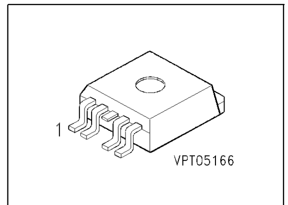
Smart Lowside Power Switch

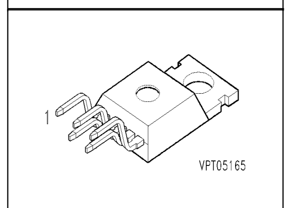
Features

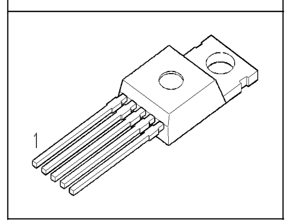
- Logic Level Input
- Input Protection (ESD)
- Thermal Shutdown
- Overload protection
- Short circuit protection
- Overvoltage protection
- Current limitation
- Maximum current adjustable with external resistor
- Current sense
- Status feedback with external input resistor
- Analog driving possible

Product Summary

Drain source voltage	V_{DS}	60	V
On-state resistance	$R_{DS(on)}$	100	mΩ
Current limit	$I_{D(lim)}$	1.5	A
Nominal load current	$I_{D(ISO)}$	3.5	A
Clamping energy	E_{AS}	1000	mJ





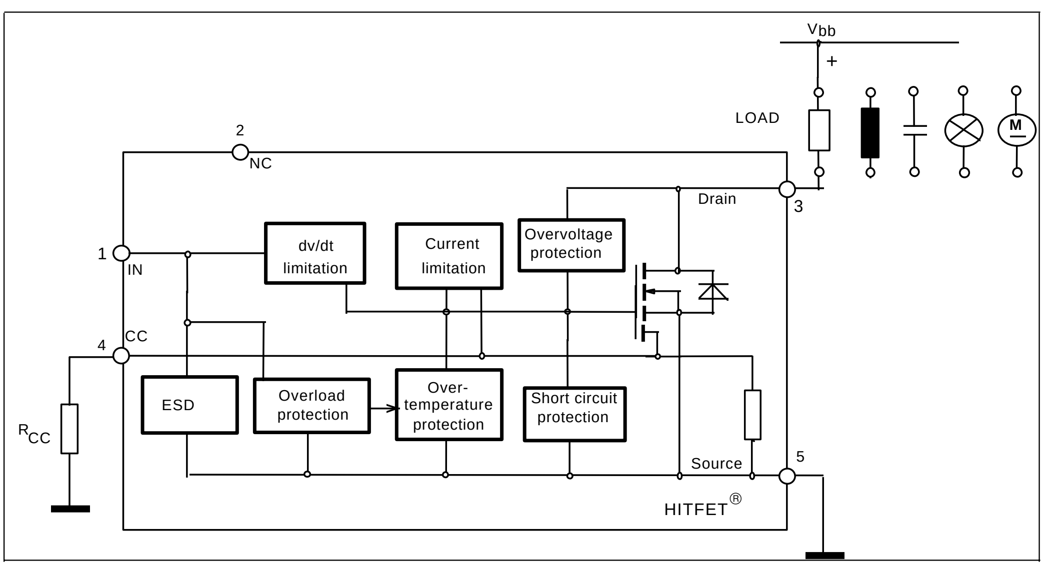


Application

- All kinds of resistive, inductive and capacitive loads in switching or linear 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 Smart SIPMOS® chip on chip technology. Fully protected by embedded protected functions.



Maximum Ratings at Tj = 25 °C unless otherwise specified

Parameter	**Symbol**	**Value**	**Unit**
Drain source voltage	V_{DS}	60	V
Drain source voltage for short circuit protection R_{CC} = 0 Ω without R_{CC}	$V_{DS(SC)}$	 15 50	
Continuous input current [1)] -0.2V ≤ V_{IN} ≤ 10V V_{IN} < -0.2V or V_{IN} > 10V	I_{IN}	 no limit | I_{IN} | ≤ 2	mA
Operating temperature	T_j	- 40 ... +150	°C
Storage temperature	T_{stg}	- 55 ... +150	
Power dissipation T_C = 25 °C	P_{tot}	50	W
Unclamped single pulse inductive energy $I_{D(ISO)}$ = 3.5 A	E_{AS}	1000	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}	3000	V
Load dump protection $V_{LoadDump}$[2)] = V_A + V_S V_{IN}=low or high; V_A=13.5 V t_d = 400 ms, R_I = 2 Ω, I_D=0,5*3.5A t_d = 400 ms, R_I = 2 Ω, I_D= 3.5A	V_{LD}	 75 70	
DIN humidity category, DIN 40 040		E	
IEC climatic category; DIN IEC 68-1		40/150/56	

Thermal resistance

junction - case:	R_{thJC}	2.5	K/W
junction - ambient:	R_{thJA}	75	
SMD version, device on PCB: [3)]	R_{thJA}	45	

[1]A sensor holding current of 500 µA has to be guaranted in the case of thermal shutdown (see also page 3)

[2]$V_{Loaddump}$ is setup without the DUT connected to the generator per ISO 7637-1 and DIN 40839

[3]Device on 50mm*50mm*1.5mm epoxy PCB FR4 with 6cm^2 (one layer, 70 µm thick) copper area for Drain connection. PCB is vertical without blown air.

Electrical Characteristics

Parameter at T_j=25°C, unless otherwise specified	**Symbol**	**Values**			**Unit**
		min.	**typ.**	**max.**	
Characteristics					
Drain source clamp voltage T_j = - 40 ...+ 150°C, I_D = 10 mA	$V_{DS(AZ)}$	60	-	73	V
Off state drain current V_{DS} = 32 V, T_j = -40...+150 °C, V_{IN} = 0 V	I_{DSS}	-	-	5	µA
Input threshold voltage I_D = 0,7 mA	$V_{IN(th)}$	1.3	1.7	2.2	V
Input current - normal operation, I_D<$I_{D(lim)}$: V_{IN} = 10 V	$I_{IN(1)}$	-	30	60	µA
Input current - current limitation mode, I_D=$I_{D(lim)}$: V_{IN} = 10 V	$I_{IN(2)}$	-	120	300	
Input current - after thermal shutdown, I_D=0 A: V_{IN} = 10 V	$I_{IN(3)}$	-	2200	4000	
Input holding current after thermal shutdown T_j = 25 °C T_j = 150 °C	$I_{IN(H)}$	 500 300	 - -	 - -	
On-state resistance I_D = 3.5 A, V_{IN} = 5 V, T_j = 25 °C I_D = 3.5 A, V_{IN} = 5 V, T_j = 150 °C	$R_{DS(on)}$	 - -	 90 180	 120 240	mΩ
On-state resistance I_D = 3.5 A, V_{IN} = 10 V, T_j = 25 °C I_D = 3.5 A, V_{IN} = 10 V, T_j = 150 °C	$R_{DS(on)}$	 - -	 80 160	 100 200	
Nominal load current (ISO 10483) V_{IN} = 10 V, V_{DS} = 0.5 V, T_C = 85 °C	$I_{D(ISO)}$	3.5	-	-	A

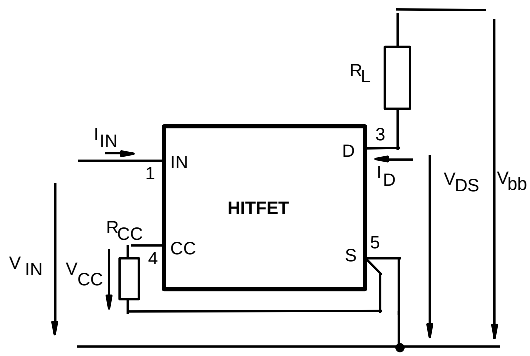
Electrical Characteristics

Parameter at T_j=25°C, unless otherwise specified	Symbol	Values min.	Values typ.	Values max.	Unit
Characteristics					
Initial peak short circuit current limit V_{IN} = 10 V, V_{DS} = 12 V	$I_{D(SCp)}$	-	80	-	A
Current limit [1)] V_{IN} = 10 V, V_{DS} = 12 V, t_m = 350 µs, T_j = -40...+150 °C, without R_{CC} V_{IN} = 10 V, V_{DS} = 12 V, t_m = 350 µs, T_j = -40...+150 °C, R_{CC} = 0 Ω	$I_{D(lim)}$	 1.5 35	 2.5 45	 6 55	
Dynamic Characteristics					
Turn-on time V_{IN} to 90% I_D: R_L = 4,7 Ω, V_{IN} = 0 to 10 V, V_{bb} = 12 V	t_{on}	-	40	70	µs
Turn-off time V_{IN} to 10% I_D: R_L = 4,7 Ω, V_{IN} = 10 to 0 V, V_{bb} = 12 V	t_{off}	-	70	150	
Slew rate on 70 to 50% V_{bb}: R_L = 4,7 Ω, V_{IN} = 0 to 10 V, V_{bb} = 12 V	$-dV_{DS}/dt_{on}$	-	1	3	V/µs
Slew rate off 50 to 70% V_{bb}: R_L = 4,7 Ω, V_{IN} = 10 to 0 V, V_{bb} = 12 V	dV_{DS}/dt_{off}	-	1	3	
Protection Functions					
Thermal overload trip temperature	T_{jt}	150	165	-	°C
Unclamped single pulse inductive energy I_D = 3.5 A, T_j = 25 °C, V_{bb} = 32 V I_D = 3.5 A, T_j = 150 °C, V_{bb} = 32 V	E_{AS}	 1000 225	 - -	 - -	mJ
Inverse Diode					
Inverse diode forward voltage I_F = 5*3.5A, t_m = 300 µs, V_{IN} = 0 V	V_{SD}	-	1	-	V

[1]Device switched on into existing short circuit (see diagram Determination of $I_{D(lim)}$. Dependant on the application, these values might be exceeded for max. 50 µs in case of short circuit occurs while the device is on condition

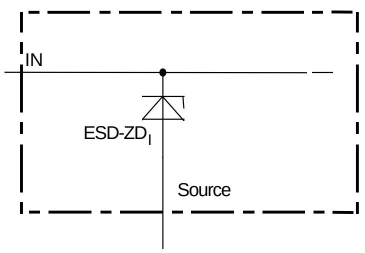
Block Diagramm

Terms



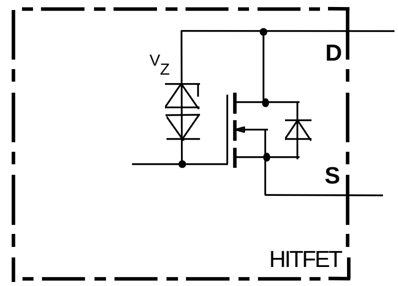
The ground lead impedance of R_{CC} should be as low as possible

Input circuit (ESD protection)

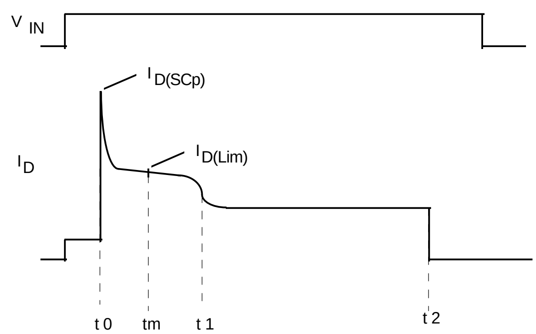


ESD zener diodes are not designed for DC current > 2 mA @ V_{IN}>10V.

Inductive and overvoltage output clamp



Short circuit behaviour



t_0: Turn on into a short circuit

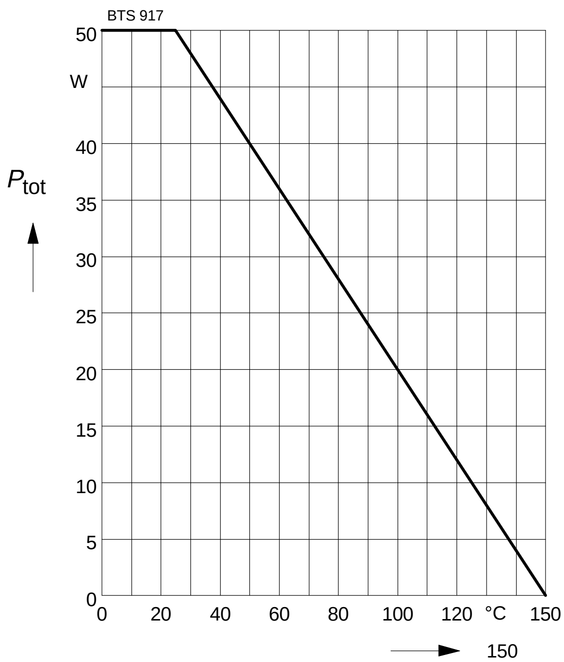
t_m: Measurementpoint for $I_{D(lim)}$

t_1: Activation of the fast temperature sensor and regulation of the drain current to a level wher the junction temperature remains constant.

t_2: Thermal shutdown caused by the second temperature sensor, achieved by an integrating measurement.

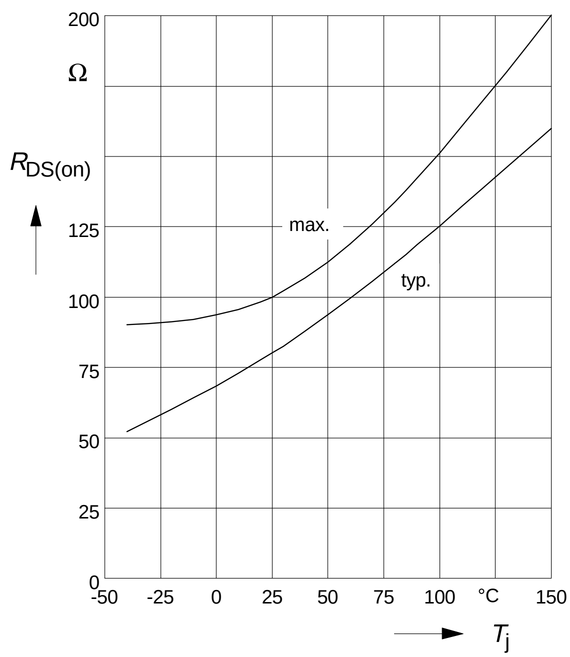
Maximum allowable power dissipation

$P_{tot} = f(T_c)$



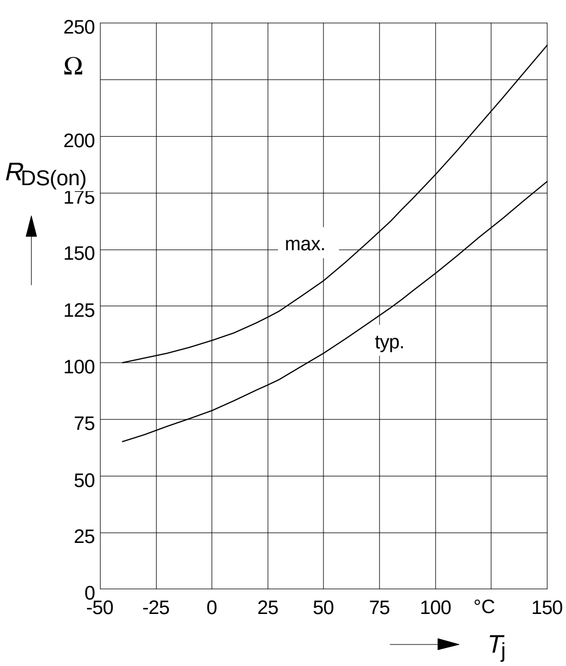
On-state resistance

$R_{ON} = f(T_j)$; I_D=3.5A; V_{IN}=10V



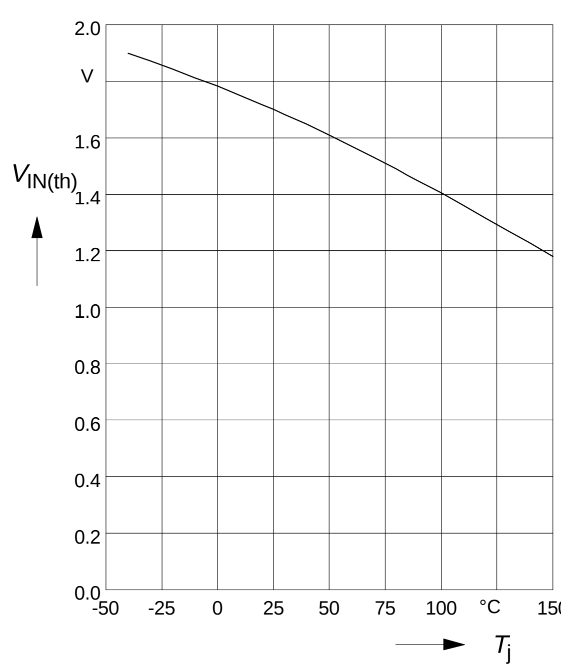
On-state resistance

$R_{ON} = f(T_j)$; I_D= 3.5A; V_{IN}=5V



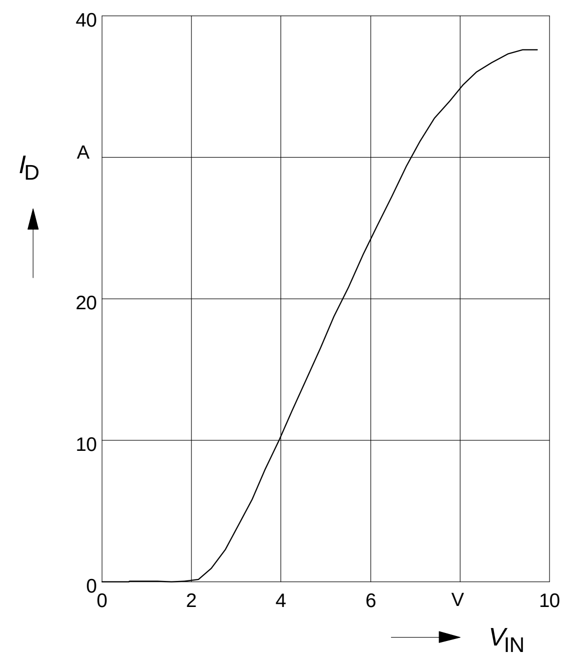
Typ. input threshold voltage

$V_{IN(th)} = f(T_j)$; I_D=0,7A; V_{DS}=12V



Typ. transfer characteristics

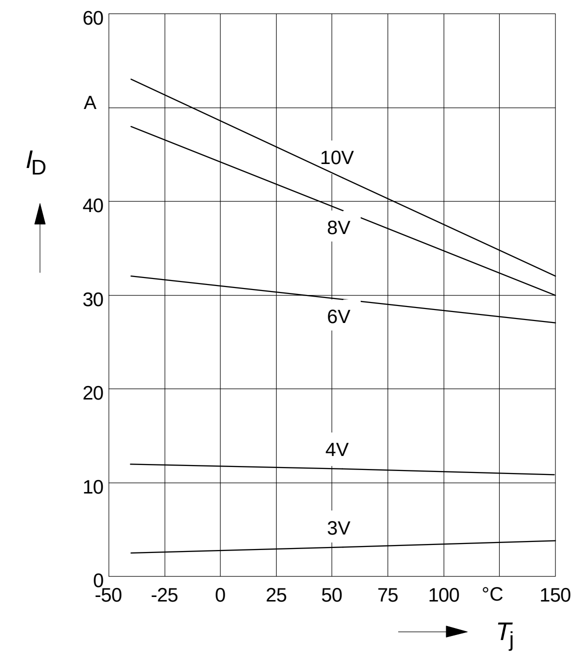
I_D = f(V_{IN}); V_{DS}=12V; T_j=25°C



Typ. short circuit current

I_{Dlim} = f(T_j); R_{CC}=0Ω, V_{DS}=12V

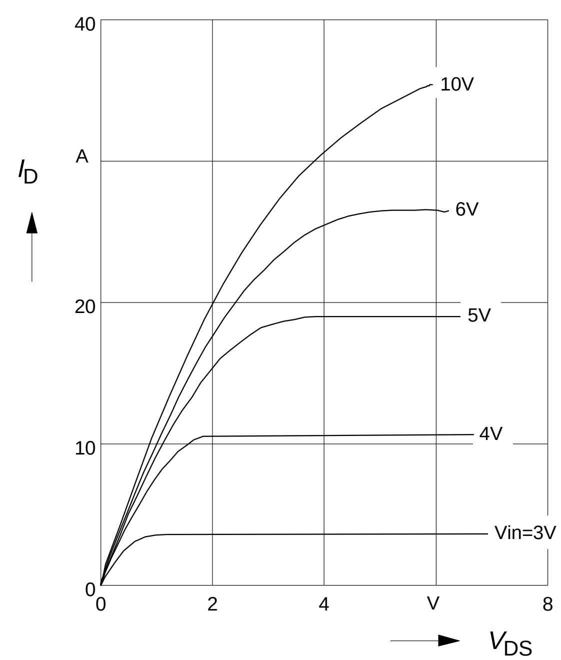
Parameter: V_{IN}



Typ. output characteristic

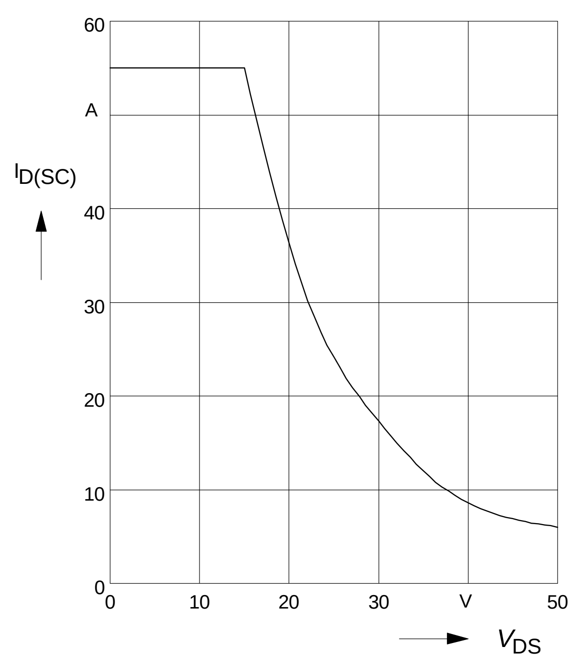
I_D = f(V_{DS}); T_j=25°C

Parameter: V_{IN}



Safe Operating Area

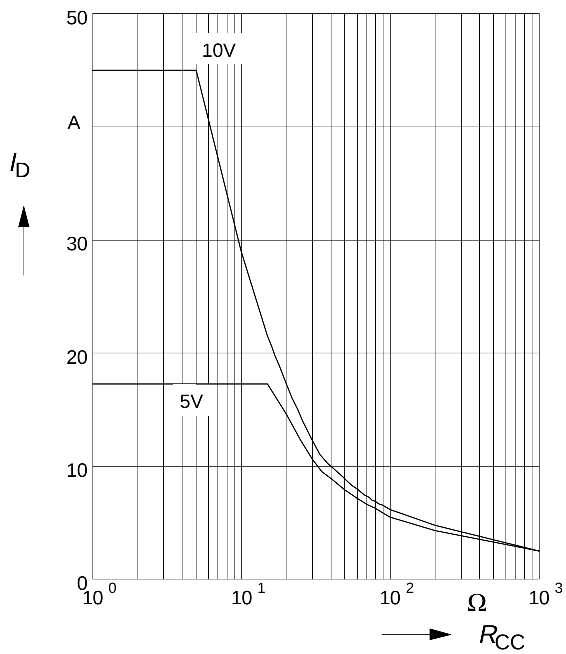
$I_{D(SC)}$ = f(V_{DS}); T_j=25°C



Typ. current limit versus R_{CC}

$I_{D(lim)} = f(R_{CC})$; T_j=25°C

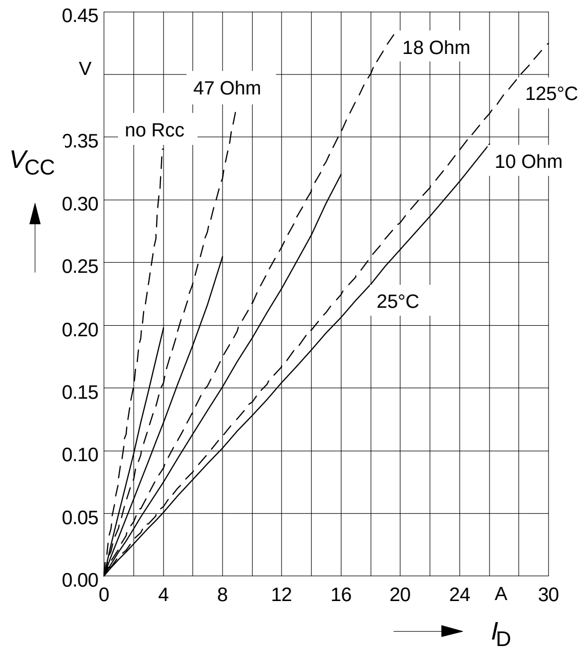
Parameter: V_{IN}



Typ. current sense characteristics

$V_{CC} = f(I_D)$; V_{IN}=10V

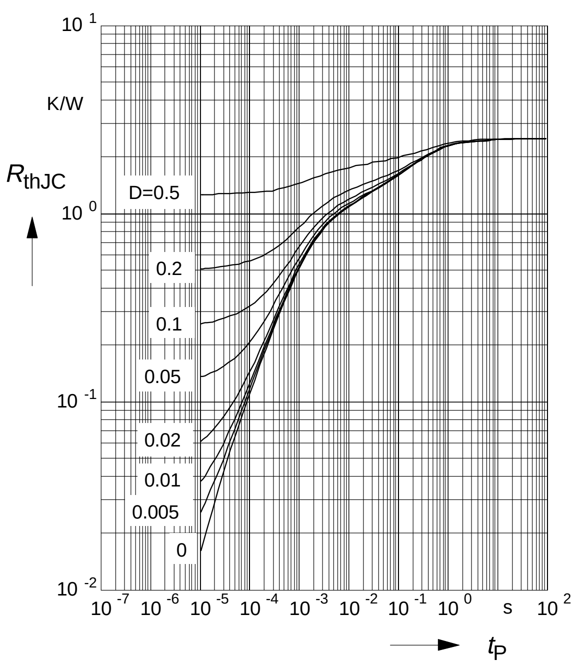
Parameter: R_{CC}, T_j



Transient thermal impedance

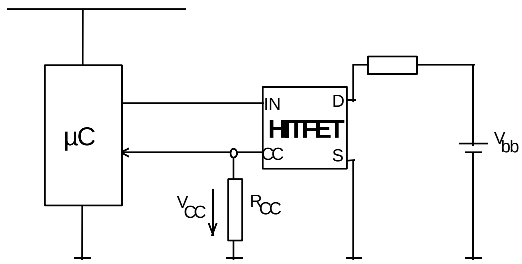
$Z_{thJC} = f(t_P)$

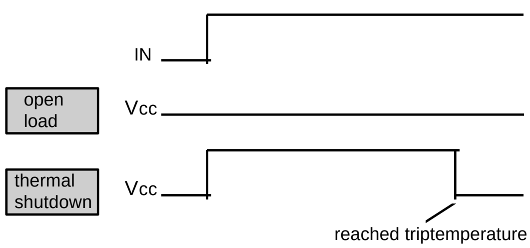
Parameter: D=t_P/T



Application examples:

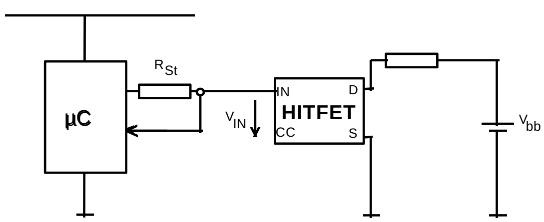
Current Sense Features and Status Signals

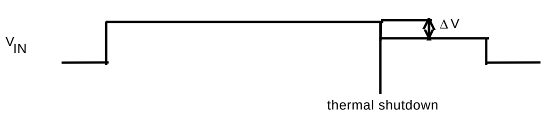




The accuray of Vcc is at each temperature about ±10 %

Status signal of thermal shutdown by monitoring input current



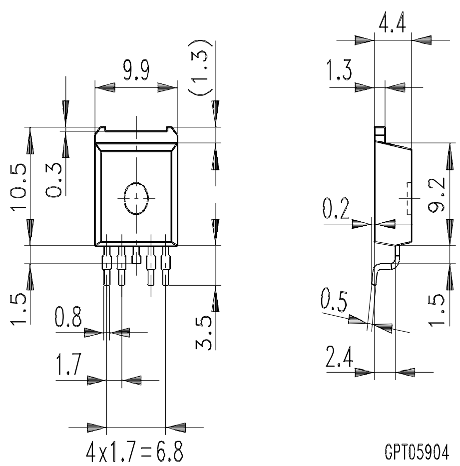


$\Delta V = R_{ST} * I_{IN(3)}$

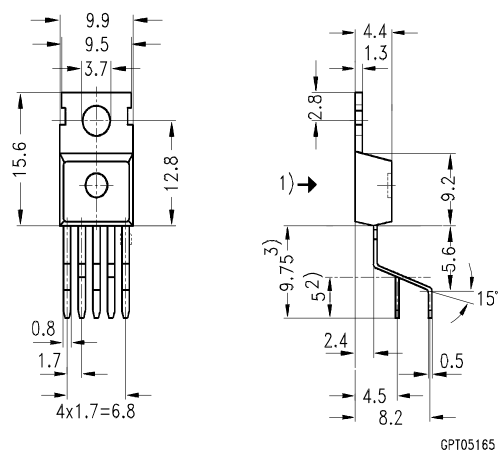
Package and ordering code

all dimensions in mm

Ordering code: Q67060-S6700-A4

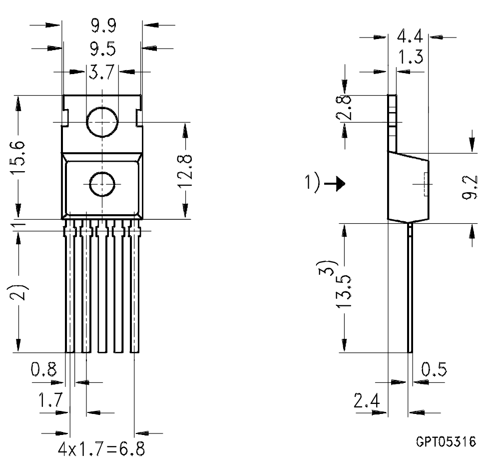


Ordering Code: Q67060-S6700-A2



1) shear and punch direction no burrs this surface
2) min. length by tinning
3) max. 11 mm allowable by tinning

Ordering Code: Q67060-S6700-A3



1) punch direction, burr max. 0.04
2) dip tinning
3) max. 14.5 by dip tinning press burr max. 0.05

Edition 7.97
Published by Siemens AG,
Bereich Halbleiter Vetrieb,
Werbung, Balanstraße 73,
81541 München
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