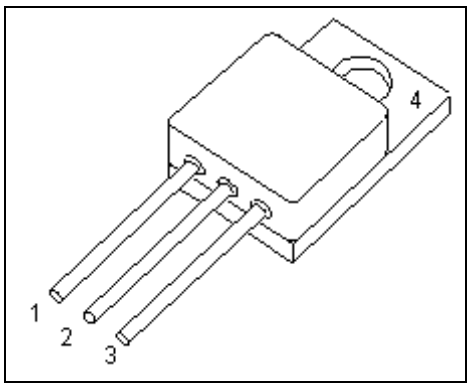
60V Radiation Hard power MOSFET

BUY06CS23K-01(ES)



Features

- Low $R_{DS(on)}$
- Single Event Effect (SEE) hardened
  LET 95, Range: 86µm (Pb) LET 62, Range: 73µm (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. 03

Description

Table 1 Product information

Type	Comment	Pin Configuration				Package
		1	2	3	4	
BUY06CS23K-01(ES)	For flight use	D	S	G	Not connected	TO-257AA
BUY06CS23K-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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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 [1]	I_D	- -	- -	23 19	A	T_C= 25 °C T_C= 100 °C
Continuous source current	I_S	-	-	23	A	
Drain current pulsed	I_{DM}	-	-	100	Apk	t_p limited by $T_{j,max}$
Total power dissipation [2]	P_{tot}	-	-	75	W	$T_C \leq 25$ °C
Operating and storage temperature	T_{op}	-55	-	150	°C	
Avalanche energy	E_{AS}	-	-	200	mJ	

[1] Limited by package

[2] For $T_C > 25$°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.

3 Electrical characteristics

at T_A=25°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= 0.25mA, V_{GS}= 0V
Temperature coefficiend of BV_{DSS}	$\Delta BV_{DSS}/\Delta T_J$	-	0.08	-	V/°C	
Gate threshold voltage	$V_{GS(th)}$	2 1.5 -	- - -	4 - 5	V	I_D= 1.0mA, $V_{DS} \geq V_{GS}$, T_A= 25°C I_D= 1.0mA, $V_{DS} \geq V_{GS}$, T_A= 125°C I_D= 1.0mA, $V_{DS} \geq V_{GS}$, T_A= -55°C
Gate to source leakage current	I_{GSS}	-100 -200	- -	100 200	nA	V_{DS}= 0V, V_{GS}= +/- 20V, T_A= 25°C V_{DS}= 0V, V_{GS}= +/- 20V, T_A= 125°C
Zero gate voltage drain current	I_{DSS}	- -	- -	25 250	µA	V_{DS}= 48V, V_{GS}= 0V, T_A= 25°C V_{DS}= 48V, V_{GS}= 0V, T_A= 125°C
Drain source on-state resistance [1]	$R_{DS(ON)}$	- -	36 -	40 65	mΩ	V_{GS}= 10V, I_D= 19A, T_A= 25°C V_{GS}= 10V, I_D= 19A, T_A= 125°C
Diode forward voltage [1,2]	V_{SD}	-	-	1.3	V	V_{GS}= 0V, I_S= 23A

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= 19A, R_G= 4.7Ω
Rise time	t_r	-	11	20	ns	V_{DD}= 50% V_{DS}, I_D= 19A, R_G= 4.7Ω
Turn-off delay time	$t_{d(OFF)}$	-	19	28	ns	V_{DD}= 50% V_{DS}, I_D= 19A, R_G= 4.7Ω
Fall time	t_f	-	7	12	ns	V_{DD}= 50% V_{DS}, I_D= 19A, R_G= 4.7Ω
Reverse recovery time	t_{rr}	-	200	220	ns	$V_{DD} \leq$ 50V, I_D= 23A
Common source input capacitance	C_{iss}	1.5	1.6	1.7	nF	V_{DS}= 40V, V_{GS}= 0V, f= 1.0MHz
Common source output capacitance	C_{oss}	450	530	600	pF	V_{DS}= 40V, V_{GS}= 0V, f= 1.0MHz
Common source reverse transfer capacitance	C_{rss}	75	90	105	pF	V_{DS}= 40V, V_{GS}= 0V, f= 1.0MHz
Gate resistance	R_G	-	1.2	-	Ω	f= 1.0MHz, open drain
Total gate charge	Q_G	-	26	28	nC	V_{DD}= 50% V_{DS}, V_{GS}= 10V, I_D= 23A

[1] Pulsed measurement: Pulse Width < 300µs, 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

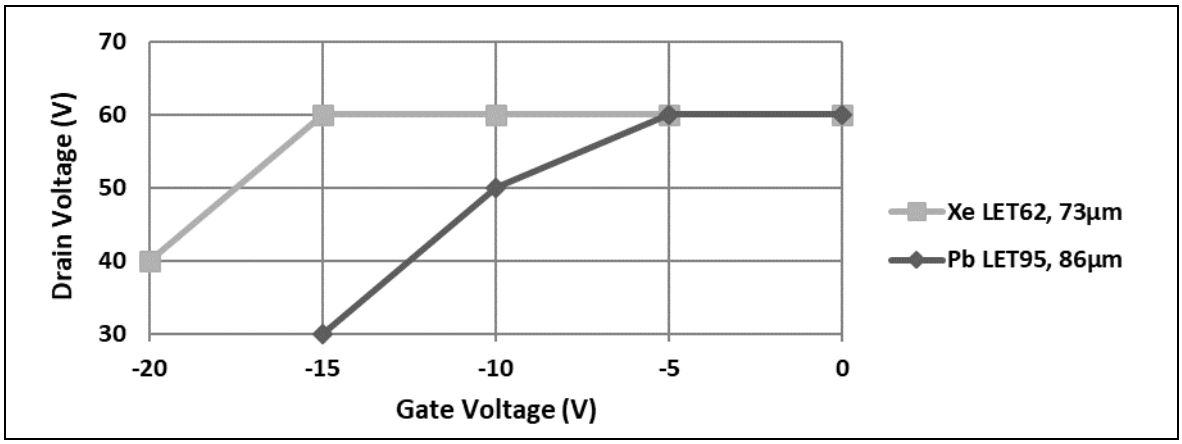
Table 6 Electrical characteristics at T_A=25°C, post Total Dose Irradiation

Parameter	Symbol	100 kRad(Si)			Unit	Note / Test Condition
		Drift Values	Absolute			
			Min.	Max.		
Drain-source breakdown voltage	BV_{DSS}	± 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}	± 20%	-100	100	nA	V_{DS}= 0V, V_{GS}= +/- 20V
Zero gate voltage drain current	I_{DSS}	-	-	25	µA	V_{DS}= 48V, V_{GS}= 0V
Drain source on-state resistance [1]	$R_{DS(ON)}$	± 20%	-	40	mΩ	V_{GS}= 10V, I_D= 19A
Diode forward voltage [1,2]	V_{SD}	± 10%	-	1.3	V	V_{GS}= 0V, I_S= 23A

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/cm²)]	Range [µm]	V_{DS} [V]				
			V_{GS}= 0V	V_{GS}= -5V	V_{GS}= -10V	V_{GS}= -15V	V_{GS}= -20V
Xe	62 ± 5%	73 ± 5%	60	60	60	60	40
Pb	95 ± 5%	86 ± 5%	60	60	50	30	-

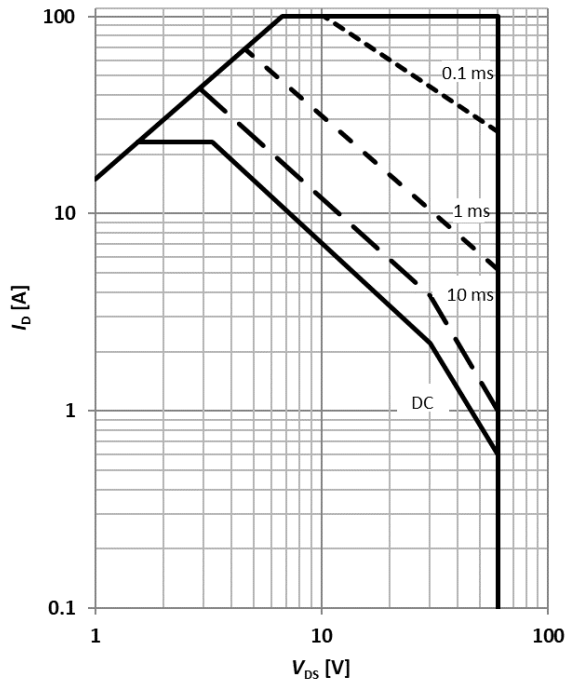


[1] Pulsed measurement: Pulse Width < 300µs, Duty Cycle <2.0%.

[2] Measured within 2.0 mm of case

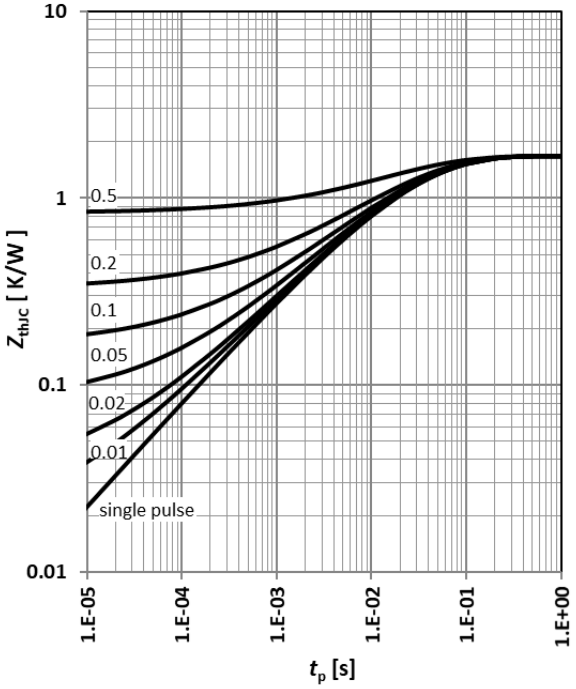
5 Electrical characteristics diagrams

Diagram 1: Safe operating area



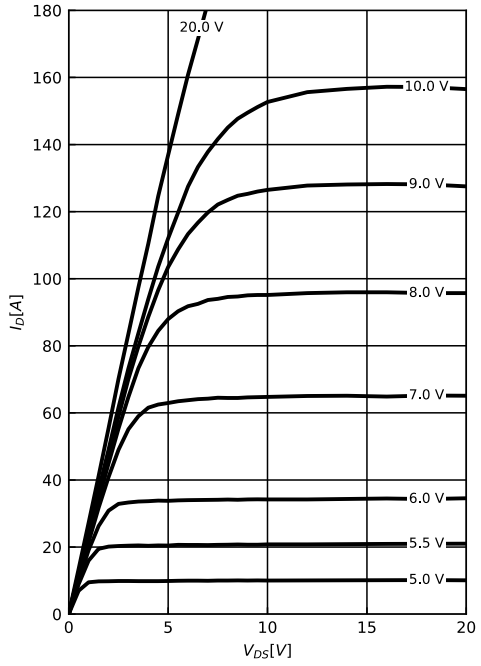
$I_D = f(V_{DS})$; $T_C = 25°C$; D=0; parameter: t_p

Diagram 2: Max. transient thermal impedance



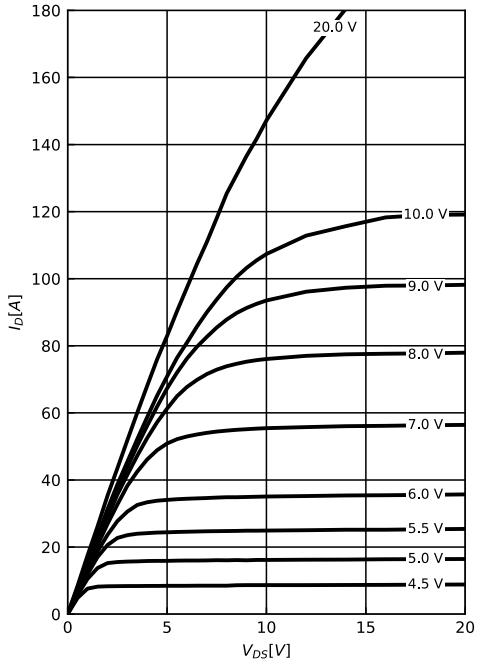
$Z_{thJC} = f(t_p)$; parameter: $D = t_p/T$

Diagram 3: Typ. output characteristics



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

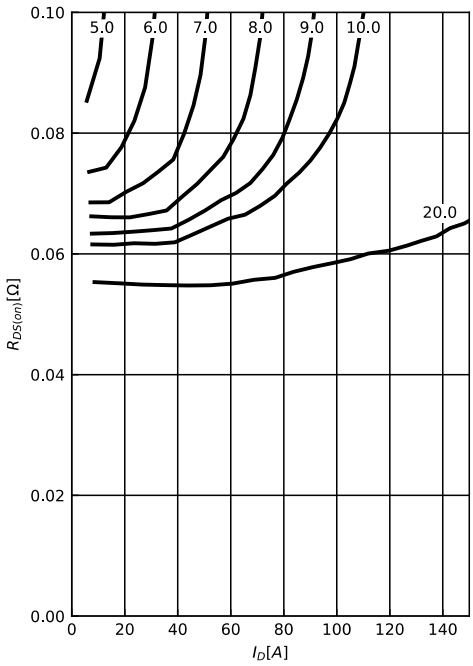
Diagram 4: Typ. output characteristics



$I_D = f(V_{DS})$; $T_j = 150$ °C; parameter: V_G

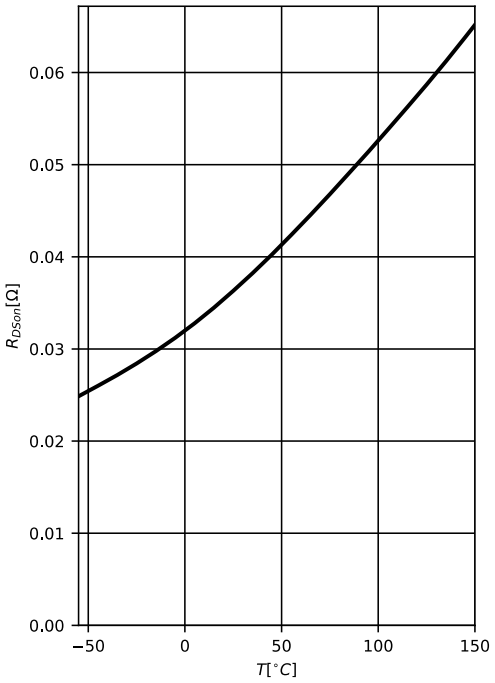
Electrical characteristics diagrams

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



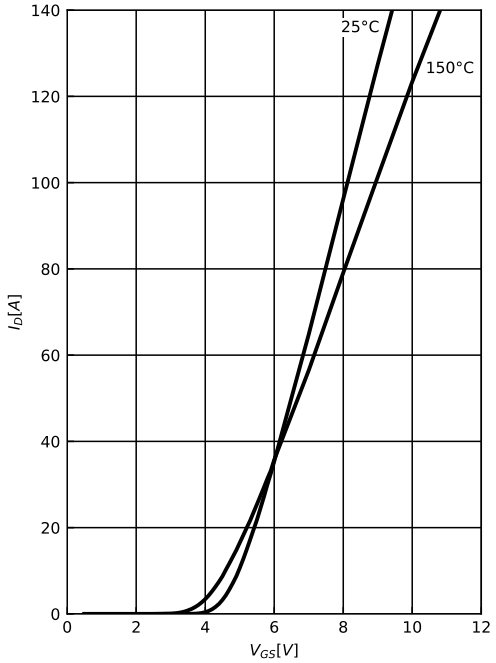
$R_{DS(on)}$ = f(I_D); T_j = 150 °C; parameter: V_{GS}

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



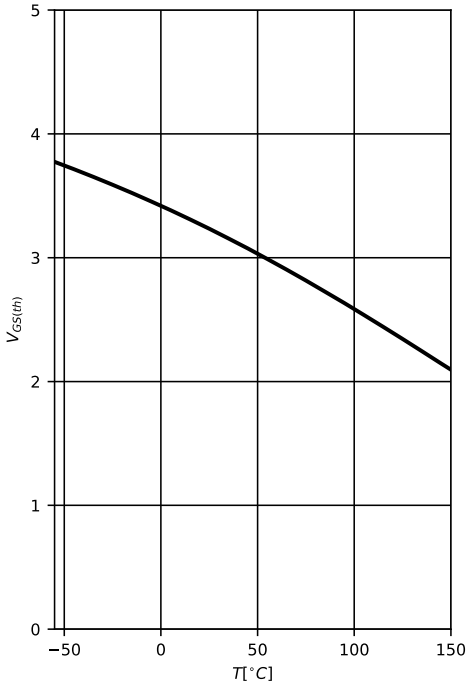
$R_{DS(on)}$ = f(T_j); I_D=19A

Diagram 7: Typ. transfer characteristics



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

Diagram 8: Typ. gate threshold voltage



I_D=f(T_j); I_D = 1mA

Electrical characteristics diagrams

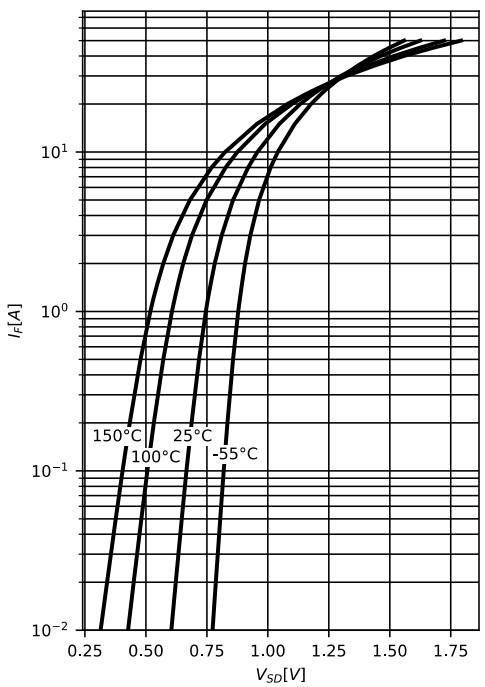
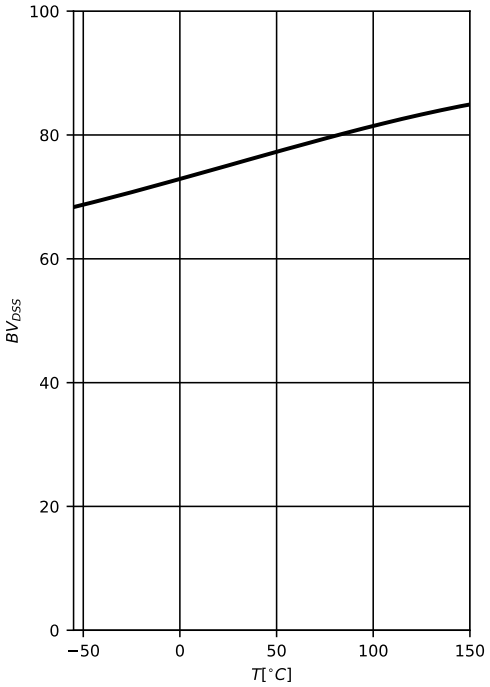
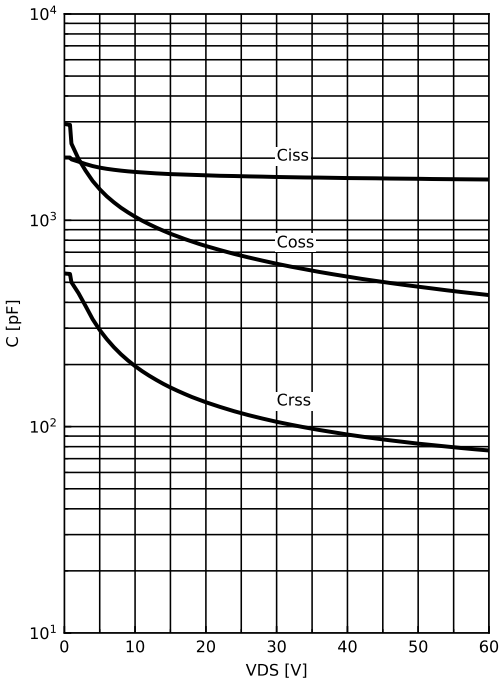
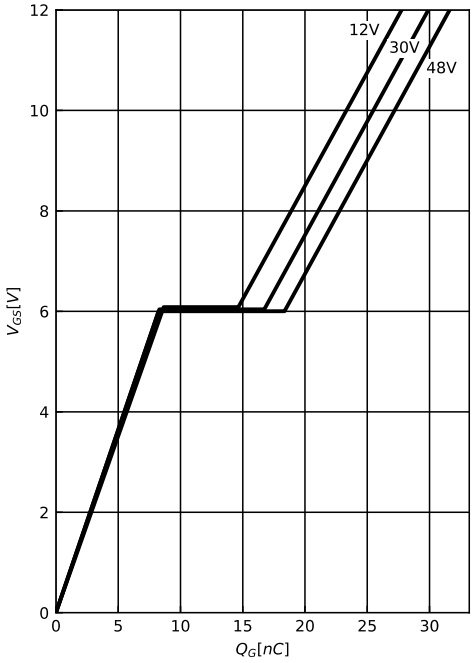
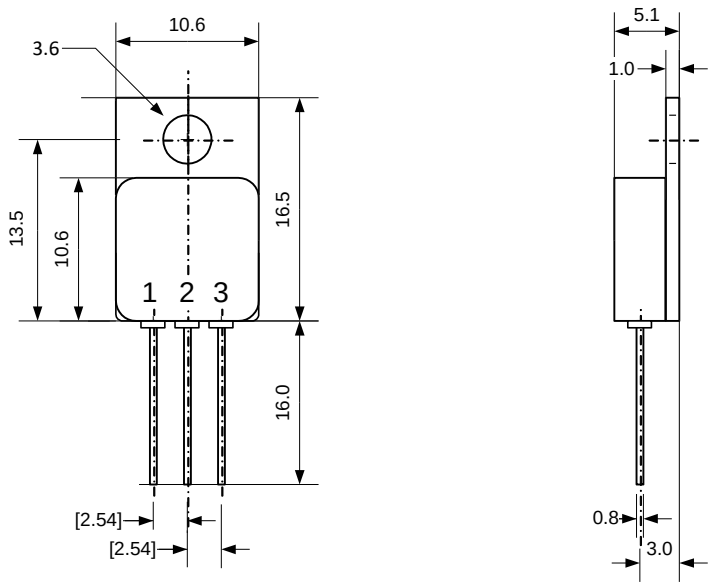
Diagram 9: Forward characteristics of reverse diode	Diagram 10: Drain-source breakdown voltage
	
$I_F = f(V_{SD})$; parameter: T_j	$BV_{DSS} = f(T_j)$; $I_D = 250\mu A$

Diagram 11: Typ. capacitances	Diagram 12: Typ. gate charge
	
$C = f(V_{DS})$; $V_{GS} = 0$ V; $f = 1$ MHz	$V_{GS} = f(Q_{gate})$; $I_D = 23.0$ A pulsed; parameter: V_{DD}

6 Package outlines



Dimensions are typical [mm]

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