

Smart Lowside Power Switch

Features

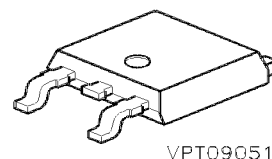
- Logic Level Input
- Input Protection (ESD)
- Thermal shutdown with auto restart
- Overload protection
- Short circuit protection
- Overvoltage protection
- Current limitation
- Analog driving possible

Product Summary

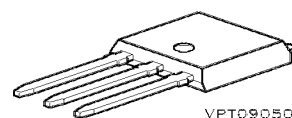
Drain source voltage	V_{DS}	42	V
On-state resistance	$R_{DS(on)}$	50	m Ω
Nominal load current	$I_{D(ISO)}$	3.3	A
Clamping energy	E_{AS}	3	J

Application

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



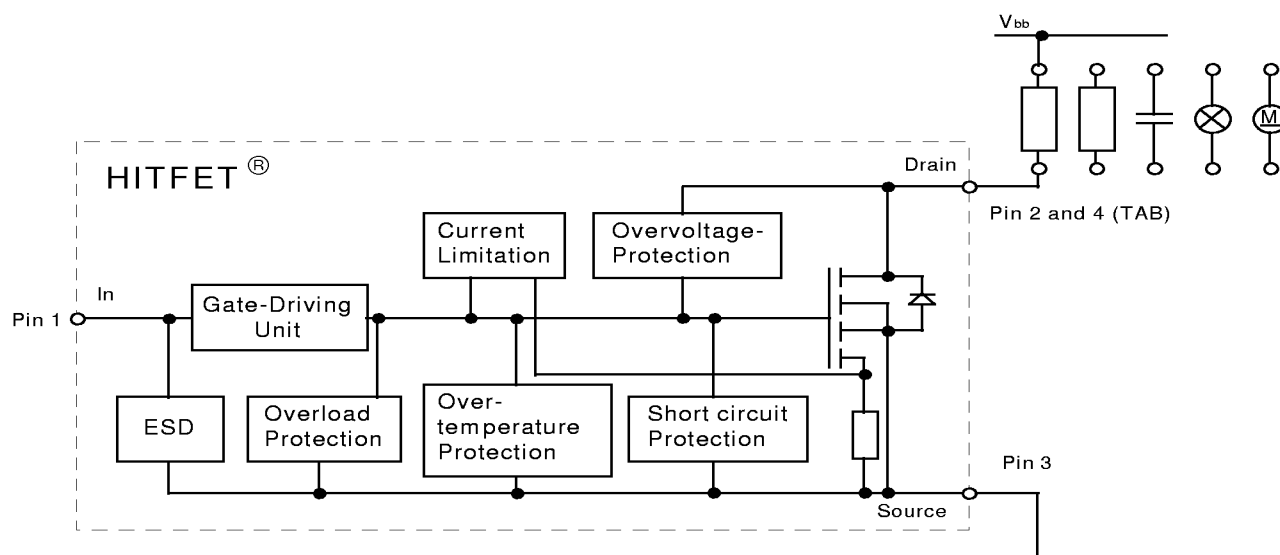
VPT09051



VPT09050

General Description

N channel vertical power FET in Smart SIPMOS[®] technology. Fully protected by embedded protection functions.



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Maximum Ratings at $T_j = 25\text{ }^{\circ}\text{C}$, 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 $T_C = 85\text{ }^{\circ}\text{C}$ 6cm ² cooling area, $T_A = 85\text{ }^{\circ}\text{C}$	P_{tot}	43 1.1	W
Unclamped single pulse inductive energy ¹⁾	E_{AS}	3	
Load dump protection $V_{LoadDump}^{2)} = V_A + V_S$ $V_{IN} = 0$ and 10 V, $t_d = 400\text{ ms}$, $R_l = 2\text{ }\Omega$, $R_L = 4.5\text{ }\Omega$, $V_A = 13.5\text{ V}$	V_{LD}	65	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}	1.5	K/W
junction - ambient:			
SMD: junction - ambient @ min. footprint	R_{thJA}	115	
@ 6 cm ² cooling area ³⁾		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 $T_j = -40 \dots +150$, $I_D = 10 \text{ mA}$	$V_{DS(AZ)}$	42	-	55	V
Off-state drain current $T_j = -40 \dots +150^{\circ}\text{C}$ $V_{DS} = 32 \text{ V}$, $V_{IN} = 0 \text{ V}$	I_{DSS}	-	1.5	10	μA
Input threshold voltage $I_D = 0.7 \text{ mA}$, $T_j = 25^{\circ}\text{C}$ $I_D = 0.7 \text{ mA}$, $T_j = 150^{\circ}\text{C}$	$V_{IN(th)}$	1.3 0.9	1.7 -	2.2 -	V
On state input current	$I_{IN(on)}$	-	10	30	μA
On-state resistance $I_D = 3 \text{ A}$, $V_{IN} = 5 \text{ V}$, $T_j = 25^{\circ}\text{C}$ $I_D = 3 \text{ A}$, $V_{IN} = 5 \text{ V}$, $T_j = 150^{\circ}\text{C}$	$R_{DS(on)}$	- -	45 75	60 100	$\text{m}\Omega$
On-state resistance $I_D = 3 \text{ A}$, $V_{IN} = 10 \text{ V}$, $T_j = 25^{\circ}\text{C}$ $I_D = 3 \text{ A}$, $V_{IN} = 10 \text{ V}$, $T_j = 150^{\circ}\text{C}$	$R_{DS(on)}$	- -	35 65	50 90	
Nominal load current $V_{IN} = 10 \text{ V}$, $T_j < 150^{\circ}\text{C}$, $T_A = 85^{\circ}\text{C}$, SMD 6 cm^2 cooling area $V_{IN} = 10 \text{ V}$, $V_{DS} = 0.5 \text{ V}$, $T_C = 85^{\circ}\text{C}$, $T_j < 150^{\circ}\text{C}$	$I_{D(ISO)}$	3.3 7.1	- -	- -	
Current limit (active if $V_{DS}>2.5 \text{ V}$) ¹⁾ $V_{IN} = 10 \text{ V}$, $V_{DS} = 12 \text{ V}$, $t_m = 200 \mu\text{s}$	$I_{D(lim)}$	18	24	30	

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, $V_{bb} = 12\text{ V}$	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, $V_{bb} = 12\text{ V}$	t_{off}	-	60	150	
Slew rate on 70 to 50% V_{bb} : $R_L = 4.7\ \Omega$, $V_{IN} = 0$ to 10 V, $V_{bb} = 12\text{ V}$	$-dV_{DS}/dt_{on}$	-	0.3	1	$\text{V}/\mu\text{s}$
Slew rate off 50 to 70% V_{bb} : $R_L = 4.7\ \Omega$, $V_{IN} = 10$ to 0 V, $V_{bb} = 12\text{ V}$	dV_{DS}/dt_{off}	-	0.7	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⁾ $I_D = 3$ A, $T_j = 25^\circ\text{C}$, $V_{bb} = 12$ V	E_{AS}	3	-	-	J

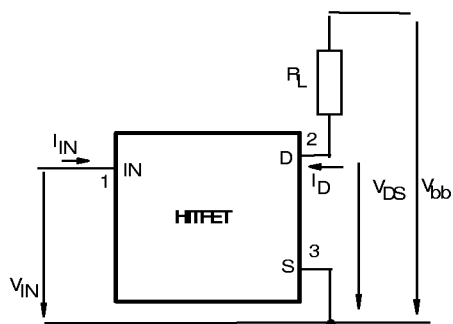
Inverse Diode

Inverse diode forward voltage $I_F = 15$ 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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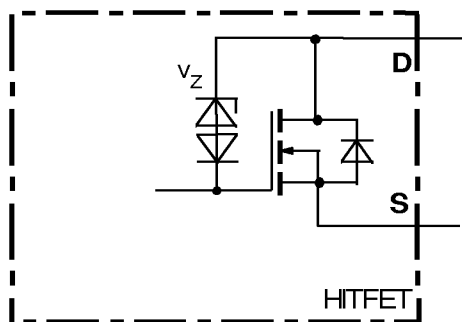
¹⁾ Not tested, specified by design.

Block diagram

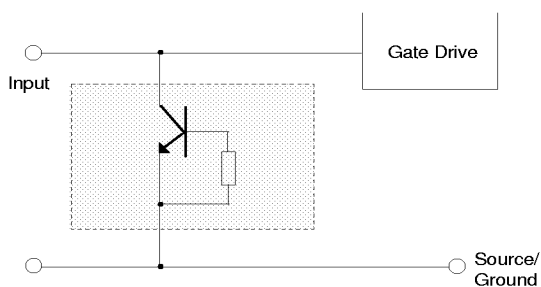
Terms



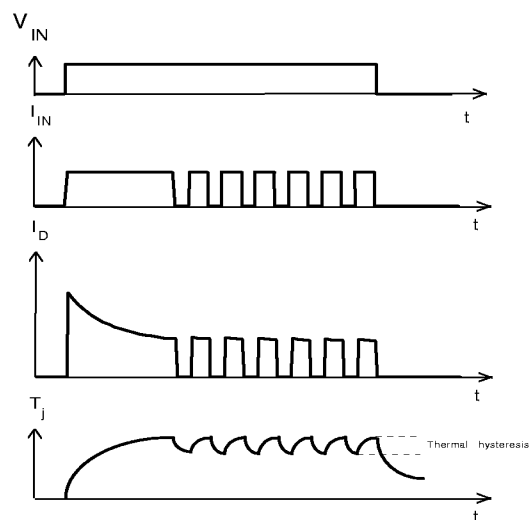
Inductive and overvoltage output clamp



Input circuit (ESD protection)



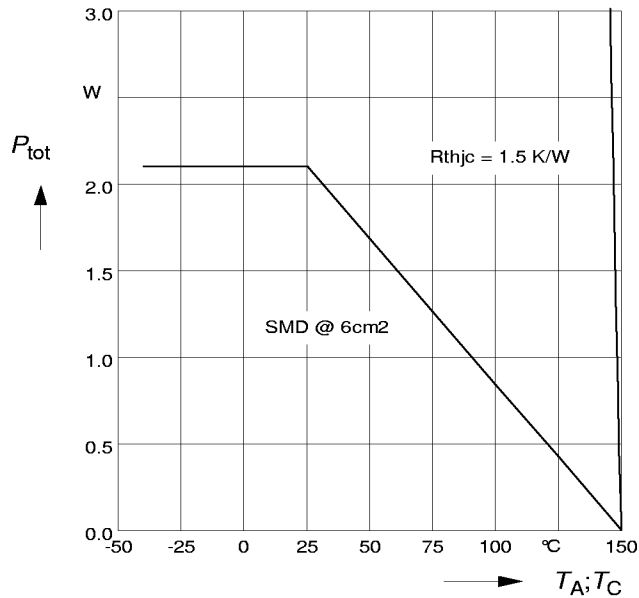
Short circuit behaviour



Maximum allowable power dissipation

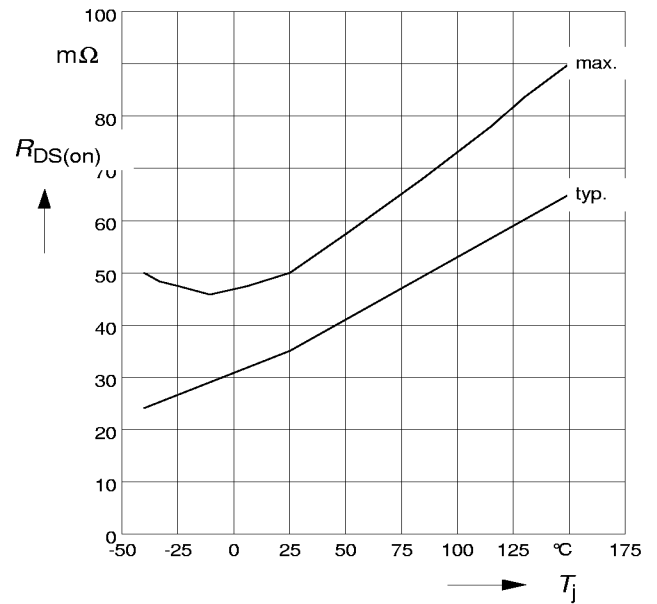
$P_{\text{tot}} = f(T_C)$ resp.

$P_{\text{tot}} = f(T_A) @ R_{\text{thJA}} = 60 \text{ K/W}$



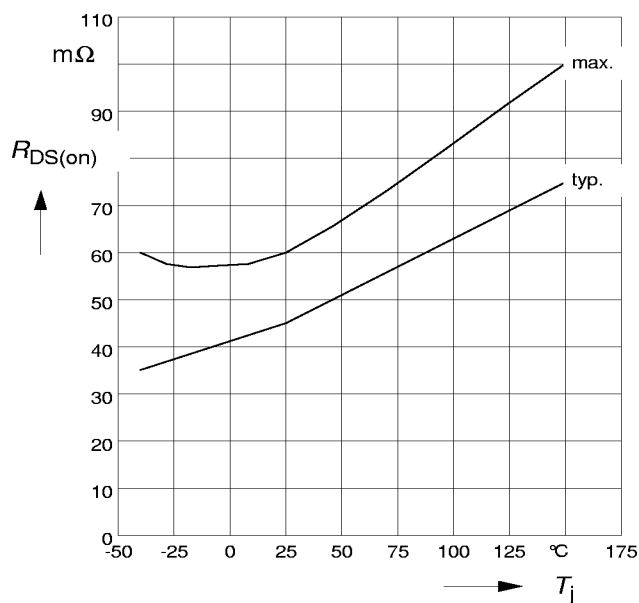
On-state resistance

$R_{\text{ON}} = f(T_j); I_D = 3 \text{ A}; V_{\text{IN}} = 10 \text{ V}$



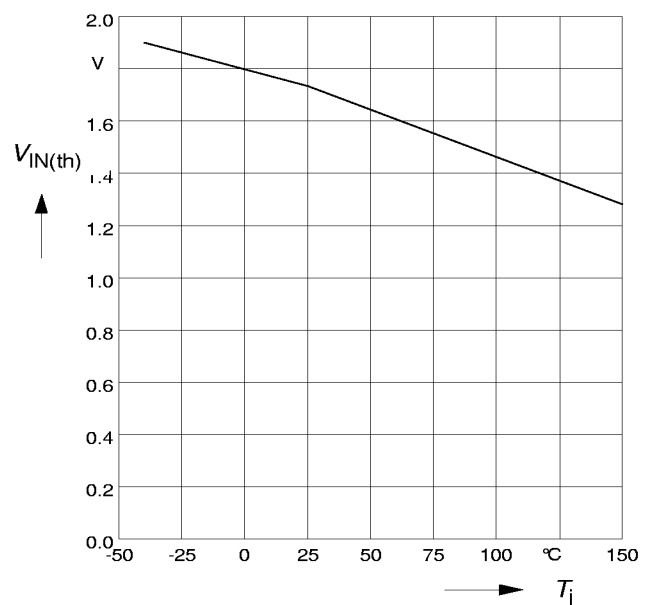
On-state resistance

$R_{\text{ON}} = f(T_j); I_D = 3 \text{ A}; V_{\text{IN}} = 5 \text{ V}$



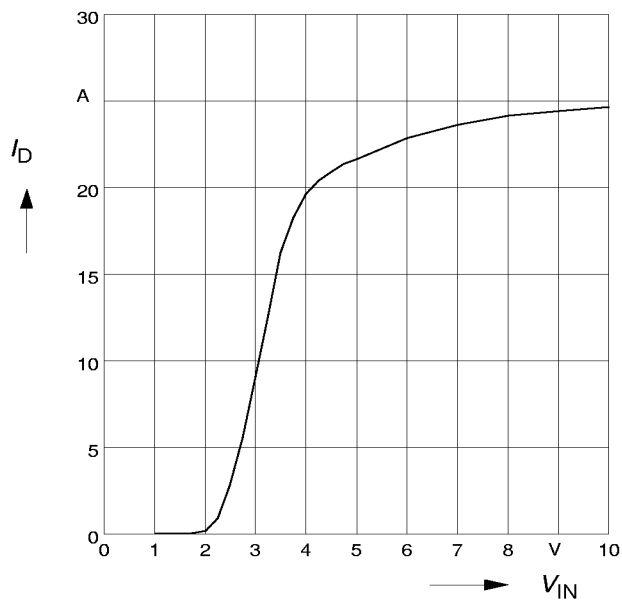
Typ. input threshold voltage

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



Typ. transfer characteristics

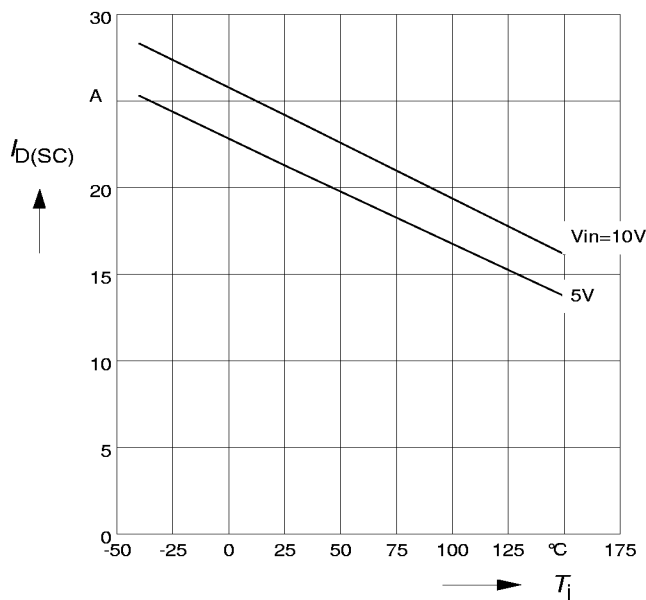
$I_D = f(V_{IN})$; $V_{DS} = 12V$; $T_{Jstart} = 25^\circ C$



Typ. short circuit current

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

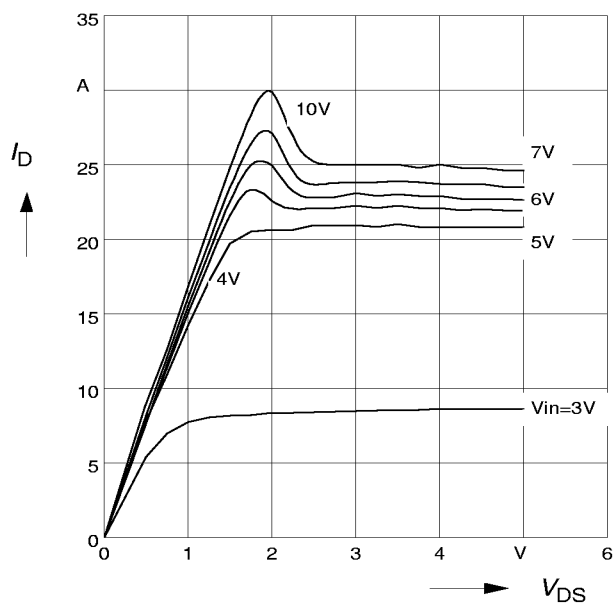
Parameter: V_{IN}



Typ. output characteristics

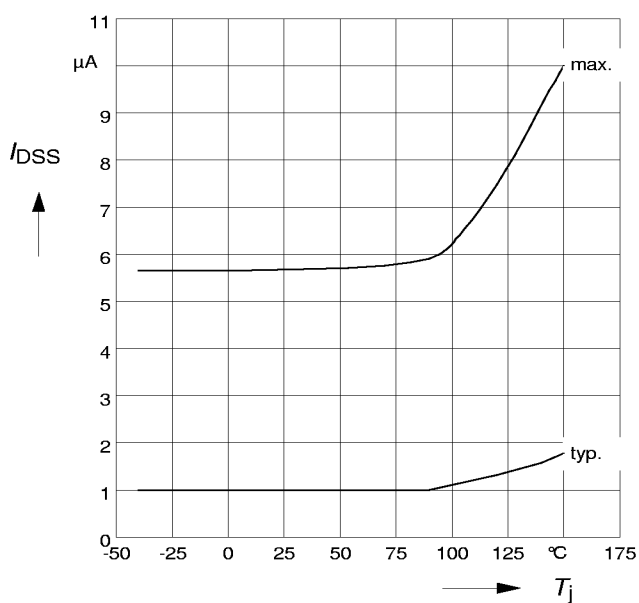
$I_D = f(V_{DS})$; $T_{Jstart} = 25^\circ C$

Parameter: V_{IN}



Typ. off-state drain current

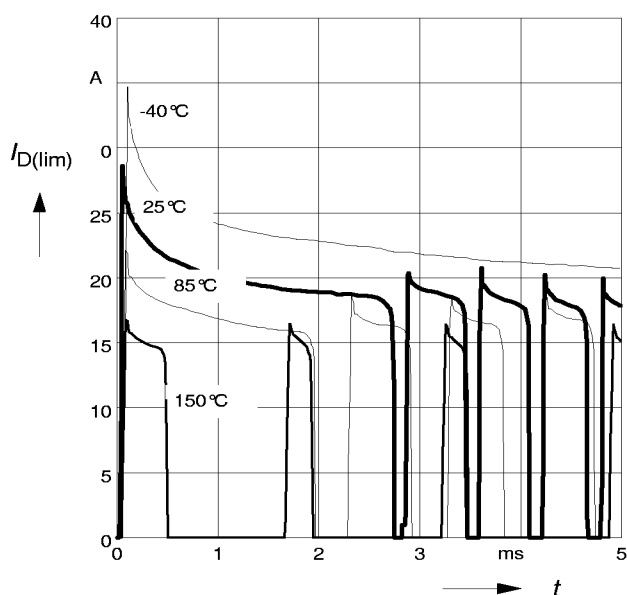
$I_{DSS} = f(T_j)$



Typ. overload current

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

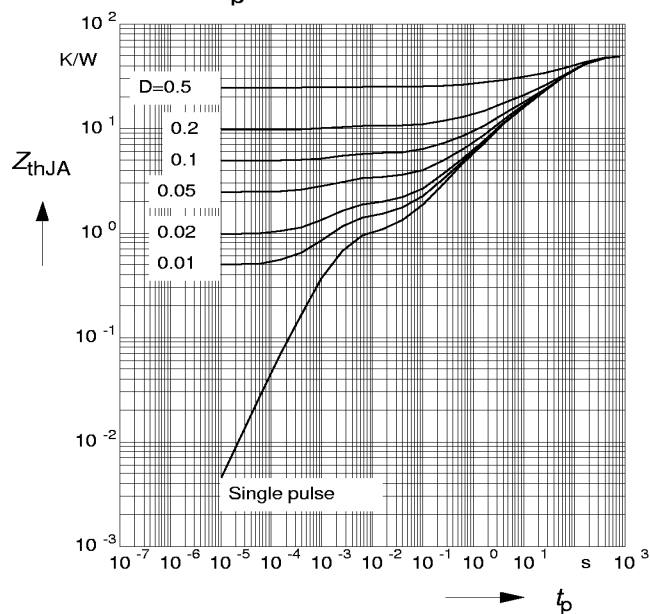
Parameter: T_{jstart}



Typ. transient thermal impedance

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

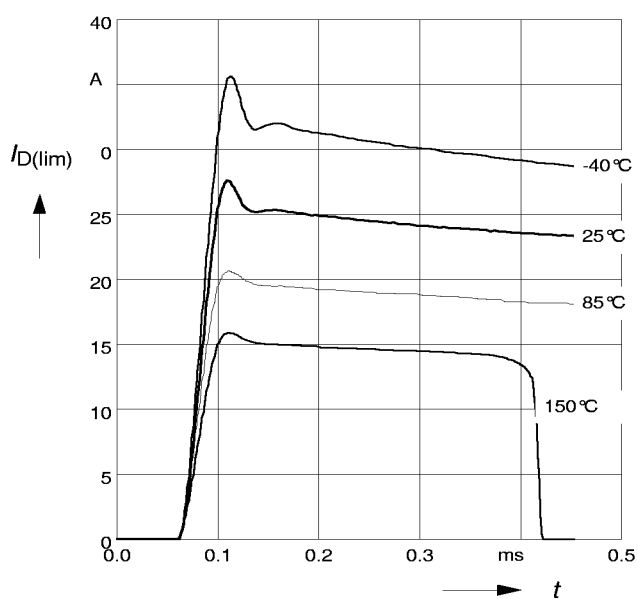
Parameter: $D=t_p/T$



Determination of $I_{D(lim)}$

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

Parameter: T_{Jstart}

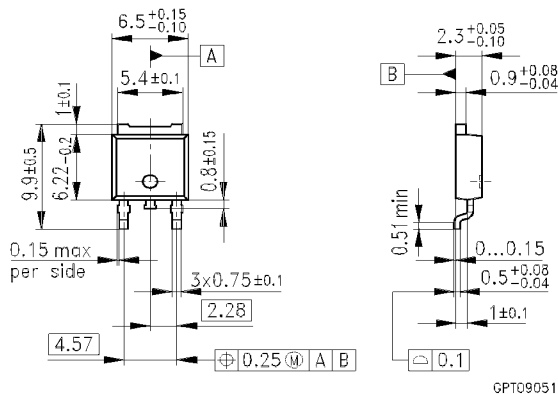


Package and ordering code

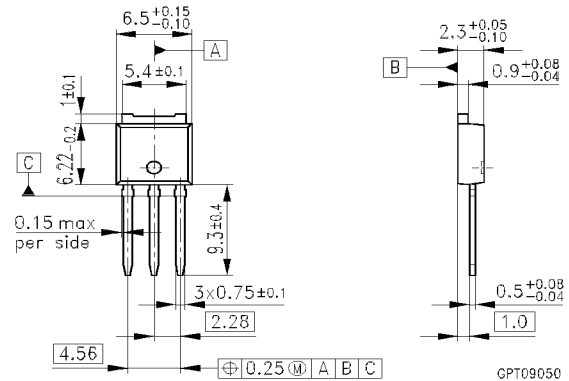
all dimensions in mm

Ordering code: Q67060-S6504-A2

Ordering code: On request



All metal surfaces tin plated, except area of cut.



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