DATA SHEET

BUK107-50DS
PowerMOS transistor
Logic level TOPFET

Product specification
Supersedes data of September 1994
File under Discrete Semiconductors, SC13a

March 1997

Philips
Semiconductors

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PowerMOS transistor
Logic level TOPFET

BUK107-50DS

DESCRIPTION

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

APPLICATIONS

General controller for driving
- lamps
- small motors
- solenoids

FEATURES

- Vertical power DMOS output stage
- Overload protected up to 85˚C ambient
- Overload protection by current limiting and overtemperature sensing
- Latched overload protection reset by input
- Input clamping suitable for pull-up resistor drive circuit
- Control of power MOSFET and supply of overload protection circuits derived from input
- ESD protection on all pins
- 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	0.7	A
P_D	Total power dissipation	1.8	W
T_j	Continuous junction temperature	150	˚C
$R_{DS(ON)}$	Drain-source on-state resistance	175	mΩ

FUNCTIONAL BLOCK DIAGRAM

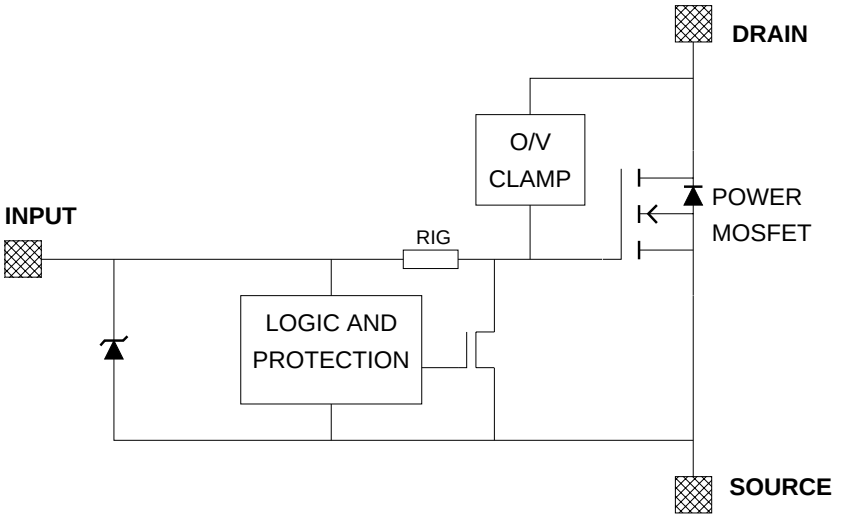
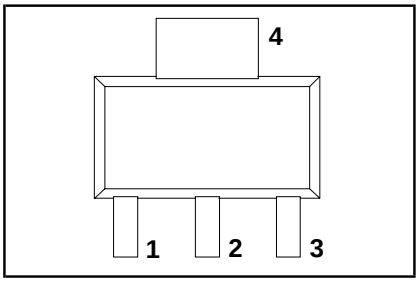


Fig.1. Elements of the TOPFET.

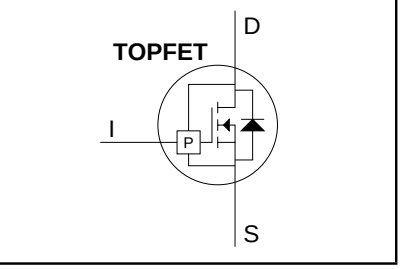
PINNING - SOT223

PIN	DESCRIPTION
1	input
2	drain
3	source
4	drain (tab)

PIN CONFIGURATION



SYMBOL



LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DS}	Continuous drain source voltage[1]	-	-	50	V
I_D	Continuous drain current[2]	-	-	self limiting	A
I_I	Continuous input current	clamping	-	3	mA
I_{IRM}	Non-repetitive peak input current	$t_p \leq 1$ ms	-	10	mA
P_D	Total power dissipation	$T_{amb} = 25$ ˚C	-	1.8	W
T_{stg}	Storage temperature	-	-55	150	˚C
T_j	Continuous junction temperature	normal operation[3]	-	150	˚C

ESD LIMITING VALUE

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_C	Electrostatic discharge capacitor voltage	Human body model; C = 250 pF; R = 1.5 kΩ	-	2	kV

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
E_{DSM}	Non-repetitive clamping energy	$T_b \leq 25$ ˚C; $I_{DM} < I_{D(lim)}$; inductive load	-	100	mJ
E_{DRM}	Repetitive clamping energy	$T_b \leq 75$ ˚C; $I_{DM} = 50$ mA; f = 250 Hz	-	4	mJ

OVERLOAD PROTECTION LIMITING VALUES

With the protection supply provided via the input pin, TOPFET can protect itself from short circuit loads.
Overload protection operates by means of drain current limiting and activating the overtemperature protection.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DDP}	Protected drain source supply voltage	$I_I = 1.5$ mA	-	35	V
		$V_{IS} = 6$ V	-	16	V

OVERLOAD PROTECTION CHARACTERISTICS

TOPFET switches off to protect itself when there is an overload fault condition.
It remains latched off until reset by the input.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
	Overload protection					
$I_{D(lim)}$	Drain current limiting	$I_I = 1.5$ mA	0.7	1.1	1.5	A
	Overtemperature protection	only in drain current limiting				
$T_{j(TO)}$	Threshold junction temperature	$I_I = 1.5$ mA	100	130	160	˚C

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

2 Refer to OVERLOAD PROTECTION CHARACTERISTICS.

3 Not in an overload condition with drain current limiting.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
	Thermal resistance					
$R_{th\ j\text{-}sp}$	Junction to solder point		-	12	18	K/W
$R_{th\ j\text{-}b}$	Junction to board[1]	Mounted on any PCB	-	40	-	K/W
$R_{th\ j\text{-}a}$	Junction to ambient	Mounted on PCB of fig. 19	-	-	70	K/W

STATIC CHARACTERISTICS

T_b = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(CL)DSS}$	Drain-source clamping voltage	V_{IS} = 0 V; I_D = 10 mA	50	55	-	V
$V_{(CL)DSS}$	Drain-source clamping voltage	V_{IS} = 0 V; I_{DM} = 200 mA; $t_p \le 300\ \mu s$; $\delta \le 0.01$	-	56	70	V
I_{DSS}	Off-state drain current	V_{DS} = 45 V; V_{IS} = 0 V	-	0.5	2	µA
I_{DSS}	Off-state drain current	V_{DS} = 50 V; V_{IS} = 0 V	-	1	20	µA
I_{DSS}	Off-state drain current	V_{DS} = 40 V; V_{IS} = 0 V; T_j = 100 ˚C	-	10	100	µA
$R_{DS(ON)}$	Drain-source on-state resistance[2]	I_I = 1.5 mA; I_{DM} = 100 mA; $t_p \le 300\ \mu s$; $\delta \le 0.01$	-	125	175	mΩ

INPUT CHARACTERISTICS

T_b = 25 ˚C unless otherwise specified. The supply for the logic and overload protection is taken from the input. The input clamping is suitable for a drive circuit with a pull-up resistor.

SYMBOL	PARAMETER	CONDITIONS		MIN.	TYP.	MAX.	UNIT
$V_{IS(TO)}$	Input threshold voltage	V_{DS} = 5 V; I_D = 1 mA		1.7	2.2	2.7	V
I_{IS}	Input supply current	normal operation;	V_{IS} = 6 V	-	550	750	µA
I_{ISL}	Input supply current	protection latched;	V_{IS} = 5 V	-	500	650	µA
			V_{IS} = 3.5 V	-	250	400	µA
V_{ISR}	Protection latch reset voltage[3]			1	2.2	3.5	V
$V_{(CL)IS}$	Input clamping voltage	I_I = 1.5 mA		6	7.5	-	V
R_{IG}	Input series resistance	to gate of power MOSFET		-	33	-	kΩ

SWITCHING CHARACTERISTICS

T_{amb} = 25 ˚C; resistive load R_L = 50 Ω; adjust V_{DD} to obtain I_D = 250 mA; refer to test circuit and waveforms

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$t_{d\ on}$	Turn-on delay time	V_{IS} = 0 V to I_I = 1.5 mA	-	4	-	µs
t_r	Rise time		-	16	-	µs
$t_{d\ off}$	Turn-off delay time	I_I = 1.5 mA to V_{IS} = 0 V	-	3	-	µs
t_f	Fall time		-	6	-	µs

1 Temperature measured 1.3 mm from tab.

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

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

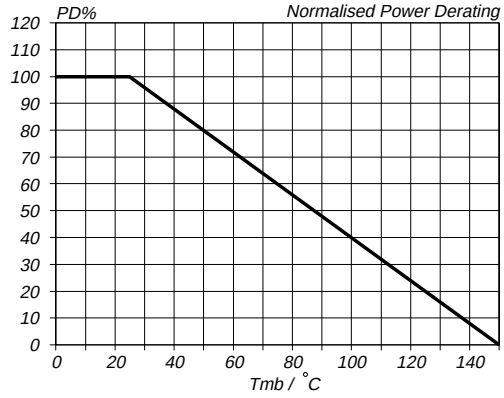


Fig.2. Normalised limiting power dissipation. $P_D\% = 100 \cdot P_D/P_D(25\ ^\circ C) = f(T_{mb})$

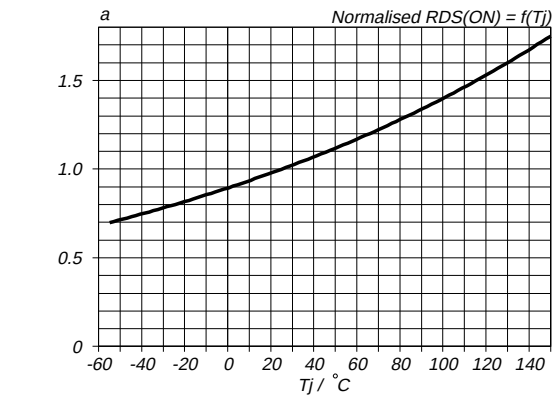


Fig.5. Normalised drain-source on-state resistance. $a = R_{DS(ON)}/R_{DS(ON)}25\ ^\circ C = f(T_j)$; I_D = 100 mA; I_l = 1.5 mA

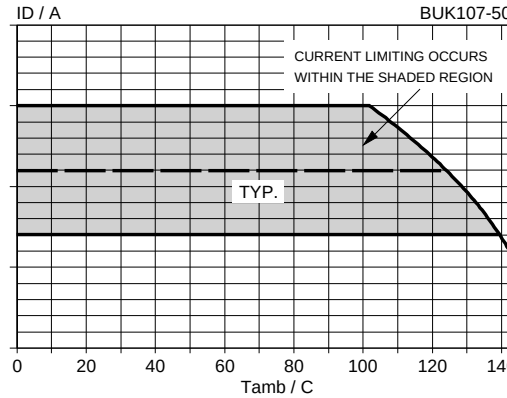


Fig.3. Continuous drain current. $I_D = f(T_{amb})$; condition: I_l = 1.5 mA

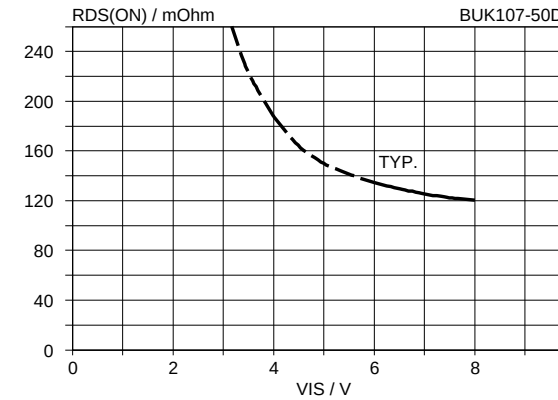


Fig.6. Typical on-state resistance, T_j = 25 ˚C. $R_{DS(ON)} = f(V_{IS})$; conditions: I_D = 100 mA, t_p = 300 µs

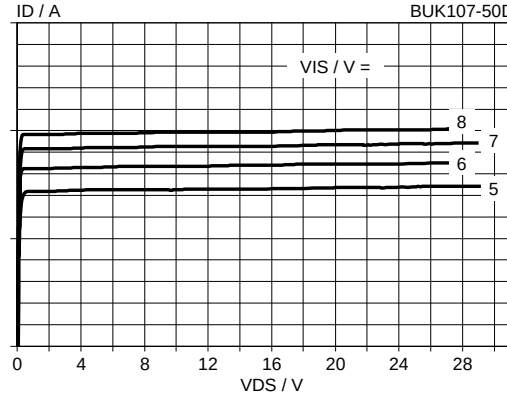


Fig.4. Typical on-state characteristics, T_j = 25 ˚C. $I_D = f(V_{DS})$; parameter V_{IS}; t_p = 300 µs

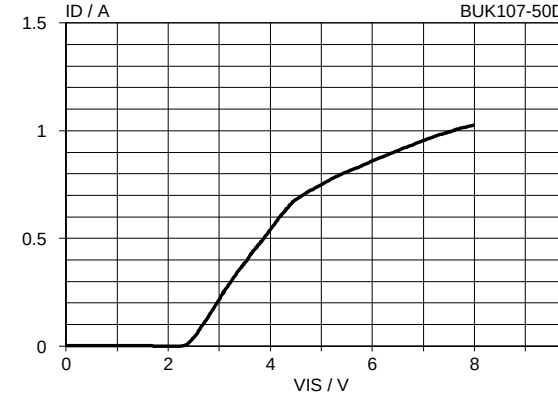


Fig.7. Typical transfer characteristics, T_j = 25 ˚C. $I_D = f(V_{IS})$; conditions: V_{DS} = 10 V, t_p = 300 µs

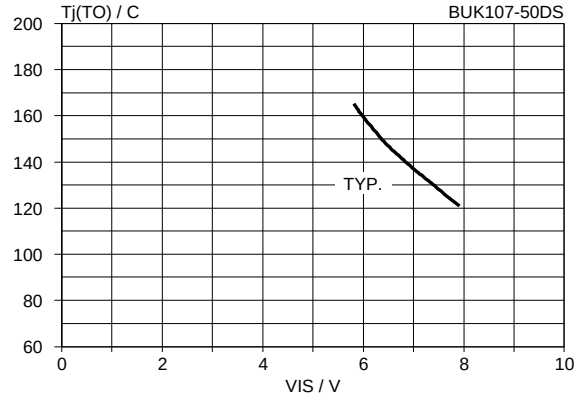


Fig.8. Typical overtemperature protection threshold. $T_{j(TO)} = f(V_{IS})$; condition: V_{DS} = 10 V

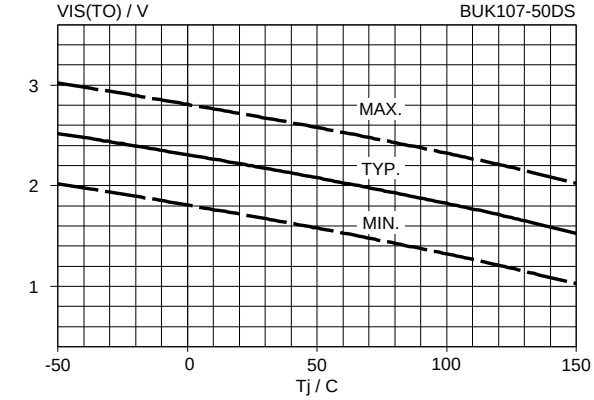


Fig.11. Input threshold voltage. $V_{IS(TO)} = f(T_j)$; conditions: I_D = 1 mA; V_{DS} = 5 V

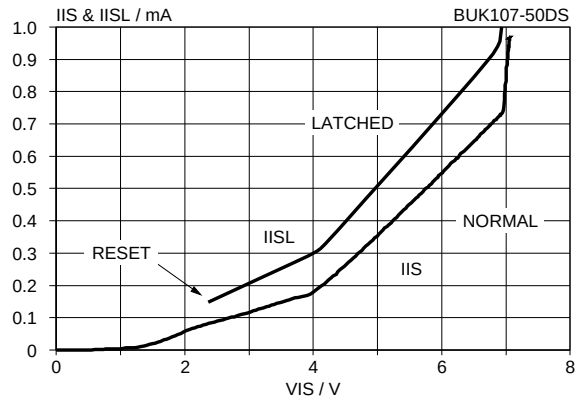


Fig.9. Typical DC input characteristics, T_j = 25 ˚C. I_{IS} & $I_{ISL} = f(V_{IS})$; normal operation & protection latched

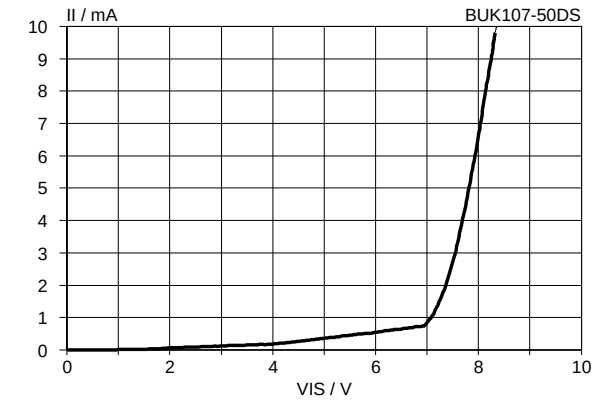


Fig.12. Typical input clamping characteristic. $I_I = f(V_{IS})$; normal operation, T_j = 25 ˚C.

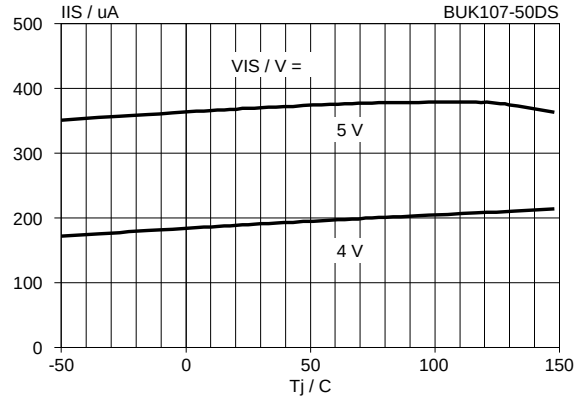


Fig.10. Typical DC input current. $I_{IS} = f(T_j)$; parameter V_{IS}; normal operation

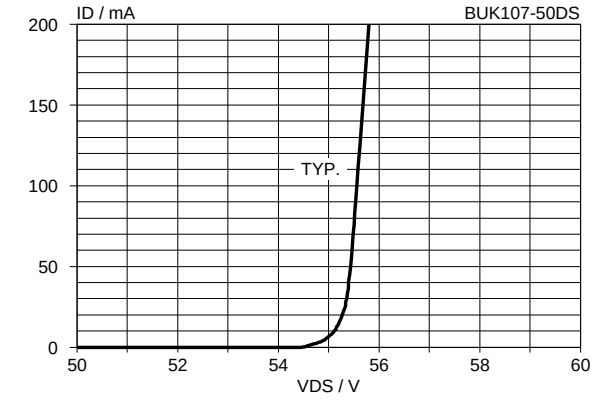


Fig.13. Overvoltage clamping characteristic, 25 ˚C. $I_D = f(V_{DS})$; conditions: V_{IS} = 0 V; $t_p \leq 300$ µs

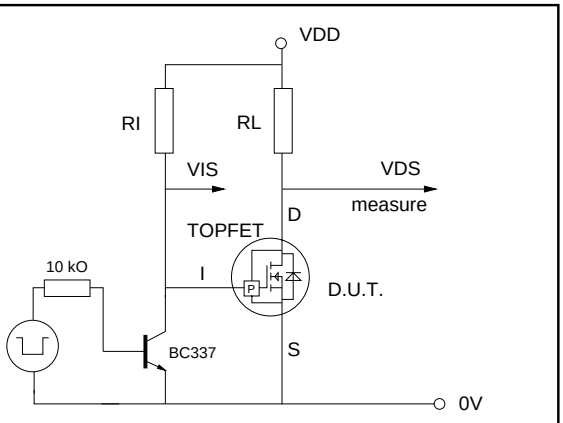


Fig.14. Test circuit for resistive load switching times. Select R_l to give I_l = 1.5 mA, ie 3.3 kΩ approx.

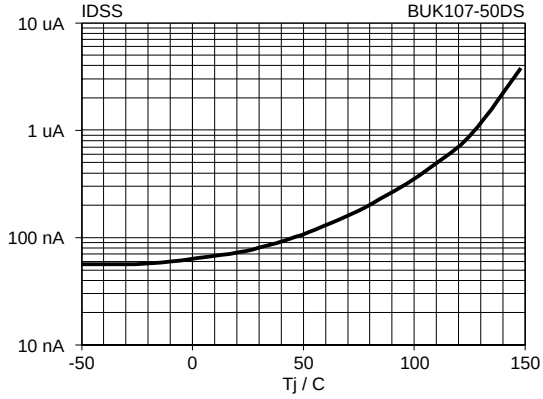


Fig.16. Typical drain source leakage current $I_{DSS} = f(T_j)$; conditions: V_{DS} = 40 V; V_{IS} = 0 V.

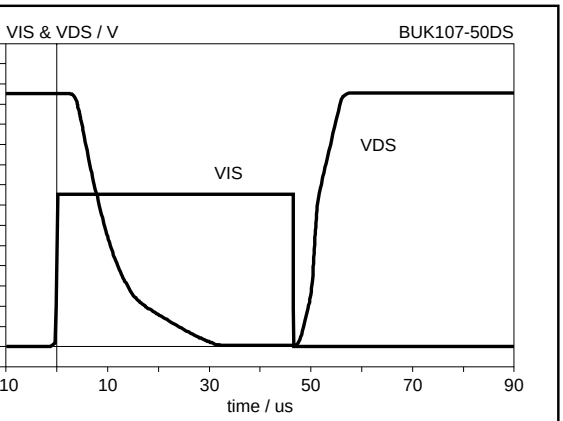


Fig.15. Typical switching waveforms, resistive load . R_L = 50 Ω; adjust V_{DD} to obtain I_D = 250 mA; T_j = 25˚C

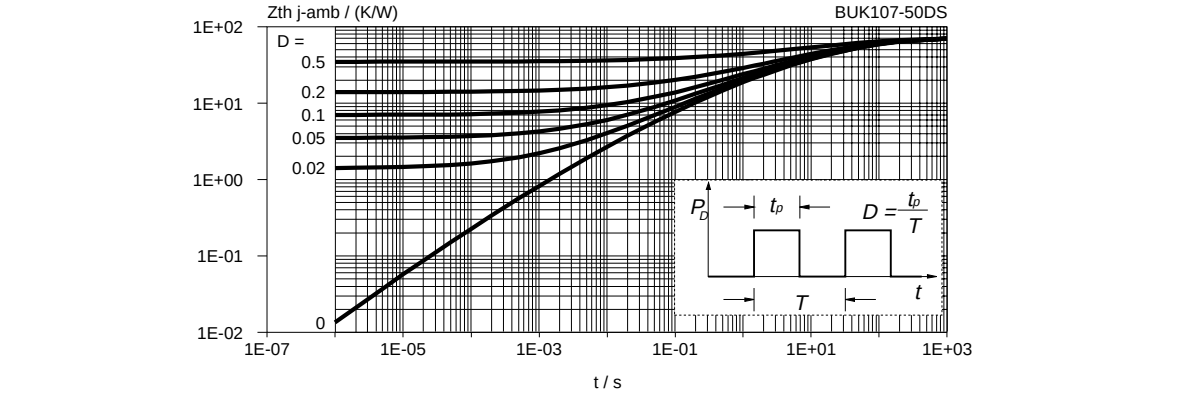


Fig.17. Transient thermal impedance, TOPFET mounted on PCB of fig 19. $Z_{th\ j\text{-}amb} = f(t)$; parameter $D = t_p/T$

MOUNTING INSTRUCTIONS

Dimensions in mm.

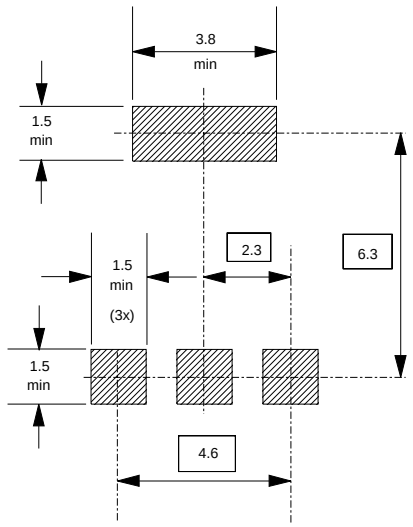


Fig.18. Soldering pattern for surface mounting.

PRINTED CIRCUIT BOARD

Dimensions in mm.

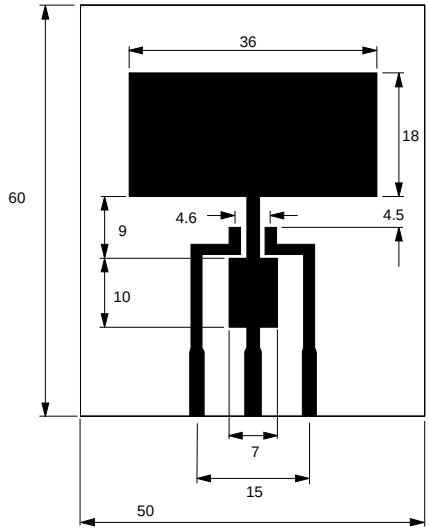


Fig.19. PCB for thermal resistance and power rating. PCB: FR4 epoxy glass (1.6 mm thick), copper laminate (35 μm thick).

MECHANICAL DATA

Dimensions in mm

Net Mass: 0.11 g

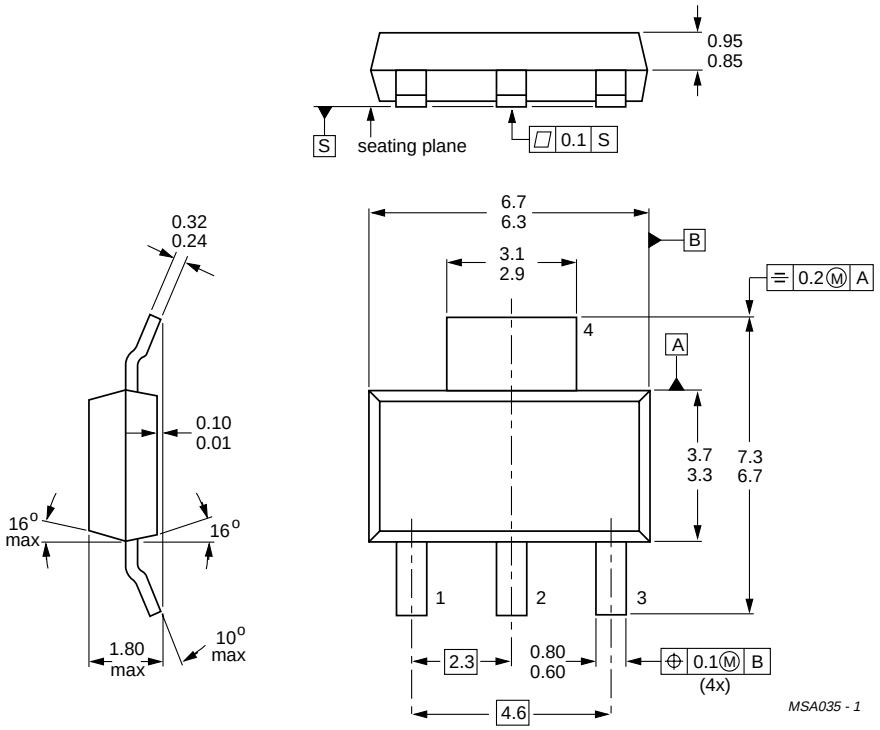


Fig.20. SOT223 surface mounting package[1].

1 For further information, refer to surface mounting instructions for SOT223 envelope. 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.	

LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices or systems where malfunction of these products can be reasonably expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.

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