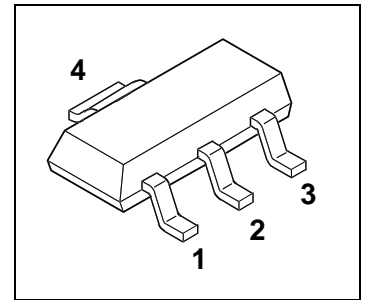


## MiniPROFET

- High-side switch
- Short-circuit protection
- Input protection
- Overtemperature protection with hysteresis
- Overload protection
- Overvoltage protection
- Switching inductive load
- Clamp of negative output voltage with inductive loads
- Undervoltage shutdown
- Maximum current internally limited
- **Electrostatic discharge (ESD)** protection
- Reverse battery protection<sup>1)</sup>



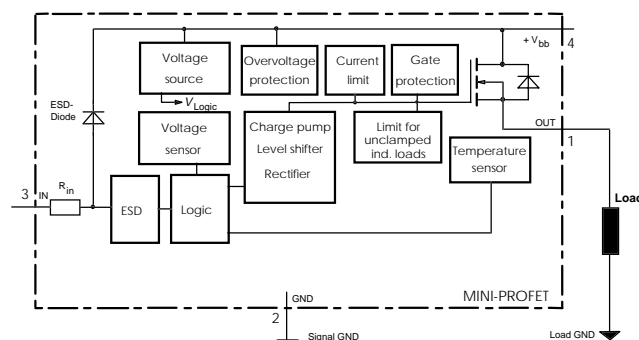
Package: SOT 223

Type	Ordering code
BSP 450	Q67000-S266

Pins			
1	2	3	4
OUT	GND	IN	V <sub>bb</sub>

## Maximum Ratings

Parameter	Symbol	Values	Unit
Supply voltage range	$V_{bb}$	-0.3...48	V
Load current	$I_L$	self-limited $I_{L(SC)}$	A
Maximum input voltage <sup>2)</sup>	$V_{IN}$	-5.0... $V_{bb}$	V
Maximum input current	$I_{IN}$	±5	mA
Inductive load switch-off energy dissipation single pulse	$E_{AS}$	0.5	J
		$I_L = 0.5A, T_A = 85^\circ C$	
Operating temperature range	$T_j$	-40 ...+125	°C
Storage temperature range	$T_{stg}$	-55 ...+150	
Max. power dissipation (DC) <sup>3)</sup>	$P_{tot}$	1.4	W
		$T_A = 25^\circ C$	
Electrostatic discharge capability (ESD) <sup>4)</sup>	$V_{ESD}$	±1	kV
Thermal resistance	$R_{thJS}$	7	K/W
	$R_{thJA}$	70	
		chip - soldering point:	
		chip - ambient <sup>3)</sup>	



1) With resistor  $R_{GND}=150\ \Omega$  in GND connection, resistor in series with IN connections reverse load current limited by connected load.

2) At  $V_{IN} > V_{bb}$ , the input current is not allowed to exceed ±5 mA.

3) BSP 450 on epoxy pcb 40 mm x 40 mm x 1.5 mm with 6 cm<sup>2</sup> copper area for  $V_{bb}$  connection

4) HBM according to MIL-STD 883D, Methode 3015.7



## Electrical Characteristics

Parameter and Conditions at $T_j = 25\text{ °C}$ , $V_{bb} = 24\text{V}$ unless otherwise specified	Symbol	Values			Unit
		min	typ	max	

## Load Switching Capabilities and Characteristics

On-state resistance (pin 4 to 1) $I_L = 0.5\text{ A}$ , $V_{in} = \text{high}$	$T_j = 25\text{ °C}$ $T_j = 125\text{ °C}$	$R_{ON}$	-- --	0.16 --	0.2 0.38	$\Omega$
Nominal load current (pin 4 to 1) <sup>5)</sup> ISO Standard: $V_{ON} = V_{bb} - V_{OUT} = 0.5\text{ V}$ $T_S = 85\text{ °C}$		$I_{L(ISO)}$	1.7	--	--	A
Turn-on time to 90% $V_{OUT}$		$t_{on}$	--	60	100	$\mu\text{s}$
Turn-off time to 10% $V_{OUT}$ $R_L = 47\ \Omega$		$t_{off}$	--	90	150	$\mu\text{s}$
Slew rate on 10 to 30% $V_{OUT}$ , $R_L = 47\ \Omega$		$dV/dt_{on}$	--	2	4	$\text{V}/\mu\text{s}$
Slew rate off 70 to 40% $V_{OUT}$ , $R_L = 47\ \Omega$		$-dV/dt_{off}$	--	2	4	$\text{V}/\mu\text{s}$

## Input

Allowable input voltage range, (pin 3 to 2)		$V_{IN}$	-3.0	--	$V_{bb}$	V
Input turn-on threshold voltage $V_{bb} = 18\text{...}30\text{V}$	 $T_j = -25\text{...}+125\text{ °C}$	$V_{IN(T+)}$	--	--	3.0	V
Input turn-off threshold voltage $V_{bb} = 18\text{...}30\text{V}$	 $T_j = -25\text{...}+125\text{ °C}$	$V_{IN(T-)}$	1.82	--	--	V
Input threshold hysteresis		$\Delta V_{IN(T)}$	--	0.1	--	V
Off state input current (pin 3) $V_{IN(off)} = 1.82\text{ V}$ $T_j = -25\text{...}+125\text{ °C}$		$I_{IN(off)}$	20	--	--	$\mu\text{A}$
On state input current (pin 3) $V_{IN(on)} = 3.0\text{ V to } V_{bb}$ $T_j = -25\text{...}+125\text{ °C}$		$I_{IN(on)}$	--	--	110	$\mu\text{A}$
Input resistance $T_j = -25\text{...}+125\text{ °C}$		$R_{IN}$	1.5	2.8	3.5	$\text{k}\Omega$

<sup>5)</sup>  $I_{L(ISO)}$  characterizes the MOSFET part of the device and may be higher than the shortcircuit current  $I_{L(SC)}$  of the whole device

Parameter and Conditions at $T_j = 25\text{ °C}$ , $V_{bb} = 24\text{V}$ unless otherwise specified	Symbol	Values			Unit
		min	typ	max	

## Operating Parameters

Operating voltage	$T_j = -25\dots+125\text{ °C}$	$V_{bb(\text{on})}$	12	--	40	V
Undervoltage shutdown	$T_j = -25\dots+125\text{ °C}$	$V_{bb(\text{under})}$	7	--	10.5	V
Undervoltage restart	$T_j = -25\dots+125\text{ °C}$ :	$V_{bb(\text{u rst})}$	--	--	11	V
Undervoltage hysteresis		$\Delta V_{bb(\text{under})}$	--	0.4	--	V
Standby current (pin 4), $V_{in} = \text{low}$	$T_j = -25\dots+100\text{ °C}$ $T_j = 125\text{ °C}^{(6)}$	$I_{bb(\text{off})}$	--	10	25 50	$\mu\text{A}$
Operating current (pin 2), $V_{in} = \text{high}$	$T_j = -25\dots+125\text{ °C}$	$I_{\text{GND}}$	--	1	1.6	mA
leakage current (pin 1) $V_{in} = \text{low}$	$T_j = -25\dots+125\text{ °C}$	$I_{L(\text{off})}$	--	--	2	$\mu\text{A}$

## Protection Functions

Current limit (pin 4 to 1)	$T_j = 25\text{ °C}$	$I_{L(\text{SC})}$	0.7	1.5	2	A
	$T_j = -25\dots+125\text{ °C}$		0.7	--	2.4	
Overvoltage protection $I_{bb}=4\text{mA}$	$T_j = -25\dots+125\text{ °C}$	$V_{bb(\text{AZ})}$	48	--	--	V
Output clamp (ind. load switch off) at $V_{\text{OUT}} = V_{bb} - V_{\text{ON}(\text{CL})}$ , $I_{bb} = 4\text{mA}$		$V_{\text{ON}(\text{CL})}$	--	72	--	V
Thermal overload trip temperature		$T_{jt}$	135	150	--	$\text{°C}$
Thermal hysteresis		$\Delta T_{jt}$	--	10	--	K
Inductive load switch-off energy dissipation <sup>7)</sup> $T_{j \text{ Start}} = 85\text{ °C}$ , single pulse, $I_L = 0.5\text{ A}$ , $V_{bb} = 12\text{ V}$		$E_{\text{AS}}$	--	--	0.5	J

## Reverse Battery

Reverse battery voltage <sup>8)</sup>		$-V_{bb}$			30	V
Continuous reverse drain current	$T_A = 25\text{ °C}$	$-I_S$	--	--	1	A
Drain-Source diode voltage $I_F = 1\text{ A}$ , $V_{in} = \text{low}$	$V_{\text{OUT}} > V_{bb}$	$-V_{\text{ON}}$	--	--	1.2	V

6) increase of standby current at  $T_j = 125\text{ °C}$  caused by temperature sense current

7) while demagnetizing load inductance, dissipated energy is  $E_{\text{AS}} = \int (V_{\text{ON}(\text{CL})} * i_L(t) dt$ ,

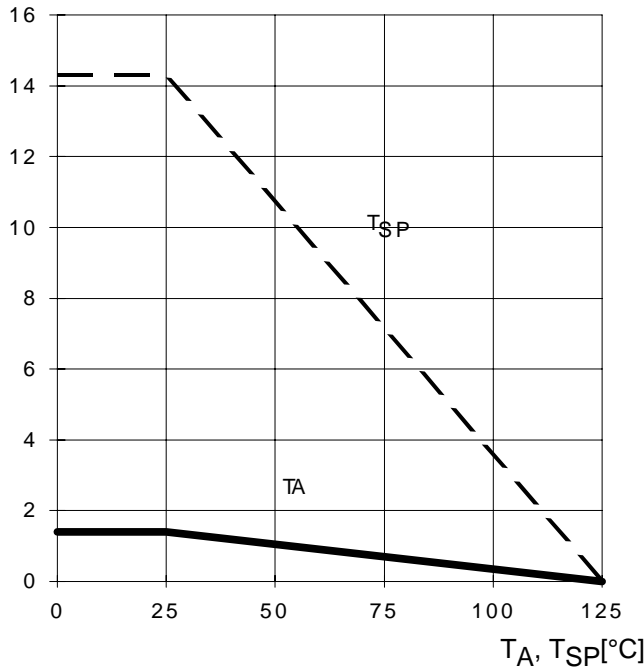
approx.  $E_{\text{AS}} = \frac{1}{2} * L * I_L^2 * \left( \frac{V_{\text{ON}(\text{CL})}}{V_{\text{ON}(\text{CL})} - V_{bb}} \right)$

8) Requires  $150\ \Omega$  resistor in GND connection. Reverse load current (through intrinsic drain-source diode) is normally limited by the connected load.

Max allowable power dissipation

$P_{tot} = f(T_A, T_{SP})$

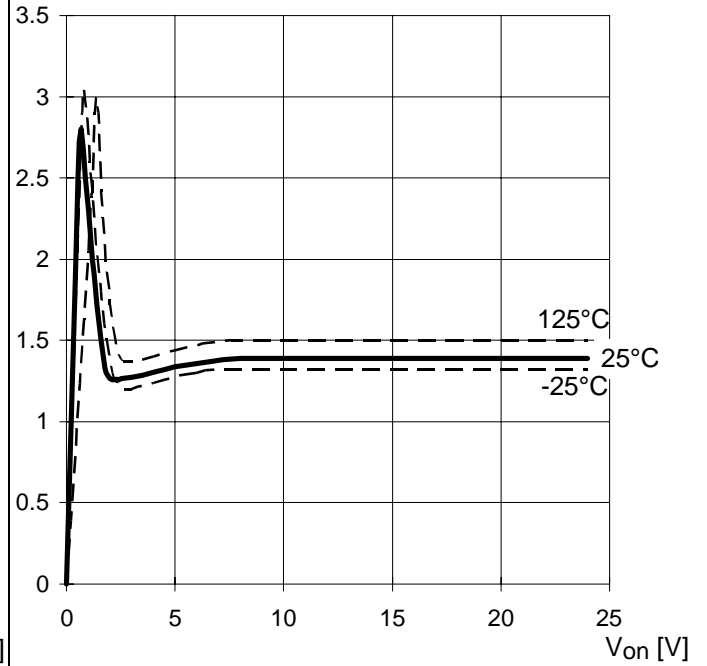
$P_{tot}$  [W]



Current limit characteristic

$I_L(SC) = f(V_{on})$  ( $V_{on}$  see testcircuit)

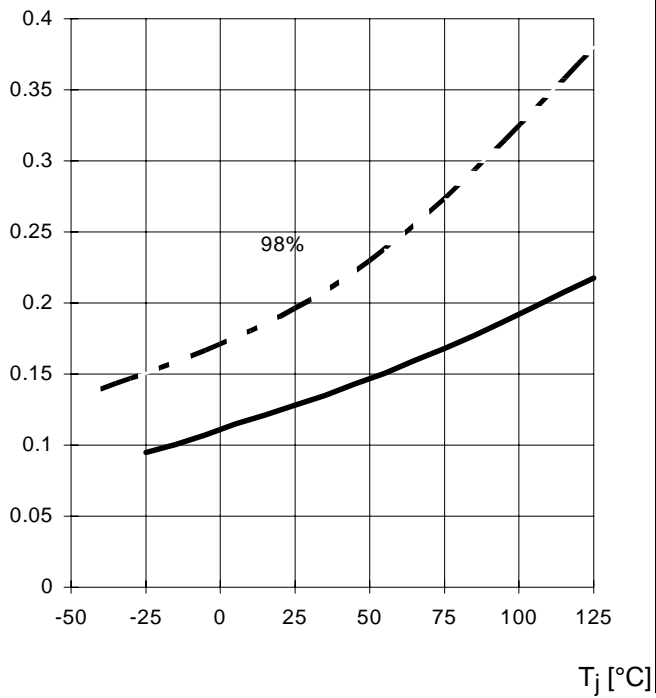
$I_L(SC)$  [A]



On state resistance (Vbb-pin to OUT pin)

$R_{ON} = f(T_j); V_{bb} = 24 V; I_L = 0.5 A$

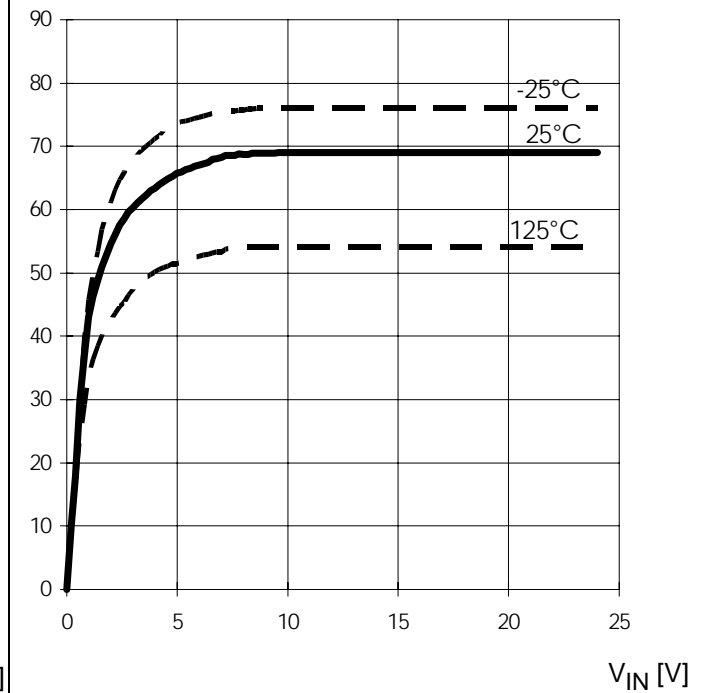
$R_{ON}$  [ $\Omega$ ]



Typ. input current

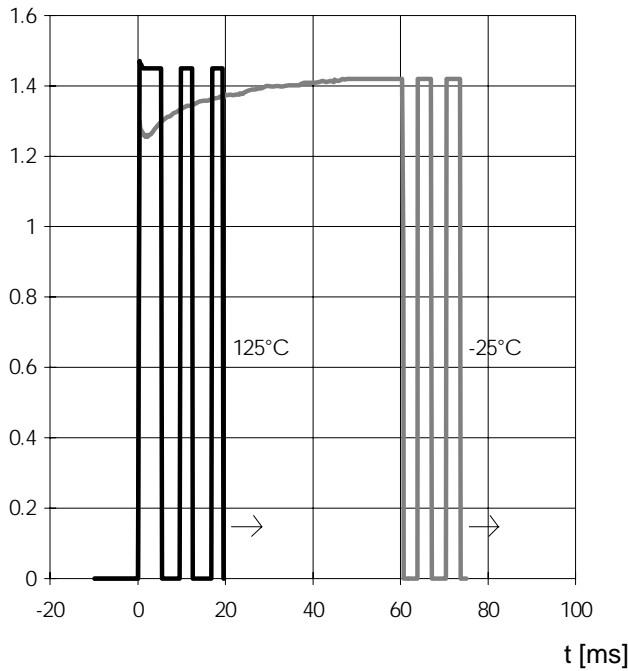
$I_{IN} = f(V_{IN}); V_{bb} = 24 V$

$I_{IN}$  [ $\mu A$ ]



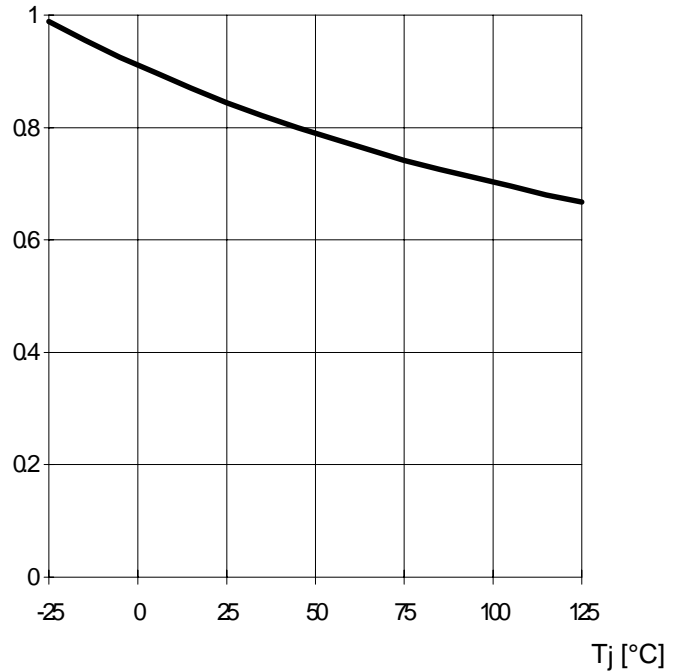
**Typ. overload current**

$I_{L(lim)} = f(t)$ ,  $V_{bb}=24V$ , no heatsink, Param.:  $T_{jstart}$   
 $I_{L(lim)}$  [A]



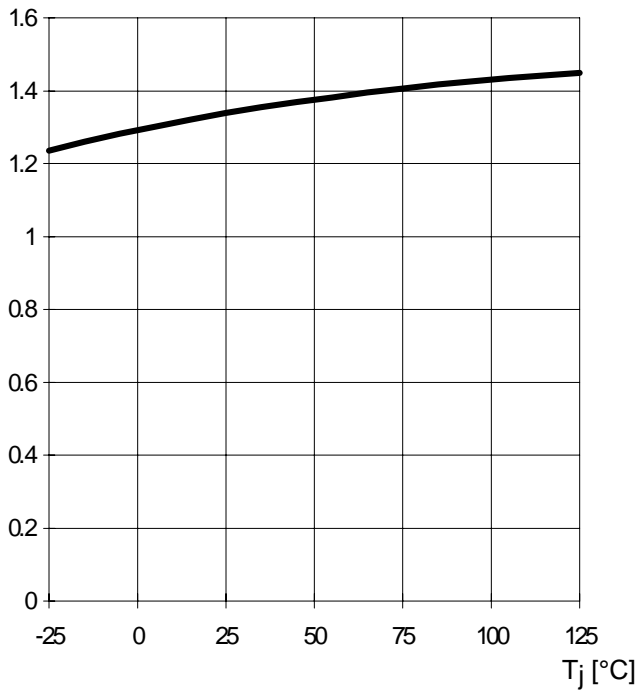
**Typ. operating current**

$I_{GND} = f(T_j)$ ,  $V_{bb}=30V$ ,  $V_{IN}=high$   
 $I_{GND}$  [mA]



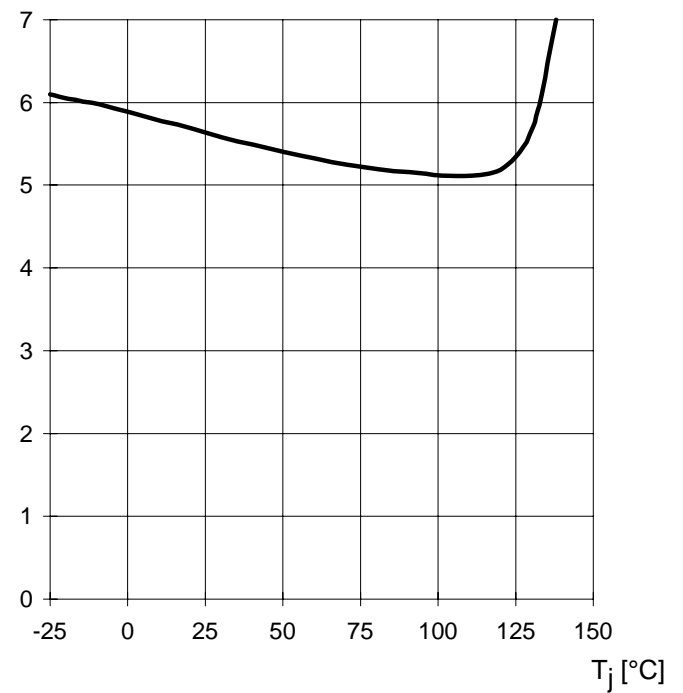
**Short circuit current**

$I_{L(SC)} = f(T_j)$ ;  $V_{bb} = 30 V$ ;  
 $I_{L(SC)}$  [A]



**Typ. standby current**

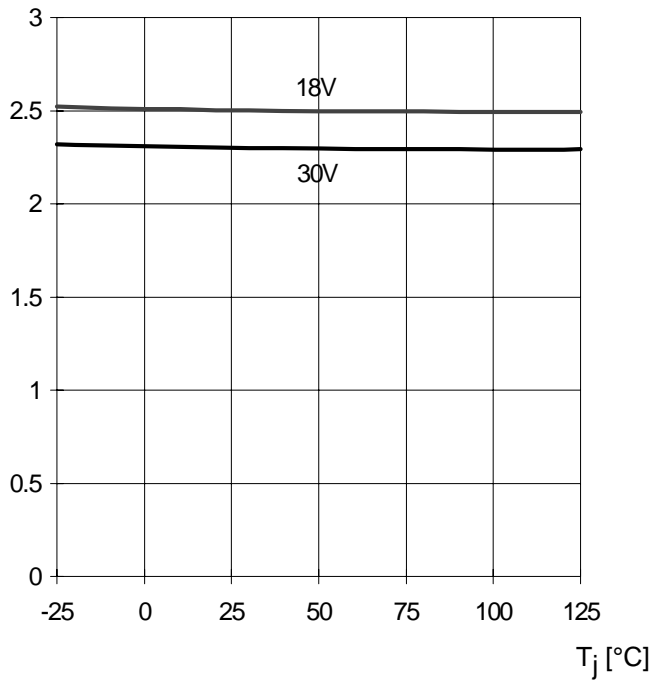
$I_{bb(off)} = f(T_j)$ ;  $V_{bb} = 30 V$ ,  $V_{IN} = low$   
 $I_{bb(off)}$  [ $\mu A$ ]



Typ. input turn on voltage threshold

$$V_{IN(T+)} = f(T_j)$$

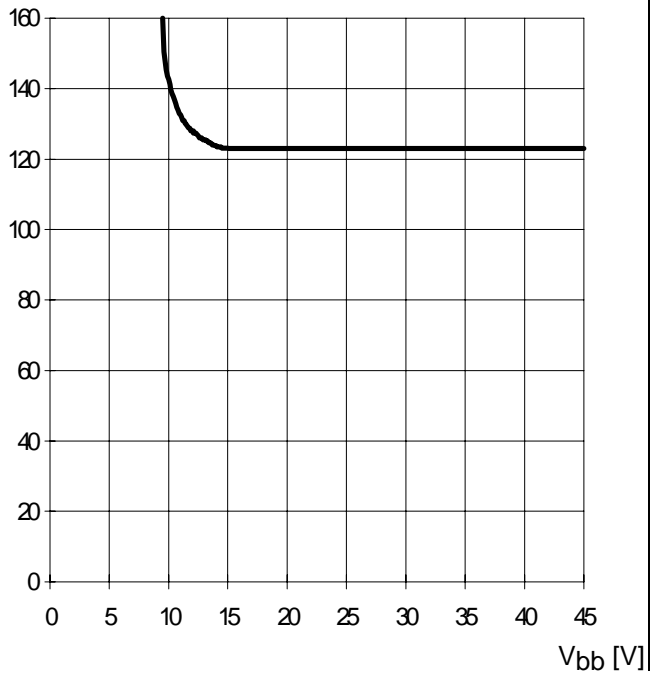
$V_{IN(T+)} [V]$



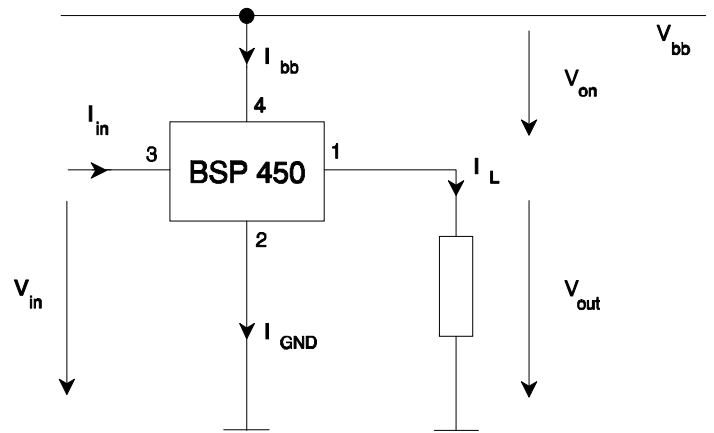
Typ. on-state resistance (Vbb-Pin to OUT-Pin)

$$R_{ON} = f(V_{bb}, I_L); I_L = 0.5A, T_j = 25^\circ C;$$

$R_{ON} [m\Omega]$



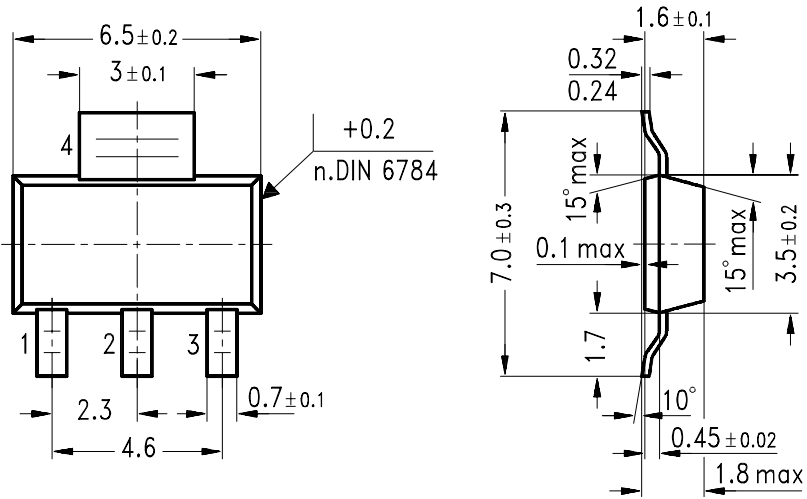
Test circuit



## Package:

all dimensions in mm.

SOT 223/4:



GPS05560