

# Logic level TOPFET

PIP3119-P

## 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

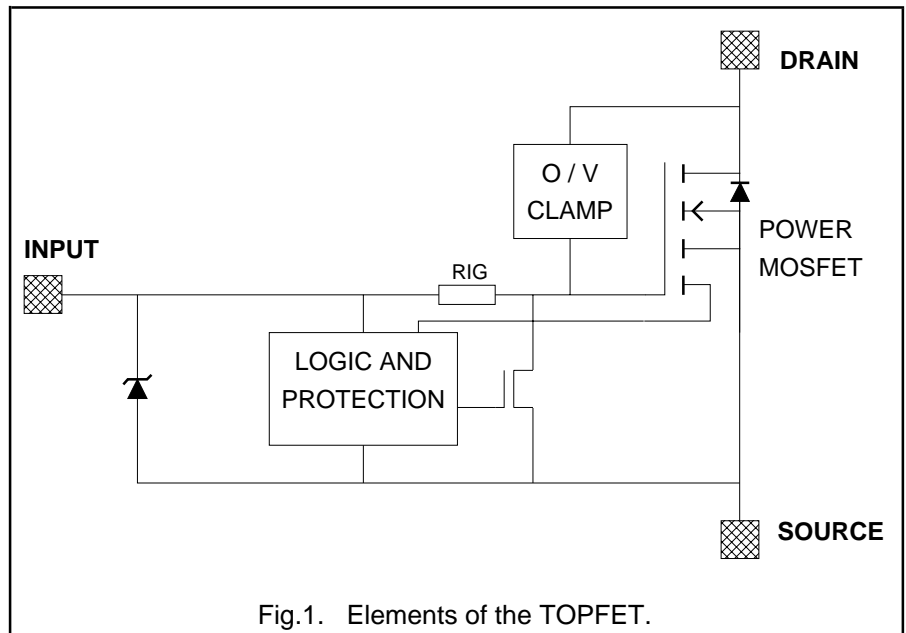
## FEATURES

- 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	20	A
$P_D$	Total power dissipation	90	W
$T_j$	Continuous junction temperature	150	°C
$R_{DS(ON)}$	Drain-source on-state resistance	28	mΩ
$I_{ISL}$	Input supply current $V_{IS} = 5\text{ V}$	650	μA

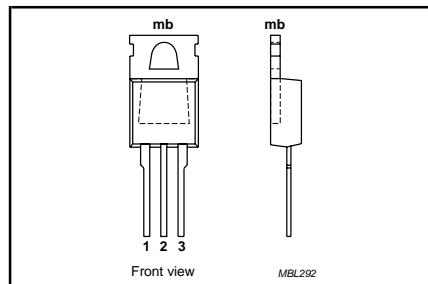
## FUNCTIONAL BLOCK DIAGRAM



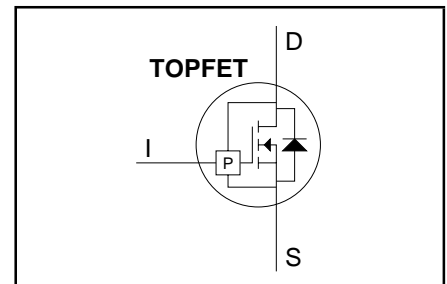
## PINNING - SOT78B

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	$V_{IS} = 5\text{ V}; T_{mb} = 25^\circ\text{C}$	-	self - limited	A
$I_D$	Continuous drain current	$V_{IS} = 5\text{ V}; T_{mb} \leq 121^\circ\text{C}$	-	20	A
$I_I$	Continuous input current		-5	5	mA
$I_{IRM}$	Repetitive peak input current	$\delta \leq 0.1, t_p = 300\ \mu\text{s}$	-50	50	mA
$P_D$	Total power dissipation	$T_{mb} \leq 25^\circ\text{C}$	-	90	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	$I_{DM} = 20\ \text{A}; V_{DD} \leq 20\ \text{V}$ $T_{mb} \leq 25^\circ\text{C}$	-	350	mJ
$E_{DRM}$	Repetitive clamping energy	$T_{mb} \leq 95^\circ\text{C}; f = 250\ \text{Hz}$	-	45	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	-	-	1.25	1.39	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
		$I_{\text{D}} = 10 \text{ mA}$ $I_{\text{DM}} = 4 \text{ A}; t_{\text{p}} \leq 300 \mu\text{s}; \delta \leq 0.01$	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	$V_{\text{IS}} \geq 4.4 \text{ V}; t_{\text{p}} \leq 300 \mu\text{s}; \delta \leq 0.01$	-	-	52	$\text{m}\Omega$
		$I_{\text{DM}} = 10 \text{ A}$ $T_{\text{mb}} = 25^{\circ}\text{C}$	-	22	28	$\text{m}\Omega$

**OVERLOAD CHARACTERISTICS** $V_{\text{IS}} = 5 \text{ V}; T_{\text{mb}} = 25^{\circ}\text{C}$  unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$I_{\text{D}}$	<b>Short circuit load</b> Drain current limiting	$V_{\text{DS}} = 13 \text{ V}$	28.5	43	57	A
		$4.4 \text{ V} \leq V_{\text{IS}} \leq 5.5 \text{ V};$ $-40^{\circ}\text{C} \leq T_{\text{mb}} \leq 150^{\circ}\text{C}$	21	-	65	A
$P_{\text{D(TO)}}$ $T_{\text{DSC}}$	<b>Overload protection</b> Overload power threshold Characteristic time	device trips if $P_{\text{D}} > P_{\text{D(TO)}}$ which determines trip time <sup>1</sup>	75	185	250	W
			200	380	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  $t_{\text{dsc}}$  varies with overload dissipation  $P_{\text{D}}$  according to the formula  $t_{\text{dsc}} \approx T_{\text{DSC}} / \ln[P_{\text{D}} / P_{\text{D(TO)}}]$ .

<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;	$V_{\text{IS}} = 5 \text{ V}$	100	220	400	$\mu\text{A}$
			$V_{\text{IS}} = 4 \text{ V}$	80	195	330	$\mu\text{A}$
$I_{\text{ISL}}$	Input supply current	protection latched;	$V_{\text{IS}} = 5 \text{ V}$	200	400	650	$\mu\text{A}$
			$V_{\text{IS}} = 3 \text{ V}$	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	
$t_{\text{lr}}$	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	$I_{\text{l}} = 1.5 \text{ mA}$	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	-	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
$t_{\text{don}}$	Turn-on delay time	$V_{\text{IS}} = 5 \text{ V}$	-	25	50	$\mu\text{s}$
$t_{\text{r}}$	Rise time		-	50	100	$\mu\text{s}$
$t_{\text{doff}}$	Turn-off delay time	$V_{\text{IS}} = 0 \text{ V}$	-	60	120	$\mu\text{s}$
$t_{\text{f}}$	Fall time		-	50	100	$\mu\text{s}$

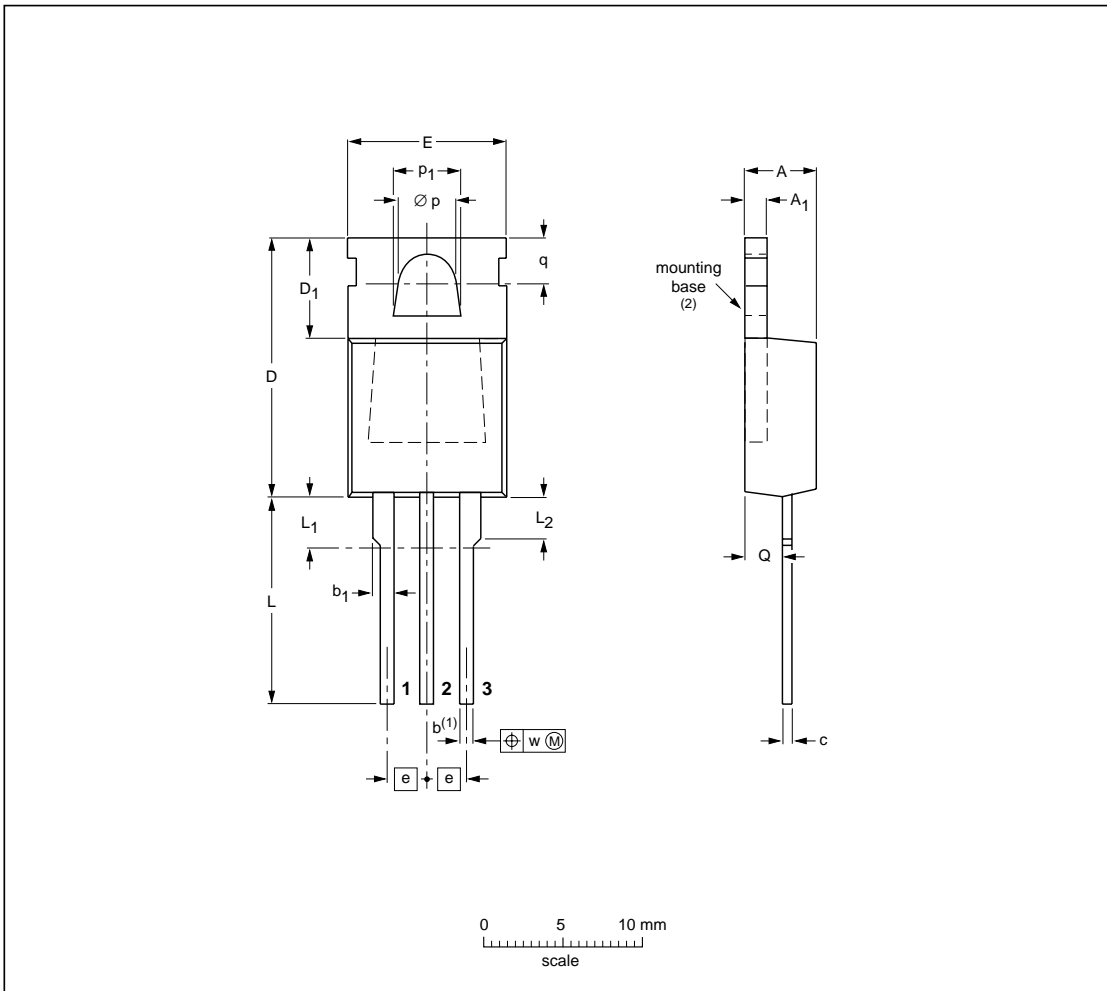
<sup>1</sup> The input voltage below which the overload protection circuits will be reset.

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

**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.	Ø 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**

1. The positional accuracy of the terminals is controlled within zone L<sub>1</sub> max.
2. 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>
Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice
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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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