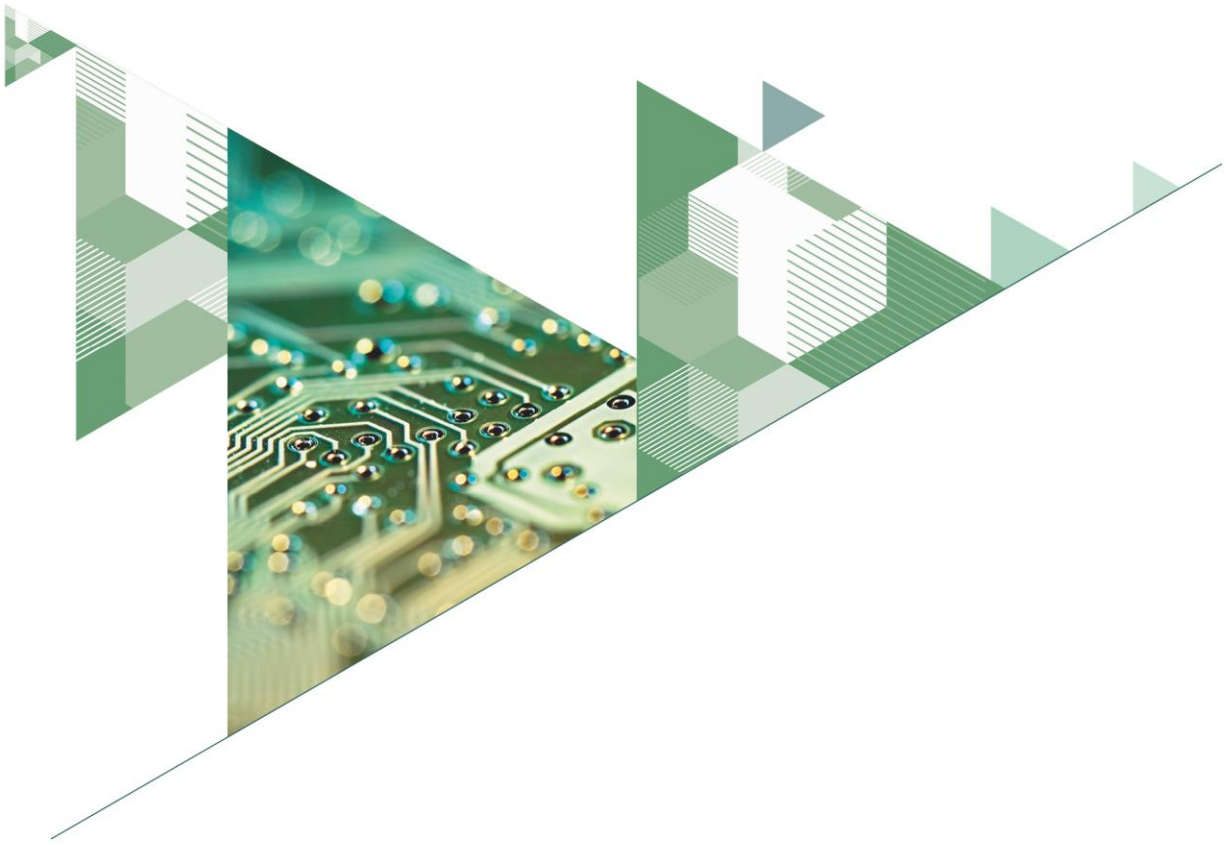


CGD65C055SP2
DATASHEET

P2 Series
650 V / 55 mΩ GaN HEMT with ICeGaN® Gate

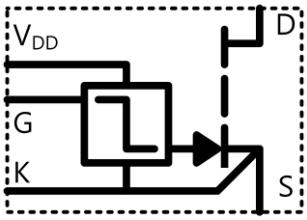
FEBRUARY 2025

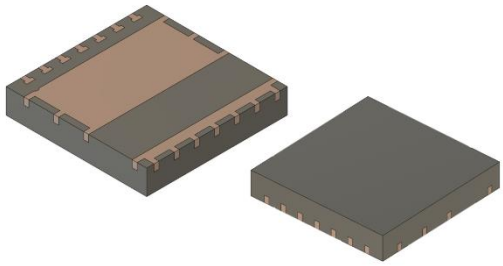
CAMBRIDGE GaN DEVICES

P2 Series
650 V / 55 mΩ GaN HEMT with ICeGaN® Gate

Key features

- 650 V – 55 mΩ / 27 A eMode GaN power switch
- ICeGaN® gate technology for high gate threshold voltage, broad gate voltage window and excellent gate robustness
- Compatible with MOSFET and IGBT drivers
- Wide gate drive voltage from 8 V to 20 V
- $R_{DS(on)}$ = 55 mΩ
- Integrated Miller Clamp for 0-V TurnOff
- Suitable for very high switching frequency
- Thermally enhanced bottom side cooled 10 × 10 mm SMD high power package
- Wettable flanks for automated optical inspection





Description

CGD65C055SP2 is a 650 V power transistor utilising the superior material attributes of enhancement mode GaN for high power applications, delivering high current, impressive breakdown voltage, and high switching frequency. Central to its design is CGD's hallmark ICeGaN® gate technology which provides a 3 V threshold voltage, genuine 0 V turn off, and a broad gate drive voltage range up to 20 V. This ensures compatibility with almost all available gate drivers and controller chips. Presented in a thermally optimised compact 10 × 10 mm SMD package with wettable flanks, this 55 mΩ GaN power transistor is tailored for bottom side cooling and superior thermal resistance, making it ideal for multi-kW applications with demanding performance criteria.

Applications

- Industrial, data centre and telecom SMPS
- Industrial motor drives
- PV inverters
- Uninterruptable power supplies
- Energy Storage System

Topologies

- AC/DC, DC/DC converters based on single-ended, half-bridge, full-bridge and three-phase topologies with hard- and soft-switching
- Bridgeless Totem pole PFC for highest efficiency
- DC/DC resonant converters
- Buck and Boost converters
- DC/AC inverters

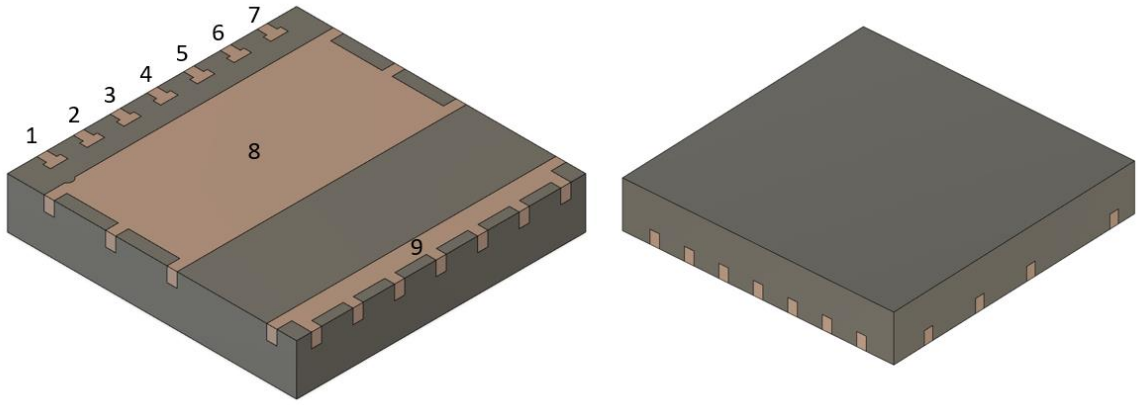


Figure 1. Package Image (Bottom View Left, Top View Right).

PIN	NAME	DESCRIPTION
1, 2, 3, 4	NC (Connect to Source)	No connect pin. Pin should always be connected to main power source via PCB layout.
5	Kelvin Source	Kelvin source connection (internally tied to power HEMT source), reference potential for gate voltage.
6	Gate	Gate signal input. Recommended gate-drive voltage: V_{drive} (V_{GS} in on-state) = 11 V to 18 V or V_{DD} (if V_{DD} < 18 V).
7	VDD	ICeGaN® gate supply voltage, relative to Kelvin Source.
8	Source	Power HEMT source, thermal pad.
9	Drain	Power HEMT drain.

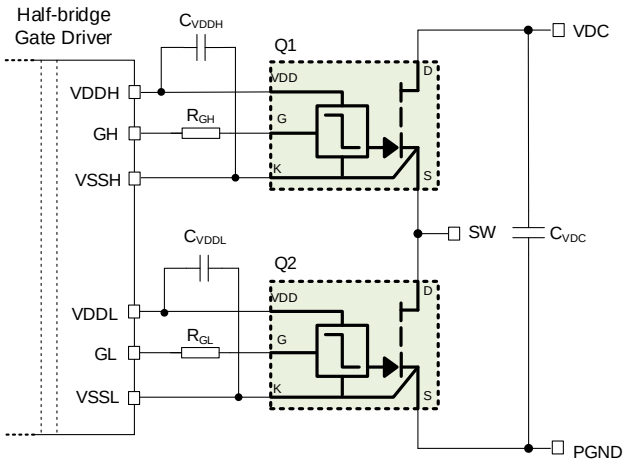


Figure 2. Example of an Application Circuit.

Absolute Maximum Ratings

T_{case} = 25 °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-Source Voltage	V_{DS}	650	V
Drain-Source Voltage - transient [1]	$V_{DS(transient)}$	750	V
Gate-to-Source Voltage	V_{GS}	-1 to +20 and $V_{GS} \leq V_{DD}$	V
Gate-to-Source Voltage – transient [2]	$V_{GS(transient)}$	-1.5 to +21.5 and $V_{GS} \leq V_{DD}$ + 1.5	V
ICeGaN® Gate Supply Voltage	V_{DD}	0 to +20	V
Continuous Drain Current (T_{case} = 25 °C)	I_D	27	A
Continuous Drain Current (T_{case} = 100 °C)	I_D	17	A
Pulsed Drain Current (10 µs, T_j = 25 °C)	I_{D_Pulse}	60	A
Pulsed Drain Current (10 µs, T_j = 150 °C)	I_{D_Pulse}	35	A

The on-state gate voltage must be above 8 V for ICeGaN circuit to work properly. The recommended range of operation for V_{drive} (V_{GS} in on-state) and V_{DD} is 11 V to 18 V for optimum performance, enabling simple integration with a large variety of control chips and gate drivers.

[1] Non-repetitive pulsed conditions, < 1 ms.
[2] Non-repetitive pulsed conditions.

Electrical Characteristics

Values at T_J = 25 °C, V_{DD} = 15 V if not listed. 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 V, I_{DSS} = 20 µA	650			V
Drain-to-Source On Resistance	$R_{DS(on)}$	V_{GS} = 15 V, I_D = 10 A		55	77	mΩ
Drain-to-Source On Resistance	$R_{DS(on)}$	T_J = 150 °C V_{GS} = 15 V, I_D = 10 A		145		mΩ
Source-to-Drain Voltage	$V_{SD(on)}$	V_{GS} = 0 V, I_D = 10 A		2.7		V
Gate-to-Source Threshold	$V_{GS(th)}$	V_{DS} = 0.1 V, I_D = 10 mA	2.2	2.9	4.2	V
Gate-to-Source Threshold	$V_{GS(th)}$	T_J = 150 °C V_{DS} = 0.1 V, I_D = 10 mA		2.6		V
Gate-to-Source Current	I_{GS}	V_{GS} = 15 V, V_{DS} = 0 V		3.5	5.5	mA
Gate-to-Source Current	I_{GS}	T_J = 150 °C V_{GS} = 15 V, V_{DS} = 0 V		2.4		mA
V_{DD} Current (V_{GS} in on-state)	I_{VDD}	V_{GS} = 15 V, V_{DS} = 0 V		1.2	2.2	mA
V_{DD} Current (V_{GS} in on-state)	I_{VDD}	T_J = 150 °C V_{GS} = 15 V, V_{DS} = 0 V		0.6		mA
V_{DD} Current (V_{GS} in off-state)	I_{VDD}	V_{GS} = 0 V, V_{DS} = 0 V		90	150	µA
V_{DD} Current (V_{GS} in off-state)	I_{VDD}	T_J = 150 °C V_{GS} = 0 V, V_{DS} = 0 V		45		µA
V_{DD} Start-up Current (V_{GS} in off-state)	I_{VDD_start}	V_{GS} = 0 V, V_{DS} = 0 V		250		µA
Drain-to-Source Leakage Current	I_{DSS}	V_{GS} = 0 V, V_{DS} = 650 V		0.7	20	µA
Drain-to-Source Leakage Current	I_{DSS}	T_J = 150 °C V_{GS} = 0 V, V_{DS} = 650 V		30		µA

CGD65C055SP2 features an advanced NL^3 (No Load, Light Load) Circuit that leads to near-zero device losses at no-load conditions through very low V_{DD} current while V_{GS} is in off-state.

DYNAMIC CHARACTERISTICS

PARAMETER		CONDITIONS	MIN	TYP	MAX	UNIT
Output Capacitance[3]	C_{OSS}	V_{DS} = 400 V, V_{GS} = 0 V f = 100 kHz		48		pF
Output Capacitance Stored Energy	E_{OSS}			6		µJ
Effective Output Capacitance, Energy Related[4]	$C_{O(ER)}$	V_{DS} = 0 V to 400 V, V_{GS} = 0 V		75		pF
Effective Output Capacitance, Time Related[5]	$C_{O(TR)}$			119		pF
Output Charge	Q_{OSS}	V_{DS} = 400 V, V_{GS} = 0 V		48		nC
Total Gate Charge[6]	Q_G	V_{DS} = 400 V, V_{GS} = 0...15 V, I_D = 10 A, I_G = 40 mA		4		nC
Reverse Recovery Charge	Q_{RR}			0		nC
Turn-on Switching Energy	E_{ON}	V_{DS}= 400 V, V_{DD}=V_{GS}=15 V, T_j=25 °C, I_D = 10 A $R_{g(on)}$ = 15 Ω, $R_{g(off)}$ =1 Ω L= 125 µH, L_p =3 nH, see Figure 18 and Figure 19		33		µJ
Turn-off Switching Energy	E_{OFF}			9.5		µJ
Turn-on Delay Time	$t_{d(on)}$			7.8		ns
Turn-off Delay Time	$t_{d(off)}$			18		ns
Rise Time	t_r			7.8		ns
Fall Time	t_f			3.7		ns

ESD RATING

PARAMETER		CONDITIONS	MIN	TYP	MAX	UNIT
ESD withstand rating	HBM	Human Body Model (per JEDEC JS-001-2017)		2000		V

Thermal Characteristics

Typical values unless otherwise specified.

PARAMETER		CONDITIONS	VALUE	UNIT
Thermal Resistance, Junction to Case	$R_{th(JC)}$		0.65	K/W
Reflow Soldering Temperature	T_{reflow}	MSL3	260	°C

[3] Evaluated using small-signal measurements.

[4] $C_{O(ER)}$ is the value of fixed capacitance that stores the same amount of energy as C_{OSS} when V_{DS} changes from 0 V to a given V_{DS}.

[5] $C_{O(TR)}$ is the value of fixed capacitance that takes the same amount of charging time as C_{OSS} when V_{DS} changes from 0 V to a given V_{DS}, assuming a constant-current charging process.

[6] Turn-on gate charge value is listed. Turn-off gate charge value would be lower, because ICeGaN® discharges the gate internally.

Figures

Figures at T_J = 25 °C, V_{DD} = 15 V if not specified.

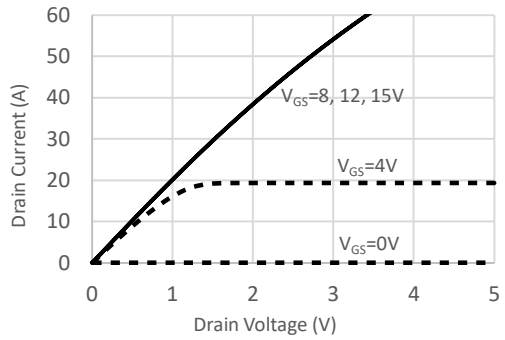


Figure 3. Forward output characteristics at T_J = 25 °C.

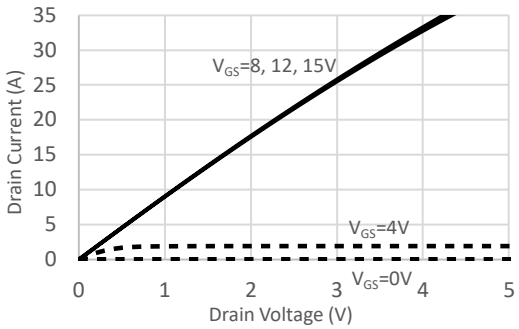


Figure 4. Forward output characteristics at T_J = 150 °C.

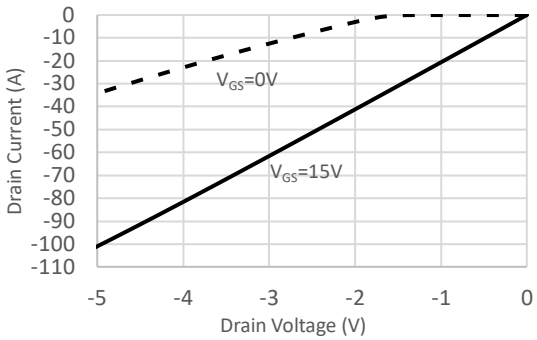


Figure 5. Reverse output characteristics at T_J = 25 °C

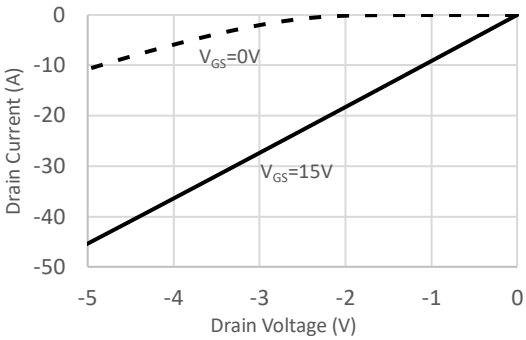


Figure 6. Reverse output characteristics at T_J = 150 °C.

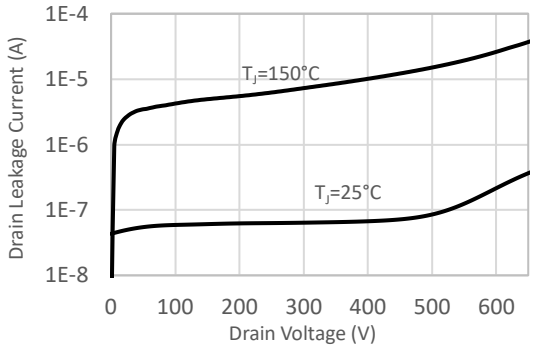


Figure 7. Drain leakage current characteristics at T_J = 25 °C and T_J = 150 °C.

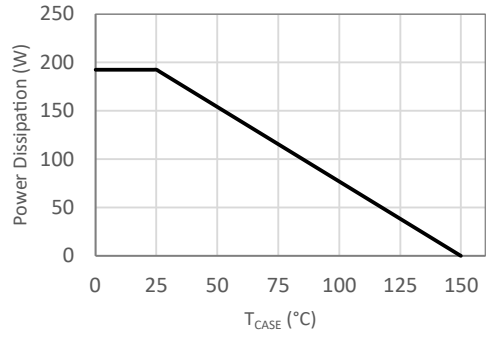


Figure 8. Power dissipation derating with case temperature.

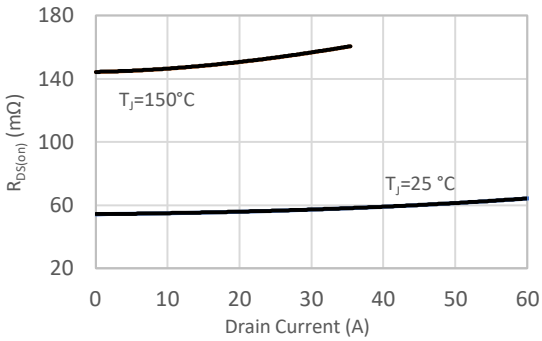


Figure 9. On-state resistance as a function of drain current at T_J = 25 °C and 150 °C at V_{GS} = 15 V.

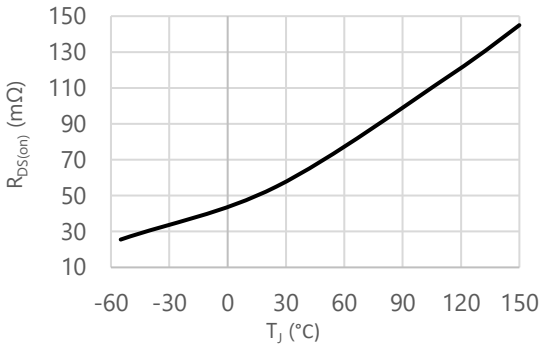


Figure 10. On-state resistance as a function of junction temperature at V_{GS} = 15 V.

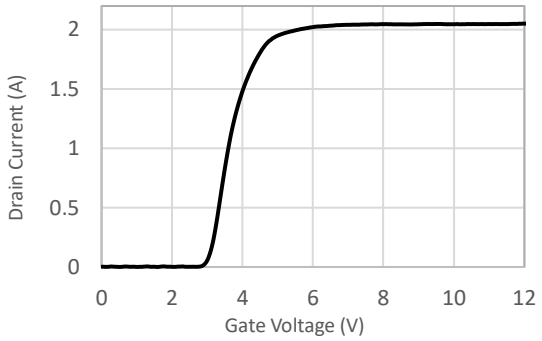


Figure 11. Transfer characteristics at V_{DS} = 0.1 V, T_J = 25 °C.

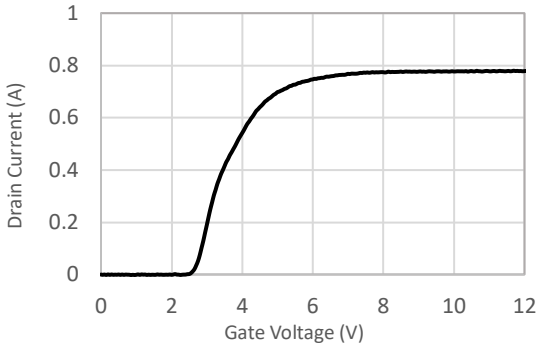


Figure 12. Transfer characteristics at V_{DS} = 0.1 V, T_J = 150 °C.

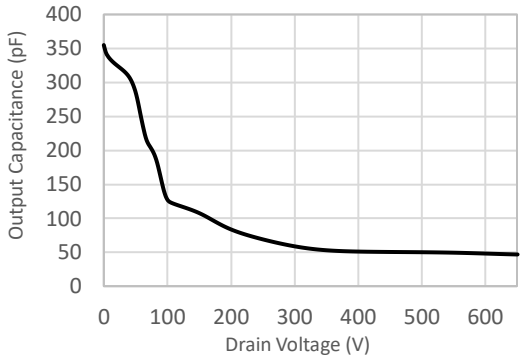


Figure 13. Typical output capacitance C_{OSS} vs. V_{DS} at 100 kHz, T_J = 25 °C.

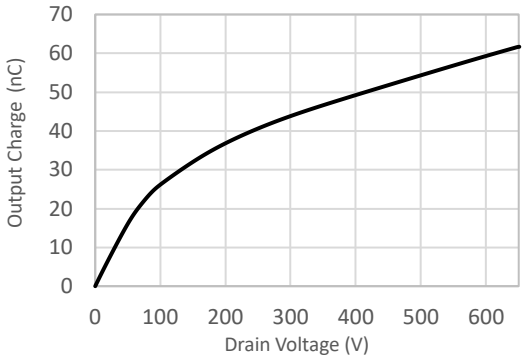


Figure 14. Typical output charge Q_{OSS} vs. V_{DS} at 100 kHz, T_J = 25 °C.

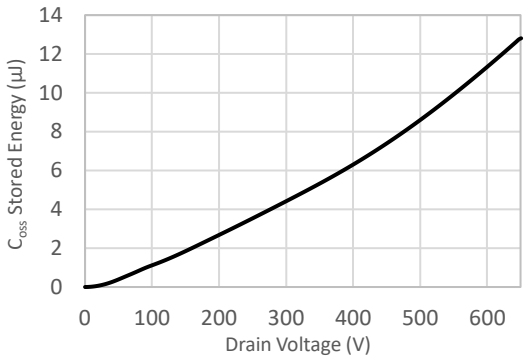


Figure 15. Typical C_{OSS} stored energy C_{OSS} vs. V_{DS} at 100 kHz, T_J = 25 °C.

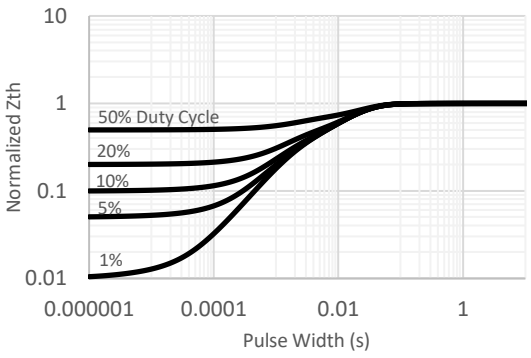


Figure 16. Normalized thermal transient impedance ($Z_{th,JC}$) as a function of pulse width.

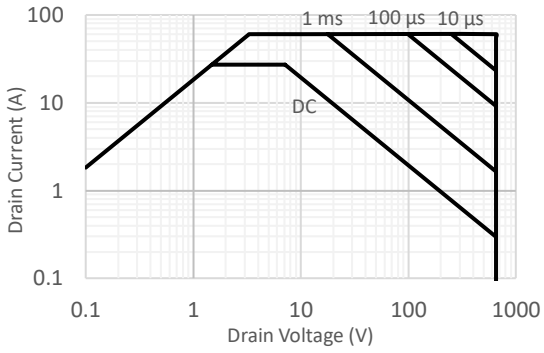


Figure 17. Safe Operating Area (SOA) based on thermal impedance $Z_{th,JC}$ at T_{case} = 25 °C.

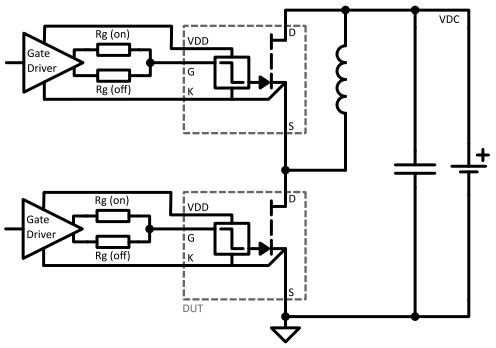


Figure 18. Inductive switching circuit. I_D = 10 A, $R_{g(on)}$ = 15 Ω, $R_{g(off)}$ = 1 Ω, V_{DD} = 15 V, V_{DC} = 400 V, L = 125 µH.

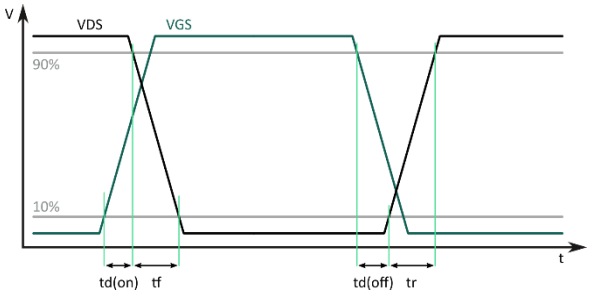


Figure 19. Switching waveform timing definitions.

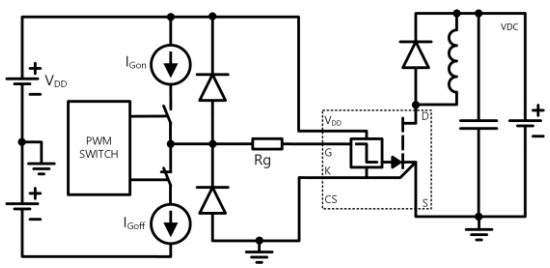


Figure 20. Q_G gate charge characterisation circuit. I_{Gon} = 40 mA, I_{Goff} = 40 mA, V_{DC} = 400 V, V_{DD}=15V, L = 125 µH, Freewheeling Diode = C4D02120A.

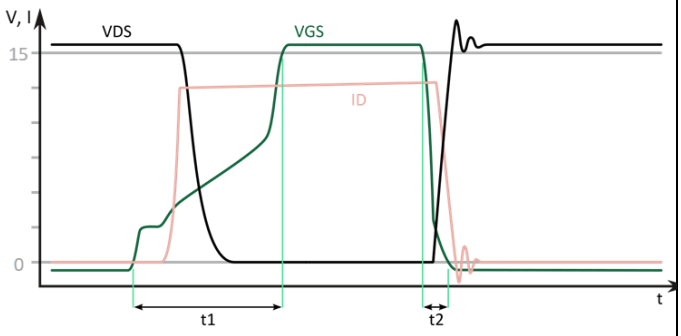
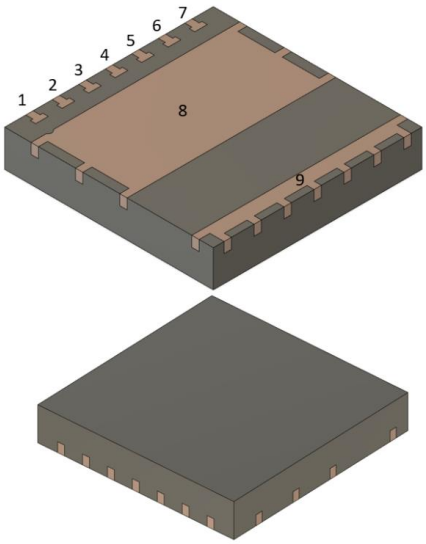


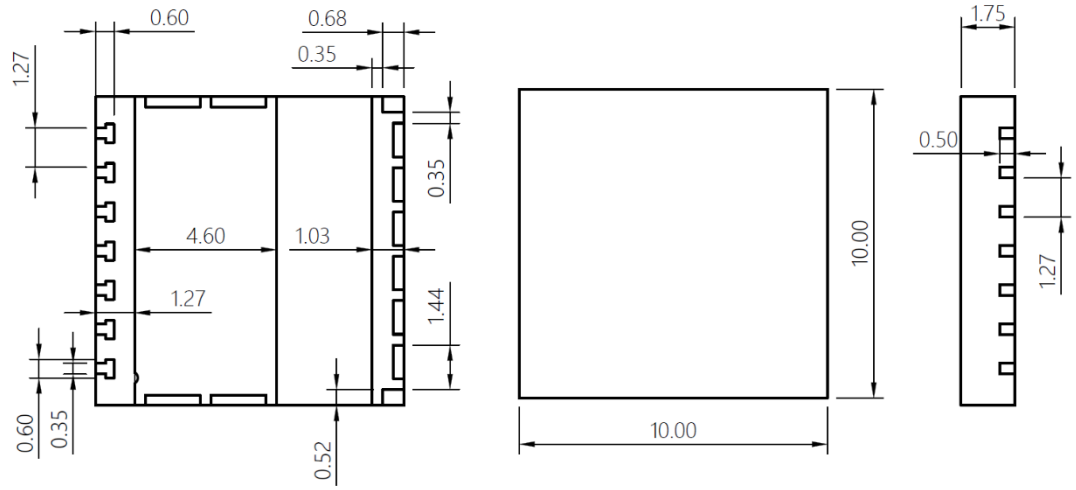
Figure 21. Q_G gate charge characterisation waveform at I_G = 40 mA and V_{DD} = 15 V. Time intervals t1 and t2 indicate the integration boundaries to calculate Q_G from I_G at turn-on and turn-off. Turn-off gate charge is lower than turn-on gate charge.

Packaging

Bottom-side cooled BHDFN-9-1 10 × 10 mm SMD.

PIN NUMBER	NAME
1, 2, 3, 4	NC (Connect to Source)
5	Kelvin Source
6	Gate
7	VDD
8	Source
9	Drain





BOTTOM VIEW TOP VIEW SIDE VIEW

CGD65C055SP2 devices have the following marking on the package: 65R1P2.

Like any unwanted electronic device, CGD components should be recycled or otherwise disposed of in accordance with local laws and regulations.

Version History

This version is 1.0.

VERSION	DESCRIPTION	DATE	BY
1.0	Initial release	12/02/2025	NG

Dare to innovate differently

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