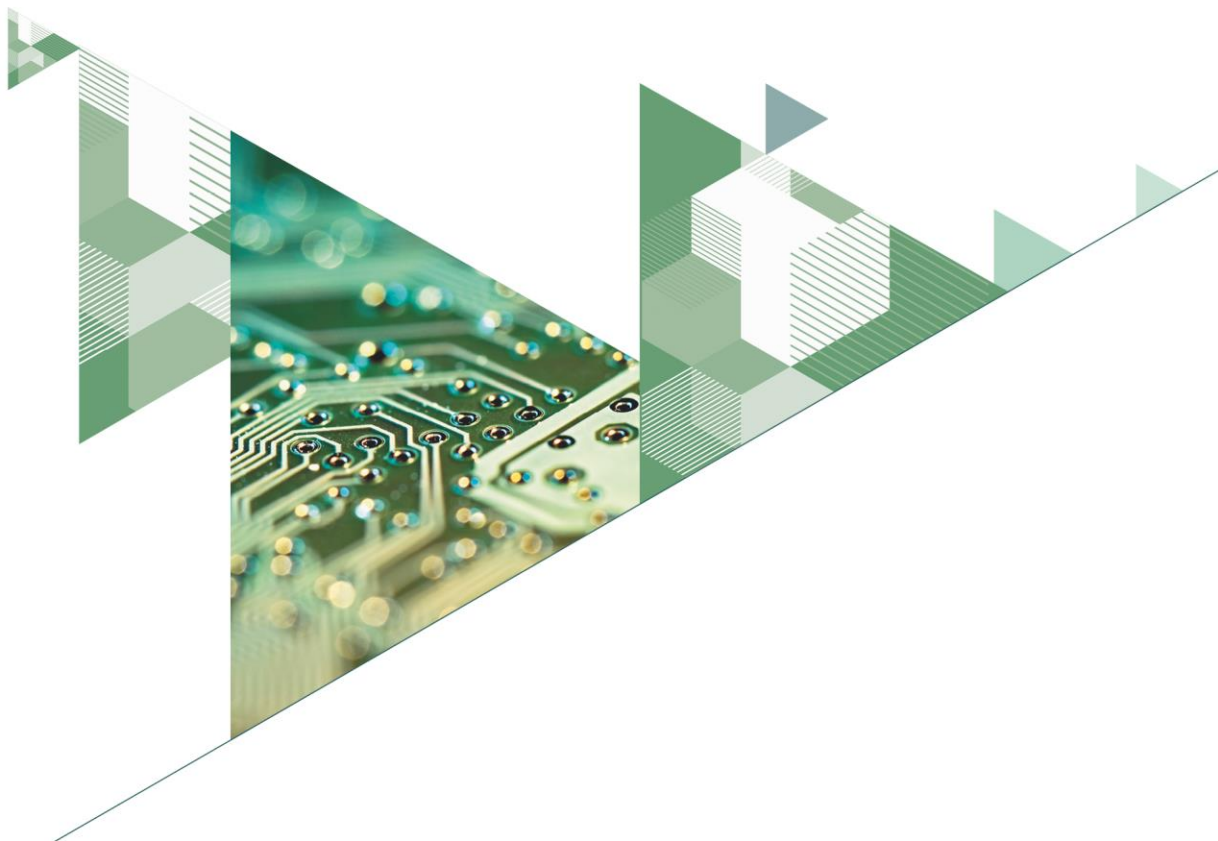




CGD65A130S2 DATASHEET

650V / 130 mΩ GaN HEMT with
ICeGaN™ Gate and Current Sense

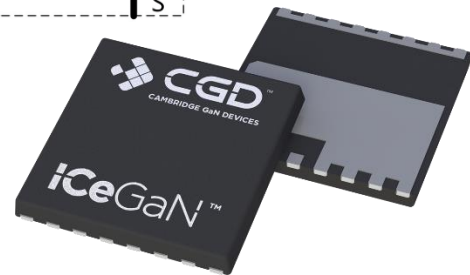
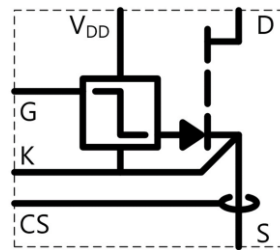
MARCH 2022



650V / 130 mΩ GaN HEMT with ICeGaN™ Gate and Current Sense

Key features

- 650 V - 12 A e-mode GaN power switch
- ICeGaN™ gate technology for high gate threshold and broad gate voltage window compatible with gate-drivers for Si MOSFETs
- Gate drive voltage 9 V to 20 V
- Current sense function
- $R_{DS(on)} = 130 \text{ m}\Omega$
- Suitable for very high switching frequency
- Kelvin Contact
- Small 8x8 mm² PCB footprint
- Bottom side cooled DFN package



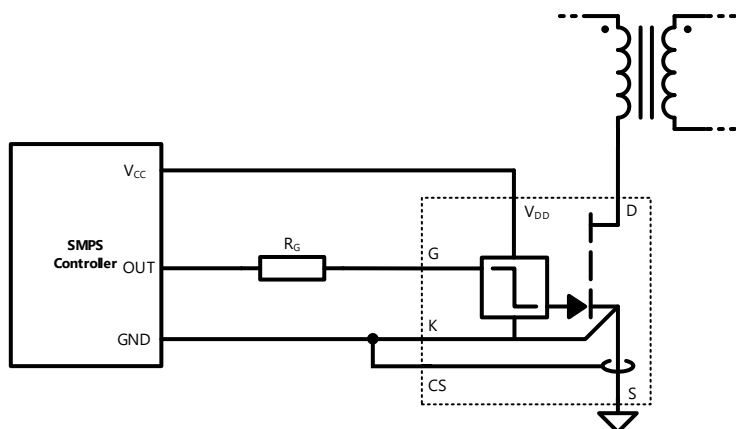
Description

The CGD65A130S2 is an enhancement mode GaN-on-silicon power transistor, exploiting the unique material properties of GaN to deliver high current, high breakdown voltage and high switching frequency for a wide range of electronics applications. The CGD65A130S2 features CGD's ICeGaN™ gate technology enabling compatibility with virtually all gate drivers and controller chips available. The integrated current sense function eliminates a separate current sense resistor and the associated efficiency losses. Because no external sense resistor is needed, the device can be directly soldered to the large copper area of the ground plane, improving the thermal performance and simplifying the thermal design. It comes in a DFN 8x8 SMD package to support high frequency operation while ensuring the highest thermal performance.

Application & Topologies

PSUs, Industrial SMPS and inverters

- Server power and data centres
- Telecom rectifiers
- Gaming PSUs
- PC power
- LED drivers
- High power ClassD Audio
- General purpose SMPS
- PV inverters
- SMPS and converters in single-switch and half-bridge topologies with hard- or soft-switching
- AC/DC and DC/DC converters
- Totem pole and single-switch PFC
- AC inverters
- Forward, flyback and LLC converters at high frequency



Exemplary Application Circuit

Absolute Maximum Ratings

$T_{\text{case}} = 25\text{ }^{\circ}\text{C}$ if not listed.

PARAMETER		VALUE	UNIT
Operating Junction Temperature	T _J	-55 to +150	°C
Storage Temperature Range	T _S	-55 to +150	°C
Drain-to-Source Voltage	V _{DS}	650	V
Drain-to-Source Voltage - transient ¹	V _{DS}	750	V
Gate-to-Source Voltage	V _{GS}	-1 to +20 and V _{GS} ≤ V _{DD}	V
Gate-to-Source Voltage - transient	V _{GS(transient)}	-1.5 to +21.5 and V _{GS} ≤ V _{DD} + 1.5	V
ICeGaN™ Gate Supply Voltage	V _{DD}	0 to +20	V
Continuous Drain Current (T _{case} = 25 °C)	I _D	12	A

The range of operation for V_{GS} and V_{DD} is 9 V to 20 V, enabling simple integration with a large variety of control chips and gate drivers.

¹ Non-repetitive pulsed conditions.

Electrical Characteristics

Values at $T_J = 25\text{ }^{\circ}\text{C}$, $V_{DD} = 12\text{ V}$ if not listed. To turn the device on the recommended gate voltage range is $V_{GS} = 9\text{ V}$ to V_{DD} . To turn the device off set $V_{GS} = 0\text{ V}$. An integrated Miller Clamp eliminates the need for negative gate voltages.

STATIC CHARACTERISTICS

PARAMETER		CONDITIONS	MIN	TYP	MAX	UNIT
Drain-to-Source Blocking Voltage	BV_{DS}	$V_{GS} = 0\text{ V}$, $I_{DSS} = 8.5\text{ }\mu\text{A}$	650			V
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 12\text{ V}$, $I_D = 0.9\text{ A}$		130	182	$\text{m}\Omega$
Drain-to-Source On Resistance	$R_{DS(on)}$	$T_J = 150\text{ }^{\circ}\text{C}$ $V_{GS} = 12\text{ V}$, $I_D = 0.9\text{ A}$		350		$\text{m}\Omega$
Source-to-Drain Voltage	$V_{SD(on)}$	$V_{GS} = 0\text{ V}$, $I_D = 0.9\text{ A}$		2.0	2.6	V
Gate-to-Source Threshold	$V_{GS(th)}$	$V_{DS} = 0.1\text{ V}$, $I_D = 4.2\text{ mA}$	2.3	2.9	3.5	V
Gate-to-Source Threshold	$V_{GS(th)}$	$T_J = 150\text{ }^{\circ}\text{C}$ $V_{DS} = 0.1\text{ V}$, $I_D = 4.2\text{ mA}$		2.6		V
Gate-to-Source Current	I_{GS}	$V_{GS} = 12\text{ V}$, $V_{DS} = 0\text{ V}$		2.8	3.7	mA
Gate-to-Source Current	I_{GS}	$T_J = 150\text{ }^{\circ}\text{C}$ $V_{GS} = 12\text{ V}$, $V_{DS} = 0\text{ V}$		2.5		mA
V_{DD} current	I_{VDD}	$V_{GS} = 12\text{ V}$, $V_{DS} = 0\text{ V}$		1.8	2.8	mA
V_{DD} current	I_{VDD}	$T_J = 150\text{ }^{\circ}\text{C}$ $V_{GS} = 12\text{ V}$, $V_{DS} = 0\text{ V}$		1.1		mA
Drain-to-Source Leakage Current	I_{DSS}	$V_{GS} = 0\text{ V}$, $V_{DS} = 650\text{ V}$		0.2	8.5	μA
Drain-to-Source Leakage Current	I_{DSS}	$T_J = 150\text{ }^{\circ}\text{C}$ $V_{GS} = 0\text{ V}$, $V_{DS} = 650\text{ V}$		12		μA

DYNAMIC CHARACTERISTICS

PARAMETER		CONDITIONS	MIN	TYP	MAX	UNIT
Output Capacitance	C_{OSS}	$V_{DS} = 400\text{ V}$, $V_{GS} = 0\text{ V}$ $f = 100\text{ kHz}$		25		pF
Output Charge	Q_{OSS}	$V_{DS} = 400\text{ V}$, $V_{GS} = 0\text{ V}$		25		nC
Total Gate Charge ²	Q_G	$V_{DS} = 400\text{ V}$, $V_{GS} = 0\text{...}12\text{ V}$ $I_D = 4.2\text{ A}$, $I_G = 20\text{ mA}$		2.3		nC
Reverse Recovery Charge	Q_{RR}	$I_S = 8\text{ A}$, $V_{DS} = 400\text{ V}$		0		nC
Turn-on delay time	$t_{d(on)}$	See Figure 15 and Figure 16		6		ns
Turn-off delay time	$t_{d(off)}$	See Figure 15 and Figure 16		20		ns
Rise time	t_r	See Figure 15 and Figure 16		6		ns
Fall time	t_f	See Figure 15 and Figure 16		6		ns

² Turn-on gate charge value is listed. Turn-off gate charge value is lower, because ICeGaN™ discharges the gate internally.

CURRENT SENSING

Please refer to the application note CG-AN2206: Current Sensing with ICeGaN™. Please contact CGD for advice on the use of the current sense function.

ESD RATING

PARAMETER		CONDITIONS	MIN	TYP	MAX	UNIT
ESD withstand rating	HBM	Human Body Model (per JEDEC JS-001-2017)	2000			V
ESD withstand rating	CDM	Charged Device Model (per JEDEC JS-002-2018)	1000			V

Thermal Characteristics

PARAMETER		CONDITIONS	MIN	TYP	MAX	UNIT
Thermal resistance, junction to case	$R_{th(jc)}$			2.3		K/W
Reflow soldering temperature	T_{reflow}	MSL3			260	°C

Figures

Figures at $T_J = 25\text{ }^{\circ}\text{C}$, $V_{DD} = 12\text{ V}$ if not specified.

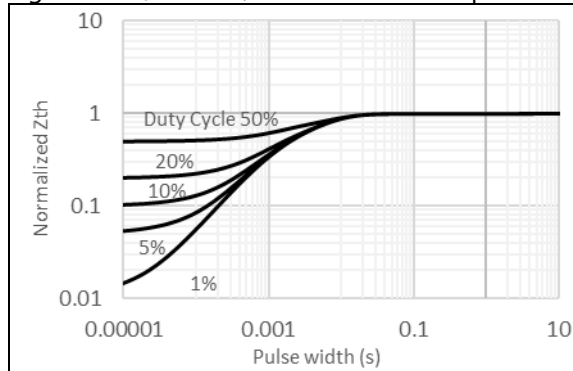


Figure 1. Normalized thermal transient impedance (Z_{thJC}) as a function of pulse width.

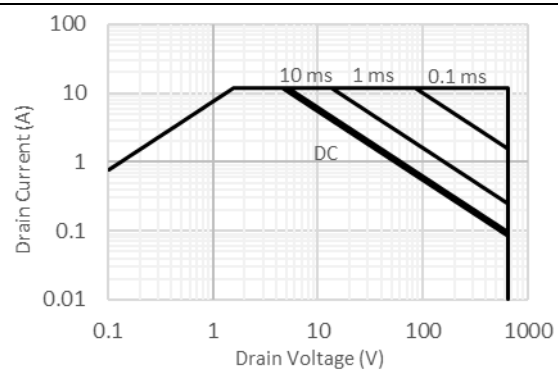


Figure 2. Safe Operating Area (SOA) based on thermal impedance Z_{thJC} at $T_{CASE} = 25\text{ }^{\circ}\text{C}$.

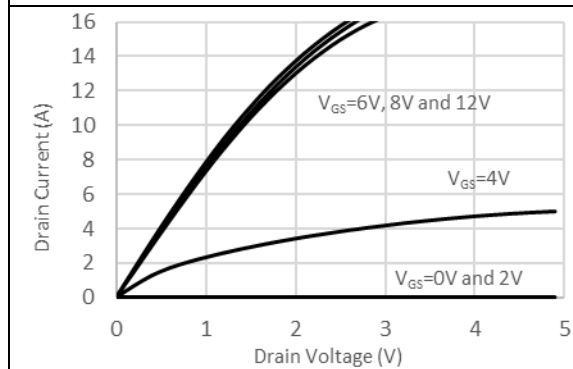


Figure 3. Forward output characteristics at $T_J = 25\text{ }^{\circ}\text{C}$.

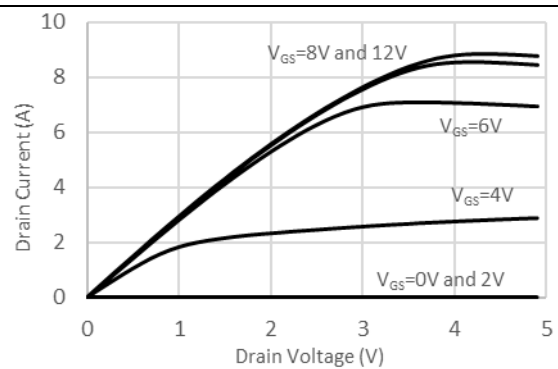


Figure 4. Forward output characteristic at $T_J = 150\text{ }^{\circ}\text{C}$.

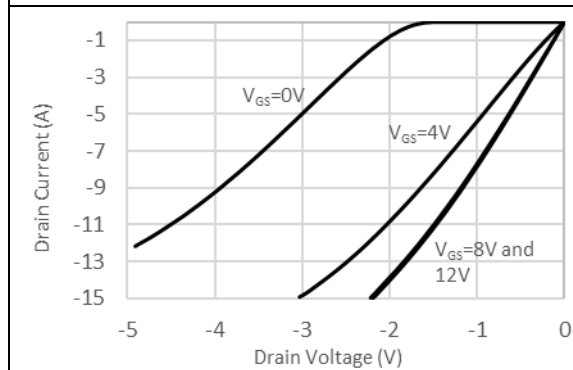


Figure 5. Reverse output characteristics at $T_J = 25\text{ }^{\circ}\text{C}$.

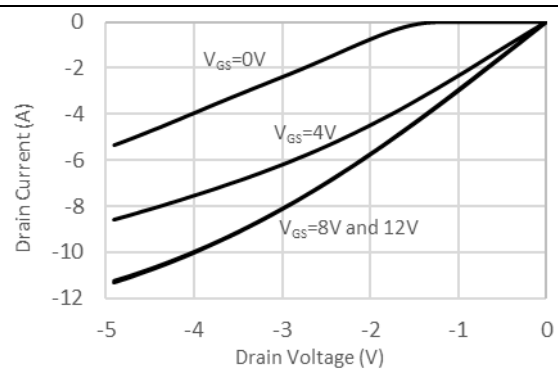


Figure 6. Reverse output characteristics at $T_J = 150\text{ }^{\circ}\text{C}$.

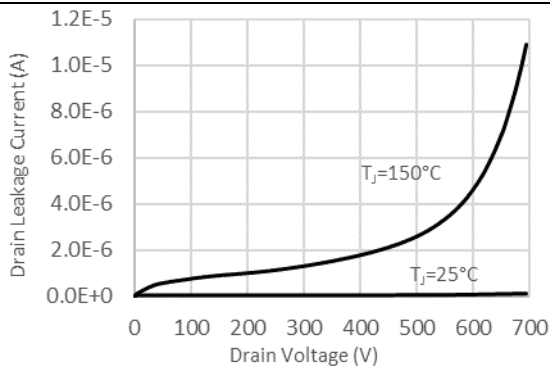


Figure 7. Drain leakage current characteristics at $T_j = 25^\circ\text{C}$ and $T_j = 150^\circ\text{C}$.

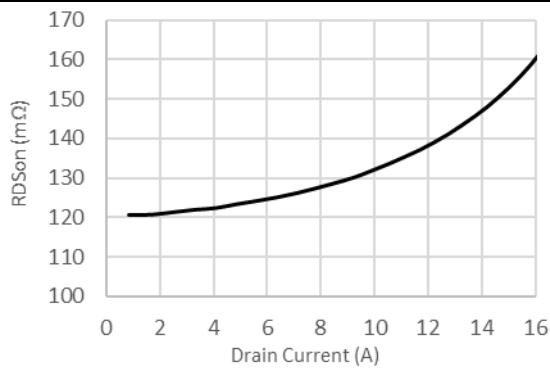


Figure 8. On-state resistance as a function of drain current at $T_j = 25^\circ\text{C}$.

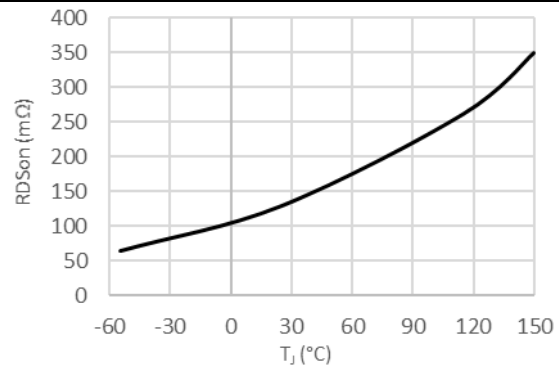


Figure 9. On-state resistance as a function of junction temperature at $V_{GS} = 12\text{ V}$.

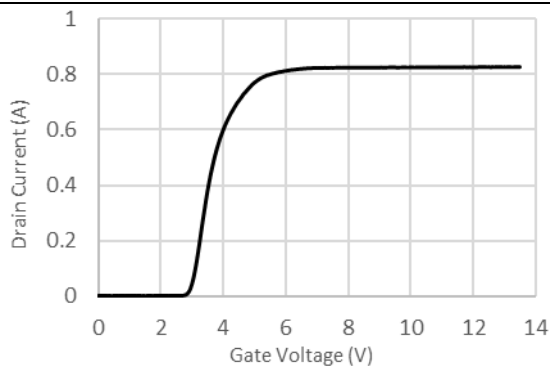


Figure 10. Transfer characteristics at $V_{DS} = 0.1\text{ V}$, $T_j = 25^\circ\text{C}$.

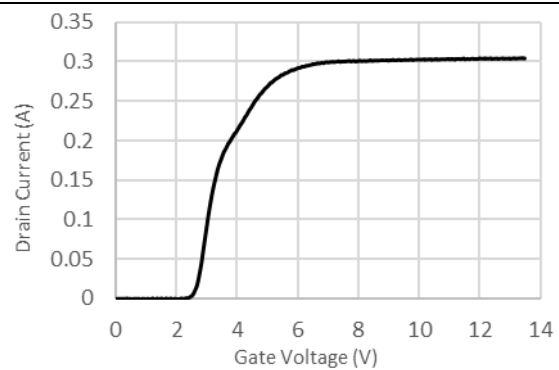


Figure 11. Transfer characteristics at $V_{DS} = 0.1\text{ V}$, $T_j = 150^\circ\text{C}$.

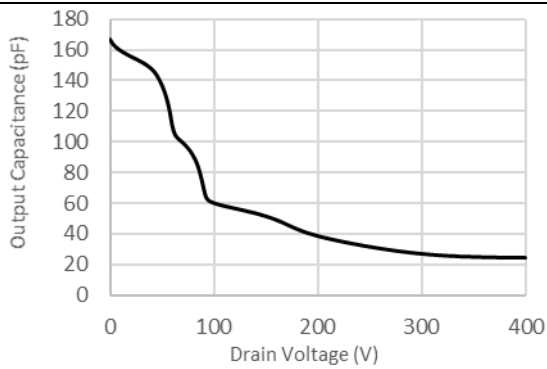


Figure 12. Typical output capacitance C_{OSS} vs. V_{DS} at 100 kHz, $T_J = 25\text{ }^{\circ}\text{C}$.

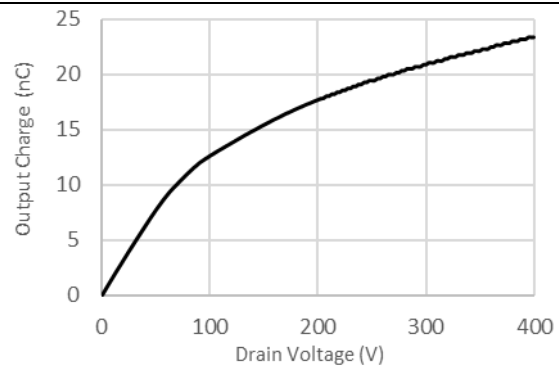


Figure 13. Typical output charge Q_{OSS} vs. V_{DS} at 100 kHz, $T_J = 25\text{ }^{\circ}\text{C}$.

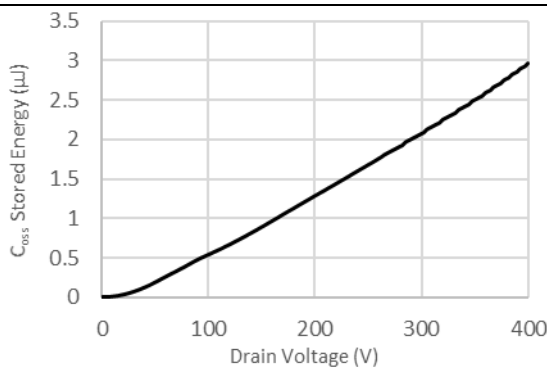


Figure 14. Typical C_{OSS} stored energy E_{OSS} vs. V_{DS} at $T_J = 25\text{ }^{\circ}\text{C}$.

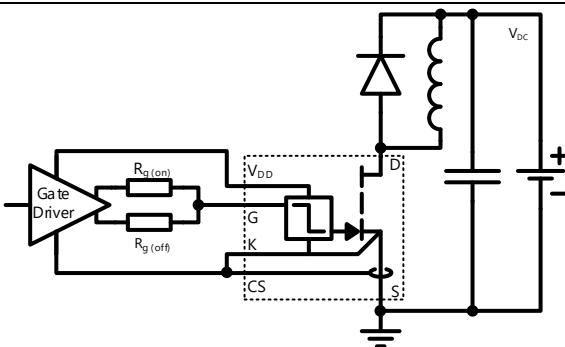


Figure 15. Inductive switching circuit. $I_D = 6\text{ A}$, $R_{g(on)} = 15\text{ }\Omega$, $R_{g(off)} = 2\text{ }\Omega$, $V_{DD} = 12\text{ V}$, $V_{DC} = 400\text{ V}$, $L = 125\text{ }\mu\text{H}$, diode = IDH04G65C5.

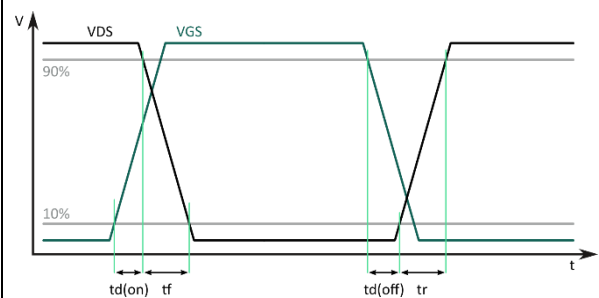


Figure 16. Switching waveform timing definitions.

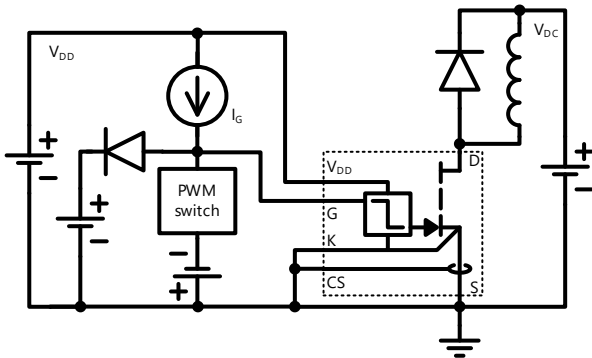


Figure 17. Q_G gate charge characterization circuit. $I_G=20\text{ mA}$, $V_{DC} = 400\text{ V}$, $V_{DD}=12\text{ V}$, $L = 125\text{ }\mu\text{H}$, freewheeling diode = IDH04G65C5.

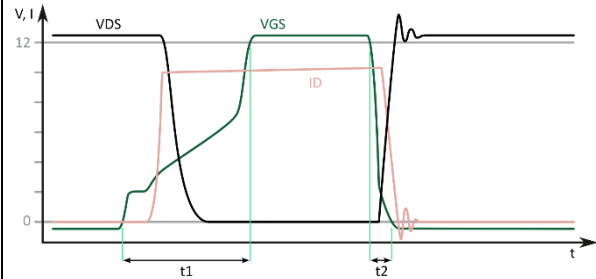
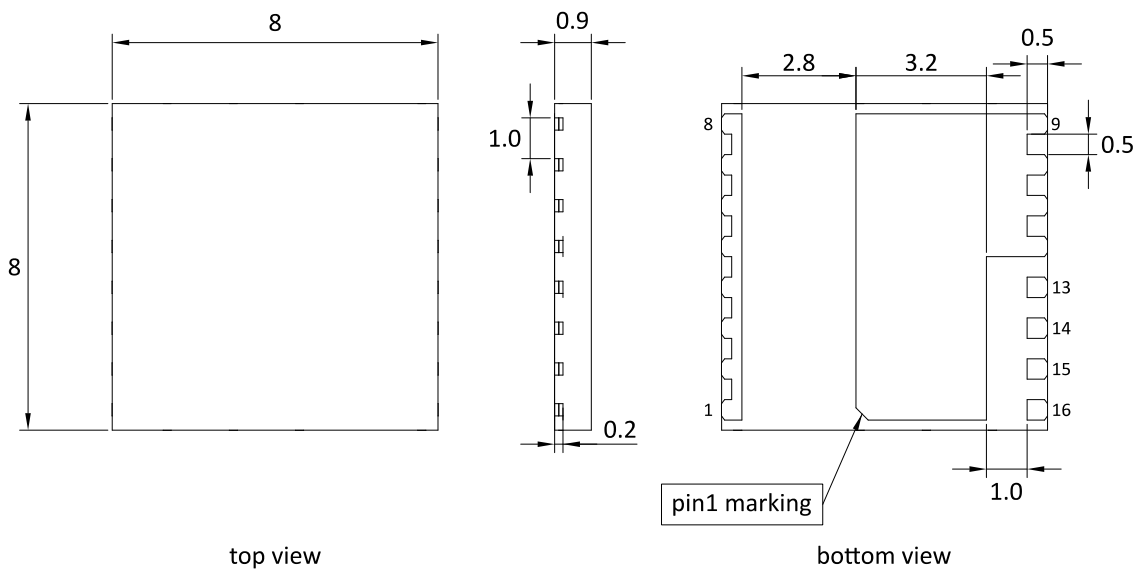
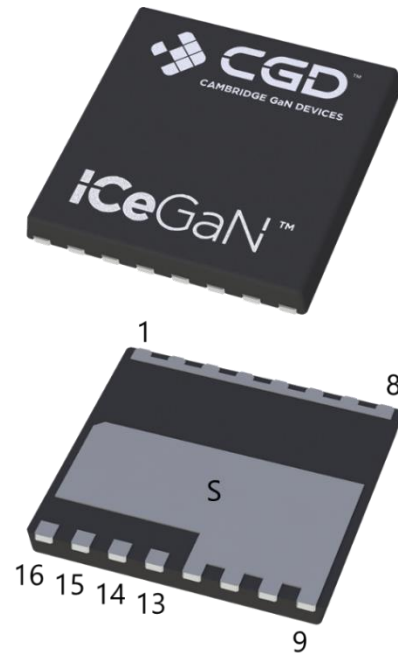


Figure 18. Q_G gate charge characterisation waveform at $I_G = 20\text{ mA}$ and $V_{DD} = 12\text{ V}$. Time intervals t_1 and t_2 indicate the integration boundaries to calculate Q_G from I_G at turn-on and turn-off. Turn-off gate charge is lower than turn-on gate charge.

Packaging

DFN8x8 mm.

PIN NUMBER	NAME
1-8	Drain
9-12	Source
13	Kelvin
14	Gate
15	Current Sense
16	V _{DD}



Version History

This version is 1.0

VERSION	DESCRIPTION	DATE	BY
1.0	Initial Release	March 2022	MA, AB, JZ

Dare to innovate differently



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