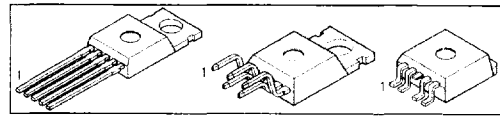
Smart Lowside Power Switch

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

Product Summary

Continuous drain source voltage	V_{DS}	60	V
On-state resistance	$R_{DS(ON)}$	18	mΩ
Current limitation	$I_{D(lim)}$	tbd	A
Load current (ISO)	$I_{D(ISO)}$	19	A
Clamping energy	E_{AS}	1900	mJ

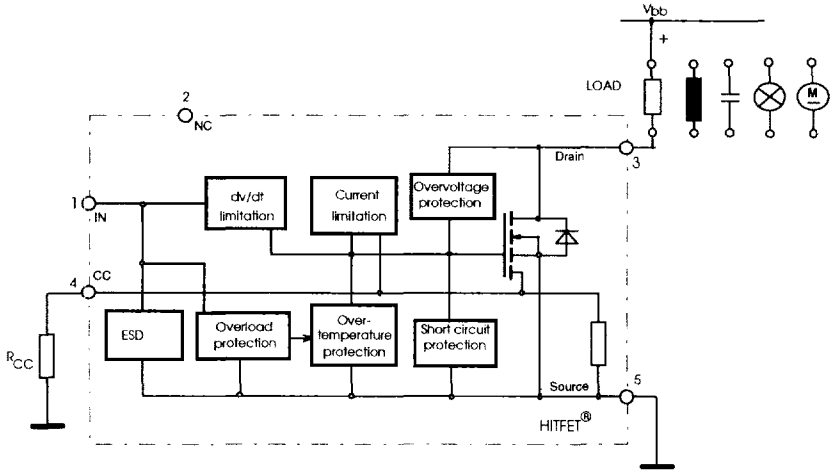


Application

- 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 protection functions.



Pin	Symbol		Function
1	IN		Input
2	NC		No connect
3	DRAIN		Output to the load
4	CC		Current control by external resistor
5	SOURCE		Ground
TAB	DRAIN		Output to the load

Maximum Ratings at T_j=25°C unless otherwise specified

Parameter		Symbol	Values	Unit
Continuous drain source voltage (overvoltage protection see page 222)		V_{DS}	60	V
Drain source voltage for short circuit protection	with R_{CC} = 0 Ω:	V_{DS}	15	V
	without R_{CC}:		50	
Continuous input current[1]	-0.2V ≤V_{IN}≤10V	I_{IN}	no limit	mA
	V_{IN}<-0.2V or V_{IN}>10V		$\|I_{IN}\|$ ≤ 2	
Operating temperature range		T_j	-40 ...+150	°C
Storage temperature range		T_{stg}	-55 ...+150	
Power dissipation (DC)		P_{tot}	240	W
Unclamped single pulse inductive energy $I_{D(ISO)}$ = 19 A		E_{AS}	1900	mJ
Electrostatic discharge voltage (Human Body Model) according to MIL STD 883D, method 3015.7 and EOS/ESD assn. standard S5.1 - 1993		V_{ESD}	3000	V
DIN humidity category, DIN 40 040			E	
IEC climatic category, DIN IEC 68-1			40/150/56	
Thermal resistance	junction - case:	R_{thJC}	≤0.52	K/W
	junction - ambient:	R_{thJA}	≤75	
	SMD version, device on PCB[2]:		≤45	

[1] A sensor holding current of 500 µA has to be guaranteed in the case of thermal shutdown (see also page 3).
[2] 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.

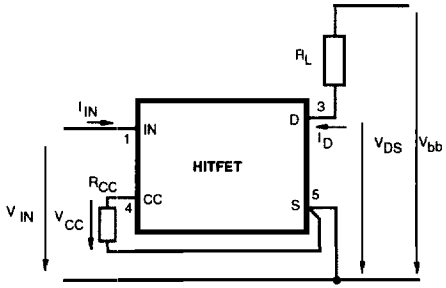
Electrical Characteristics

Parameter 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:	$V_{DS(AZ)}$	60	--	--	V
Off state drain current V_{IN} = 0 V, V_{DS} = 32 V T_j =-40...+150°C:	I_{DSS}	--	--	25	µA
Input threshold voltage I_D = 3.9 mA	$V_{IN(th)}$	1.3	1.7	2.2	V
Input current normal operation, I_D<$I_{D(lim)}$:	$I_{IN(1)}$	--	--	100	µA
V_{IN} = 10 V current limitation mode, I_D=$I_{D(lim)}$:	$I_{IN(2)}$	110	400	800	
after thermal shutdown, I_D=0 A:	$I_{IN(3)}$	1000	3000	6000	
Input holding current after thermal shutdown	$I_{IN(H)}$				µA
T_j =25°C:		500	--	--	
T_j =150°C:		300	--	--	
On-state resistance					
I_D = 19 A, V_{IN} = 5 V T_j=25°C:	$R_{DS(on)}$	--	18	22	mΩ
T_j=150°C:		--	30	44	
On-state resistance					
I_D = 19 A, V_{IN} = 10 V T_j=25°C:	$R_{DS(on)}$	--	14	18	mΩ
T_j=150°C:		--	25	36	
Nominal load current(ISO 10483)	$I_{D(ISO)}$	19	--	--	A
V_{IN} = 10 V, V_{DS} = 0.5 V, T_C = 85°C					
Adjustable current limit without R_{CC}:	$I_{D(lim)}$	9.5	19	40	A
V_{IN} = 5-10 V, V_{DS} = 12 V with R_{CC} =0 Ω		tbd	150	--	

Parameter and Conditions at T_j = 25 °C, unless otherwise specified	Symbol	Values			Unit
		min	typ	max	
Dynamic characteristics					
Turn-on time V_{IN} to 90% I_D: R_L = 1.5 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 = 1.5 Ω, V_{IN}= 10 to 0 V, V_{bb}= 12 V	t_{off}	--	70	170	µs
Slew rate on 70 to 50% V_{bb}: R_L = 1.5 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 = 1.5 Ω, V_{IN}= 10 to 0 V, V_{bb}= 12 V	dV_{DS}/dt_{off}	--	1	3	V/µs
Protection Functions					
Thermal overload trip temperature	T_{jt}	150	165	--	°C
Unclamped single pulse inductive energy $I_{D(ISO)}$=19 A, V_{bb}=32 V T_j=25 °C	E_{AS}	1900	--	--	mJ
T_j=150 °C		500	--	--	
Inverse Diode					
Continuous source drain voltage V_{IN} = 0 V, $-I_D$ = 5*19 A, t_p = 300 µs	V_{SD}	--	1.1	--	V

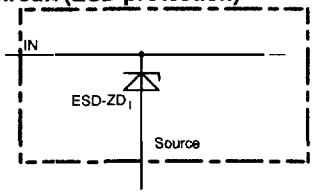
Block diagram

Terms



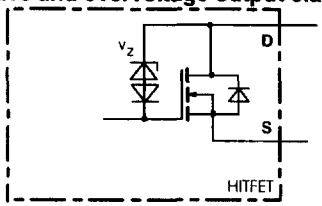
The ground lead impedance of R_{CC} should be as low as possible.

Input circuit (ESD protection)

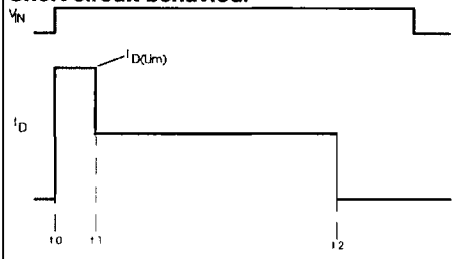


ESD zener diodes are not designed for DC current > 2 mA

Inductive and overvoltage output clamp



Short circuit behaviour

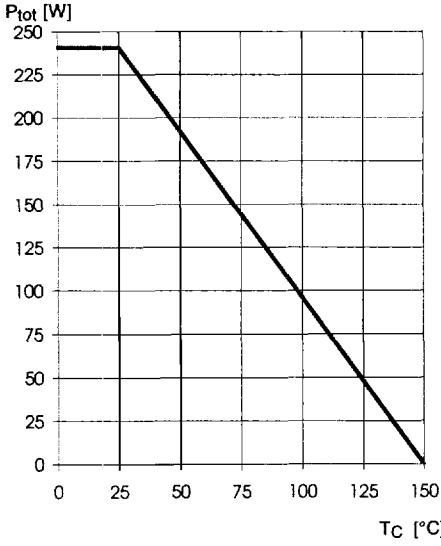


t_0: Turn on into a short circuit

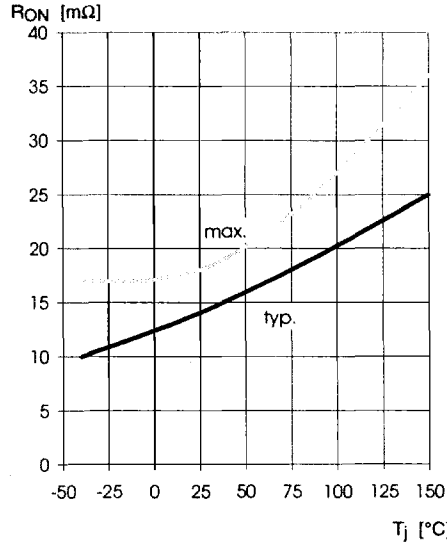
t_1: Activation of the fast temperature sensor and regulation of the drain current to a level where the junction temperature remains constant.

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

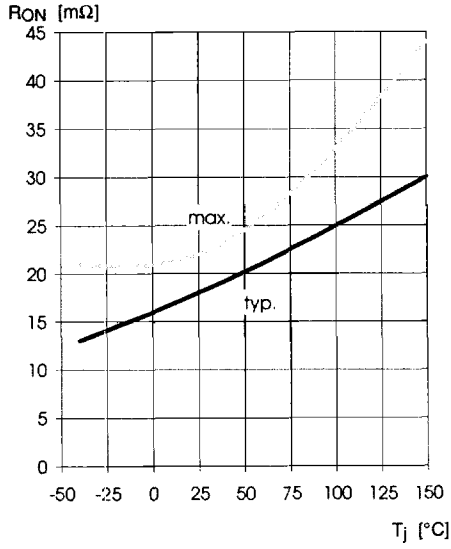
Maximum allowable power dissipation
$P_{tot} = f(T_C)$



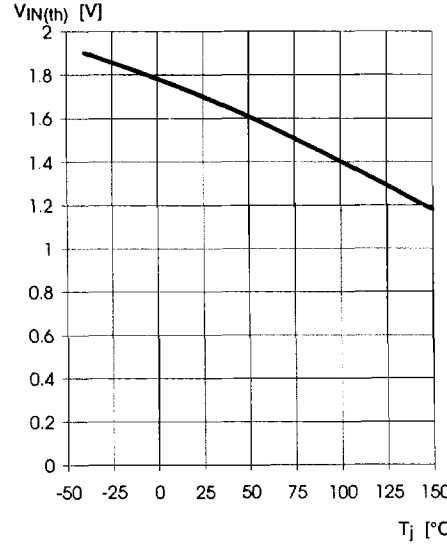
On-state resistance
$R_{ON} = f(T_j)$; I_D= 19 A; V_{IN}= 10 V



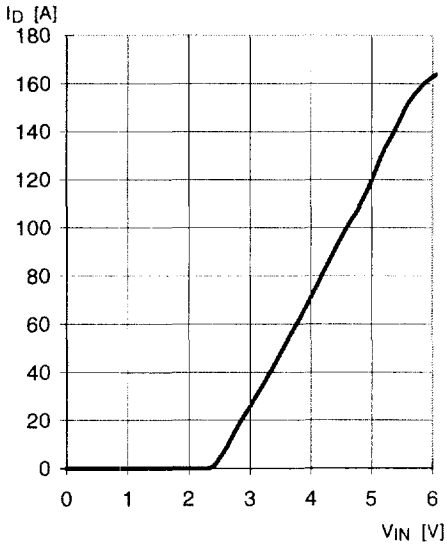
On-state resistance
$R_{ON} = f(T_j)$; I_D= 19 A; V_{IN}= 5 V



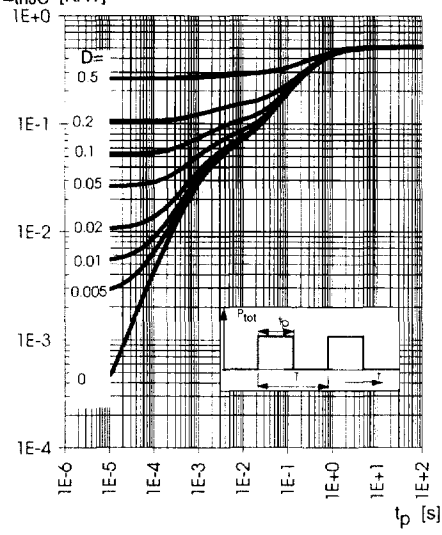
Typ. input threshold voltage
$V_{IN(th)} = f(T_j)$; I_D= 3.9 mA; V_{DS}= 12 V



Typ. transfer characteristic
$I_D = f(V_{IN})$; V_{DS}=12V, T_j= 25°C



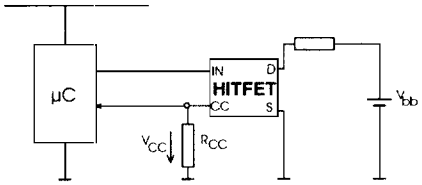
Transient thermal impendance
$Z_{thJC} = f(t_p)$
Parameter: $D=t_p/T$



Application examples:

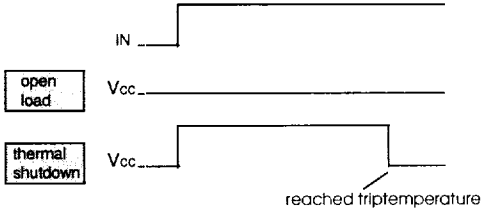
Current Sense Features and Status Signals

- **Current sense**

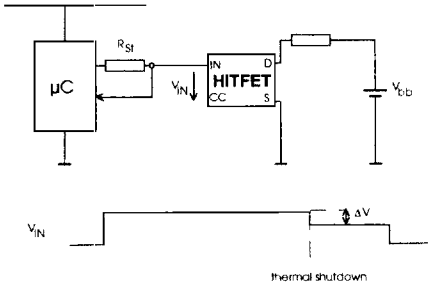


  - Current monitoring
  - Failure detection (Status)*)
    - Open load
    - Thermal shutdown

*) Identification of failure mode after restart



- **Status signal of thermal shutdown by monitoring input current**

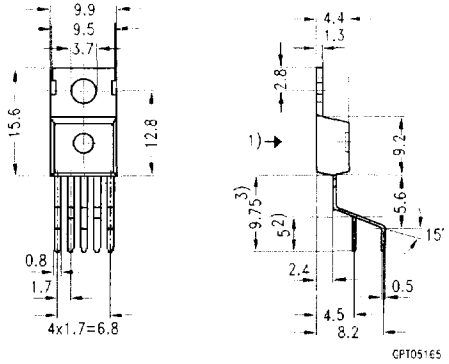


V_{IN}=5V		V_{IN}=10V	
R_{St}=500Ω	ΔV=1V	R_{St}=1kΩ	ΔV=2.5V
R_{St}=1kΩ	ΔV=2V	R_{St}=2kΩ	ΔV=4.5V

Package and ordering code

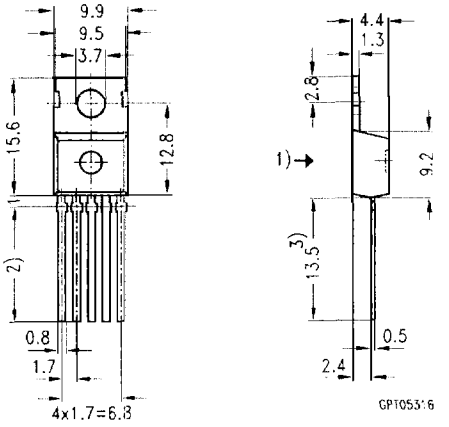
all dimensions in mm

TO220/5	Ordering code
	Q67060-S6703-A2



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

TO220/5	Ordering code
E3043	Q67060-S6703-A3



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

SMD TO220/5		Ordering code
E3062A	T&R	Q67060-S6703-A4