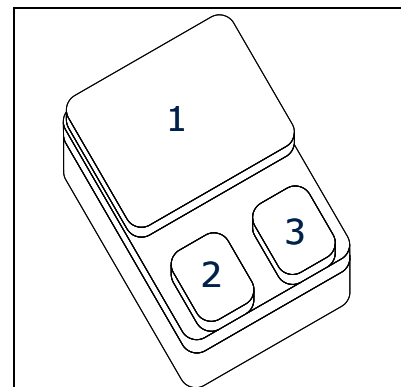


650V Radiation Hard power MOSFET

BUY65CS28A-01(ES)

Features

- Low $R_{DS(on)}$
- Single Event Effect (SEE) hardened
 LET 90, Range: 122 μ m (Pb) LET 62, Range: 73 μ m (Xe)
 $V_{GS} = -10V, V_{DS} = 650V$ $V_{GS} = -15V, V_{DS} = 650V$
 $V_{GS} = -12V, V_{DS} = 350V$ $V_{GS} = -20V, V_{DS} = 350V$
- Total Ionisation Dose (TID) hardened
 100 kRad approved (Level R)
- Hermetically sealed
- N-channel



Product validation

-  **ESA Space Qualified**
 ESCC Detail Spec. No.: 5205/033
 Type Variant No. 02

Description

Table 1 **Product information**

Type	Comment	Pin Configuration				Package
		1	2	3	-	
BUY65CS28A-01(ES)	For flight use	D	G	S	-	SMD2
BUY65CS28A-01(P) ¹	Not for flight use ¹					

¹ (P) parts have the same fit, form and function as (ES) parts,
 no radiation hardness; no screening acc. to Chart F3 in ESCC Generic Specification No. 5000

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Maximum ratings

1 Maximum ratings

Table 2 Maximum ratings

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Drain source voltage	V_{DS}	-	-	650	V	
Gate source voltage	V_{GS}	-20	-	20	V	static
Drain gate voltage	V_{DG}	-	-	650	V	
Continuous drain current ¹	I_D	-	-	28	A	$T_C = 25\text{ °C}$ $T_C = 100\text{ °C}$
		-	-	18		
Continuous source current	I_S	-	-	28	A	
Drain current pulsed	I_{DM}	-	-	80	Apk	t_p limited by $T_{j,max}$
Total power dissipation ²	P_{tot}	-	-	215	W	$T_C \leq 25\text{ °C}$
Operating and storage temperature	T_{op}	-55	-	150	°C	
Avalanche energy	E_{AS}	-	-	200	mJ	

¹ Limited by $T_{j,max}$ ² For $T_C > 25\text{ °C}$ derating is required.

2 Thermal characteristics

Table 3 Thermal characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	$R_{th,JC}$	-	-	0.58	K/W	
Soldering temperature	T_{sol}	-	-	250	°C	Duration 10 seconds maximum and the same terminal shall not be resoldered until 3 minutes have elapsed.

Electrical characteristics

3 Electrical characteristics

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

Table 4 Static characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage	BV_{DSS}	650	-	-	V	$I_D = 0.25\text{mA}$, $V_{GS} = 0\text{V}$
Temperature coefficient of BV_{DSS}	$\Delta BV_{DSS}/\Delta T_J$	-	1.05	-	V/ $^\circ\text{C}$	
Gate threshold voltage	$V_{GS(th)}$	2	-	4	V	$I_D = 1.0\text{mA}$, $V_{DS} \geq V_{GS}$, $T_A = 25^\circ\text{C}$
		1.5	-	-		$I_D = 1.0\text{mA}$, $V_{DS} \geq V_{GS}$, $T_A = 125^\circ\text{C}$
		-	-	5		$I_D = 1.0\text{mA}$, $V_{DS} \geq V_{GS}$, $T_A = -55^\circ\text{C}$
Gate to source leakage current	I_{GSS}	-100	-	100	nA	$V_{DS} = 0\text{V}$, $V_{GS} = \pm 20\text{V}$, $T_A = 25^\circ\text{C}$
		-200	-	200		$V_{DS} = 0\text{V}$, $V_{GS} = \pm 20\text{V}$, $T_A = 125^\circ\text{C}$
Zero gate voltage drain current	I_{DSS}	-	-	25	μA	$V_{DS} = 520\text{V}$, $V_{GS} = 0\text{V}$, $T_A = 25^\circ\text{C}$
		-	-	250		$V_{DS} = 520\text{V}$, $V_{GS} = 0\text{V}$, $T_A = 125^\circ\text{C}$
Drain source on-state resistance ¹	$R_{DS(ON)}$	-	116	150	m Ω	$V_{GS} = 10\text{V}$, $I_D = 18\text{A}$, $T_A = 25^\circ\text{C}$
		-	-	260		$V_{GS} = 10\text{V}$, $I_D = 18\text{A}$, $T_A = 125^\circ\text{C}$
Diode forward voltage ^{1,2}	V_{SD}	-	-	1.2	V	$V_{GS} = 0\text{V}$, $I_S = 28\text{A}$

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Turn-on delay time	$t_{d(ON)}$	-	22	28	ns	$V_{DD} = 50\% V_{DS}$, $I_D = 18\text{A}$, $R_G = 4.7\Omega$
Rise time	t_r	-	16	20	ns	$V_{DD} = 50\% V_{DS}$, $I_D = 18\text{A}$, $R_G = 4.7\Omega$
Turn-off delay time	$t_{d(OFF)}$	-	53	80	ns	$V_{DD} = 50\% V_{DS}$, $I_D = 18\text{A}$, $R_G = 4.7\Omega$
Fall time	t_f	-	7	15	ns	$V_{DD} = 50\% V_{DS}$, $I_D = 18\text{A}$, $R_G = 4.7\Omega$
Reverse recovery time	t_{rr}	-	990	1080	ns	$V_{DD} \leq 50\text{V}$, $I_D = 28\text{A}$
Common source input capacitance	C_{iss}	4.1	4.8	5.5	nF	$V_{DS} = 100\text{V}$, $V_{GS} = 0\text{V}$, $f = 1.0\text{MHz}$
Common source output capacitance	C_{oss}	120	146	170	pF	$V_{DS} = 100\text{V}$, $V_{GS} = 0\text{V}$, $f = 1.0\text{MHz}$
Common source reverse transfer capacitance	C_{rss}	5	11	17	pF	$V_{DS} = 100\text{V}$, $V_{GS} = 0\text{V}$, $f = 1.0\text{MHz}$
Gate resistance	R_G	-	0.85	-	Ω	$f = 1.0\text{MHz}$, open drain
Total gate charge	Q_G	-	67	85	nC	$V_{DD} = 50\% V_{DS}$, $V_{GS} = 10\text{V}$, $I_D = 28\text{A}$

¹ Pulsed measurement: Pulse Width < 300 μs , Duty Cycle < 2.0%.² Measured within 2.0 mm of case

4 Radiation characteristics

Infineon radiation hard power MOSFETs are tested to verify their radiation hardness capability. Every manufacturing wafer lot is tested for total dose steady-state irradiation according to the ESCC Basic Specification No. 22900. The following bias condition is used during irradiation testing:

- $V_{GS} = +15V$
- $V_{DS} = 0V$

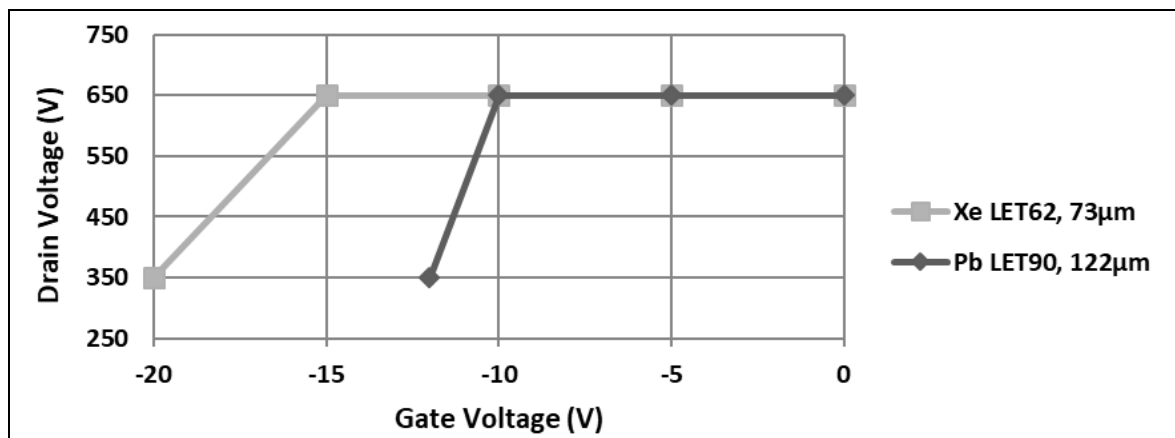
Table 6 Electrical characteristics at $T_A = 25^\circ C$, post Total Dose Irradiation

Parameter	Symbol	100 kRad(Si)			Unit	Note / Test Condition
		Drift Values	Absolute			
			Min.	Max.		
Drain-source breakdown voltage	BV_{DSS}	$\pm 20\%$	650	-	V	$I_D= 0.25mA, V_{GS}= 0V$
Gate threshold voltage	$V_{GS(th)}$	+10%, -50%	2	4	V	$I_D= 1.0mA, V_{DS} \geq V_{GS}$
Gate to source leakage current	I_{GSS}	$\pm 20\%$	-100	100	nA	$V_{DS}= 0V, V_{GS}= +/- 20V$
Zero gate voltage drain current	I_{DSS}	-	-	25	μA	$V_{DS}= 520V, V_{GS}= 0V$
Drain source on-state resistance ¹	$R_{DS(ON)}$	$\pm 20\%$	-	150	m Ω	$V_{GS}= 10V, I_D= 18A$
Diode forward voltage ^{1,2}	V_{SD}	$\pm 10\%$	-	1.2	V	$V_{GS}= 0V, I_S= 28A$

Infineon radiation hard power MOSFETs have been characterized in heavy ion environments for Single Event Effects (SEE) according to the ESCC Basic Specification No. 25100

Table 7 Typical Single Event Effect safe operating area

Ion	LET [MeV/(mg/cm ²)]	Range [μm]	V_{DS} [V]					
			$V_{GS} = 0V$	$V_{GS} = -5V$	$V_{GS} = -10V$	$V_{GS} = -12V$	$V_{GS} = -15V$	$V_{GS} = -20V$
Xe	$62 \pm 5\%$	$73 \pm 5\%$	650	650	650	650	650	350
Pb	$90 \pm 5\%$	$122 \pm 5\%$	650	650	650	350	-	-



¹ Pulsed measurement: Pulse Width < 300 μs , Duty Cycle < 2.0%.

² Measured within 2.0 mm of case

5 Electrical characteristics diagrams

Diagram 1: Safe operating area

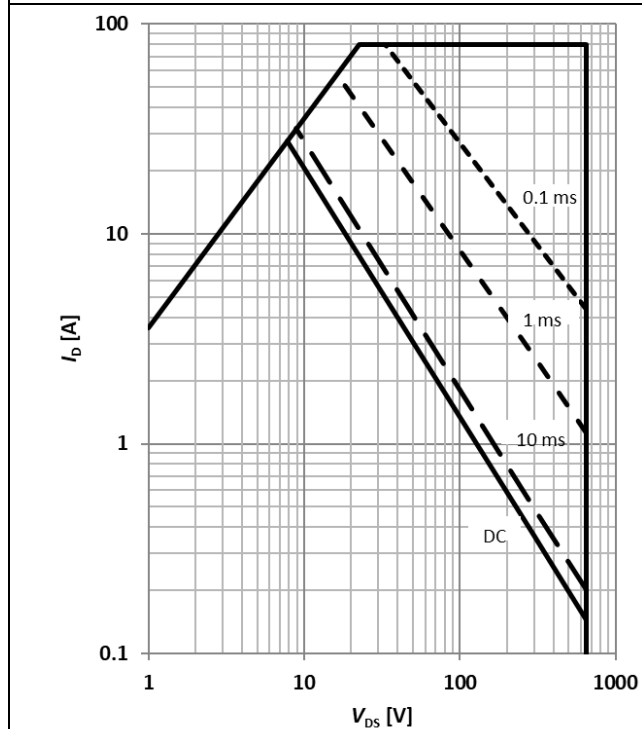

 $I_D = f(V_{DS}); T_C = 25^\circ\text{C}; D=0; \text{parameter: } t_p$

Diagram 2: Max. transient thermal impedance

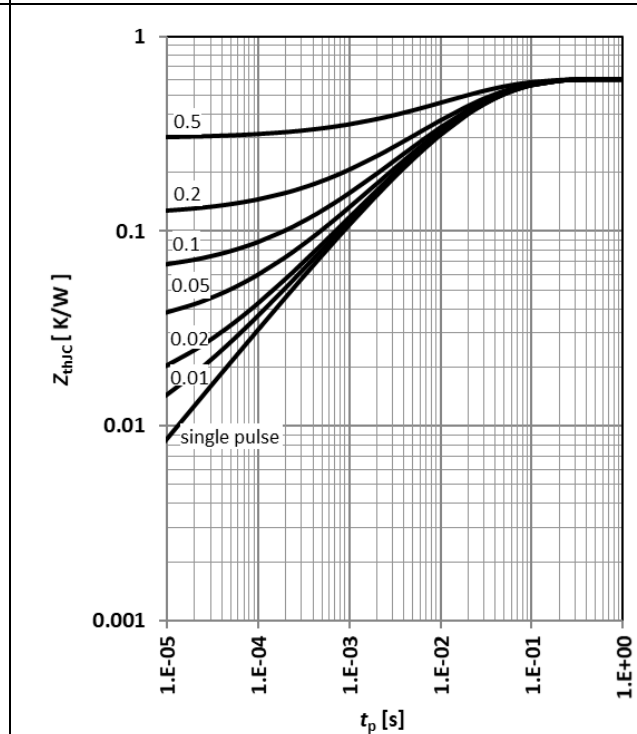

 $Z_{thJC} = f(t_p); \text{parameter: } D = t_p/T$

Diagram 3: Typ. output characteristics

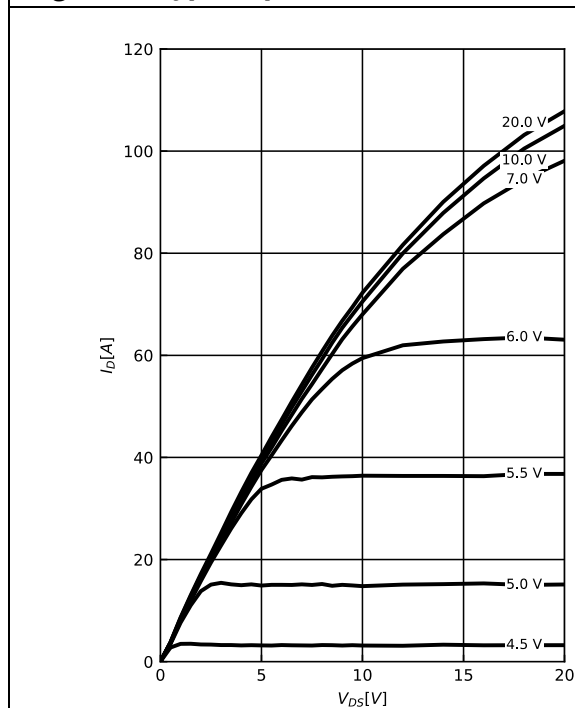
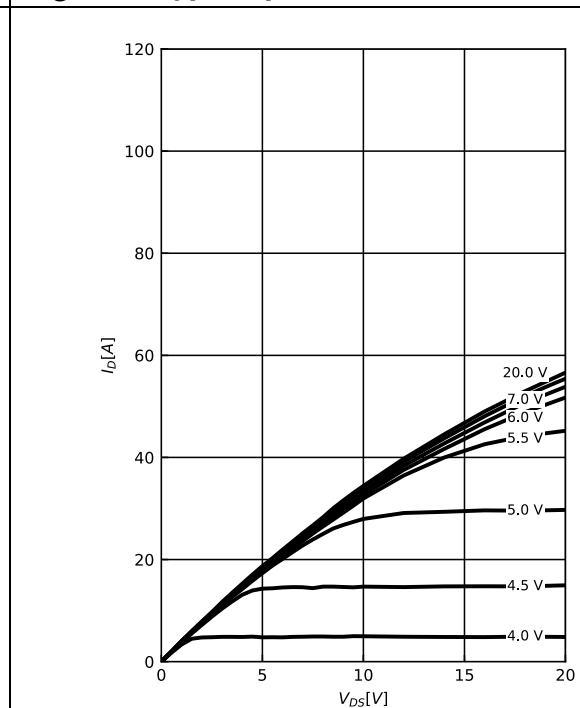

 $I_D = f(V_{DS}); T_J = 25^\circ\text{C}; \text{parameter: } V_{GS}$

Diagram 4: Typ. output characteristics

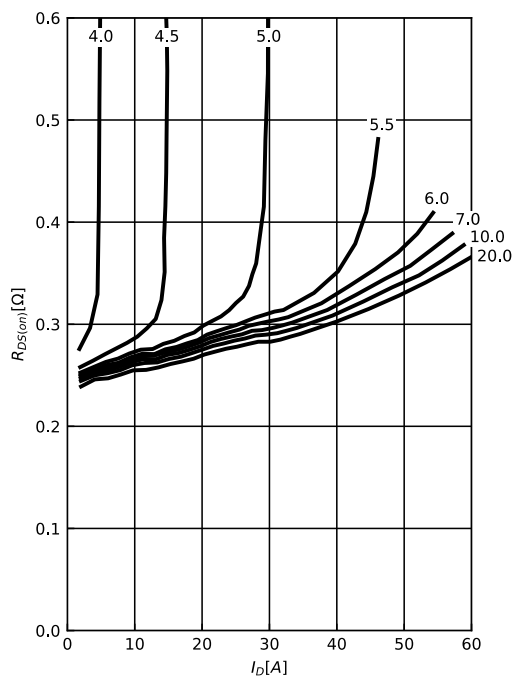

 $I_D = f(V_{DS}); T_J = 150^\circ\text{C}; \text{parameter: } V_G$

650V Radiation Hard power MOSFET

BUY65CS28A-01(ES)

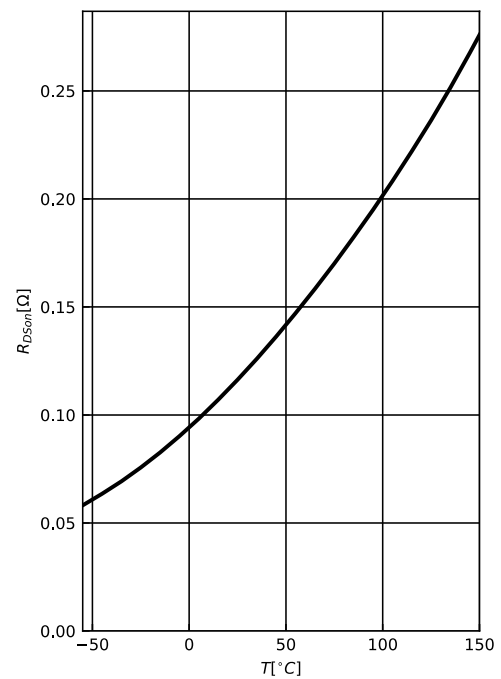
Electrical characteristics diagrams

Diagram 5: Typ. drain-source on-state resistance



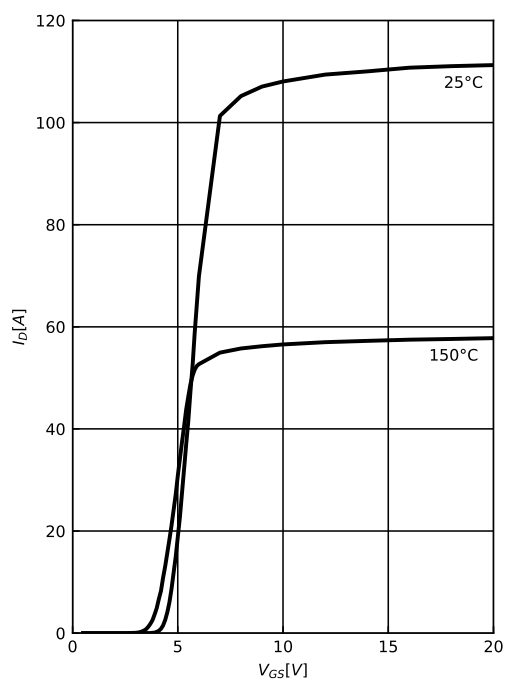
$$R_{DS(on)} = f(I_D); T_j = 150^\circ\text{C}; \text{parameter: } V_{GS}$$

Diagram 6: Typ. drain-source on-state resistance



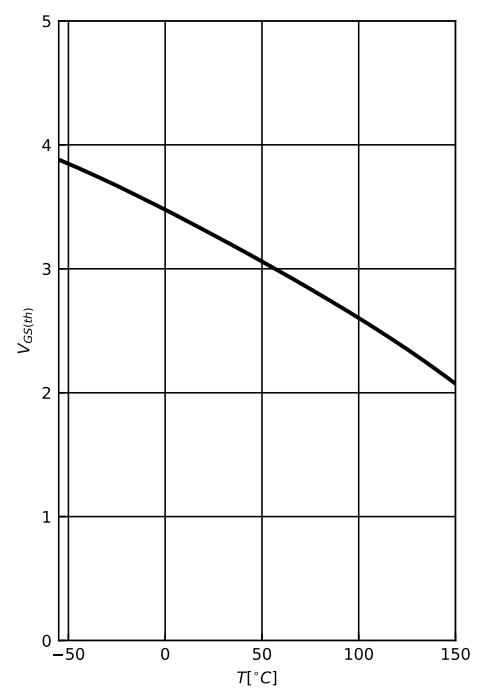
$$R_{DS(on)} = f(T_j); I_D = 18\text{A}$$

Diagram 7: Typ. transfer characteristics



$$I_D = f(V_{GS}); V_{DS} = 20\text{V}; \text{parameter: } T_j$$

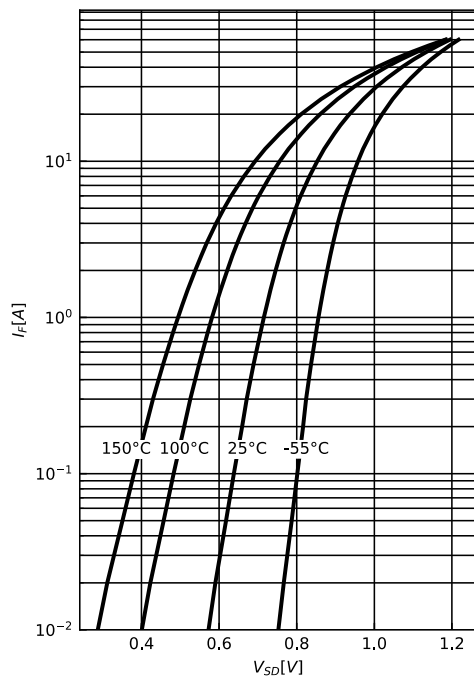
Diagram 8: Typ. gate threshold voltage



$$V_{GS(th)} = f(T_j); I_D = 1\text{mA}$$

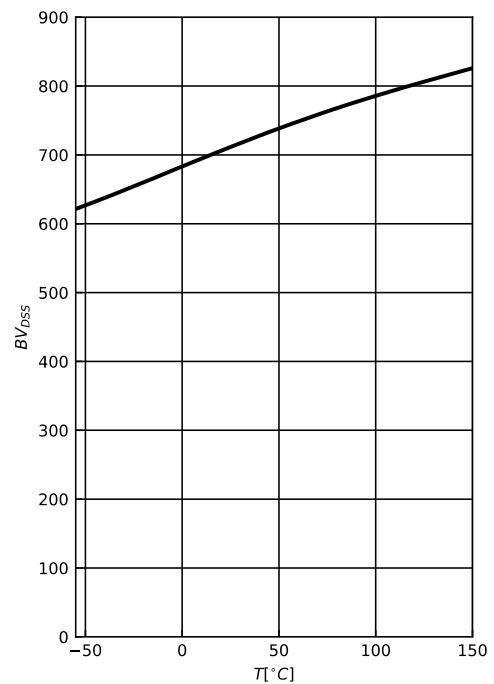
Electrical characteristics diagrams

Diagram 9: Forward characteristics of reverse diode



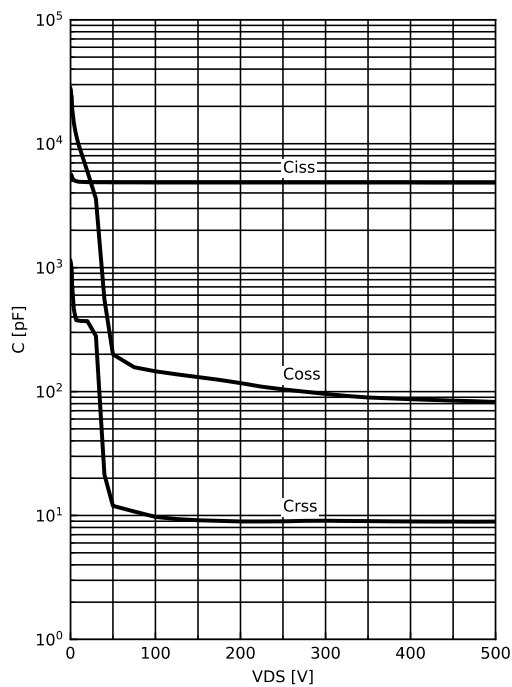
$$I_F = f(V_{DS}); \text{ parameter: } T_j$$

Diagram 10: Drain-source breakdown voltage



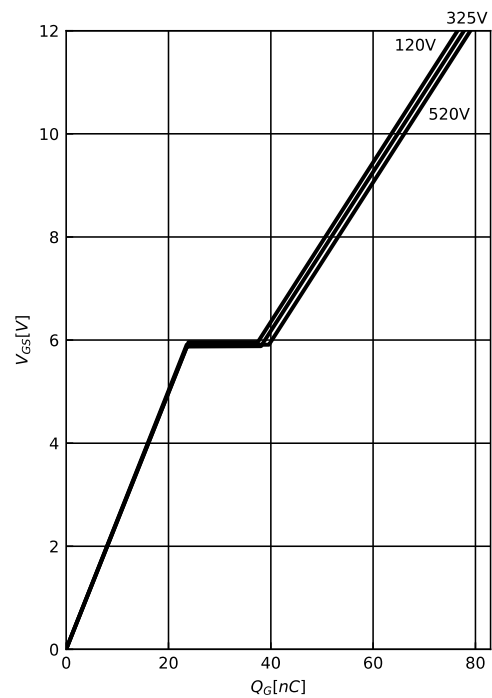
$$BV_{DS} = f(T_j); I_D = 250 \mu A$$

Diagram 11: Typ. capacitances



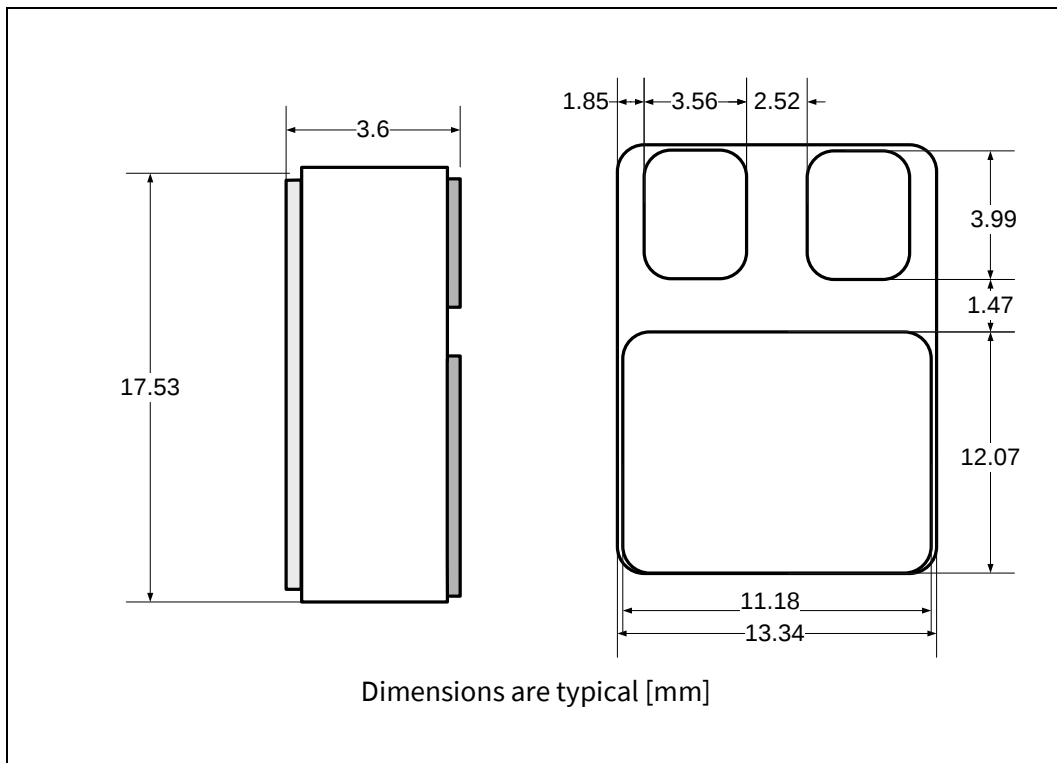
$$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$$

Diagram 12: Typ. gate charge



$$V_{GS} = f(Q_{\text{gate}}); I_D = 28.0 \text{ A pulsed}; \text{ parameter: } V_{DS}$$

6 Package outlines



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