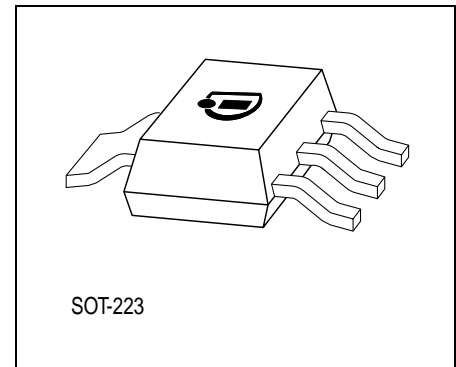


Data Sheet V1.0

Features

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



Application

- All kinds of resistive, inductive and capacitive loads in switching applications
- μ C compatible power switch for 12 V and 24 V DC applications and for 42 Volt Powernet
- Replaces electromechanical relays and discrete circuits

General Description

N channel vertical power FET in Smart Power Technology. Fully protected by embedded protection functions.

Type	Ordering Code	Package
HITFET® BSP 75N	Q67060-S7215	P-SOT223-4-7

Product Summary

Parameter	Symbol	Value	Unit
Continuous drain source voltage	V_{DS}	60	V
On-state resistance	$R_{DS(ON)}$	550	m Ω
Current limitation	$I_{D(lim)}$	1	A
Nominal load current	$I_{D(Nom)}$	0.7	A
Clamping energy	E_{AS}	550	mJ

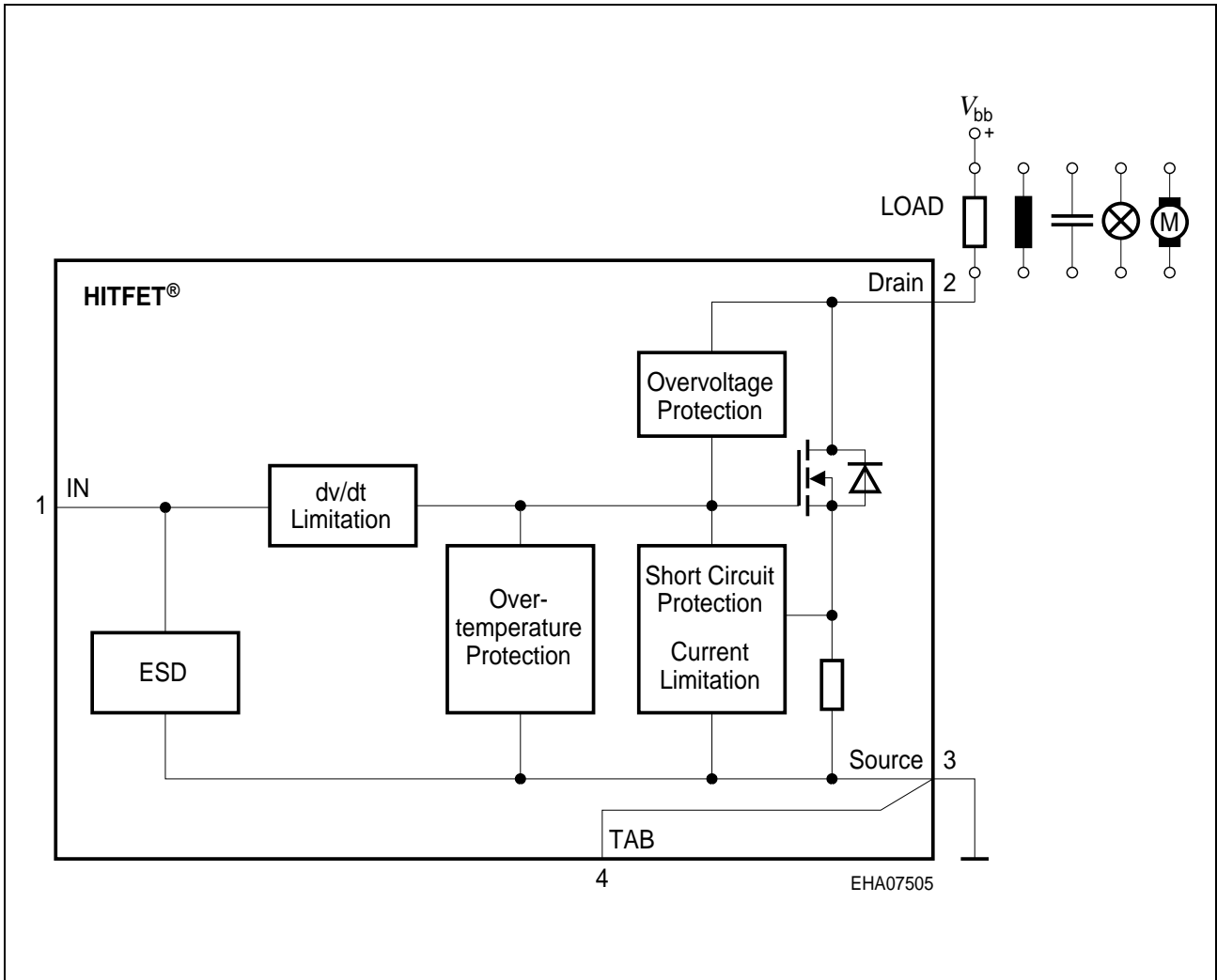


Figure 1 Block Diagram

Pin Definitions and Functions

Pin	Symbol	Function
1	IN	Input
2	DRAIN	Output to the load
3 + TAB	SOURCE	Ground (internally connected)

Circuit Description

The BSP 75N 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 $V_{DS(AZ)}$ (min 60V) when inductive loads are switched off.
- **Current limitation:** By means of an internal current measurement the drain current is limited at $I_{D(lim)}$ (1.5 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).

Absolute Maximum Ratings

$T_j = 25\text{ °C}$, unless otherwise specified

Parameter	Symbol	Values	Unit	Remarks
Continuous drain source voltage	V_{DS}	60	V	–
Drain source voltage for short circuit protection	V_{DS}	32	V	–
Continuous input voltage	V_{IN}	-0.2 ... +10	V	–
Peak input voltage	V_{IN}	-0.2 ... +20	V	–
Continuous Input current -0.2V $\leq V_{IN} \leq 10V$ $V_{IN} < 0.2V$ or $V_{IN} > 10V$	I_{IN}	no limit $ I_{IN} \leq 2$	mA	–
Operating temperature range	T_j	-40 ... +150	°C	–
Storage temperature range	T_{stg}	-55 ... +150	°C	–
Power dissipation (DC)	P_{tot}	1.8	W	–
Unclamped single pulse inductive energy ¹⁾	E_{AS}	550	mJ	$I_{D(ISO)} = 0.7\text{ A}$
Load dump protection IN = low or high (8 V); $R_L = 50\ \Omega$ IN = high (8 V); $R_L = 22\ \Omega$	$V_{LoadDump}$ ²⁾	80 47	V	$V_{LoadDump} = V_P + V_S$; $V_P = 13.5\text{ V}$ R_l ³⁾ = 2 Ω ; $t_d = 400\text{ ms}$;
Electrostatic discharge voltage (Human Body Model) ⁴⁾	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 ⁵⁾	R_{thJA}	≤ 70	K/W	–

¹⁾ Not tested, specified by design

²⁾ $V_{LoadDump}$ is setup without DUT connected to the generator per ISO 7637-1 and DIN 40 839.

³⁾ R_l = internal resistance of the load dump test pulse generator LD200.

⁴⁾ according to MIL STD 883D, method 3015.7 and EOS/ESD assn. standard S5.1 - 1993

⁵⁾ Device on epoxy pcb 40 mm \times 40 mm \times 1.5 mm epoxy PCB FR4 with 6 cm² (one layer, 70 μ m thick) copper area for device connection. Device mounted vertical without blown air.

Electrical Characteristics
 $T_j = 25\text{ °C}$, unless otherwise specified

Parameter	Symbol	Limit Values			Unit	Test Conditions
		min.	typ.	max.		

Static Characteristics

Drain source clamp voltage	$V_{DS(AZ)}$	60	–	75	V	$I_D = 10\text{ mA}$, $T_j = -40 \dots +150\text{ °C}$
Off state drain current	I_{DSS}	–	–	5	μA	$V_{IN} = 0\text{ V}$, $V_{DS} = 32\text{ V}$, $T_j = -40 \dots +150\text{ °C}$
Input threshold voltage	$V_{IN(th)}$	1	1.7	2.5	V	$I_D = 10\text{ mA}$
Input current: normal operation, $I_D < I_{D(lim)}$: current limitation mode, $I_D = I_{D(lim)}$: After thermal shutdown, $I_D = 0\text{ A}$:	$I_{IN(1)}$ $I_{IN(2)}$ $I_{IN(3)}$	–	100 200 1000	200 300 2000	μA	$V_{IN} = 5\text{ V}$
On-state resistance $T_j = 25\text{ °C}$ $T_j = 150\text{ °C}$	$R_{DS(on)}$	–	550 850	675 1350	$\text{m}\Omega$	$I_D = 0.7\text{ A}$, $V_{IN} = 5\text{ V}$
On-state resistance $T_j = 25\text{ °C}$ $T_j = 150\text{ °C}$	$R_{DS(on)}$	–	475 750	550 1000	$\text{m}\Omega$	$I_D = 0.7\text{ A}$, $V_{IN} = 10\text{ V}$
Nominal load current	$I_{D(Nom)}$	0.7	–	–	A	$V_{BB} = 12\text{ V}$, $V_{DS} = 0.5\text{ V}$, $T_S = 85\text{ °C}$, $T_j < 150\text{ °C}$
Current limit	$I_{D(lim)}$	1	1.5	1.9	A	$V_{IN} = 10\text{ V}$, $V_{DS} = 12\text{ V}$

Dynamic Characteristics

Turn-on time	V_{IN} to 90% I_D :	t_{on}	–	10	20	μs	$R_L = 22\ \Omega$, $V_{IN} = 0$ to 10 V, $V_{BB} = 12\text{ V}$
Turn-off time	V_{IN} to 10% I_D :	t_{off}	–	10	20	μs	$R_L = 22\ \Omega$, $V_{IN} = 10$ to 0 V, $V_{BB} = 12\text{ V}$

Electrical Characteristics (cont'd)
 $T_j = 25\text{ °C}$, unless otherwise specified

Parameter	Sym- bol	Limit Values			Unit	Test Conditions
		min.	typ.	max.		
Slew rate on 70 to 50% V_{BB} :	$-dV_{DS}/dt_{on}$	–	4	10	V/ μ s	$R_L = 22\ \Omega$, $V_{IN} = 0$ to 10 V, $V_{BB} = 12$ V
Slew rate off 50 to 70% V_{BB} :	dV_{DS}/dt_{off}	–	4	10	V/ μ s	$R_L = 22\ \Omega$, $V_{IN} = 10$ to 0 V, $V_{BB} = 12$ V

Protection Functions ¹⁾

Thermal overload trip temperature	T_{jt}	150	165	180	°C	–
Thermal hysteresis	ΔT_{jt}	–	10	–	K	–
Unclamped single pulse inductive energy $T_j = 25\text{ °C}$ $T_j = 150\text{ °C}$	E_{AS}	550 200	– –	– –	mJ	$I_{D(ISO)} = 0.7$ A, $V_{BB} = 32$ V

Inverse Diode

Continuous source drain voltage	V_{SD}	–	1	–	V	$V_{IN} = 0$ V, $-I_D = 2 \times 0.7$ A
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¹⁾ Integrated protection functions are designed to prevent IC destruction under fault conditions described in the datasheet. Fault conditions are considered as “outside” normal operating range. Protection functions are not designed for continuous, repetitive operation.

Block Diagram

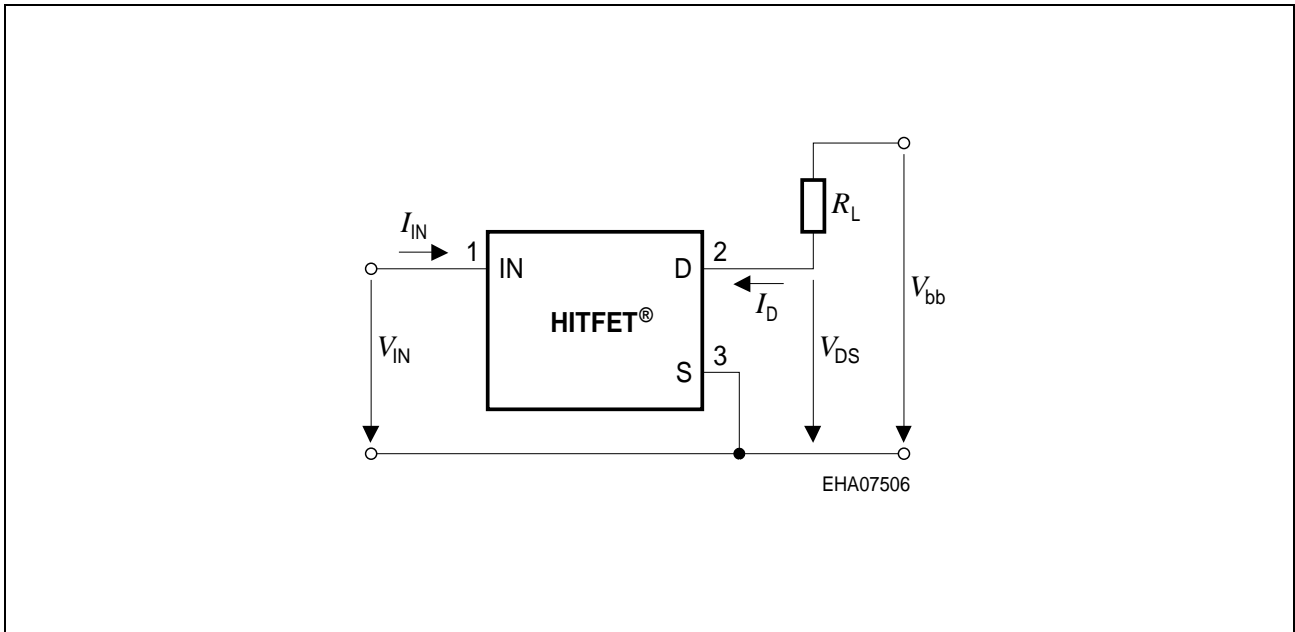


Figure 2 Terms

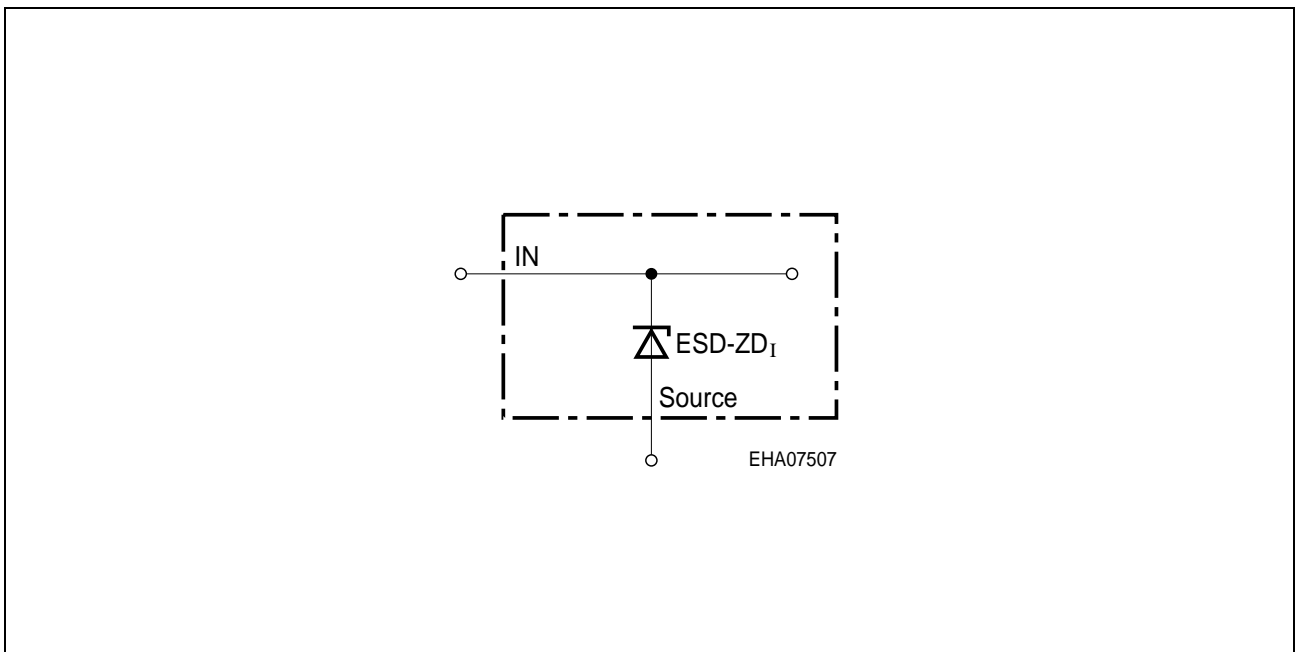


Figure 3 Input Circuit (ESD protection)

ESD zener diodes are not designed for DC current.

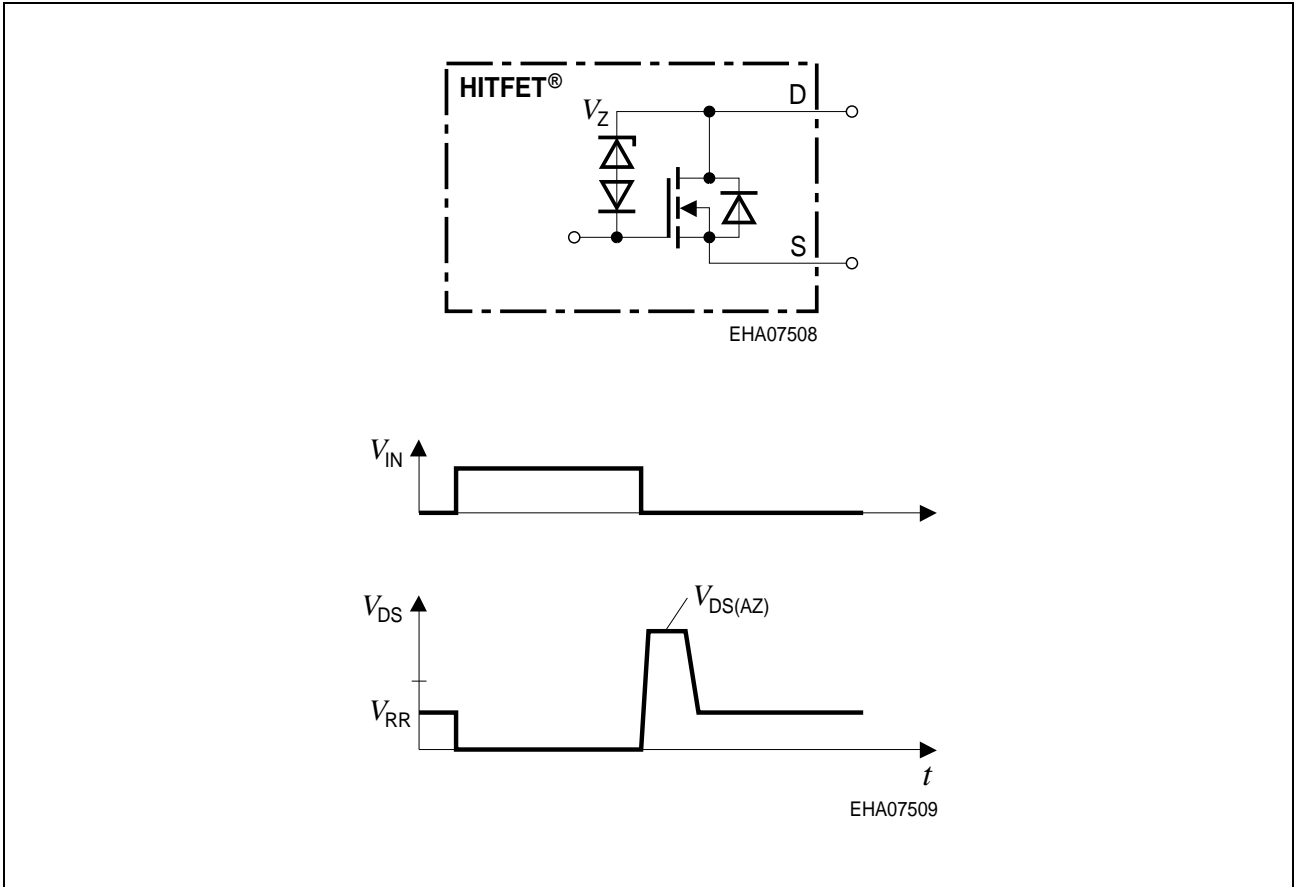


Figure 4 Inductive and Overvoltage Output Clamp

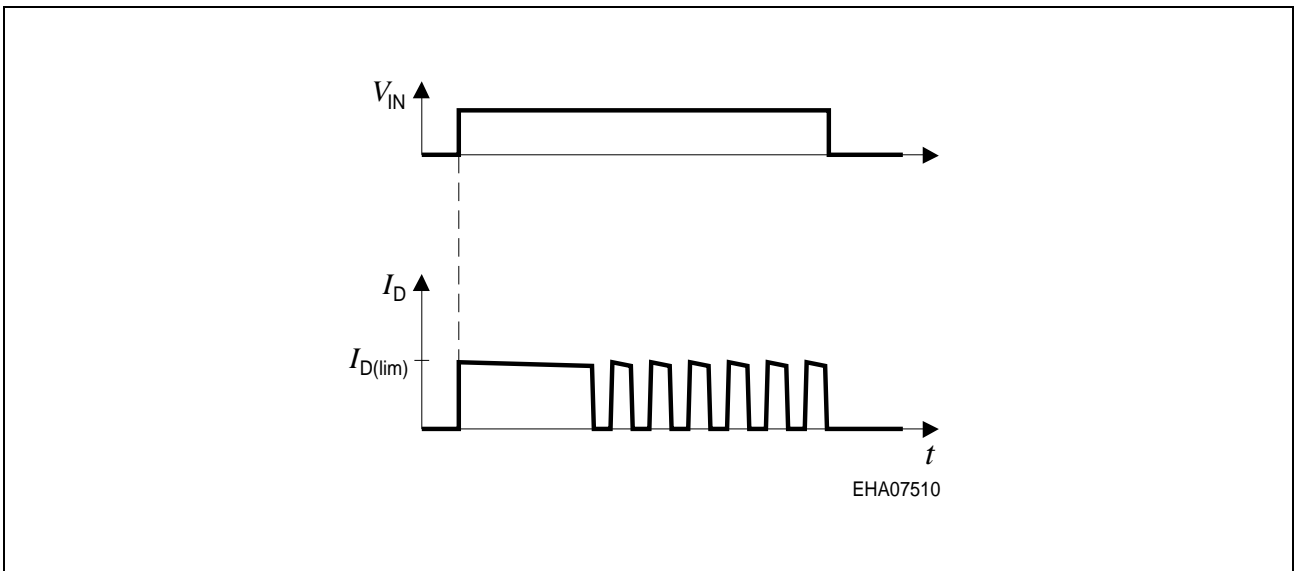
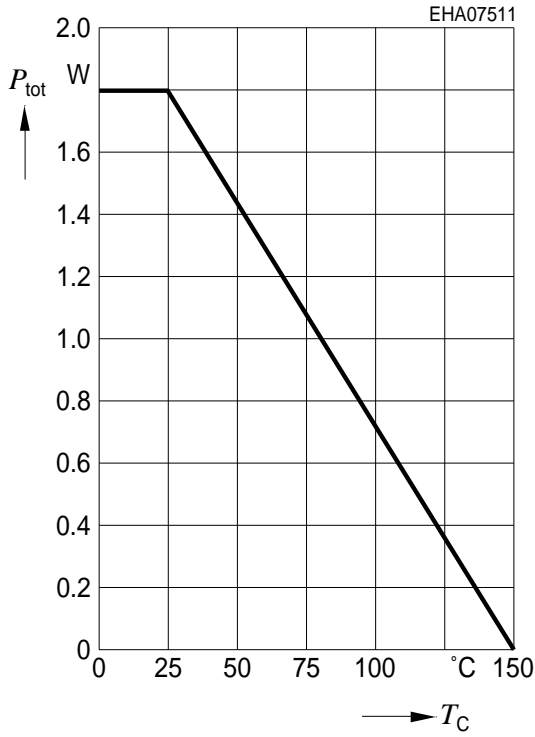


Figure 5 Turn on into Overload or short Circuit

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

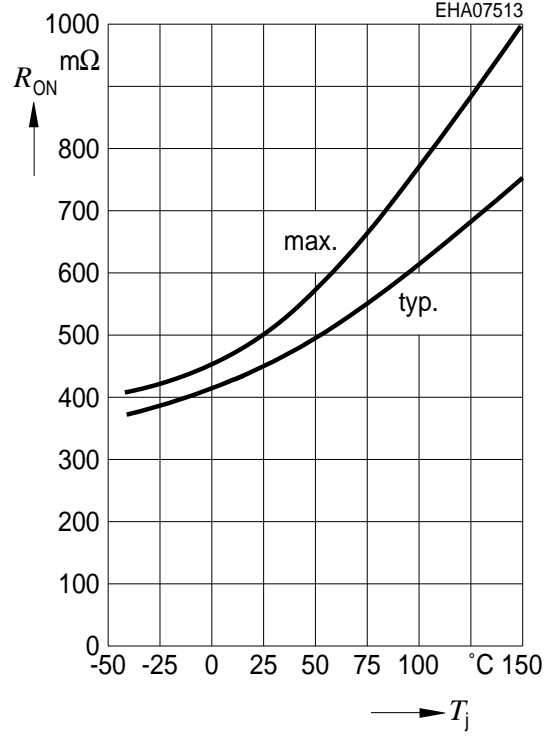
1 Max. allowable power dissipation

$P_{tot} = f(T_C)$



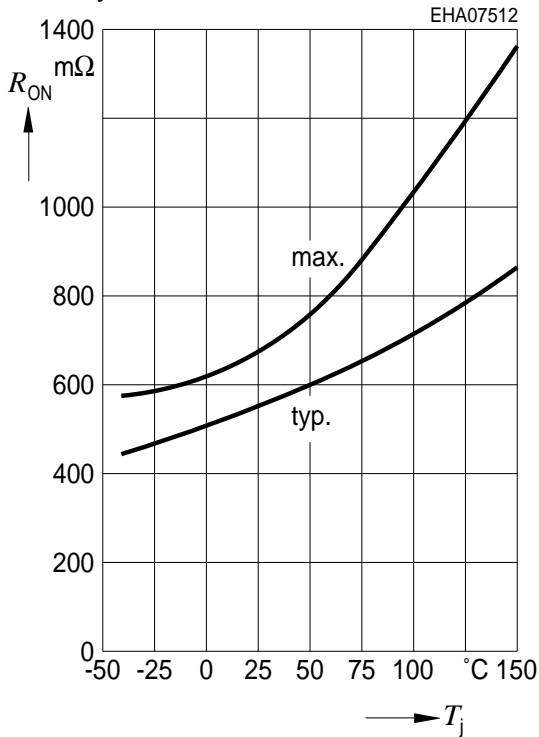
2 On-state resistance

$R_{ON} = f(T_j); I_D = 0.7 \text{ A}; V_{IN} = 10 \text{ V}$



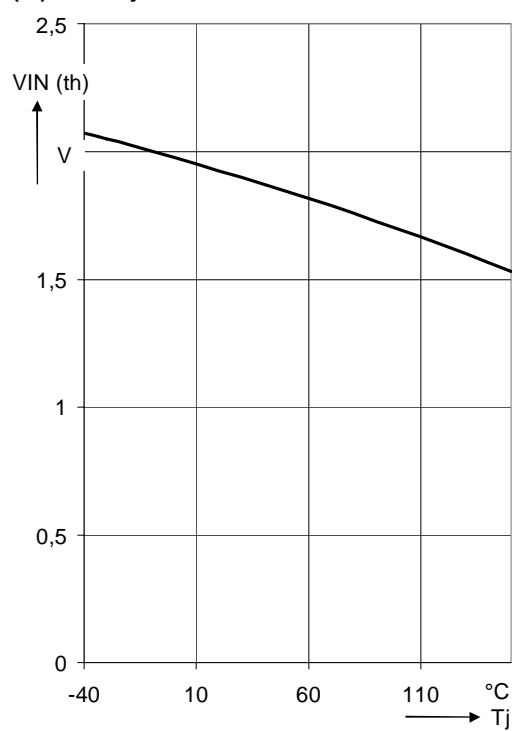
3 On-state resistance

$R_{ON} = f(T_j); I_D = 0.7 \text{ A}; V_{IN} = 5 \text{ V}$



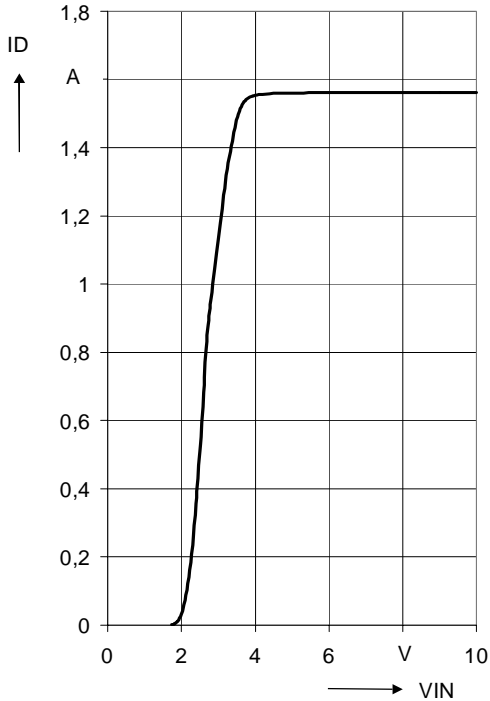
4 Typ. input threshold voltage

$V_{IN(th)} = f(T_j); I_D = 10 \text{ mA}; V_{DS} = 12 \text{ V}$



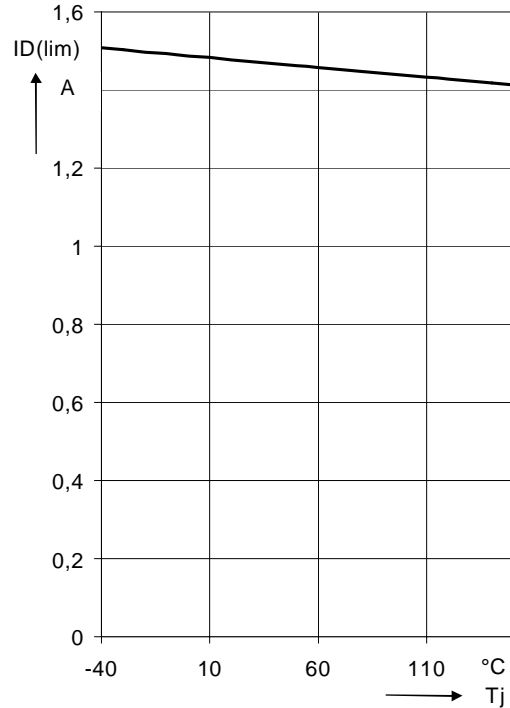
5 Typ. transfer characteristic

$I_D = f(V_{IN}); V_{DS} = 12\text{ V}, T_j = 25\text{ °C}$



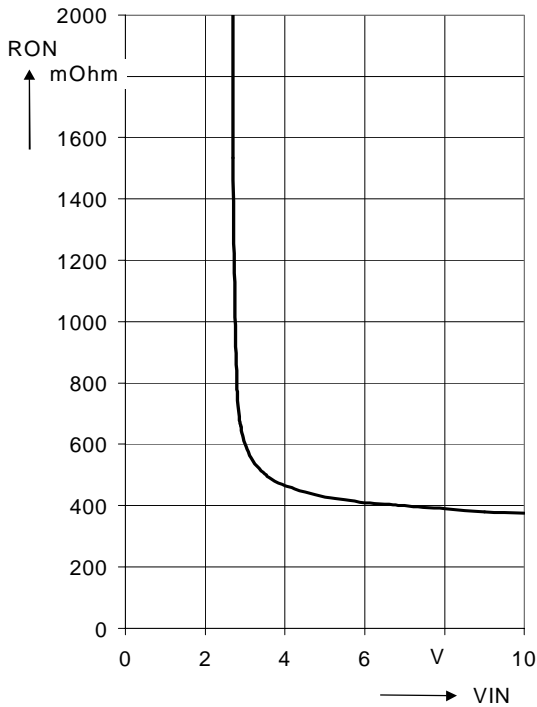
6 Typ. short circuit current

$I_{D(lim)} = f(T_j); V_{DS} = 12\text{ V}, V_{IN} = 10\text{ V}$



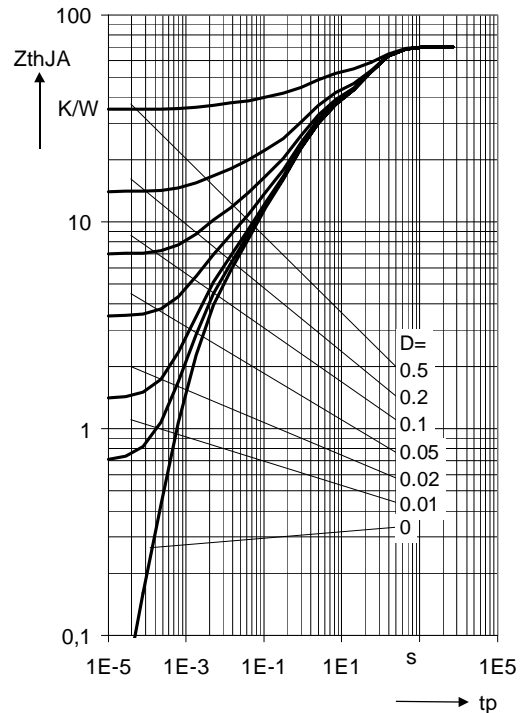
7 Typ. On-state Resistance

$R_{ON} = f(V_{IN}); I_D = 0.7\text{ A}, T_j = 25\text{ °C}$



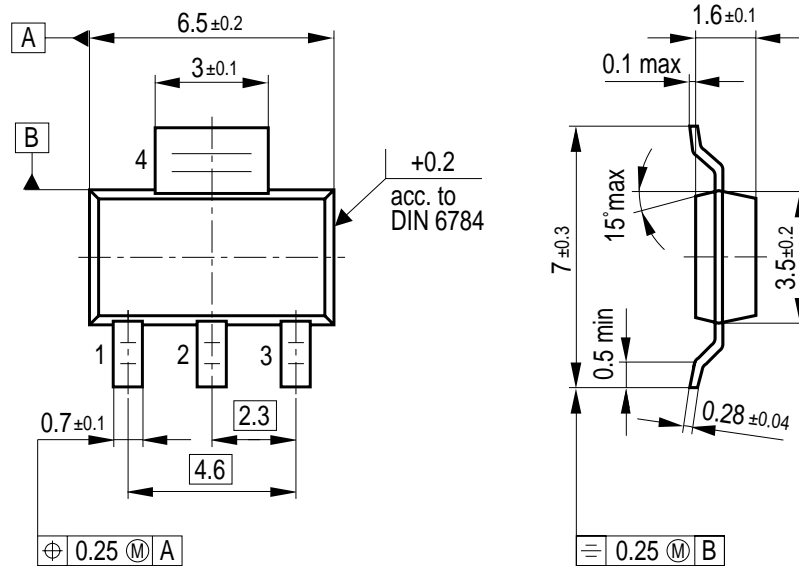
8 Max. transient thermal impedance

$Z_{thJA} = f(t_p) @ 6\text{ cm}^2\text{ cooling area}$



Package Outlines

P-SOT223-4-7
(Small Outline Transistor)



GPS05560

Sorts of Packing

Package outlines for tubes, trays etc. are contained in our Data Book "Package Information"

SMD = Surface Mounted Device

Dimensions in mm

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