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**PowerMOS transistor  
Logic level TOPFET**

**BUK117-50DL**

**DESCRIPTION**

Monolithic temperature and overload protected logic level power MOSFET in **TOPFET2** technology assembled in a 3 pin plastic package.

**APPLICATIONS**

General purpose switch for driving

- lamps
- motors
- solenoids
- heaters

in automotive systems and other applications.

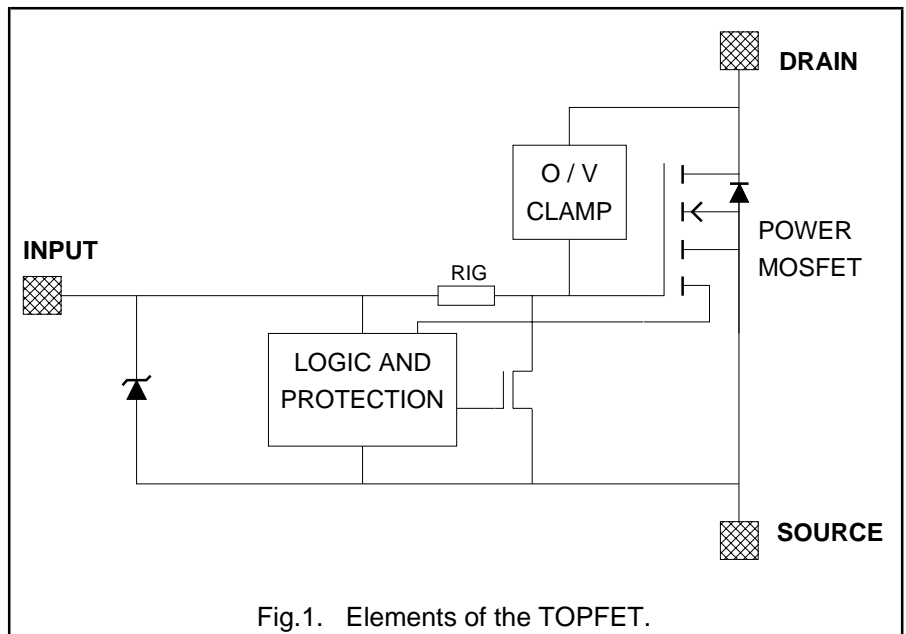
**FEATURES**

- TrenchMOS output stage
- Current limiting
- Overload protection
- Overtemperature protection
- Protection latched reset by input
- 5 V logic compatible input level
- Control of output stage and supply of overload protection circuits derived from input
- Low operating input current permits direct drive by micro-controller
- 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	8	A
$P_D$	Total power dissipation	40	W
$T_j$	Continuous junction temperature	150	°C
$R_{DS(ON)}$	Drain-source on-state resistance	100	mΩ
$I_{ISL}$	Input supply current $V_{IS} = 5\text{ V}$	650	μA

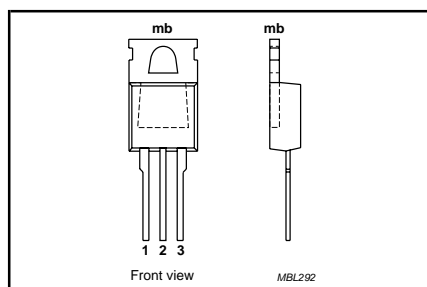
**FUNCTIONAL BLOCK DIAGRAM**



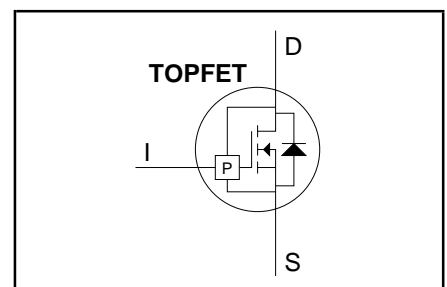
**PINNING - SOT78B**

PIN	DESCRIPTION
1	input
2	drain
3	source
tab	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 <sup>1</sup>	-	-	50	V
$I_D$	Continuous drain current	$V_{IS} = 5 \text{ V}; T_{mb} = 25 \text{ }^\circ\text{C}$	-	self - limited	A
$I_D$	Continuous drain current	$V_{IS} = 5 \text{ V}; T_{mb} \leq 110 \text{ }^\circ\text{C}$	-	8	A
$I_I$	Continuous input current	-	-5	5	mA
$I_{IRM}$	Non-repetitive peak input current	$t_p \leq 1 \text{ ms}$	-10	10	mA
$P_D$	Total power dissipation	$T_{mb} \leq 25 \text{ }^\circ\text{C}$	-	40	W
$T_{stg}$	Storage temperature	-	-55	175	$^\circ\text{C}$
$T_j$	Continuous junction temperature <sup>2</sup>	normal operation	-	150	$^\circ\text{C}$
$T_{sold}$	Lead temperature	during soldering	-	260	$^\circ\text{C}$

### 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

### 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
$E_{DSM}$	<b>Inductive load turn-off</b> Non-repetitive clamping energy	$I_{DM} = 8 \text{ A}; V_{DD} \leq 20 \text{ V}$ $T_{mb} \leq 25 \text{ }^\circ\text{C}$	-	100	mJ
$E_{DRM}$	Repetitive clamping energy	$T_{mb} \leq 95 \text{ }^\circ\text{C}; f = 250 \text{ Hz}$	-	20	mJ

### OVERLOAD PROTECTION LIMITING VALUE

With an adequate protection supply provided via the input pin, TOPFET can protect itself from two types of overload - overtemperature and short circuit load.

SYMBOL	PARAMETER	REQUIRED CONDITION	MIN.	MAX.	UNIT
$V_{DS}$	Drain source voltage <sup>3</sup>	$4 \text{ V} \leq V_{IS} \leq 5.5 \text{ V}$	0	35	V

### THERMAL CHARACTERISTIC

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$R_{th\ j-mb}$	<b>Thermal resistance</b> Junction to mounting base	-	-	2.5	3.1	K/W

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

<sup>2</sup> 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.

<sup>3</sup> All control logic and protection functions are disabled during conduction of the source drain diode.

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**OUTPUT CHARACTERISTICS**
Limits are for  $-40^{\circ}\text{C} \leq T_{\text{mb}} \leq 150^{\circ}\text{C}$ ; typicals are for  $T_{\text{mb}} = 25^{\circ}\text{C}$  unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(\text{CL})\text{DSS}}$	<b>Off-state</b> Drain-source clamping voltage	$V_{\text{IS}} = 0 \text{ V}$	50	-	-	V
		$I_{\text{D}} = 10 \text{ mA}$ $I_{\text{DM}} = 1 \text{ A}; t_{\text{p}} \leq 300 \mu\text{s}; \delta \leq 0.01$	50	60	70	V
$I_{\text{DSS}}$	Drain source leakage current	$V_{\text{DS}} = 40 \text{ V}$	-	-	100	$\mu\text{A}$
		$T_{\text{mb}} = 25^{\circ}\text{C}$	-	0.1	10	$\mu\text{A}$
$R_{\text{DS(ON)}}$	<b>On-state</b> Drain-source resistance	$I_{\text{DM}} = 3 \text{ A}; t_{\text{p}} \leq 300 \mu\text{s}; \delta \leq 0.01$	-	-	190	$\text{m}\Omega$
		$V_{\text{IS}} \geq 4.4 \text{ V}$	-	68	100	$\text{m}\Omega$
		$V_{\text{IS}} \geq 4 \text{ V}$	-	-	200	$\text{m}\Omega$
		$T_{\text{mb}} = 25^{\circ}\text{C}$	-	72	105	$\text{m}\Omega$

**OVERLOAD CHARACTERISTICS**
 $-40^{\circ}\text{C} \leq T_{\text{mb}} \leq 150^{\circ}\text{C}$  unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$I_{\text{D}}$	<b>Short circuit load</b> Drain current limiting	$V_{\text{DS}} = 13 \text{ V}$	8	12	16	A
		$V_{\text{IS}} = 5 \text{ V};$ $4.4 \text{ V} \leq V_{\text{IS}} \leq 5.5 \text{ V}$	6	-	18	A
		$4 \text{ V} \leq V_{\text{IS}} \leq 5.5 \text{ V}$	5	-	18	A
$P_{\text{D(TO)}}$ $T_{\text{DSC}}$	<b>Overload protection</b> Overload power threshold Characteristic time	$V_{\text{IS}} = 5 \text{ V};$ device trips if $P_{\text{D}} > P_{\text{D(TO)}}$ which determines trip time <sup>1</sup>	20	55	80	W
		$T_{\text{mb}} = 25^{\circ}\text{C}$	200	350	600	$\mu\text{s}$
$T_{\text{j(TO)}}$	<b>Overtemperature protection</b> Threshold junction temperature <sup>2</sup>		150	170	-	$^{\circ}\text{C}$

<sup>1</sup> Trip time  $t_{\text{d,sc}}$  varies with overload dissipation  $P_{\text{D}}$  according to the formula  $t_{\text{d,sc}} \approx T_{\text{DSC}} / \ln[ P_{\text{D}} / P_{\text{D(TO)}} ]$ .

<sup>2</sup> This is independent of the  $dV/dt$  of input voltage  $V_{\text{IS}}$ .

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### INPUT CHARACTERISTICS

The supply for the logic and overload protection is taken from the input.

Limits are for  $-40^{\circ}\text{C} \leq T_{\text{mb}} \leq 150^{\circ}\text{C}$ ; typicals are for  $T_{\text{mb}} = 25^{\circ}\text{C}$  unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{\text{IS(TO)}}$	Input threshold voltage	$V_{\text{DS}} = 5 \text{ V}; I_{\text{D}} = 1 \text{ mA}$ $T_{\text{mb}} = 25^{\circ}\text{C}$	0.6	-	2.4	V
			1.1	1.6	2.1	V
$I_{\text{IS}}$	Input supply current	normal operation; $V_{\text{IS}} = 5 \text{ V}$ $V_{\text{IS}} = 4 \text{ V}$	100	220	400	$\mu\text{A}$
			80	195	330	$\mu\text{A}$
$I_{\text{ISL}}$	Input supply current	protection latched; $V_{\text{IS}} = 5 \text{ V}$ $V_{\text{IS}} = 3 \text{ V}$	200	400	650	$\mu\text{A}$
			130	250	430	$\mu\text{A}$
$V_{\text{ISR}}$	Protection reset voltage <sup>1</sup>	reset time $t_{\text{r}} \geq 100 \mu\text{s}$	1.5	2	2.9	V
$t_{\text{r}}$	Latch reset time	$V_{\text{IS1}} = 5 \text{ V}, V_{\text{IS2}} < 1 \text{ V}$	10	40	100	$\mu\text{s}$
$V_{\text{(CL)IS}}$	Input clamping voltage	$I_{\text{I}} = 1.5 \text{ mA}$	5.5	-	8.5	V
$R_{\text{IG}}$	Input series resistance <sup>2</sup> to gate of power MOSFET	$T_{\text{mb}} = 25^{\circ}\text{C}$	-	33	-	$\text{k}\Omega$

### SWITCHING CHARACTERISTICS

$T_{\text{mb}} = 25^{\circ}\text{C}$ ;  $V_{\text{DD}} = 13 \text{ V}$ ; resistive load  $R_{\text{L}} = 4 \Omega$ . Refer to waveform figure and test circuit.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$t_{\text{d on}}$	Turn-on delay time	$V_{\text{IS}} = 5 \text{ V}$	-	10	20	$\mu\text{s}$
$t_{\text{r}}$	Rise time		-	20	40	$\mu\text{s}$
$t_{\text{d off}}$	Turn-off delay time	$V_{\text{IS}} = 0 \text{ V}$	-	30	60	$\mu\text{s}$
$t_{\text{f}}$	Fall time		-	20	40	$\mu\text{s}$

<sup>1</sup> The input voltage below which the overload protection circuits will be reset.

<sup>2</sup> Not directly measurable from device terminals.

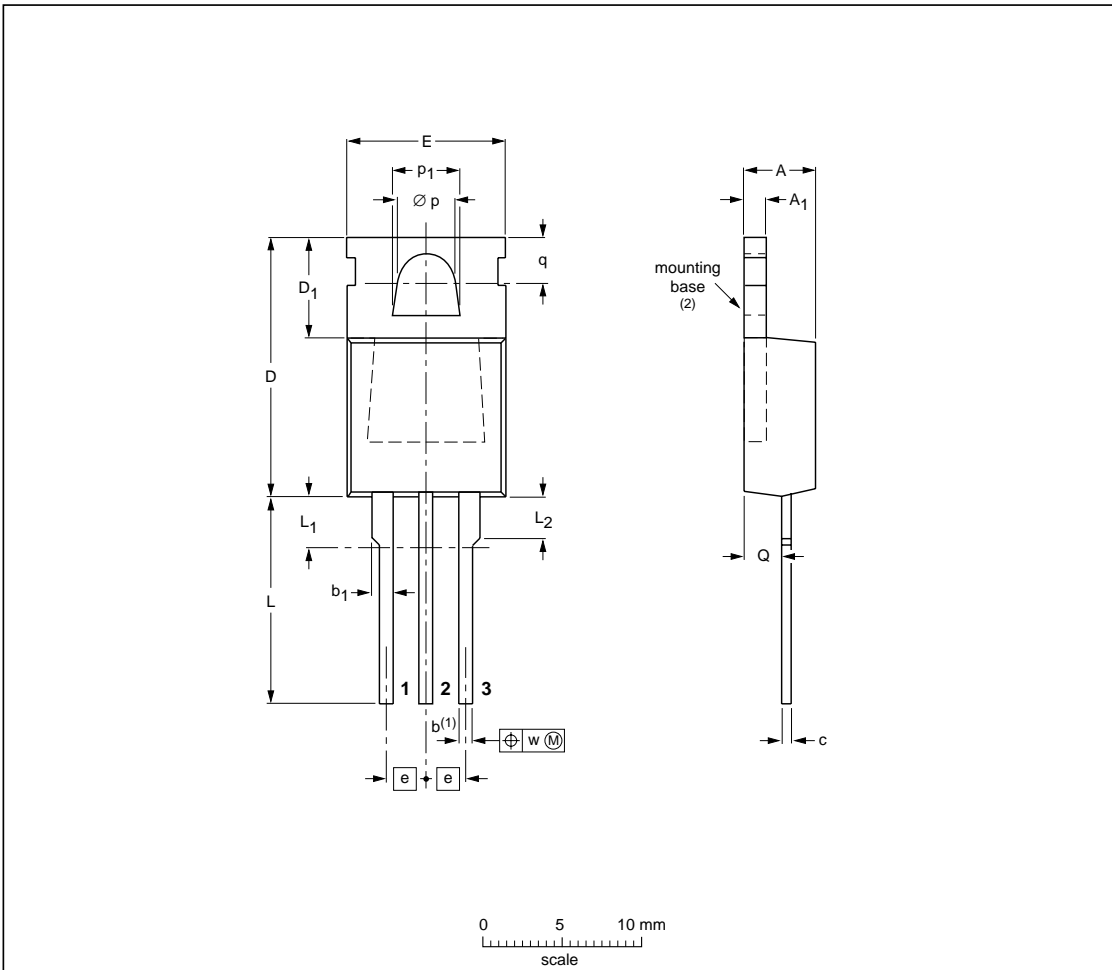
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MECHANICAL DATA

Plastic single-ended package; heatsink mounted; 1 mounting hole; 3-leads

SOT78B



DIMENSIONS (mm are the original dimensions)

UNIT	A	A <sub>1</sub>	b <sup>(1)</sup>	b <sub>1</sub>	c	D	D <sub>1</sub>	E	e	L	L <sub>1</sub>	L <sub>2</sub> max.	∅ p	p <sub>1</sub>	q	Q	w
mm	4.5 4.1	1.39 1.27	0.85 0.60	1.3 1.0	0.7 0.4	15.8 15.2	6.4 5.9	10.3 9.7	2.54	15.0 13.5	3.30 2.79	3.0	3.8 3.6	4.3 4.1	3.0 2.7	2.6 2.2	0.4

Notes

- The positional accuracy of the terminals is controlled within zone L<sub>1</sub> max.
- Mounting base configuration is not defined within the dimensions E and D

OUTLINE VERSION	REFERENCES			EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ		
SOT78B					01-02-22

Fig.2. SOT78B (TO220AB) package<sup>1</sup>, pin 2 connected to mounting base.

<sup>1</sup> Refer to mounting instructions for SOT78 (TO220) envelopes. Epoxy meets UL94 V0 at 1/8". Net mass: 2 g

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**DEFINITIONS**

<b>DATA SHEET STATUS</b>		
<b>DATA SHEET STATUS<sup>1</sup></b>	<b>PRODUCT STATUS<sup>2</sup></b>	<b>DEFINITIONS</b>
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<b>Application information</b>		
Where application information is given, it is advisory and does not form part of the specification.		
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