RoHS

AEC
Qualified

- 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]
- AEC qualified
- Green product (RoHS compliant)

PG-SOT-223
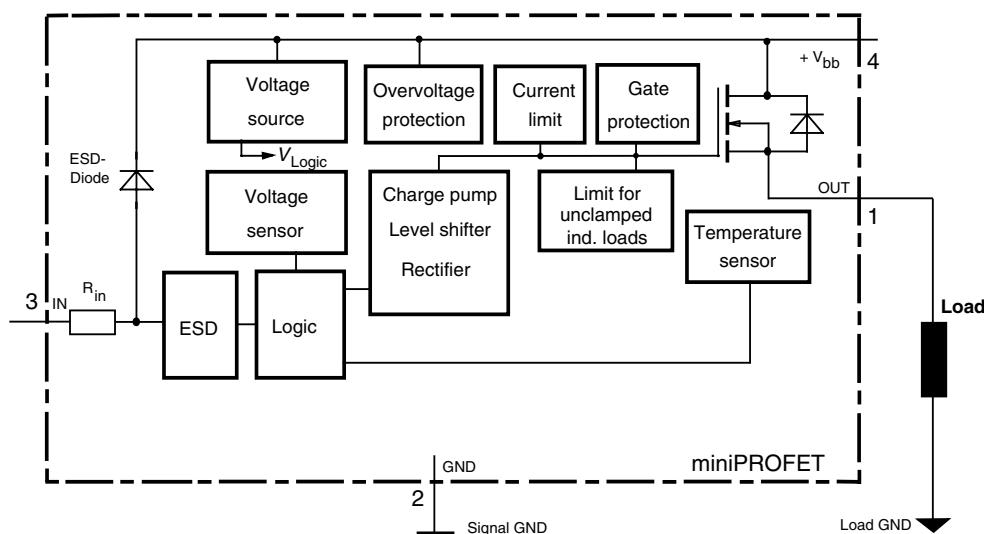
Application
- µC compatible power switch for 12 V DC grounded loads
- All types of resistive, inductive and capacitive loads
- Replaces electromechanical relays and discrete circuits

General Description
N channel vertical power FET with charge pump, ground referenced CMOS compatible input,monolithically integrated in Smart SIPMOS® technology. Fully protected by embedded protection functions.

Blockdiagramm:

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

Pin	Symbol		Function
1	OUT	O	Output to the load
2	GND	-	Logic ground
3	IN	I	Input, activates the power switch in case of logical high signal
4	Vbb	+	Positive power supply voltage

Maximum Ratings at T_j = 25 °C unless otherwise specified

Parameter	Symbol	Values	Unit
Supply voltage	V_{bb}	40	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 = 150°C (not tested, specified by design)	E_{AS}	0.5	J
Load dump protection[3] $V_{LoadDump}=U_A+V_s$ R_L= 24Ω R_l=2Ω , t_d=400ms, IN= low or high, U_A=13,5V R_L= 80Ω (not tested, specified by design)	$V_{Load\ dump}$[4]	60 80	V
Electrostatic discharge capability (ESD)[5] PIN 3 PIN 1,2,4	V_{ESD}	±1 ±2	kV
Operating temperature range Storage temperature range	T_j T_{stg}	-40 ...+150 -55 ...+150	°C
Max. power dissipation (DC)[6] T_A = 25 °C	P_{tot}	1.8	W
Thermal resistance chip - soldering point: chip - ambient:[6]	R_{thJS} R_{thJA}	7 70	K/W

[2] At V_{IN} > V_{bb}, the input current is not allowed to exceed ±5 mA.
[3] Supply voltages higher than $V_{bb(AZ)}$ require an external current limit for the GND pin, e.g. with a 150 Ω resistor in the GND connection A resistor for the protection of the input is integrated.
[4] $V_{Load\ dump}$ is setup without the DUT connected to the generator per ISO 7637-1 and DIN 40839
[5] HBM according to MIL-STD 883D, Methode 3015.7
[6] BSP 452 on epoxy pcb 40 mm x 40 mm x 1.5 mm with 6 cm² copper area for V_{bb} connection

Electrical Characteristics

Parameter and Conditions at T_j = 25 °C, V_{bb} = 13.5V 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 A, V_{in} = high T_j = 25°C	R_{ON}	--	0.16	0.2	Ω
T_j = 150°C		--	--	0.4	
Nominal load current (pin 4 to 1)[7] ISO Standard: V_{ON} = V_{bb} - V_{OUT} = 0.5 V T_S = 85 °C	$I_{L(ISO)}$	0.7	--	--	A
Turn-on time to 90% V_{OUT}	t_{on}	--	60	100	μs
Turn-off time to 10% V_{OUT} R_L = 24 Ω	t_{off}	--	60	150	
Slew rate on 10 to 30% V_{OUT}, R_L = 24 Ω	dV/dt_{on}	--	2	4	V/μs
Slew rate off 70 to 40% V_{OUT}, R_L = 24 Ω	$-dV/dt_{off}$	--	2	4	V/μs

Input

	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 T_j = -40...+150°C	$V_{IN(T+)}$	--	--	3.5	V
Input turn-off threshold voltage T_j = -40...+150°C	$V_{IN(T-)}$	1.5	--	--	V
Input threshold hysteresis	$\Delta V_{IN(T)}$	--	0.5	--	V
Off state input current (pin 3) $V_{IN(off)}$ = 1.2 V T_j = -40...+150°C	$I_{IN(off)}$	10	--	60	μA
On state input current (pin 3) $V_{IN(on)}$ = 3.0 V to V_{bb} T_j = -40...+150°C	$I_{IN(on)}$	10	--	100	μA
Input resistance	R_{IN}	1.5	2.8	3.5	kΩ

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[7] $I_{L(ISO)}$ is limited by current limitation, see $I_{L(SC)}$, next page

Parameter and Conditions	Symbol	Values			Unit
at T_j = 25 °C, V_{bb} = 13.5V unless otherwise specified		min	typ	max	

Operating Parameters

Parameter and Conditions		Symbol	min	typ	max	Unit
Operating voltage[8]	T_j =-40...+150°C	$V_{bb(on)}$	5.0	--	34	V
Undervoltage shutdown	T_j =-40...+150°C	$V_{bb(under)}$	3.5	--	5	V
Undervoltage restart	T_j =-40...+25°C T_j =+150°C	$V_{bb(u\,rst)}$	--	--	6.5 7.0	V
Undervoltage restart of charge pumpe see diagram page 7		$V_{bb(ucp)}$	--	5.6	7	V
Undervoltage hysteresis $\Delta V_{bb(under)} = V_{bb(u\,rst)} - V_{bb(under)}$		$\Delta V_{bb(under)}$	--	0.3	--	V
Overvoltage shutdown	T_j =-40...+150°C	$V_{bb(over)}$	34	--	42	V
Overvoltage restart	T_j =-40...+150°C	$V_{bb(o\,rst)}$	33	--	--	V
Overvoltage hysteresis	T_j =-40...+150°C	$\Delta V_{bb(over)}$	--	0.7	--	V
Standby current (pin 4), V_{in} = low	T_j =-40...+150°C	$I_{bb(off)}$	--	10	25	µA
Operating current (pin 2), V_{in} = 5 V		I_{GND}	--	1	1.6	mA
leakage current (pin 1) V_{in} = low	T_j =-40...+25°C T_j =150°C	$I_{L(off)}$	--	2	5 7	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
V_{bb} = 20V	T_j = -40...+150°C		0.7	--	2.4	
Overvoltage protection I_{bb}=4mA	T_j =-40...+150°C	$V_{bb(AZ)}$	41	--	--	V
Output clamp (ind. load switch off) at $V_{OUT}=V_{bb}-V_{ON(CL)}$, I_{bb} = 4mA		$V_{ON(CL)}$	41	47	--	V
Thermal overload trip temperature		T_{jt}	150	--	--	°C
Thermal hysteresis		ΔT_{jt}	--	10	--	K
Inductive load switch-off energy dissipation[9] $T_{j\,Start}$ = 150 °C, single pulse, I_L = 0.5 A, V_{bb} = 12 V (not tested, specified by design)		E_{AS}	--	--	0.5	J
Reverse battery (pin 4 to 2) [10] (not tested, specified by design)		$-V_{bb}$	--	--	30	V

[8] At supply voltage increase up to V_{bb}= 5.6 V typ without charge pump, $V_{OUT} \approx V_{bb}$ - 2 V
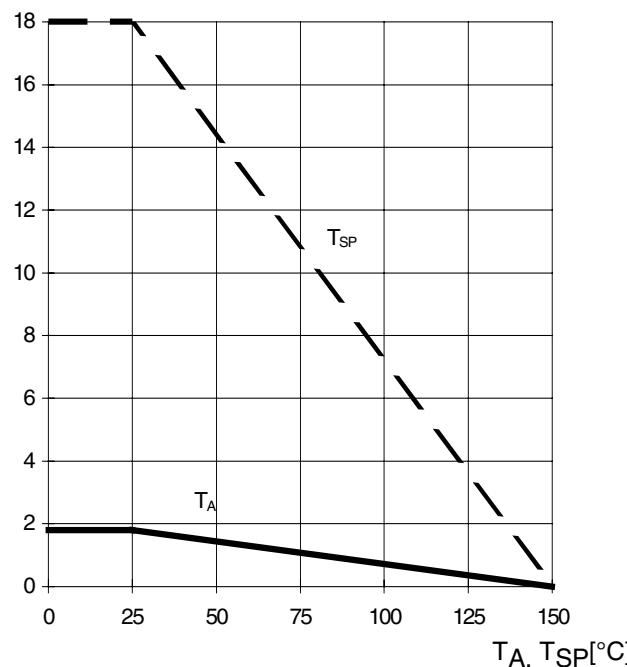
[9] While demagnetizing load inductance, dissipated energy in PROFET is $E_{AS}= \int V_{ON(CL)} * i_L(t)\, dt$, approx.

$$E_{AS}= \frac{1}{2} * L * I_L^2 * (\frac{V_{ON(CL)}}{V_{ON(CL)} - V_{bb}})$$
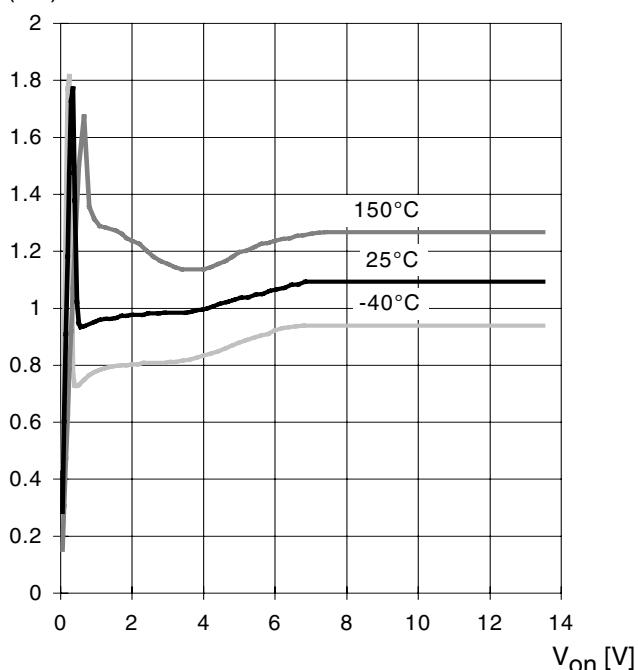
[10] Requires 150 Ω resistor in GND connection. Reverse load current (through intrinsic drain-source diode) is normally limited by the connected load.

Max. allowable power dissipation
P_{tot} = f (T_A, T_{SP})
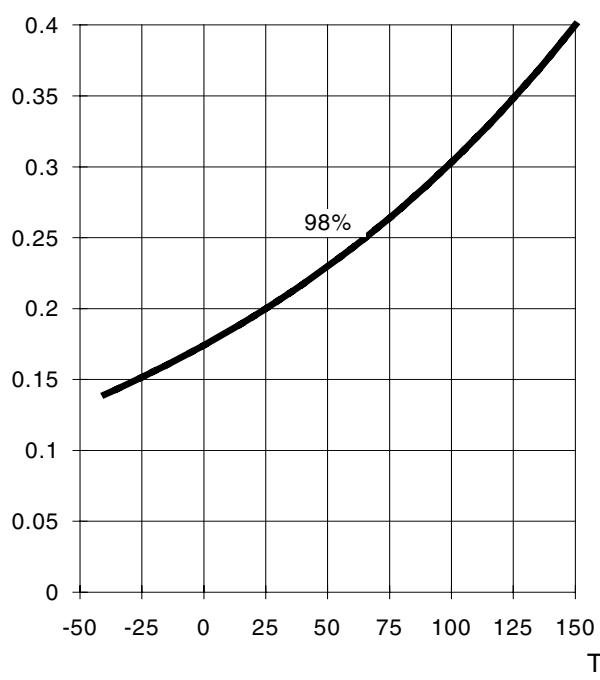
P_{tot} [W]

T_A, T_{SP}[°C]

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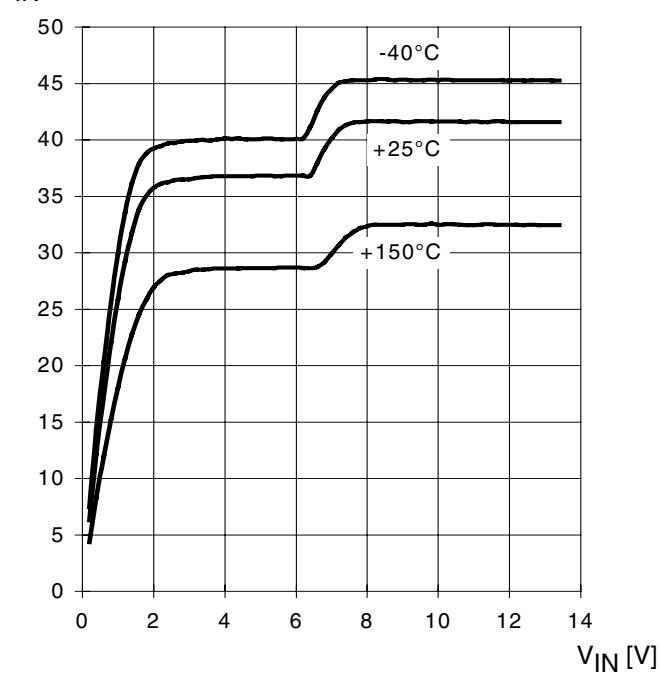
$I_{L(SC)}$ [A]

V_{on} [V]
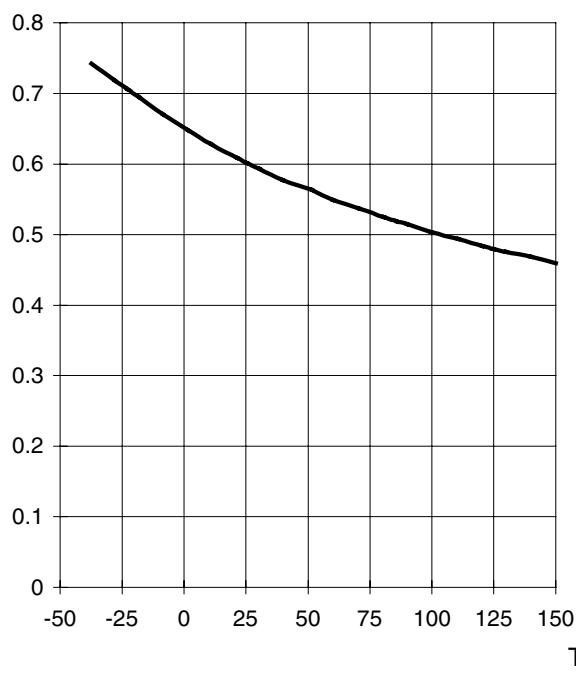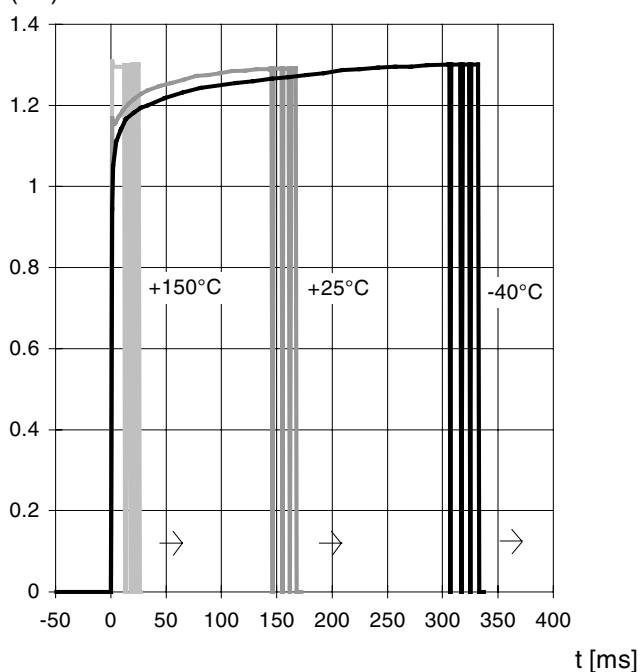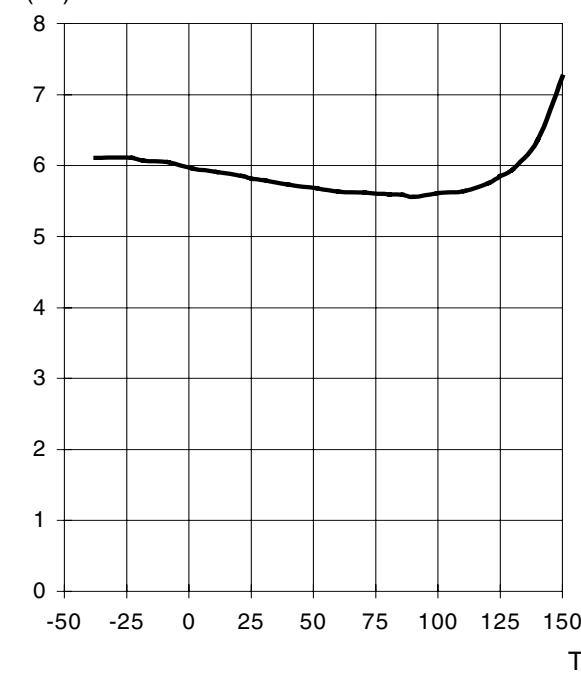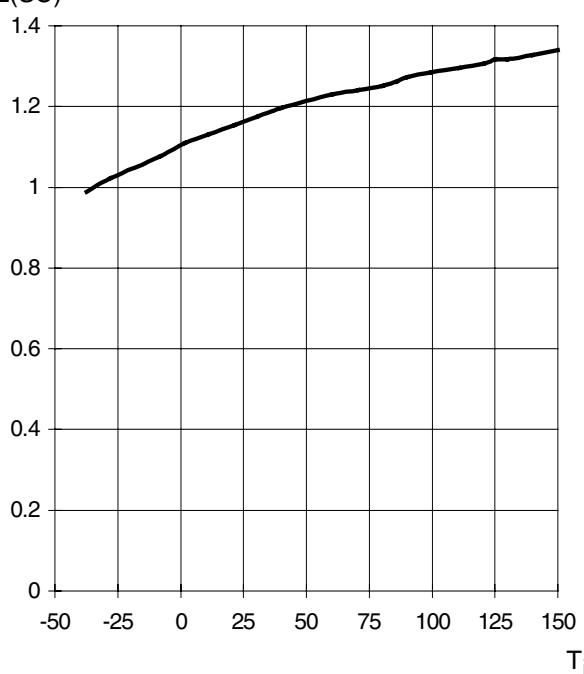
On state resistance (Vbb-pin to OUT-pin)
R_{ON} = f (Tj); V_{bb} = 13.5 V; I_L = 0.5 A

R_{ON} [Ω]

T_j [°C]
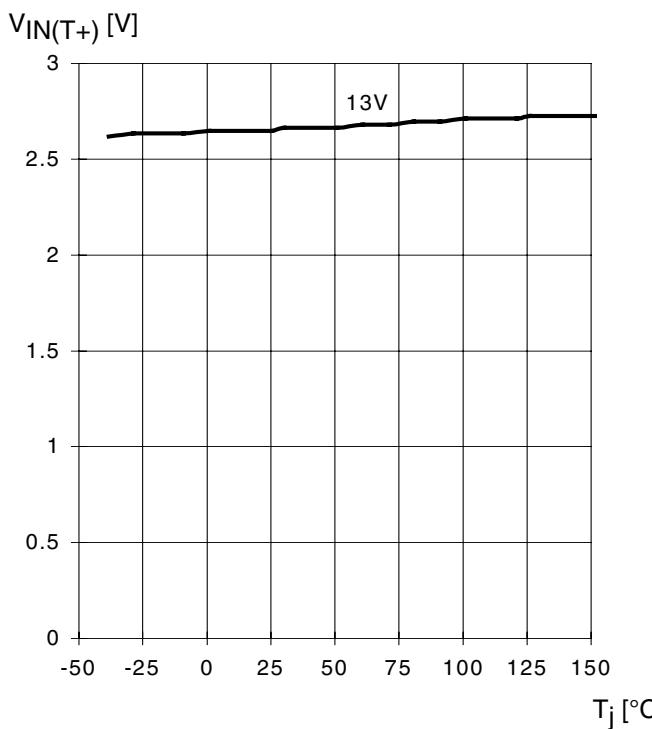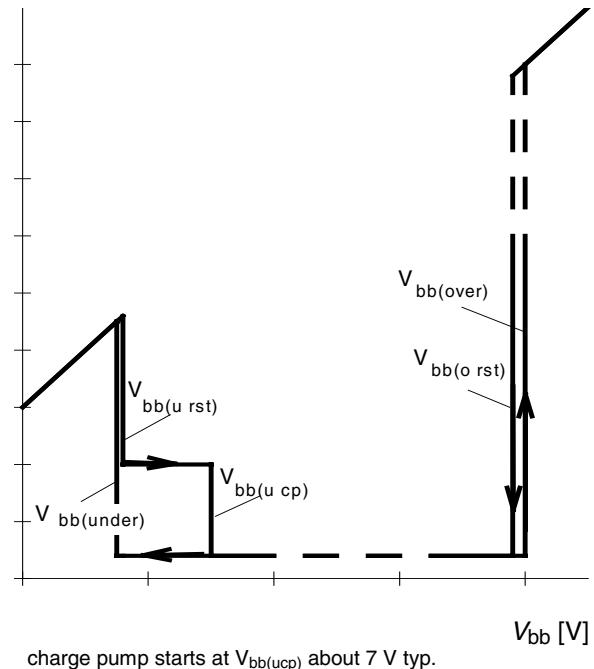
Typ. input current
I_{IN} = f (V_{IN}); V_{bb} = 13,5 V

I_{IN} [µA]

V_{IN} [V]
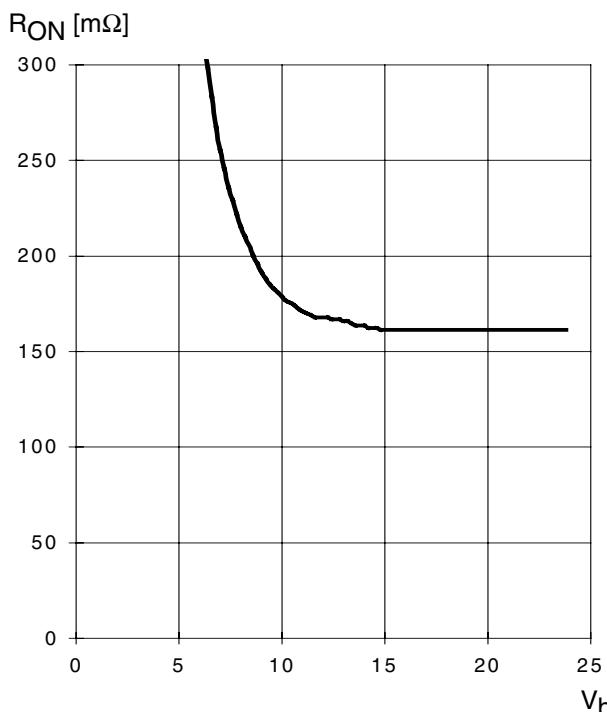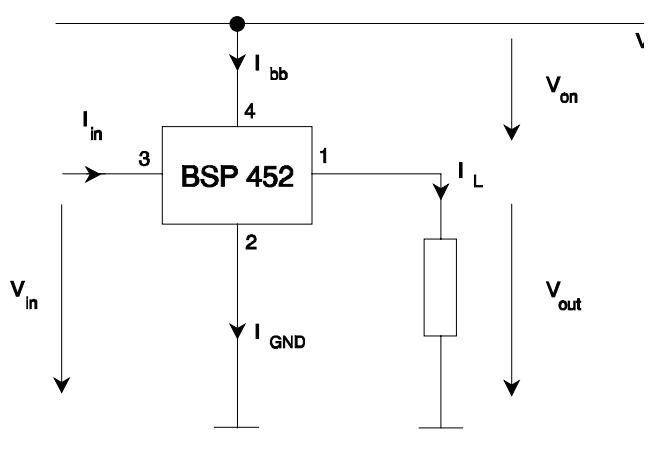
Typ. operating current
$I_{GND} = f (T_j)$; $V_{bb} = 13,5$ V; V_{IN} = high

I_{GND} [mA]

Typ. overload current
$I_{L(lim)} = f (t)$; $V_{bb} = 13,5$ V, no heatsink, Param.: T_{jstart}

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

+150°C   +25°C   -40°C

t [ms]

T_j [°C]

Typ. standby current
$I_{bb(off)} = f (T_j)$; $V_{bb} = 13,5$ V; V_{IN} = low

$I_{bb(off)}$ [µA]

Short circuit current
$I_{L(SC)} = f (T_j)$; $V_{bb} = 13,5$ V

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

T_j [°C]

T_j [°C]

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

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

T_j [°C]
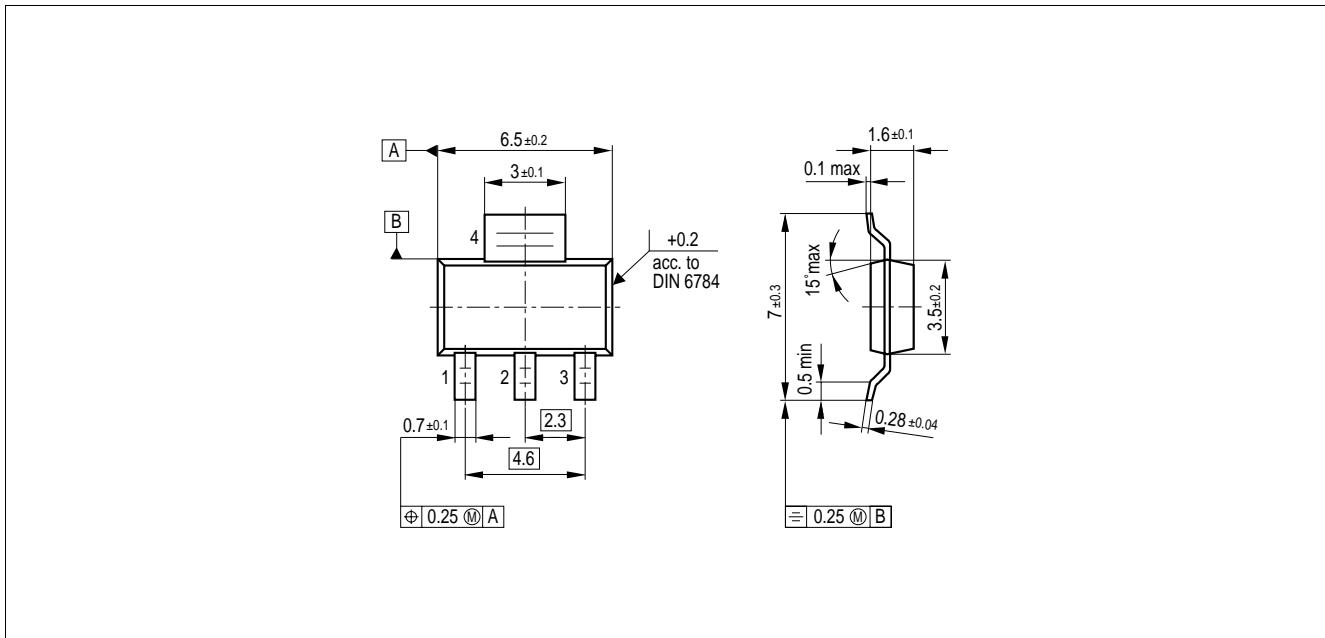
Figure 6: Undervoltage restart of charge pumpe

V_{ON} [V]

V_{bb} [V]

charge pump starts at $V_{bb(ucp)}$ about 7 V typ.

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 Outlines

Figure 1   **PG-SOT-223** (Plastic Dual Small Outline Package) (RoHS-compliant)

To meet the world-wide customer requirements for environmentally friendly products and to be compliant with government regulations the device is available as a green product. Green products are RoHS-Compliant (i.e Pb-free finish on leads and suitable for Pb-free soldering according to IPC/JEDEC J-STD-020).

Please specify the package needed (e.g. green package) when placing an order

You can find all of our packages, sorts of packing and others in our
Infineon Internet Page "Products": **http://www.infineon.com/products**.

Dimensions in mm

Revision History

Version	Date	Changes
1.0	2007-05-25	Creation of the green datasheet. First page : Adding the green logo and the AEC qualified Adding the bullet AEC qualified and the RoHS compliant features Package page Modification of the package to be green.

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