

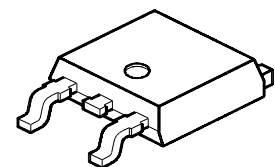
Smart Lowside Power Switch

Features

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

Product Summary

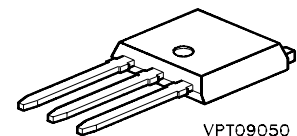
Drain source voltage	V_{DS}	42	V
On-state resistance	$R_{DS(on)}$	28	m Ω
Nominal load current	$I_{D(ISO)}$	4.6	A
Clamping energy	E_{AS}	3.5	J



VPT09051

Application

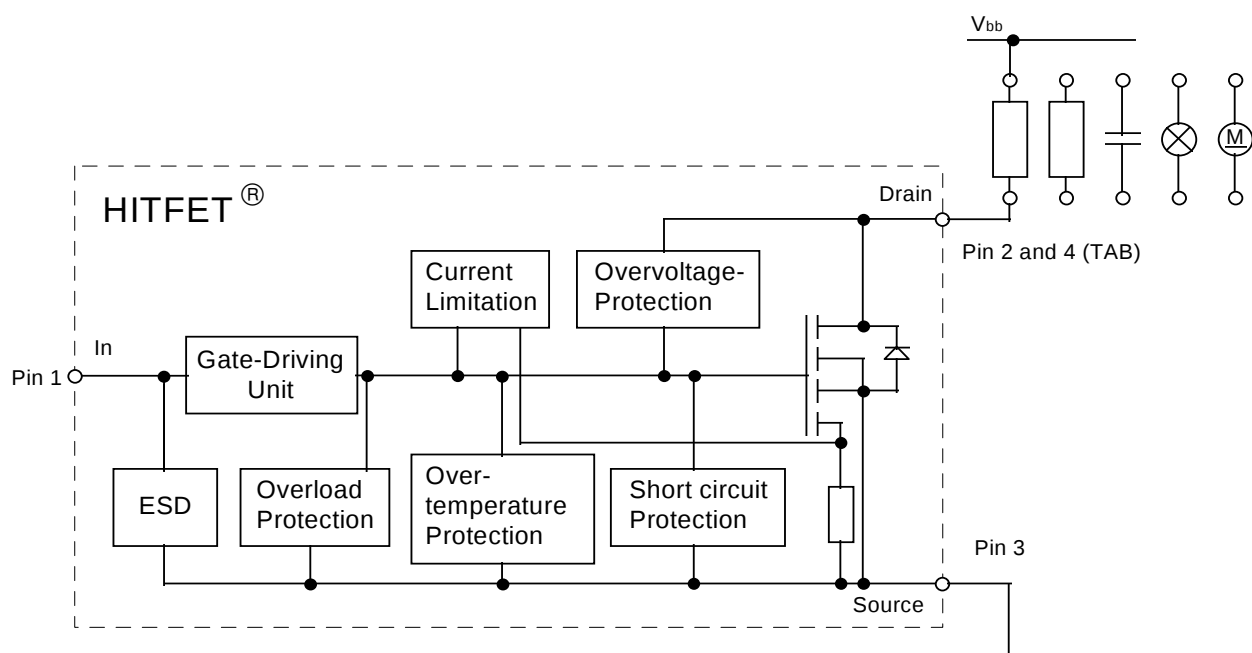
- All kinds of resistive, inductive and capacitive loads in switching or linear applications
- μC compatible power switch for 12 V and 24 V DC applications
- Replaces electromechanical relays and discrete circuits



VPT09050

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	$V_{DS(SC)}$	42	
Continuous input voltage	V_{IN}	-0.2 ... +10	
Peak input voltage ($I_{IN} \leq 2 \text{ mA}$)	$V_{IN(peak)}$	-0.2 ... V_{DS}	
Operating temperature	T_j	-40 ... +150	$^\circ\text{C}$
Storage temperature	T_{stg}	-55 ... +150	
Power dissipation $T_C = 85^\circ\text{C}$ 6cm ² cooling area, $T_A = 85^\circ\text{C}$	P_{tot}	59 1.1	W
Unclamped single pulse inductive energy ¹⁾	E_{AS}	3.5	
Load dump protection $V_{LoadDump}^{2)} = V_A + V_S$ $V_{IN} = 0$ and 10 V, $t_d = 400 \text{ ms}$, $R_I = 2 \Omega$, $R_L = 3 \Omega$, $V_A = 13.5 \text{ V}$	V_{LD}	67.5	V
Electrostatic discharge voltage (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 - case:	R_{thJC}	1.1	K/W
junction - ambient:			
SMD: junction - ambient @ min. footprint @ 6 cm ² cooling area ³⁾	R_{thJA}	115 55	

¹ Not tested, specified by design.

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, 70μm 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.	
Characteristics					
Drain source clamp voltage $T_j = -40 \dots +150$, $I_D = 10 \text{ mA}$	$V_{\text{DS(AZ)}}$	42	-	55	V
Off-state drain current $T_j = -40 \dots +150^{\circ}\text{C}$ $V_{\text{DS}} = 32 \text{ V}$, $V_{\text{IN}} = 0 \text{ V}$	I_{DSS}	-	1.5	20	μA
Input threshold voltage $I_D = 1.2 \text{ mA}$, $T_j = 25^{\circ}\text{C}$ $I_D = 1.2 \text{ mA}$, $T_j = 150^{\circ}\text{C}$	$V_{\text{IN(th)}}$	1.3 0.9	1.7 -	2.2 -	V
On state input current	$I_{\text{IN(on)}}$	-	10	30	μA
On-state resistance $I_D = 4.6 \text{ A}$, $V_{\text{IN}} = 5 \text{ V}$, $T_j = 25^{\circ}\text{C}$ $I_D = 4.6 \text{ A}$, $V_{\text{IN}} = 5 \text{ V}$, $T_j = 150^{\circ}\text{C}$	$R_{\text{DS(on)}}$	- -	27 54	34 68	$\text{m}\Omega$
On-state resistance $I_D = 4.6 \text{ A}$, $V_{\text{IN}} = 10 \text{ V}$, $T_j = 25^{\circ}\text{C}$ $I_D = 4.6 \text{ A}$, $V_{\text{IN}} = 10 \text{ V}$, $T_j = 150^{\circ}\text{C}$	$R_{\text{DS(on)}}$	- -	23 46	28 56	
Nominal load current $V_{\text{IN}} = 10 \text{ V}$, $T_j < 150^{\circ}\text{C}$, $T_{\text{A}} = 85^{\circ}\text{C}$, SMD 6 cm^2 cooling area $V_{\text{IN}} = 10 \text{ V}$, $V_{\text{DS}} = 0.5 \text{ V}$, $T_{\text{C}} = 85^{\circ}\text{C}$, $T_j < 150^{\circ}\text{C}$	$I_{\text{D(ISO)}}$	4.6 12.6	- -	- -	
Current limit (active if $V_{\text{DS}} > 2.5 \text{ V}$) ¹⁾ $V_{\text{IN}} = 10 \text{ V}$, $V_{\text{DS}} = 12 \text{ V}$, $t_{\text{m}} = 200 \mu\text{s}$	$I_{\text{D(lim)}}$	30	45	55	

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

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}	-	60	150	μs
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	150	
Slew rate on 70 to 50% V_{bb} : $R_L = 4.7\ \Omega$, $V_{IN} = 0$ to 10 V, $V_{bb} = 12$ V	$-dV_{DS}/dt_{on}$	-	0.3	1	V/ μs
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}	-	0.3	1	

Protection Functions

Thermal overload trip temperature	T_{jt}	150	165	-	$^\circ\text{C}$
Thermal hysteresis	ΔT_{jt}	-	10	-	K
Input current protection mode	$I_{IN(Prot)}$	-	140	300	μA
Unclamped single pulse inductive energy ¹⁾ $I_D = 4.6$ A, $T_j = 25\ ^\circ\text{C}$, $V_{bb} = 12$ V	E_{AS}	3.5	-	-	J

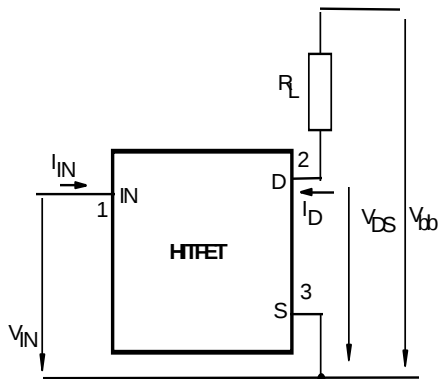
Inverse Diode

Inverse diode forward voltage $I_F = 23$ A, $t_m = 250\ \mu\text{s}$, $V_{IN} = 0$ V, $t_P = 300\ \mu\text{s}$	V_{SD}	-	1.0	-	V
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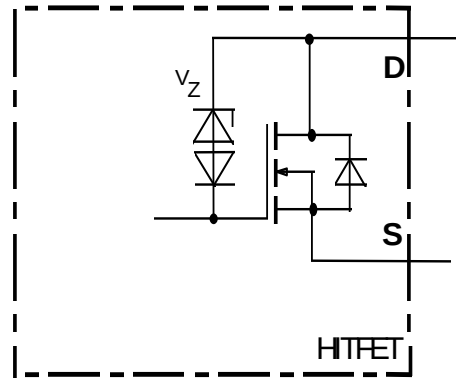
¹ Not tested, specified by design.

Block diagram

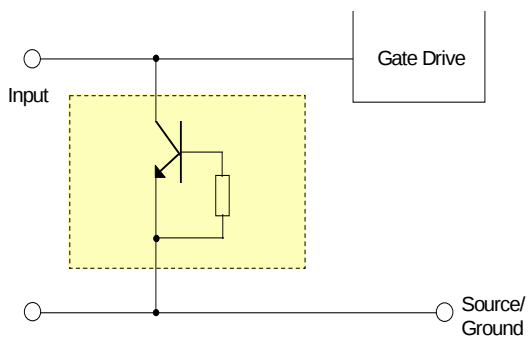
Terms



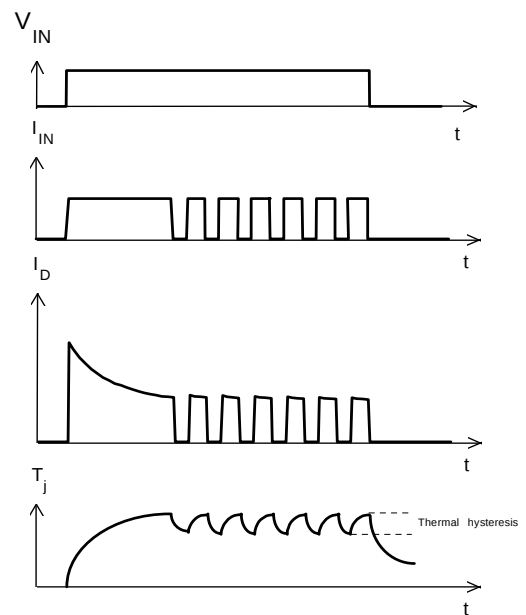
Inductive and overvoltage output clamp



Input circuit (ESD protection)



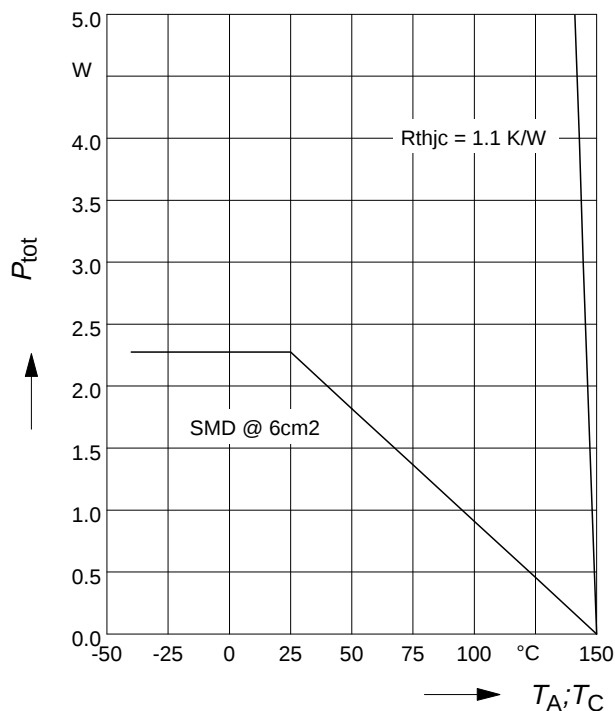
Short circuit behaviour



Maximum allowable power dissipation

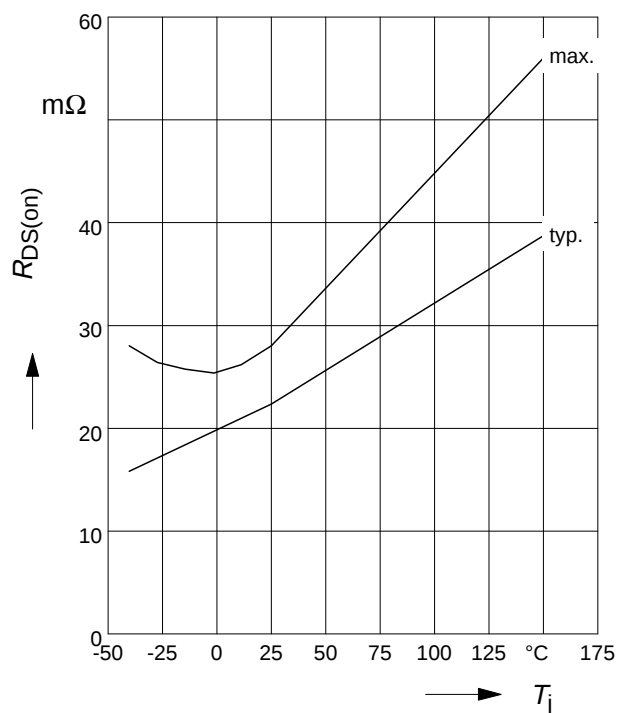
$$P_{\text{tot}} = f(T_C) \text{ resp.}$$

$$P_{\text{tot}} = f(T_A) @ R_{\text{thJA}} = 55 \text{ K/W}$$



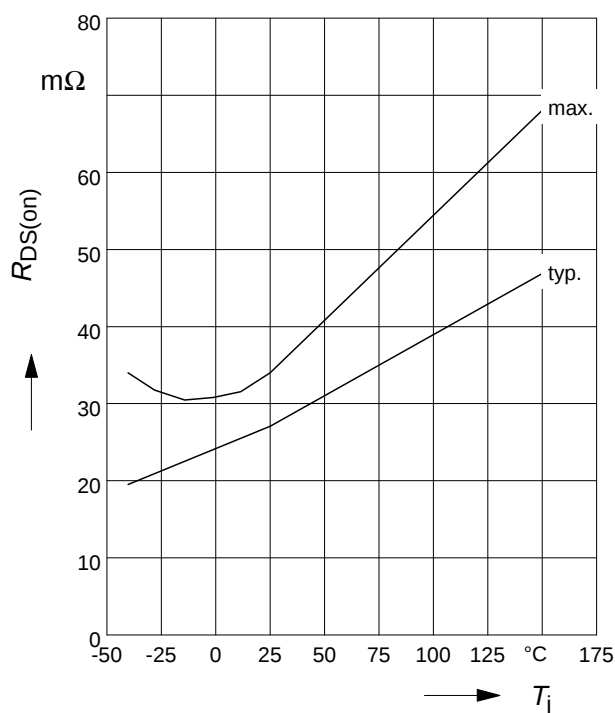
On-state resistance

$$R_{\text{ON}} = f(T_j); I_D = 4.6 \text{ A}; V_{\text{IN}} = 10 \text{ V}$$



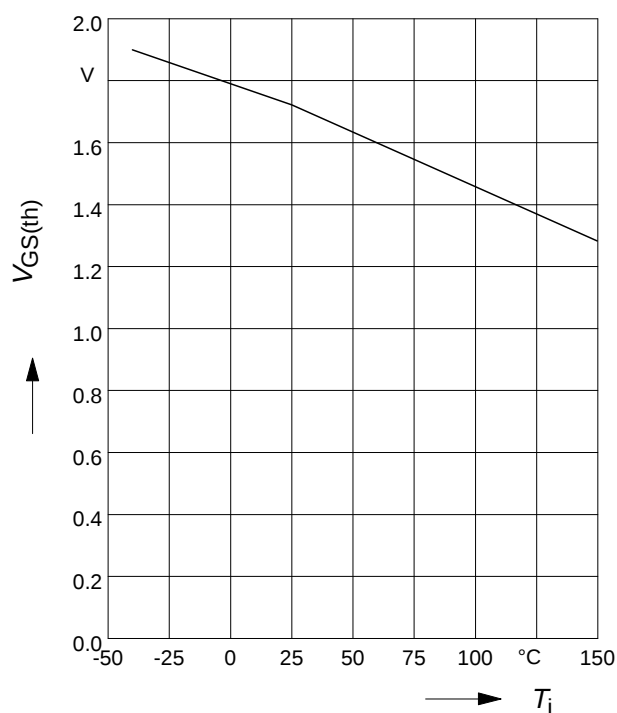
On-state resistance

$$R_{\text{ON}} = f(T_j); I_D = 4.6 \text{ A}; V_{\text{IN}} = 5 \text{ V}$$



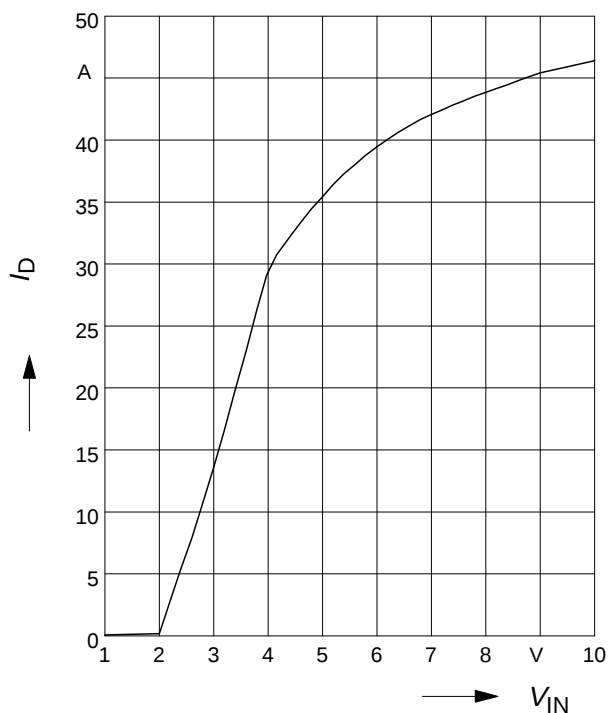
Typ. input threshold voltage

$$V_{\text{IN(th)}} = f(T_j); I_D = 1.2 \text{ mA}; V_{\text{DS}} = 12 \text{ V}$$



Typ. transfer characteristics

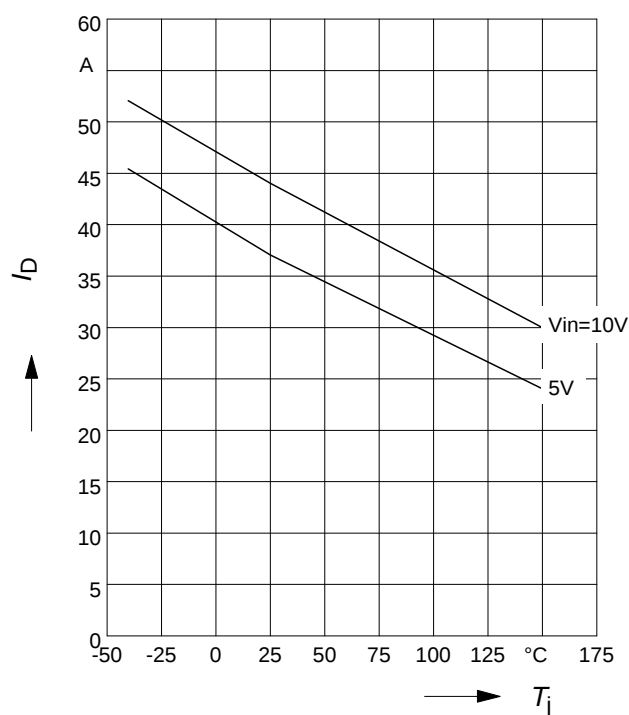
$I_D = f(V_{IN})$; $V_{DS} = 12V$; $T_{Jstart} = 25^\circ C$



Typ. short circuit current

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

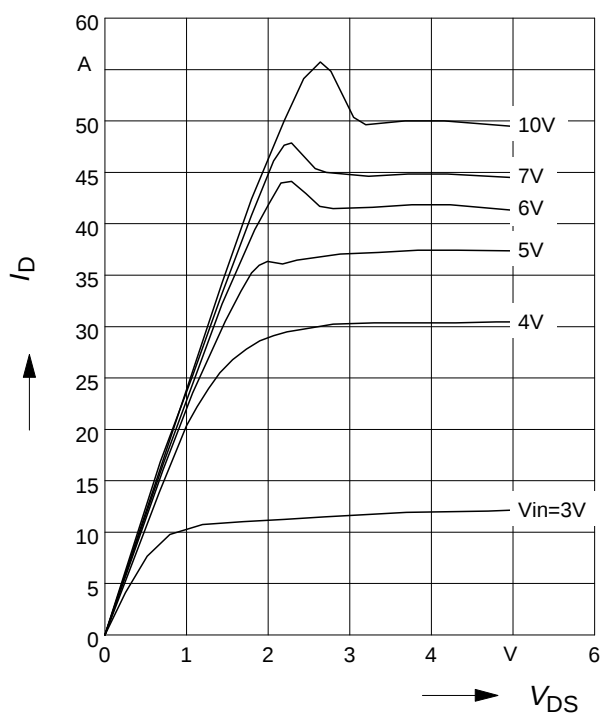
Parameter: V_{IN}



Typ. output characteristics

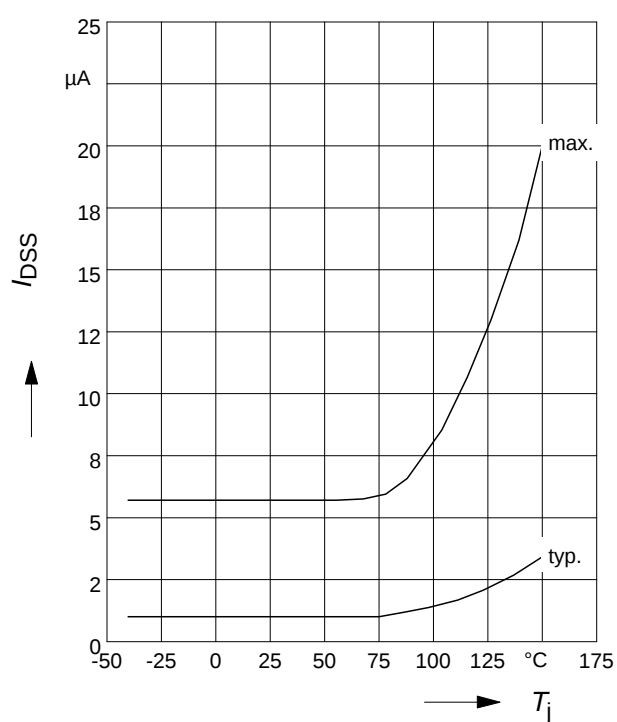
$I_D = f(V_{DS})$; $T_{Jstart} = 25^\circ C$

Parameter: V_{IN}



Typ. off-state drain current

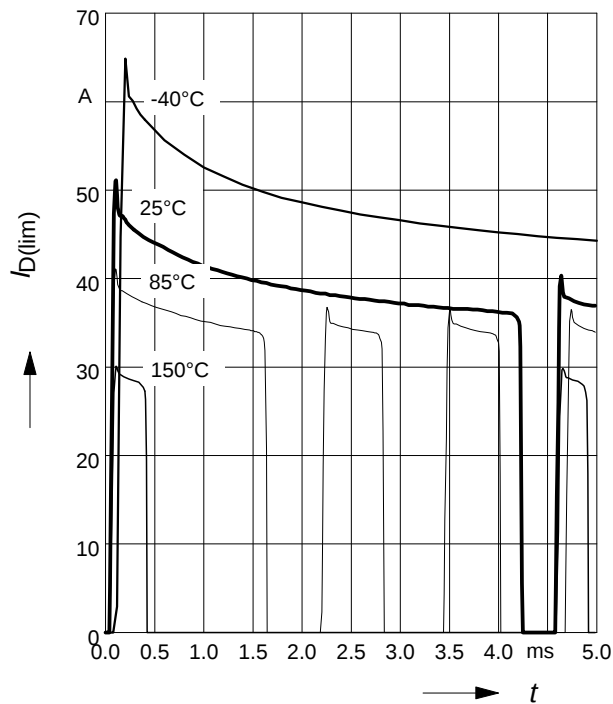
$I_{DSS} = f(T_j)$



Typ. overload current

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

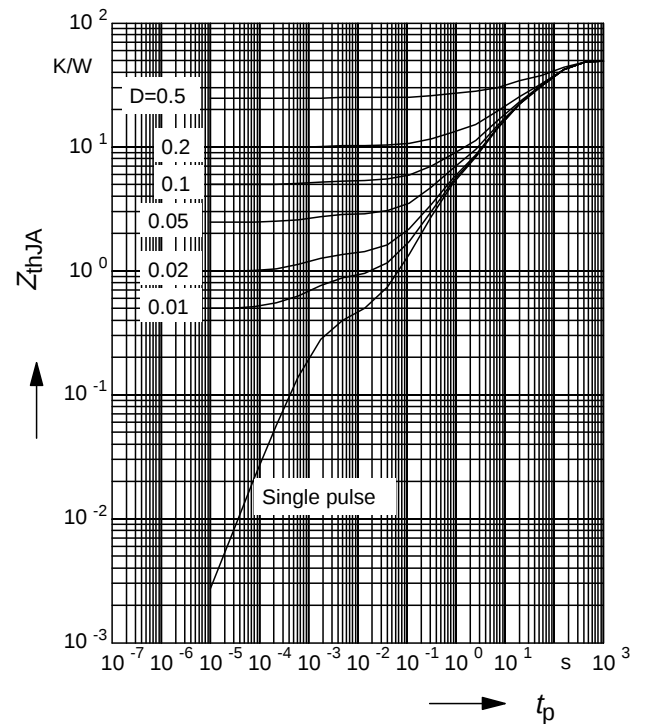
Parameter: T_{jstart}



Typ. transient thermal impedance

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

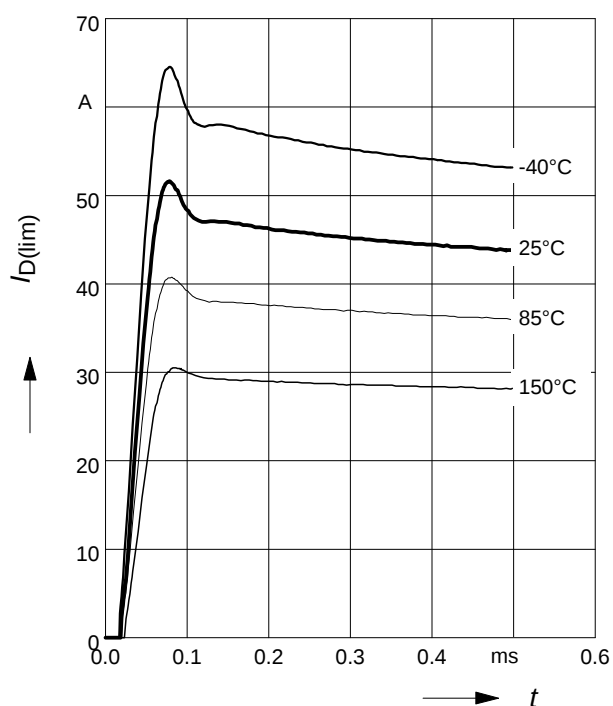
Parameter: $D = t_p / T$



Determination of $I_{D(lim)}$

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

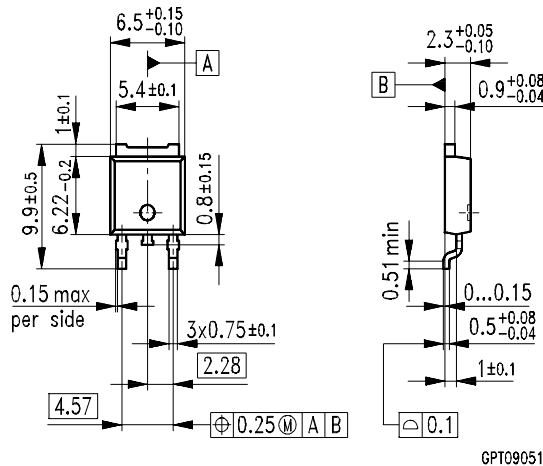
Parameter: T_{jstart}



Package and ordering code all dimensions in mm

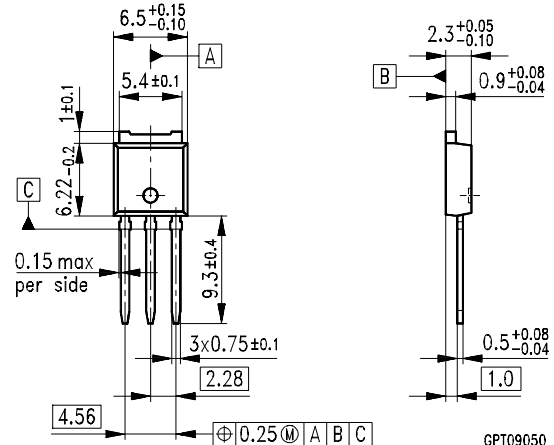
Ordering code: Q67060-S7401-A2

Ordering code: On request



GPT09051

All metal surfaces tin plated, except area of cut.



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Edition 7.97

Published by Siemens AG,
Bereich Halbleiter Vertrieb,
Werbung, Balanstraße 73,
81541 München

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