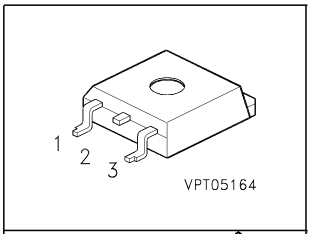
Smart Lowside Power Switch

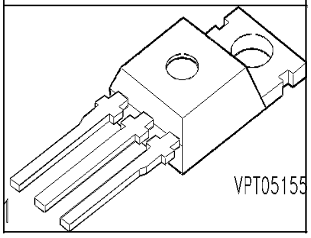
Features

- Logic Level Input
- Input Protection (ESD)
- Thermal shutdown with latch
- 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	$R_{DS(on)}$	100	mΩ
Current limit	$I_{D(lim)}$	7	A
Nominal load current	$I_{D(ISO)}$	3.5	A
Clamping energy	E_{AS}	1000	mJ



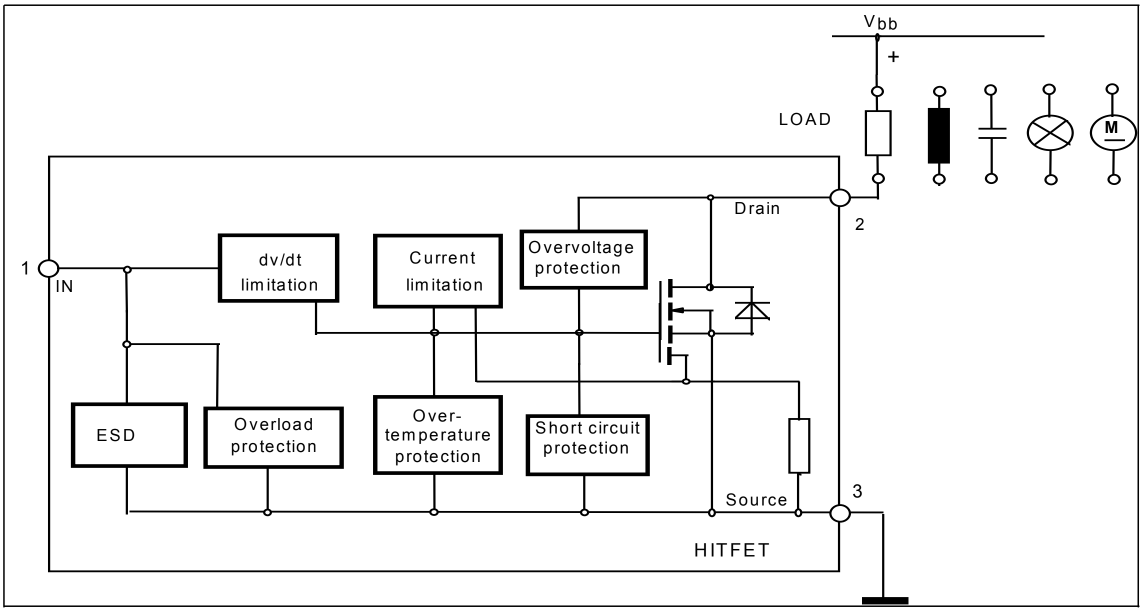


Application

- 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.



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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 $\| I_{IN} \| \le 2$	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, $R_I = 2\ \Omega$, I_D=0,5*3.5A t_d = 400 ms, $R_I = 2\ \Omega$, 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] In case of thermal shutdown a minimum sensor holding current of 500 µA has to be guaranteed (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, 70µm thick) copper area for Drain connection. PCB mounted 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	$I_{IN(3)}$	800	2200	4000	
Input holding current after thermal shutdown [1)] T_j = 25 °C T_j = 150 °C	$I_{IN(H)}$	 500 300	 - -	 - -	
On-state resistance V_{IN} = 5 V, I_D = 3.5 A, T_j = 25 °C V_{IN} = 5 V, I_D = 3.5 A, T_j = 150 °C	$R_{DS(on)}$	 - -	 90 180	 120 240	mΩ
On-state resistance V_{IN} = 10 V, I_D = 3.5 A, T_j = 25 °C V_{IN} = 10 V, I_D = 3.5 A, 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

[1] If the input current is limited by external components, low drain currents can flow and heat the device.
Auto restart behaviour can occur.

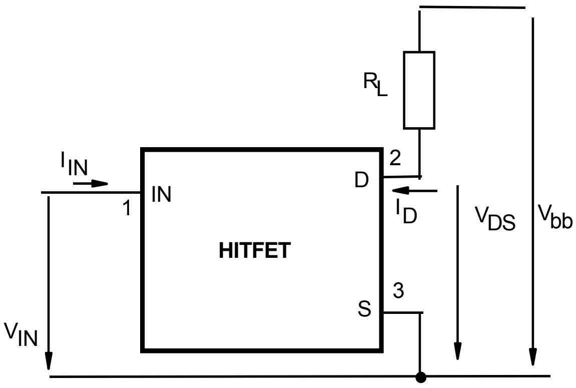
Electrical Characteristics

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	$I_{D(SCp)}$	-	25	-	A
Current limit [1] V_{IN} = 10 V, V_{DS} = 12 V, t_m = 350 µs, T_j = -40...+150 °C	$I_{D(lim)}$	7	10	15	
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

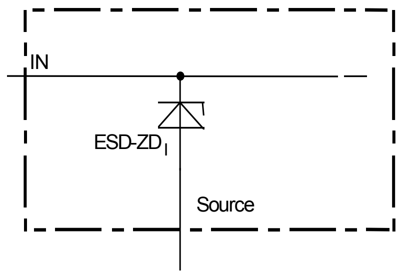
[1] Device switched on into existing short circuit (see diagram Determination of $I_{D(lim)}$). If the device is in on condition and a short circuit occurs, these values might be exceeded for max. 50 µs.

Block Diagramm

Terms

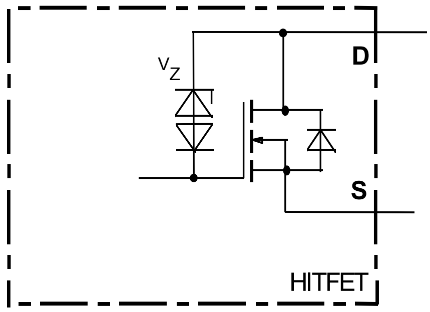


Input circuit (ESD protection)

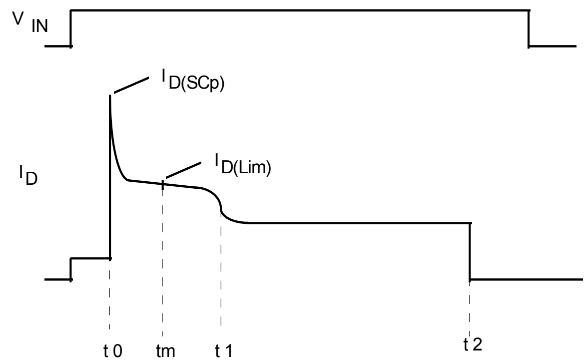


ESD zener diodes are not designed for DC current > 2 mA @ V_{IN}>10V.

Inductive and overvoltage output clamp



Short circuit behaviour



t_0: Turn on into a short circuit

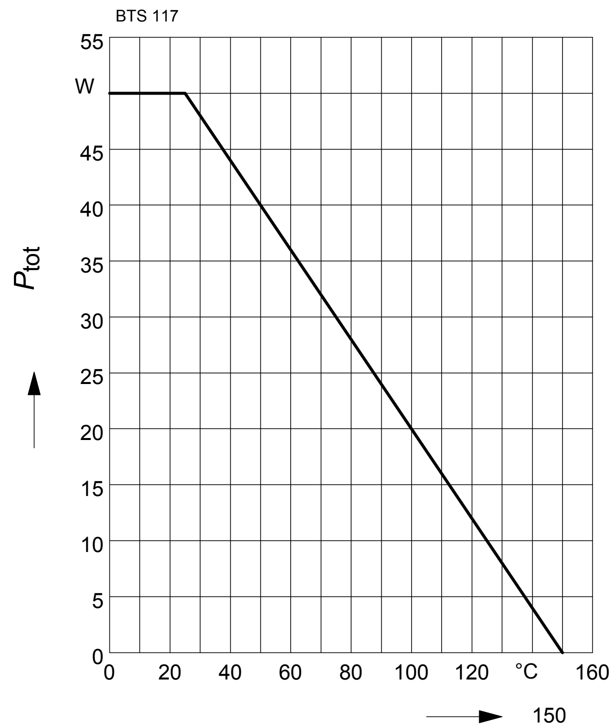
t_m: Measurementpoint for $I_{D(lim)}$

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

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

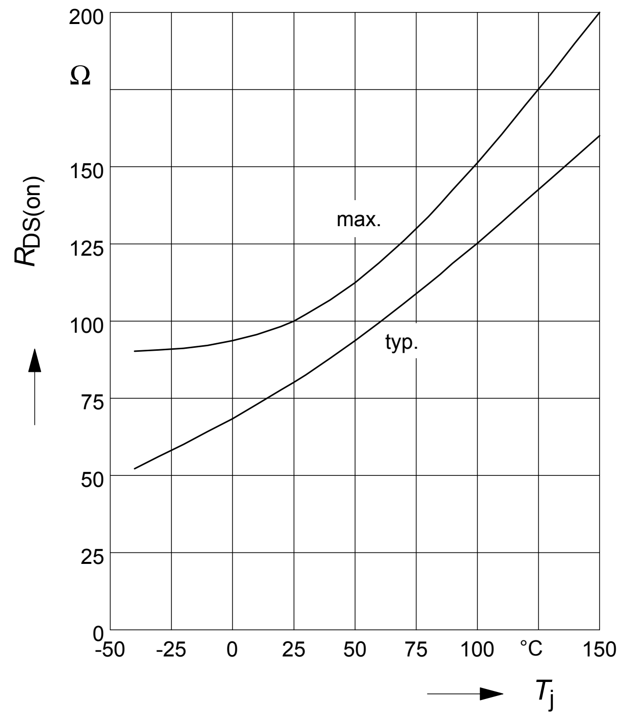
Maximum allowable power dissipation

$P_{tot} = f(T_c)$



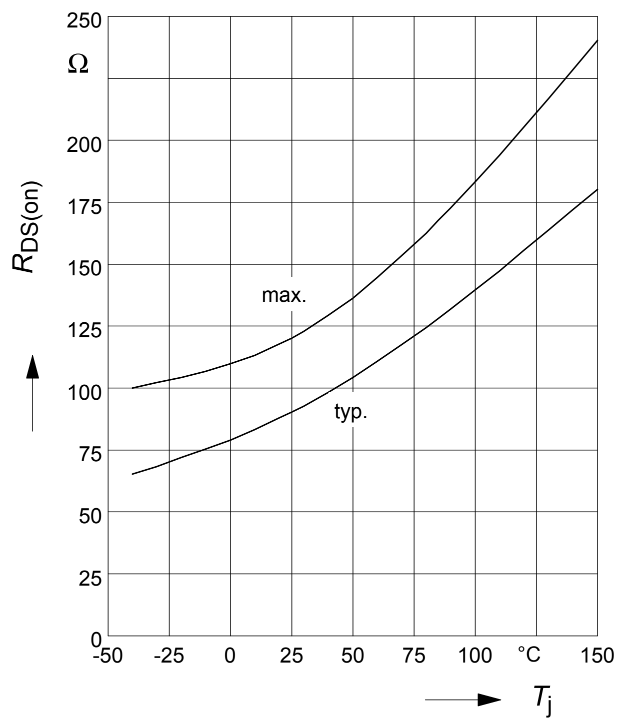
On-state resistance

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



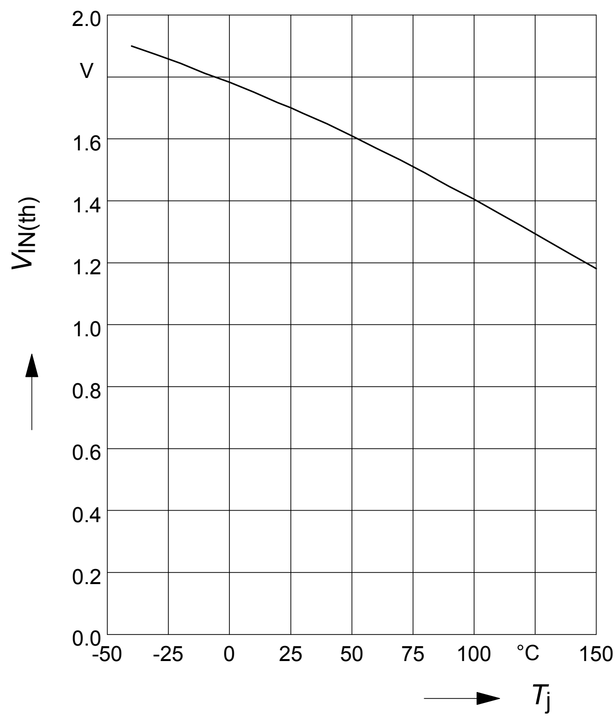
On-state resistance

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



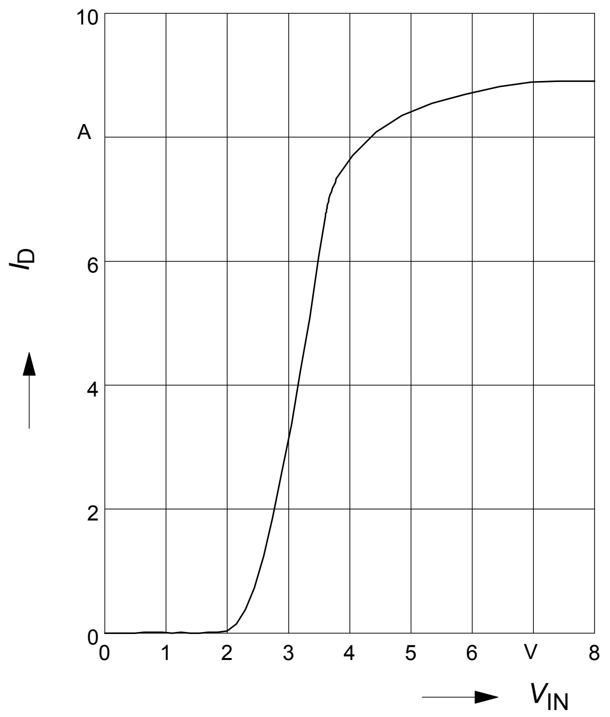
Typ. input threshold voltage

$V_{IN(th)} = f(T_j)$; I_D=0.7mA; V_{DS}=12V



Typ. transfer characteristics

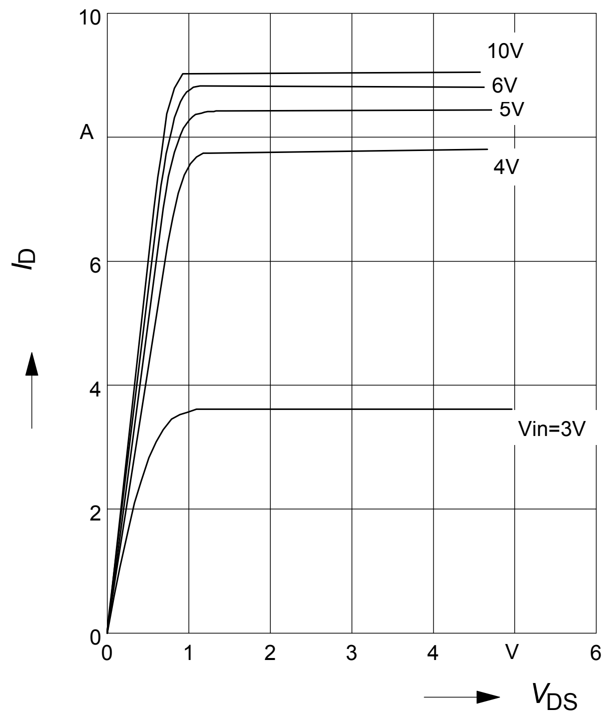
$\mathbf{I_D = f(V_{IN})}$; V_{DS}=12V; T_j=25°C



Typ. output characteristic

$\mathbf{I_D = f(V_{DS})}$; T_j=25°C

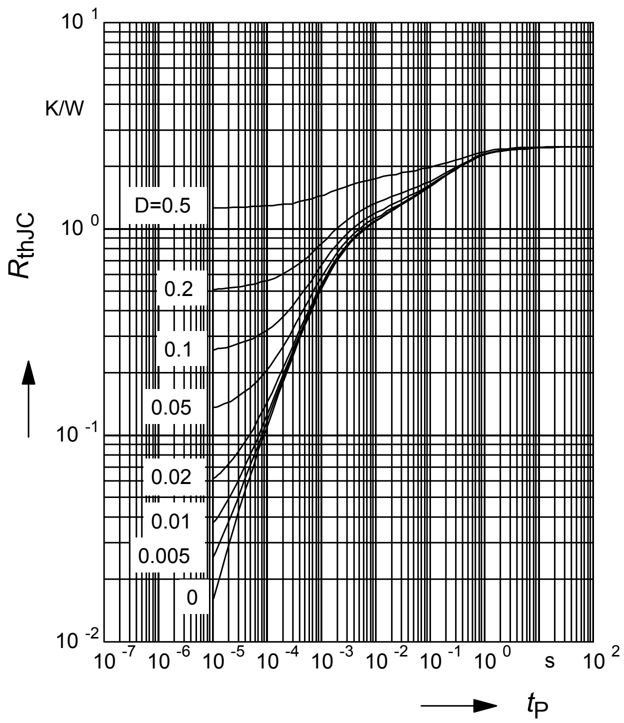
Parameter: V_{IN}



Transient thermal impedance

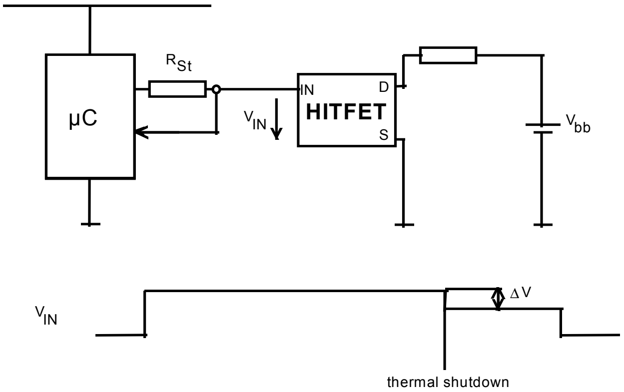
$Z_{thJC} = f\,(t_p)$

parameter : $D = t_p/T$



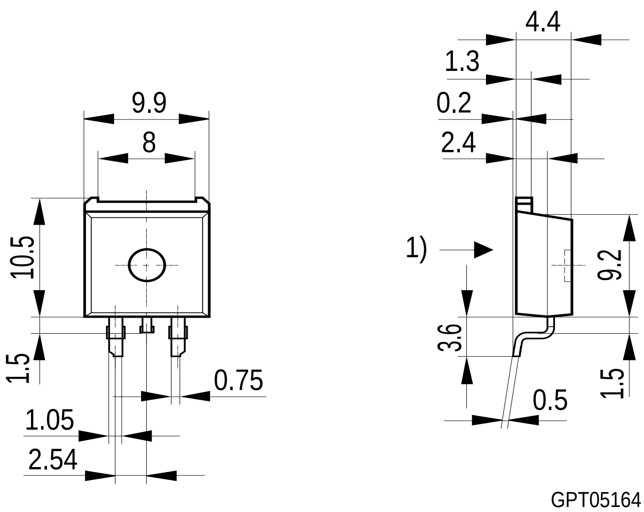
Application examples:

Status signal of thermal shutdown by monitoring input current

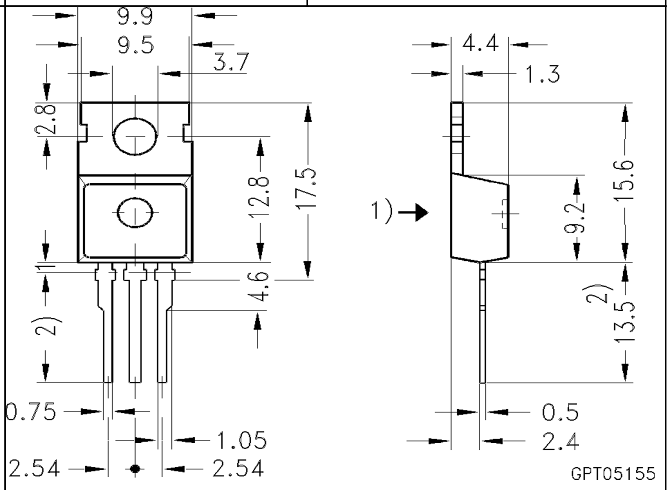


$\Delta V = R_{ST} * I_{IN(3)}$

Package	Ordering Code	Package	Ordering Code
P-TO220-3-45	Q67060-S6500-A3	P-TO220-3-1	Q67060-S6500-A2



1) shear and punch direction no burrs this surface



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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