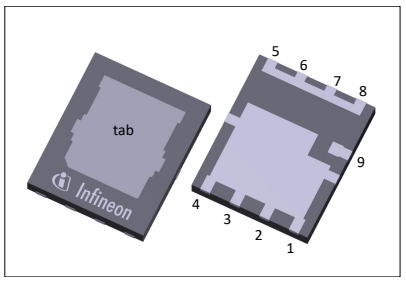
MOSFET

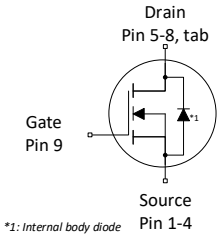
OptiMOS™ 6 Power-Transistor, 40 V

PG-WHTFN-9



Features

- N-channel, logic level
- Very low on-resistance $R_{DS(on)}$
- Superior thermal resistance
- Optimized design for double side cooling
- 100% avalanche tested
- Pb-free lead plating; RoHS compliant
- Halogen-free according to IEC61249-2-21



Product validation

Fully qualified according to JEDEC for Industrial Applications

Table 1 Key performance parameters

Parameter	Value	Unit
V_{DS}	40	V
$R_{DS(on),max}$	0.49	mΩ
I_D	611	A
Q_{oss}	142	nC
Q_G	62	nC

Hal Pb RoHS

Type / Ordering code	Package	Marking	Related links
IQDH45N04LM6CGSC	PG-WHTFN-9	MA	-

Table of contents

1 Maximum ratings

at T_A=25 °C, unless otherwise specified

Table 2 Maximum ratings

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Continuous drain current [1]	I_D	-	-	611 432 397 58	A	V_{GS}=10 V, T_C=25 °C V_{GS}=10 V, T_C=100 °C V_{GS}=4.5 V, T_C=100 °C V_{GS}=10 V, T_A=25 °C, R_{THJA}=50 °C/W [2]
Pulsed drain current [3]	$I_{D,pulse}$	-	-	2444	A	T_C=25 °C
Avalanche energy, single pulse [4]	E_{AS}	-	-	1115	mJ	I_D=50 A, R_{GS}=25 Ω
Gate source voltage	V_{GS}	-20	-	20	V	-
Power dissipation	P_{tot}	-	-	333 3.0	W	T_C=25 °C T_A=25 °C, R_{thJA}=50 °C/W [2]
Operating and storage temperature	T_j, T_{stg}	-55	-	175	°C	-

[1] Rating refers to the product only with datasheet specified absolute maximum values, maintaining case temperature as specified. For other case temperatures please refer to Diagram 2. De-rating will be required based on the actual environmental conditions.

[2] Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm^2 (one layer, 70 µm thick) copper area for source connection. PCB is vertical in still air.

[3] See Diagram 3 for more detailed information

[4] See Diagram 13 for more detailed information

2 Thermal characteristics

Table 3 Thermal characteristics

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case, bottom	R_{thJC}	-	-	0.45	°C/W	-
Thermal resistance, junction - case, top	R_{thJC}	-	-	0.56	°C/W	-
Thermal resistance, junction - ambient, 6 cm^2 cooling area [5]	R_{thJA}	-	-	50	°C/W	-

[5] Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm^2 (one layer, 70 µm thick) copper area for source connection. PCB is vertical in still air.

3 Electrical characteristics

at T_j=25 °C, unless otherwise specified

Table 4 Static characteristics

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage	$V_{(BR)DSS}$	40	-	-	V	V_{GS}=0 V, I_D=1 mA
Gate threshold voltage	$V_{GS(th)}$	1.3	1.6	2.3	V	V_{DS}=V_{GS}, I_D=1449 µA
Zero gate voltage drain current	I_{DSS}	-	0.1 10	1 100	µA	V_{DS}=40 V, V_{GS}=0 V, T_j=25 °C V_{DS}=40 V, V_{GS}=0 V, T_j=125 °C
Gate-source leakage current	I_{GSS}	-	10	100	nA	V_{GS}=20 V, V_{DS}=0 V
Drain-source on-state resistance	$R_{DS(on)}$	-	0.4 0.5	0.49 0.58	mΩ	V_{GS}=10 V, I_D=50 A V_{GS}=4.5 V, I_D=50 A
Gate resistance	R_G	-	0.68	-	Ω	-
Transconductance	g_{fs}	185	370	-	S	$\|V_{DS}\|\geq 2\|I_D\|R_{DS(on)max}$, I_D=50 A

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Input capacitance [6]	C_{iss}	-	9000	12000	pF	V_{GS}=0 V, V_{DS}=20 V, f=1 MHz
Output capacitance [6]	C_{oss}	-	2900	3800	pF	V_{GS}=0 V, V_{DS}=20 V, f=1 MHz
Reverse transfer capacitance [6]	C_{rss}	-	68	120	pF	V_{GS}=0 V, V_{DS}=20 V, f=1 MHz
Turn-on delay time	$t_{d(on)}$	-	9	-	ns	V_{DD}=20 V, V_{GS}=10 V, I_D=50 A, $R_{G,ext}$=1.6 Ω
Rise time	t_r	-	6	-	ns	V_{DD}=20 V, V_{GS}=10 V, I_D=50 A, $R_{G,ext}$=1.6 Ω
Turn-off delay time	$t_{d(off)}$	-	49	-	ns	V_{DD}=20 V, V_{GS}=10 V, I_D=50 A, $R_{G,ext}$=1.6 Ω
Fall time	t_f	-	14	-	ns	V_{DD}=20 V, V_{GS}=10 V, I_D=50 A, $R_{G,ext}$=1.6 Ω

[6] Defined by design. Not subject to production test.

Table 6 Gate charge characteristics [7)]

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	23	-	nC	V_{DD}=20 V, I_D=50 A, V_{GS}=0 to 4.5 V
Gate charge at threshold	$Q_{g(th)}$	-	14	-	nC	V_{DD}=20 V, I_D=50 A, V_{GS}=0 to 4.5 V
Gate to drain charge [8)]	Q_{gd}	-	15	23	nC	V_{DD}=20 V, I_D=50 A, V_{GS}=0 to 4.5 V
Switching charge	Q_{sw}	-	23	-	nC	V_{DD}=20 V, I_D=50 A, V_{GS}=0 to 4.5 V
Gate charge total [8)]	Q_g	-	62	78	nC	V_{DD}=20 V, I_D=50 A, V_{GS}=0 to 4.5 V
Gate plateau voltage	$V_{plateau}$	-	2.5	-	V	V_{DD}=20 V, I_D=50 A, V_{GS}=0 to 4.5 V
Gate charge total [8)]	Q_g	-	129	172	nC	V_{DD}=20 V, I_D=50 A, V_{GS}=0 to 10 V
Gate charge total, sync. FET	$Q_{g(sync)}$	-	54	-	nC	V_{DS}=0.1 V, V_{GS}=0 to 4.5 V
Output charge [8)]	Q_{oss}	-	142	189	nC	V_{DS}=20 V, V_{GS}=0 V

[7)] See "Gate charge waveforms" for parameter definition

[8)] Defined by design. Not subject to production test.

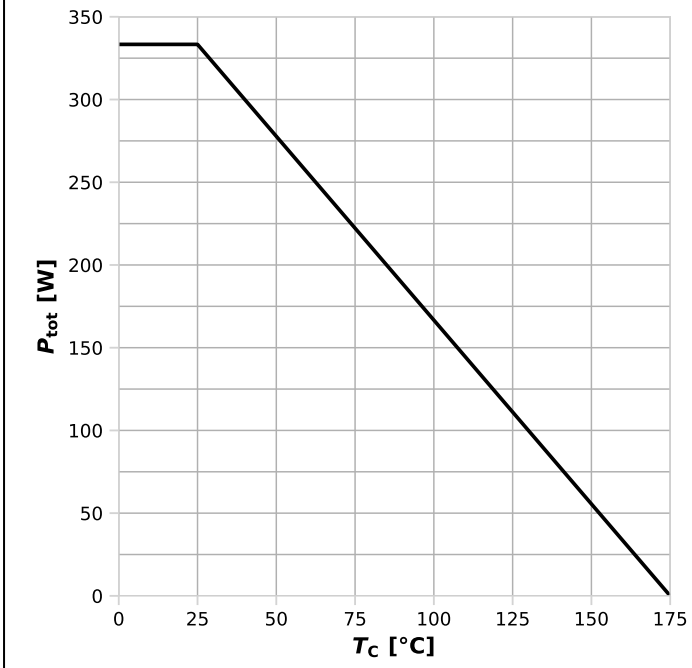
Table 7 Reverse diode

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Diode continuous forward current	I_S	-	-	285	A	T_C=25 °C
Diode pulse current	$I_{S,pulse}$	-	-	2444	A	T_C=25 °C
Diode forward voltage	V_{SD}	-	0.76	1.0	V	V_{GS}=0 V, I_F=50 A, T_j=25 °C
Reverse recovery time [9)]	t_{rr}	-	54	108	ns	V_R=20 V, I_F=25 A, di_F/dt=100 A/µs
Reverse recovery charge [9)]	Q_{rr}	-	63	126	nC	V_R=20 V, I_F=25 A, di_F/dt=100 A/µs
Reverse recovery time [9)]	t_{rr}	-	31	62	ns	V_R=20 V, I_F=50 A, di_F/dt=1000 A/µs
Reverse recovery charge [9)]	Q_{rr}	-	277	554	nC	V_R=20 V, I_F=50 A, di_F/dt=1000 A/µs

[9)] Defined by design. Not subject to production test.

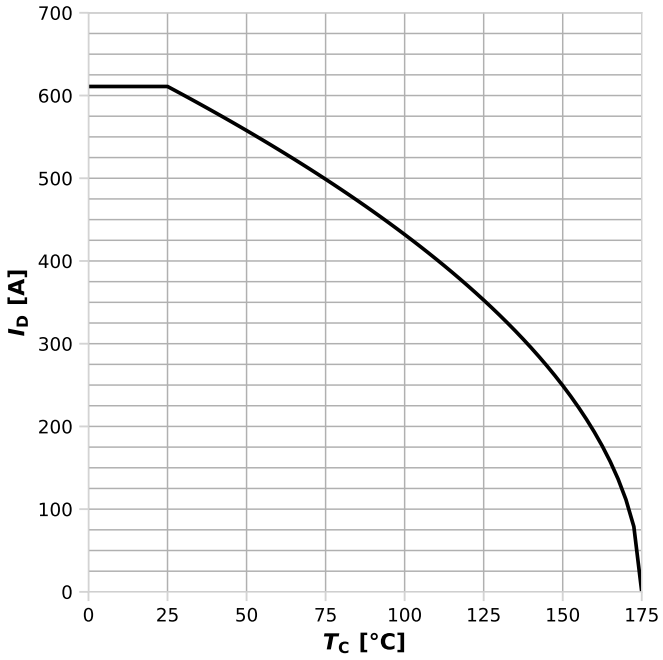
4 Electrical characteristics diagrams

Diagram 1: Power dissipation



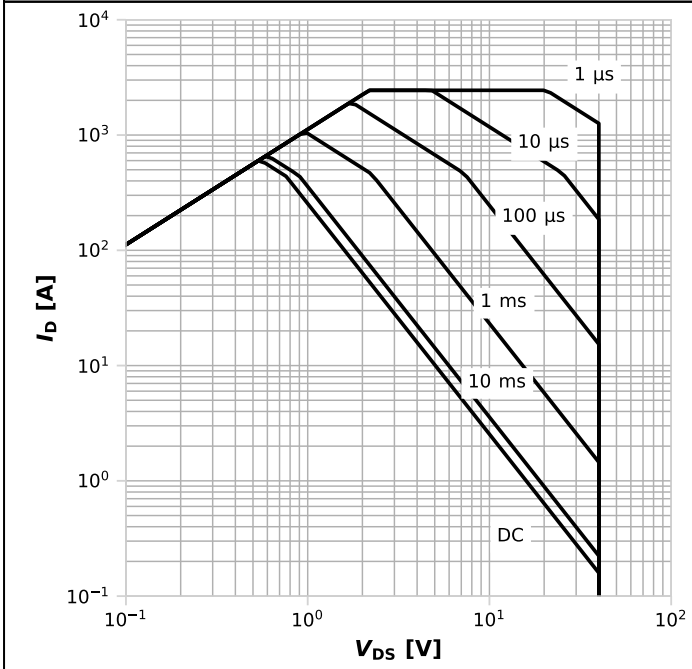
P_{tot}=f(T_C)

Diagram 2: Drain current



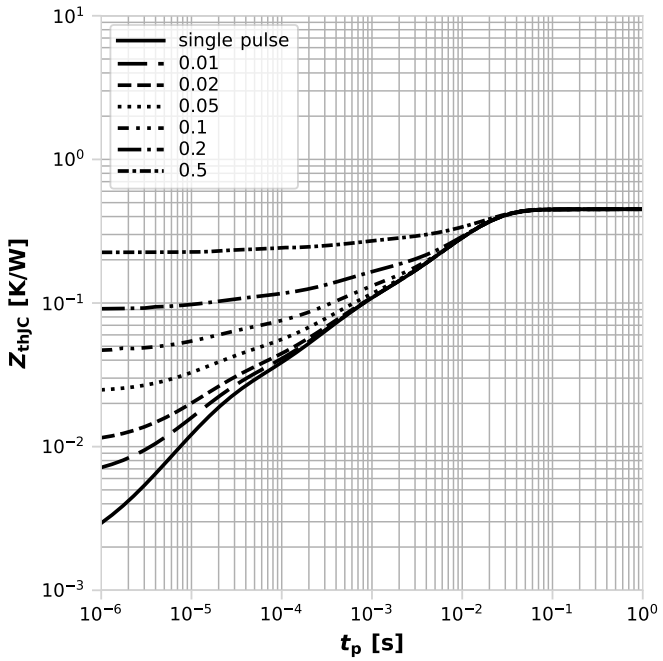
I_D=f(T_C); V_{GS}≥10 V

Diagram 3: Safe operating area



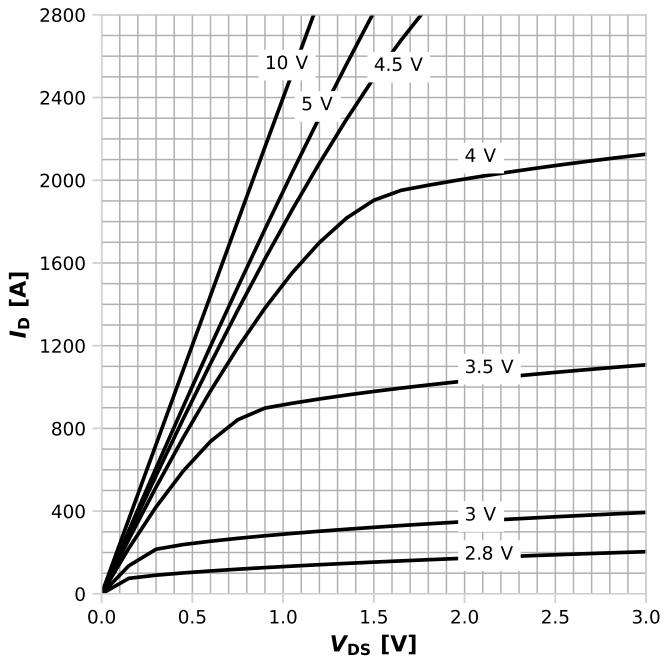
I_D=f(V_{DS}); T_C=25 °C; D=0; parameter: t_p

Diagram 4: Max. transient thermal impedance



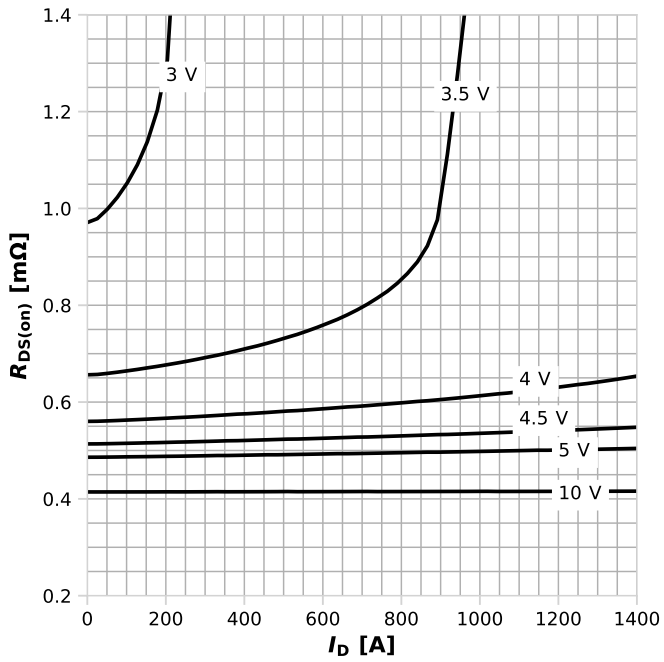
Z_{thJC}=f(t_p); parameter: D=t_p/T

Diagram 5: Typ. output characteristics



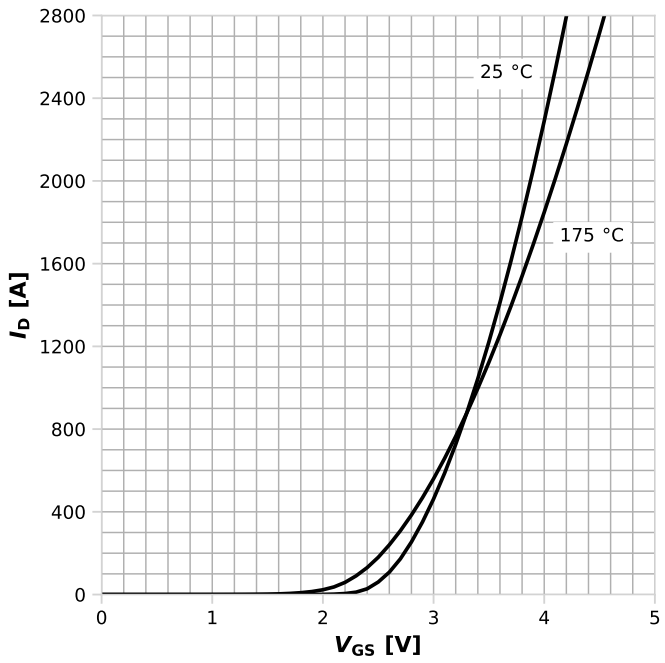
I_D=f(V_{DS}), T_j=25 °C; parameter: V_{GS}

Diagram 6: Typ. drain-source on resistance



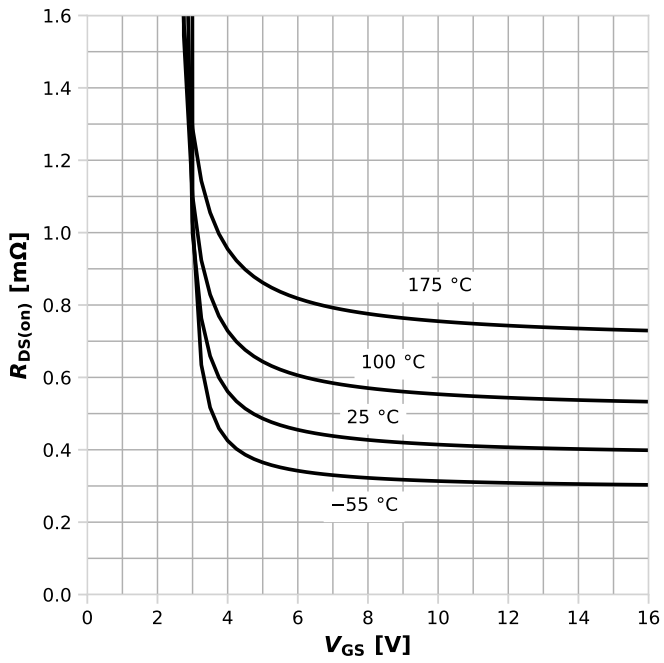
$R_{DS(on)}$=f(I_D), T_j=25 °C; parameter: V_{GS}

Diagram 7: Typ. transfer characteristics



I_D=f(V_{GS}), $|V_{DS}|>2|I_D|R_{DS(on)max}$; parameter: T_j

Diagram 8: Typ. drain-source on resistance



$R_{DS(on)}$=f(V_{GS}), I_D=50 A; parameter: T_j

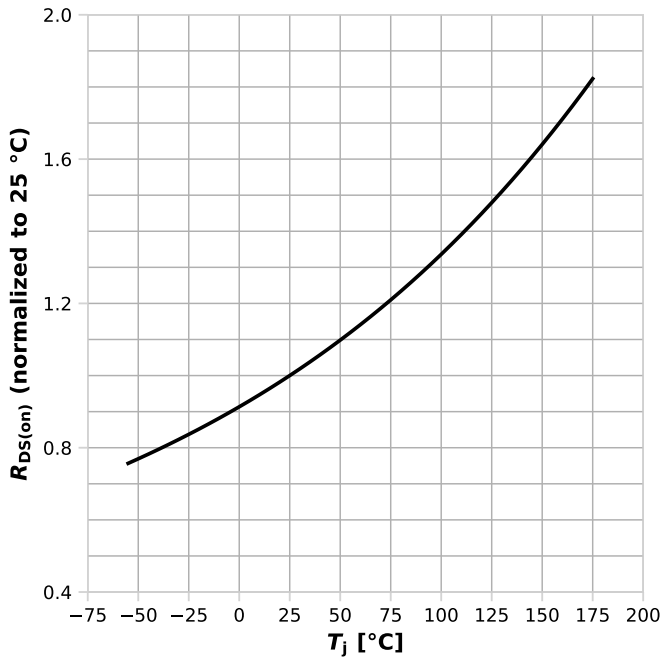
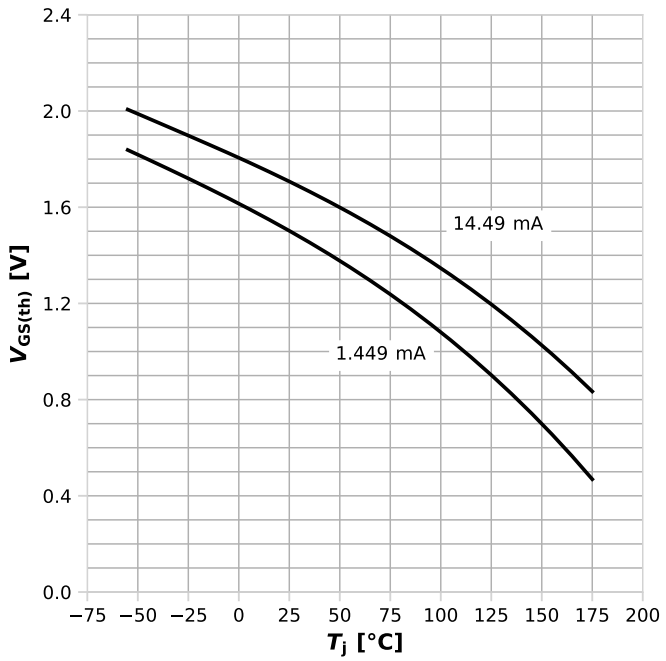
Diagram 9: Normalized drain-source on resistance	Diagram 10: Typ. gate threshold voltage
	
$R_{DS(on)}$=f(T_j), I_D=50 A, V_{GS}=10 V	$V_{GS(th)}$=f(T_j), V_{GS}=V_{DS}; parameter: I_D

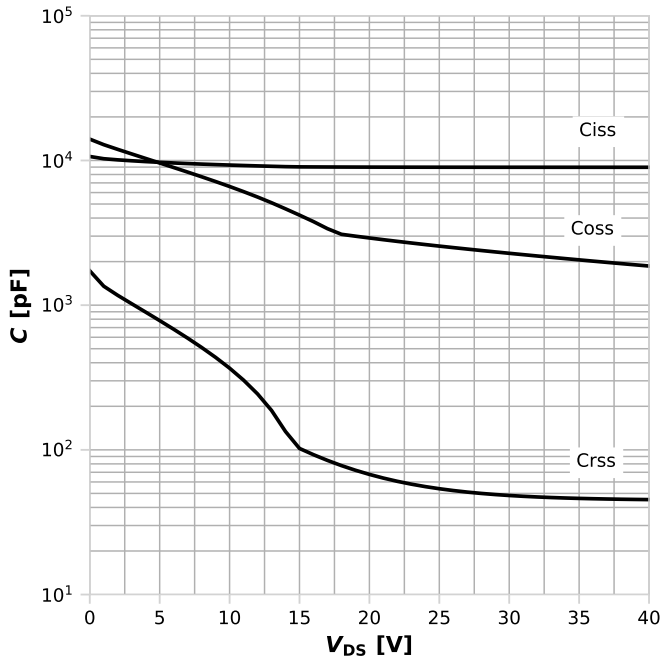
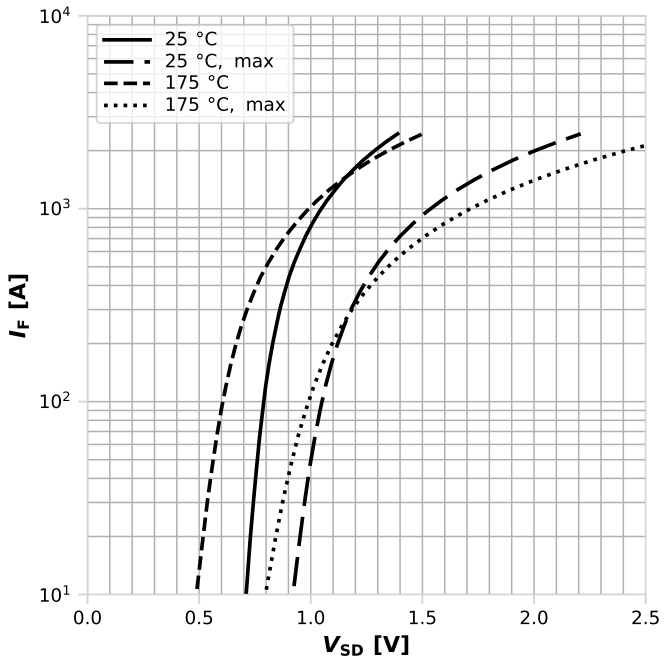
Diagram 11: Typ. capacitances	Diagram 12: Forward characteristics of reverse diode
	
C=f(V_{DS}); V_{GS}=0 V; f=1 MHz	I_F=f(V_{SD}); parameter: T_j

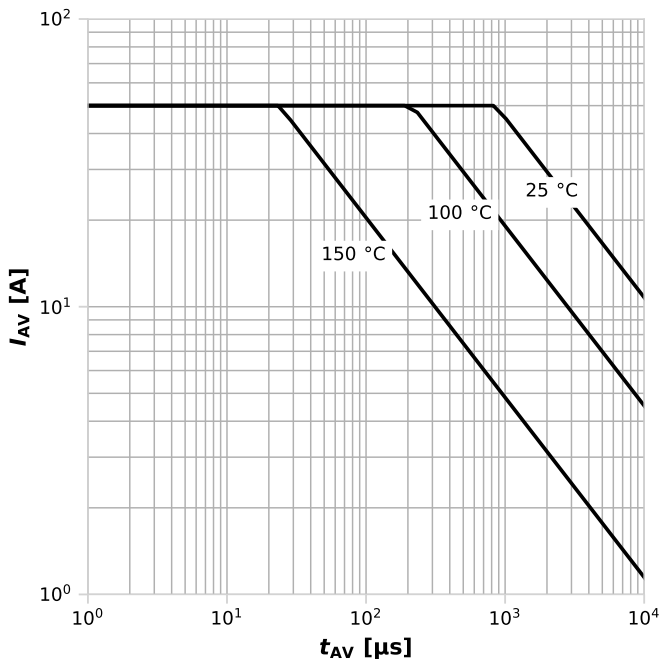
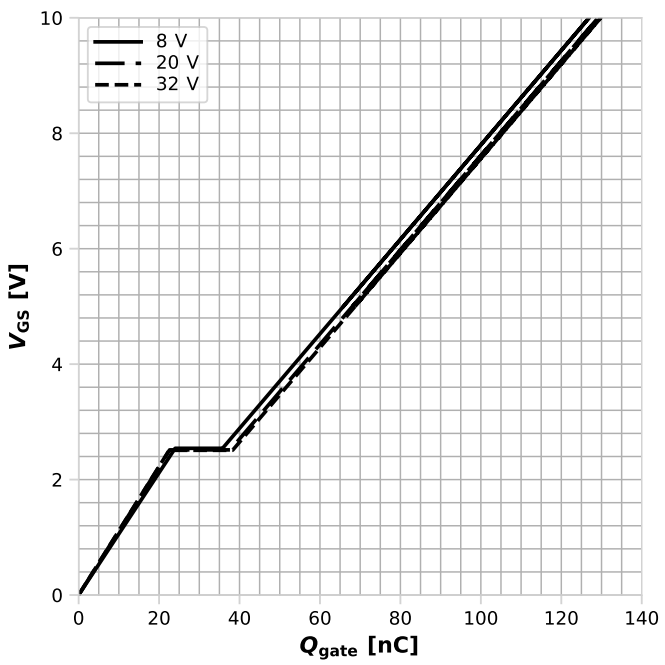
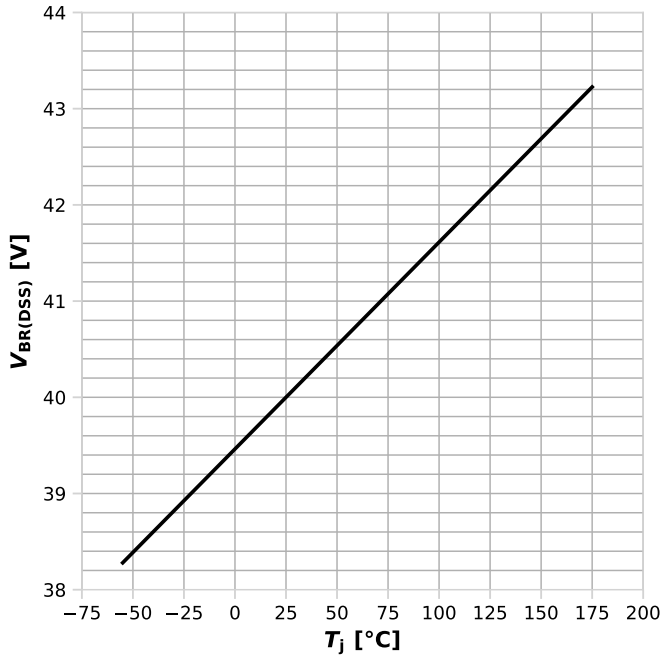
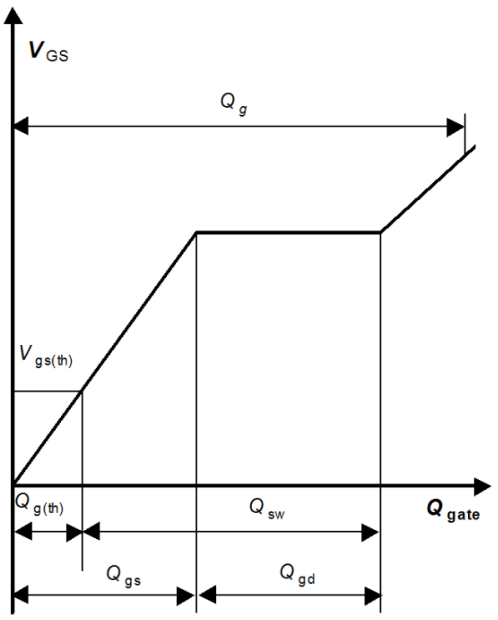
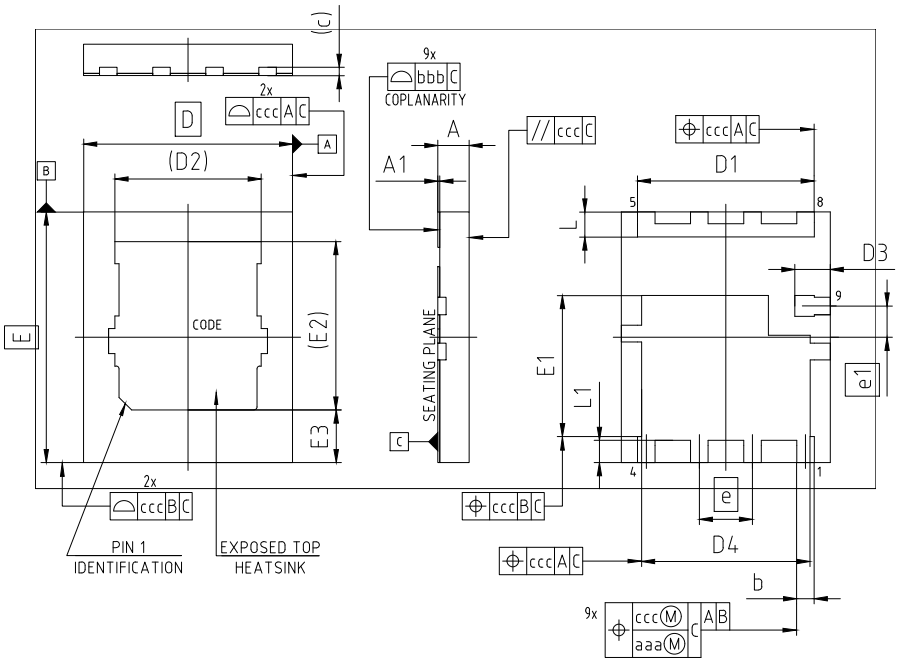
Diagram 13: Avalanche characteristics	Diagram 14: Typ. gate charge
	
I_{AS}=f(t_{AV}); R_{GS}=25 Ω; parameter: $T_{j,start}$	V_{GS}=f(Q_{gate}), I_D=50 A pulsed, T_j=25 °C; parameter: V_{DD}

Diagram 15: Min. drain-source breakdown voltage	Gate charge waveforms
	
$V_{BR(DSS)}$=f(T_j); I_D=1 mA	-

5 Package outlines



PACKAGE - GROUP NUMBER:	PG-WHTFN-9-U02				
DIMENSIONS	MILLIMETERS		DIMENSIONS	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.55	0.75	e	1.27	
A1	0.00	0.05	e1	0.75	
b	0.32	0.52	L	0.50	0.70
c	0.20		L1	0.44	0.64
D	5.00		aaa	0.05	
D1	4.13	4.33	bbb	0.08	
D2	3.50		ccc	0.10	
D3	0.75	0.95			
D4	3.93	4.13			
E	6.00				
E1	3.28	3.48			
E2	4.03				
E3	1.16	1.36			

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

Figure 1 Outline PG-WHTFN-9, dimensions in mm

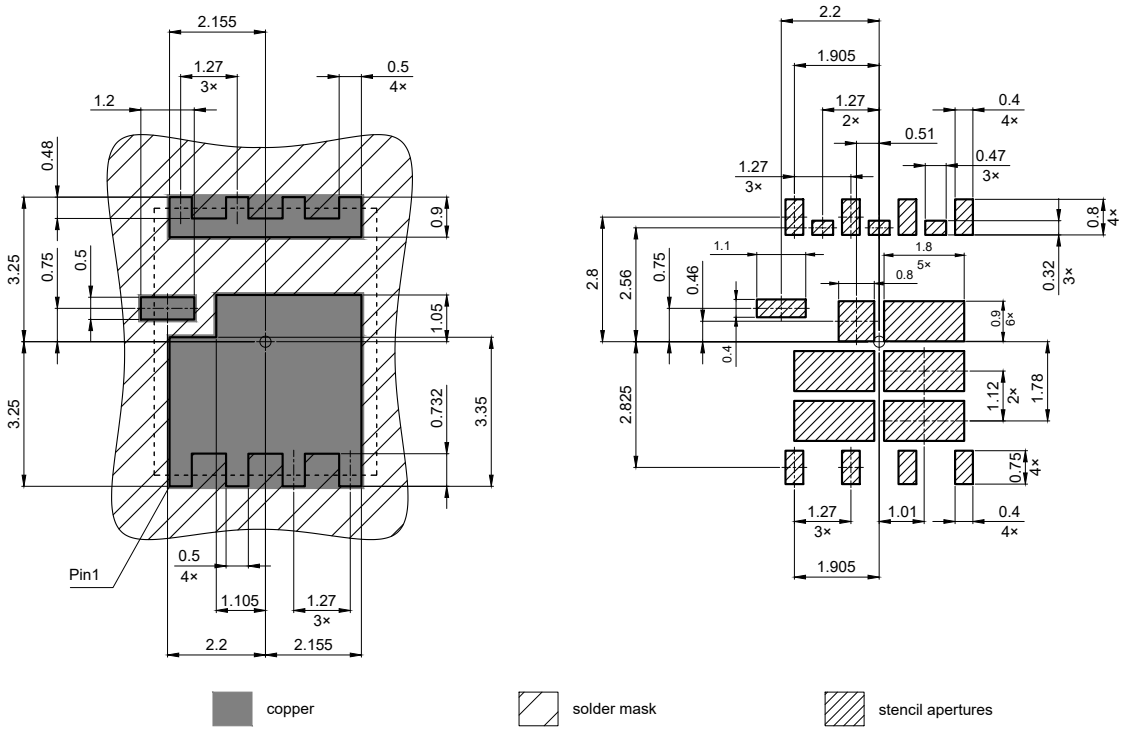


Figure 2 Footprint drawing PG-WHTFN-9, dimensions in mm

Revision history

IQDH45N04LM6CGSC

Revision 2024-10-23, Rev. 2.2

Previous revisions

Revision	Date	Subjects (major changes since last revision)
2.0	2024-06-17	Release of final
2.1	2024-07-16	Updated max Rdson
2.2	2024-10-23	Update package drawing and diagram circuit

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