# SIEMENS

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
- **E**lectro**s**tatic **d**ischarge (**ESD**) protection
- Reverse battery protection[1]
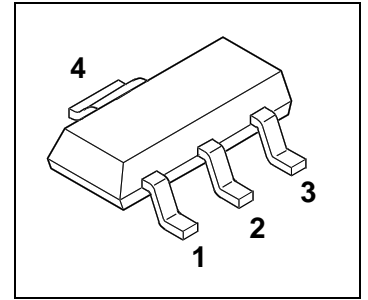
Package: SOT 223

Type	Ordering code
BSP 450	Q67000-S266

Pins			
1	2	3	4
OUT	GND	IN	V_{bb}

Maximum Ratings

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

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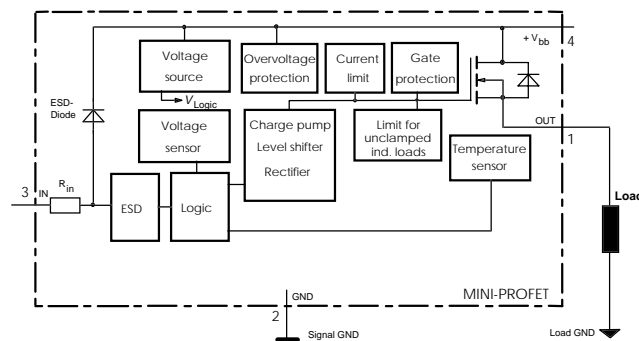
[1] With resistor R_{GND}=150 Ω in GND connection, resistor in series with IN connections reverse load current
   limited by connected load.

[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 cm² copper area for V_{bb} connection

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

Electrical Characteristics

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

Load Switching Capabilities and Characteristics

Parameter and Conditions	Symbol	min	typ	max	Unit
On-state resistance (pin 4 to 1) I_L = 0.5 A, V_{in} = high $\quad T_j$ = 25°C	R_{ON}	--	0.16	0.2	Ω
T_j = 125°C		--	--	0.38	
Nominal load current (pin 4 to 1)[5] ISO Standard: $V_{ON} = V_{bb} - V_{OUT}$ = 0.5 V T_S = 85 °C	$I_{L(ISO)}$	1.7	--	--	A
Turn-on time $\quad$ to 90% V_{OUT}	t_{on}	--	60	100	µs
Turn-off time $\quad$ to 10% V_{OUT} R_L = 47 Ω	t_{off}	--	90	150	
Slew rate on 10 to 30% V_{OUT}, R_L = 47 Ω	dV/dt$_{on}$	--	2	4	V/µs
Slew rate off 70 to 40% V_{OUT}, R_L = 47 Ω	-dV/dt$_{off}$	--	2	4	V/µs

Input

Parameter and Conditions	Symbol	min	typ	max	Unit
Allowable input voltage range, (pin 3 to 2)	V_{IN}	-3.0	--	V_{bb}	V
Input turn-on threshold voltage $\quad$⌐ V_{bb} = 18...30V $\quad T_j$ = -25...+125°C	$V_{IN(T+)}$	--	--	3.0	V
Input turn-off threshold voltage $\quad$¬ V_{bb} = 18...30V $\quad T_j$ = -25...+125°C	$V_{IN(T-)}$	1.82	--	--	V
Input threshold hysteresis	$\Delta V_{IN(T)}$	--	0.1	--	V
Off state input current (pin 3) $\quad V_{IN(off)}$ = 1.82 V T_j = -25...+125°C	$I_{IN(off)}$	20	--	--	µA
On state input current (pin 3) $\quad V_{IN(on)}$ = 3.0 V to V_{bb} T_j = -25...+125°C	$I_{IN(on)}$	--	--	110	µA
Input resistance $\quad T_j$ = -25...+125°C	R_{IN}	1.5	2.8	3.5	kΩ

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[5] $I_{L(ISO)}$ 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	Symbol	Values			Unit
at T_j = 25 °C, V_{bb} = 24V unless otherwise specified		min	typ	max	

Operating Parameters

Parameter and Conditions	Symbol	min	typ	max	Unit
Operating voltage T_j =-25...+125°C	$V_{bb(on)}$	12	--	40	V
Undervoltage shutdown T_j =-25...+125°C	$V_{bb(under)}$	7	--	10.5	V
Undervoltage restart T_j =-25...+125°C:	$V_{bb(u\,rst)}$	--	--	11	V
Undervoltage hysteresis	$\Delta V_{bb(under)}$	--	0.4	--	V
Standby current (pin 4), V_{in} = low T_j =-25...+100°C	$I_{bb(off)}$	--	10	25	μA
T_j =125°C[6]				50	
Operating current (pin 2), V_{in} = high T_j =-25...+125°C	I_{GND}	--	1	1.6	mA
leakage current (pin 1) V_{in} = low T_j =-25...+125°C	$I_{L(off)}$	--	--	2	μA

Protection Functions

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

Reverse Battery

Parameter and Conditions	Symbol	min	typ	max	Unit
Reverse battery voltage[8]	$-V_{bb}$			30	V
Continious reverse drain current T_A = 25°C	$-I_S$	--	--	1	A
Drain-Source diode voltage I_F = 1 A, V_{in} = low $V_{OUT} > V_{bb}$	$-V_{ON}$	--	--	1.2	V

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[6] increase of standby current at T_j = 125°C caused by temperature sense current

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

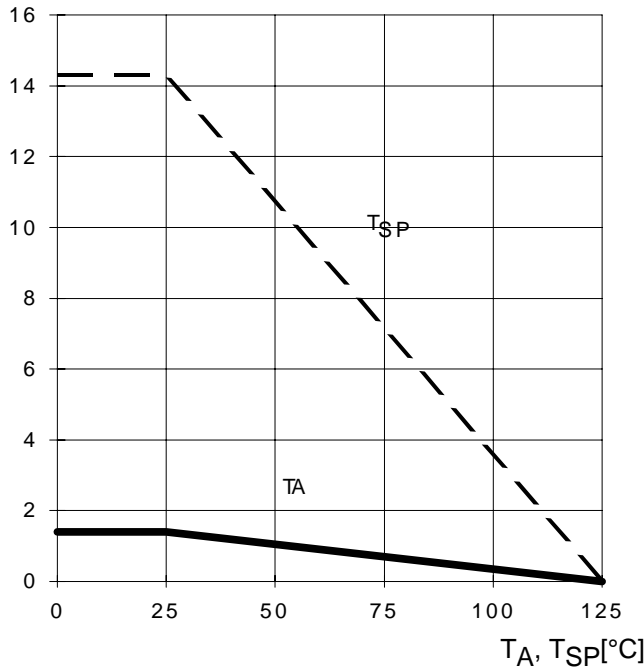approx. $E_{AS} = \frac{1}{2} * L * I_L^2 * (\frac{V_{ON(CL)}}{V_{ON(CL)} - V_{bb}})$

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

Max allowable power dissipation
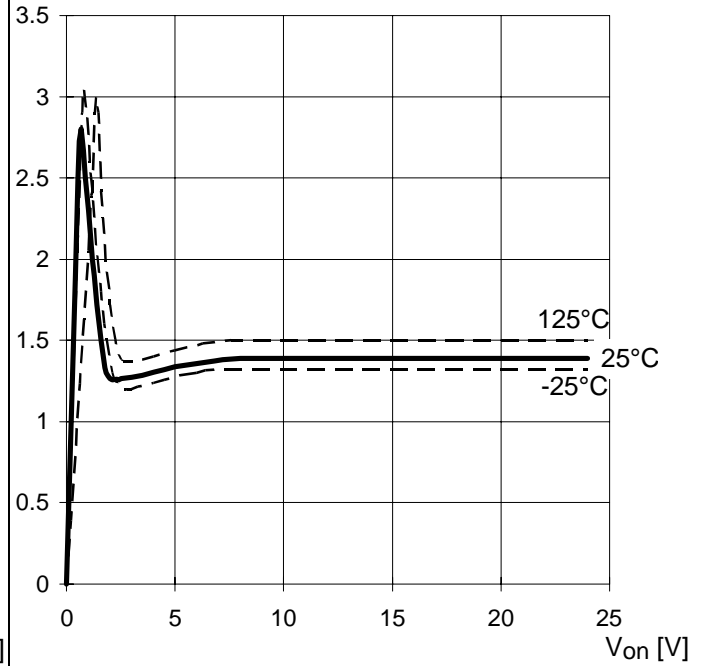
$P_{tot} = f(T_A, T_{SP})$

P_{tot} [W]

Current limit characteristic
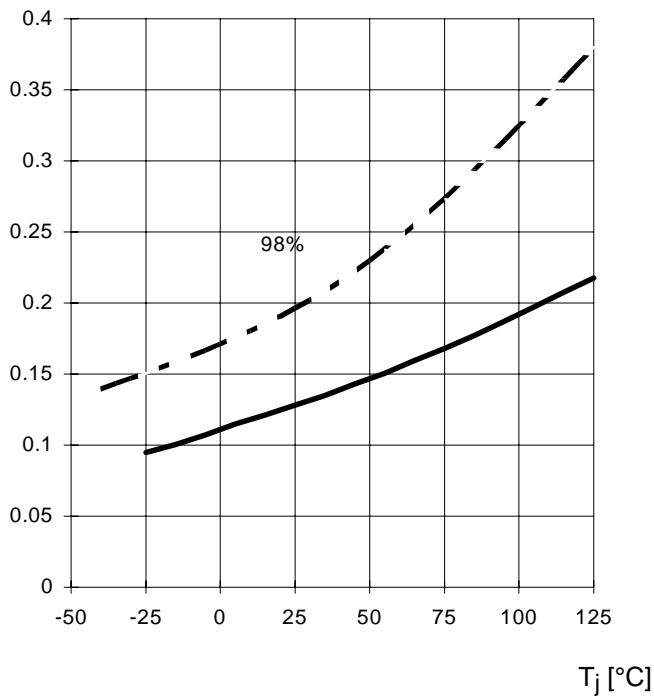
$I_{L(SC)} = f(V_{on})$ (V_{on} see testcircuit)

$I_{L(SC)}$ [A]

On state resistance (Vbb-pin to OUT pin)
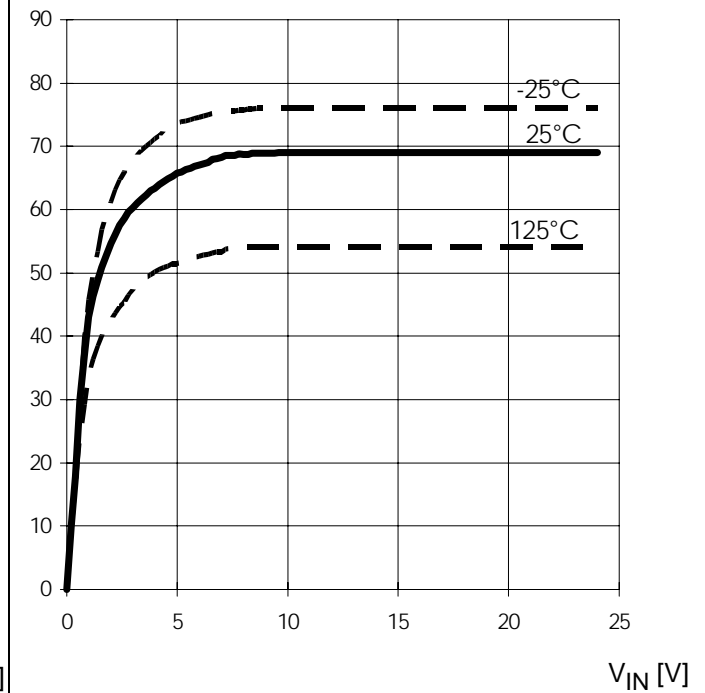
$R_{ON} = f(T_j)$; $V_{bb} = 24$ V; $I_L = 0.5$ A
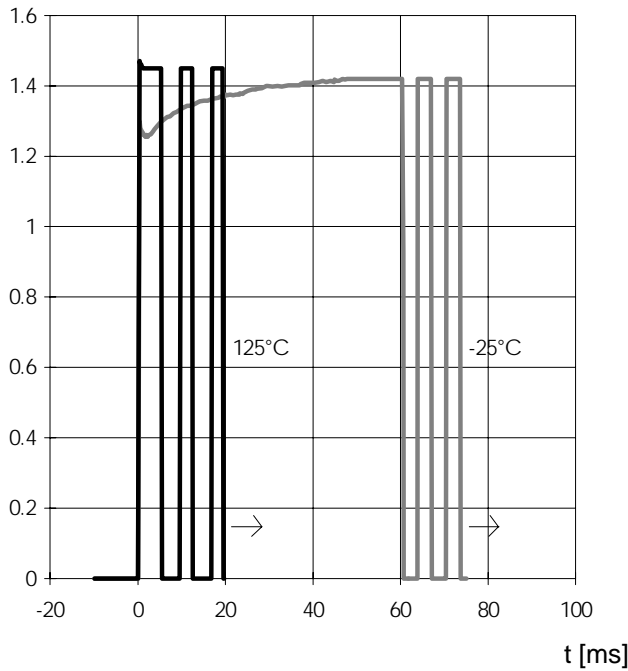
R_{ON} [Ω]

Typ. input current
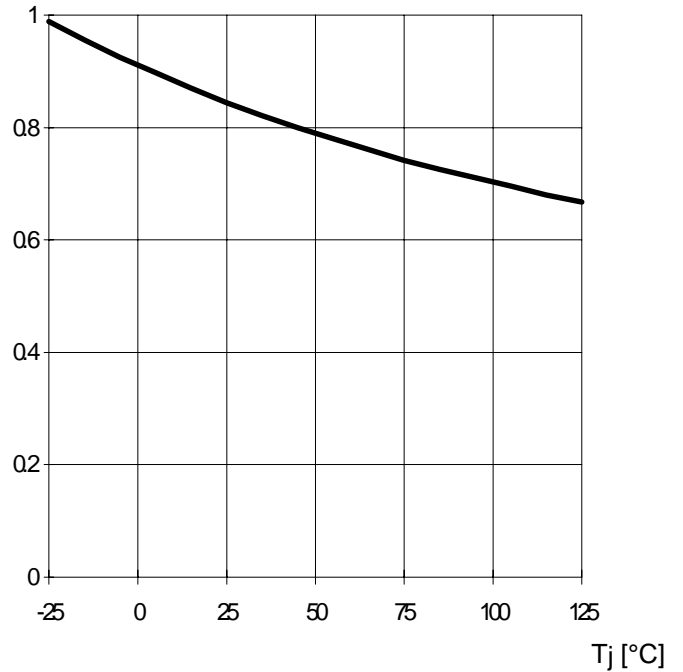
$I_{IN} = f(V_{IN})$; $V_{bb} = 24$ V

I_{IN} [μA]

Typ. overload current

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

$I_{L(lim)}$ [A]

Typ. operating current

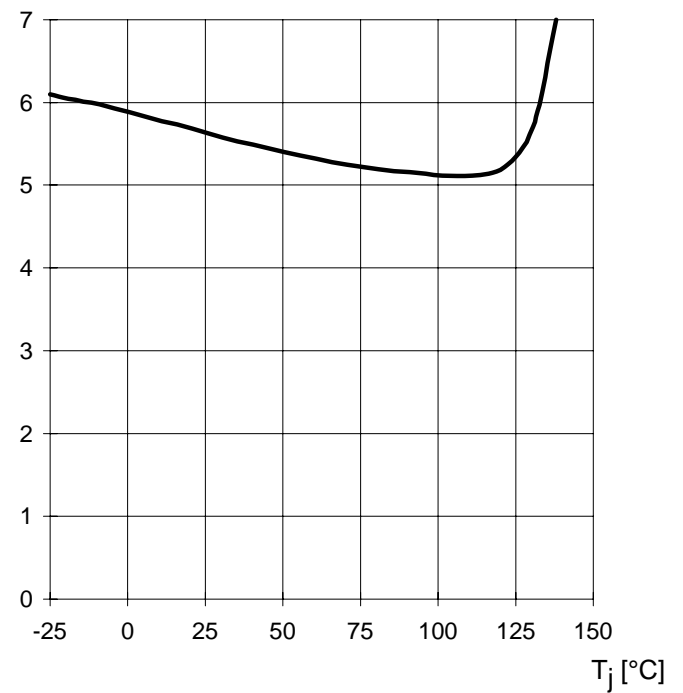I_{GND} **= f (Tj),** V_{bb}=30V, V_{IN}=high

GND [mA]

Short circuit current

$I_{L(SC)}$ **= f (T$_j$);** V_{bb} = 30 V;
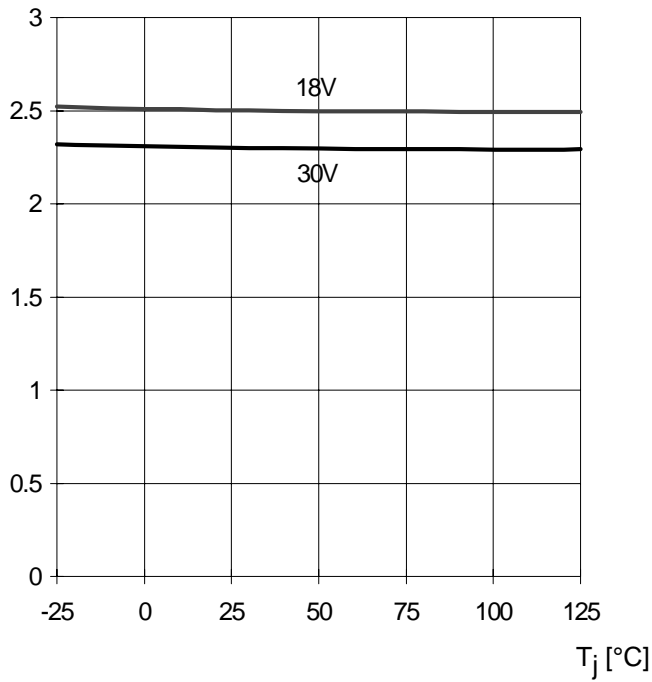
$I_{L(SC)}$ [A]
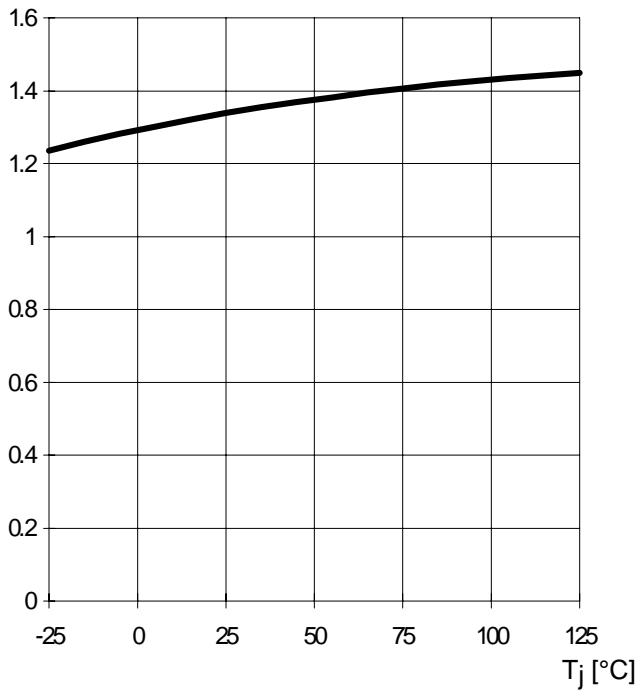
Typ. standby current

$I_{bb(off)}$ **= f(T$_j$);** V_{bb} = 30 V, V_{IN} = low

$I_{bb(off)}$ [µA]

Typ. input turn on voltage threshold
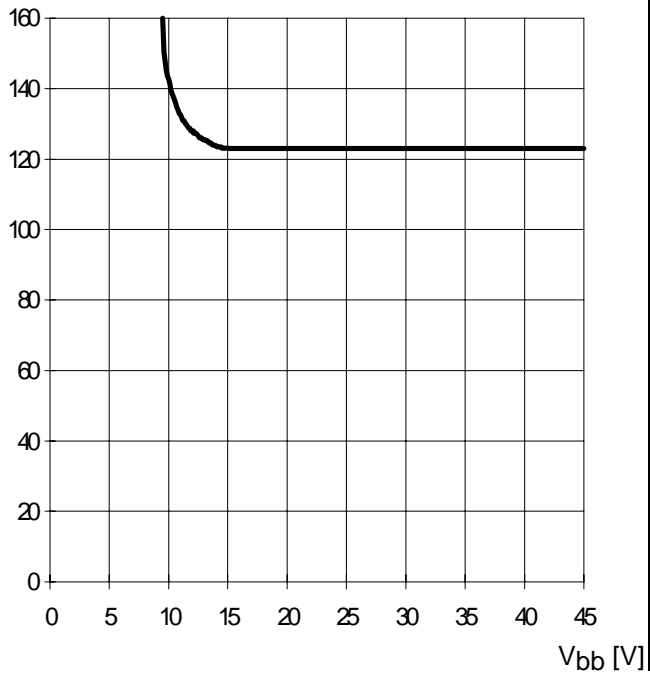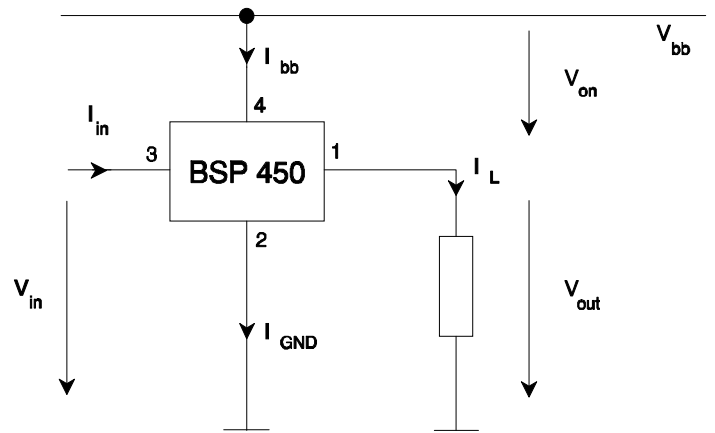
$V_{IN(T+)} = f (T_j)$

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

T_j [°C]

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

$R_{ON} = f (V_{bb}, I_L)$; $I_L = 0.5A$, $T_j = 25$ °C;
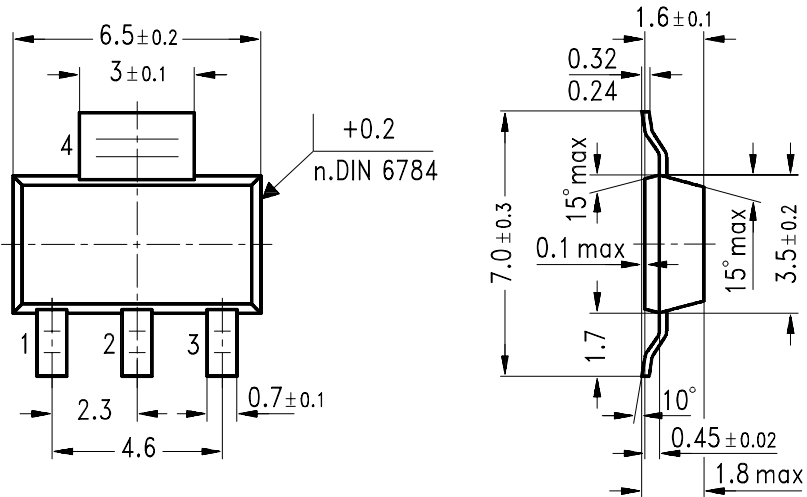
R_{ON} [mΩ]

V_{bb} [V]

Test circuit

Package:

all dimensions in mm.

SOT 223/4:

GPS05560