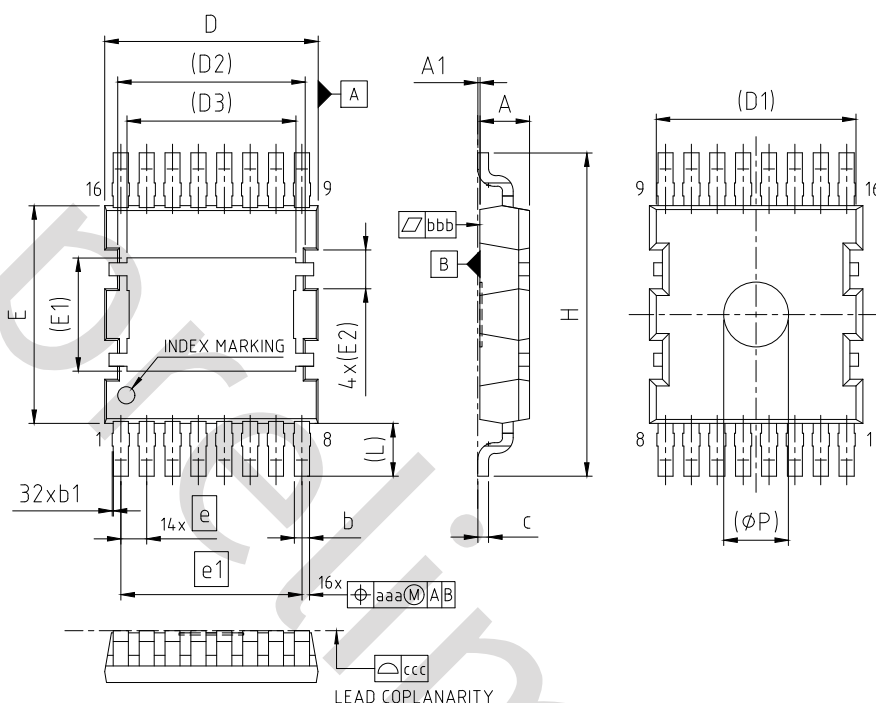


Table 11 Diode mode



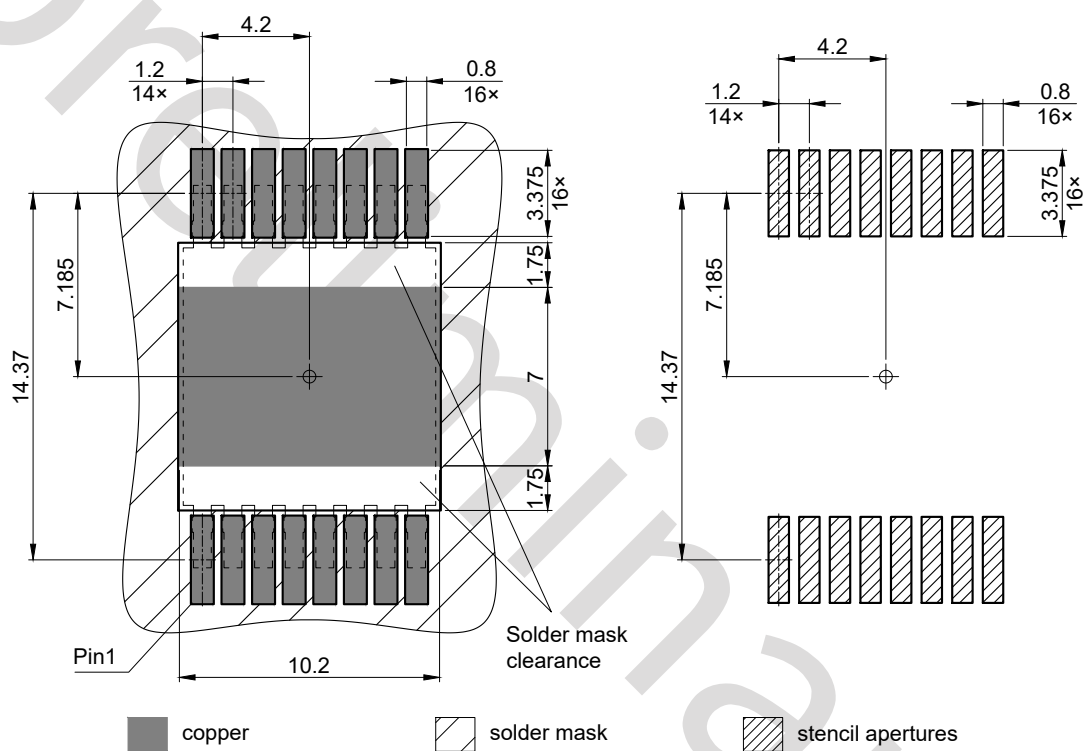
7 Package outlines



PACKAGE - GROUP NUMBER: PG-HDSOP-16-U06					
DIMENSIONS	MILLIMETERS		DIMENSIONS	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	2.25	2.35	e	1.20	
A1	---	0.15	e1	8.40	
b	0.60	0.80	H	14.80	15.20
b1	---	0.15	L	2.45	
c	0.40	0.60	ØP	3.00	
D	9.70	10.10	aaa	0.25	
D1	9.27		bbb	0.02	
D2	8.70		ccc	0.10	
D3	7.83				
E	10.00	10.30			
E1	5.26				
E2	1.80				

NOTE: DIMENSIONS DO NOT INCLUDE MOLD FLASH, PROTRUSION OR GATE BURRS

Figure 1 Outline PG-HDSOP-16, dimensions in mm



All dimensions are in units mm
Based on stencil thickness 0.2 mm
All pads are non-solder mask defined

Figure 2 Footprint drawing PG-HDSOP-16, dimensions in mm

8 Appendix A

Table 12 **Related links**

- IFX CoolGaN™ GaN 650 V webpage
- IFX CoolGaN™ GaN 650 V reliability white paper
- IFX CoolGaN™ GaN 650 V gate driver application note
- IFX CoolGaN™ GaN 650 V applications information

Preliminary

Revision history

IGLT65R055B2

Revision 2025-01-28, Rev. 0.1

Previous revisions

Revision	Date	Subjects (major changes since last revision)
0.1	2025-01-28	Release of preliminary

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