Smart Lowside Power Switch

Features

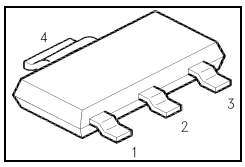
- Logic Level Input
- Input protection (ESD)
- Thermal shutdown (with restart)
- Overload protection
- Short circuit protection
- Overvoltage protection
- Current limitation

Product Summary

Continuous drain source voltage	V_{DS}	55	V
On-state resistance	$R_{DS(ON)}$	550	mΩ
Current limitation	$I_{D(lim)}$	1	A
Load current (ISO)	$I_{D(ISO)}$	0.7	A
Clamping energy	E_{AS}	550	mJ

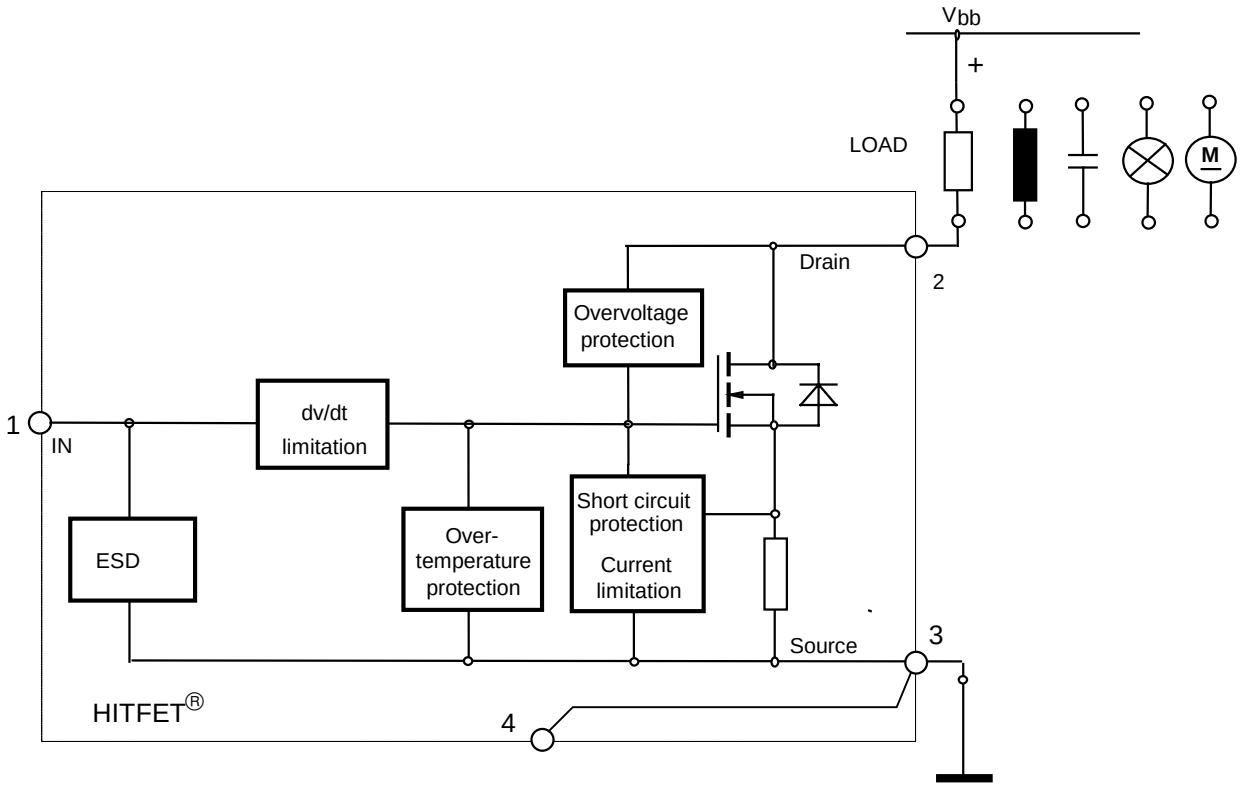
Application

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



General Description

N channel vertical power FET in **S**mart **P**ower **T**echnology. Fully protected by embedded protection functions.



Pin	Symbol		Function
1	IN		Input
2	DRAIN		Output to the load
3	SOURCE		Ground
TAB	SUBSTRATE		Internally connected to source (pin 3)

Maximum Ratings at T_j=25°C unless otherwise specified

Parameter	Symbol	Values	Unit
Continuous drain source voltage (overvoltage protection see page 4)	V_{DS}	55	V
Drain source voltage for short circuit protection	V_{DS}	32	V
Load dump protection $V_{LoadDump}=U_P+U_S$; U_P=13.5 V	$V_{LoadDump}$ [2]		V
R_I [1]=2 Ω; t_d=400ms; IN=low or high (8V) R_L=50 Ω		80	
R_I=2 Ω; t_d=400ms; IN=high (8V) R_L=22 Ω		47	
Continuous input voltage	V_{IN}	-0.2 ... +10	V
Peak input voltage	V_{IN}	-0.2 ... +20	V
Operating temperature range	T_j	-40 ...+150	°C
Storage temperature range	T_{stg}	-55 ...+150	
Power dissipation (DC)	P_{tot}	1.8	W
Unclamped single pulse inductive energy $I_{D(ISO)}$ = 0.7 A	E_{AS}	550	mJ
Electro**s**tatic **d**ischarge voltage (Human Body Model) according to MIL STD 883D, method 3015.7 and EOS/ESD assn. standard S5.1 - 1993	V_{ESD}	4000	V
DIN humidity category, DIN 40 040		E	
IEC climatic category, DIN IEC 68-1		40/150/56	

Thermal resistance junction soldering point:	R_{thJS}	≤10	K/W
junction - ambient [3]:	R_{thJA}	≤70	

[1] R_I=internal resistance of the load dump test pulse generator LD200
[2] $V_{LoadDump}$ is setup without DUT connected to the generator per ISO 7637-1 and DIN 40 839.
[3] Device on epoxy pcb 40mm x 40 mm x 1.5mm with 6cm^2 copper area for pin 4 connection

Electrical Characteristics

Parameter and Conditions at T_j = 25 °C, unless otherwise specified	Symbol	Values			Unit
		min	typ	max	
Static Characteristics					
Drain source clamp voltage I_D = 10 mA T_j =-40...+150°C:	$V_{DS(AZ)}$	55	--	70	V
Off state drain current V_{IN} = 0 V, V_{DS} = 32 V T_j =-40...+150°C:	I_{DSS}	--	--	5	µA
Input threshold voltage I_D = 10 mA	$V_{IN(th)}$	2	2.5	3	V
Input current normal operation, I_D<$I_{D(lim)}$:	$I_{IN(1)}$	--	100	200	µA
V_{IN} = 5 V current limitation mode, I_D=$I_{D(lim)}$:	$I_{IN(2)}$	--	200	300	
after thermal shutdown, I_D=0 A:	$I_{IN(3)}$	1000	1500	2000	
On-state resistance I_D = 0.7 A, V_{IN} = 5 V T_j=25°C:	$R_{DS(on)}$	--	550	675	mΩ
T_j=150°C:		--	850	1350	
On-state resistance I_D = 0.7 A, V_{IN} = 10 V T_j=25°C:	$R_{DS(on)}$	--	475	550	mΩ
T_j=150°C:		--	750	1000	
Nominal load current(ISO 10483) V_{IN} = 10 V, V_{DS} = 0.5 V, T_S = 85°C	$I_{D(ISO)}$	0.7	--	--	A
Current limit V_{IN} = 10 V, V_{DS} = 12 V	$I_{D(lim)}$	1	1.5	1.9	A
Dynamic characteristics					
Turn-on time V_{IN} to 90% I_D: R_L = 22 Ω, V_{IN}= 0 to 10 V, V_{bb}= 12 V	t_{on}	--	10	20	µs
Turn-off time V_{IN} to 10% I_D: R_L = 22 Ω, V_{IN}= 10 to 0 V, V_{bb}= 12 V	t_{off}	--	10	20	µs
Slew rate on 70 to 50% V_{bb}: R_L = 22 Ω, V_{IN} = 0 to 10 V, V_{bb} = 12 V	$-dV_{DS}/dt_{on}$	--	4	10	V/µs
Slew rate off 50 to 70% V_{bb}: R_L = 22 Ω, V_{IN}= 10 to 0 V, V_{bb}= 12 V	dV_{DS}/dt_{off}	--	4	10	V/µs

Parameter and Conditions at T_j = 25 °C, unless otherwise specified	Symbol	Values			Unit
		min	typ	max	
Protection Functions					
Thermal overload trip temperature	T_{jt}	150	165	--	°C
Thermal hysteresis	ΔT_{jt}	--	10	--	K
Unclamped single pulse inductive energy $I_{D(ISO)}$=0.7 A, V_{bb}=32 V T_j=25 °C T_j=150 °C	E_{AS}	550 200	-- --	-- --	mJ
Inverse Diode					
Continuous source drain voltage V_{IN} = 0 V, $-I_D$ = 2*0.7 A	V_{SD}	--	1	--	V

Circuit Description

The BSP 75 is a monolithic power switch in Smart Power Technology (SPT) with a logic level input, an open drain DMOS output stage and integrated protection functions. It is designed for all kind of resistive and inductive loads (relays, solenoid) in automotive and industrial applications.

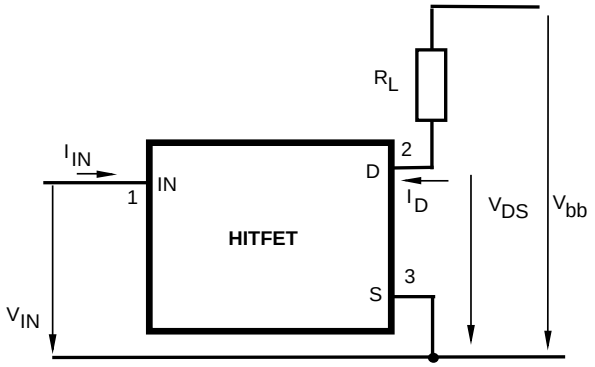
Protection functions

- **Overvoltage protection:** An internal clamp limits the output voltage at $V_{DS(AZ)}$ (about 63 V) when inductive loads are switched off.
- **Current limitation:** By means of an internal current measurement the drain current is limited at $I_{D(lim)}$ (1.4 - 1.5 A typ.). If the current limitation is active the device operates in the linear region, so power dissipation may exceed the capability of the heatsink. This operation leads to an increasing junction temperature until the overtemperature threshold is reached.
- **Overtemperature and short circuit protection:** This protection is based on sensing the chip temperature. The location of the sensor ensures a fast and accurate junction temperature detection. Overtemperature shutdown occurs at minimum 150 °C. A hysteresis of typ. 10 K enables an automatical restart by cooling.

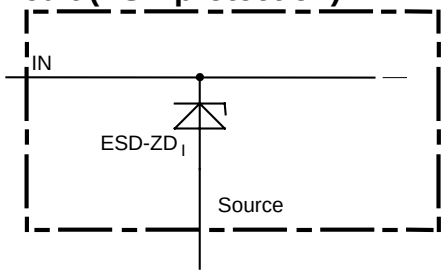
The device is ESD protected according Human Body Model (4 kV) and load dump protected (see Maximum Ratings).

Block diagram

Terms

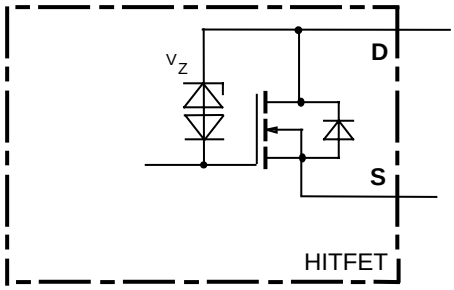


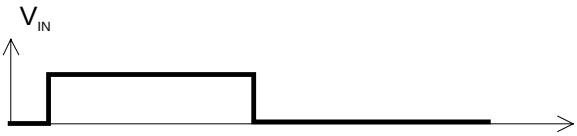
Input circuit (ESD protection)

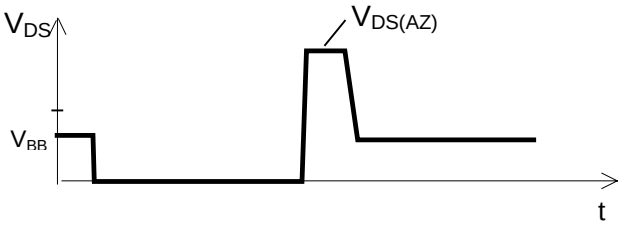


ESD zener diodes are not designed for DC current.

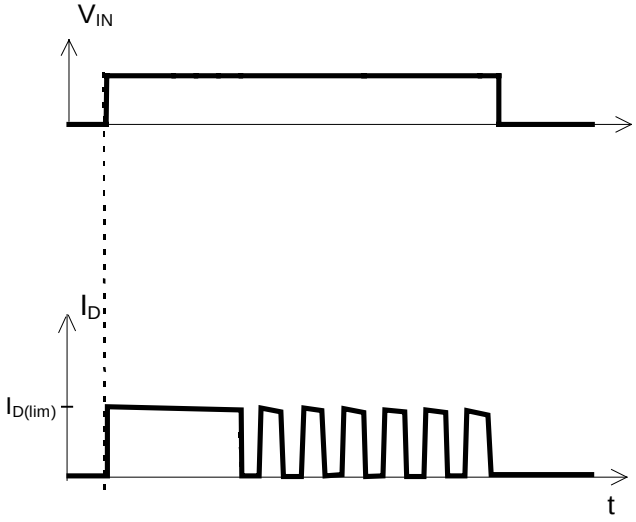
Inductive and overvoltage output clamp





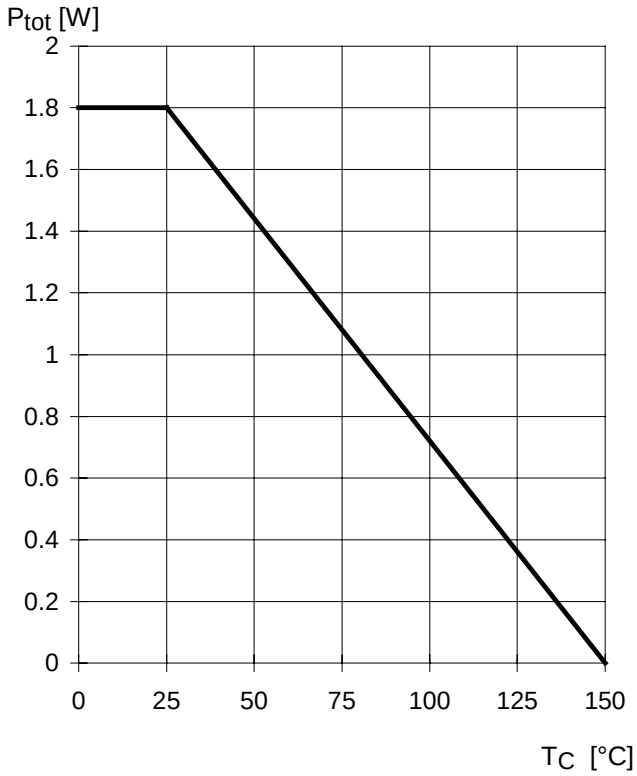


Turn on into overload or short circuit

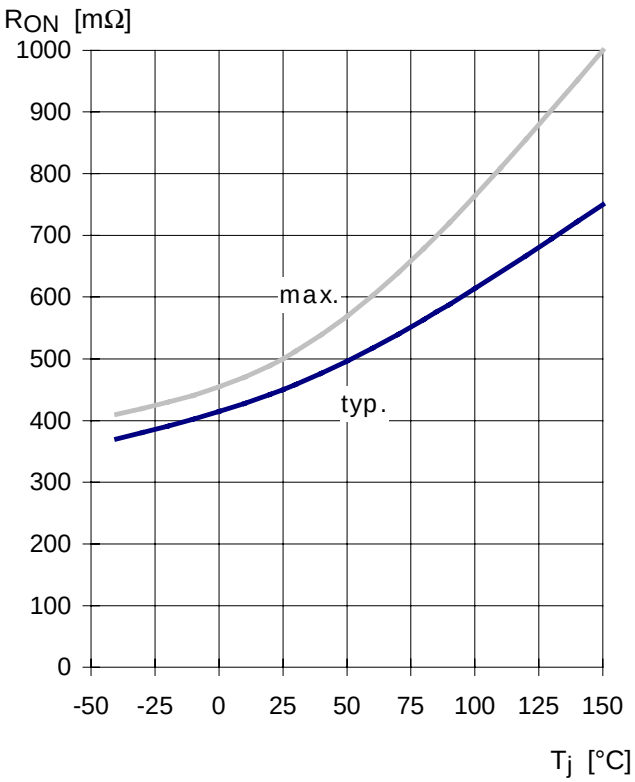


Shut down by overtemperature and restart by cooling. Current internally limited at $I_{D(lim)}$.

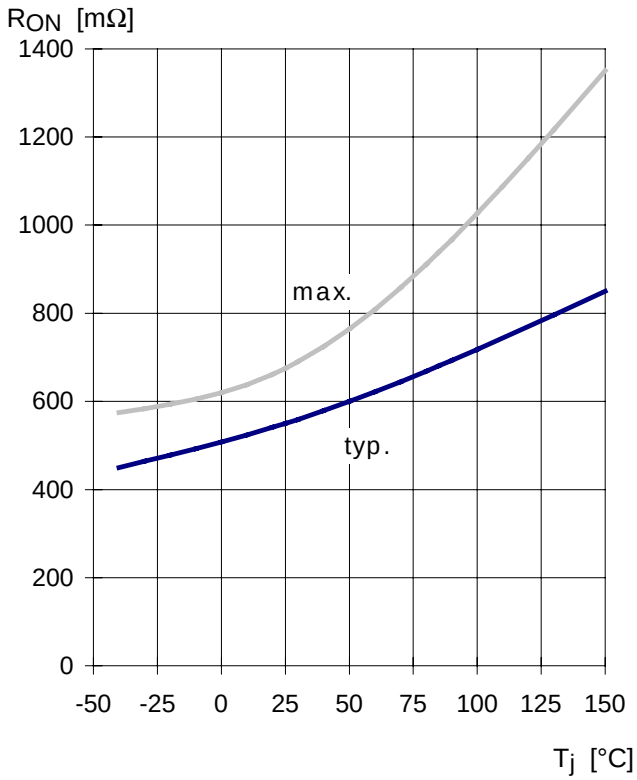
Maximum allowable power dissipation
$P_{tot} = f(T_C)$



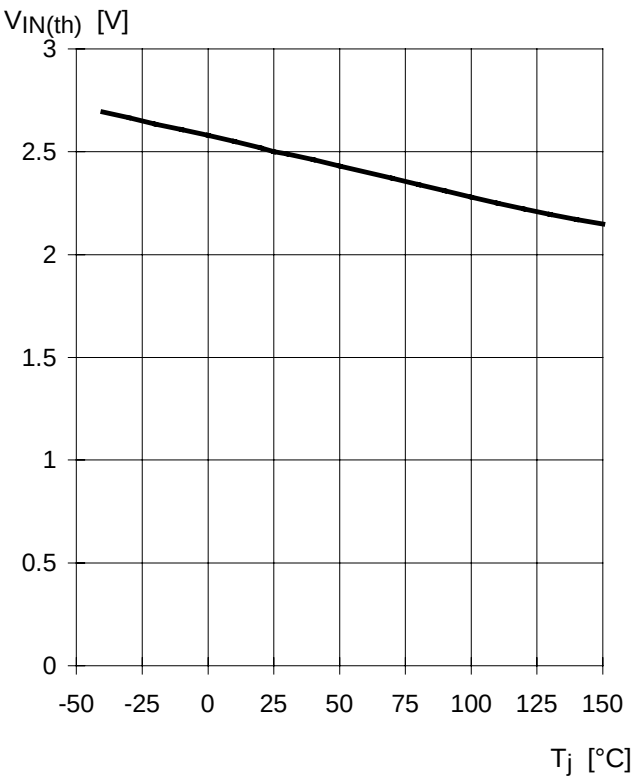
On-state resistance
$R_{ON} = f(T_j)$; I_D= 0.7 A; V_{IN}= 10 V



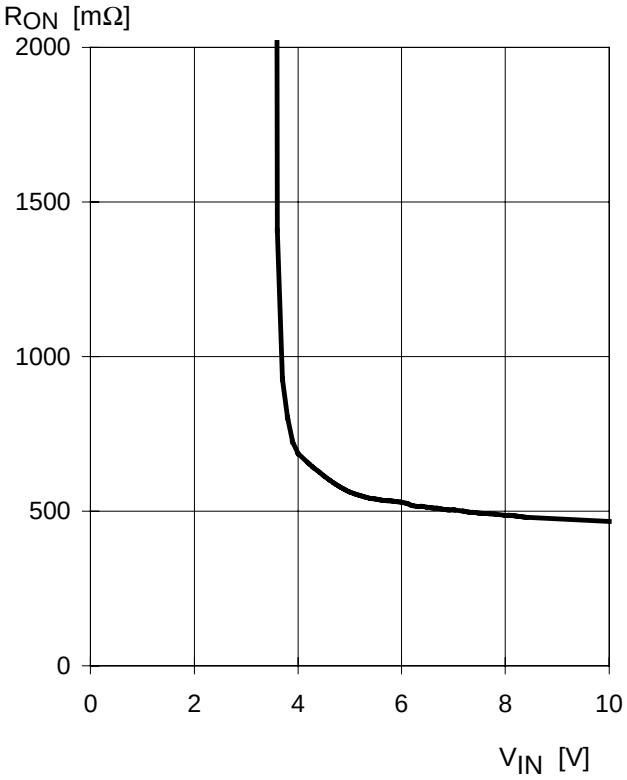
On-state resistance
$R_{ON} = f(T_j)$; I_D= 0.7 A; V_{IN}= 5 V



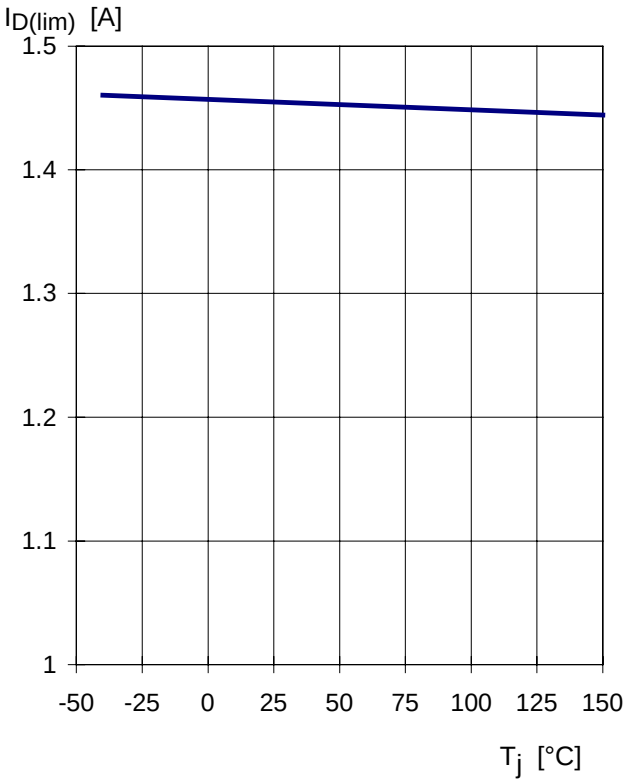
Typ. input threshold voltage
$V_{IN(th)} = f(T_j)$; I_D= 10 mA; V_{DS}= 12 V



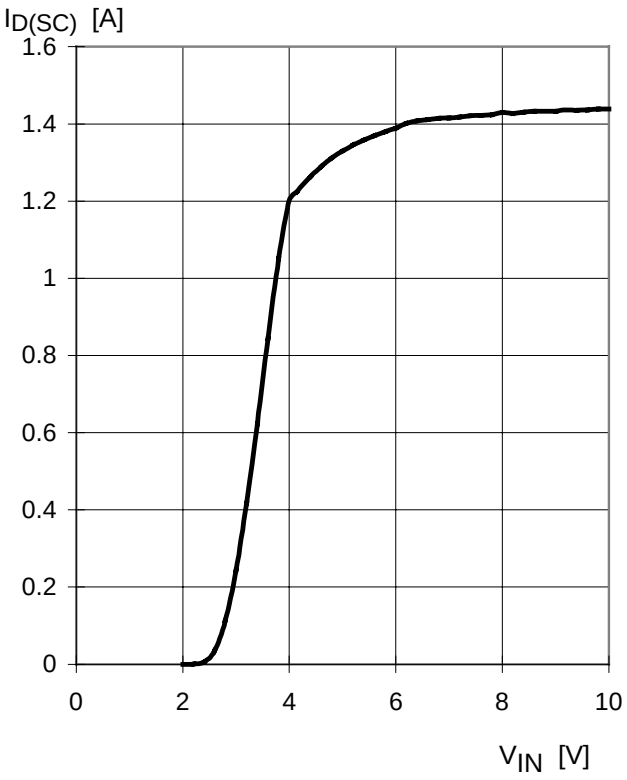
Typ. on-state resistance
$R_{ON} = f(V_{IN})$ I_D= 0.7 A; T_j= 25°C



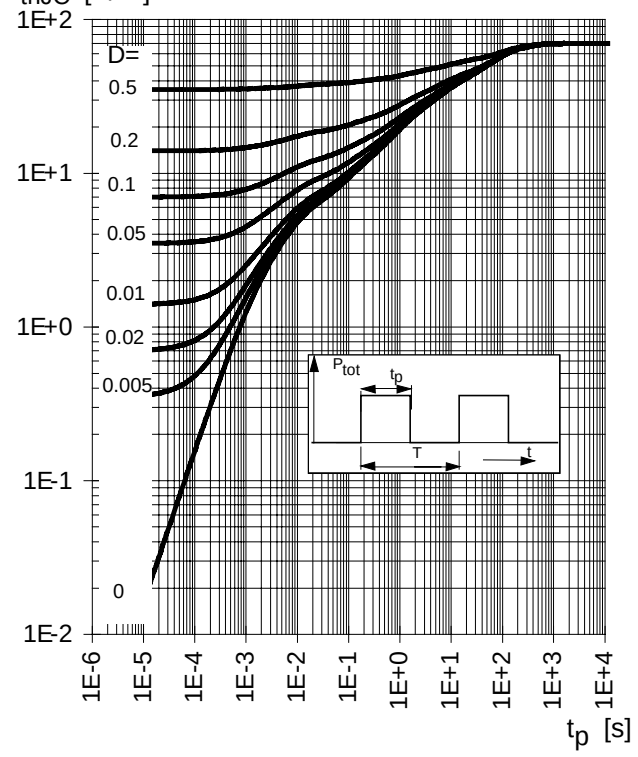
Typ. current limitation
$I_{D(lim)} = f(T_j)$; V_{DS}=12V, V_{IN}= 10V



Typ. short circuit current
$I_{D(SC)} = f(V_{IN})$; V_{DS}=12V, T_j= 25°C

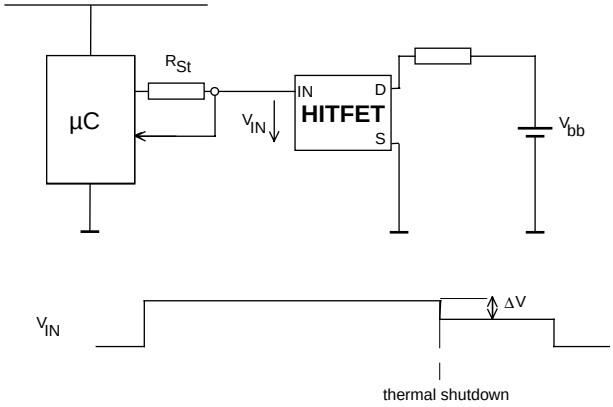


Transient thermal impendance
$Z_{thJC} = f(t_p)$
Parameter: $D=t_p/T$



Application examples:

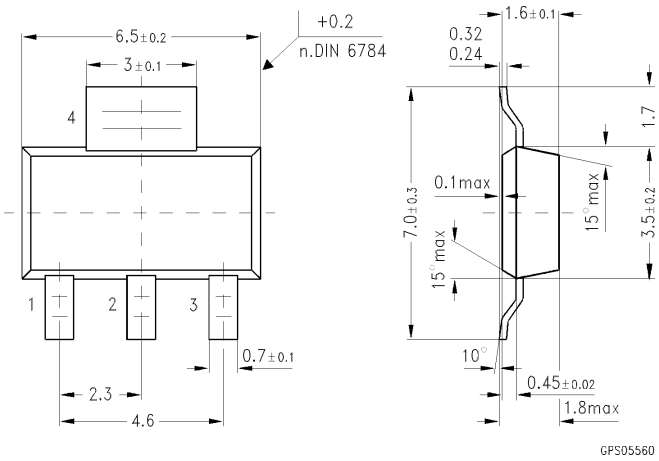
Status signal of thermal shutdown by monitoring input current



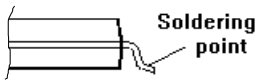
Package and ordering code

all dimensions in mm

SOT223/4	Ordering code
BSP75	Q67060-S7200-A2



Definition of soldering point with temperature T_S:
upper side of solder edge of device pin 4.



Pin 4

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