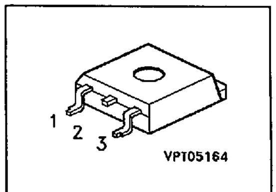
Smart Lowside Power Switch

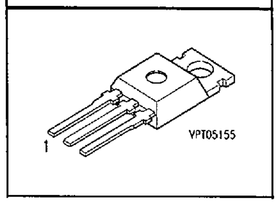
Features

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

Product Summary

Drain source voltage	V_{DS}	60	V
On-state resistance	$R_{DS(on)}$	50	mΩ
Current limit	$I_{D(lim)}$	21	A
Nominal load current	$I_{D(ISO)}$	7	A
Clamping energy	E_{AS}	2000	mJ



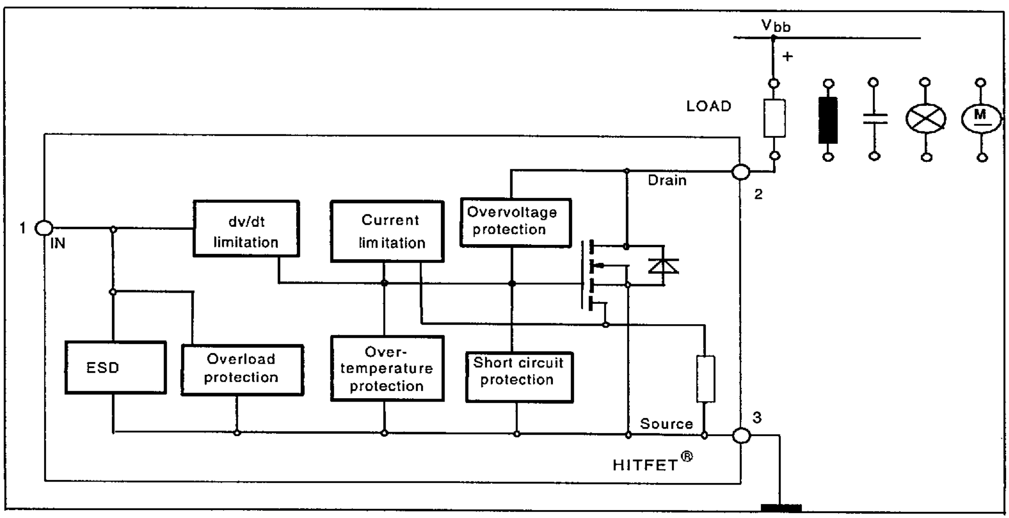


Application

- 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	$V_{DS(SC)}$	32	
Continuous input current [1] $-0.2V \le V_{IN} \le 10V$ $V_{IN} < -0.2V$ or $V_{IN} > 10V$	I_{IN}	 no limit $\mid I_{IN} \mid \le 2$	mA
Operating temperature	T_j	- 40 ... +150	°C
Storage temperature	T_{stg}	- 55 ... +150	
Power dissipation T_C = 25 °C	P_{tot}	90	W
Unclamped single pulse inductive energy $I_{D(ISO)}$ = 7 A	E_{AS}	2000	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*7A t_d = 400 ms, R_I = 2 Ω, I_D= 7A	V_{LD}	 90 74	
DIN humidity category, DIN 40 040		E	
IEC climatic category; DIN IEC 68-1		40/150/56	

Thermal resistance

junction - case:	R_{thJC}	1.4	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 guaranteed 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 6cm² (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}	-	-	10	µA
Input threshold voltage I_D = 1,4 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	55	µA
Input current - current limitation mode, I_D=$I_{D(lim)}$: V_{IN} = 10 V	$I_{IN(2)}$	60	150	350	
Input current - after thermal shutdown, I_D=0 A: V_{IN} = 10 V	$I_{IN(3)}$	1000	2500	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 = 7 A, V_{IN} = 5 V, T_j = 25 °C I_D = 7 A, V_{IN} = 5 V, T_j = 150 °C	$R_{DS(on)}$	 - -	 50 90	 60 120	mΩ
On-state resistance I_D = 7 A, V_{IN} = 10 V, T_j = 25 °C I_D = 7 A, V_{IN} = 10 V, T_j = 150 °C	$R_{DS(on)}$	 - -	 40 75	 50 100	
Nominal load current (ISO 10483) V_{IN} = 10 V, V_{DS} = 0.5 V, T_C = 85 °C	$I_{D(ISO)}$	7	-	-	A

Electrical Characteristics

Parameter at T_j=25°C, unless otherwise specified	Symbol	Values			Unit
		min.	typ.	max.	
Characteristics					
Initial peak short circuit current limit V_{IN} = 10 V, V_{DS} = 12 V	$I_{D(SCp)}$	-	65	-	A
Current limit [1] V_{IN} = 10 V, V_{DS} = 12 V, t_m = 350 µs, T_j = -40...+150 °C	$I_{D(lim)}$	21	28	40	
Dynamic Characteristics					
Turn-on time V_{IN} to 90% I_D: R_L = 2,2 Ω, V_{IN} = 0 to 10 V, V_{bb} = 12 V	t_{on}	--	40	100	µs
Turn-off time V_{IN} to 10% I_D: R_L = 2,2 Ω, V_{IN} = 10 to 0 V, V_{bb} = 12 V	t_{off}	--	70	170	
Slew rate on 70 to 50% V_{bb}: R_L = 2,2 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 = 2,2 Ω, V_{IN} = 10 to 0 V, V_{bb} = 12 V	dV_{DS}/dt_{off}	--	1	3	

Protection Functions

Parameter	Symbol	min.	typ.	max.	Unit
Thermal overload trip temperature	T_{jt}	150	165	-	°C
Unclamped single pulse inductive energy	E_{AS}				mJ
I_D = 7 A, T_j = 25 °C, V_{bb} = 32 V		2000	-	-	
I_D = 7 A, T_j = 150 °C, V_{bb} = 32 V		450	-	-	

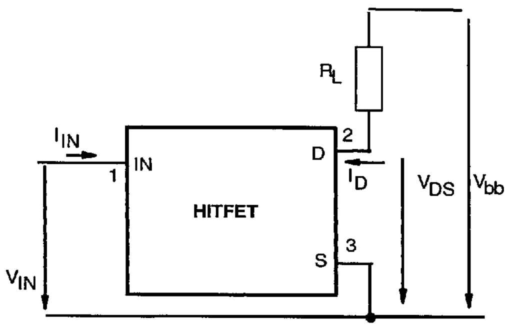
Inverse Diode

Parameter	Symbol	min.	typ.	max.	Unit
Inverse diode forward voltage I_F = 5*7A, t_m = 300 µs, V_{IN} = 0 V	V_{SD}	-	1.08	-	V

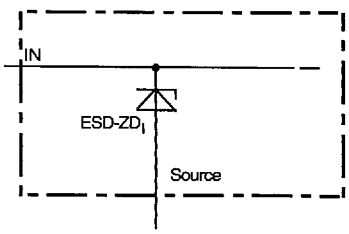
[1] Device switched on into existing short circuit (see diagram Determination of $I_{D(lim)}$. Dependant on the application, these values might be exceeded for max. 50 µs in case of short circuit occurs while the device is on condition

Block Diagramm

Terms

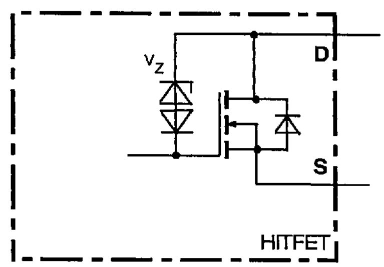


Input circuit (ESD protection)

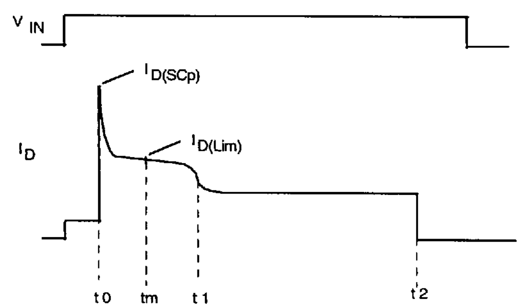


ESD zener diodes are not designed for DC current > 2 mA @ V_{IN}>10V.

Inductive and overvoltage output clamp



Short circuit behaviour



t_0: Turn on into a short circuit

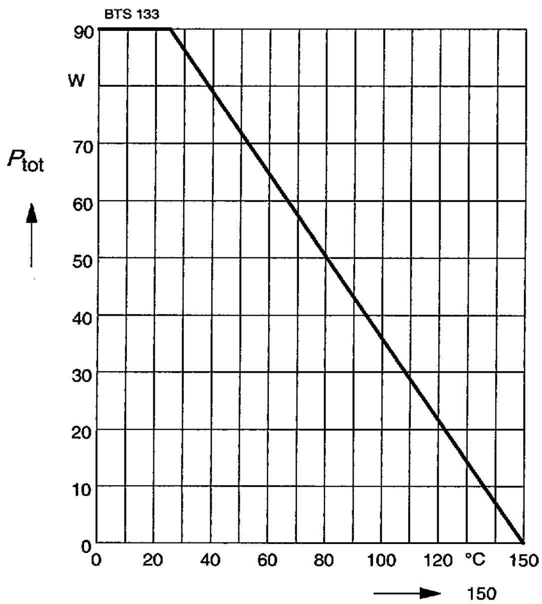
t_m: Measurementpoint for $I_{D(lim)}$

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.

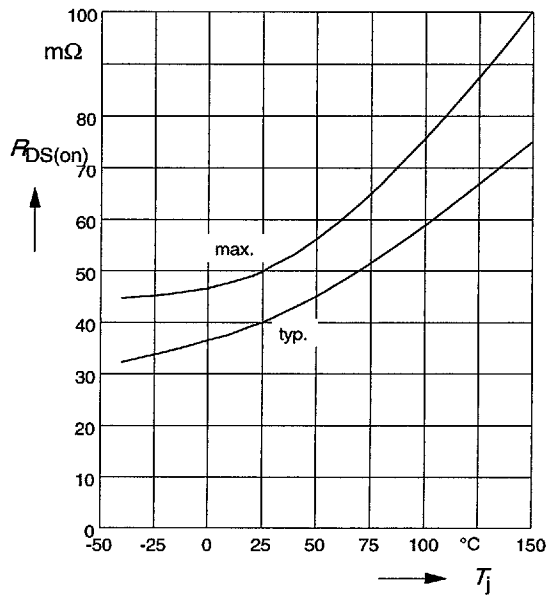
Maximum allowable power dissipation

$P_{tot} = f(T_c)$



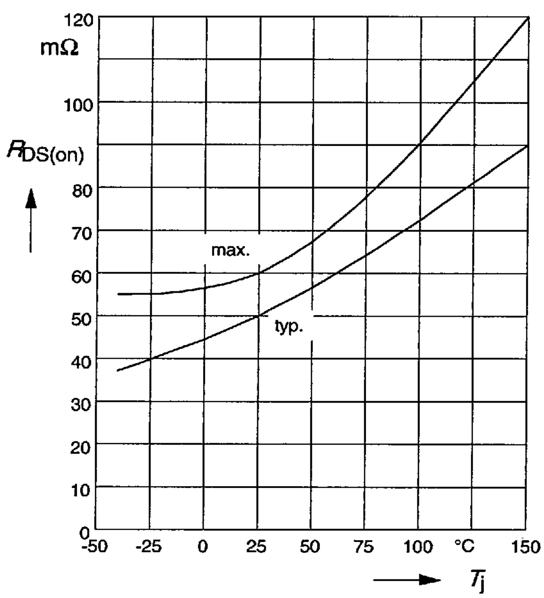
On-state resistance

$R_{ON} = f(T_j)$; I_D=7A; V_{IN}=10V



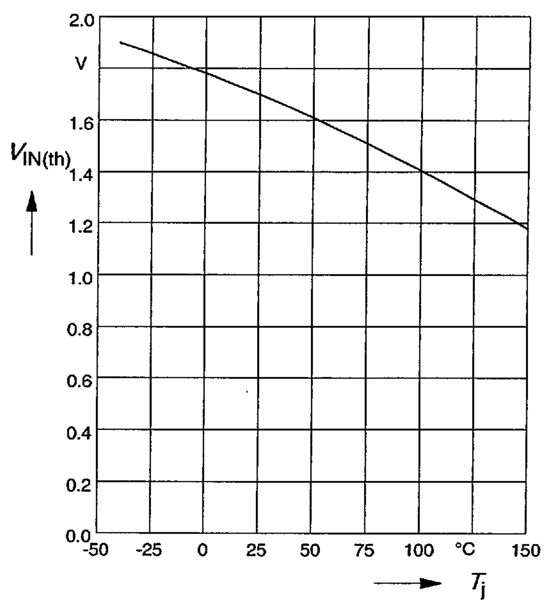
On-state resistance

$R_{ON} = f(T_j)$; I_D= 7A; V_{IN}=5V



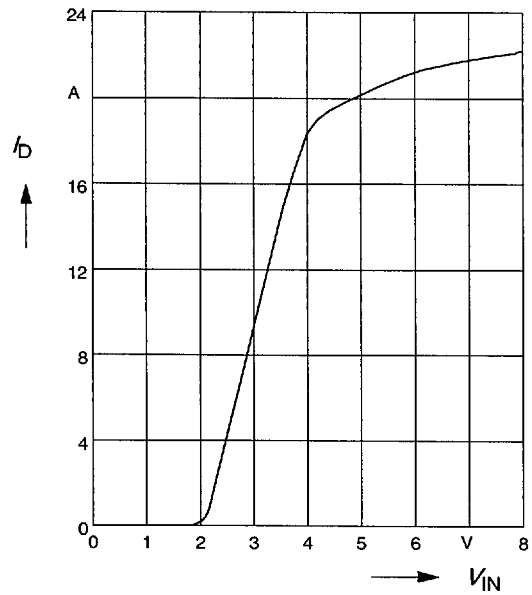
Typ. input threshold voltage

$V_{IN(th)} = f(T_j)$; I_D=1,4A; V_{DS}=12V



Typ. transfer characteristics

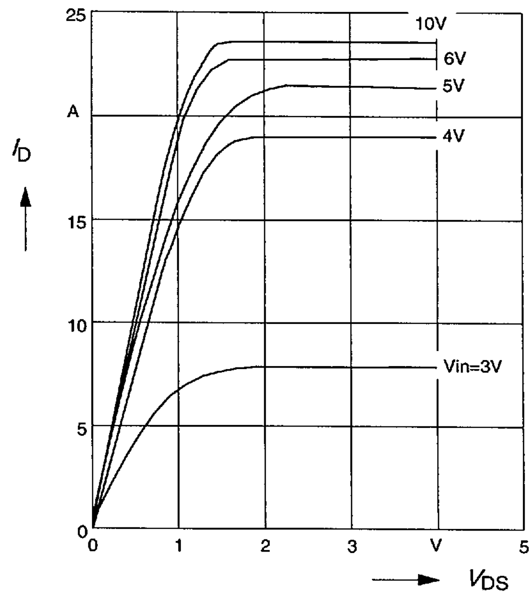
$I_D = f(V_{IN})$; V_{DS}=12V; T_j=25°C



Typ. output characteristic

$I_D = f(V_{DS})$; T_j=25°C

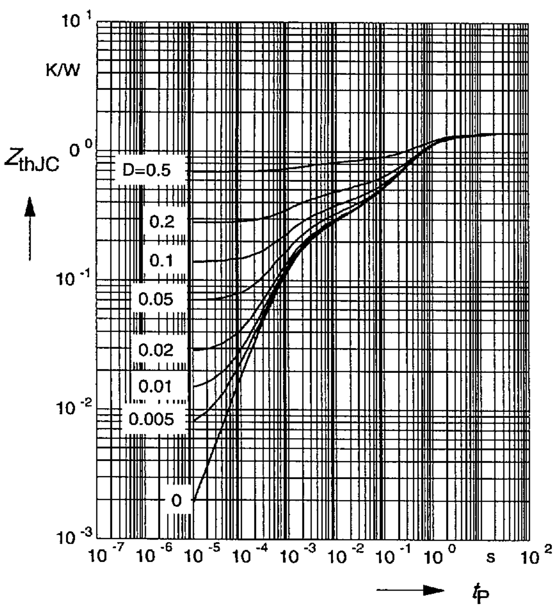
Parameter: V_{IN}



Transient thermal impedance

$Z_{thJC} = f(t_P)$

Parameter: $D=t_P/T$



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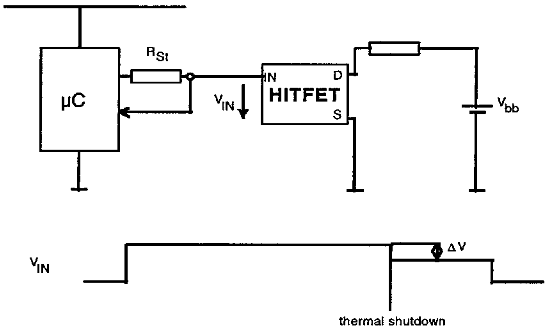
Application examples:

Status signal of thermal shutdown by monitoring input current

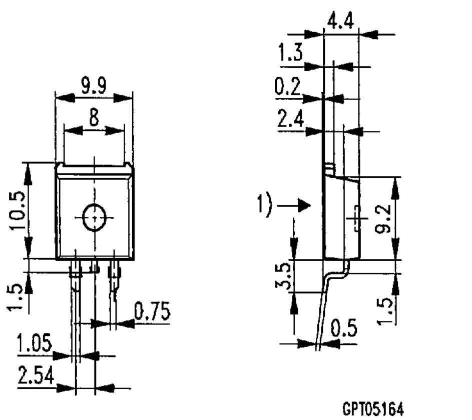


$\Delta V = R_{ST} * I_{IN(3)}$

Package and ordering code

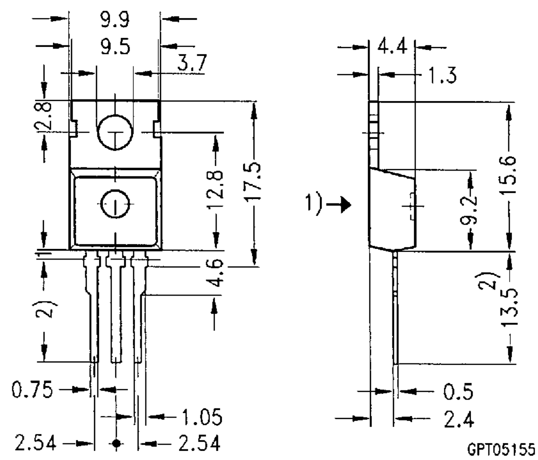
all dimensions in mm

Ordering code: Q67060-S6501-A3



1) shear and punch direction no burrs this surface

Ordering Code: Q67060-S6501-A2



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

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