PowerMOS transistor
Voltage clamped logic level FET
with temperature sensing diodes

BUK9120-48TC

GENERAL DESCRIPTION

Protected N-channel enhancement mode logic level field-effect power transistor in a plastic envelope suitable for surface mounting. Using **'trench'** technology the device features very low on-state resistance and has integral zener diodes giving ESD protection up to 2kV and active drain voltage clamping. Temperature sensitive diodes are incorporated for monitoring chip temperature.
The device is intended for use in automotive and general purpose switching applications.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
$V_{(CL)DSR}$	Drain-source clamp voltage	40	45	55	V
I_D	Drain current (DC)			52	A
P_{tot}	Total power dissipation			116	W
T_j	Junction temperature			175	˚C
$R_{DS(ON)}$	Drain-source on-state resistance; V_{GS} = 5 V			20	mΩ
V_F	Forward voltage,temperature sense diodes	685	710	735	mV
$-S_F$	Negative temperature coefficient, temperature sense diodes	1.26	1.4	1.54	mV/K

PINNING - SOT426

PIN	DESCRIPTION
1	gate
2	T1
3	(connected to mb)
4	T2
5	source
mb	drain

PIN CONFIGURATION

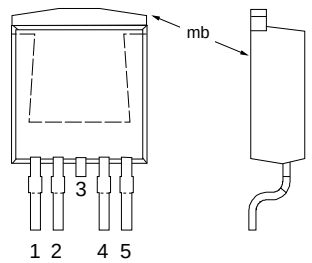

Fig. 1.

SYMBOL

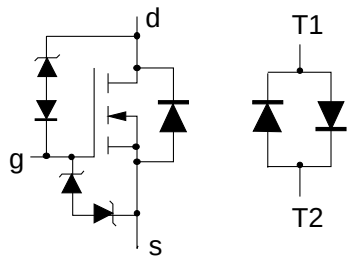

Fig. 2.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DS}	Drain-source voltage	continuous	-	40	V
V_{DG}	Drain-gate voltage	continuous	-	38	V
$\pm V_{GS}$	Gate-source voltage	-	-	10	V
I_D	Drain current (DC)	T_{mb} = 25 ˚C	-	52	A
I_D	Drain current (DC)	T_{mb} = 100 ˚C	-	37	A
I_D	Drain current (DC)	T_{mb} = 140 ˚C	-	25	A
I_{DM}	Drain current (pulse peak value)	T_{mb} = 25 ˚C	-	208	A
P_{tot}	Total power dissipation	T_{mb} = 25 ˚C	-	116	W
I_{GD}	Drain-gate clamp current	5ms pulse; Δ = 0.01	-	50	mA
I_{GS}	Gate-source clamp current	5ms pulse; Δ = 0.01	-	50	mA
V_{TS}	Source T1/T2 voltage	-	-	±100	V
T_{stg}	Storage temperature	-	- 55	175	˚C
T_j	Junction temperature	-	- 55	175	˚C

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ESD LIMITING VALUE

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_C	Electrostatic discharge voltage, pins 1,3,5	Human body model (100pF,1.5KΩ)	-	2	kV

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$R_{th\ j\text{-}mb}$	Thermal resistance junction to mounting base		-	-	1.29	K/W
$R_{th\ j\text{-}a}$	Thermal resistance junction to ambient	minimum footprint, FR4 board	-	50	-	K/W

STATIC CHARACTERISTICS

T_j = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)DG}$	Drain-gate zener voltage	250uA; -55˚C ≤ T_j ≤ 175˚C	38	43		V
$V_{GS(TO)}$	Gate threshold voltage	V_{DS} = V_{GS}; I_D = 1 mA;	1.0	1.5	2.0	V
		T_j = 175˚C	0.5	-	-	V
		T_j = -55˚C	-	-	2.3	V
I_{DSS}	Zero gate voltage drain current	V_{DS} = +35 V; V_{GS} = 0 V;	-	0.1	100	µA
		T_j =175 ˚C	-	-	250	µA
I_{DSS}	Zero gate voltage drain current	V_{DS} = +15 V; V_{GS} = 0 V;	-	0.004	2	µA
		T_j =175 ˚C	-	-	250	µA
I_{GSS}	Gate source leakage current	V_{GS} = ±5 V; V_{DS} = 0 V;	-	0.02	1	µA
		T_j =175 ˚C	-	-	10	µA
$\pm V_{(BR)GSS}$	Gate source breakdown voltage	±1 mA;	10	-	-	V
$R_{DS(ON)}$	Drain-source on-state resistance	V_{GS} = 5 V; I_D = 20 A	-	16	20	mΩ
		T_j =175 ˚C	-	-	42	mΩ
V_F	Forward voltage, temperature sense diodes	I_F = 250 uA;	685	710	735	V mV
$-S_F$	Negative temperature coefficient, temperature sense diodes from 25 ˚C to 140 ˚C	I_F = 250 uA	1.26	1.4	1.54	mV/K
V_{HYS}	Forward voltage hysteresis; temperature sense diodes	I_F = 125 uA to 250uA	25		50	mV

DYNAMIC CHARACTERISTICS

T_j = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(CL)DSR}$	Drain source clamp voltage (peak value)	R_G = 10 kΩ; I_D = 10 A; -55 ≤ T_j ≤ 175˚C	40	45	55	V
g_{fs}	Forward transconductance	V_{DS} = 25 V; I_D = 10 A	20	53	-	S
C_{iss}	Input capacitance	V_{GS} = 0 V; V_{DS} = 25 V; f = 1 MHz	-	2200	2900	pF
C_{oss}	Output capacitance		-	400	500	pF
C_{rss}	Feedback capacitance		-	215	300	pF
$t_{d\ on}$	Turn-on delay time	V_{DD} = 30 V; I_D = 25 A;	-	12	18	µs
t_r	Turn-on rise time	V_{GS} = 5 V; R_G = 10 kΩ;	-	55	80	µs
$t_{d\ off}$	Turn-off delay time		-	60	85	µs
t_f	Turn-off fall time		-	45	60	µs
L_d	Internal drain inductance	Measured from upper edge of drain 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

REVERSE DIODE LIMITING VALUES AND CHARACTERISTICS

T_j = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{DR}	Continuous reverse drain current	-	-	-	52	A
I_{DRM}	Pulsed reverse drain current	-	-	-	208	A
V_{SD}	Diode forward voltage	I_F = 20 A ; V_{GS} = 0 V	-	0.95	1.2	V
		I_F = 40 A ; V_{GS} = 0 V	-	1	-	V

CLAMPED ENERGY LIMITING VALUE

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
W_{DSRS}	Non-repetitive drain-source clamped inductive turn off energy	T_j = 25˚C prior to clamping; I_D = 20 A; V_{DD} ≤ 16 V; V_{GS} = 5 V; R_G = 10 kΩ; inductive load	-	450	mJ

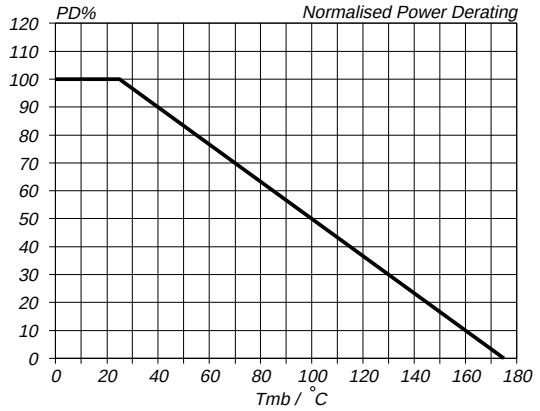

Fig.3. Normalised power dissipation.
PD% = 100·P_D/$P_{D\ 25\ °C}$ = f(T_{mb})

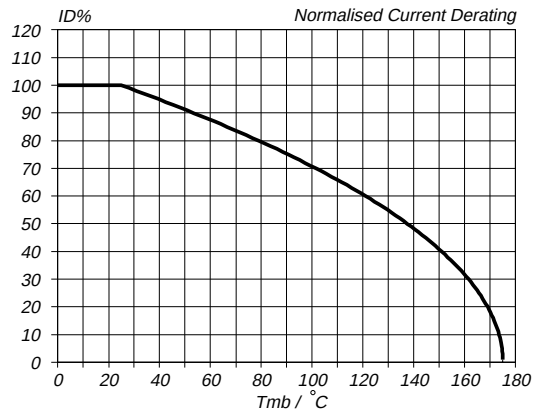

Fig.4. Normalised continuous drain current.
ID% = 100·I_D/$I_{D\ 25\ °C}$ = f(T_{mb}); conditions: V_{GS} ≥ 5 V

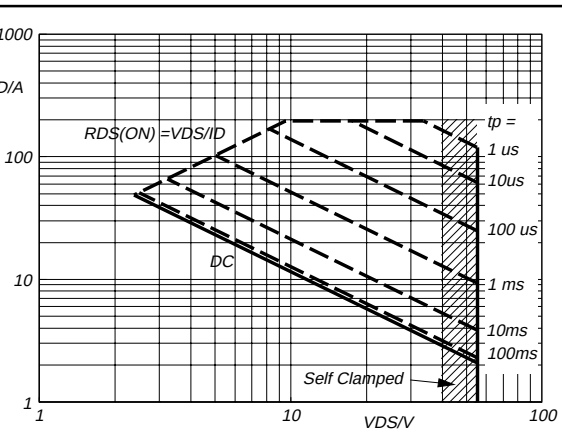

Fig.5. Safe operating area. T_{mb} = 25 ˚C
I_D & I_{DM} = f(V_{DS}); I_{DM} single pulse; parameter t_p

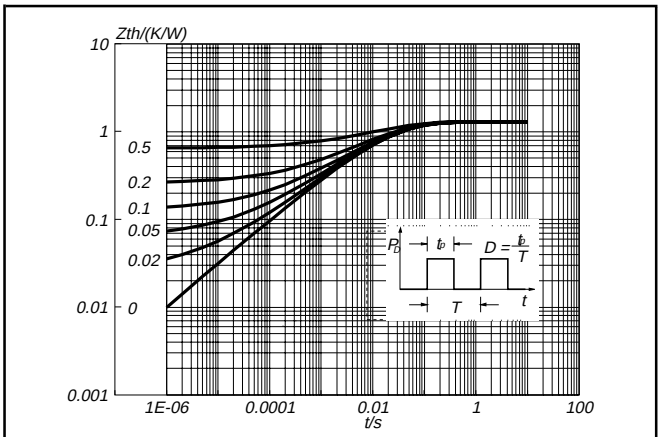

Fig.6. Transient thermal impedance.
$Z_{th\ j\text{-}mb}$ = f(t); parameter D = t_p/T

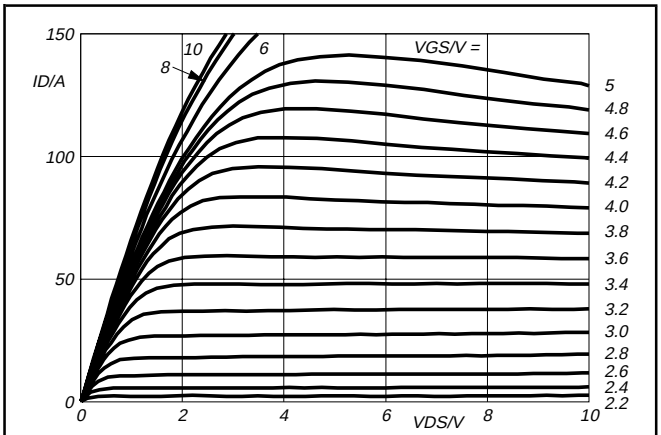

Fig.7. Typical output characteristics, T_j = 25 ˚C.
I_D = f(V_{DS}); parameter V_{GS}

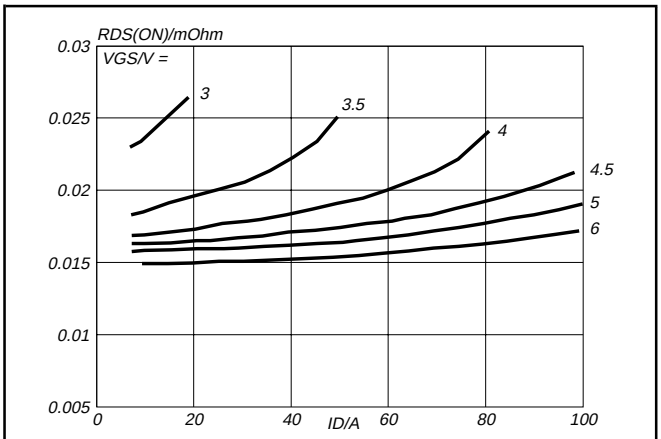

Fig.8. Typical on-state resistance, T_j = 25 ˚C.
$R_{DS(ON)}$ = f(I_D); parameter V_{GS}

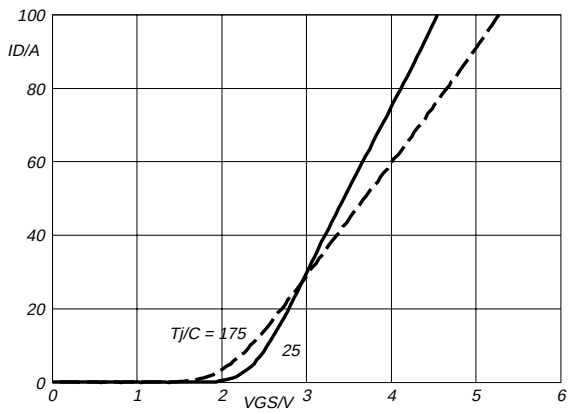

Fig.9. Typical transfer characteristics.
$I_D = f(V_{GS})$; conditions: V_{DS} = 25 V; parameter T_j

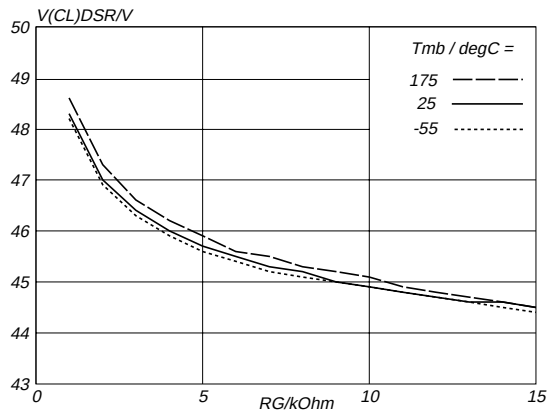

Fig.12. Typical clamping voltage
$V_{(CL)DSR} = f(R_G)$; conditions: I_D = 10 A

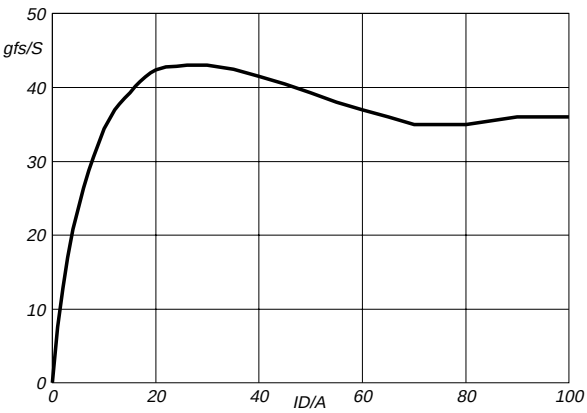

Fig.10. Typical transconductance, T_j = 25 ˚C.
$g_{fs} = f(I_D)$; conditions: V_{DS} = 25 V

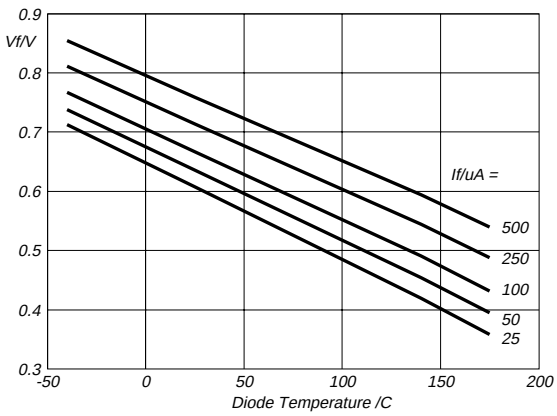

Fig.13. Typical Vf of sense diodes
Vf = f(K); parameter I_f

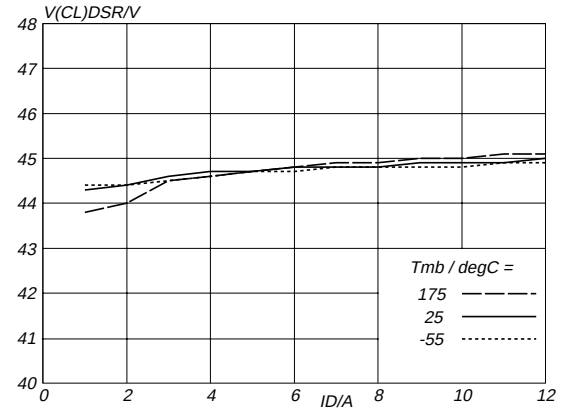

Fig.11. Typical clamping voltage
$V_{(CL)DSR} = f(I_D)$; conditions: R_G = 10 kOhm

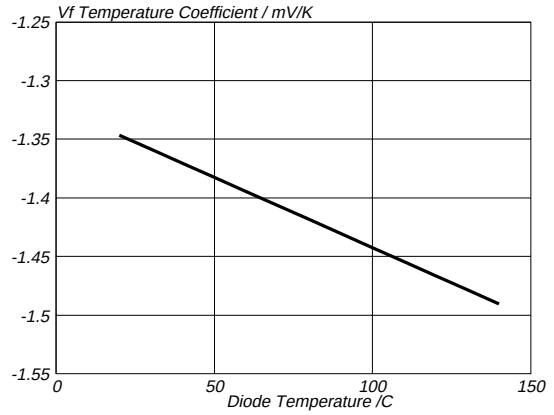

Fig.14. Typical Vf temperature coefficient
Vf Temp.Coef.= f(K); conditions: I_F = 250 uA

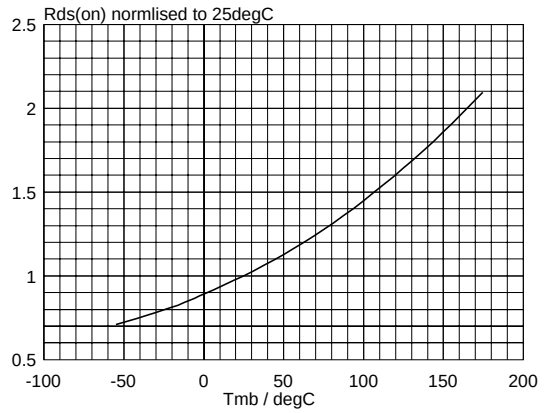

Fig.15. Normalised drain-source on-state resistance. $a = R_{DS(ON)}/R_{DS(ON)25\,°C} = f(T_j)$; I_D = 25 A; V_{GS} = 5 V

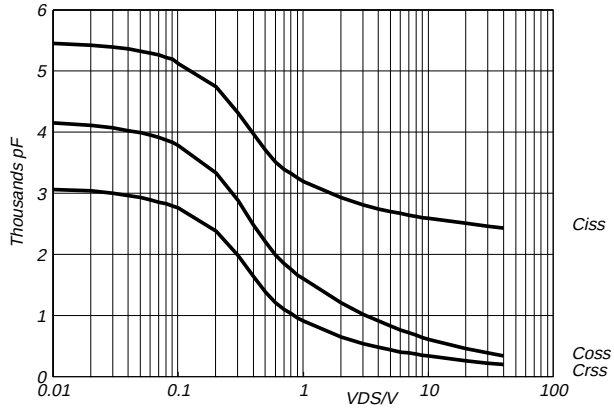

Fig.18. Typical capacitances, C_{iss}, C_{oss}, C_{rss}. $C = f(V_{DS})$; conditions: V_{GS} = 0 V; f = 1 MHz

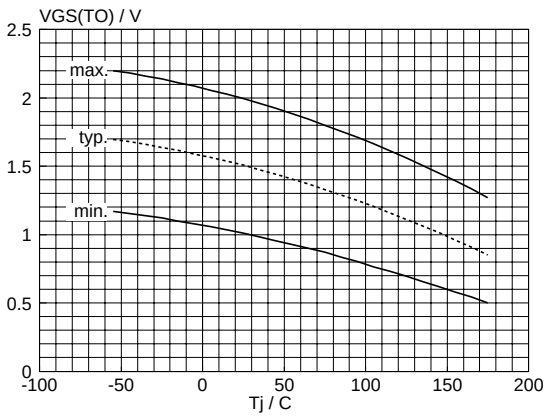

Fig.16. Gate threshold voltage. $V_{GS(TO)} = f(T_j)$; conditions: I_D = 1 mA; $V_{DS} = V_{GS}$

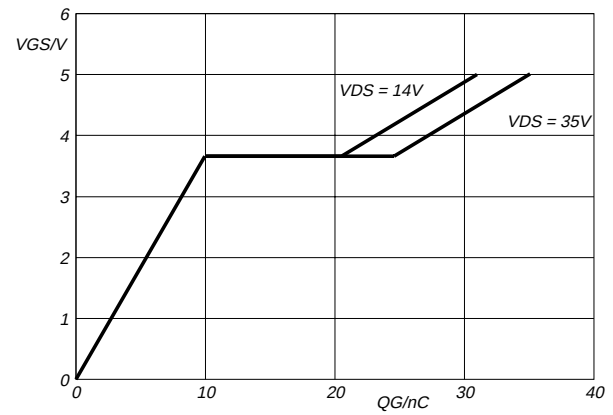

Fig.19. Typical turn-on gate-charge characteristics. $V_{GS} = f(Q_G)$; conditions: I_D = 50 A; parameter V_{DS}

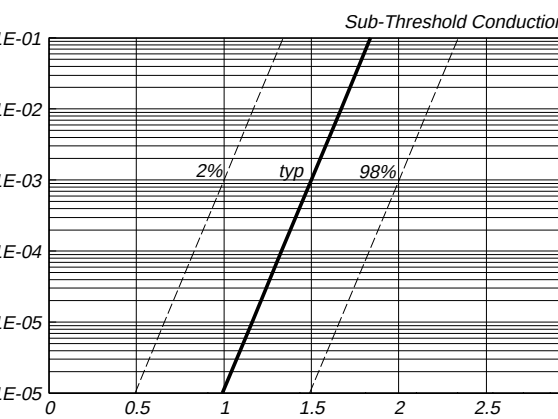

Fig.17. Sub-threshold drain current. $I_D = f(V_{GS})$; conditions: T_j = 25 ˚C; $V_{DS} = V_{GS}$

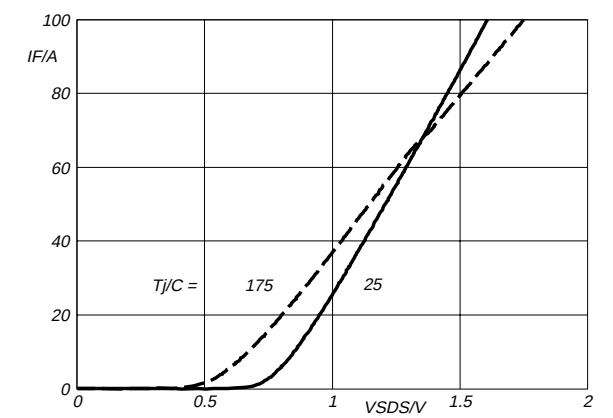

Fig.20. Typical reverse diode current. $I_F = f(V_{SDS})$; conditions: V_{GS} = 0 V; parameter T_j

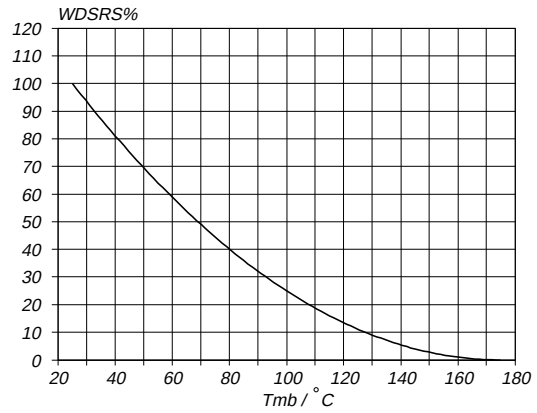

Fig.21. Normalised avalanche energy rating. $W_{DSRS}\% = f(T_{mb})$; conditions: I_D = 20 A

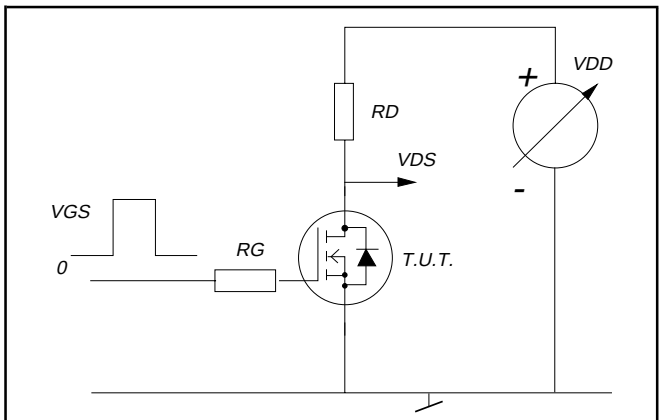

Fig.23. Switching test circuit.

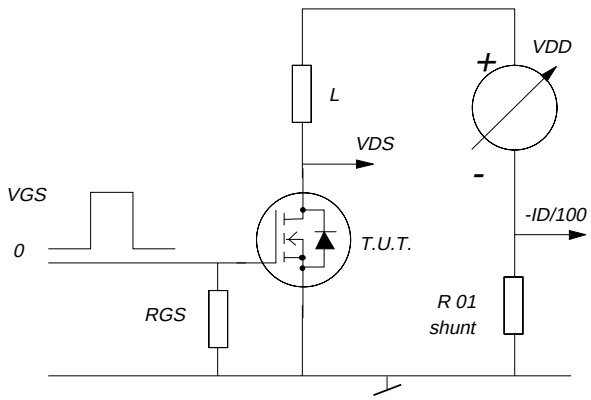

Fig.22. Avalanche energy test circuit.

$$W_{DSS} = 0.5 \cdot LI_D^2 \cdot BV_{DSS}/(BV_{DSS} - V_{DD})$$

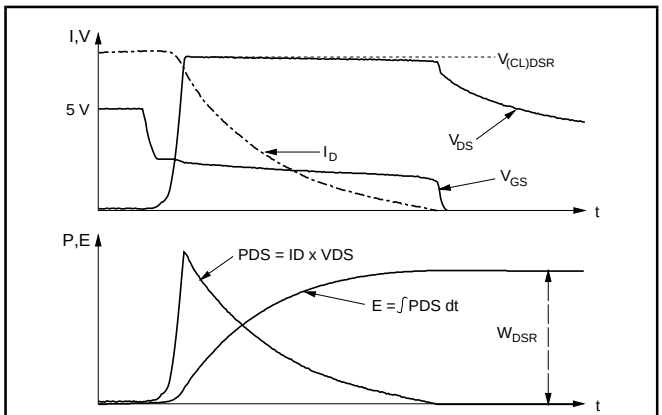

Fig.24. Typical Inductive Clamping Waveforms

MECHANICAL DATA

Dimensions in mm

Net Mass: 1.4 g

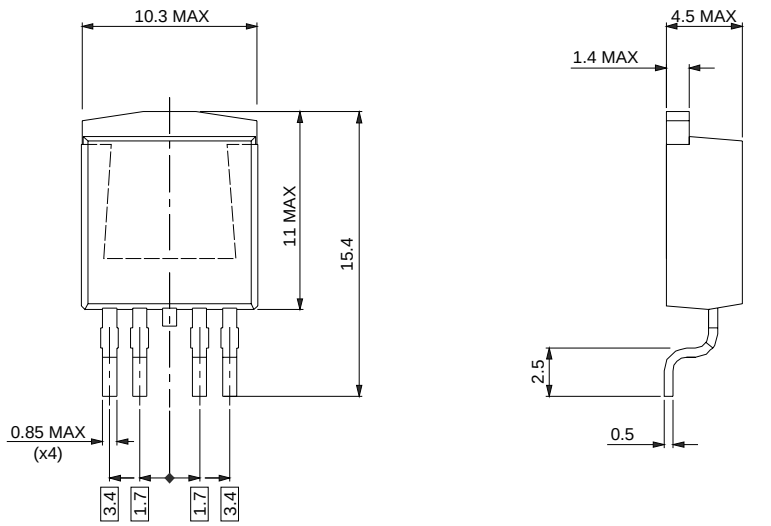

Fig.25. SOT426 : centre pin connected to mounting base.

MOUNTING INSTRUCTIONS

Dimensions in mm

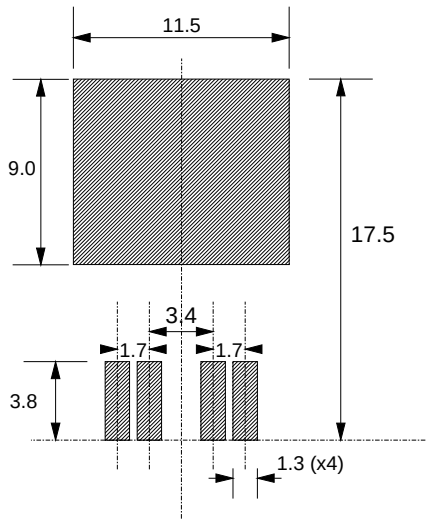

Fig.26. SOT426 : soldering pattern for surface mounting.

Notes

1. Observe the general handling precautions for electrostatic-discharge sensitive devices (ESDs) to prevent damage to MOS gate oxide.
2. Epoxy meets UL94 V0 at 1/8".

DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values are given in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of this specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

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