

MOSFET

OptiMOS™6 Power-Transistor, 40 V

Features

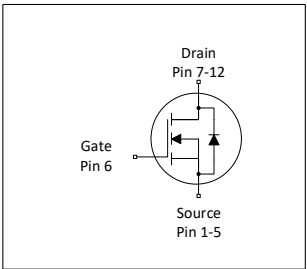
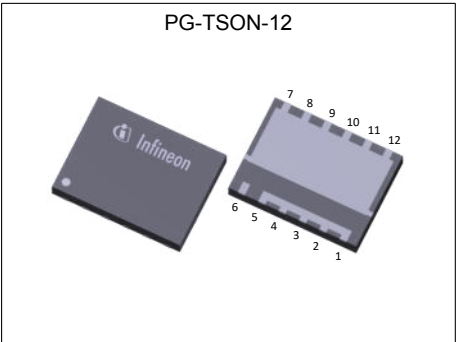
- Optimized for Low Voltage Drives applications
- Optimized for Battery Powered applications
- Optimized for Synchronous Rectification
- Very low on-resistance $R_{DS(on)}$
- 100% avalanche tested
- Superior thermal resistance
- N-channel, normal level
- Pb-free lead plating; RoHS compliant
- Halogen-free according to IEC61249-2-21
- 175°C rated

Product validation

Fully qualified according to JEDEC for Industrial Applications

Table 1 Key Performance Parameters

Parameter	Value	Unit
V_{DS}	40	V
$R_{DS(on),max}$	0.39	mΩ
I_D	600	A
Q_{oss}	199	nC
Q_G (0V..10V)	182	nC



RoHS

Type / Ordering Code	Package	Marking	Related Links
IQFH39N04NM6	PG-TSON-12	H39N04NM6	-

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1 Maximum ratings

at $T_A=25\text{ °C}$, unless otherwise specified

Table 2 Maximum ratings

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Continuous drain current ¹⁾	I_D	-	-	600 422 63	A	$V_{GS}=10\text{ V}$, $T_C=25\text{ °C}$ $V_{GS}=10\text{ V}$, $T_C=100\text{ °C}$ $V_{GS}=10\text{ V}$, $T_A=25\text{ °C}$, $R_{THJA}=50\text{ °C/W}^{2)}$
Pulsed drain current ³⁾	$I_{D,pulse}$	-	-	2400	A	$T_C=25\text{ °C}$
Avalanche energy, single pulse ⁴⁾	E_{AS}	-	-	1260	mJ	$I_D=100\text{ A}$, $R_{GS}=25\text{ }\Omega$
Gate source voltage	V_{GS}	-20	-	20	V	-
Power dissipation	P_{tot}	-	-	273 3.0	W	$T_C=25\text{ °C}$ $T_A=25\text{ °C}$, $R_{THJA}=50\text{ °C/W}^{2)}$
Operating and storage temperature	T_j, T_{stg}	-55	-	175	°C	-

2 Thermal characteristics

Table 3 Thermal characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case, bottom	R_{thJC}	-	-	0.55	°C/W	-
Thermal resistance, junction - case, top	R_{thJC}	-	-	20	°C/W	-
Thermal resistance, junction - ambient, 6 cm ² cooling area ²⁾	R_{thJA}	-	-	50	°C/W	-

¹⁾ Rating refers to the product only with datasheet specified absolute maximum values, maintaining case temperature at specified. For other case temperature 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 cm² (one layer, 70 µm thick) copper area for drain connection. PCB is vertical in still air.

³⁾ See Diagram 3 for more detailed information

⁴⁾ See Diagram 13 for more detailed information

3 Electrical characteristics

at $T_j=25\text{ °C}$, 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	$V_{GS}=0\text{ V}$, $I_D=1\text{ mA}$
Gate threshold voltage	$V_{GS(th)}$	1.8	2.3	2.8	V	$V_{DS}=V_{GS}$, $I_D=1050\text{ }\mu\text{A}$
Zero gate voltage drain current	I_{DSS}	-	0.1 10	1 100	μA	$V_{DS}=40\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=25\text{ °C}$ $V_{DS}=40\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=125\text{ °C}$
Gate-source leakage current	I_{GSS}	-	10	100	nA	$V_{GS}=20\text{ V}$, $V_{DS}=0\text{ V}$
Drain-source on-state resistance	$R_{DS(on)}$	-	0.27 0.31	0.39 0.43	m Ω	$V_{GS}=10\text{ V}$, $I_D=100\text{ A}$ $V_{GS}=6\text{ V}$, $I_D=50\text{ A}$
Gate resistance	R_G	-	0.8	-	Ω	-
Transconductance ¹⁾	g_{fs}	310	-	-	S	$ V_{DS} \geq 2 I_D /R_{DS(on)max}$, $I_D=100\text{ A}$

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	12600	16400	pF	$V_{GS}=0\text{ V}$, $V_{DS}=20\text{ V}$, $f=1\text{ MHz}$
Output capacitance ¹⁾	C_{oss}	-	4090	5320	pF	$V_{GS}=0\text{ V}$, $V_{DS}=20\text{ V}$, $f=1\text{ MHz}$
Reverse transfer capacitance ¹⁾	C_{rss}	-	93	158	pF	$V_{GS}=0\text{ V}$, $V_{DS}=20\text{ V}$, $f=1\text{ MHz}$
Turn-on delay time	$t_{d(on)}$	-	23	-	ns	$V_{DD}=20\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=100\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$
Rise time	t_r	-	70	-	ns	$V_{DD}=20\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=100\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$
Turn-off delay time	$t_{d(off)}$	-	69	-	ns	$V_{DD}=20\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=100\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$
Fall time	t_f	-	14	-	ns	$V_{DD}=20\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=100\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$

Table 6 Gate charge characteristics²⁾

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	42	-	nC	$V_{DD}=20\text{ V}$, $I_D=100\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Gate charge at threshold	$Q_{g(th)}$	-	28	-	nC	$V_{DD}=20\text{ V}$, $I_D=100\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Gate to drain charge ¹⁾	Q_{gd}	-	25	38	nC	$V_{DD}=20\text{ V}$, $I_D=100\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Switching charge	Q_{sw}	-	39	-	nC	$V_{DD}=20\text{ V}$, $I_D=100\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Gate charge total ¹⁾	Q_g	-	182	273	nC	$V_{DD}=20\text{ V}$, $I_D=100\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Gate plateau voltage	$V_{plateau}$	-	3.3	-	V	$V_{DD}=20\text{ V}$, $I_D=100\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Gate charge total, sync. FET	$Q_{g(sync)}$	-	172	-	nC	$V_{DS}=0.1\text{ V}$, $V_{GS}=0\text{ to }10\text{ V}$
Output charge ¹⁾	Q_{oss}	-	199	259	nC	$V_{DS}=20\text{ V}$, $V_{GS}=0\text{ V}$

¹⁾ Defined by design. Not subject to production test.

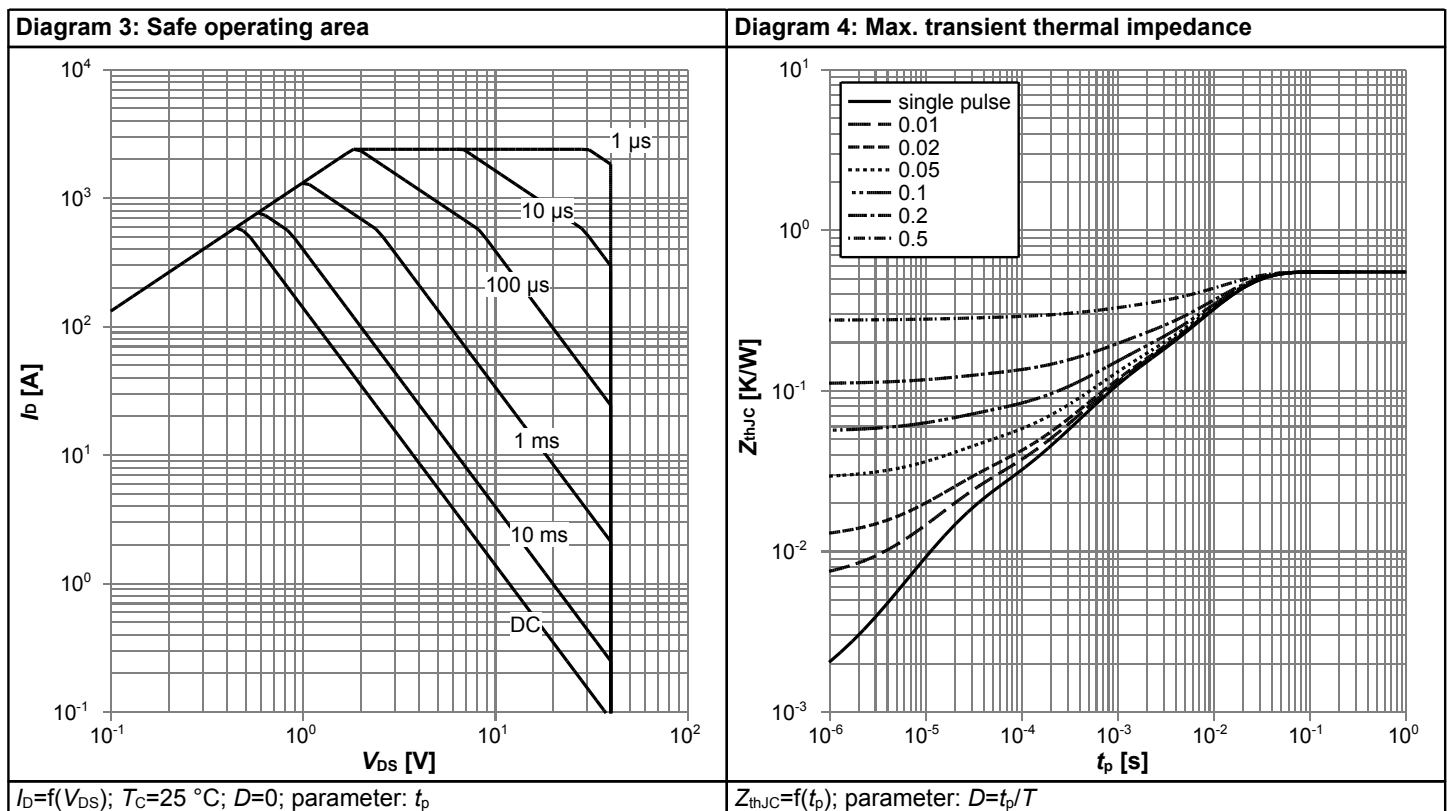
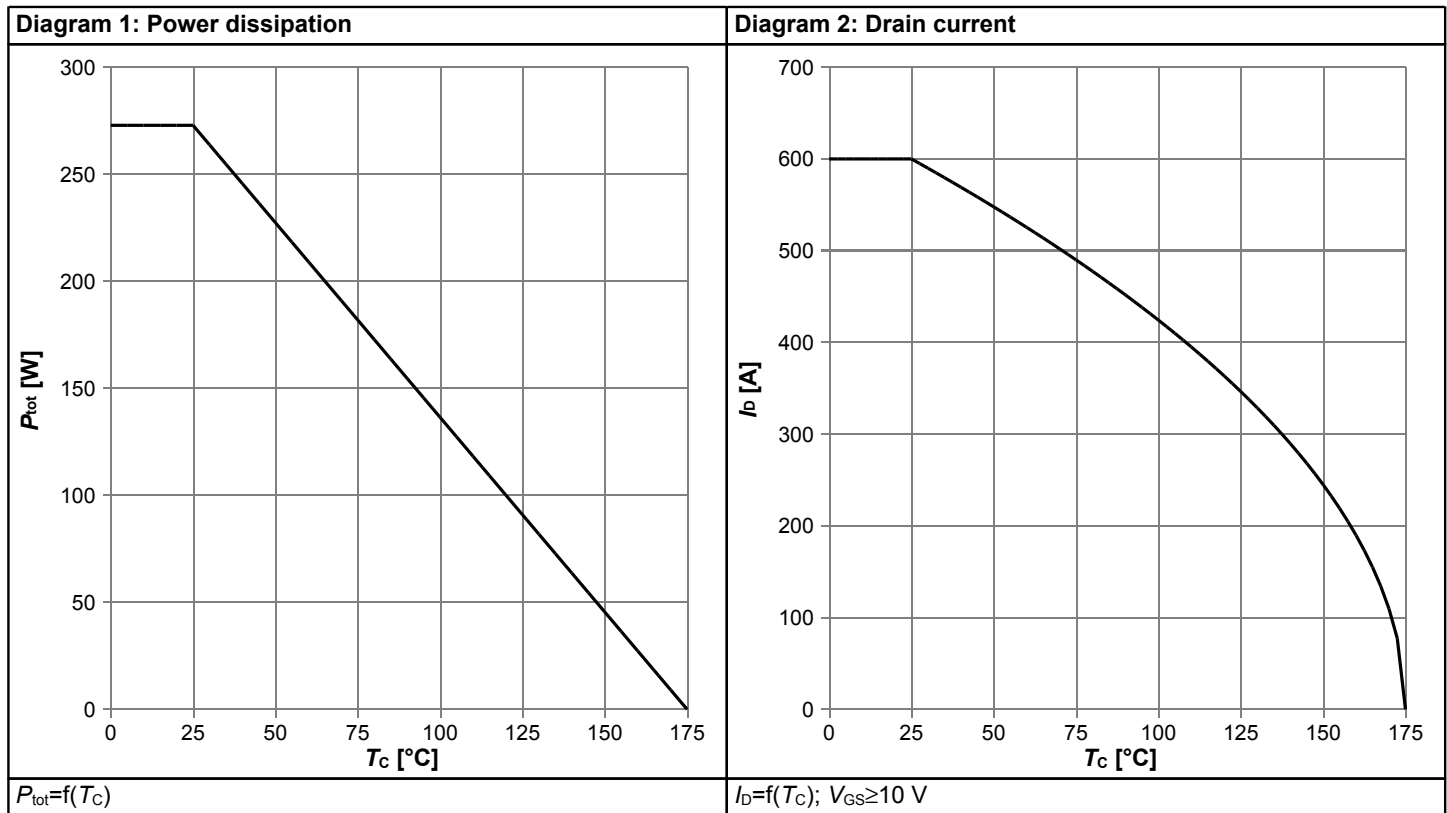
²⁾ See "Gate charge waveforms" for parameter definition

Table 7 Reverse diode

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode continuous forward current	I_S	-	-	275	A	$T_C=25\text{ °C}$
Diode pulse current	$I_{S,pulse}$	-	-	2400	A	$T_C=25\text{ °C}$
Diode forward voltage	V_{SD}	-	0.78	1	V	$V_{GS}=0\text{ V}$, $I_F=100\text{ A}$, $T_J=25\text{ °C}$
Reverse recovery time ¹⁾	t_{rr}	-	49	98	ns	$V_R=20\text{ V}$, $I_F=100\text{ A}$, $di_F/dt=500\text{ A}/\mu\text{s}$
Reverse recovery charge ¹⁾	Q_{rr}	-	312	624	nC	$V_R=20\text{ V}$, $I_F=100\text{ A}$, $di_F/dt=500\text{ A}/\mu\text{s}$

¹⁾ Defined by design. Not subject to production test.

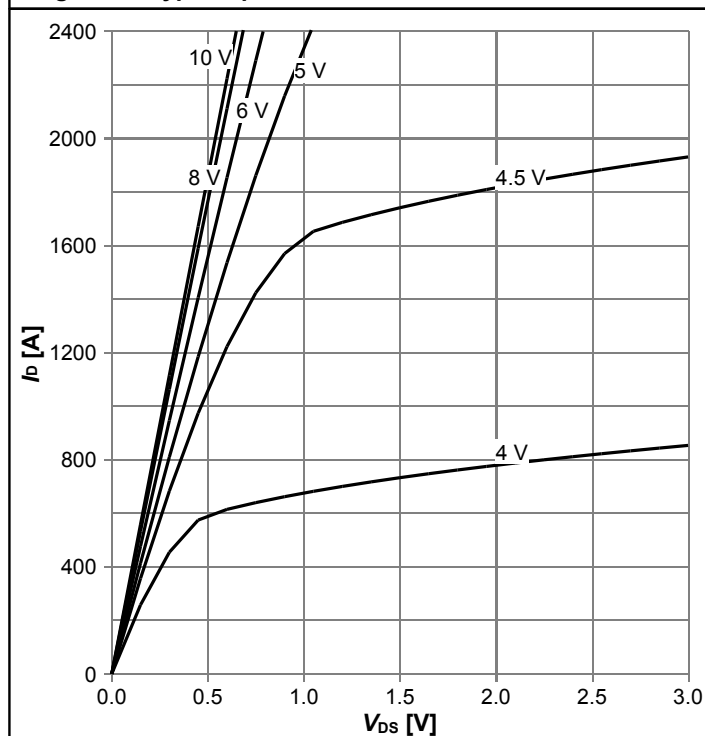
4 Electrical characteristics diagrams



OptiMOS™6 Power-Transistor, 40 V

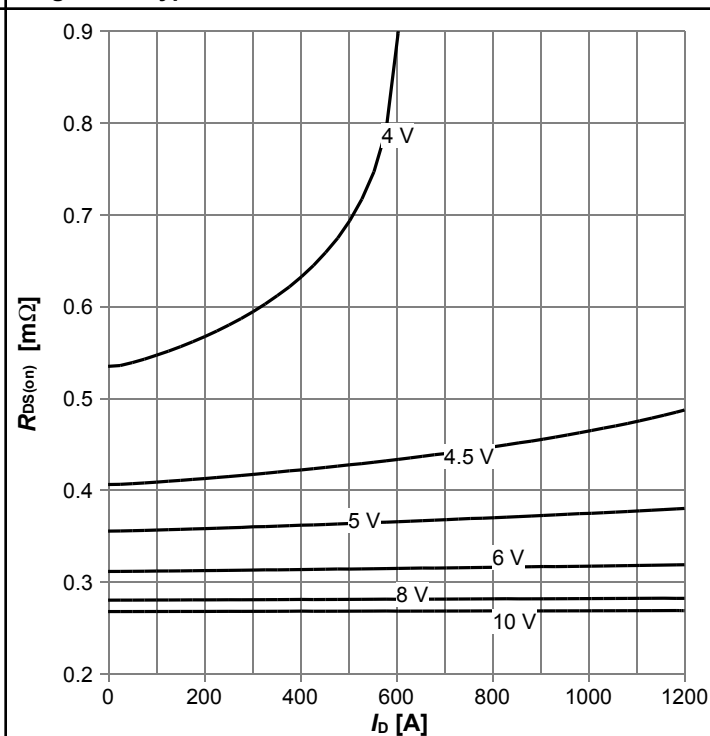
IQFH39N04NM6

Diagram 5: Typ. output characteristics



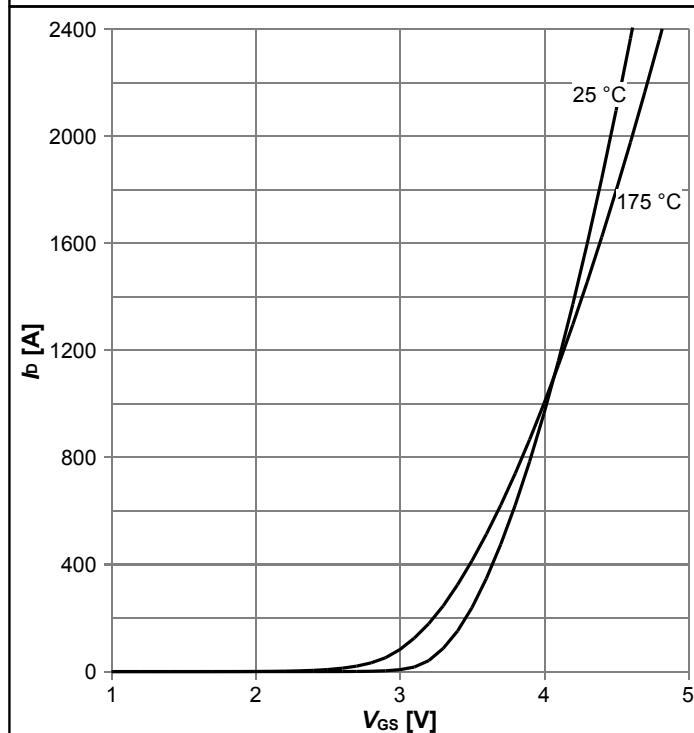
$I_D = f(V_{DS})$, $T_j = 25^\circ\text{C}$; parameter: V_{GS}

Diagram 6: Typ. drain-source on resistance



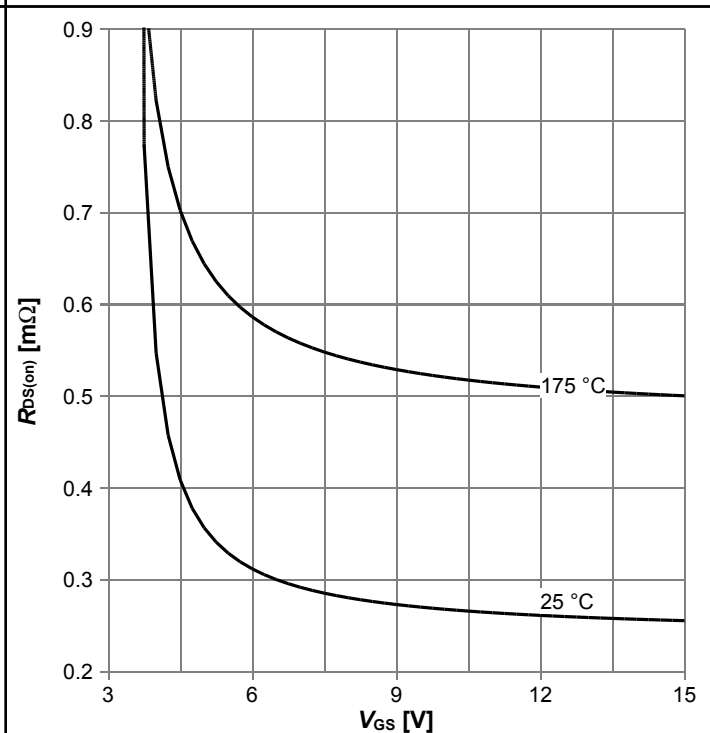
$R_{DS(on)} = f(I_D)$, $T_j = 25^\circ\text{C}$; parameter: V_{GS}

Diagram 7: Typ. transfer characteristics



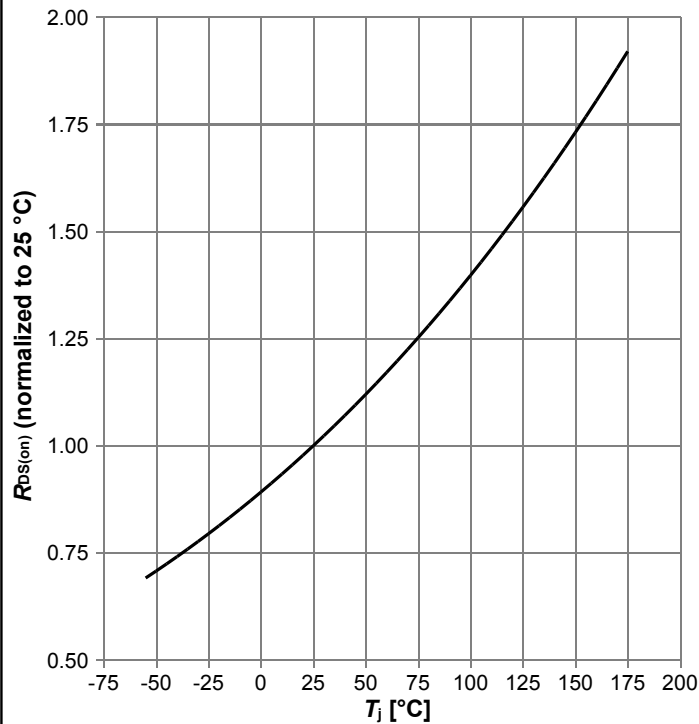
$I_D = f(V_{GS})$, $|V_{DS}| > 2|I_D|R_{DS(on)max}$; parameter: T_j

Diagram 8: Typ. drain-source on resistance



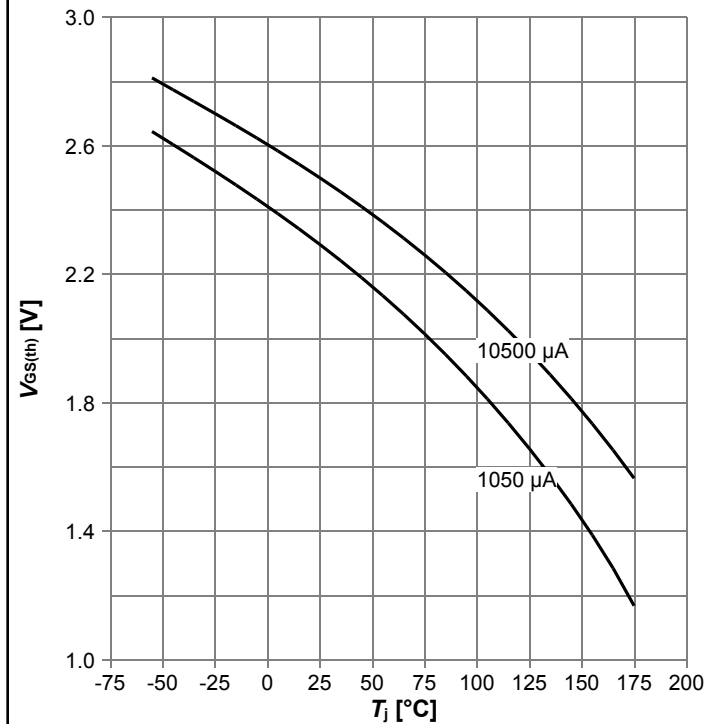
$R_{DS(on)} = f(V_{GS})$, $I_D = 100\text{ A}$; parameter: T_j

Diagram 9: Normalized drain-source on resistance



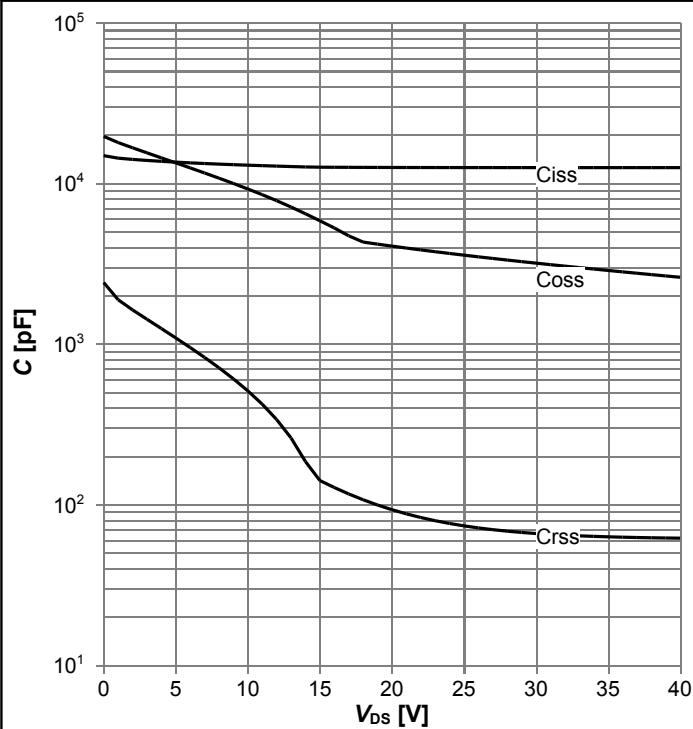
$R_{DS(on)} = f(T_j)$, $I_D = 100$ A, $V_{GS} = 10$ V

Diagram 10: Typ. gate threshold voltage



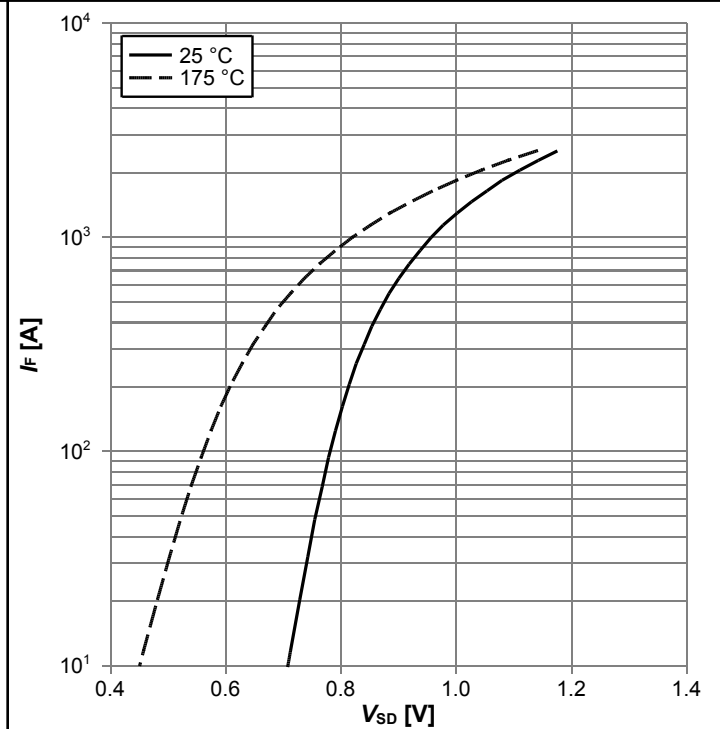
$V_{GS(th)} = f(T_j)$, $V_{GS} = V_{DS}$; parameter: I_D

Diagram 11: Typ. capacitances



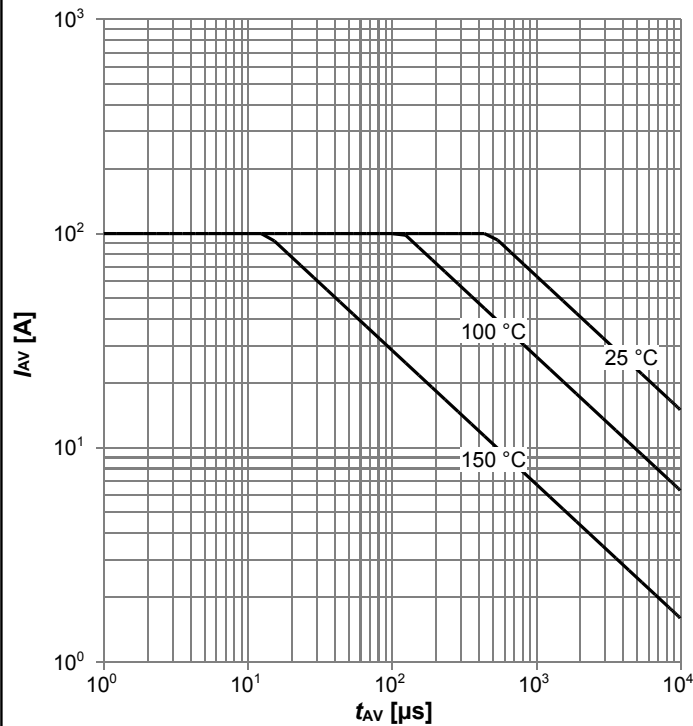
$C = f(V_{DS})$; $V_{GS} = 0$ V; $f = 1$ MHz

Diagram 12: Typ. forward characteristics of reverse diode



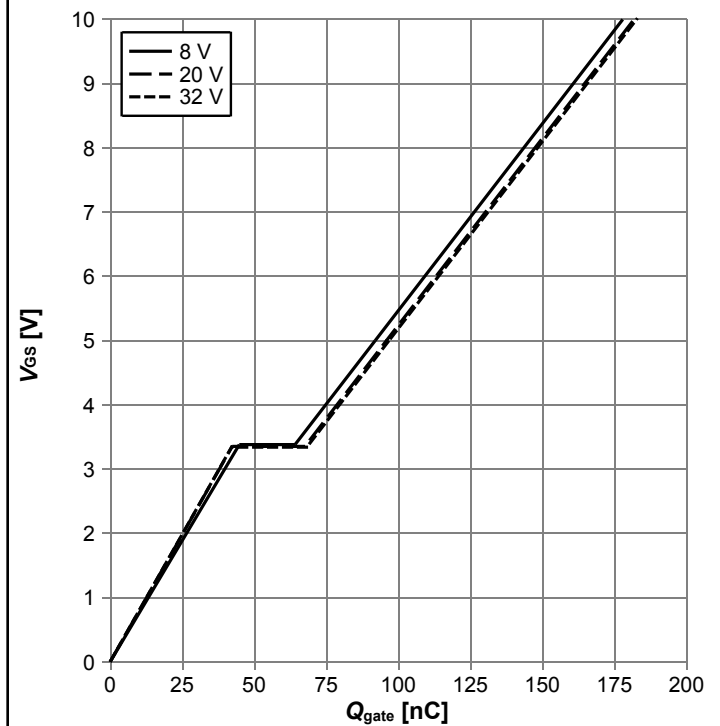
$I_F = f(V_{SD})$; parameter: T_j

Diagram 13: Avalanche characteristics



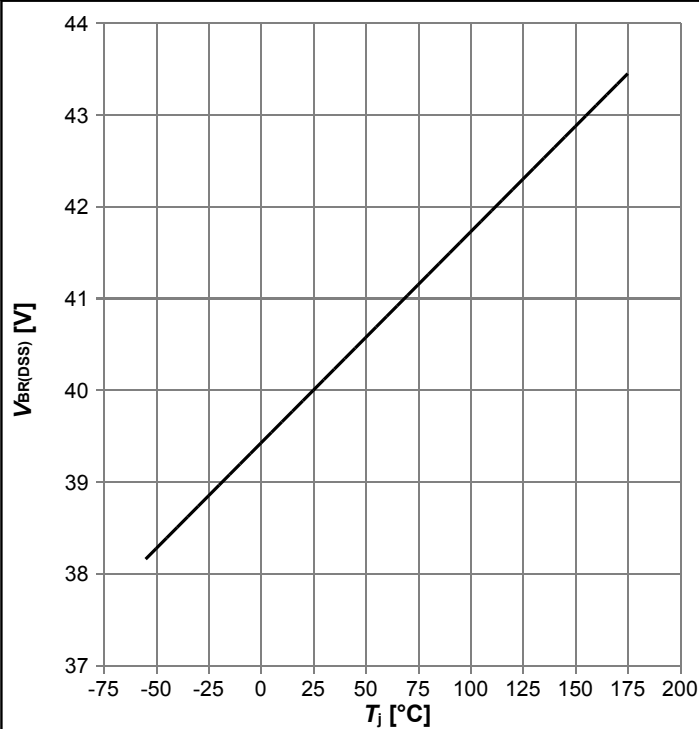
$I_{AS}=f(t_{AV})$; $R_{GS}=25\ \Omega$; parameter: $T_{j,start}$

Diagram 14: Typ. gate charge



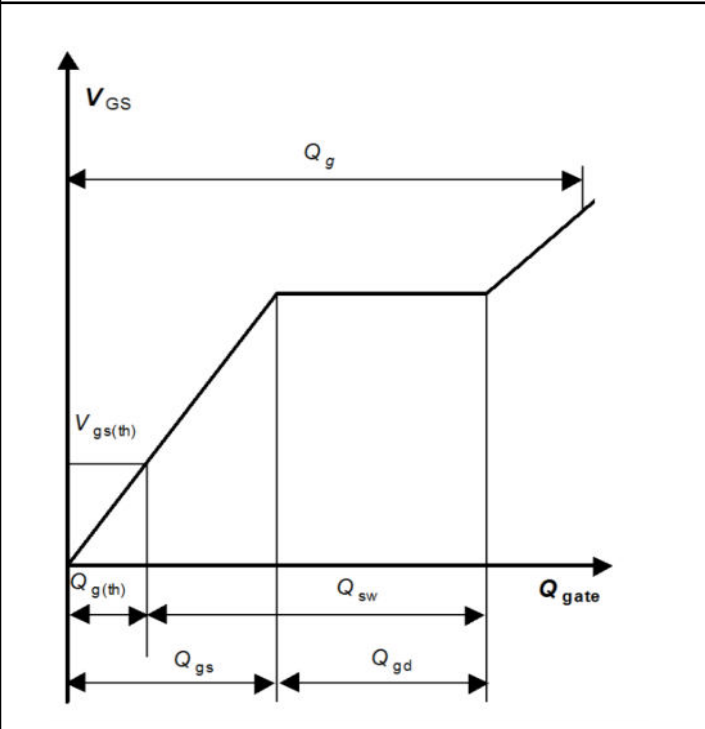
$V_{GS}=f(Q_{gate})$, $I_D=100\text{ A}$ pulsed, $T_j=25\text{ °C}$; parameter: V_{DD}

Diagram 15: Drain-source breakdown voltage

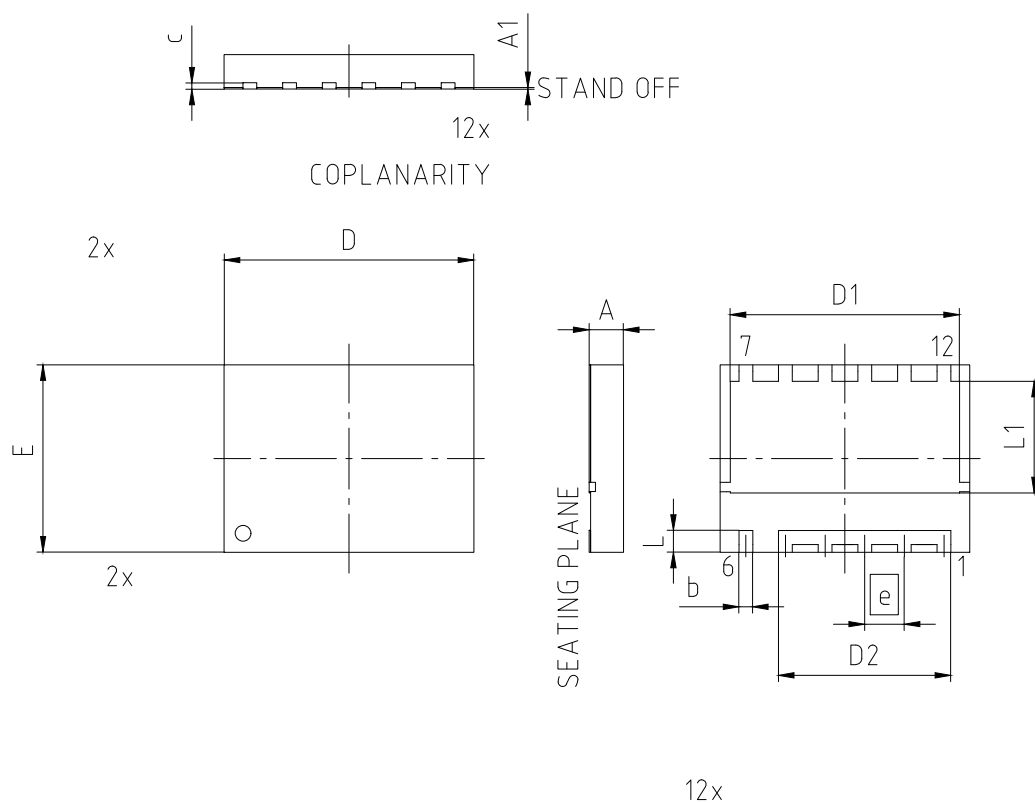


$V_{BR(DSS)}=f(T_j)$; $I_D=1\text{ mA}$

Diagram Gate charge waveforms

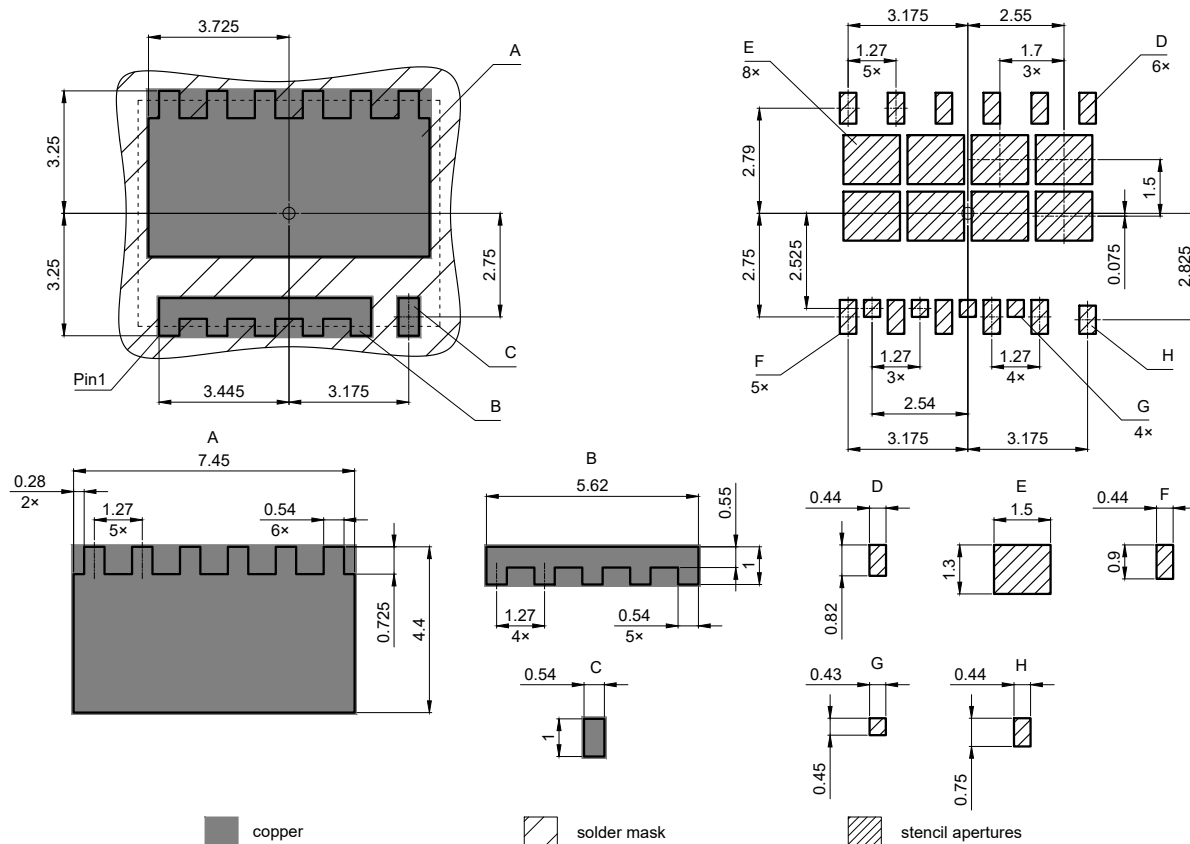


5 Package Outlines



PACKAGE - GROUP NUMBER: PG-TSON-12-U01		
DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	-	1.10
A1	-	0.05
b	0.39	0.49
c	0.20	
D	8.00	
D1	7.25	7.45
D2	5.42	5.62
E	6.00	
e	1.27	
L	0.60	0.80
L1	3.48	3.68

Figure 1 Outline PG-TSON-12, dimensions in mm



All dimensions are in units mm
All pads are solder mask defined

Figure 2 Outline Boardpad (PG-TSON-12), dimensions in mm

Revision History

IQFH39N04NM6

Revision: 2023-09-06, Rev. 2.0

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2023-09-06	Release of final version

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