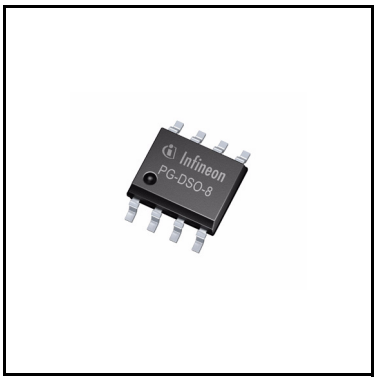
BSP752R

Smart High-Side Power Switch

AEC Qualified RoHS



PG-DSO-8

Features

- Overload protection
- Current limitation
- Short circuit protection
- Thermal shutdown with restart
- Overvoltage protection (including load dump)
- Fast demagnetization of inductive loads
- Reverse battery protection with external resistor
- Open drain diagnostic output for overtemperature and short circuit
- Open load detection in OFF-State with external resistor
- CMOS compatible input
- Loss of GND and loss of V_{bb} protection
- ESD - Protection
- Very low standby current
- AEC Qualified
- Green Product (RoHS compliant)

Applications

- All types of resistive, inductive and capacitive loads
- µC compatible power switch for 12V, 24V and 42V DC applications
- Replaces electromechanical relays and discrete circuits

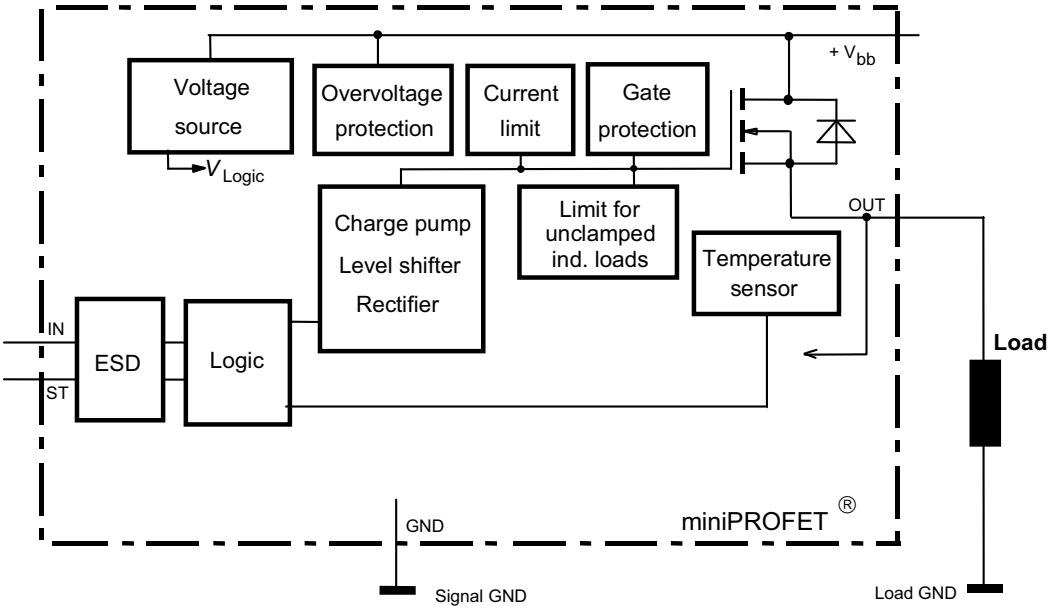
Description

N Channel vertical power FET with charge pump, ground referenced CMOS compatible input and diagnostic feedback, monolithically integrated in Smart SIPMOS® technology.
Providing embedded protective functions.

Table 1 Product Summary

Parameter	Symbol	Values
Overvoltage protection	$V_{bb(AZ)}$	62 V
Operating voltage	$V_{bb(on)}$	6...52 V
ON-State Resistance	R_{ON}	200 mΩ
Nominal load curent	$I_{L(nom)}$	1.3 A

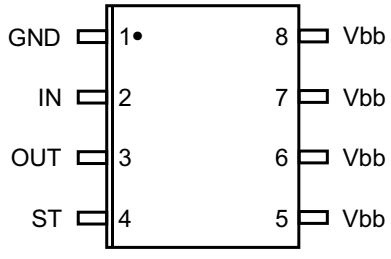
Block Diagram



Pin	Symbol	Function
1	GND	Logic ground
2	IN	Input, activates the power switch in case of logic high signal
3	OUT	Output to the load
4	ST	Diagnostic feedback
5	Vbb	Positive power supply voltage
6	Vbb	Positive power supply voltage
7	Vbb	Positive power supply voltage
8	Vbb	Positive power supply voltage

Pin configuration

Top view



Maximum Ratings at T_j = 25°C, unless otherwise specified

Parameter	Symbol	Value	Unit
Supply voltage	V_{bb}	52	V
Supply voltage for full short circuit protection	$V_{bb(SC)}$	50	
Continuous input voltage	V_{IN}	-10 ... +16	
Load current (Short - circuit current, see page 5)	I_L	self limited	A
Current through input pin (DC)	I_{IN}	± 5	mA
Operating temperature	T_j	-40 ...+150	°C
Storage temperature	T_{stg}	-55 ... +150	
Power dissipation [1]	P_{tot}	1.5	W
Inductive load switch-off energy dissipation [1][2] single pulse, (see page 9) Tj =150 °C, I_L = 1 A	E_{AS}	125	mJ
Load dump protection [2] $V_{LoadDump}$ [3]= V_A + V_S R_I=2Ω, t_d=400ms, V_{IN}= low or high, V_A=13,5V	$V_{Loaddump}$		V
R_L = 13.5 Ω		73.5	
R_L = 27 Ω		83.5	
Electro**s**tatic **d**ischarge voltage (Human Body Model)	V_{ESD}		kV
according to ANSI EOS/ESD - S5.1 - 1993			
ESD STM5.1 - 1998			
Input pin		± 1	
all other pins		± 5	

Thermal Characteristics

Thermal resistance @ min. footprint	$R_{th(JA)}$	-	95	-	K/W
Thermal resistance @ 6 cm² cooling area [1]	$R_{th(JA)}$	-	70	83	

[1] Device on 50mm*50mm*1.5mm epoxy PCB FR4 with 6 cm2 (one layer, 70µm thick) copper area for drain connection. PCB is vertical without blown air. (see page 17)

[2] not subject to production test, specified by design

[3] $V_{Loaddump}$ is setup without the DUT connected to the generator per ISO 7637-1 and DIN 40839 . Supply voltages higher than $V_{bb(AZ)}$ require an external current limit for the GND pin, e.g. with a 150Ω resistor in GND connection. A resistor for the protection of the input is integrated.

Electrical Characteristics

Parameter and Conditions at T_j = -40...+150°C, V_{bb} = 12..42V, unless otherwise specified	Symbol	Values			Unit
		min.	typ.	max.	
Load Switching Capabilities and Characteristics					
On-state resistance T_j = 25 °C, I_L = 1 A, V_{bb} = 9...52 V T_j = 150 °C	R_{ON}	 - -	 150 270	 200 380	mΩ
Nominal load current; Device on PCB [1] T_C = 85 °C, $T_j \leq$ 150 °C	$I_{L(nom)}$	1.3	1.7	-	A
Turn-on time to 90% V_{OUT} R_L = 47 Ω	t_{on}	-	80	180	µs
Turn-off time to 10% V_{OUT} R_L = 47 Ω	t_{off}	-	80	200	
Slew rate on 10 to 30% V_{OUT}, R_L = 47 Ω, V_{bb} = 13.5 V	dV/dt_{on}	-	0.7	2	V/µs
Slew rate off 70 to 40% V_{OUT}, R_L = 47 Ω, V_{bb} = 13.5 V	$-dV/dt_{off}$	-	0.9	2	
Operating Parameters					
Operating voltage	$V_{bb(on)}$	6	-	52	V
Undervoltage shutdown of charge pump T_j = -40...+85 °C T_j = 150 °C	$V_{bb(under)}$	 - -	 - -	 4 5.5	
Undervoltage restart of charge pump	$V_{bb(u\ cp)}$	-	4	5.5	
Standby current T_j = -40...+85 °C, V_{IN} = low T_j = +150 °C[2], V_{IN} = low	$I_{bb(off)}$	 - -	 - -	 15 18	µA
Leakage output current (included in $I_{bb(off)}$) V_{IN} = low	$I_{L(off)}$	-	-	5	
Operating current V_{IN} = high	I_{GND}	-	0.8	2	mA

[1] Device on 50mm*50mm*1.5mm epoxy PCB FR4 with 6 cm2 (one layer, 70µm thick) copper area for drain connection. PCB is vertical without blown air. (see page 17)

[2] higher current due temperature sensor

Electrical Characteristics

Parameter and Conditions at T_j = -40...+150°C, V_{bb} = 12..42V, unless otherwise specified	Symbol	Values			Unit
		min.	typ.	max.	
Protection Functions[1)]					
Initial peak short circuit current limit (pin 5 to 3)	$I_{L(SCp)}$				A
T_j = -40 °C, V_{bb} = 20 V, t_m = 150 µs		-	-	9	
T_j = 25 °C		-	6.5	-	
T_j = 150 °C		4	-	-	
T_j = -40...+150 °C, V_{bb} > 40 V , (see page 12)		-	5[2)]	-	
Repetitive short circuit current limit	$I_{L(SCr)}$				
T_j = T_{jt} (see timing diagrams)					
V_{bb} < 40 V		-	6	-	
V_{bb} > 40 V		-	4.5	-	
Output clamp (inductive load switch off) at V_{OUT} = V_{bb} - $V_{ON(CL)}$, I_{bb} = 4 mA	$V_{ON(CL)}$	59	63	-	V
Overvoltage protection [3)] I_{bb} = 4 mA	$V_{bb(AZ)}$	62	-	-	
Thermal overload trip temperature	T_{jt}	150	-	-	°C
Thermal hysteresis	ΔT_{jt}	-	10	-	K
Reverse Battery					
Reverse battery[4)]	$-V_{bb}$	-	-	52	V
Drain-source diode voltage (V_{OUT} > V_{bb}) T_j = 150 °C	$-V_{ON}$	-	600	-	mV

[1] 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.

[2] not subject to production test, specified by design

[3] see also $V_{ON(CL)}$ in circuit diagram on page 8

[4] 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 current has to be limited (see max. ratings page 3).

Electrical Characteristics

Parameter at T_j = -40...+150°C, V_{bb} = 12..42V, unless otherwise specified	Symbol	Values			Unit
		min.	typ.	max.	
Input and Status feedback					
Input turn-on threshold voltage	$V_{IN(T+)}$	-	-	2.2	V
Input turn-off threshold voltage	$V_{IN(T-)}$	0.8	-	-	
Input threshold hysteresis	$\Delta V_{IN(T)}$	-	0.4	-	
Off state input current V_{IN} = 0.7 V	$I_{IN(off)}$	1	-	25	µA
On state input current V_{IN} = 5 V	$I_{IN(on)}$	3	-	25	
Status output (open drain), Zener limit voltage I_{ST} = 1.6 mA	$V_{ST(high)}$	5.4	6.1	-	V
Status output (open drain), ST low voltage T_j = -40...+25 °C, I_{ST} = 1.6 mA T_j = 150 °C, I_{ST} = 1.6 mA	$V_{ST(low)}$	 - -	 - -	 0.4 0.6	
Status invalid after positive input slope [1)] V_{bb} = 20 V	$t_{d(ST+)}$	-	120	160	µs
Status invalid after negative input slope [1)]	$t_{d(ST-)}$	-	250	400	
Input resistance (see page 8)	R_I	2	3.5	5	kΩ

Diagnostic Characteristics

Short circuit detection voltage	$V_{OUT(SC)}$	-	2.8	-	V
Open load detection voltage[2)]	$V_{OUT(OL)}$	-	3	4	
Internal output pull down[3)] (see page 9 and 14) $V_{OUT(OL)}$ = 4 V	R_O	 -	 200	 -	kΩ

[1] no delay time after overtemperature switch off and short circuit in on-state
[2] External pull up resistor required for open load detection in off state.
[3] not subject to production test, specified by design

	Input level	Output level	Status
Normal operation	L H	L H	H H
Short circuit to GND	L H	L L *	H L
Short circuit to V_{bb} (in off-state)	L H	H H	L H
Overload	L H	L H **	H H
Overtemperature	L H	L L	H L
Open Load in off-state	L H	Z H	H (L[1)]) H

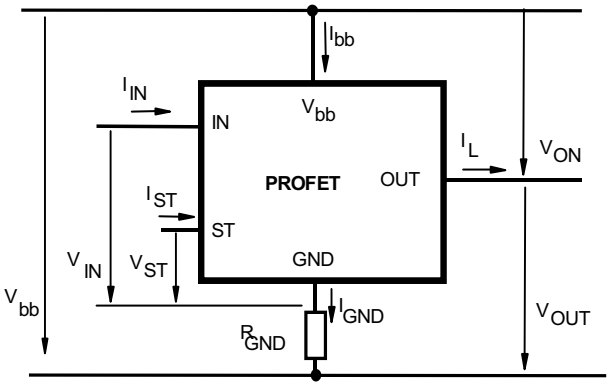
*) Out ="L": V_{OUT} < 2.8V typ.

**) Out ="H": V_{OUT} > 2.8V typ.

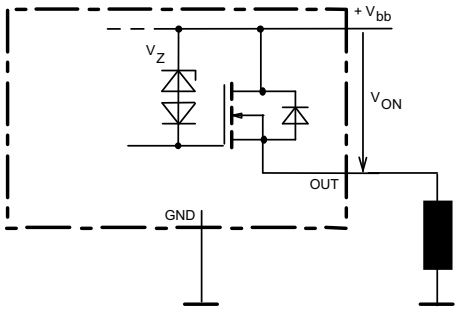
Z = high impedance, potential depends on external circuit

[1]with external resistor between V_{bb} and OUT

Terms

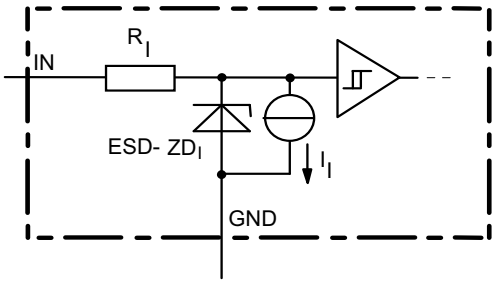


Inductive and overvoltage output clamp



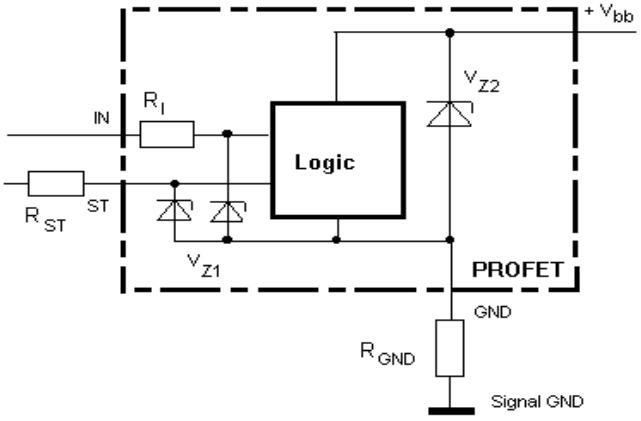
V_{ON} clamped to 59V min.

Input circuit (ESD protection)



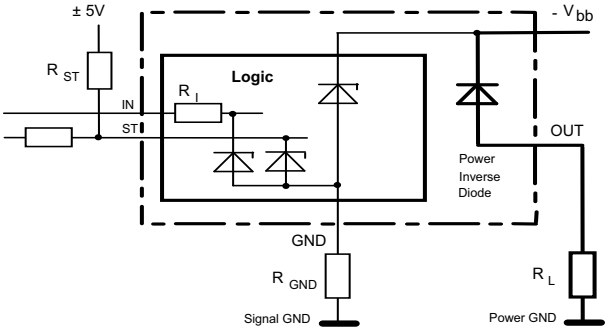
The use of ESD zener diodes as voltage clamp at DC conditions is not recommended

Overvoltage protection of logic part



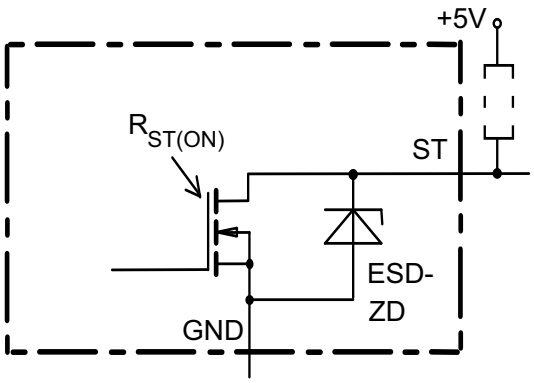
V_{Z1}=6.1V typ., V_{Z2}=$V_{bb(AZ)}$=62V min.,
R_I=3.5 kΩ typ., R_{GND}=150Ω

Reverse battery protection



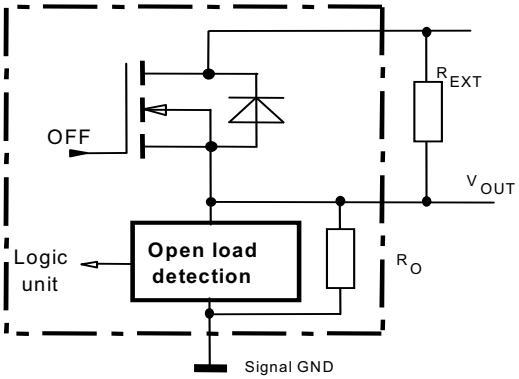
R_{GND}=150Ω, R_I=3.5kΩ typ.,
Temperature protection is not active during inverse current

Status output

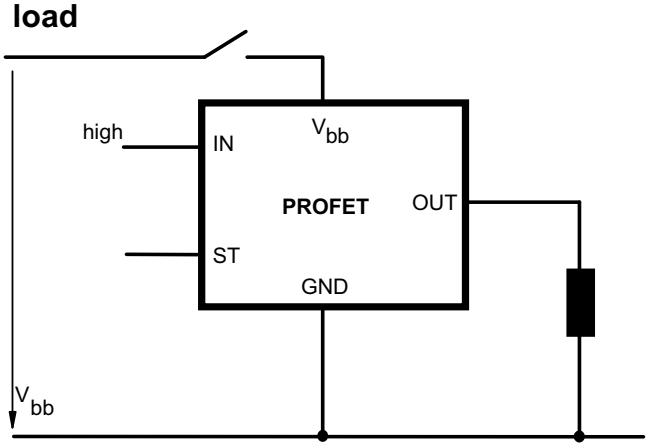


Open-load detection

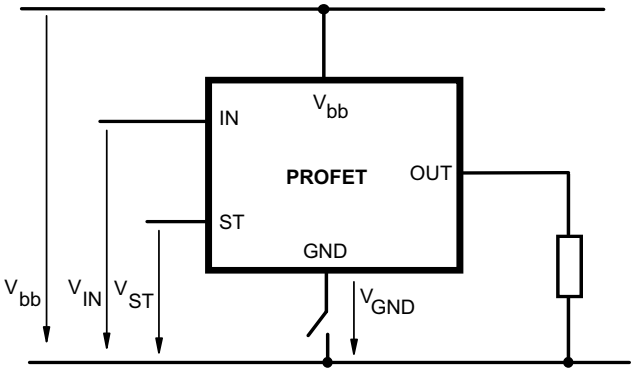
OFF-state diagnostic condition:
V_{OUT} > 3V typ.; IN=low



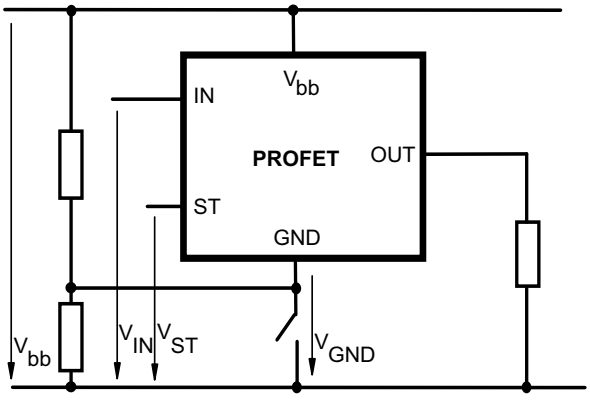
V_{bb} disconnect with charged inductive load



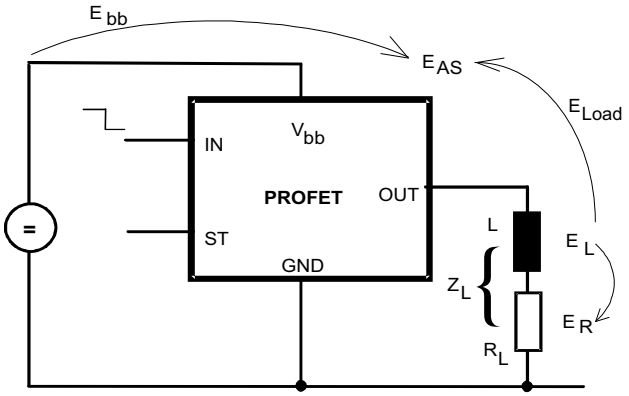
GND disconnect



GND disconnect with GND pull up



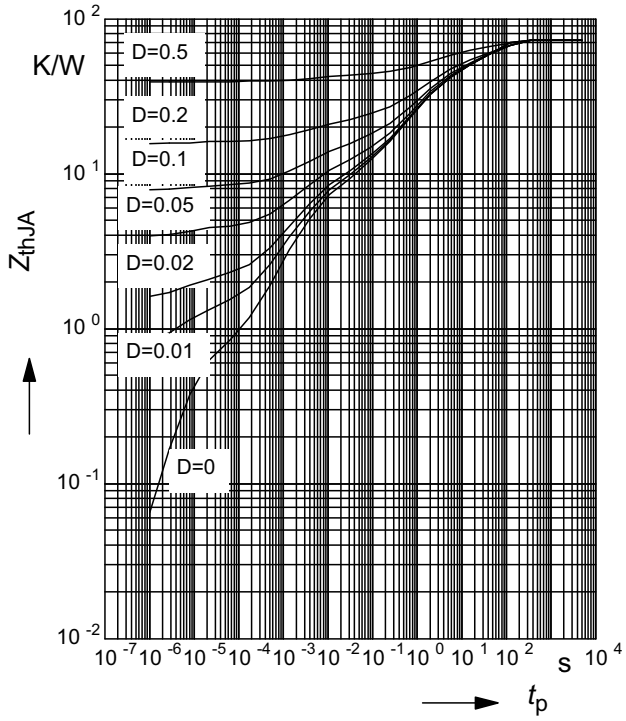
Inductive Load switch-off energy dissipation



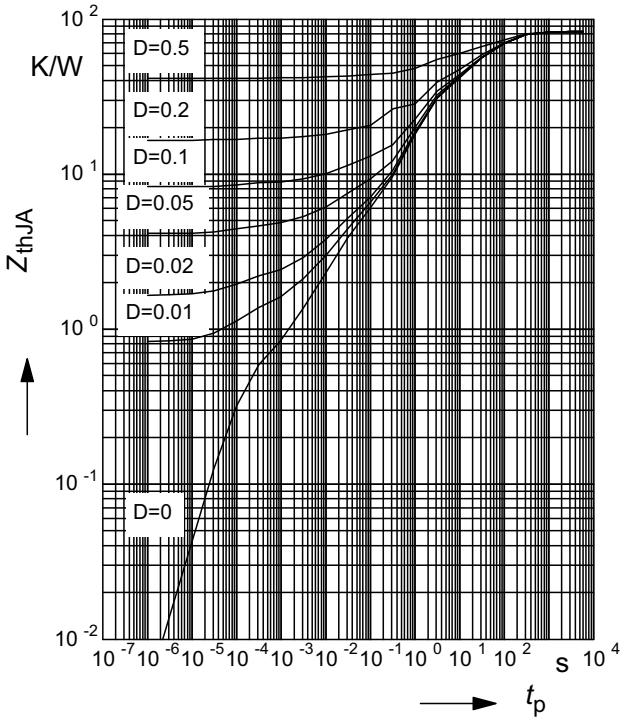
Energy stored in load inductance: $E_L = ½ * L * I_L^2$
While demagnetizing load inductance,
the enérgy dissipated in PROFET is
$E_{AS} = E_{bb} + E_L - E_R = V_{ON(CL)} * i_L(t)\,dt$,
with an approximate solution for $R_L > 0\Omega$:

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

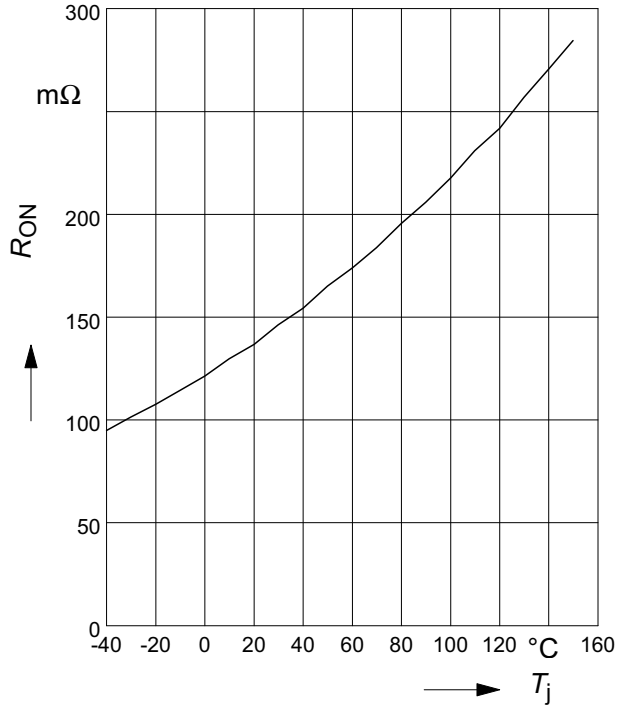
Typ. transient thermal impedance
Z_{thJA}=f(t_p) @ 6cm² heatsink area
Parameter: $D=t_p/T$



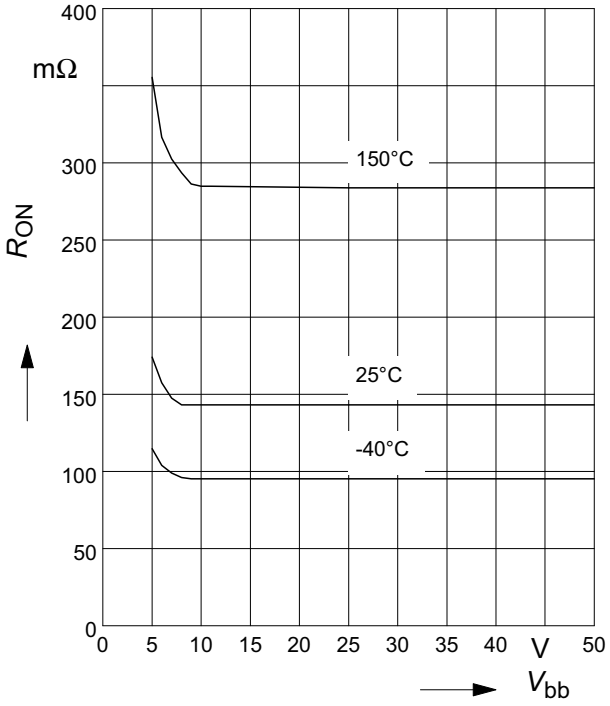
Typ. transient thermal impedance
Z_{thJA}=f(t_p) @ min. footprint
Parameter: $D=t_p/T$



Typ. on-state resistance
R_{ON} = f(T_j) ; V_{bb} = 13,5V ; V_{in} = high

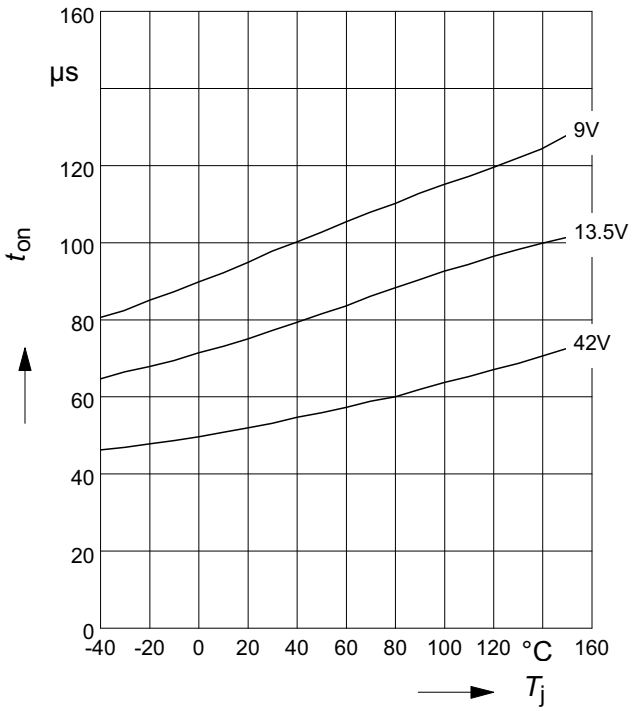


Typ. on-state resistance
R_{ON} = f(V_{bb}); I_L = 1 A ; V_{in} = high



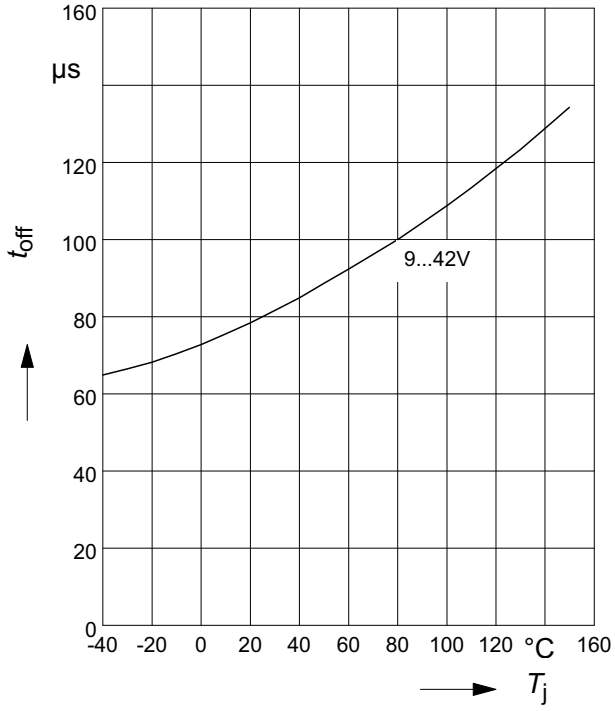
Typ. turn on time

t_{on} = f(T_j); R_L = 47Ω



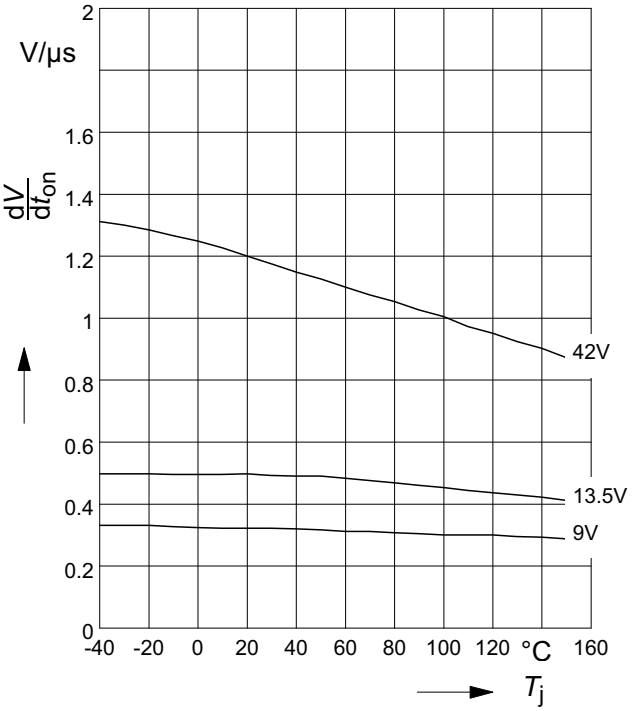
Typ. turn off time

t_{off} = f(T_j); R_L = 47Ω



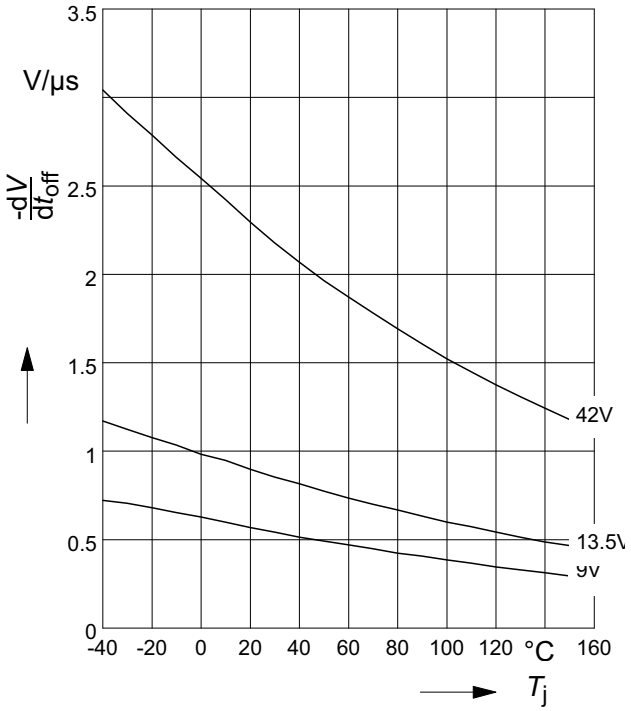
Typ. slew rate on

dV/dt_{on} = f(T_j) ; R_L = 47 Ω



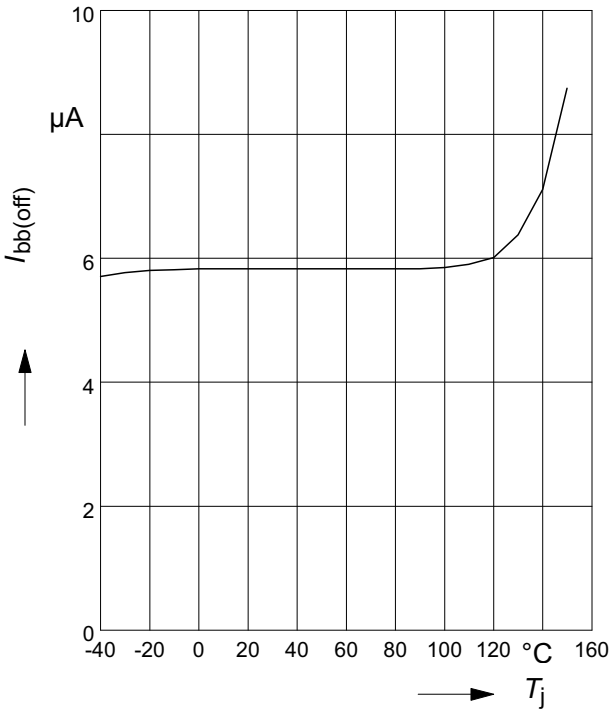
Typ. slew rate off

dV/dt_{off} = f(T_j); R_L = 47 Ω



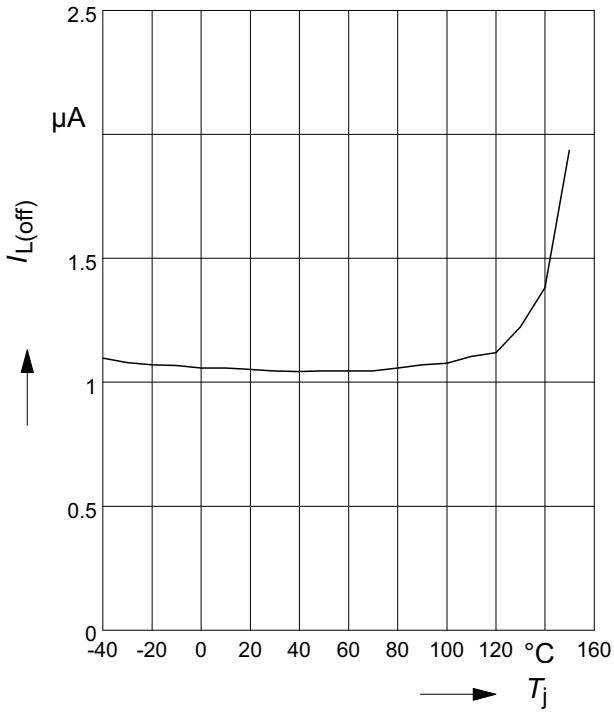
Typ. standby current

$I_{bb(off)} = f(T_j)$; V_{bb} = 42V ; V_{IN} = low



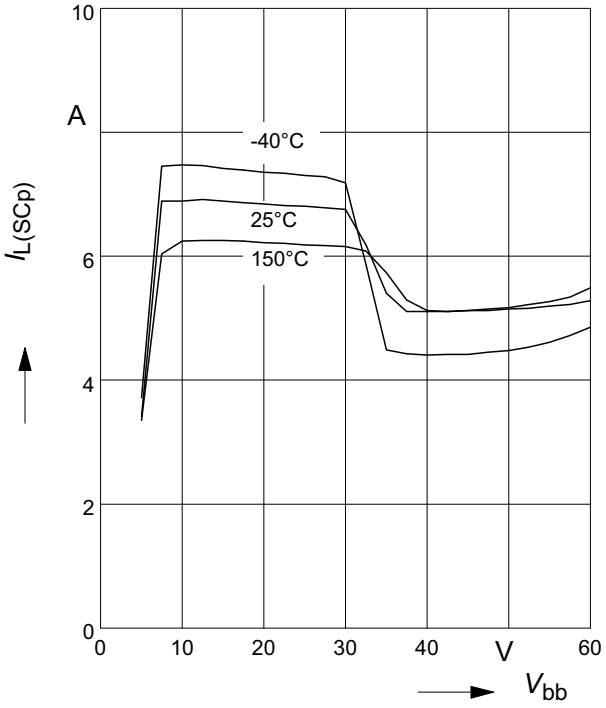
Typ. leakage current

$I_{L(off)} = f(T_j)$; V_{bb} = 42V ; V_{IN} = low



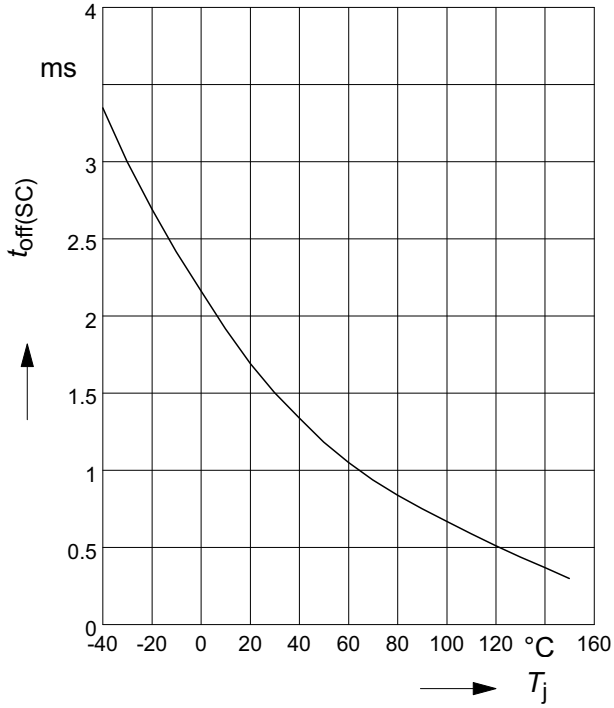
Typ. initial peak short circuit current limit

$I_{L(SCp)} = f(V_{bb})$



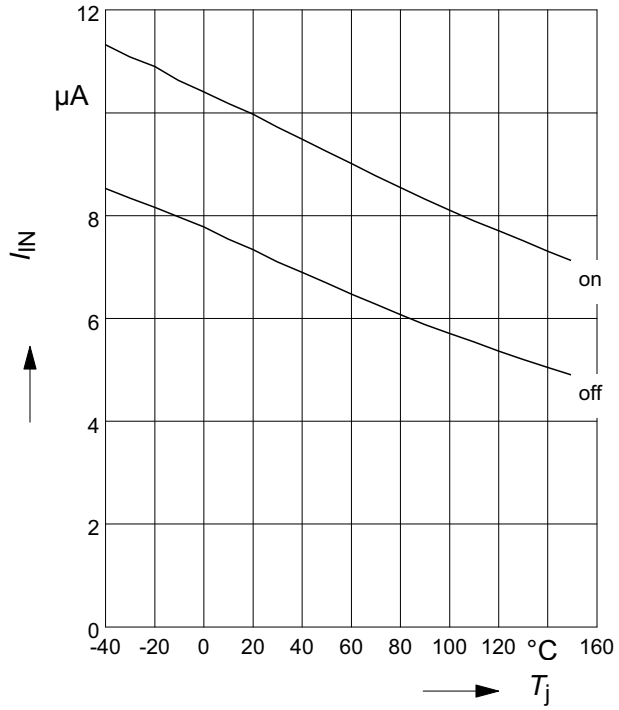
Typ. initial short circuit shutdown time

$t_{off(SC)} = f(T_{j,start})$; V_{bb} = 20V



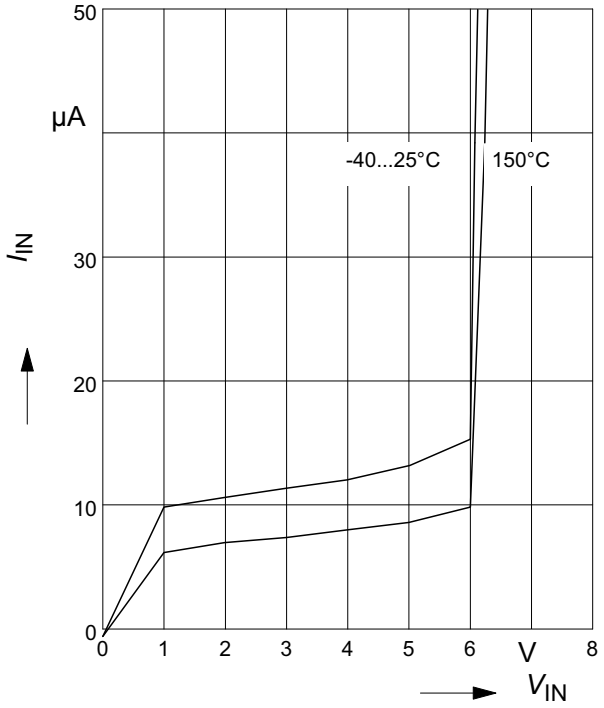
Typ. input current

$I_{IN(on/off)}$ = f(T_j); V_{bb} = 13,5V; V_{IN} = low/high
$V_{INlow} \leq 0{,}7V$; V_{INhigh} = 5V



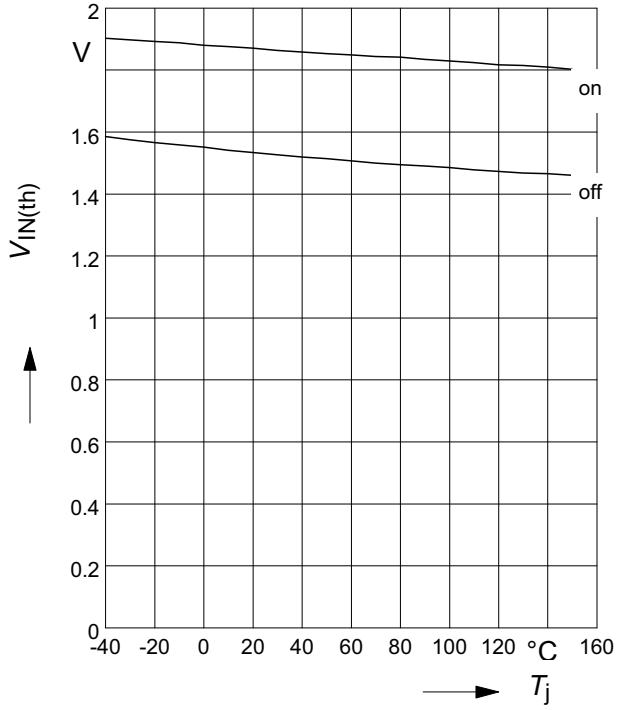
Typ. input current

I_{IN} = f(V_{IN}); V_{bb} = 13.5V



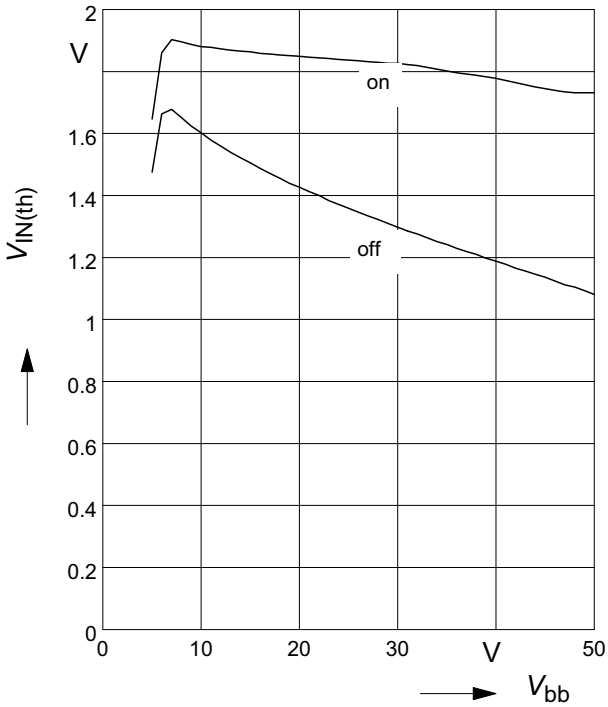
Typ. input threshold voltage

$V_{IN(th)}$ = f(T_j) ; V_{bb} = 13,5V



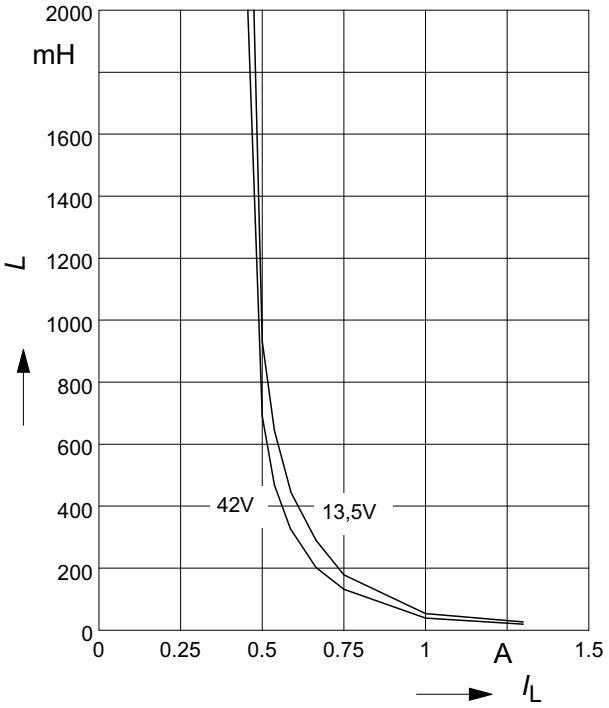
Typ. input threshold voltage

$V_{IN(th)}$ = f(V_{bb}) ; T_j = 25°C



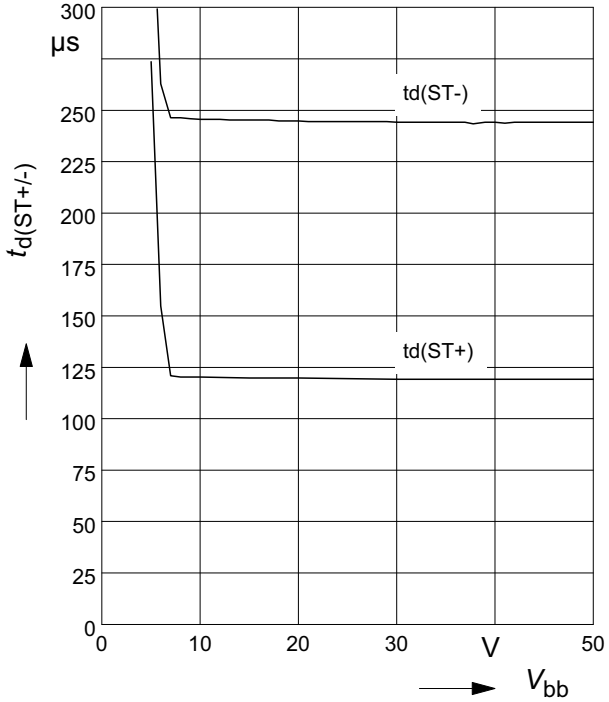
Maximum allowable load inductance for a single switch off

$L = f(I_L)$; T_{jstart}=150°C, R_L=0Ω



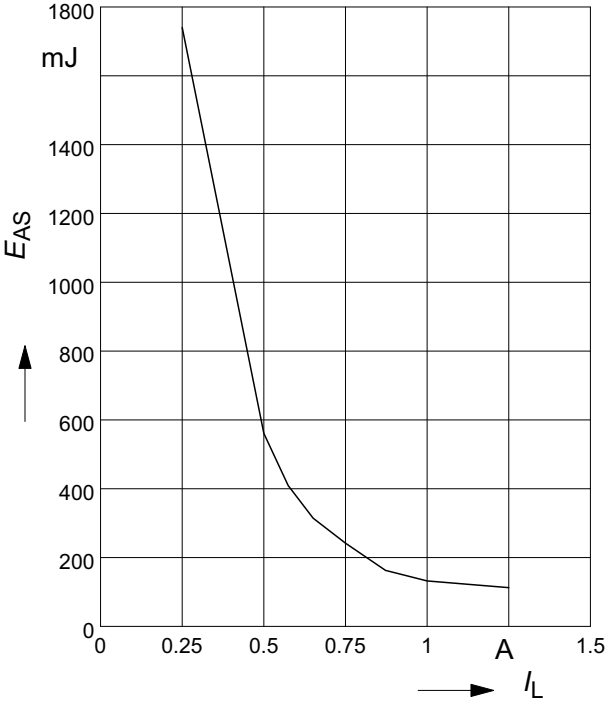
Typ. status delay time

$t_{d(ST)} = f(V_{bb})$; T_j = 25°C



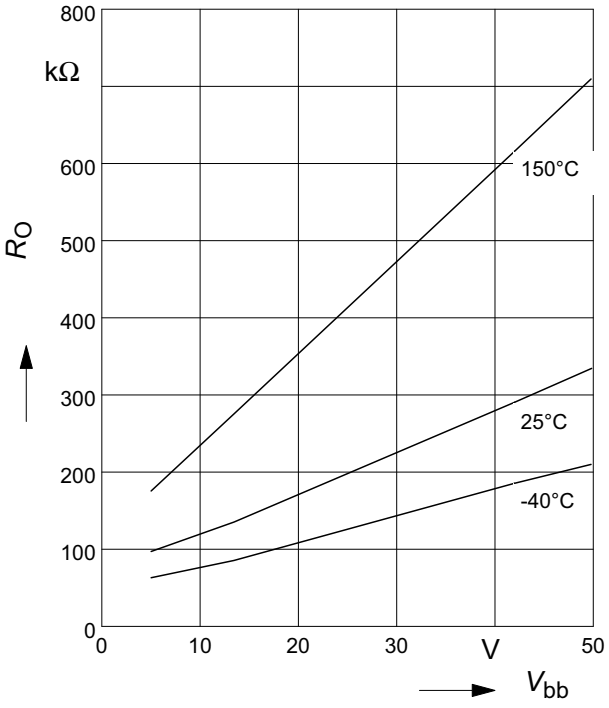
Maximum allowable inductive switch-off energy, single pulse

$E_{AS} = f(I_L)$; T_{jstart} = 150°C, V_{bb} = 13,5V



Typ. internal output pull down

$R_O = f(V_{bb})$



Timing diagrams

Figure 1a: Vbb turn on:

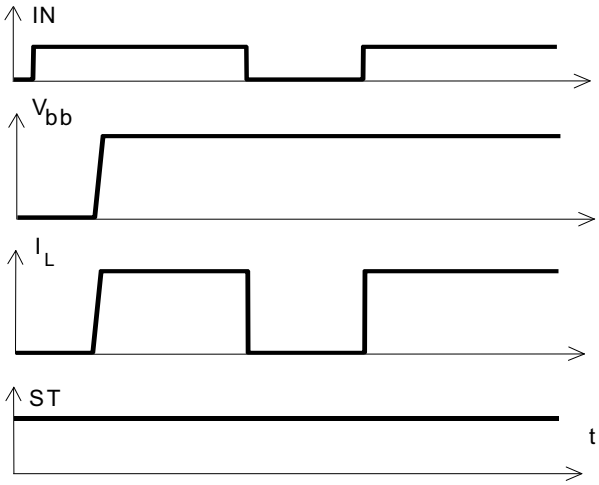


Figure 2a: Switching a resistive load, turn-on/off time and slew rate definition

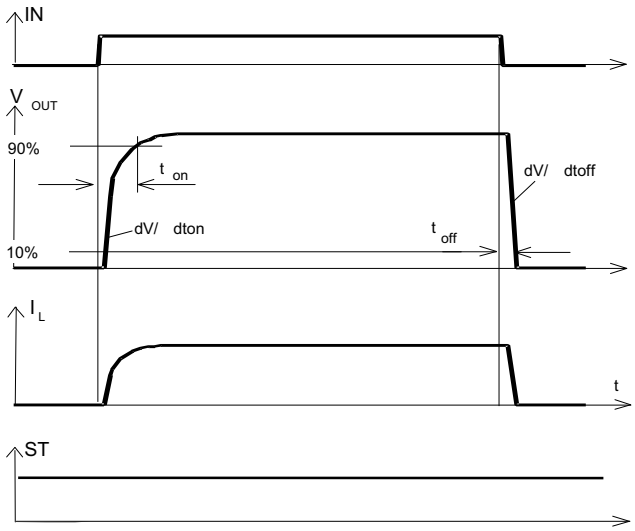


Figure 2b: Switching a lamp,

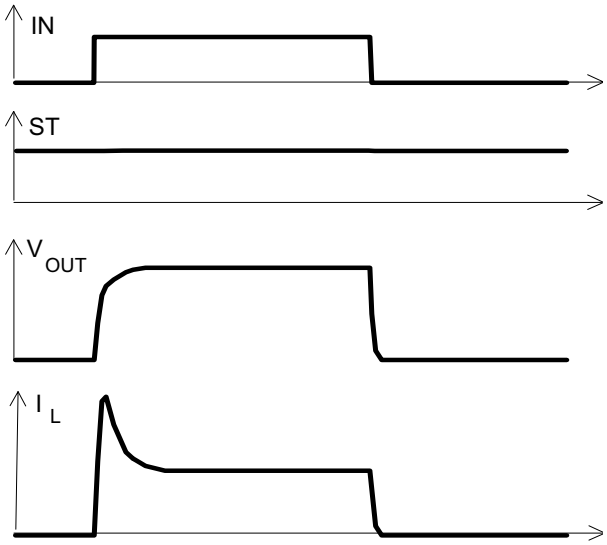


Figure 2c: Switching an inductive load

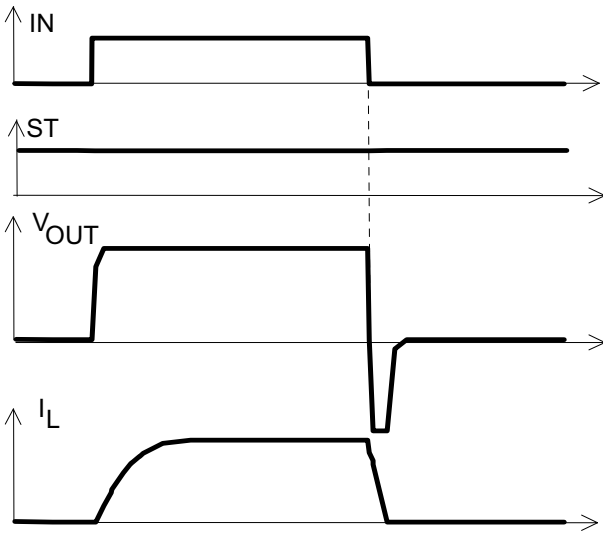
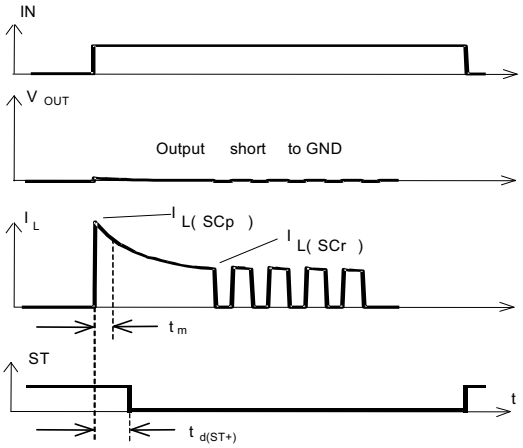


Figure 3a: Turn on into short circuit,
shut down by overtemperature, restart by cooling



Heating up of the chip may require several milliseconds, depending on external conditions.

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

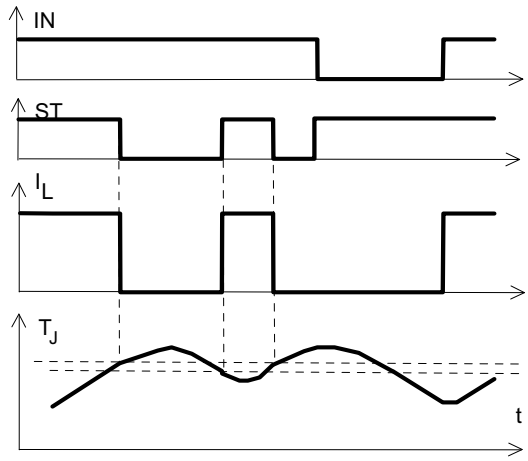


Figure 3b: Short circuit in on-state
shut down by overtemperature, restart by cooling

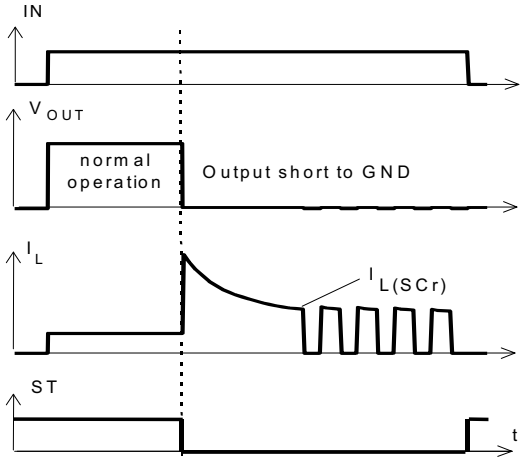
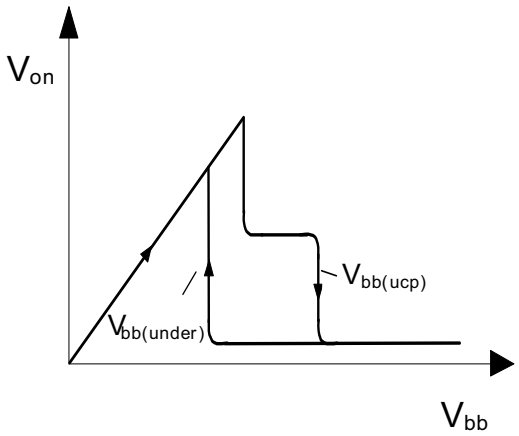


Figure 5: Undervoltage restart of charge pump



Package Outlines

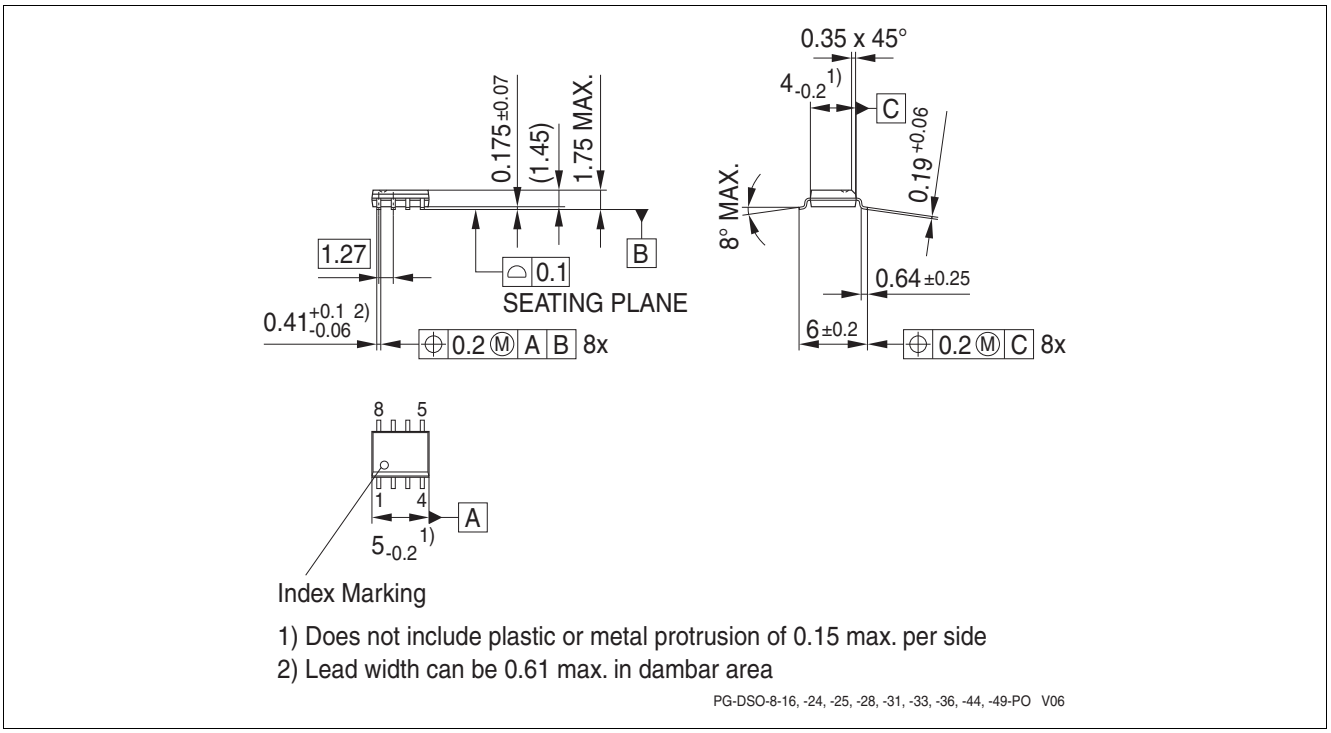


Figure 1 **PG-DSO-8-24** (Plastic Dual Small Outline Package) (RoHS-compliant)

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).

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
V1.3	2017-06-13	Updated **Table 1** (typo $V_{bb(on)}$ *and* R_{ON}) Cover page icons updated Updated Backcover page
V1.2	2016-02-22	Updated to latest template Updated Package drawing Added page 14
V1.1	2007-05-29	Created of the green datasheet. First page : Added the green logo and the AEC qualified Added the bullet AEC qualified and the RoHS compliant features Package page Modified of the package to be green.

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