

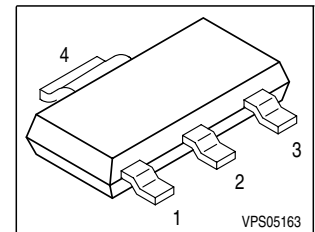
# Smart Lowside Power Switch

## Features

- Logic Level Input
- Input Protection (ESD)
- Thermal shutdown
- Overload protection
- Short circuit protection
- Overvoltage protection
- Current limitation
- Analog driving possible

## Product Summary

Drain source voltage	$V_{DS}$	42	V
On-state resistance	$R_{DS(on)}$	200	m $\Omega$
Nominal load current	$I_{D(Nom)}$	1.4	A
Clamping energy	$E_{AS}$	150	mJ

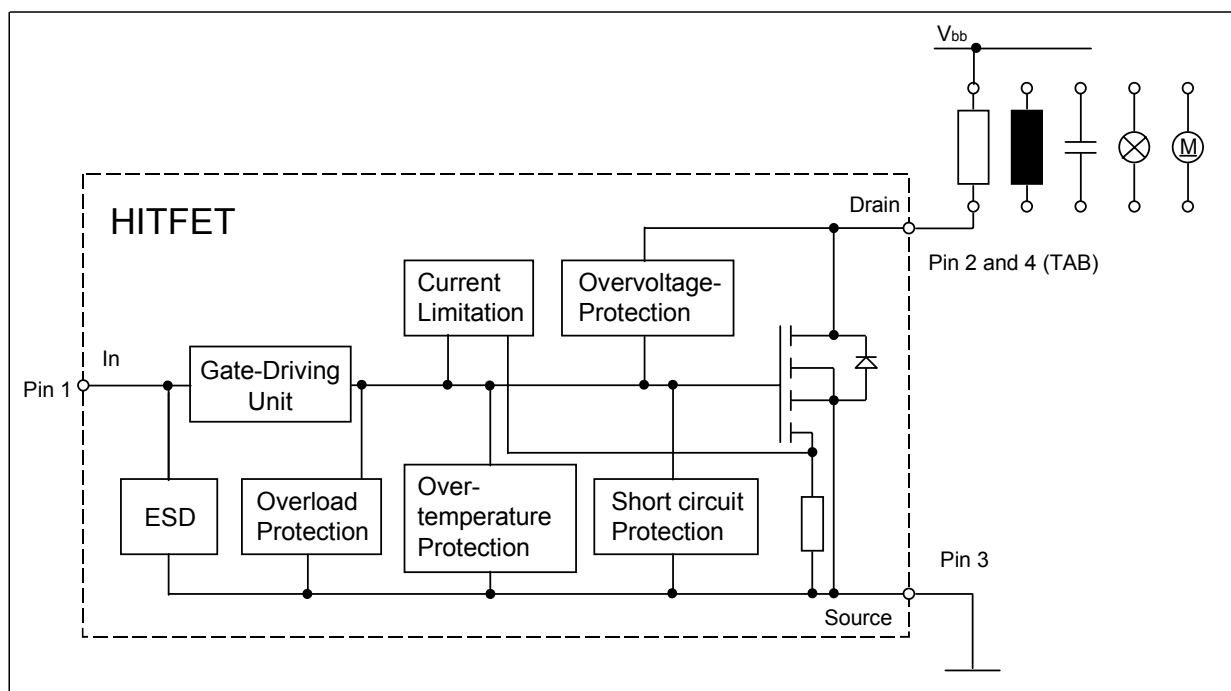


## Application

- All kinds of resistive, inductive and capacitive loads in switching or linear applications
- $\mu$ C compatible power switch for 12 V DC applications
- Replaces electromechanical relays and discrete circuits

## General Description

N channel vertical power FET in Smart SIPMOS® technology. Fully protected by embedded protection functions.



**Maximum Ratings at  $T_j = 25^\circ\text{C}$ , unless otherwise specified**

Parameter	Symbol	Value	Unit
Drain source voltage	$V_{DS}$	42	V
Drain source voltage for short circuit protection $T_j = -40\dots 150^\circ\text{C}$	$V_{DS(SC)}$	18	
Continuous input current $-0.2\text{V} \leq V_{IN} \leq 10\text{V}$ $V_{IN} < -0.2\text{V}$ or $V_{IN} > 10\text{V}$	$I_{IN}$	no limit $ I_{IN}  \leq 2$	mA
Operating temperature	$T_j$	-40 ... +150	$^\circ\text{C}$
Storage temperature	$T_{stg}$	-55 ... +150	
Power dissipation $T_C = 85^\circ\text{C}$	$P_{tot}$	3.8	W
Unclamped single pulse inductive energy <sup>1)</sup>	$E_{AS}$	150	mJ
Load dump protection $V_{LoadDump}^{2)} = V_A + V_S$ $V_{IN} = 0$ and $10\text{V}$ , $t_d = 400\text{ms}$ , $R_l = 2\ \Omega$ , $R_L = 9\ \Omega$ , $V_A = 13.5\text{V}$	$V_{LD}$	50	V
<b>Electrostatic discharge voltage</b> (Human Body Model) according to MIL STD 883D, method 3015.7 and EOS/ESD assn. standard S5.1 - 1993	$V_{ESD}$	2	kV
DIN humidity category, DIN 40 040		E	
IEC climatic category; DIN IEC 68-1		40/150/56	

**Thermal resistance**

junction - ambient: @ min. footprint @ $6\text{cm}^2$ cooling area <sup>3)</sup>	$R_{thJA}$	125 72	K/W
junction-soldering point:	$R_{thJS}$	17	K/W

<sup>1</sup> Not tested, specified by design.

<sup>2</sup>  $V_{LoadDump}$  is setup without the DUT connected to the generator per ISO 7637-1 and DIN 40839

<sup>3</sup> Device on  $50\text{mm} \times 50\text{mm} \times 1.5\text{mm}$  epoxy PCB FR4 with  $6\text{cm}^2$  (one layer,  $70\mu\text{m}$  thick) copper area for drain connection. PCB mounted vertical without blown air.

**Electrical Characteristics**

Parameter at $T_j = 25^\circ\text{C}$ , unless otherwise specified	Symbol	Values			Unit
		min.	typ.	max.	
<b>Characteristics</b>					
Drain source clamp voltage $T_j = -40 \dots +150$ , $I_D = 10 \text{ mA}$	$V_{DS(AZ)}$	42	-	55	V
Off-state drain current $T_j = -40 \dots +150^\circ\text{C}$ $V_{DS} = 32 \text{ V}$ , $V_{IN} = 0 \text{ V}$	$I_{DSS}$	-	1.5	10	$\mu\text{A}$
Input threshold voltage $I_D = 0.15 \text{ mA}$ , $T_j = 25^\circ\text{C}$ $I_D = 0.15 \text{ mA}$ , $T_j = 150^\circ\text{C}$	$V_{IN(th)}$	1.3 0.8	1.7 -	2.2 -	V
On state input current	$I_{IN(on)}$	-	10	30	$\mu\text{A}$
On-state resistance $V_{IN} = 5 \text{ V}$ , $I_D = 1.4 \text{ A}$ , $T_j = 25^\circ\text{C}$ $V_{IN} = 5 \text{ V}$ , $I_D = 1.4 \text{ A}$ , $T_j = 150^\circ\text{C}$	$R_{DS(on)}$	- -	190 350	240 480	$\text{m}\Omega$
On-state resistance $V_{IN} = 10 \text{ V}$ , $I_D = 1.4 \text{ A}$ , $T_j = 25^\circ\text{C}$ $V_{IN} = 10 \text{ V}$ , $I_D = 1.4 \text{ A}$ , $T_j = 150^\circ\text{C}$	$R_{DS(on)}$	- -	150 280	200 400	
Nominal load current $V_{DS} = 0.5 \text{ V}$ , $T_j < 150^\circ\text{C}$ , $V_{IN} = 10 \text{ V}$ , $T_A = 85^\circ\text{C}$	$I_{D(Nom)}$	1.4	-	-	A
Current limit (active if $V_{DS} > 2.5 \text{ V}$ ) <sup>1)</sup> $V_{IN} = 10 \text{ V}$ , $V_{DS} = 12 \text{ V}$ , $t_m = 200 \mu\text{s}$	$I_{D(lim)}$	5	7.5	10	

<sup>1)</sup>Device switched on into existing short circuit (see diagram Determination of  $I_{D(lim)}$ ). If the device is in on condition and a short circuit occurs, these values might be exceeded for max. 50  $\mu\text{s}$ .

### Electrical Characteristics

Parameter at $T_j = 25^\circ\text{C}$ , unless otherwise specified	Symbol	Values			Unit
		min.	typ.	max.	

### Dynamic Characteristics

Turn-on time $V_{IN}$ to 90% $I_D$ : $R_L = 4.7 \Omega$ , $V_{IN} = 0$ to 10 V, $V_{bb} = 12$ V	$t_{on}$	-	45	100	$\mu\text{s}$
Turn-off time $V_{IN}$ to 10% $I_D$ : $R_L = 4.7 \Omega$ , $V_{IN} = 10$ to 0 V, $V_{bb} = 12$ V	$t_{off}$	-	60	100	$\mu\text{s}$
Slew rate on 70 to 50% $V_{bb}$ : $R_L = 4.7 \Omega$ , $V_{IN} = 0$ to 10 V, $V_{bb} = 12$ V	$-dV_{DS}/dt_{on}$	-	0.4	1.5	V/ $\mu\text{s}$
Slew rate off 50 to 70% $V_{bb}$ : $R_L = 4.7 \Omega$ , $V_{IN} = 10$ to 0 V, $V_{bb} = 12$ V	$dV_{DS}/dt_{off}$	-	0.6	1.5	V/ $\mu\text{s}$

### Protection Functions<sup>1)</sup>

Thermal overload trip temperature	$T_{jt}$	150	175	-	$^\circ\text{C}$
Input current protection mode	$I_{IN(Prot)}$	25	50	300	$\mu\text{A}$
Input current protection mode $T_j = 150^\circ\text{C}$	$I_{IN(Prot)}$	-	40	300	$\mu\text{A}$
Unclamped single pulse inductive energy <sup>2)</sup> $I_D = 1.4$ A, $T_j = 25^\circ\text{C}$ , $V_{bb} = 12$ V	$E_{AS}$	150	-	-	mJ

### Inverse Diode

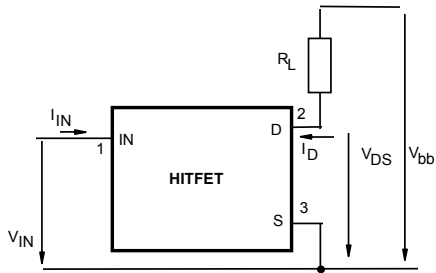
Inverse diode forward voltage $I_F = 7$ A, $t_m = 250 \mu\text{s}$ , $V_{IN} = 0$ V, $t_P = 300 \mu\text{s}$	$V_{SD}$	-	1	-	V
--------------------------------------------------------------------------------------------------------------------	----------	---	---	---	---

<sup>1</sup> 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.

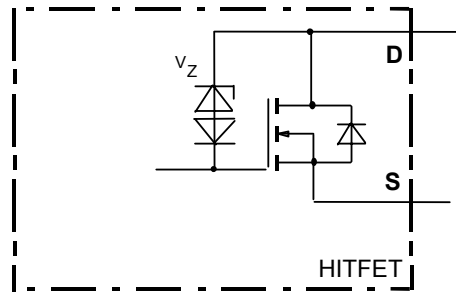
<sup>2</sup> Not tested, specified by design.

## Block diagram

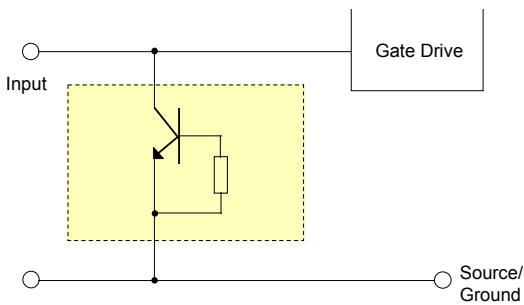
### Terms



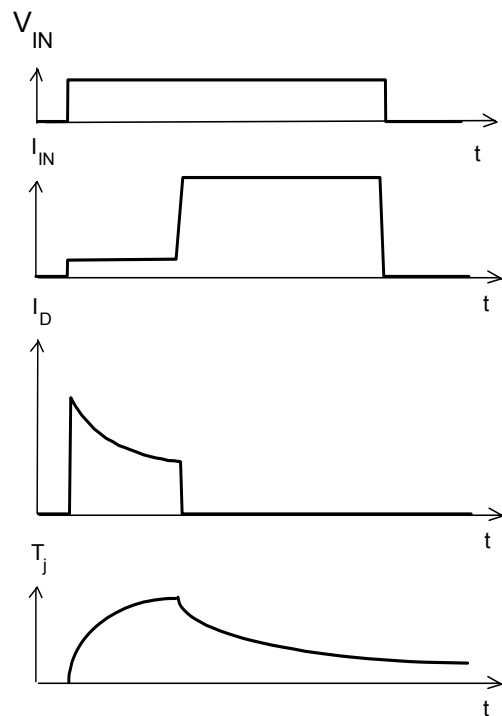
### Inductive and overvoltage output clamp



### Input circuit (ESD protection)



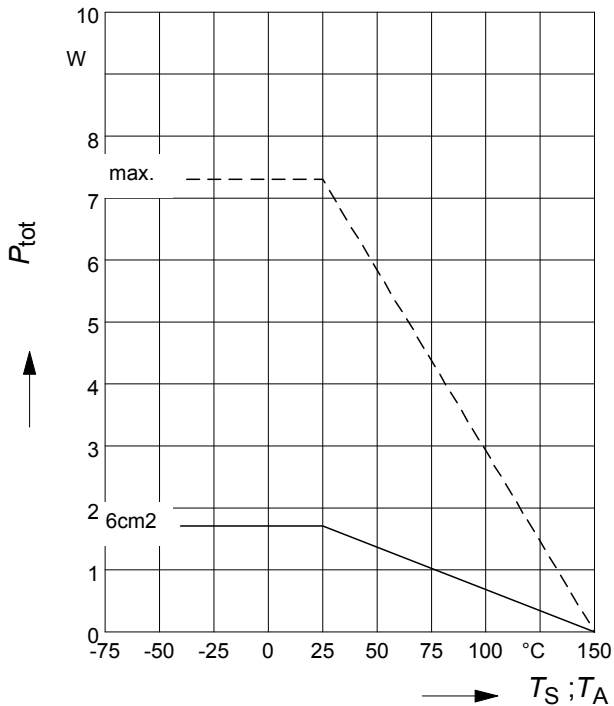
### Short circuit behaviour



### 1 Maximum allowable power dissipation

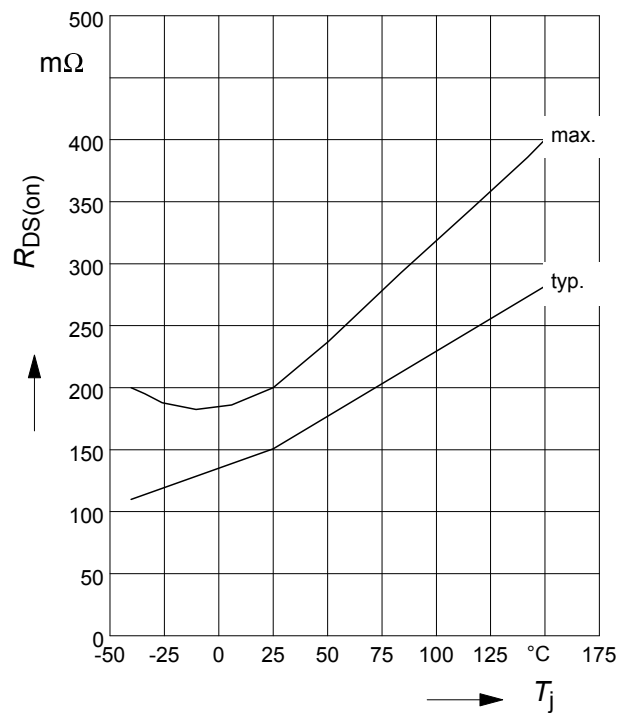
$P_{tot} = f(T_S)$  resp.

$P_{tot} = f(T_A) @ R_{thJA}=72 \text{ K/W}$



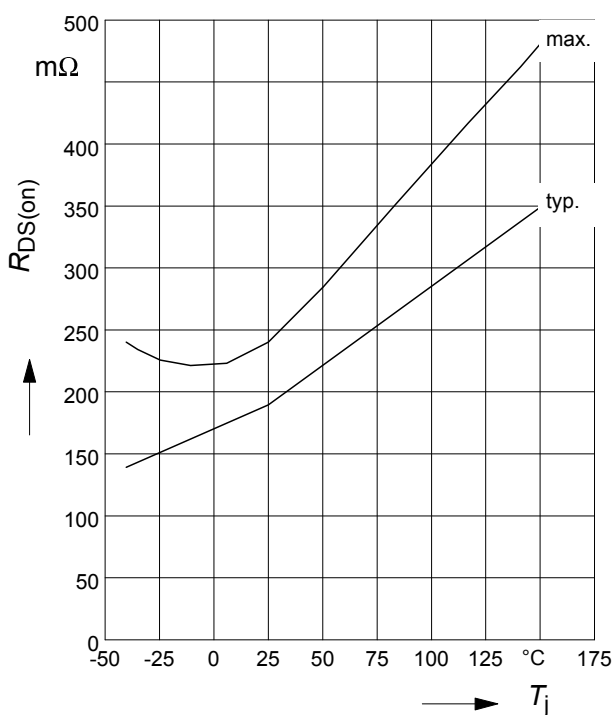
### 2 On-state resistance

$R_{ON} = f(T_j); I_D=1.4A; V_{IN}=10V$



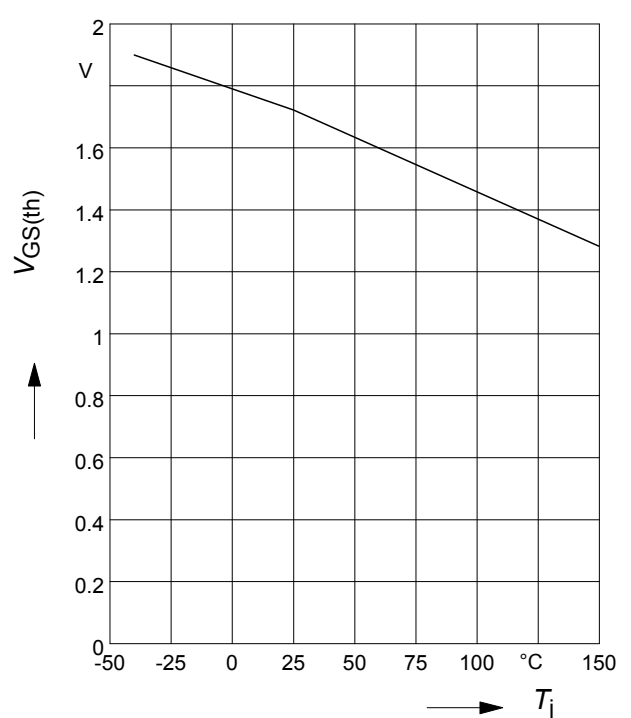
### 3 On-state resistance

$R_{ON} = f(T_j); I_D = 1.4A; V_{IN}=5V$



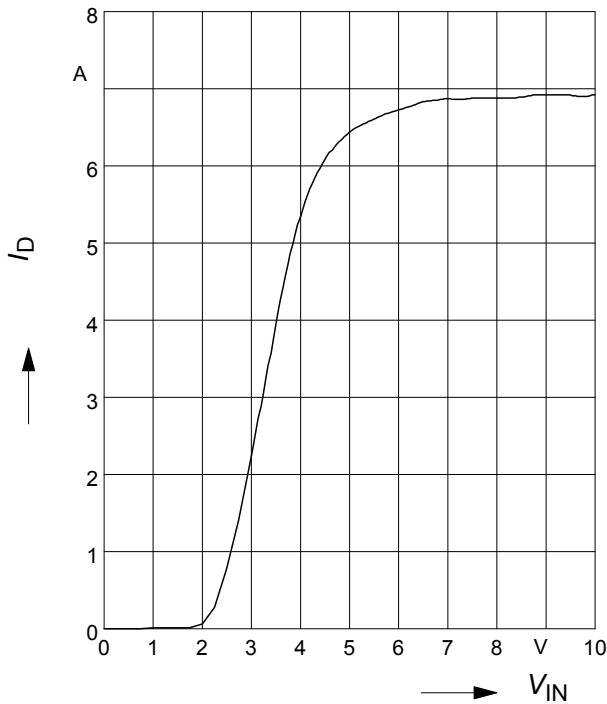
### 4 Typ. input threshold voltage

$V_{IN(th)} = f(T_j); I_D = 0.15 \text{ mA}; V_{DS} = 12V$



**5 Typ. transfer characteristics**

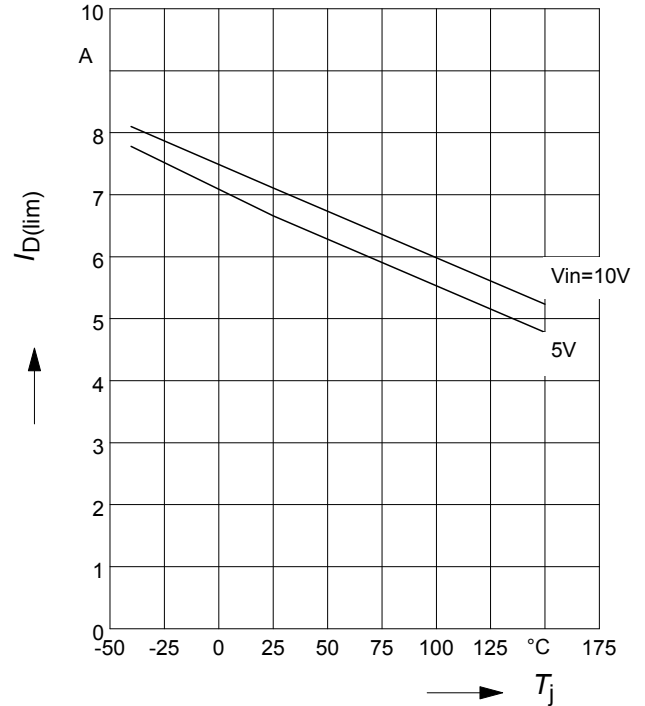
$I_D = f(V_{IN}); V_{DS} = 12V; T_{Jstart} = 25^\circ C$



**6 Typ. short circuit current**

$I_{D(lim)} = f(T_j); V_{DS} = 12V$

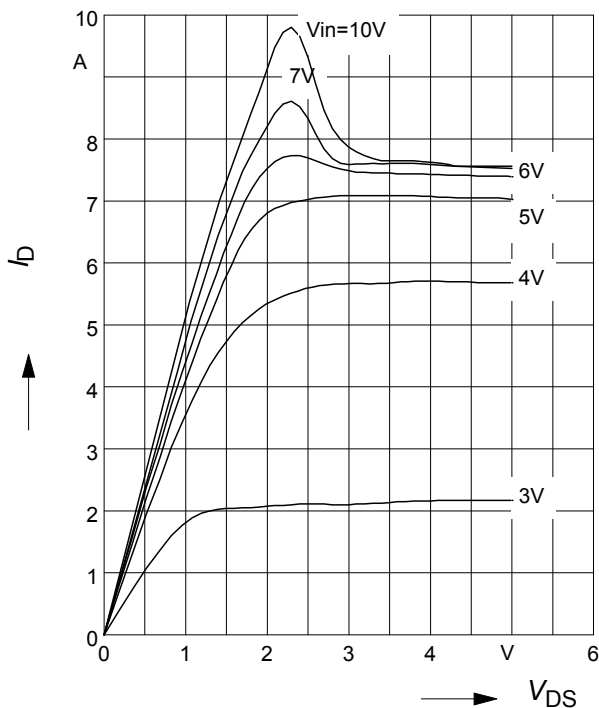
Parameter:  $V_{IN}$



**7 Typ. output characteristics**

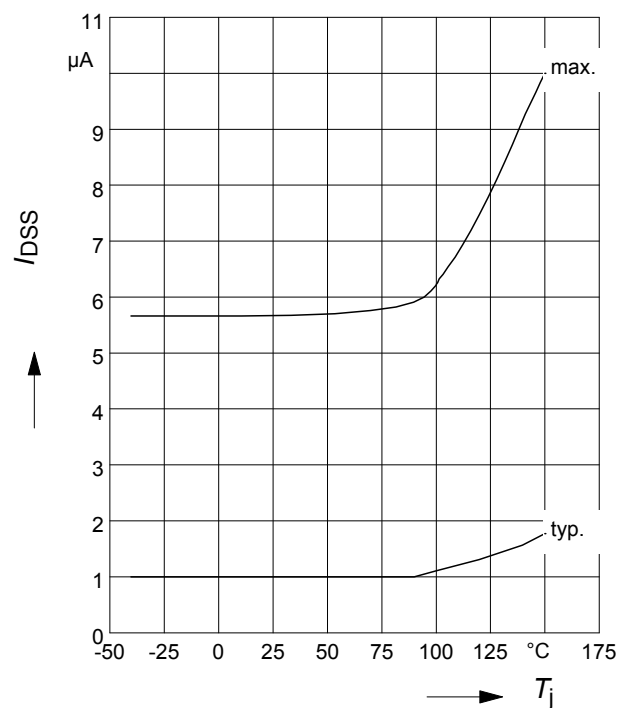
$I_D = f(V_{DS}); T_{Jstart} = 25^\circ C$

Parameter:  $V_{IN}$



**8 Typ. off-state drain current**

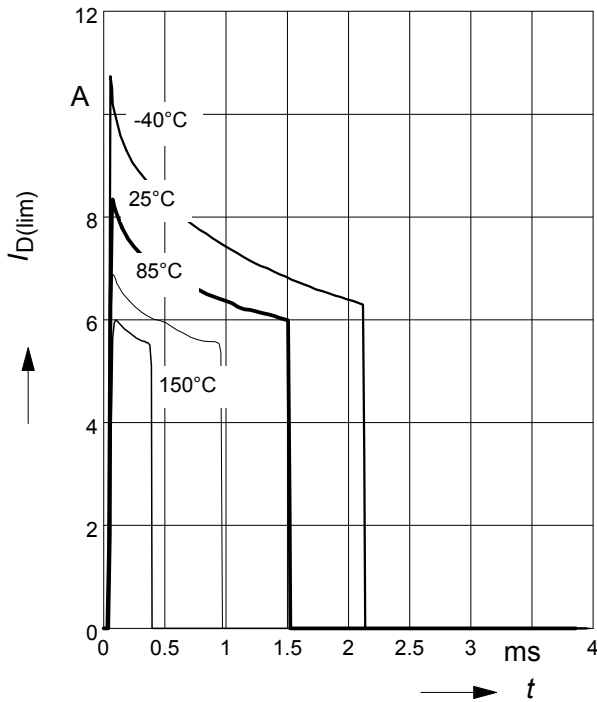
$I_{DSS} = f(T_j)$



**9 Typ. overload current**

$I_{D(lim)} = f(t)$ ,  $V_{bb}=12\text{ V}$ , no heatsink

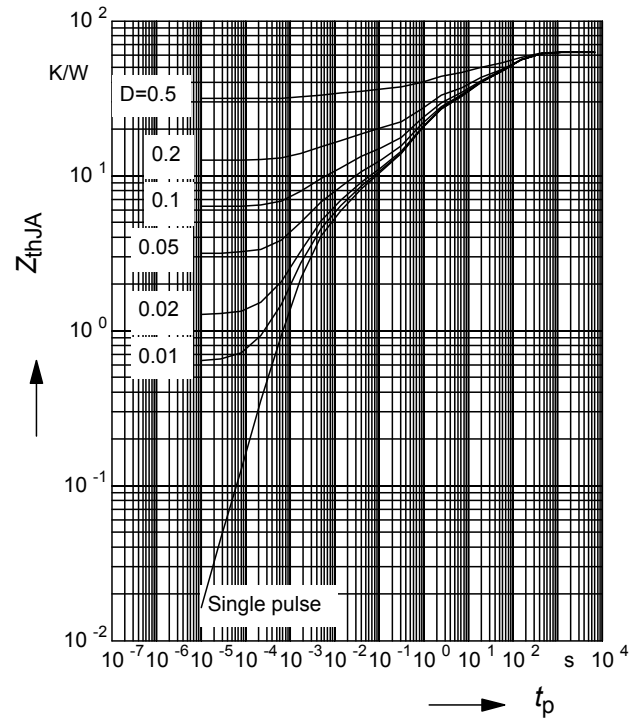
Parameter:  $T_{jstart}$



**10 Typ. transient thermal impedance**

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

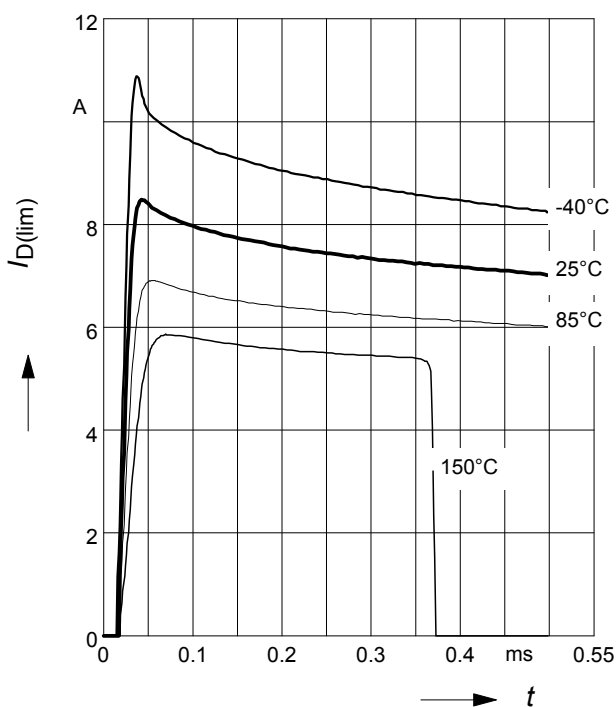
Parameter:  $D=t_p/T$



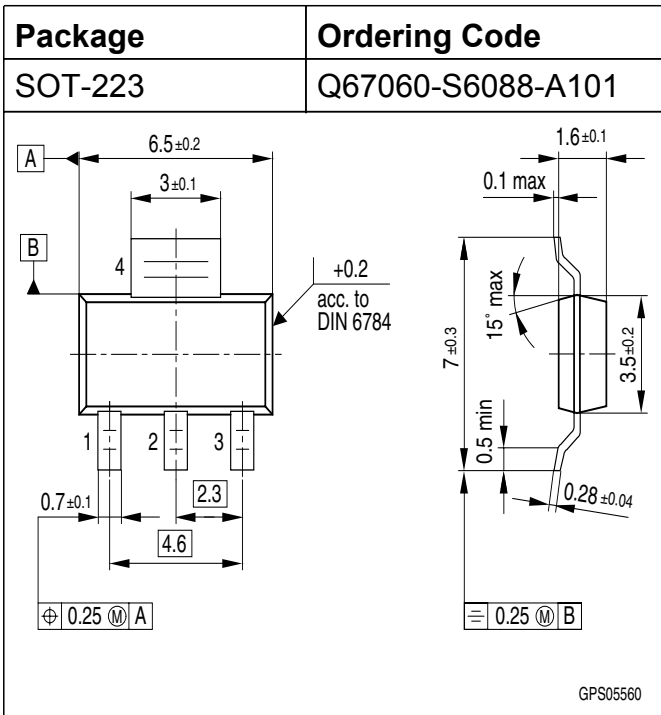
**11 Determination of  $I_{D(lim)}$**

$I_{D(lim)} = f(t)$ ;  $t_m = 200\mu\text{s}$

Parameter:  $T_{jstart}$







**Published by**  
**Infineon Technologies AG,**  
**Bereichs Kommunikation**  
**St.-Martin-Strasse 53,**  
**D-81541 München**  
**© Infineon Technologies AG 1999**  
**All Rights Reserved.**

**Attention please!**

The information herein is given to describe certain components and shall not be considered as warranted characteristics.

Terms of delivery and rights to technical change reserved.

We hereby disclaim any and all warranties, including but not limited to warranties of non-infringement, regarding circuits, descriptions and charts stated herein.

Infineon Technologies is an approved CECC manufacturer.

**Information**

For further information on technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies Office in Germany or our Infineon Technologies Representatives worldwide (see address list).

**Warnings**

Due to technical requirements components may contain dangerous substances.

For information on the types in question please contact your nearest Infineon Technologies Office.

Infineon Technologies Components may only be used in life-support devices or systems with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support device or system, or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body, or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.