

EVAL_IGK080B041S_GaN user guide

CoolGaN™ BDS evaluation board

About this document

Scope and purpose

This user guide provides an overview of the EVAL_IGK080B041S_GaN Evaluation Board including its main features, key components, pin assignments, and mechanical dimensions.

EVAL_IGK080B041S_GaN is a small daughter board designed specifically to assemble and evaluate SG-UFWLB-16 pin BGA (WLCSP-1.7x1.7 mm) package GaN bidirectional switch (BDS) [1]. The berg stick connector on this evaluation board is in line with the board- to-board connector on the EVAL_GD_BDS_GaN Evaluation Board, which eventually can be used a gate driver for this BDS board.

Note: This board is sensitive to ESD and must be used only under laboratory conditions.

Intended audience

This document is primarily intended to guide engineers evaluating bidirectional GaN switch performance.

About this product group

Target applications

- [Consumer Electronics: USB-C chargers](#) and load switches
- [eFuses](#)
- [Battery management systems \(BMS\)](#)

Product family

[CoolGaN™ BDS](#) are normally-off monolithic GaN bidirectional switches with dual-gate independent control, enabling a common-drain structure for blocking voltage and current in both directions. They replace multiple unidirectional switches, reducing component count while improving switching speed and overall performance. CoolGaN™ BDS switches enhance efficiency, power density, and reliability in applications.

Evaluation Board

This board can be used during the design-in process for evaluation and measurement of characteristics, and proof of data sheet specifications for the GaN BDS.

Note: PCB and auxiliary circuits are NOT optimized for final customer design.

Safety precautions

Safety precautions

Note: Please note the following warnings regarding the hazards associated with development systems.

Table 1 Safety precautions

	Warning: The evaluation or reference board contains DC bus capacitors, which take time to discharge after removal of the main supply. Before working on the drive system, wait 5 minutes for capacitors to discharge to safe voltage levels. Failure to do so may result in personal injury or death. Darkened display LEDs are not an indication that capacitors have discharged to safe voltage levels.
	Warning: Remove or disconnect power from the drive before you disconnect or reconnect wires or perform maintenance work. Wait five minutes after removing power to discharge the bus capacitors. Do not attempt to service the drive until the bus capacitors have discharged to zero. Failure to do so may result in personal injury or death.
	Caution: The heat sink and device surfaces of the evaluation or reference board may become hot during testing. Hence, necessary precautions are required while handling the board. Failure to comply may cause injury.
	Caution: Only personnel familiar with the drive, power electronics and associated machinery should plan, install, commission and subsequently service the system. Failure to comply may result in personal injury and/or equipment damage.
	Caution: The evaluation or reference board contains parts and assembly's sensitive to electrostatic discharge (ESD). Electrostatic control precautions are required when installing, testing, servicing or repairing the assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with electrostatic control procedures, refer to the applicable ESD protection handbooks and guidelines.
	Caution: A drive that is incorrectly applied or installed can lead to component damage or reduction in product lifetime. Wiring or application errors such as under sizing the motor, supplying an incorrect or inadequate AC supply, or excessive ambient temperatures may result in system malfunction.
	Caution: The evaluation or reference board is shipped with packing materials that need to be removed prior to installation. Failure to remove all packing materials that are unnecessary for system installation may result in overheating or abnormal operating conditions.

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1 The board at a glance

1 The board at a glance

The EVAL_IGK080B041S_GaN Evaluation Board consists of a GaN bidirectional switch (BDS) in the SG-UFWLB-16 pin BGA (WLCSP-1.7 x 1.7 mm) package. The board has 3 Input terminals namely, D1 (drain 1), D2 (drain 2), and G (gate).

The input terminals (berg stick) are in line with the board-to-board connector terminals on EVAL_GD_BDS_GaN Evaluation Board.

1.1 Scope

This evaluation board intended to evaluate bidirectional GaN switch performance.

1.2 Block diagram

Figure 1 shows a typical block diagram of the EVAL_IGK080B041S_GaN board consisting of 3 terminals D1, D2, and G.

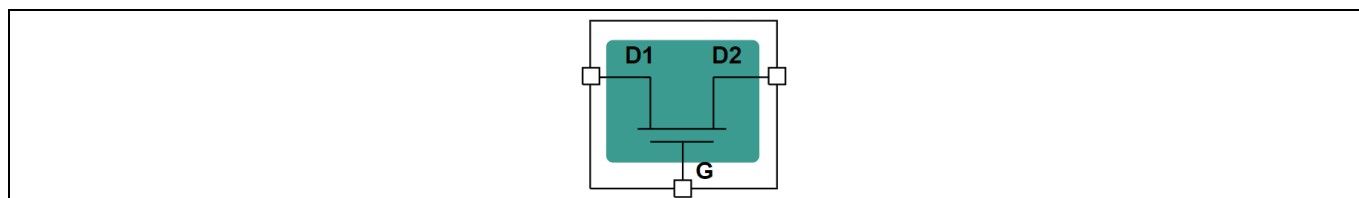


Figure 1 EVAL_IGK080B041S_GaN block diagram

1.3 Main features

- 40 V, 6 mΩ GaN BDS switch (IGK080B041S) [1], specifically designed for SG-UFWLB-16 pin BGA (WLCSP-1.7x1.7 mm) package
- Maximum current of 20 A

1.4 Board parameters and technical data

Table 2 EVAL board parameters

Parameter	Symbol	Conditions	Value			Unit
			Min	Typ.	Max.	
Drain-drain on state resistance	$R_{DD(on)}$	$V_{GD} = 5V, I_D = 5A$	–	6	8	mΩ
Continuous drain-drain voltage	V_{D1D2}	–	–	–	40	V
Gate-drain voltage	V_{GD1} or V_{GD2}	–	-40	–	6	V
Drain current	I_{DD}	$T_{amb} = 25^{\circ}C$	–	–	20	A
System environment						
Ambient temperature	$T_{amb.}$	–	–	25	–	°C
PCB characteristics						
Dimensions	L	Length	–	27.7	–	mm
	W	Width	–	12.5	–	mm
	H	Height	–	7.6	–	mm

1 The board at a glance

Parameter	Symbol	Conditions	Value			Unit
			Min	Typ.	Max.	
No. of layers	–	–	–	4	–	
PCB thickness	–	–	–	1.6	–	mm
Copper thickness	–	All layers	–	1	–	oz.
Weight	–	Weight of entire PCB assembly	–	–	–	g
Material	–	FR-4, RoHS-compliant				

2 System and functional description

This evaluation board is designed to evaluate a single GaN BDS in the SG-UFWLB-16 pin BGA (WLCSP-1.7x1.7 mm) package.

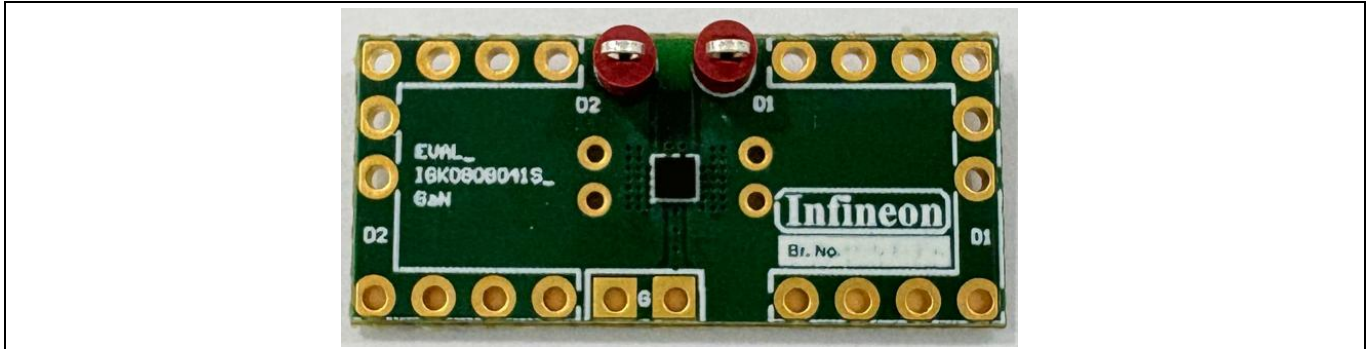


Figure 2 EVAL_IGK080B041S_GaN Evaluation Board

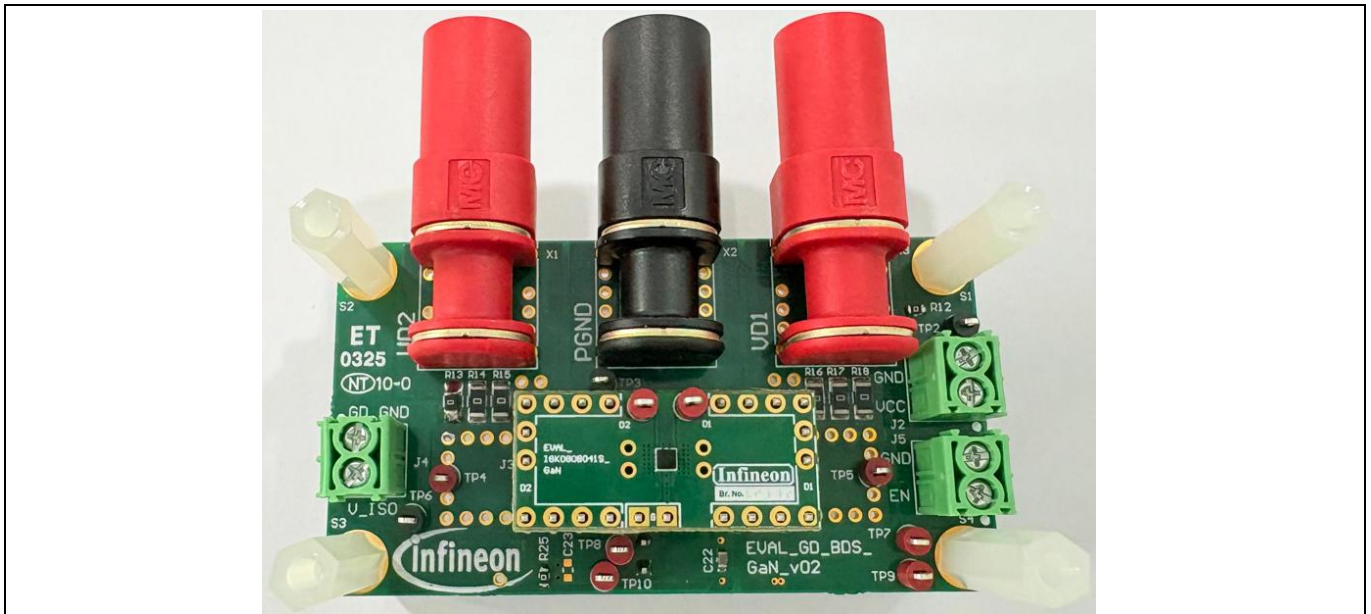


Figure 3 EVAL_IGK080B041S_GaN as a daughter board for EVAL_GD_BDS_GaN gate driver evaluation board

The GaN BDS switch in this evaluation board can be used along with a gate driver evaluation board (such as EVAL_GD_BDS_GaN) to drive this common-source configuration.

When the gate is referenced to D2 and V_{GD2} exceeds $V_{GD(th)}$ of the GaN BDS switch, bidirectional current flow is enabled. With $V_{GD2} = 5\text{ V}$, current can flow in both directions with minimal voltage drop ($R_{ON} \times I_{Load}$) and low power loss. If the gate signal is off with respect to D2 (i.e., $V_{GD2} = 0\text{ V}$), the channel acts like a diode, permitting conduction only from D2 to D1 with a higher voltage drop (2 to 2.5 V) [2].

Similarly, when the gate is referenced to D1 and V_{GD1} exceeds $V_{GD(th)}$, the bidirectional flow is again enabled. When the gate is turned off with respect to D1 (i.e., $V_{GD1} = 0\text{ V}$), the channel acts like a diode in other direction, allowing conduction from D1 to D2 with a higher voltage drop [2].

Thus, when the current direction is fixed, then referencing to a particular ground reference helps to control the GaN BDS switch effectively [2].

3 System design

3 System design

3.1 Schematics

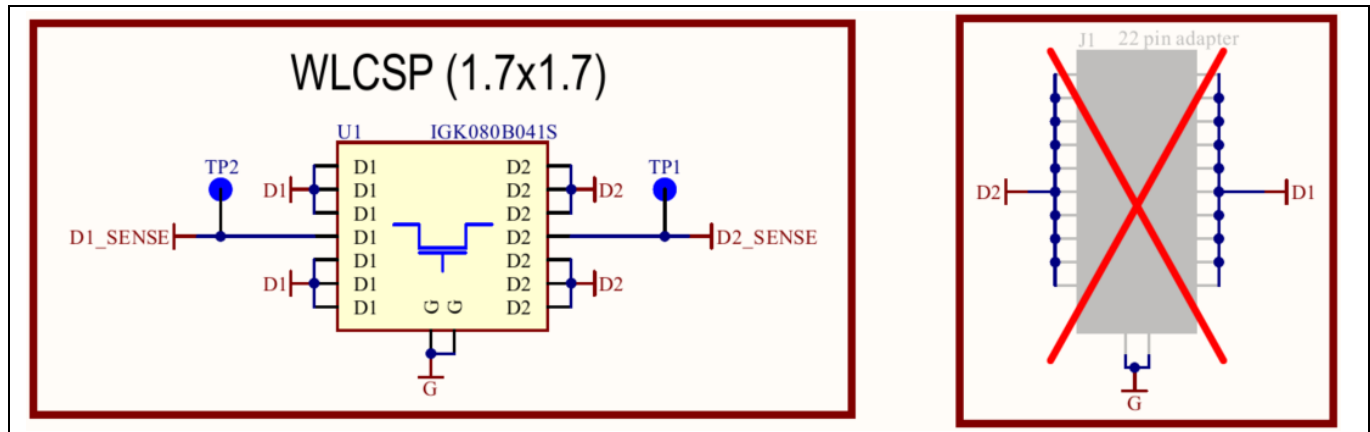


Figure 4 EVAL_IGK080B041S_GaN schematics

3.2 Layout

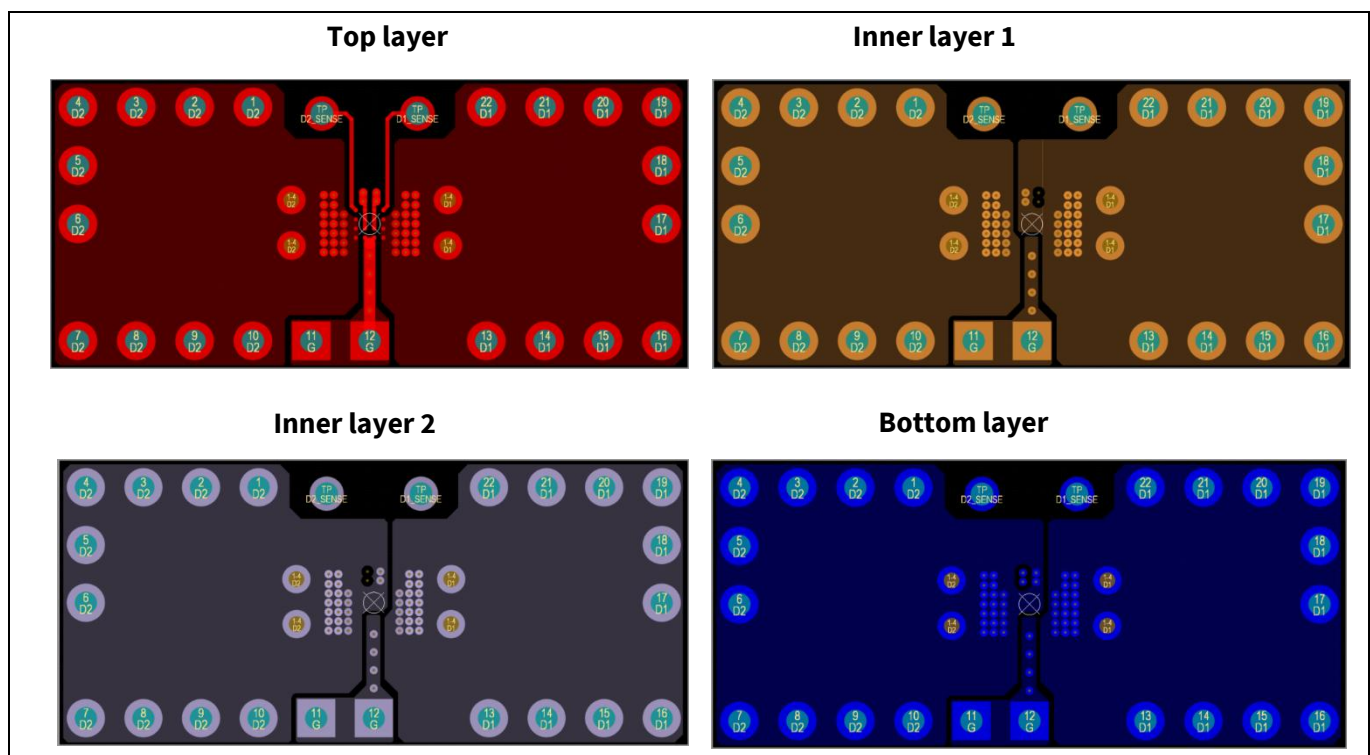


Figure 5 EVAL_IGK080B041S_GaN layout (top view)

3 System design

3.3 Bill of materials

The complete bill of materials is available on the download section of the board webpage. A log-in is required to download this material.

Table 3 BOM of the most important/critical parts of the evaluation or reference board (example)

Sl. No.	Ref designator	Description	Manufacturer	Manufacturer P/N	Populated
1	Q1	40 V 6 mΩ GaN BDS common source	Infineon Technologies	IGK080B041S	Yes

3.4 Connector details

Table 4 Connectors

Pin	Label	Function
D2	J1 – pins 1, 2, 9, 10	Drain-2 power input/output
D1	J1 – pins 13, 14, 21, 22	Drain-1 power input/output
G	J1 – pins 11, 12	Gate

4 System performance

4.1 Test points

Table 5 Test points

TP No.	Net	Description
TP1	D2 – Sense	Test point for Drain-2 Ron Sense
TP2	D1 – Sense	Test point for Drain-1 Ron Sense

4.2 BDS – Independent evaluation

4.2.1 Test setup

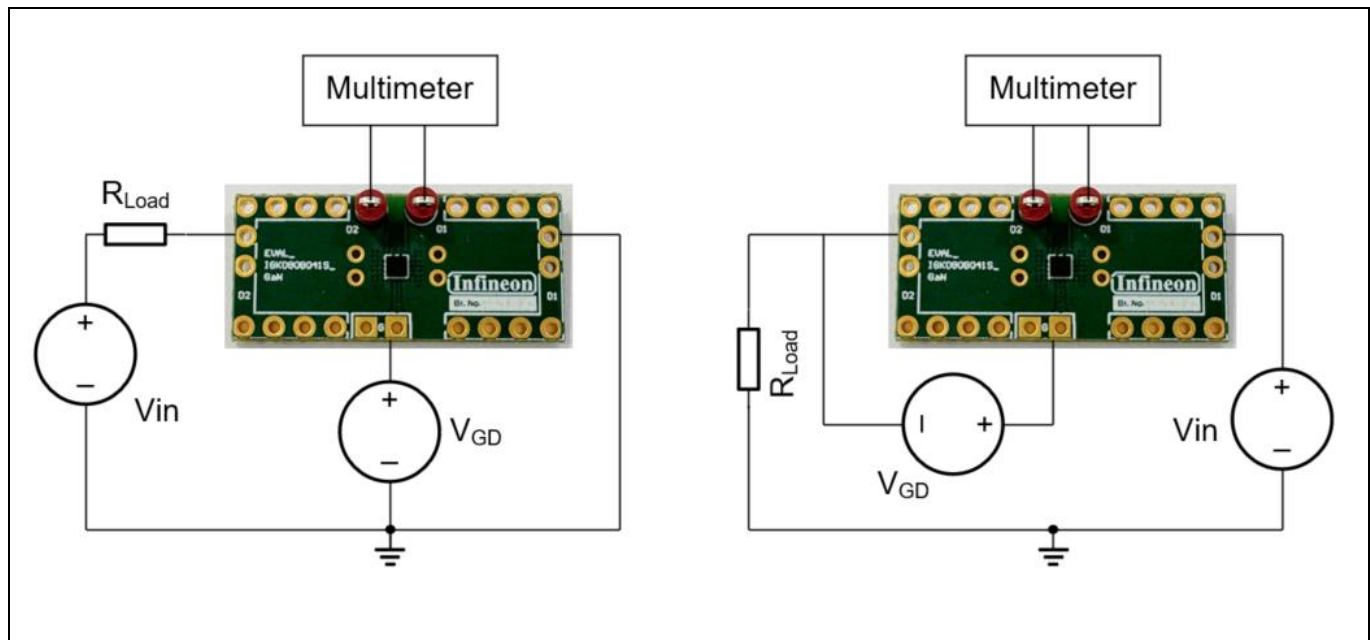


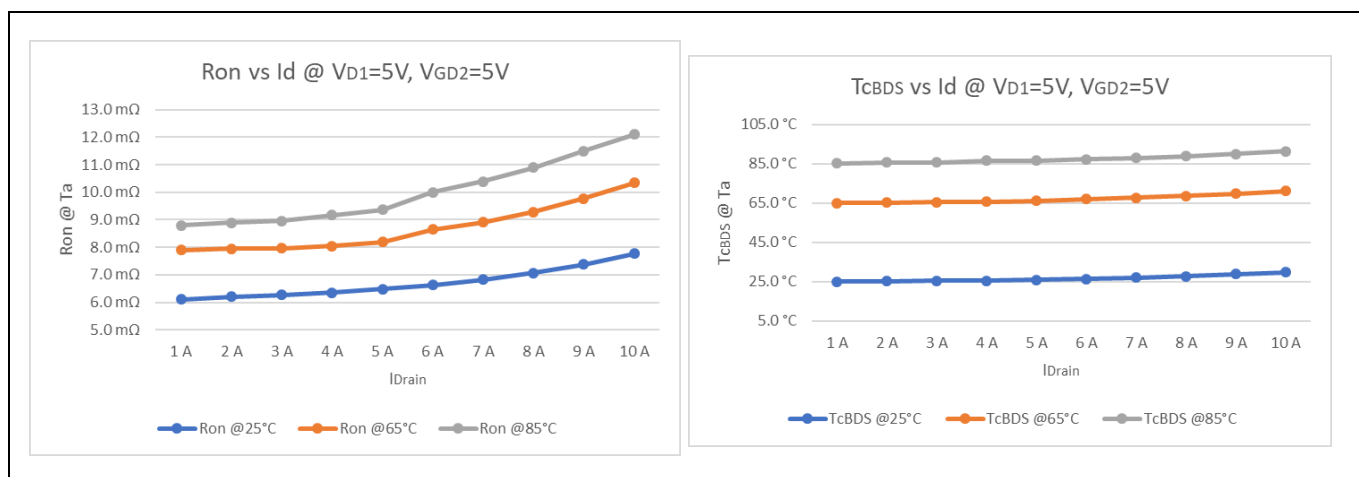
Figure 6 Test setup

Figure 6 represents the test setups to validate the GaN BDS in the EVAL_IGK080B041S_GaN Evaluation Board and test its operation at the required conditions. The input supply (V_{in}) can be given to either of the drain potentials (D1 or D2) and the gate voltage is given with respect to the other drain as shown in Figure 6. Also, BDS can be used in either the low or high side configuration, provided that the gate voltage needs to be given with respect to the drain potential that is not connected to the input supply.

4 System performance

4.2.2 On-state resistance (R_{on}) vs. drain current (I_{drain})Table 6 Measurement results - R_{on} , T_c vs. I_d at $V_{D1} = 5\text{ V}$ and varying ambient temperature

$V_{D1} = 5\text{ V}, V_{GD2} = 5\text{ V}$		$T_{amb} = 25^\circ\text{C}$		$T_{amb} = 65^\circ\text{C}$		$T_{amb} = 85^\circ\text{C}$	
I_{drain}		R_{on}	$T_{C_{BDS}}$	R_{on}	$T_{C_{BDS}}$	R_{on}	$T_{C_{BDS}}$
1 A		6.1 mΩ	25.1°C	7.9 mΩ	65.0°C	8.8 mΩ	85.2°C
2 A		6.2 mΩ	25.2°C	8.0 mΩ	65.2°C	8.9 mΩ	85.6°C
3 A		6.3 mΩ	25.4°C	8.0 mΩ	65.4°C	9.0 mΩ	85.8°C
4 A		6.4 mΩ	25.6°C	8.1 mΩ	65.8°C	9.2 mΩ	86.5°C
5 A		6.5 mΩ	26.0°C	8.2 mΩ	66.2°C	9.4 mΩ	86.7°C
6 A		6.6 mΩ	26.4°C	8.7 mΩ	67.1°C	10.0 mΩ	87.2°C
7 A		6.8 mΩ	27.1°C	8.9 mΩ	67.8°C	10.4 mΩ	87.9°C
8 A		7.1 mΩ	27.8°C	9.3 mΩ	68.7°C	10.9 mΩ	88.9°C
9 A		7.4 mΩ	28.8°C	9.8 mΩ	69.8°C	11.5 mΩ	90.0°C
10 A		7.8 mΩ	29.9°C	10.4 mΩ	71.2°C	12.1 mΩ	91.4°C

Figure 7 BDS R_{on} and case temperature (T_c) variation with respect to drain current (I_d) at $V_{D1} = 5\text{ V}$ Table 7 Measurement results - R_{on} , T_c vs. I_d at $V_{D1} = 28\text{ V}$ and varying ambient temperature

$V_{D1} = 28\text{ V}, V_{GD2} = 5\text{ V}$		$T_{amb} = 25^\circ\text{C}$		$T_{amb} = 65^\circ\text{C}$		$T_{amb} = 85^\circ\text{C}$	
I_{drain}		R_{on}	$T_{C_{BDS}}$	R_{on}	$T_{C_{BDS}}$	R_{on}	$T_{C_{BDS}}$
1 A		6.4 mΩ	25.0°C	7.7 mΩ	65.1°C	8.9 mΩ	85.2°C
2 A		6.6 mΩ	25.1°C	8.1 mΩ	65.2°C	9.0 mΩ	85.4°C
3 A		6.7 mΩ	25.3°C	8.2 mΩ	65.4°C	9.1 mΩ	85.7°C
4 A		6.8 mΩ	25.6°C	8.4 mΩ	65.7°C	9.2 mΩ	86.3°C
5 A		6.9 mΩ	26.2°C	8.4 mΩ	66.5°C	9.5 mΩ	87.0°C

4 System performance

Key insights from the measurements are as follows:

- **R_{on} increases with both drain current and ambient temperature in all cases** (similar to a typical MOSFET behavior)
- **V_{D1} impact (5 V vs 28 V at $V_{GD2} = 5$ V) is small:** R_{on} is slightly higher at 28 V at 25°C (e.g., $\sim +0.3$ mΩ at 1 A and $\sim +0.4$ mΩ at 5 A), while at 65–85°C the differences are minor/mixed
- **T_{cBDS} closely tracks T_{amb} and increases only slightly with higher current** (generally within a few °C above ambient), indicating limited self-heating over these test points. The device temperatures are measured using thermocouples placed on the device case

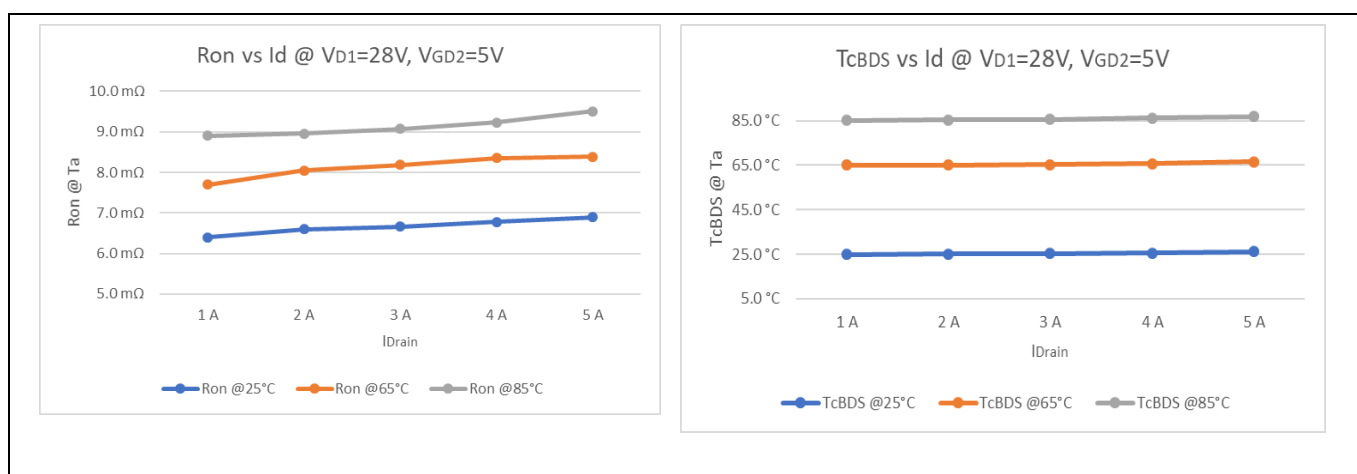


Figure 8 BDS R_{on} and case temperature (T_c) variation with respect to drain current (I_d) at $V_{D1} = 28$ V

4.2.3 On-state resistance (R_{on}) and gate leakage current (I_{gss}) vs. gate-drain voltage (V_{GD2})

Table 8 Measurement results - R_{on} , I_{gss} vs. V_{GD2} at $V_{D1} = 5$ V, $I_d = 5$ A

	$T_{amb} = 25^\circ\text{C}$			$T_{amb} = 85^\circ\text{C}$		
V_{GD2}	I_{gss} at 5 V, 25°C	R_{on} at 5 V, 25°C	T_{cBDS}	I_{gss} at 5 V, 85°C	R_{on} at 5 V, 85°C	T_{cBDS}
3.5 V	1.15 μA	7.9 mΩ	26.2°C	4.83 μA	12.2 mΩ	85.9°C
4.0 V	1.51 μA	7.2 mΩ	26.1°C	5.75 μA	10.9 mΩ	85.7°C
4.5 V	2.70 μA	6.8 mΩ	26.1°C	8.30 μA	10.2 mΩ	85.6°C
5.0 V	6.41 μA	6.6 mΩ	26.1°C	18.80 μA	9.6 mΩ	85.3°C
5.5 V	17.70 μA	6.4 mΩ	26.1°C	67.60 μA	9.3 mΩ	85.1°C

Table 9 Measurement results - R_{on} , I_{gss} vs. V_{GD2} at $V_{D1} = 28$ V, $I_d = 5$ A

	$T_{amb} = 25^\circ\text{C}$			$T_{amb} = 85^\circ\text{C}$		
V_{GD2}	I_{gss} at 28 V, 25°C	R_{on} at 28 V, 25°C	T_{cBDS}	I_{gss} at 28 V, 85°C	R_{on} at 28 V, 85°C	T_{cBDS}
3.5 V	1.21 μA	8.0 mΩ	26.2°C	5.31 μA	12.4 mΩ	86.8°C
4.0 V	1.68 μA	7.2 mΩ	26.1°C	6.72 μA	11.1 mΩ	86.3°C
4.5 V	3.33 μA	6.8 mΩ	26.1°C	10.30 μA	10.4 mΩ	85.9°C
5.0 V	8.10 μA	6.5 mΩ	26.1°C	23.40 μA	9.7 mΩ	85.6°C
5.5 V	20.60 μA	6.4 mΩ	26.1°C	84.50 μA	9.5 mΩ	85.3°C

4 System performance

Key insights from the measurements are as follows:

- **Clear gate-drive tradeoff:** Increasing V_{GD2} from 3.5 to 5.5 V reduces R_{on} (better conduction) but increases I_{gss} (more gate leakage)
 - At 25°C ($V_{D1}=5V$), R_{on} improves 7.9 to 6.4 mΩ (~19% drop), while I_{gss} rises from 1.15 to 17.7 μA (~15×)
 - At 85°C ($V_{D1}=5V$), R_{on} improves 12.2 to 9.3 mΩ (~24% drop), while I_{gss} rises from 4.83 to 67.6 μA (~14×)
- **Temperature effect dominates R_{on} and I_{gss} :**
 - For the same V_{GD2} , going 25°C to 85°C increases R_{on} by ~45–55% (e.g., at $V_{GD2}=5.0V$: 6.6 to 9.6 mΩ)
 - I_{gss} increases strongly with temperature (typically ~4–5× at a given V_{GD2} ; e.g., at 5.0 V: 6.41 to 18.8 μA)
- **V_{D1} (5 V vs. 28 V) has minimal influence** on both R_{on} and I_{gss} across the tested points:
 - Differences are small (generally ≤ 0.2 mΩ in R_{on} and modest I_{gss} shifts), suggesting the behavior is primarily set by gate drive and temperature, not V_{D1} in this range
- **Diminishing returns above ~5.0 V gate drive:**

R_{on} improvement from 5.0 to 5.5 V is small (~0.1–0.3 mΩ), while I_{gss} increases by ~2–4×. This indicates ~5.0 V is a practical “knee” where extra drive gives limited R_{on} benefit but significantly higher leakage
- **T_{cBDS} tracks ambient closely** (~26°C at 25°C ambient; ~85–87°C at 85°C ambient) with little spread vs. V_{GD2} , implying power loss is not the main driver in these sweeps; the R_{on}/I_{gss} changes are mainly electrical (gate drive) and intrinsic temperature dependence

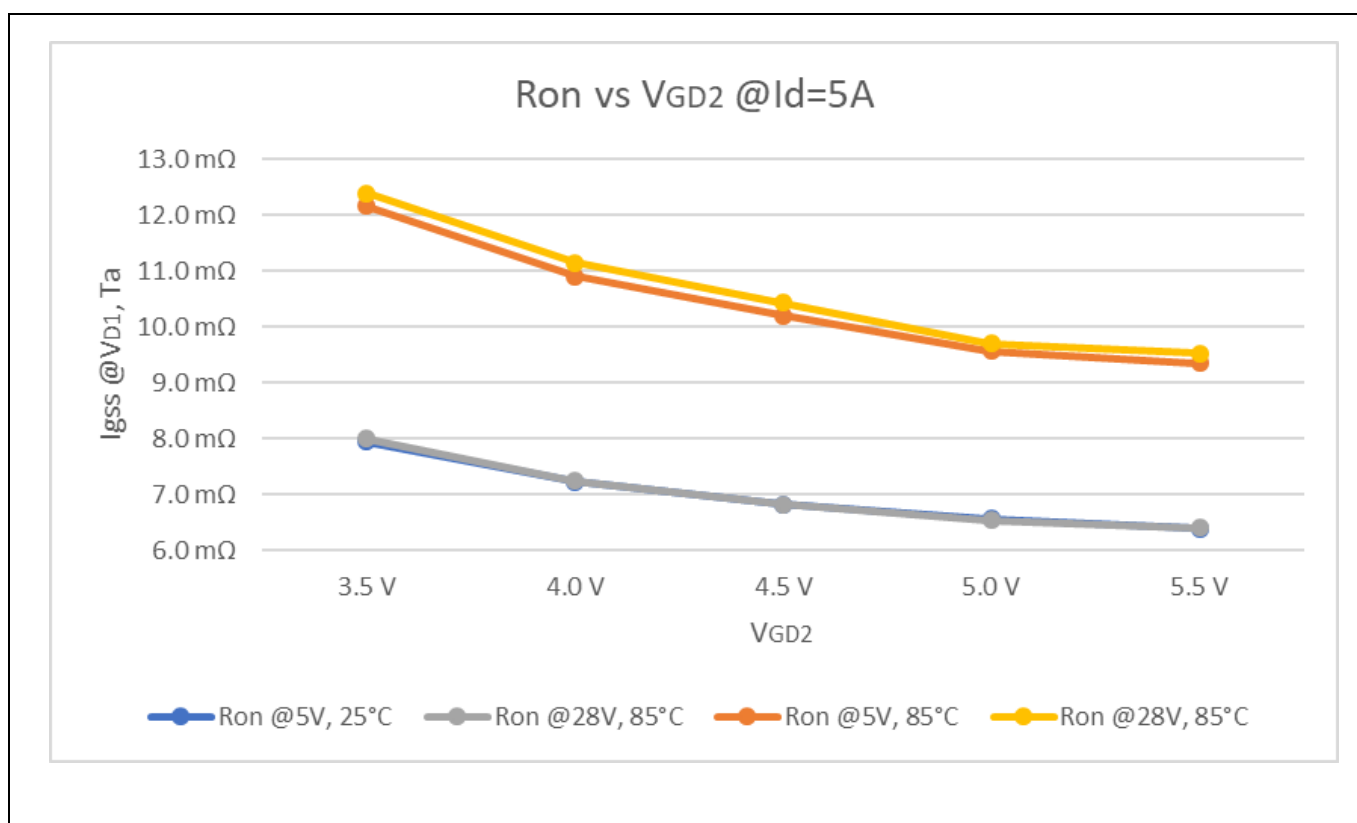


Figure 9 On-state resistance (R_{on}) variations with respect to gate-drain voltages (V_{GD2}) at $V_{D1} = 5V$ and 28 V

4 System performance

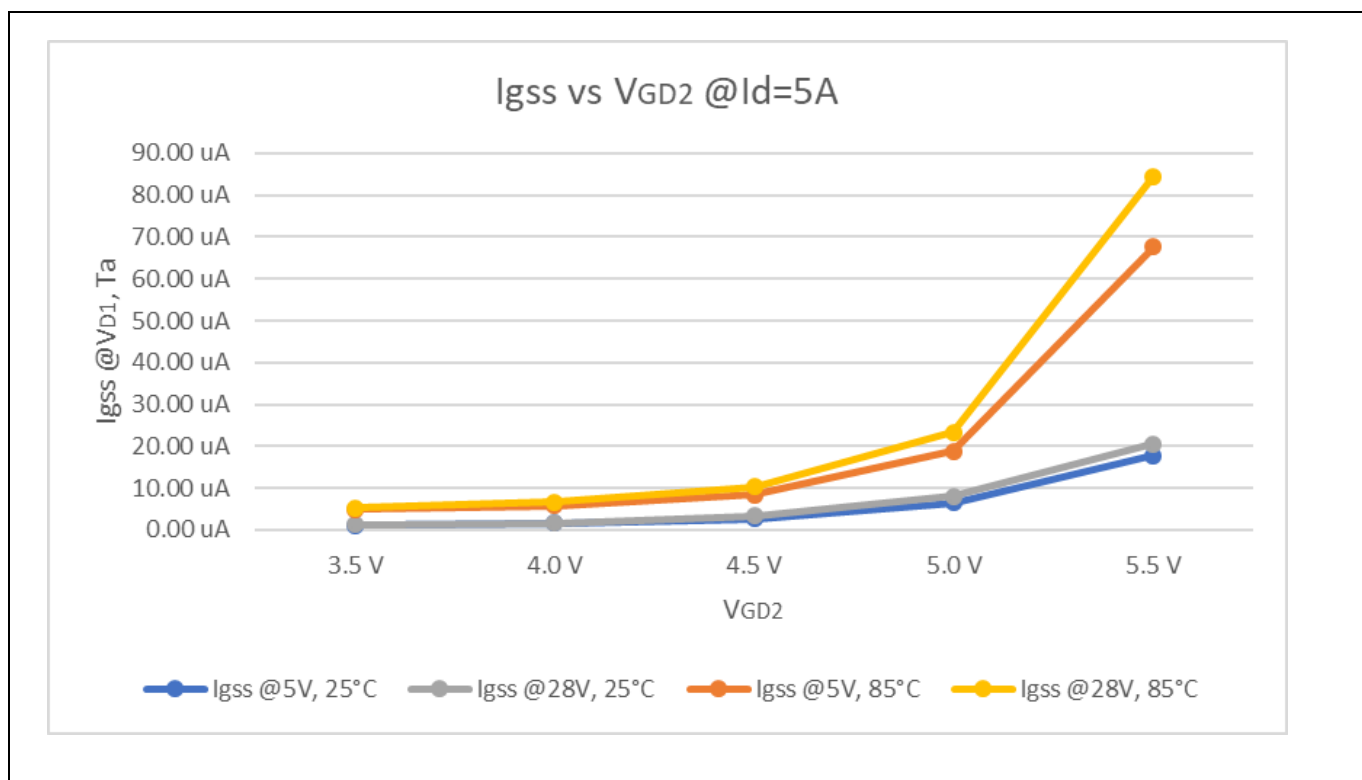


Figure 10 Gate leakage current (I_{gss}) variations with respect to gate-drain voltages (V_{GD2}) at $V_{D1} = 5\text{ V}$ and 28 V

4.3 Evaluation with EVAL_GD_BDS_GaN gate driver board

4.3.1 Test setup

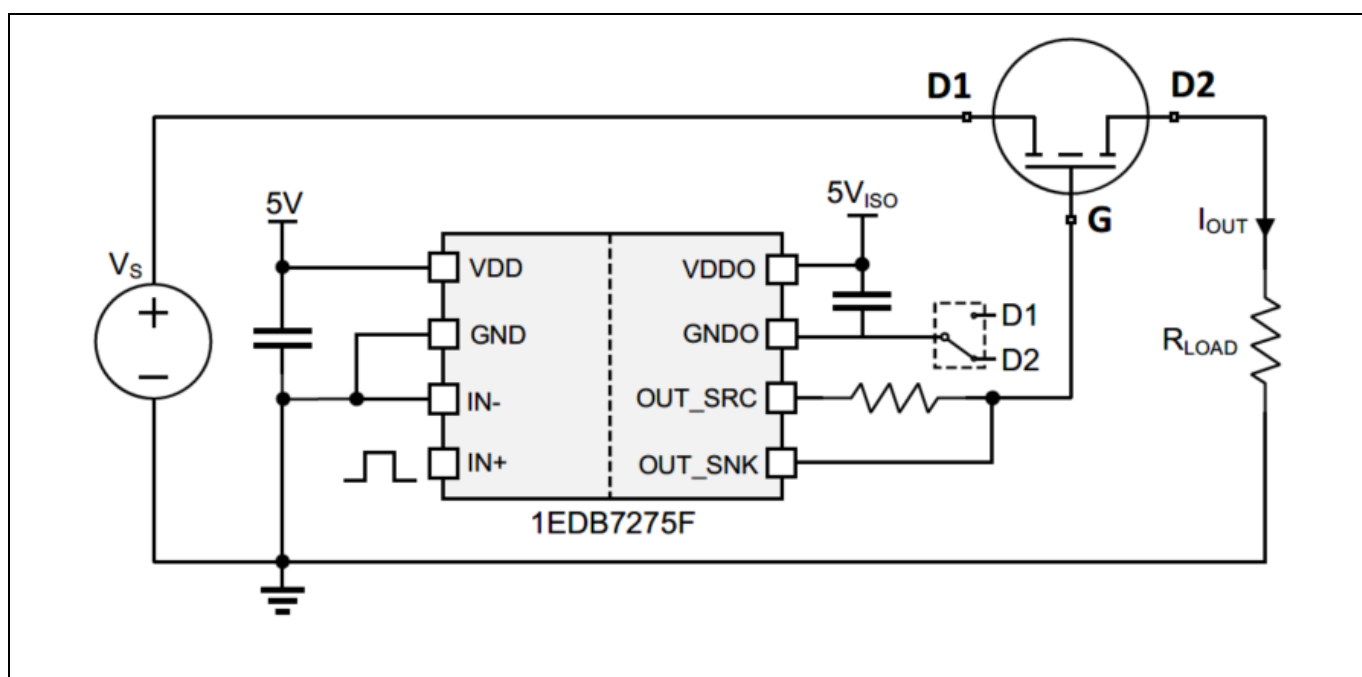


Figure 11 GaN BDS as a high-side switch using 1EDB7275F isolated gate driver

Figure 10 shows high-side operation of the GaN BDS using the 1EDB7275F isolated gate driver from Infineon for unidirectional current flow. The gate reference selector switch allows the gate return path to be connected to

4 System performance

either D1 or D2, depending on the intended direction of current flow. The 1EDB7275F has a UVLO threshold of 4.2 V. Therefore, it can be powered directly from a 5 V supply.

4.3.2 Cyclic turn on/off waveform

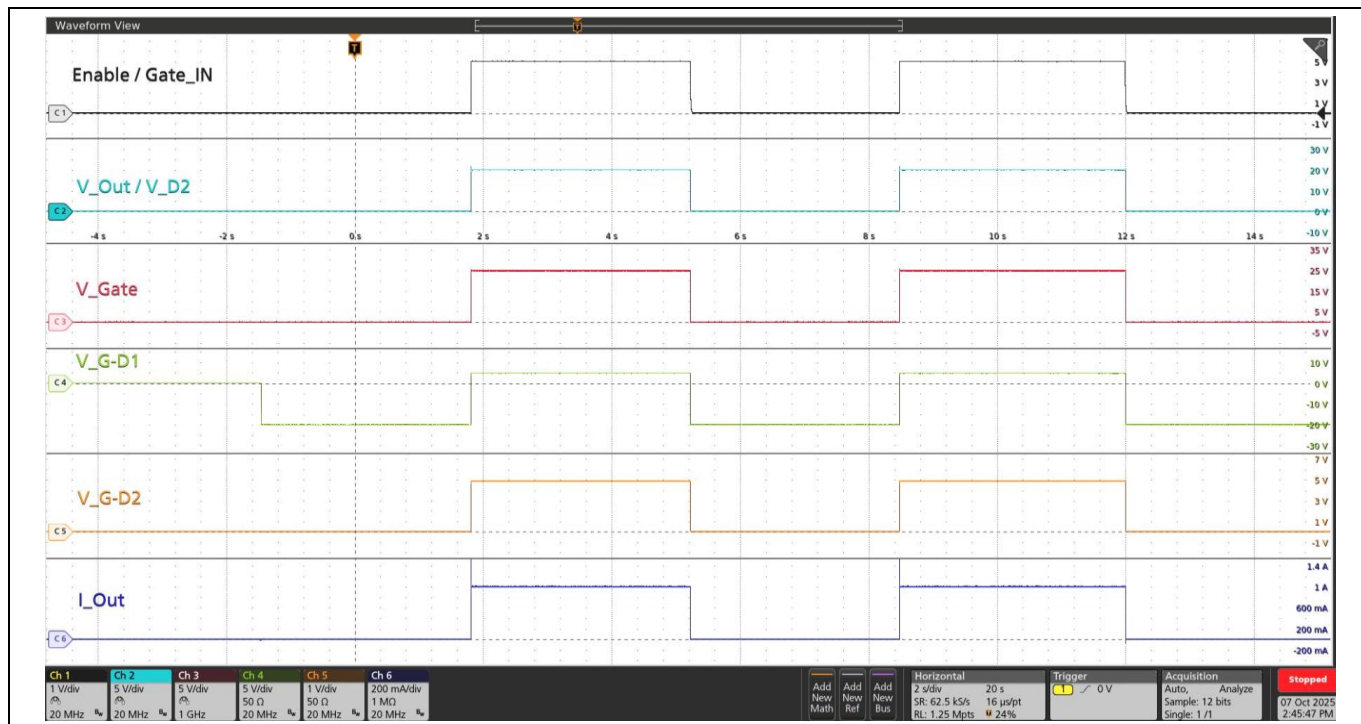


Figure 12 Unidirectional current flow and gate reference to D2

For the circuit in [Figure 10](#) (with $V_S = 20\text{ V}$ and $R_{Load} = 20\ \Omega$), [Figure 12](#) shows the corresponding waveforms when the gate voltage is referenced to D2. When the power supplies (V_S and V_{DD}) are on and Enable/IN is inactive, gate voltage $V_G = V_{GD2} = 0\text{ V}$, and thus $V_{GD1} = -20\text{ V}$. Asserting Enable/IN causes V_{GD2} to increase to 5 V ($V_G = 25\text{ V}$), thereby turning on the GaN BDS.

For the same circuit, when the gate is referenced to D1, [Figure 13](#) shows the corresponding waveforms. When the power supplies (V_S , V_{DD} , and V_{DDO}) are on and Enable/IN is inactive, gate voltage $V_G = V_{GD1} = 20\text{ V}$, which turns on the GaN BDS and allows current flow from D1 to D2 with a significant voltage drop ($V_{D1D2} \approx 2\text{ V}$), similar to diode mode. Asserting Enable/IN increases V_{GD1} to 5 V ($V_G = 25\text{ V}$), fully turning on the GaN BDS and decreasing the voltage drop to $R_{ON} \times I_{OUT}$.

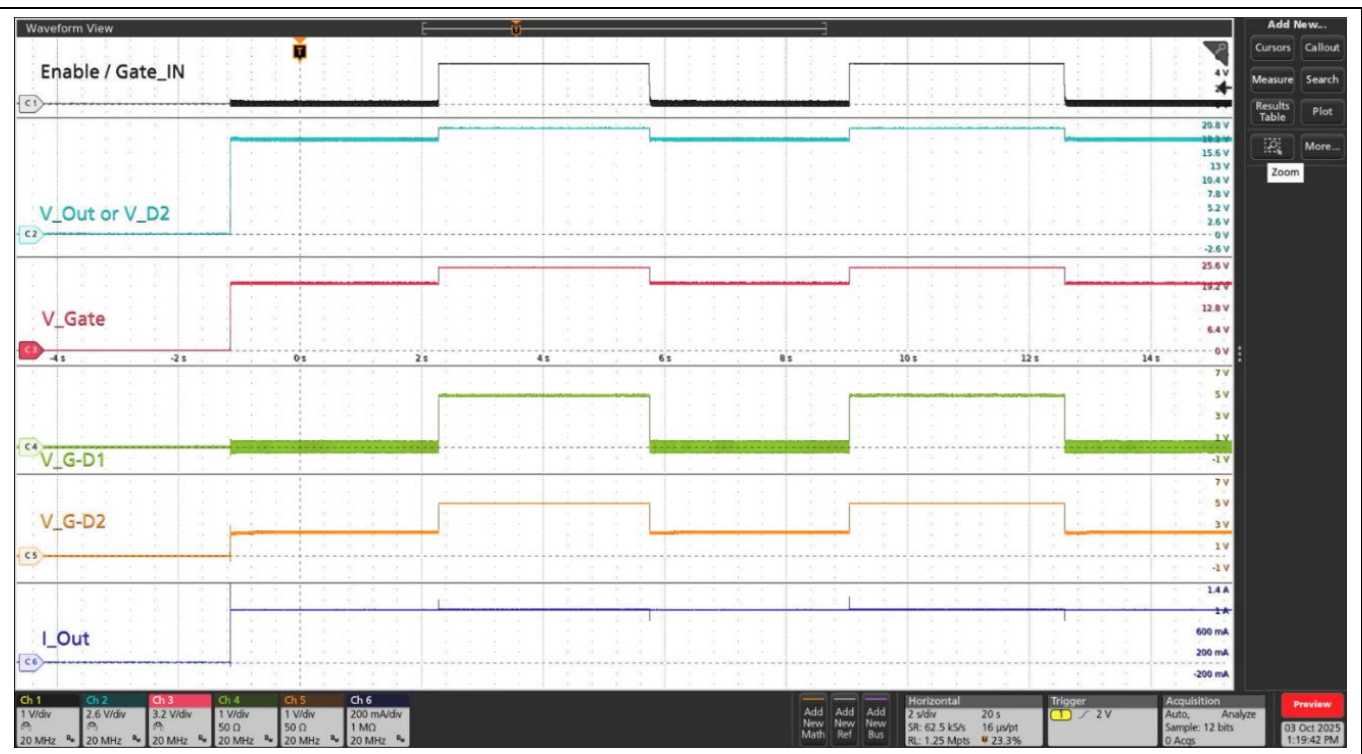


Figure 13 Unidirectional current flow and gate reference to D1

4.3.3 Startup behavior

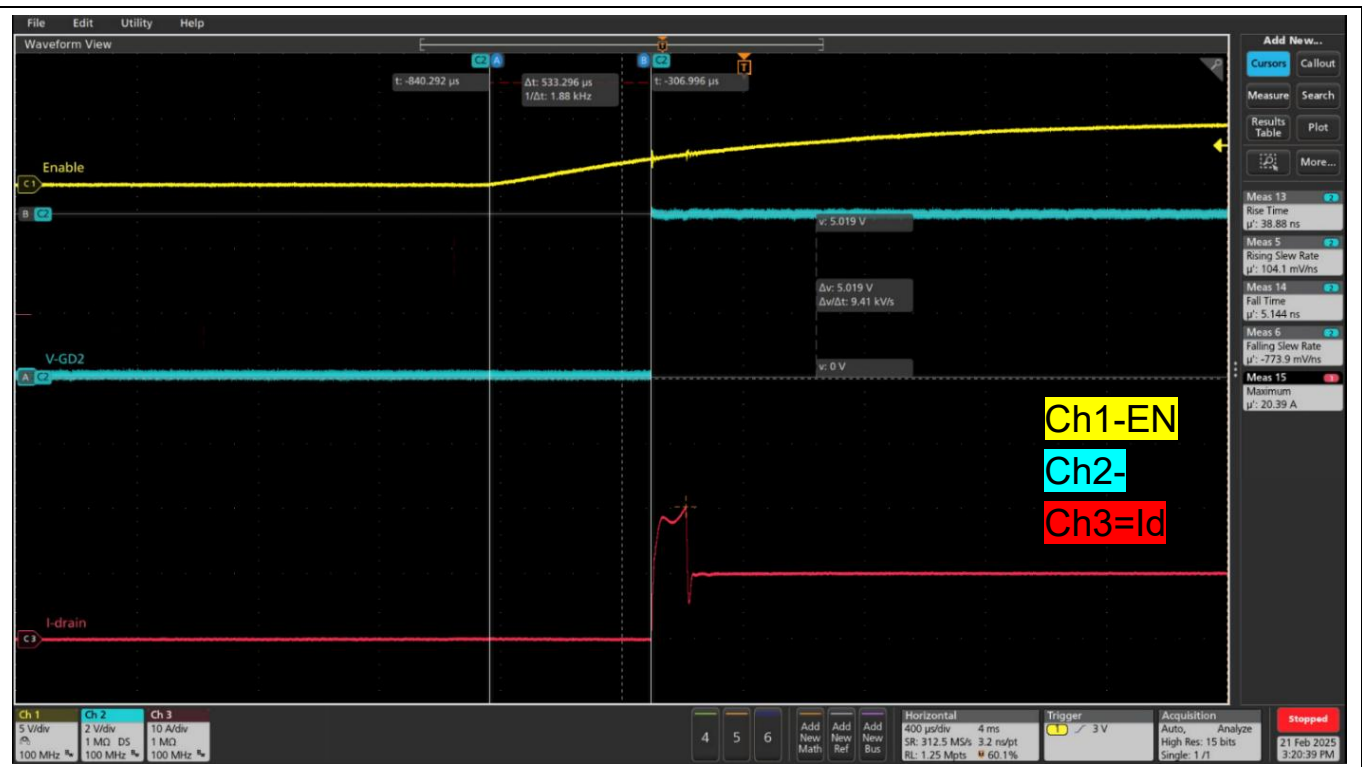


Figure 14 Turn on without RC delay on gate drive path- $V_{D1}=5\text{ V}$, $I_d=10\text{ A}$ (load), $V_{GD2} = 0\text{ V}$ to 5 V , $I_{d_max} = 20.39\text{ A}$, $t_{I_max} = 120\text{ μs}$

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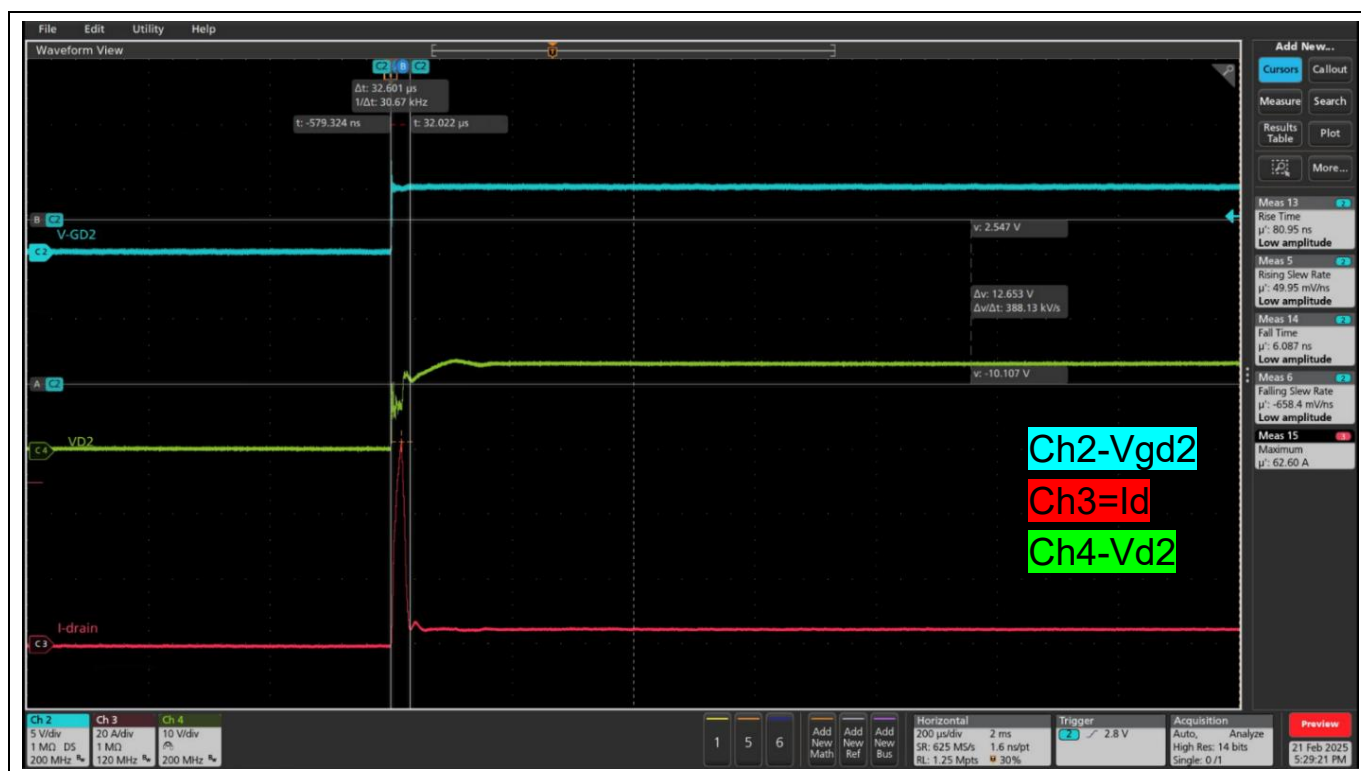


Figure 15 Turn on without RC delay on gate drive path- $V_{D1}=20$ V, $I_d=5$ A (load), $V_{GD2} = 0$ V to 5 V, $I_{d_max} = 62.6$ A, $t_{lmax} = 32.6$ μs

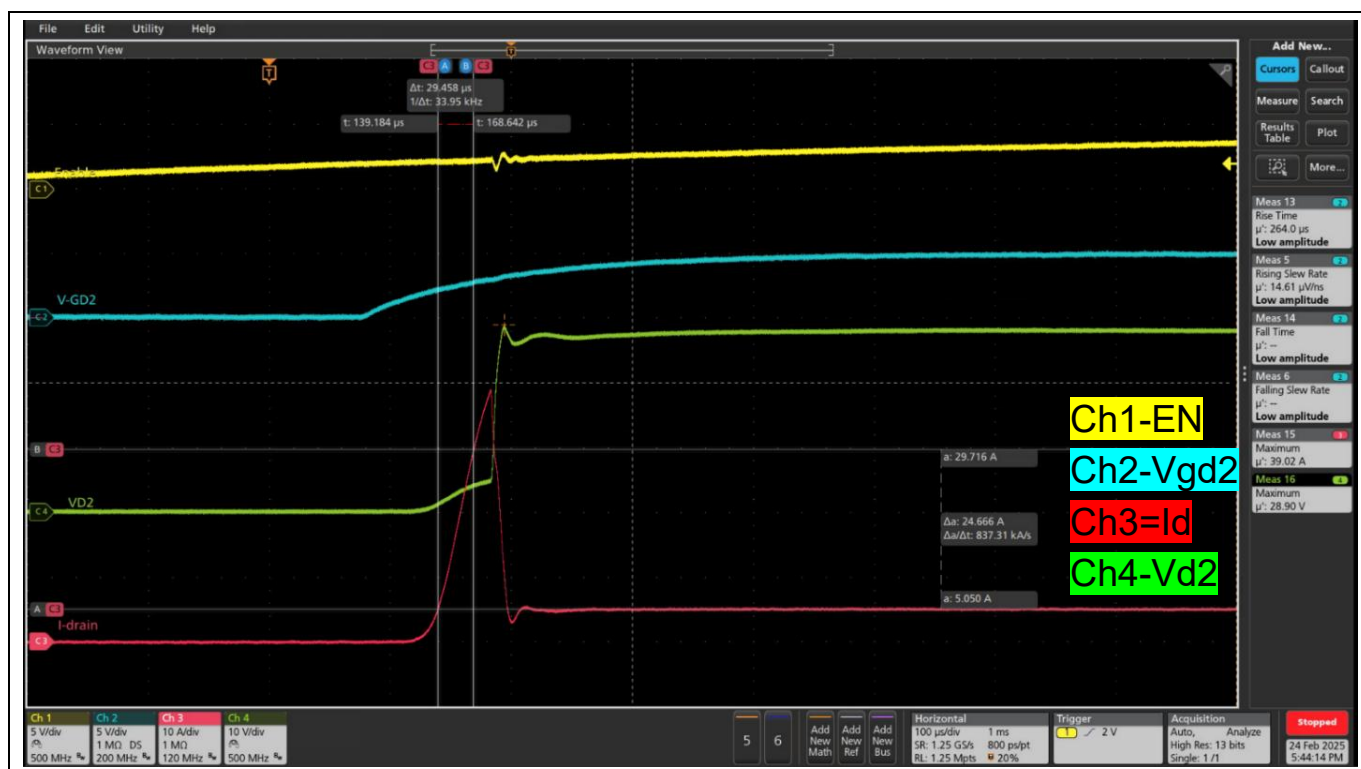


Figure 16 Turn on with RC (1 kΩ, 100 nF) delay on gate drive path- $V_{D1}=28$ V, $I_d=5$ A (load), $V_{GD2} = 0$ V to 5 V, $I_{d_max} = 39.02$ A, $dI/dt = 0.837$ A/μs

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Since the isolated gate driver voltage is supplied externally, turn-on is fast with negligible delay. However, rapid turn-on can cause large inrush currents, which can damage the BDS if not controlled. Additionally, the inrush current increases with the increase in input voltage applied to the drain terminal.

By using an RC delay circuit on the gate terminal, the turn-on can be slowed, and inrush current can be limited.

5 Conclusion

This user guide provides a comprehensive overview of the working and results for the 40 V, 6 mΩ, GaN BDS evaluation board, enabling the user to start experimenting and working with the 1.7 x 1.7 mm WLCSP package BDS.

The board demonstrates the on-state resistance and device temperature variations with respect to the increasing drain current, as well as the variations in the on-state resistance with the changes in the gate-drain voltage.

Note that these device parameter values measured are strictly for the particular device tested and may vary. However, these values will always be within the limits specified in BDS datasheet.

6 Related resources

- [Gallium nitride \(GaN\)](#) webpage
- EVAL_GD_BDS_GaN Evaluation Board
- Infineon Developer Community: [GaN](#) forum

References

- [1] Infineon Technologies AG. Datasheet (2026): *IGK080B041S. V 1.1*; [Available online](#)
- [2] Infineon Technologies AG. Whitepaper (2026): *Gate driving techniques for medium voltage GaN bidirectional switches*; [Available online](#)

Glossary

Table 10 Abbreviations

Abbreviation	Expansion
BDS	Bidirectional switch
EN	Enable
EVAL	Evaluation
GaN	Gallium Nitride
GD	Gate driver
PCB	Printed circuit board

Revision history

Document revision	Date	Description of changes
V 1.0	2026-06-15	Initial release

Trademarks

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Safety & Operating Instructions:

Customer shall check the Evaluation Board for any physical damage which may have occurred during transport. If customer detects any damages or defects in the Evaluation Board, customer shall not connect the Evaluation Board to a power source. Customer shall contact Infineon for further support. If customer observes unusual operating behavior during the evaluation process, customer shall immediately shut off the power supply to the Evaluation Board and consult Infineon for support.

Customer shall not touch the Evaluation Board during operation and keep a safe distance.

Customer shall not touch the Evaluation Board after disconnecting the power supply, several components may still store electrical voltage and can discharge through physical contact. Several parts, like heat sinks and transformers, may still be very hot. Allow the components to cool before touching or servicing.

The electrical installation must be completed in accordance with the appropriate safety requirements.