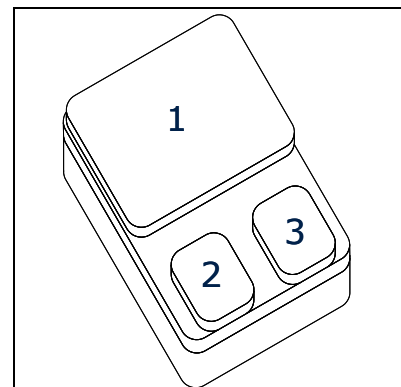


# 60V Radiation Hard power MOSFET


## BUY06CS35J-01(ES)

### Features

- Low  $R_{DS(on)}$
- Single Event Effect (SEE) hardened  
 LET 95, Range: 86 $\mu$ m (Pb)      LET 62, Range: 73 $\mu$ m (Xe)  
 $V_{GS} = -5V, V_{DS} = 60V$        $V_{GS} = -15V, V_{DS} = 60V$   
 $V_{GS} = -10V, V_{DS} = 50V$        $V_{GS} = -20V, V_{DS} = 40V$
- Total Ionisation Dose (TID) hardened  
 100 kRad approved (Level R)
- Hermetically sealed
- N-channel



### Product validation

-  **ESA Space Qualified**  
 ESCC Detail Spec. No.: 5205/032  
 Type Variant No. 01

### Description

**Table 1**      **Product information**

Type	Comment	Pin Configuration				Package
		1	2	3	-	
BUY06CS35J-01(ES)	For flight use	D	G	S	-	SMD05
BUY06CS35J-01(P) <sup>1</sup>	Not for flight use <sup>1</sup>					

<sup>1</sup> (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	$V_{DS}$	-	-	60	V	
Gate source voltage	$V_{GS}$	-20	-	20	V	static
Drain gate voltage	$V_{DG}$	-	-	60	V	
Continuous drain current <sup>1</sup>	$I_D$	-	-	35	A	$T_C = 25\text{ °C}$ $T_C = 100\text{ °C}$
		-	-	23		
Continuous source current	$I_S$	-	-	35	A	
Drain current pulsed	$I_{DM}$	-	-	100	Apk	$t_p$ limited by $T_{j,max}$
Total power dissipation <sup>2</sup>	$P_{tot}$	-	-	75	W	$T_C \leq 25\text{ °C}$
Operating and storage temperature	$T_{op}$	-55	-	150	°C	
Avalanche energy	$E_{AS}$	-	-	200	mJ	

<sup>1</sup> Limited by  $T_{j,max}$ <sup>2</sup> 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	$R_{th,JC}$	-	-	1.66	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	$BV_{DSS}$	60	-	-	V	$I_D = 0.25\text{mA}$ , $V_{GS} = 0\text{V}$
Temperature coefficient of $BV_{DSS}$	$\Delta BV_{DSS}/\Delta T_J$	-	0.08	-	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	$\mu\text{A}$	$V_{DS} = 48\text{V}$ , $V_{GS} = 0\text{V}$ , $T_A = 25^\circ\text{C}$
		-	-	250		$V_{DS} = 48\text{V}$ , $V_{GS} = 0\text{V}$ , $T_A = 125^\circ\text{C}$
Drain source on-state resistance <sup>1</sup>	$R_{DS(ON)}$	-	28	35	m $\Omega$	$V_{GS} = 10\text{V}$ , $I_D = 23\text{A}$ , $T_A = 25^\circ\text{C}$
		-	-	52		$V_{GS} = 10\text{V}$ , $I_D = 23\text{A}$ , $T_A = 125^\circ\text{C}$
Diode forward voltage <sup>1,2</sup>	$V_{SD}$	-	-	1.2	V	$V_{GS} = 0\text{V}$ , $I_S = 35\text{A}$

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Turn-on delay time	$t_{d(ON)}$	-	12	18	ns	$V_{DD} = 50\% V_{DS}$ , $I_D = 23\text{A}$ , $R_G = 4.7\Omega$
Rise time	$t_r$	-	13	20	ns	$V_{DD} = 50\% V_{DS}$ , $I_D = 23\text{A}$ , $R_G = 4.7\Omega$
Turn-off delay time	$t_{d(OFF)}$	-	19	28	ns	$V_{DD} = 50\% V_{DS}$ , $I_D = 23\text{A}$ , $R_G = 4.7\Omega$
Fall time	$t_f$	-	8.5	12	ns	$V_{DD} = 50\% V_{DS}$ , $I_D = 23\text{A}$ , $R_G = 4.7\Omega$
Reverse recovery time	$t_{rr}$	-	200	220	ns	$V_{DD} \leq 50\text{V}$ , $I_D = 35\text{A}$
Common source input capacitance	$C_{iss}$	1.5	1.6	1.7	nF	$V_{DS} = 40\text{V}$ , $V_{GS} = 0\text{V}$ , $f = 1.0\text{MHz}$
Common source output capacitance	$C_{oss}$	450	530	600	pF	$V_{DS} = 40\text{V}$ , $V_{GS} = 0\text{V}$ , $f = 1.0\text{MHz}$
Common source reverse transfer capacitance	$C_{rss}$	75	90	105	pF	$V_{DS} = 40\text{V}$ , $V_{GS} = 0\text{V}$ , $f = 1.0\text{MHz}$
Gate resistance	$R_G$	-	1.2	-	$\Omega$	$f = 1.0\text{MHz}$ , open drain
Total gate charge	$Q_G$	-	25	28	nC	$V_{DD} = 50\% V_{DS}$ , $V_{GS} = 10\text{V}$ , $I_D = 35\text{A}$

<sup>1</sup> Pulsed measurement: Pulse Width < 300 $\mu\text{s}$ , Duty Cycle < 2.0%.<sup>2</sup> 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:

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

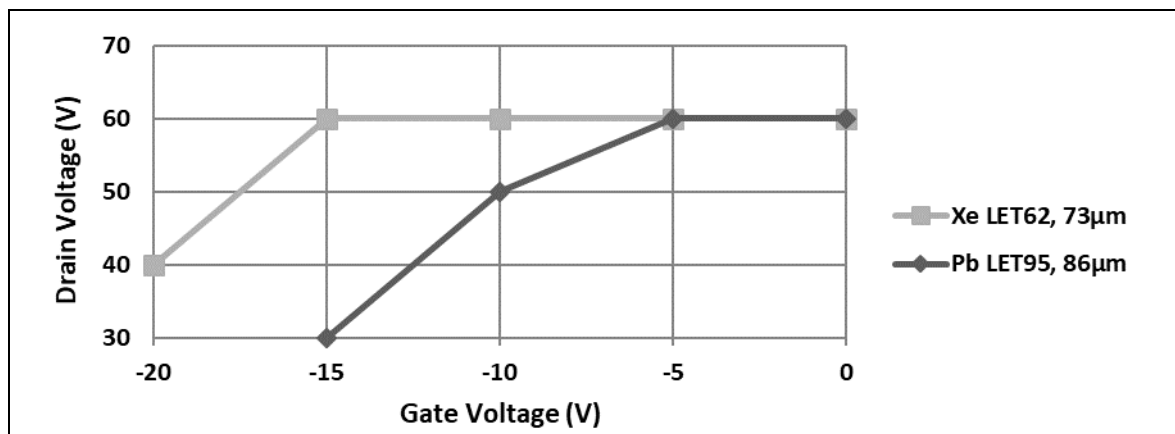
**Table 6 Electrical characteristics at  $T_A=25^\circ C$ , post Total Dose Irradiation**

Parameter	Symbol	100 kRad(Si)			Unit	Note / Test Condition
		Drift Values	Absolute			
			Min.	Max.		
Drain-source breakdown voltage	$BV_{DSS}$	$\pm 20\%$	60	-	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	$\mu A$	$V_{DS}= 48V, V_{GS}= 0V$
Drain source on-state resistance <sup>1</sup>	$R_{DS(ON)}$	$\pm 20\%$	-	35	m $\Omega$	$V_{GS}= 10V, I_D= 23A$
Diode forward voltage <sup>1,2</sup>	$V_{SD}$	$\pm 10\%$	-	1.2	V	$V_{GS}= 0V, I_S= 35A$

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 <sup>2</sup> )]	Range [ $\mu m$ ]	$V_{DS}$ [V]				
			$V_{GS} = 0V$	$V_{GS} = -5V$	$V_{GS} = -10V$	$V_{GS} = -15V$	$V_{GS} = -20V$
Xe	$62 \pm 5\%$	$73 \pm 5\%$	60	60	60	60	40
Pb	$95 \pm 5\%$	$86 \pm 5\%$	60	60	50	30	-



<sup>1</sup> Pulsed measurement: Pulse Width < 300 $\mu s$ , Duty Cycle < 2.0%.

<sup>2</sup> Measured within 2.0 mm of case

## 5 Electrical characteristics diagrams

Diagram 1: Safe operating area

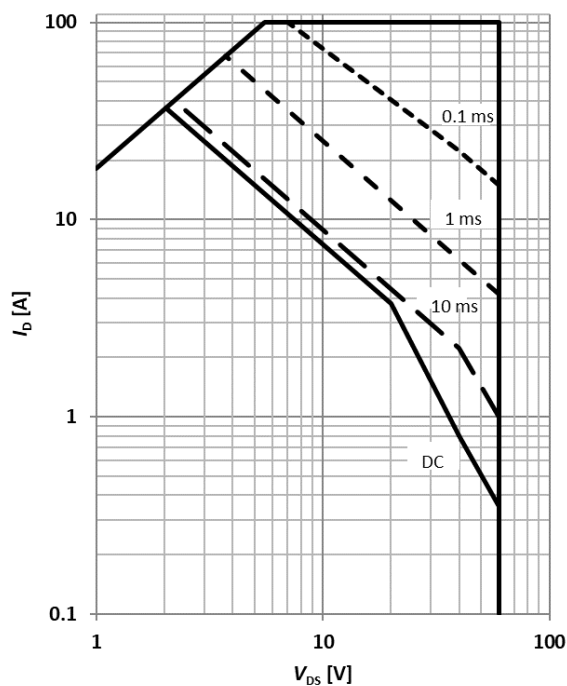

 $I_D = f(V_{DS}); T_C = 25^\circ\text{C}; D=0; \text{parameter: } t_p$ 

Diagram 2: Max. transient thermal impedance

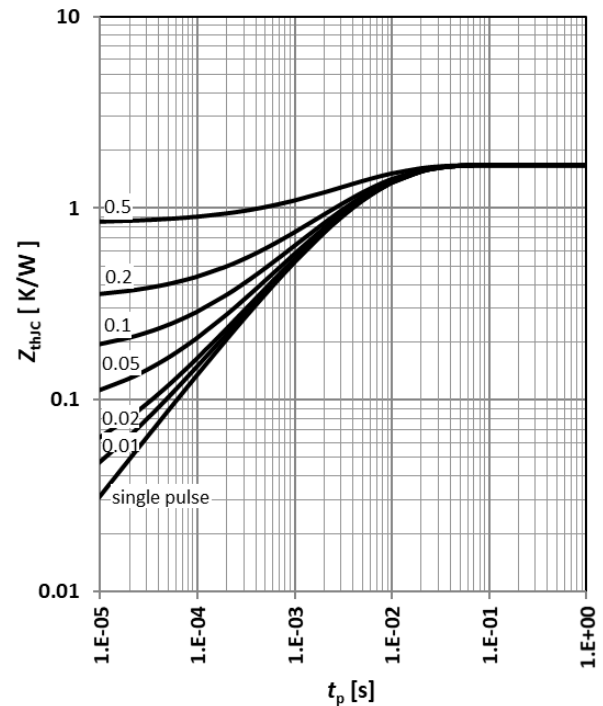

 $Z_{thJC} = f(t_p); \text{parameter: } D = t_p/T$ 

Diagram 3: Typ. output characteristics

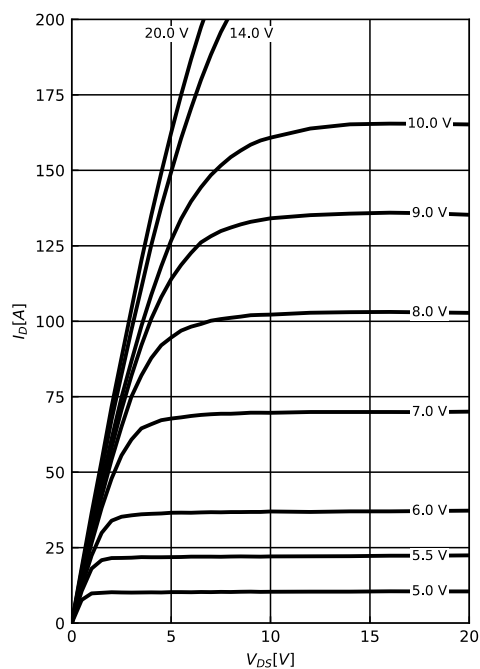
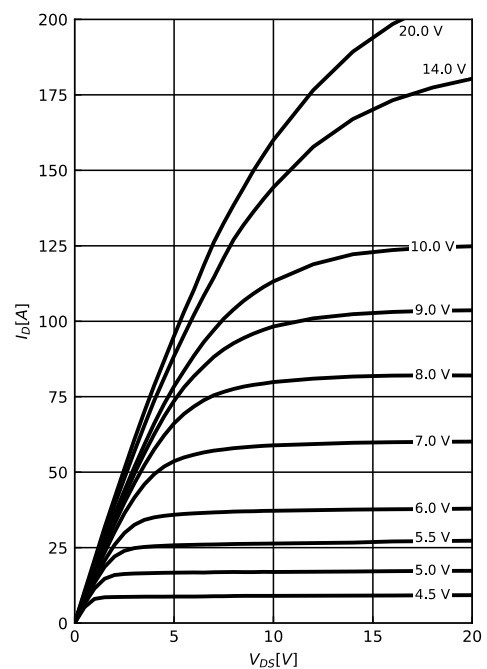
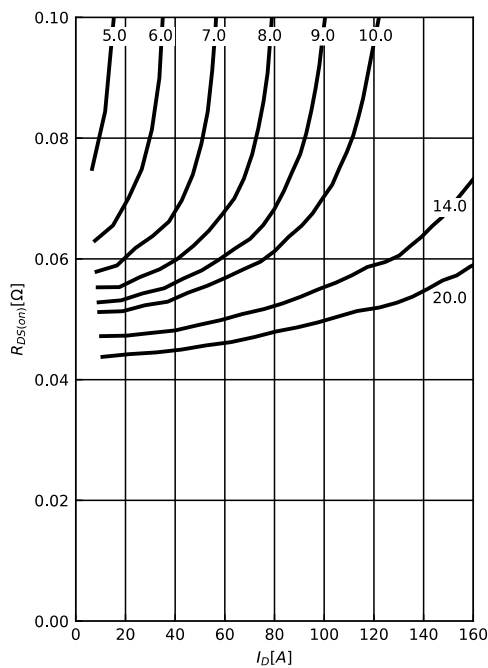

 $I_D = f(V_{DS}); T_J = 25^\circ\text{C}; \text{parameter: } V_{GS}$ 

Diagram 4: Typ. output characteristics


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

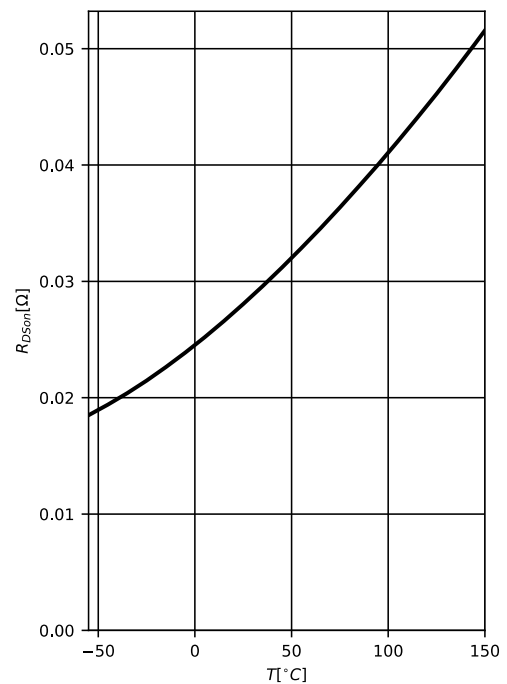
## Electrical characteristics diagrams

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



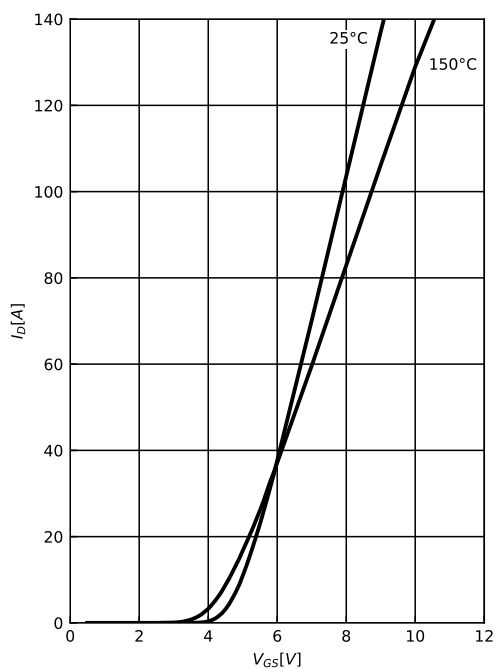
$$R_{DS(on)} = f(I_D); T_j = 150^\circ\text{C}; \text{parameter: } V_{GS}$$

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



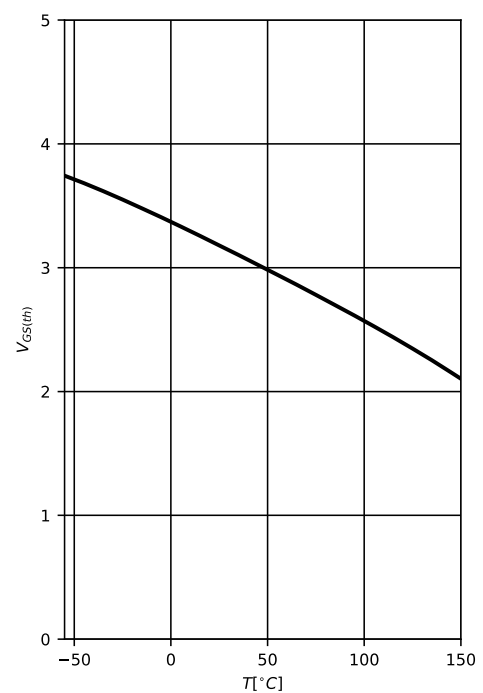
$$R_{DS(on)} = f(T_j); I_D = 23\text{A}$$

Diagram 7: Typ. transfer characteristics



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

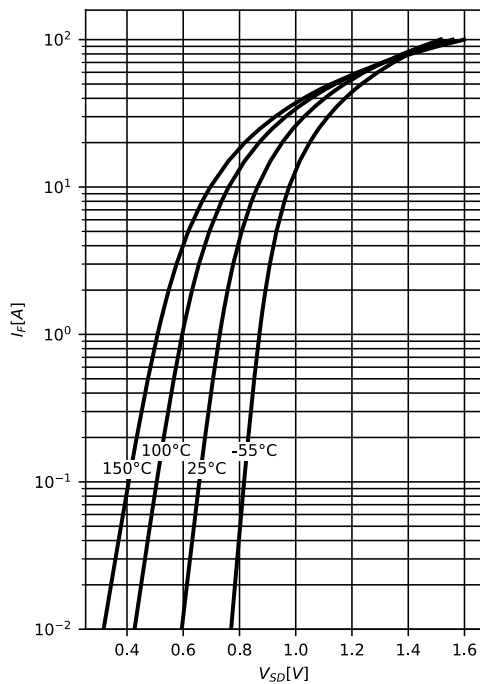
Diagram 8: Typ. gate threshold voltage



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

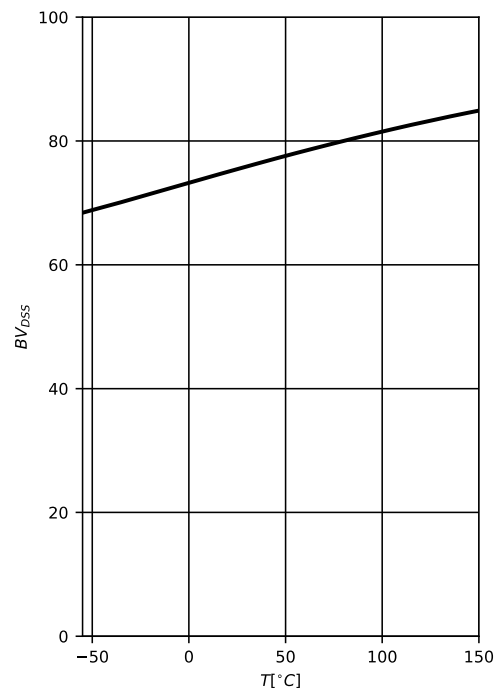
### Electrical characteristics diagrams

**Diagram 9: Forward characteristics of reverse diode**



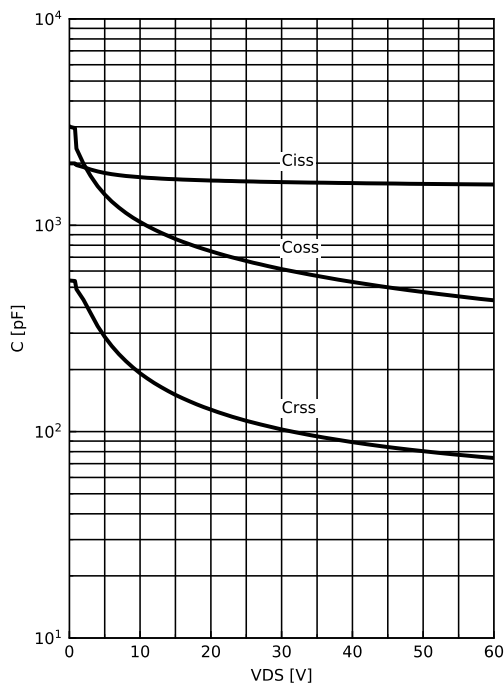
$$I_F = f(V_{SD}); \text{ parameter: } T_j$$

**Diagram 10: Drain-source breakdown voltage**



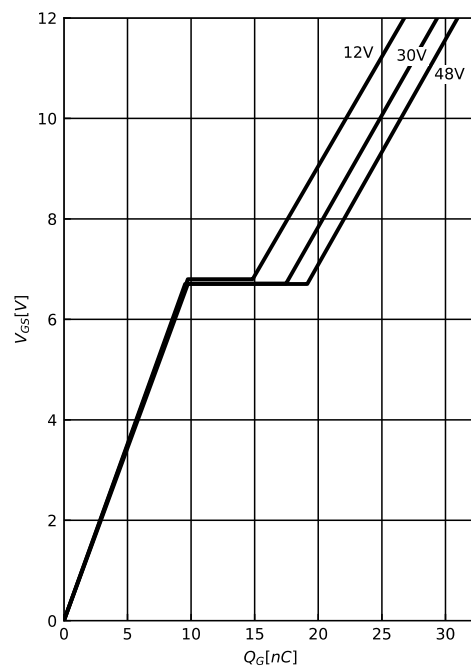
$$BV_{DSS} = f(T_j); I_D = 250\mu A$$

**Diagram 11: Typ. capacitances**



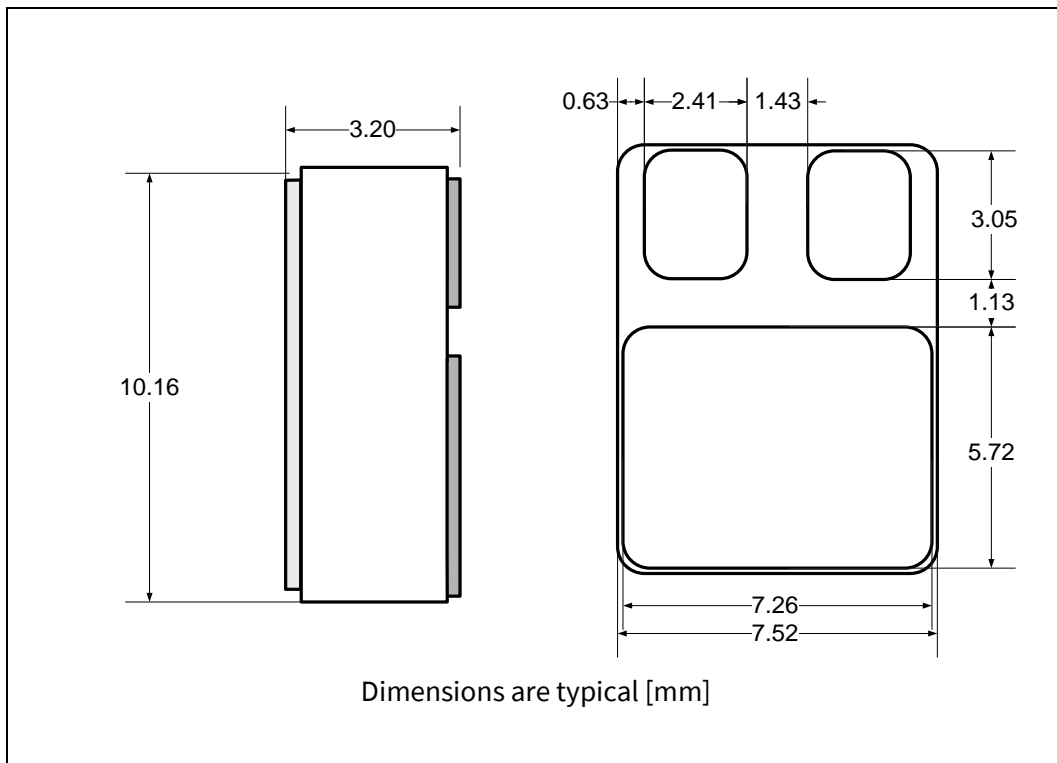
$$C = f(V_{DS}); V_{GS} = 0 V; f = 1 \text{ MHz}$$

**Diagram 12: Typ. gate charge**



$$V_{GS} = f(Q_{gate}); I_D = 35.0 \text{ A pulsed}; \text{ parameter: } V_{DD}$$

## 6 Package outlines



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