

PowerMOS transistor
Logic level TOPFET

BUK109-50DL

DESCRIPTION

Monolithic temperature and overload protected logic level power MOSFET in a 3 pin plastic surface mount envelope, intended as a general purpose switch for automotive systems and other applications.

APPLICATIONS

- General controller for driving
- lamps
 - motors
 - solenoids
 - heaters

FEATURES

- Vertical power DMOS output stage
- Low on-state resistance
- Overload protection against over temperature
- Overload protection against short circuit load
- Latched overload protection reset by input
- 5 V logic compatible input level
- Control of power MOSFET and supply of overload protection circuits derived from input
- Lower operating input current permits direct drive by micro-controller
- ESD protection on input pin
- Overvoltage clamping for turn off of inductive loads

QUICK REFERENCE DATA

SYMBOL	PARAMETER	MAX.	UNIT
V_{DS}	Continuous drain source voltage	50	V
I_D	Continuous drain current	26	A
P_D	Total power dissipation	75	W
T_j	Continuous junction temperature	150	°C
$R_{DS(ON)}$	Drain-source on-state resistance	60	mΩ
I_{ISL}	Input supply current $V_{IS} = 5\text{ V}$	650	μA

FUNCTIONAL BLOCK DIAGRAM

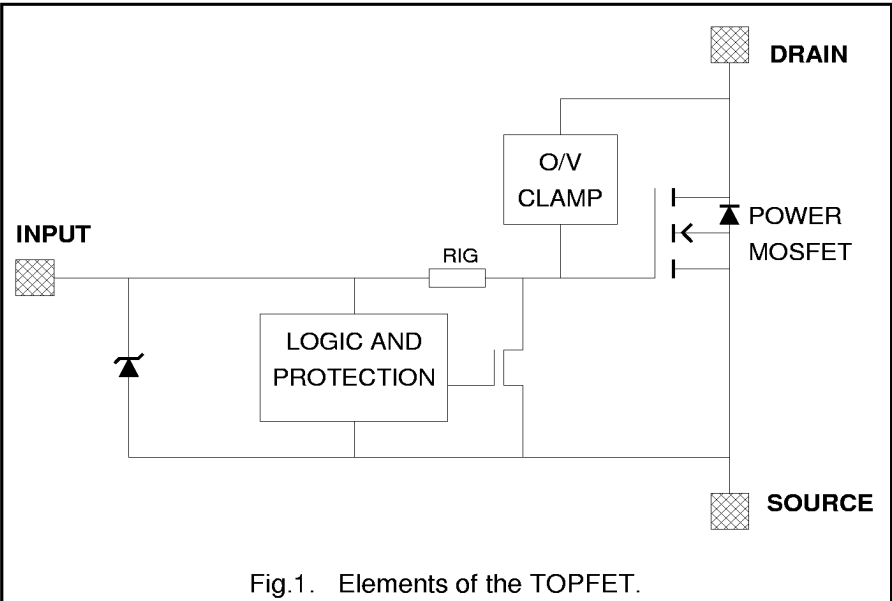
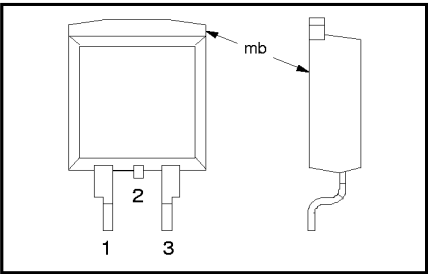


Fig.1. Elements of the TOPFET.

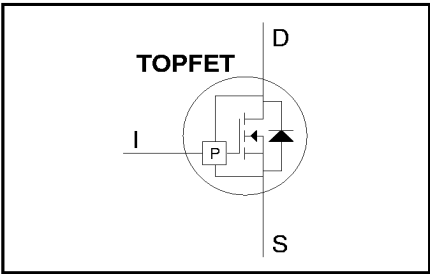
PINNING - SOT404

PIN	DESCRIPTION
1	input
2	drain
3	source
mb	drain

PIN CONFIGURATION



SYMBOL



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LIMITING VALUES

Limiting values in accordance with the Absolute Maximum Rating System (IEC 134)

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DS}	Continuous drain source voltage ¹	-	-	50	V
V_{IS}	Continuous input voltage	-	0	6	V
I_D	Continuous drain current	$T_{mb} \leq 25\text{ }^{\circ}\text{C}; V_{IS} = 5\text{ V}$	-	26	A
I_D	Continuous drain current	$T_{mb} \leq 100\text{ }^{\circ}\text{C}; V_{IS} = 5\text{ V}$	-	16	A
I_{DRM}	Repetitive peak on-state drain current	$T_{mb} \leq 25\text{ }^{\circ}\text{C}; V_{IS} = 5\text{ V}$	-	100	A
P_D	Total power dissipation	$T_{mb} \leq 25\text{ }^{\circ}\text{C}$	-	75	W
T_{stg}	Storage temperature	-	-55	150	$^{\circ}\text{C}$
T_j	Continuous junction temperature ²	normal operation	-	150	$^{\circ}\text{C}$
T_{sold}	Lead temperature	during soldering	-	250	$^{\circ}\text{C}$

OVERLOAD PROTECTION LIMITING VALUES

With the protection supply provided via the input pin, TOPFET can protect itself from two types of overload.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{ISP}	Protection supply voltage ³	for valid protection	4	-	V
	Over temperature protection				
$V_{DDP(T)}$	Protected drain source supply voltage	$V_{IS} = 5\text{ V}$	-	50	V
	Short circuit load protection⁴				
$V_{DDP(P)}$	Protected drain source supply voltage ⁵	$V_{IS} = 5\text{ V}$	-	20	V
P_{DSM}	Instantaneous overload dissipation	$T_{mb} = 25\text{ }^{\circ}\text{C}$	-	1.3	kW

OVERVOLTAGE CLAMPING LIMITING VALUES

At a drain source voltage above 50 V the power MOSFET is actively turned on to clamp overvoltage transients.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{DROM}	Repetitive peak clamping current	$V_{IS} = 0\text{ V}$	-	26	A
E_{DSM}	Non-repetitive clamping energy	$T_{mb} \leq 25\text{ }^{\circ}\text{C}; I_{DM} = 26\text{ A};$ $V_{DD} \leq 20\text{ V};$ inductive load	-	625	mJ
E_{DRM}	Repetitive clamping energy	$T_{mb} \leq 95\text{ }^{\circ}\text{C}; I_{DM} = 8\text{ A};$ $V_{DD} \leq 20\text{ V}; f = 250\text{ Hz}$	-	40	mJ

ESD LIMITING VALUE

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_C	Electrostatic discharge capacitor voltage	Human body model; $C = 250\text{ pF}; R = 1.5\text{ k}\Omega$	-	2	kV

¹ Prior to the onset of overvoltage clamping. For voltages above this value, safe operation is limited by the overvoltage clamping energy.

² A higher T_j is allowed as an overload condition but at the threshold $T_{j(TO)}$ the over temperature trip operates to protect the switch.

³ The input voltage for which the overload protection circuits are functional.

⁴ For further information, refer to OVERLOAD PROTECTION CHARACTERISTICS.

⁵ The short circuit load protection is able to save the device providing the instantaneous on-state dissipation is less than the limiting value for P_{DSM} , which is always the case when V_{DS} is less than $V_{DDP(P)}$ maximum.

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THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$R_{th\ j-mb}$	Thermal resistance Junction to mounting base	-	-	1.3	1.67	K/W
$R_{th\ j-a}$	Thermal resistance Junction to ambient	minimum footprint FR4 PCB (see fig. 23)	-	50	-	K/W

STATIC CHARACTERISTICS

 $T_{mb} = 25\text{ °C}$ unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(CL)DSS}$	Drain-source clamping voltage	$V_{IS} = 0\text{ V}$; $I_D = 10\text{ mA}$	50	-	-	V
$V_{(CL)DSS}$	Drain-source clamping voltage	$V_{IS} = 0\text{ V}$; $I_{DM} = 2\text{ A}$; $t_p \leq 300\text{ }\mu\text{s}$; $\delta \leq 0.01$	-	-	70	V
I_{DSS}	Zero input voltage drain current	$V_{DS} = 12\text{ V}$; $V_{IS} = 0\text{ V}$	-	0.5	10	μA
I_{DSS}	Zero input voltage drain current	$V_{DS} = 50\text{ V}$; $V_{IS} = 0\text{ V}$	-	1	20	μA
I_{DSS}	Zero input voltage drain current	$V_{DS} = 40\text{ V}$; $V_{IS} = 0\text{ V}$; $T_j = 125\text{ °C}$	-	10	100	μA
$R_{DS(ON)}$	Drain-source on-state resistance ¹	$V_{IS} = 5\text{ V}$; $I_{DM} = 13\text{ A}$; $t_p \leq 300\text{ }\mu\text{s}$; $\delta \leq 0.01$	-	45	60	m Ω

OVERLOAD PROTECTION CHARACTERISTICS

TOPFET switches off when one of the overload thresholds is reached. It remains latched off until reset by the input.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$E_{DS(TO)}$	Short circuit load protection ² Overload threshold energy	$T_{mb} = 25\text{ °C}$; $L \leq 10\text{ }\mu\text{H}$; $R_L = 10\text{ m}\Omega$ $V_{DD} = 13\text{ V}$; $V_{IS} = 5\text{ V}$	-	0.4	-	J
$t_{d\ sc}$	Response time	$V_{DD} = 13\text{ V}$; $V_{IS} = 5\text{ V}$	-	0.8	-	ms
$I_{D(SC)}$	Drain current ³	$V_{DD} = 13\text{ V}$; $V_{IS} = 5\text{ V}$	-	45	-	A
$I_{DM(SC)}$	Peak drain current ⁴	$V_{IS} = 5\text{ V}$; $V_{DD} = 13\text{ V}$	-	105	-	A
$T_{j(TO)}$	Over temperature protection Threshold junction temperature	$V_{IS} = 5\text{ V}$; from $I_D \geq 1\text{ A}$ ⁵	150	-	-	°C

TRANSFER CHARACTERISTIC

 $T_{mb} = 25\text{ °C}$

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
g_{fs}	Forward transconductance	$V_{DS} = 10\text{ V}$; $I_{DM} = 13\text{ A}$ $t_p \leq 300\text{ }\mu\text{s}$; $\delta \leq 0.01$	10	16	-	S

1 Continuous input voltage. The specified pulse width is for the drain current.

2 Refer to OVERLOAD PROTECTION LIMITING VALUES.

3 Continuous drain-source supply voltage. Pulsed input voltage.

4 Continuous input voltage. Momentary short circuit load connection. (The higher peak current is due to the effect of capacitance C_{gd}).

5 The over temperature protection feature requires a minimum on-state drain source voltage for correct operation. The specified minimum I_D ensures this condition.

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INPUT CHARACTERISTICS

$T_{mb} = 25\text{ }^{\circ}\text{C}$ unless otherwise specified. The supply for the logic and overload protection is taken from the input.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{IS(TO)}$	Input threshold voltage	$V_{DS} = 5\text{ V}$; $I_D = 1\text{ mA}$	1.0	1.5	2.0	V
I_{IS}	Input supply current	normal operation; $V_{IS} = 5\text{ V}$	100	200	350	μA
		$V_{IS} = 4\text{ V}$	-	160	270	μA
V_{ISR}	Protection reset voltage ¹	$T_j = 25\text{ }^{\circ}\text{C}$	2.0	2.6	3.5	V
		$T_j = 150\text{ }^{\circ}\text{C}$	1.0	-	-	
I_{ISL}	Input supply current	protection latched; $V_{IS} = 5\text{ V}$	-	330	650	μA
		$V_{IS} = 3.5\text{ V}$	-	240	430	μA
$V_{(BR)IS}$	Input breakdown voltage	$I_I = 10\text{ mA}$	6	-	-	V
R_{IG}	Input series resistance to gate of power MOSFET	$T_j = 25\text{ }^{\circ}\text{C}$	-	33	-	$\text{k}\Omega$
		$T_j = 150\text{ }^{\circ}\text{C}$	-	50	-	$\text{k}\Omega$

SWITCHING CHARACTERISTICS

$T_{mb} = 25\text{ }^{\circ}\text{C}$. $R_I = 50\text{ }\Omega$. Refer to waveform figure and test circuit.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$t_{d\text{ on}}$	Turn-on delay time	$V_{DD} = 13\text{ V}$; $V_{IS} = 5\text{ V}$	-	17	-	μs
t_r	Rise time	resistive load $R_L = 2.1\text{ }\Omega$	-	75	-	μs
$t_{d\text{ off}}$	Turn-off delay time	$V_{DD} = 13\text{ V}$; $V_{IS} = 0\text{ V}$	-	60	-	μs
t_f	Fall time	resistive load $R_L = 2.1\text{ }\Omega$	-	70	-	μs

REVERSE DIODE LIMITING VALUE

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_S	Continuous forward current	$T_{mb} \leq 25\text{ }^{\circ}\text{C}$; $V_{IS} = 0\text{ V}$	-	26	A

REVERSE DIODE CHARACTERISTICS

$T_{mb} = 25\text{ }^{\circ}\text{C}$

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{SDO}	Forward voltage	$I_S = 26\text{ A}$; $V_{IS} = 0\text{ V}$; $t_p = 300\text{ }\mu\text{s}$	-	1.0	1.5	V
t_{rr}	Reverse recovery time	not applicable ²	-	-	-	-

ENVELOPE CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
L_d	Internal drain inductance	Measured from upper edge of tab to centre of die	-	2.5	-	nH
L_s	Internal source inductance	Measured from source lead soldering point to source bond pad	-	7.5	-	nH

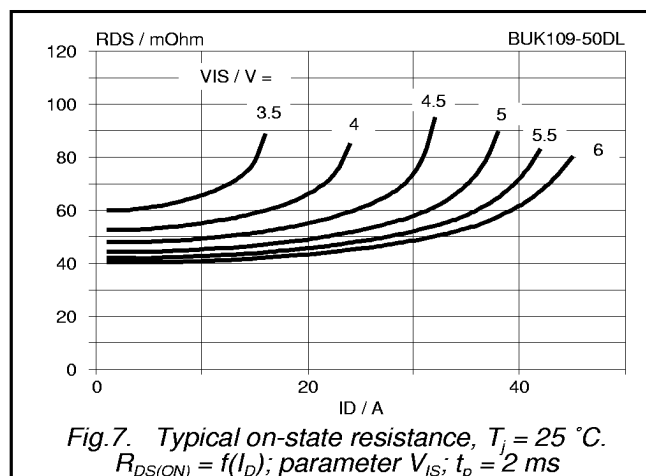
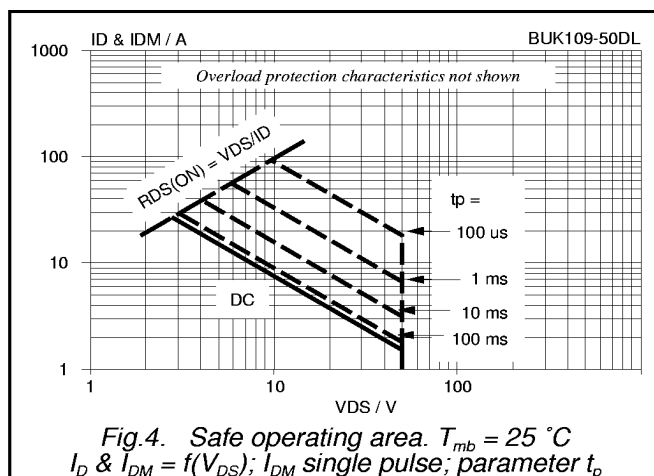
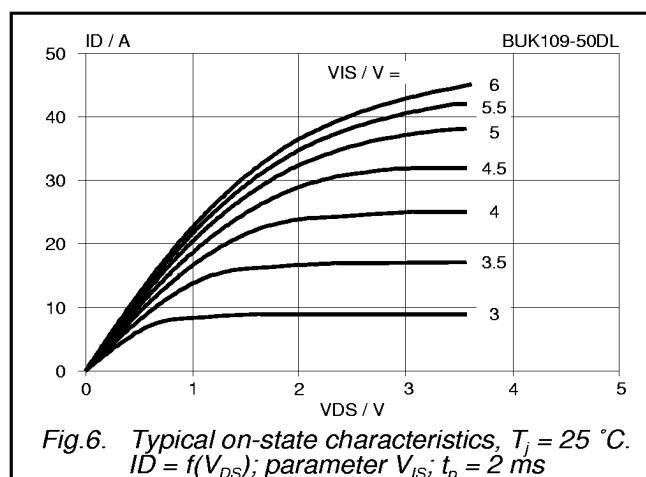
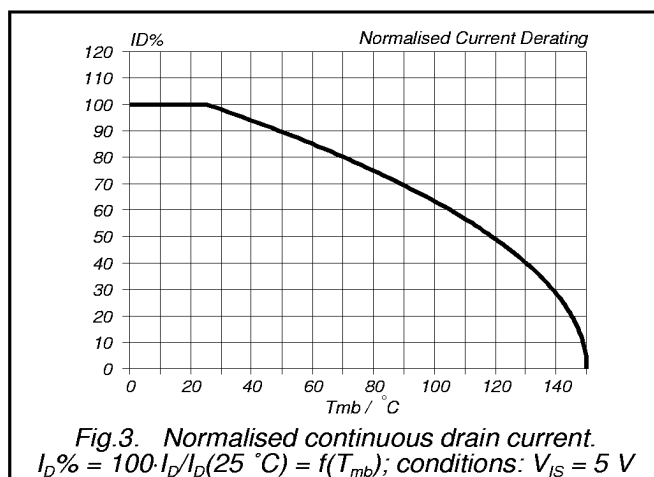
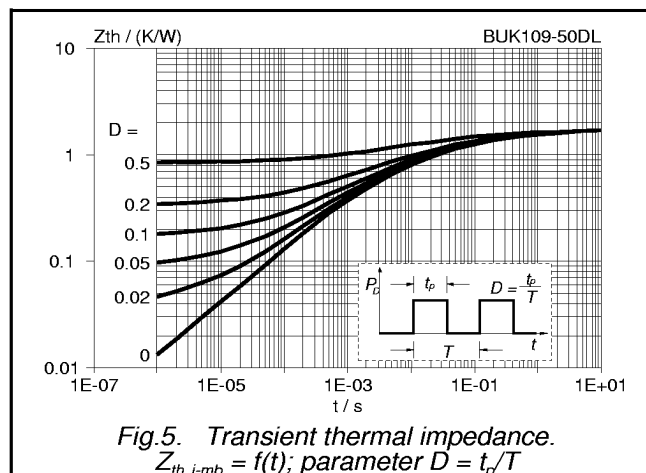
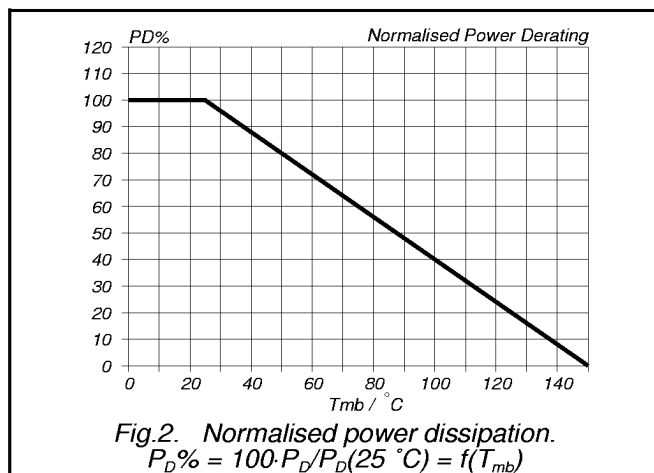
¹ The input voltage below which the overload protection circuits will be reset.

² The reverse diode of this type is not intended for applications requiring fast reverse recovery.

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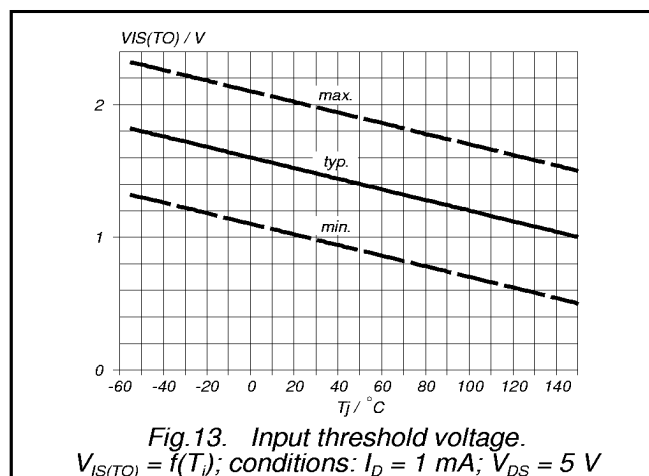
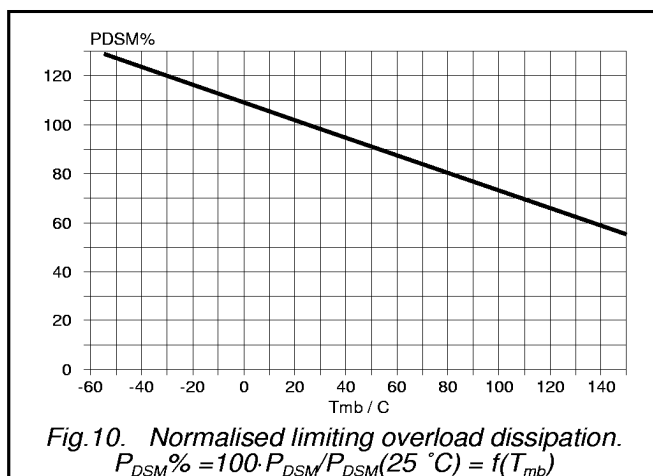
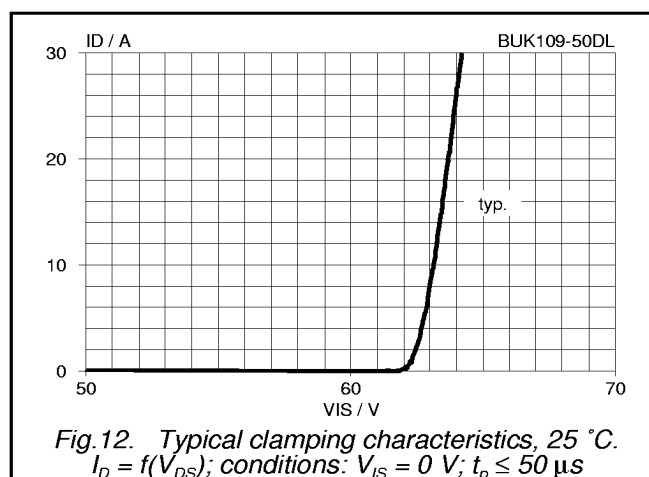
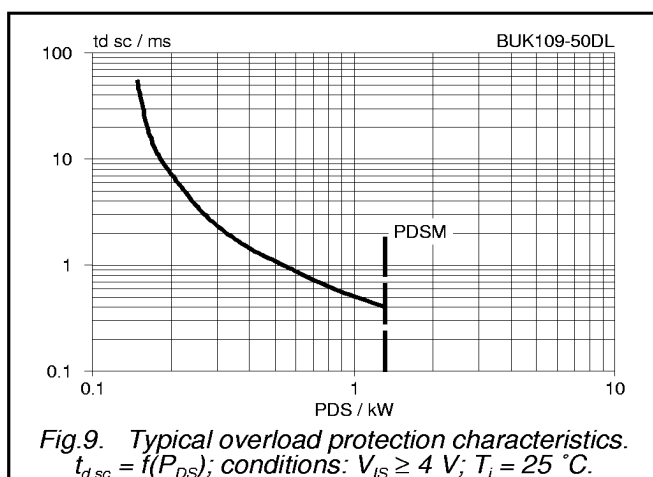
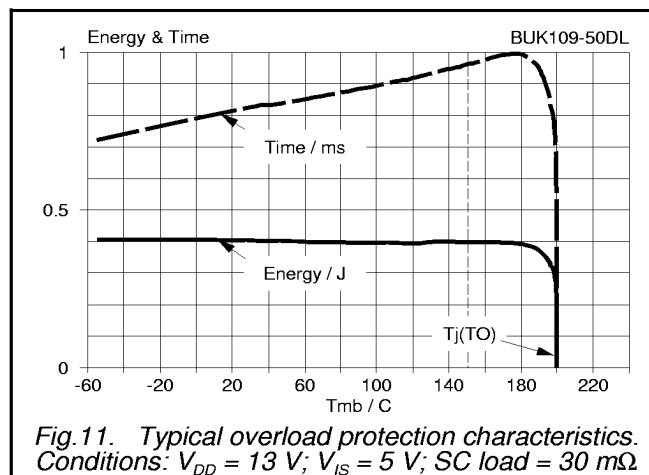
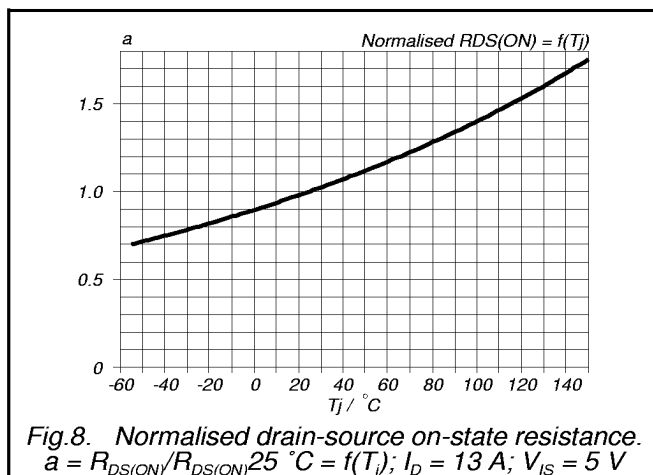
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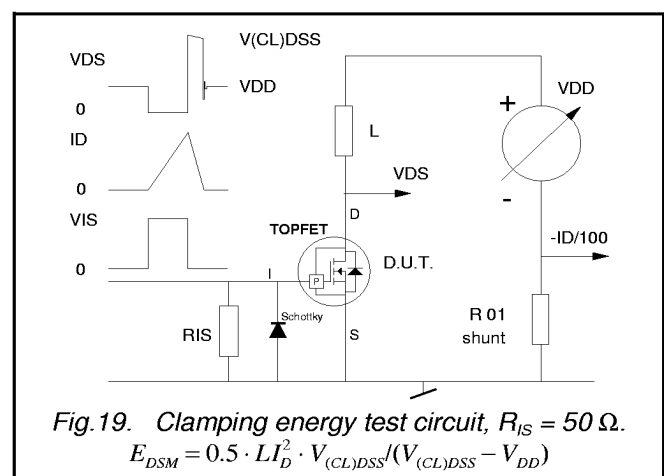
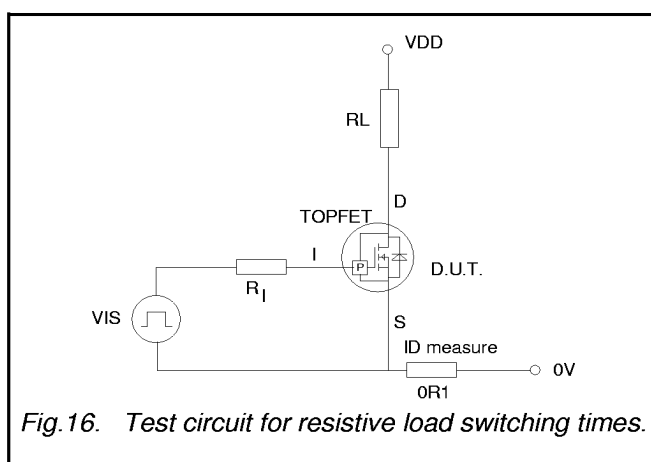
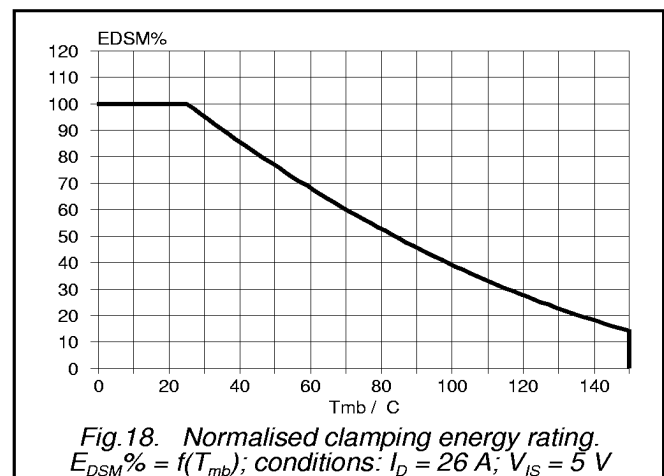
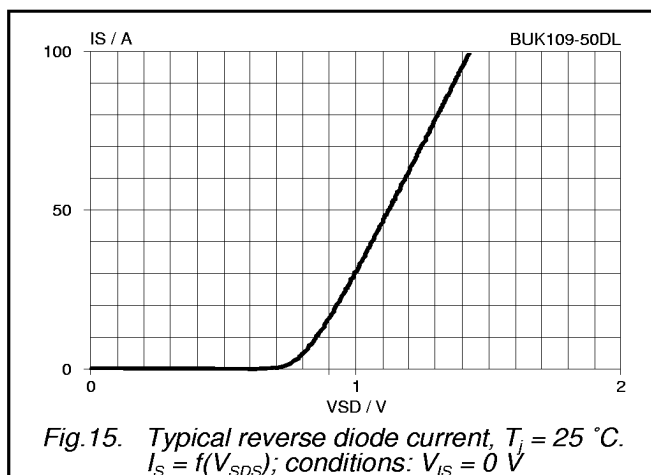
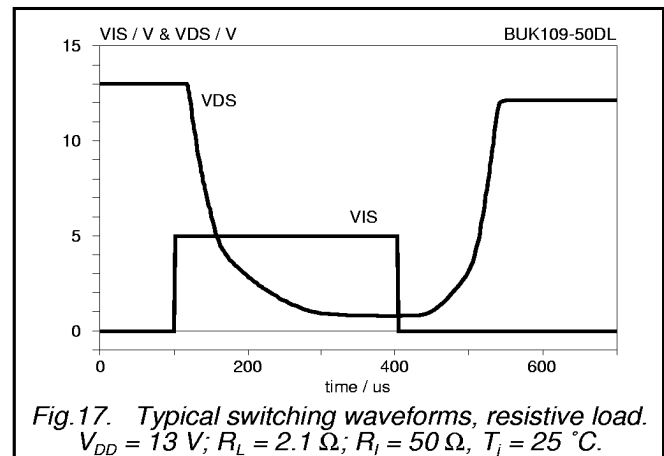
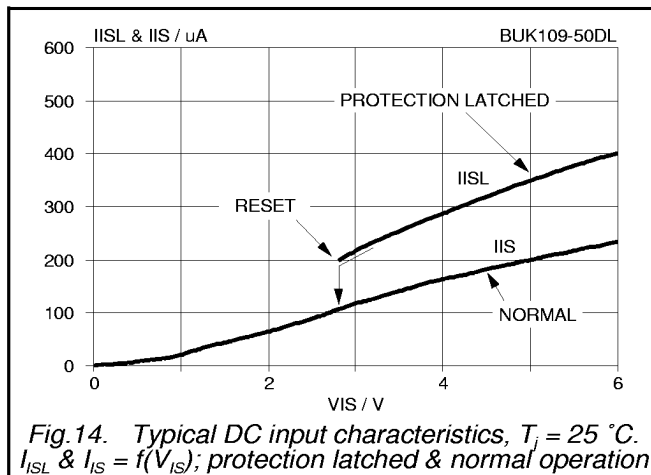
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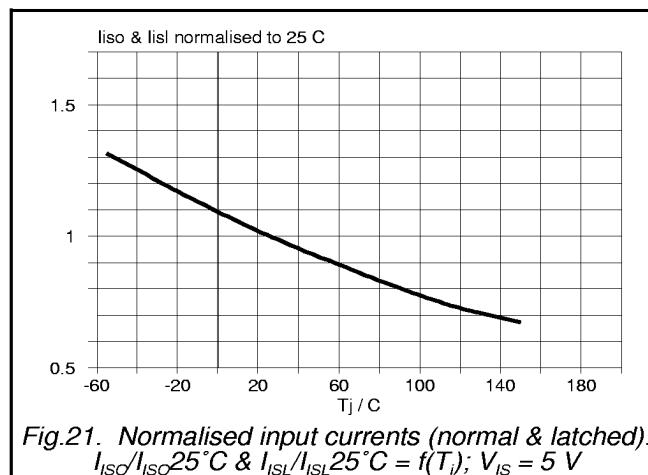
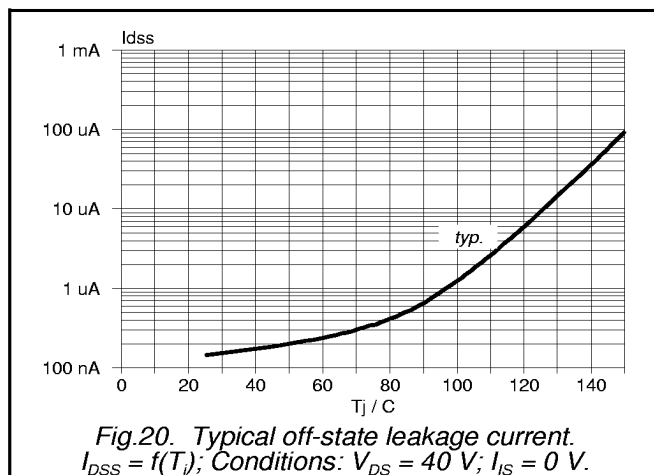
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MECHANICAL DATA

Dimensions in mm

Net Mass: 1.4 g

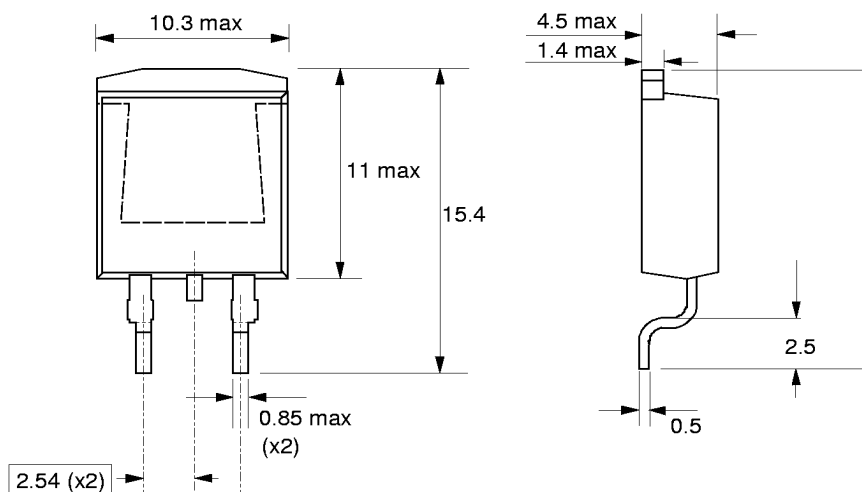


Fig.22. SOT404 : centre pin connected to mounting base.

Notes

1. Epoxy meets UL94 V0 at 1/8".

MOUNTING INSTRUCTIONS

Dimensions in mm

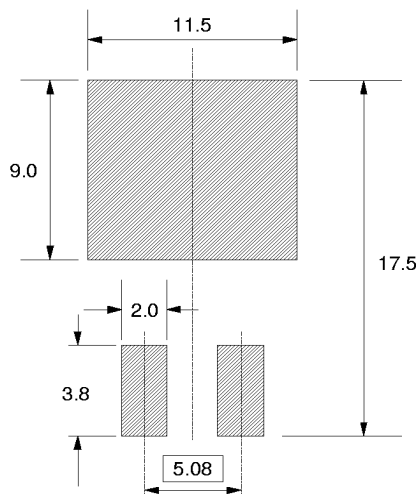


Fig.23. SOT404 : minimum pad sizes for surface mounting.

Notes

1. Plastic meets UL94 V0 at 1/8".