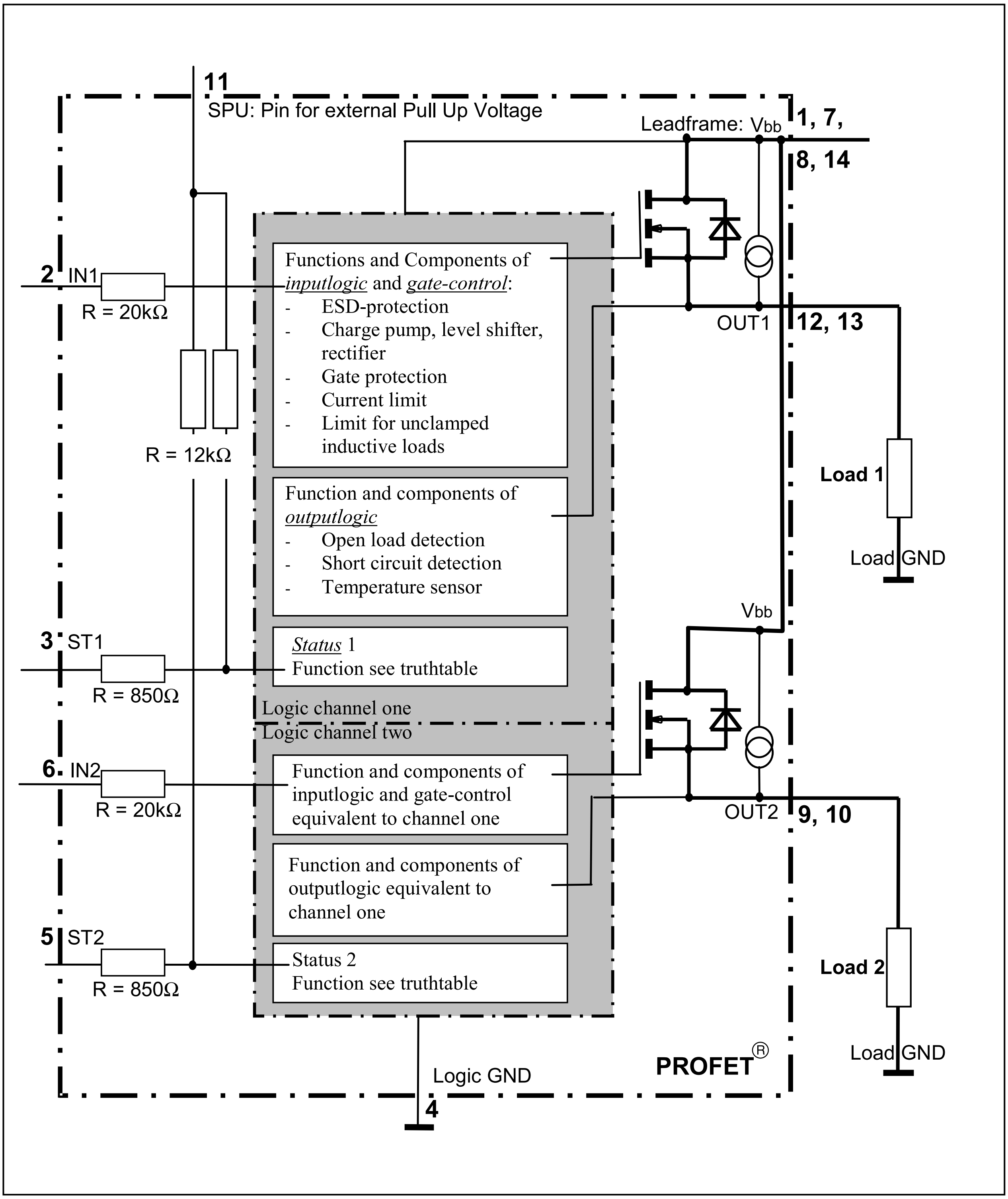
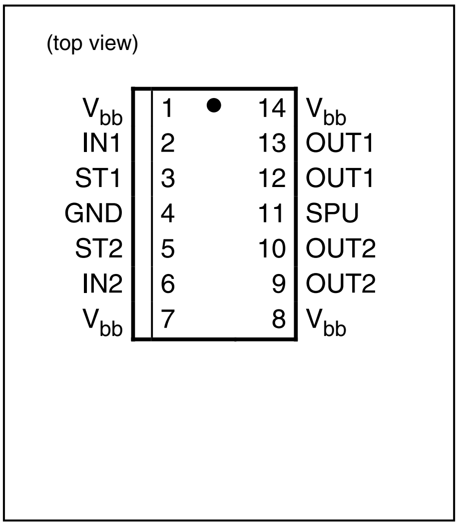
Functional diagram



Pin Definitions and Functions

Pin	Symbol	Function
1,7, 8,14,	V_{bb}	**Positive power supply voltage**. Design the wiring for the simultaneous max. short circuit currents from channel 1 to 2 and also for low thermal resistance
2	IN1	**Input 1,2** activates channel 1,2 in case of logic high signal
6	IN2	
12,13	OUT1	**Output 1,2** protected high-side power output of channel 1,2. Design the wiring for the max. short circuit current; both outputpins have to be connected in parallel for operation according this spec.
9,10	OUT2	
3	ST1	**Diagnostic feedback 1,2** of channel 1,2 open drain
5	ST2	
4	GND	**Logic Ground**
11	SPU	Connection for **external pull up voltage** source for the open drain status output. Pull up resistors are integrated.

Pin configuration



Parameter	Symbol	Values	Unit
Supply voltage (overvoltage protection see page 6)	V_{bb}	58	V
Supply voltage for full short circuit protection $T_{j,start}$ = -40 ...+150°C	V_{bb}	50	V
Output Voltage to V_{bb}	V_{ON}	70	V
Negative voltage slope at output	$-dV_{OUT}/dt$	20	V/µs
Load current (Short-circuit current, see page 7)	I_L	$I_{L(LIM)}$ [1]	A
Load dump protection[2] $V_{LoadDump} = V_A + V_s$, V_A = 27 V R_I[3] = 8 Ω, t_d = 200 ms; IN = low or high, each channel loaded with R_L = 20 Ω,	$V_{Load\,dump}$[4]	70	V
Operating temperature range Storage temperature range	T_j T_{stg}	-40 ...+150 -55 ...+150	°C
Power dissipation (DC)[5] T_a = 25°C: (all channels active) T_a = 85°C:	P_{tot}	3.0 1.6	W
Maximal switchable inductance, single pulse V_{bb} = 12V, $T_{j,start}$ = 150°C[5], I_L = 2.5 A, E_{AS} = 110 mJ, 0 Ω one channel: I_L = 3.5 A, E_{AS} = 278 mJ, 0 Ω two parallel channels: see diagrams on page 12	Z_L	23.0 30.0	mH
Electrostatic discharge capability (ESD): (Human Body Model) acc. MIL-STD883D, method 3015.7 and ESD assn. std. S5.1-1993 R=1.5kΩ; C=100pF	V_{ESD}	1.0	kV
Input voltage (DC)	V_{IN}	±42	V
Current through input pin (DC) Current through status pin (DC)	I_{IN} I_{ST}	±2.0 ±2.0	mA
Status pull up voltage	V_{SPU}	±42	V

---

1) Current limit is a protection function. Operation in current limitation is considered as "outside" normal operating range. Protection functions are not designed for continuous repetitive operation.

2) Supply voltages higher than $V_{bb(AZ)}$ require an external current limit for the GND and status pins (a 150Ω resistor for the GND connection is recommended.

3) R_I = internal resistance of the load dump test pulse generator

4) $V_{Load\,dump}$ is setup without the DUT connected to the generator per ISO 7637-1 and DIN 40839

5) Device on 50mm*50mm*1.5mm epoxy PCB FR4 with 6cm² (one layer, 70µm thick) copper area for V_{bb} connection. PCB is vertical without blown air. See page 15

Parameter and Conditions		Symbol	Values			Unit
			min	typ	Max	
Thermal resistance						
junction - soldering point[5),6)]	each channel:	R_{thjs}	--	--	25	K/W
junction - ambient[5)]	one channel active:	R_{thja}	--	45	--	
	all channels active:		--	41	--	

Electrical Characteristics

Parameter and Conditions, each of the two channels at T_j = -40...+150°C, V_{bb} = 24 V unless otherwise specified	Symbol	Values			Unit
		min	typ	Max	

Load Switching Capabilities and Characteristics

Parameter and Conditions	Symbol	min	typ	Max	Unit
On-state resistance (V_{bb} to OUT); I_L = 2 A, $V_{bb} \geq 7V$					
each channel, T_j = 25°C:	R_{ON}	--	90	105	mΩ
T_j = 150°C:		--	170	210	
two parallel channels, T_j = 25°C:		--	45	53	
see diagram, page 12					

6) Soldering point: Upper side of solder edge of device pin 15. See page 15

Parameter and Conditions, each of the two channels at T_j = -40...+150°C, V_{bb} = 24 V unless otherwise specified	**Symbol**	**Values**			**Unit**
		min	typ	Max	
Nominal load current one channel active: / two parallel channels active: Device on PCB[7], T_a = 85°C, $T_j \leq$ 150°C	$I_{L(NOM)}$	2.5 4.0	2.9 4.2	-- --	A
Output current while GND disconnected or pulled up [8]; Vbb = 30 V, V_{IN} = 0, see diagram page 11	$I_{L(GNDhigh)}$	--	--	1.0	mA
Turn-on time[9] IN ⎍ to 90% V_{OUT}: / Turn-off time IN ⎍ to 10% V_{OUT}: $R_L = 12\,\Omega$	t_{on} t_{off}	-- --	-- --	55 95	µs
Slew rate on [9] 10 to 30% V_{OUT}, $R_L = 12\,\Omega$:	dV/dt_{on}	1.0	--	5	V/µs
Slew rate off [9] 70 to 40% V_{OUT}, $R_L = 12\,\Omega$:	$-dV/dt_{off}$	1.0	--	5	V/µs

Operating Parameters

Operating voltage	$V_{bb(on)}$	7.0	--	58	V
Undervoltage restart of charge pump T_j =-40...+25°C: / T_j =+150°C:	$V_{bb(ucp)}$	-- --	4 --	5.5 7.0	V
Overvoltage protection[10] I_{bb} = 40 mA	$V_{bb(AZ)}$	58.5	63	69	V
Standby current[11] T_j =-40°C...+25°C: / T_j =+125°C[12]: / T_j =+150°C: V_{IN} = 0; see diagram page 10	$I_{bb(off)}$	-- -- --	13 25	23 23 35	µA
Off-State output current (included in $I_{bb(off)}$) V_{IN} = 0; each channel	$I_{L(off)}$	--	3	--	µA
Operating current [13], V_{IN} = 5V, one channel on: / all channels on:	I_{GND}	-- --	1.0 2.0	1.5 3.0	mA

7) Device on 50mm*50mm*1.5mm epoxy PCB FR4 with 6cm² (one layer, 70µm thick) copper area for V_{bb} connection. PCB is vertical without blown air. See page 15
8) not subject to production test, specified by design
9) See timing diagram on page 13.
10) Supply voltages higher than $V_{bb(AZ)}$ require an external current limit for the GND; a 150Ω resistor is recommended. See also $V_{ON(CL)}$ in table of protection functions and circuit diagram on page 10.
11) Measured with load; for the whole device; all channels off
12) not subject to production test, specified by design
13) Add I_{ST}, if I_{ST} > 0

Parameter and Conditions, each of the two channels at T_j = -40...+150°C, V_{bb} = 24 V unless otherwise specified	**Symbol**	**Values**			**Unit**
		min	typ	Max	

Protection Functions[14)]

Current limit, (see timing diagrams, page 13) T_j =-40°C: T_j =25°C: T_j =+150°C:	$I_{L(lim)}$	-- -- 5	10 9 8	12 -- --	A
Repetitive short circuit current limit [15)], $T_j = T_{jt}$ each channel / two parallel channels (see timing diagrams, page 13)	$I_{L(SCr)}$	-- --	8 8	-- --	A
Initial short circuit shutdown time $T_{j,start}$ =25°C: (see timing diagrams on page 13)	$t_{off(SC)}$	--	2	--	ms
Output clamp (inductive load switch off)[16)] at $V_{ON(CL)} = V_{bb} - V_{OUT}$, I_L = 1 A	$V_{ON(CL)}$	59	64	70	V
Thermal overload trip temperature	T_{jt}	150	--	--	°C
Thermal hysteresis	ΔT_{jt}	--	10	--	K

Reverse Battery

Reverse battery voltage [17)]	$-V_{bb}$	--	--	24	V
Drain-source diode voltage ($V_{out} > V_{bb}$) [18)] I_L = -3.0 A, T_j = +150°C	$-V_{ON}$	--	650	--	mV

Inverse current [19)]

GND current in case of 3A inverse current [20)]	$I_{GND(inv\ cur)}$	--	--	15	mA

14) Integrated protection functions are designed to prevent IC destruction under fault conditions described in the data sheet. Fault conditions are considered as "outside" normal operating range. Protection functions are not designed for continuous repetitive operation.

15) not subject to production test, specified by design

16) If channels are connected in parallel, output clamp is usually accomplished by the channel with the lowest $V_{ON(CL)}$

17) Requires a 150 Ω resistor in GND connection. The reverse load current through the intrinsic drain-source diode has to be limited by the connected load. Power dissipation is higher compared to normal operating conditions due to the voltage drop across the drain-source diode. The temperature protection is not active during reverse current operation! Input and Status currents have to be limited (see max. ratings page 4 and circuit page 10).

18) not subject to production test, specified by design

19) not subject to production test, specified by design

20) In case of an inverse current of 3A the both status outputs must not be disturbed.
The neighbour channel can be switched normally; not all paramters lay within the range of the spec
Please note, that in case of an inverse current no protection function is active. The power dissipation is higher compared to normal operation in forward mode due to the voltage drop across the drain-source diode

Parameter and Conditions, each of the two channels at T_j = -40...+150°C, V_{bb} = 24 V unless otherwise specified		Symbol	Values			Unit
			min	typ	Max	
Diagnostic Characteristics						
Open load detection current [21]		$I_{L(off)}$	--	3	--	µA
Open load detection voltage		$V_{OUT(OL)}$	2.0	2.85	3.7	V
Short circuit detection voltage [22] V_{bb}(pin 1,7,8,14) to OUT1 (pin 12,13) resp. V_{bb}(pin 1,7,8,14) to OUT2 (pin 9,10)		$V_{ON(SC)}$	--	4.0	--	V
Input and Status Feedback [23]						
Integrated resistors; T_j =25°C: (see circuit page 2)	Input Status Status pull up	R_I R_{ST} $R_{pull\ up}$	-- 0.53 --	20 0.85 12	-- 1.2 --	kΩ kΩ kΩ
Input turn-on threshold voltage		$V_{IN(T+)}$	1.2	--	2.2	V
Input turn-off threshold voltage		$V_{IN(T-)}$	1.0	--	--	V
Input threshold hysteresis		$\Delta V_{IN(T)}$	--	0.25	--	V
Off state input current	V_{IN} = 0.4 V:	$I_{IN(off)}$	1	--	15	µA
On state input current	V_{IN} = 5 V:	$I_{IN(on)}$	10	25	50	µA
Status output (open drain) Zener limit voltage Status low voltage	 V_{SPU} = 5V:	 $V_{ST(high)}$ $V_{ST(low)}$	 5.4 --	 6.1 --	 -- 0.4	 V

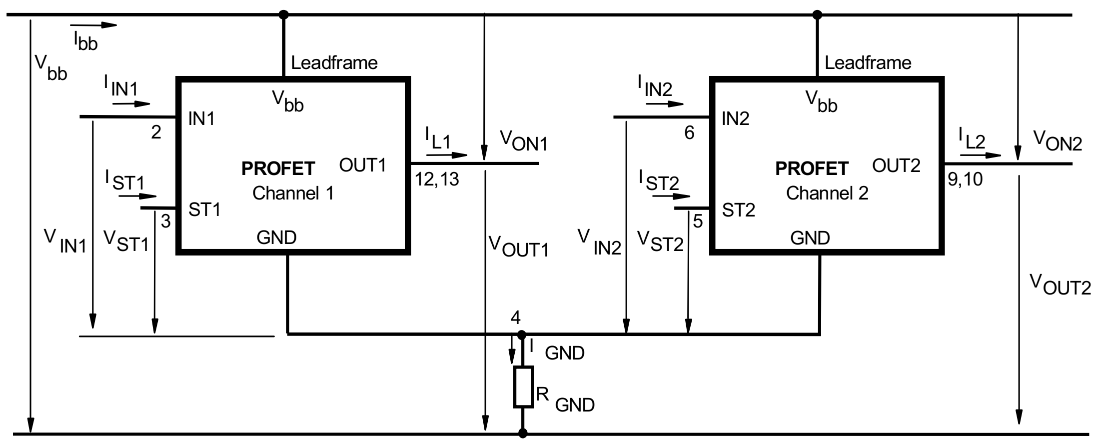
21) not subject to production test, specified by design
22) not subject to production test, specified by design
23) If a ground resistor R_{GND} is used, add the voltage drop across these resistors.

Truth Table

Channel 1	Input 1	Output 1	Status 1
Channel 2	Input 2	Output 2	Status 2
	level	level	BTS 723
Normal operation	**L** **H**	**L** **H**	**L** **H**
Open load	**L** **H**	**V_{OUT} > 2.7V** **H**	**H** **H**
Short circuit to GND	**L** **H**	**L** **L**	**L** **L**
Short circuit to V_{bb}	**L** **H**	**H** **H**	**H** **H**
Overtem-perature	**L** **H**	**L** **L**	**L** **L**

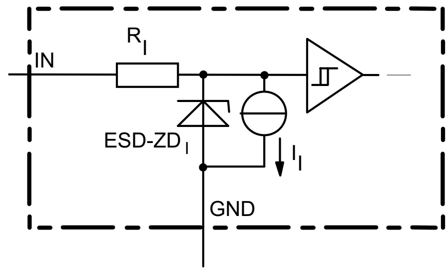
Parallel switching of channel 1 and 2 is easily possible by connecting the inputs and outputs in parallel. In this mode it is recommended to use only one status.

Terms



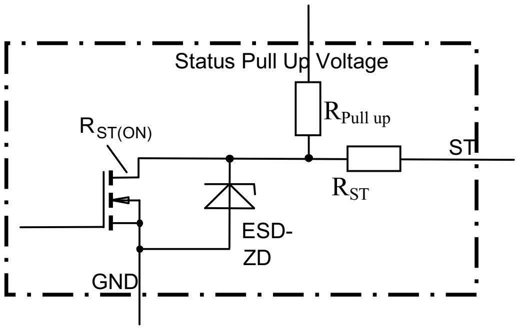
Leadframe (V_{bb}) is connected to pin **1,7,8,14**
External R_{GND} optional; a single resistor $R_{GND} = 150\Omega$ for reverse battery protection up to the max. operating voltage.

Input circuit (ESD protection), IN1 or IN2



The use of ESD zener diodes as voltage clamp at DC conditions is not recommended.

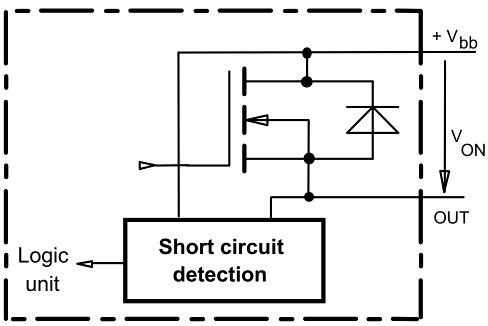
Status output, ST1 or ST2



ESD-Zener diode: 6.1 V typ., $R_{ST(ON)}$ < 250 Ω,
R_{ST} = 850 Ω typ., $R_{pull\ up}$ = 12 kΩ typ.
The use of ESD zener diodes as voltage clamp at DC conditions is not recommended

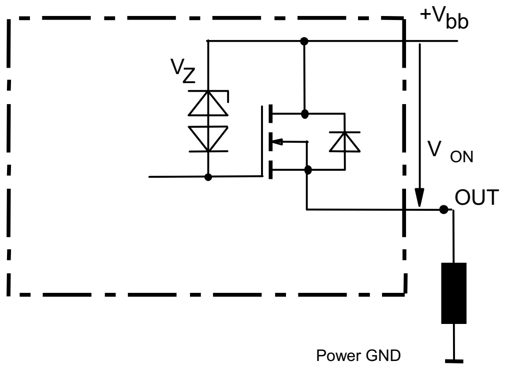
Short Circuit detection

Fault Signal at ST-Pin: V_{ON} > 4.0 V typ, no switch off by the PROFET itself, external switch off recommended!



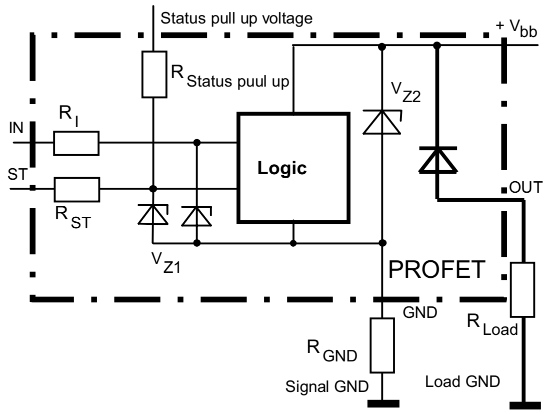
Inductive and overvoltage output clamp,

OUT1 or OUT2



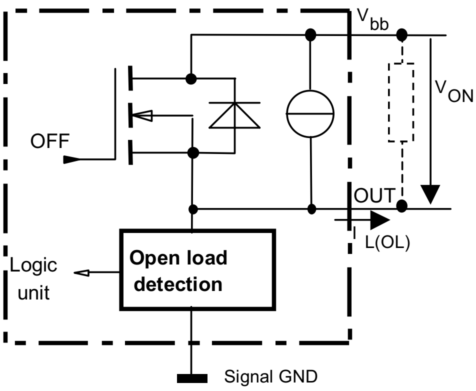
V_{ON} clamped to $V_{ON(CL)}$ = 64 V typ.

Overvolt. and reverse batt. protection

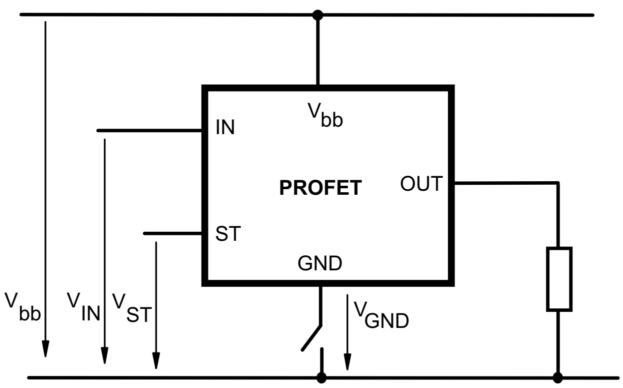


V_{Z1} = 6.1 V typ., V_{Z2} = 63 V typ., R_{GND} = 150 Ω,
R_I = 850 Ω typ., R_{ST} = 20 kΩ typ., $R_{pull\ up}$ = 12 kΩ typ
In case of reverse battery the load current has to be limited by the load. Temperature protection is not active

Open-load detection, OUT1 or OUT2
OFF-state diagnostic condition:
Open load, if V_{OUT} > 2.7 V typ. (IN low)
$I_{L(OL)}$ typ. 2µA
An external resitor can be used to increase the open load detection current

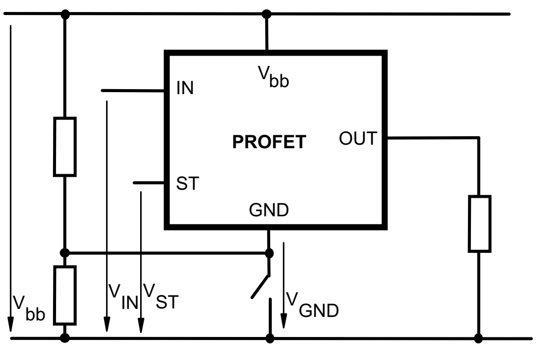


GND disconnect



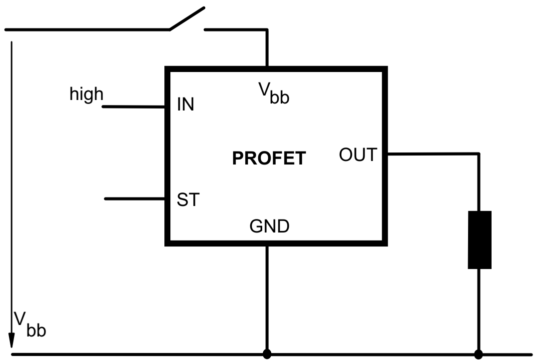
Any kind of load.
Due to V_{GND} > 0, no V_{ST} = low signal available.

GND disconnect with GND pull up



Any kind of load. If V_{GND} > V_{IN} - $V_{IN(T+)}$ device stays off
Due to V_{GND} > 0, no V_{ST} = low signal available.

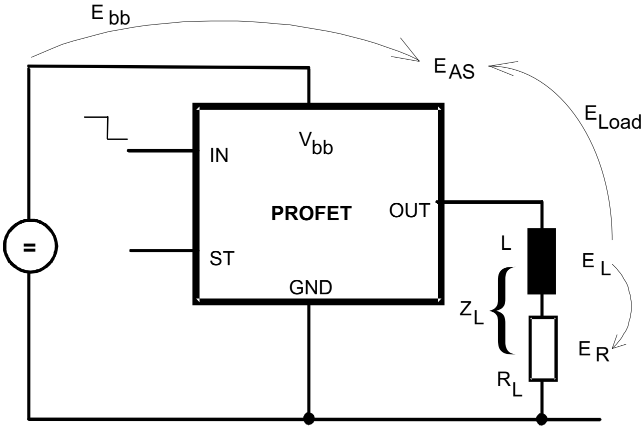
V_{bb} disconnect with energized inductive load



For inductive load currents up to the limits defined by Z_L (max. ratings and diagram on page 12) each switch is protected against loss of V_{bb}.

Consider at your PCB layout that in the case of Vbb disconnection with energized inductive load all the load current flows through the GND connection.

Inductive load switch-off energy dissipation



Energy stored in load inductance:

$$E_L = {}^1/_2 \cdot L \cdot I_L^2$$

While demagnetizing load inductance, the energy dissipated in PROFET is

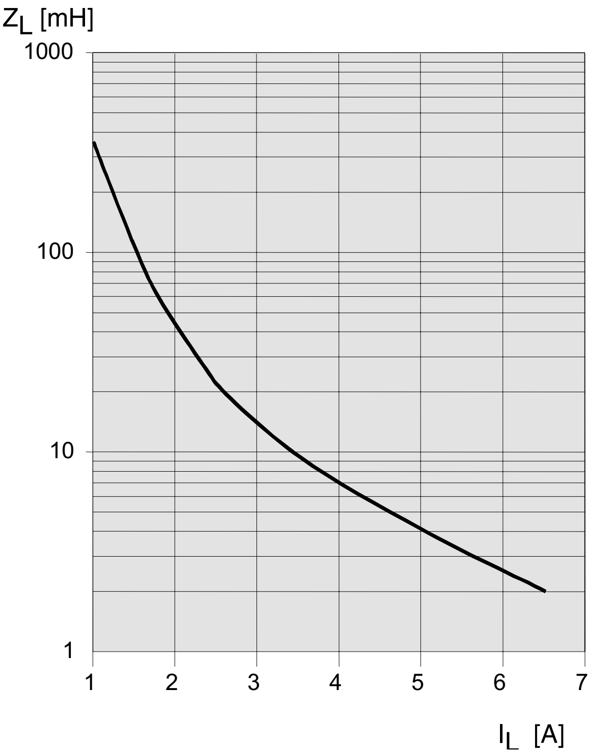
$$E_{AS} = E_{bb} + E_L - E_R = \quad V_{ON(CL)} \cdot i_L(t)\ dt,$$

with an approximate solution for $R_L > 0\,\Omega$:

$$E_{AS} = \frac{I_L \cdot L}{2 \cdot R_L}\left(V_{bb} + |V_{OUT(CL)}|\right)\ ln\left(1 + \frac{I_L \cdot R_L}{|V_{OUT(CL)}|}\right)$$

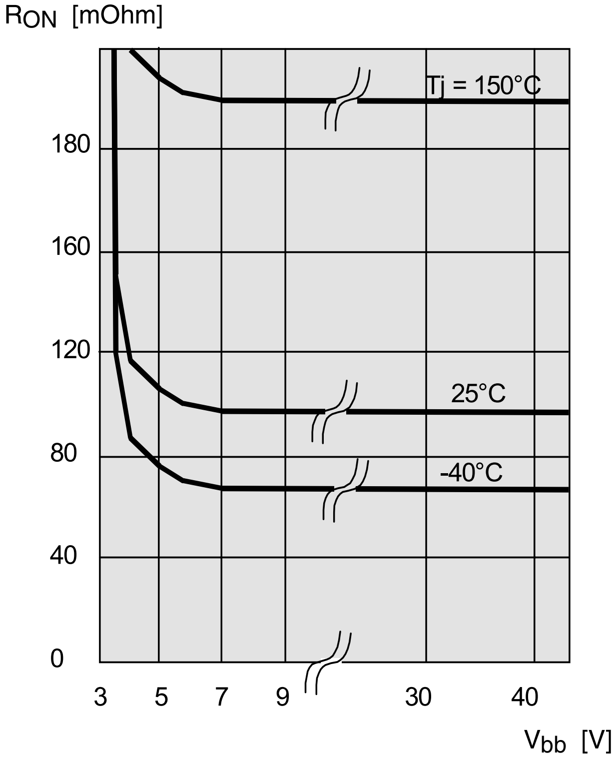
Maximum allowable load inductance for a single switch off (one channel)[5)]

$L = f(I_L)$; $T_{j,start} = 150°C$, $V_{bb} = 12\,V$, $R_L = 0\,\Omega$



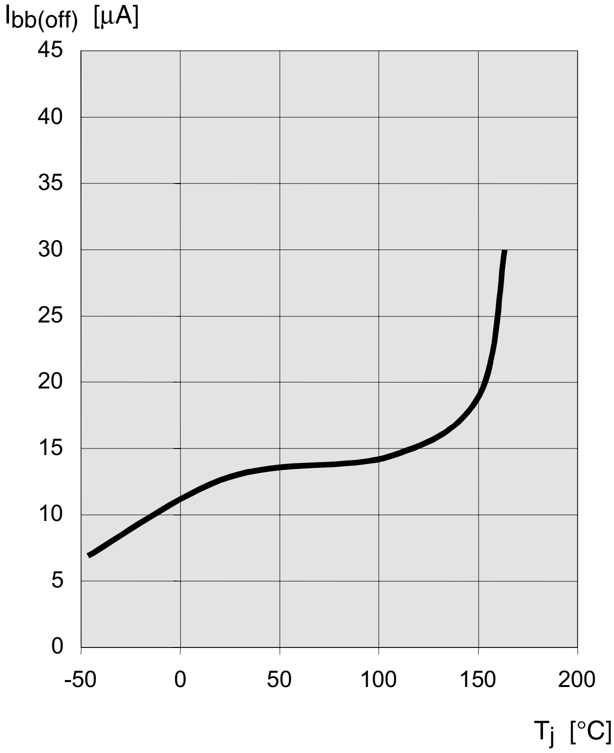
Typ. on-state resistance

$R_{ON} = f(V_{bb}, T_j)$; $I_L = 2\,A$, IN = high



Typ. standby current

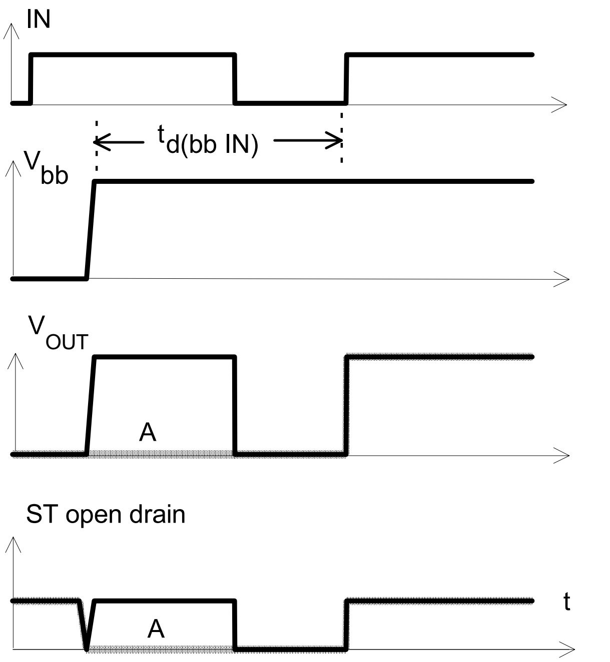
$I_{bb(off)} = f(T_j)$; V_{bb} = 9...34 V, IN1,2,3,4 = low



Timing diagrams

All channels are symmetric and consequently the diagrams are valid for channel 1 and channel 2

Figure 1a: V_{bb} turn on, :



in case of too early V_{IN}=high the device may not turn on (curve A)
$t_{d(bb\ IN)}$ approx. 150 µs

Figure 2a: Switching a resistive load, turn-on/off time and slew rate definition:

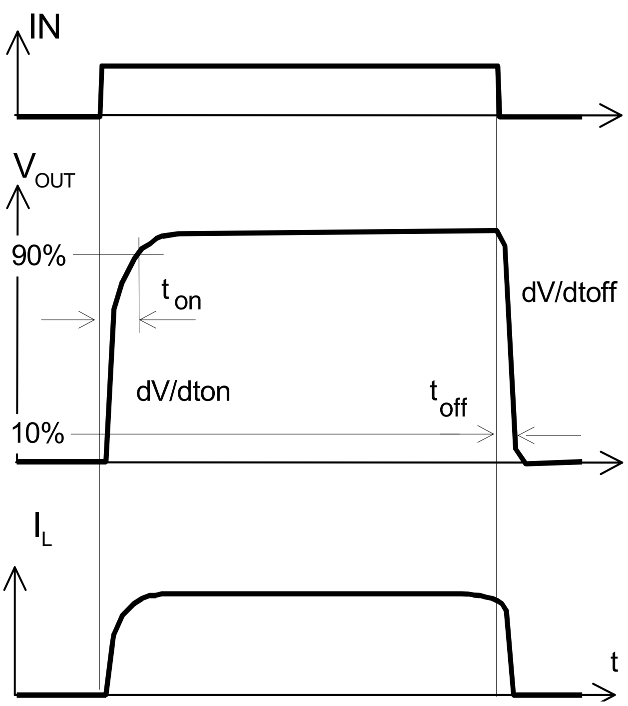


Figure 2b: Switching an inductive load

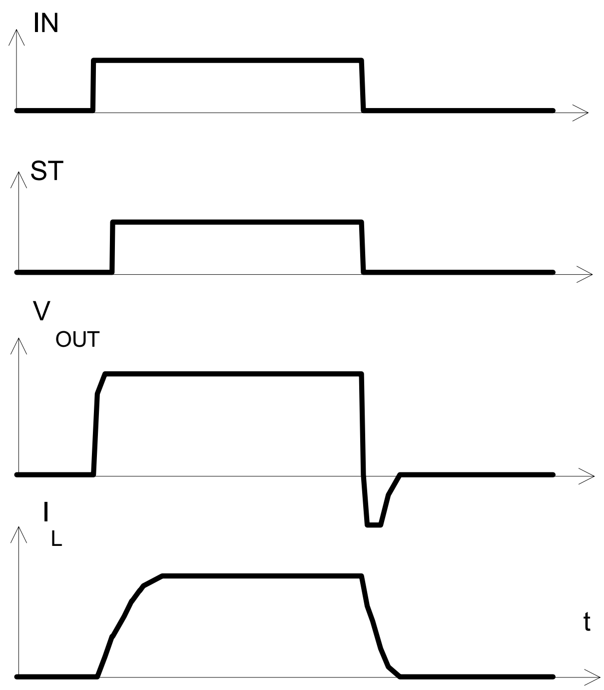


Figure 3a: Short circuit:
shut down by overtempertature, reset by cooling

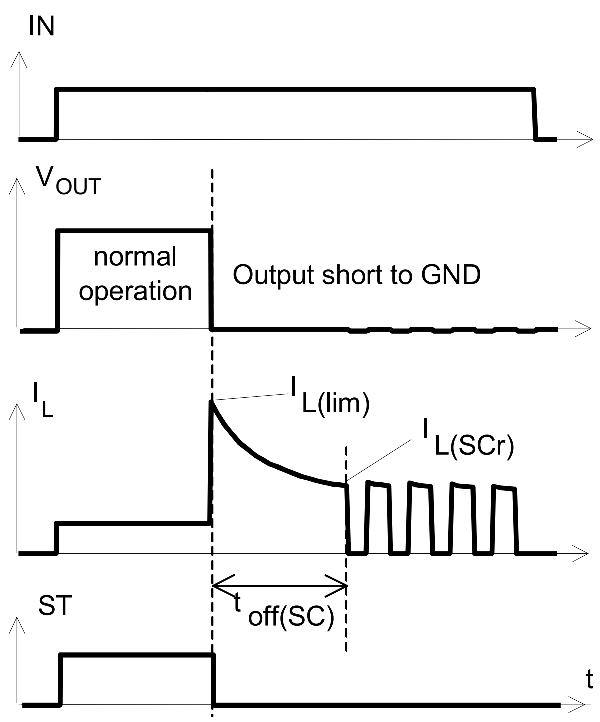


Figure 4a: Overtemperature:
Reset if $T_j < T_{jt}$

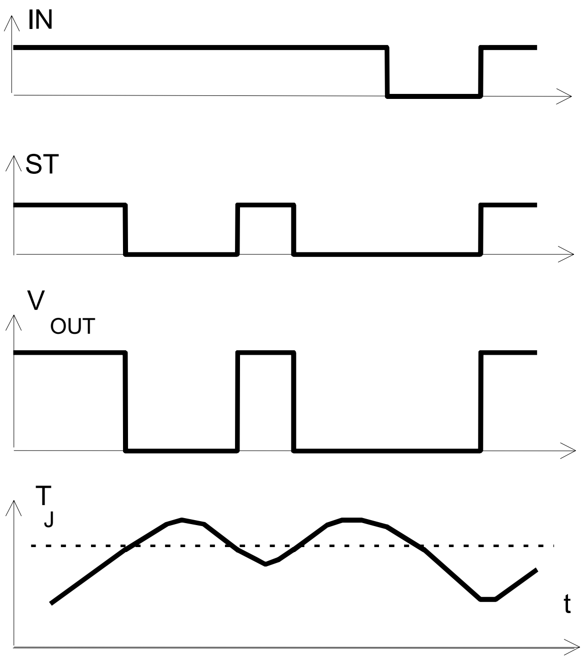
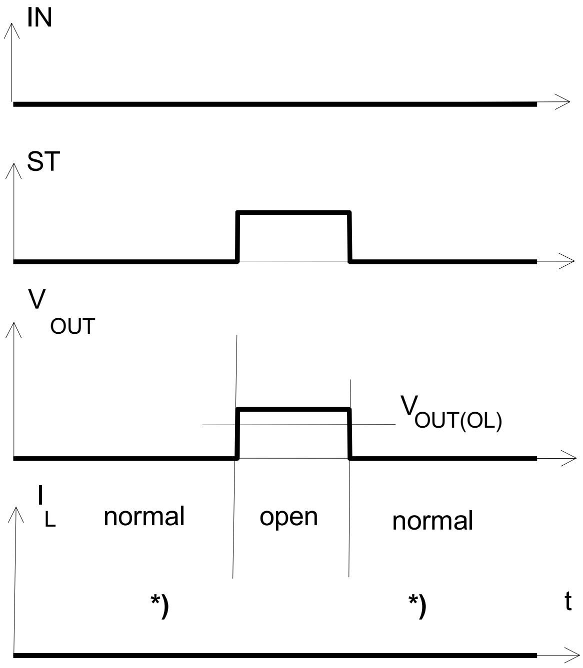
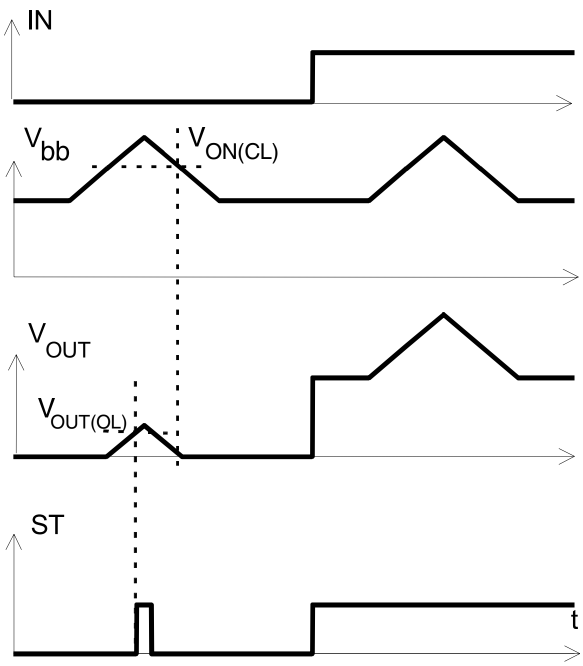


Figure 5a: Open load, : detection in OFF-state, open load occurs in off-state



*) I_L = 2 µA typ. V_{OUT} > 2.7V

Figure 6: Overvoltage, no shutdown:



Package Outlines

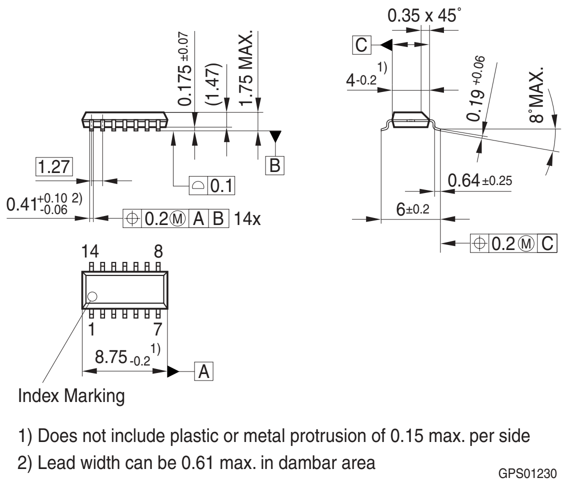


Figure 1 **PG-DSO-14-37** (Plastic Dual Small Outline Package) (RoHS-compliant)

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
V1.1	2007-09-25	Modification of the package drawing
V1.0	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.

Edition 2007-09-25

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