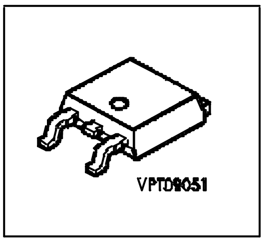
Smart Lowside Power Switch

Features

- Logic Level Input
- Input Protection (ESD)
- Thermal shutdown
- 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	mΩ
Nominal load current	$I_{D(Nom)}$	4.6	A
Clamping energy	E_{AS}	3.5	J

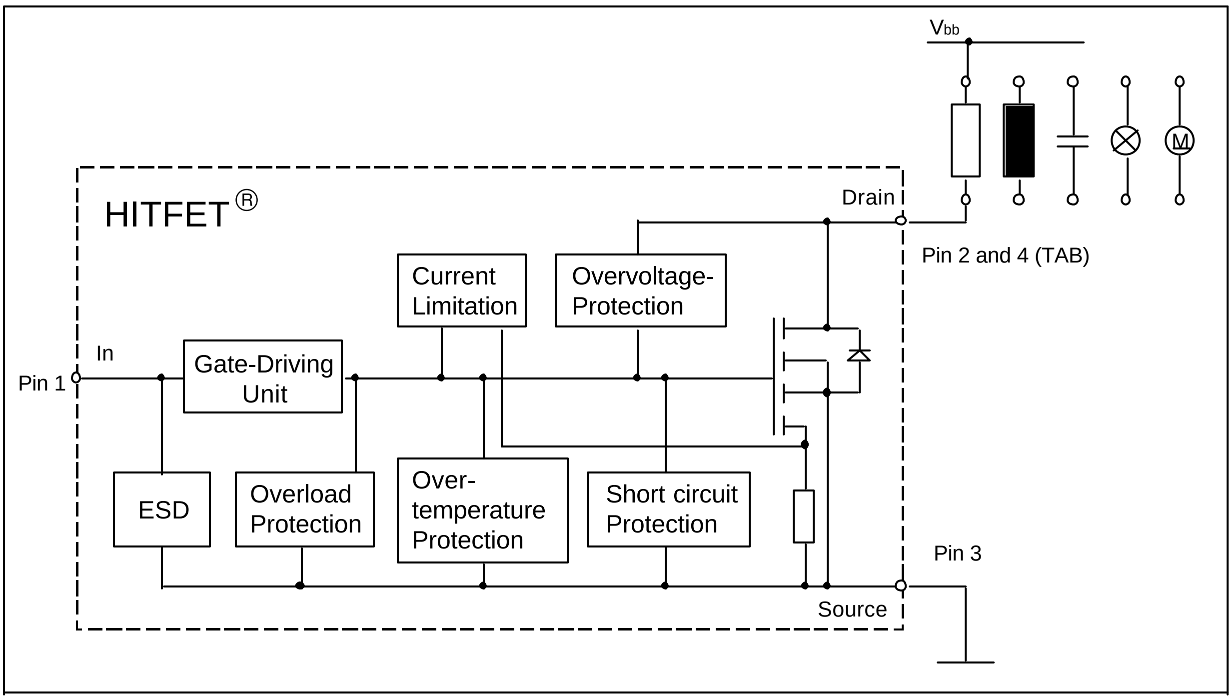


Application

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

General Description

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



Maximum Ratings at T_j = 25°C, unless otherwise specified

Parameter	Symbol	Value	Unit
Drain source voltage	V_{DS}	42	V
Drain source voltage for short circuit protection T_j = -40...150°C	$V_{DS(SC)}$	28	
Continuous input current $-0.2V \le V_{IN} \le 10V$ $V_{IN} < -0.2V$ or $V_{IN} > 10V$	I_{IN}	 no limit $\lvert I_{IN} \rvert \le 2$	mA
Operating temperature	T_j	-40 ...+150	°C
Storage temperature	T_{stg}	-55 ... +150	
Power dissipation T_C = 85 °C 6cm² cooling area , T_A = 85 °C	P_{tot}	 59 1.1	W
Unclamped single pulse inductive energy 1)	E_{AS}	3.5	J
Load dump protection $V_{LoadDump}$ 2) = $V_A + V_S$ V_{IN} = 0 and 10 V, t_d = 400 ms, R_I = 2 Ω, R_L = 3 Ω, V_A = 13.5 V	V_{LD}	67.5	V
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}	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
SMD: junction - ambient @ min. footprint @ 6 cm² 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°C, unless otherwise specified	Symbol	Values			Unit
		min.	typ.	max.	
Characteristics					
Drain source clamp voltage T_j = - 40 ...+ 150, I_D = 10 mA	$V_{DS(AZ)}$	42	-	55	V
Off-state drain current T_j = -40 ... +150°C V_{DS} = 32 V, V_{IN} = 0 V	I_{DSS}	-	1.5	20	µA
Input threshold voltage	$V_{IN(th)}$				V
I_D = 1.2 mA, T_j = 25 °C		1.3	1.7	2.2	
I_D = 1.2 mA, T_j = 150 °C		0.8	-	-	
On state input current	$I_{IN(on)}$	-	10	30	µA
On-state resistance	$R_{DS(on)}$				mΩ
V_{IN} = 5 V, I_D = 4.6 A, T_j = 25 °C		-	27	34	
V_{IN} = 5 V, I_D = 4.6 A, T_j = 150 °C		-	54	68	
On-state resistance	$R_{DS(on)}$				
V_{IN} = 10 V, I_D = 4.6 A, T_j = 25 °C		-	23	28	
V_{IN} = 10 V, I_D = 4.6 A, T_j = 150 °C		-	46	56	
Nominal load current T_j < 150°C, V_{IN} = 10 V, T_A = 85 °C, SMD [1)]	$I_{D(Nom)}$	4.6	-	-	A
Nominal load current V_{IN} = 10 V, V_{DS} = 0.5 V, T_C = 85 °C, T_j < 150°C	$I_{D(ISO)}$	12.6	-	-	
Current limit (active if V_{DS}>2.5 V)[2)] V_{IN} = 10 V, V_{DS} = 12 V, t_m = 200 µs	$I_{D(lim)}$	30	45	55	

[1]@ 6 cm^2 cooling area

[2]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.

Electrical Characteristics

Parameter at T_j = 25°C, unless otherwise specified	Symbol	Values min.	Values typ.	Values max.	Unit
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}	-	60	120	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}	-	60	120	
Slew rate on 70 to 50% V_{bb}: R_L = 4.7 Ω, V_{IN} = 0 to 10 V, V_{bb} = 12 V	$-dV_{DS}/dt_{on}$	-	0.3	1.5	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}	-	0.3	1.5	
Protection Functions[1)]					
Thermal overload trip temperature	T_{jt}	150	175	-	°C
Input current protection mode	$I_{IN(Prot)}$	-	220	400	µA
Input current protection mode T_j = 150 °C	$I_{IN(Prot)}$	-	180	400	
Unclamped single pulse inductive energy [2)] I_D = 4.6 A, T_j = 25 °C, V_{bb} = 12 V	E_{AS}	3.5	-	-	J

Inverse Diode

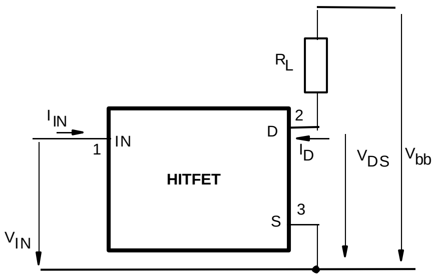
Inverse diode forward voltage I_F = 51 A, t_m = 250 µs, V_{IN} = 0 V, t_P = 300 µs	V_{SD}	-	1.0	-	V

[1]Integrated protection functions are designed to prevent IC destruction under fault conditions described in the data sheet. Fault conditions are considered as "outside" normal operating range. Protection functions are not designed for continuous repetitive operation.

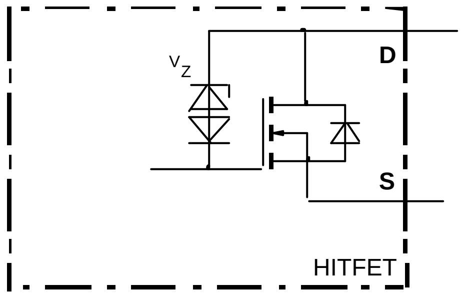
[2] Not tested, specified by design.

Block diagram

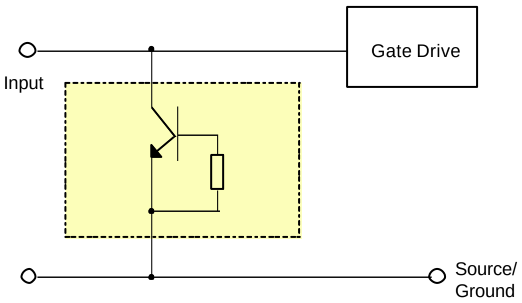
Terms



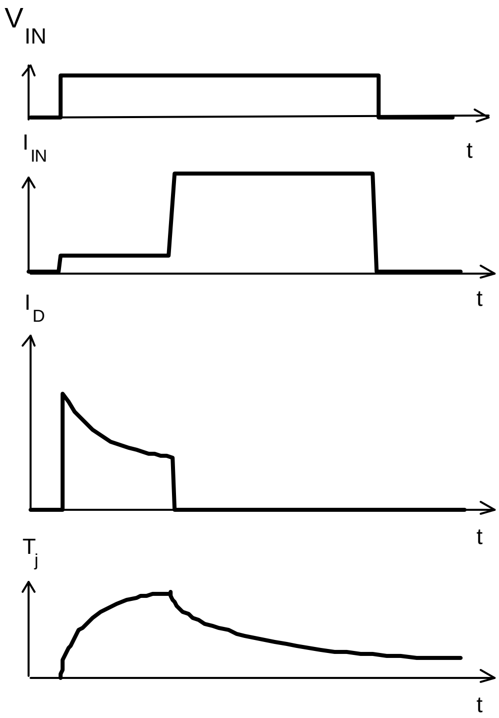
Inductive and overvoltage output clamp



Input circuit (ESD protection)



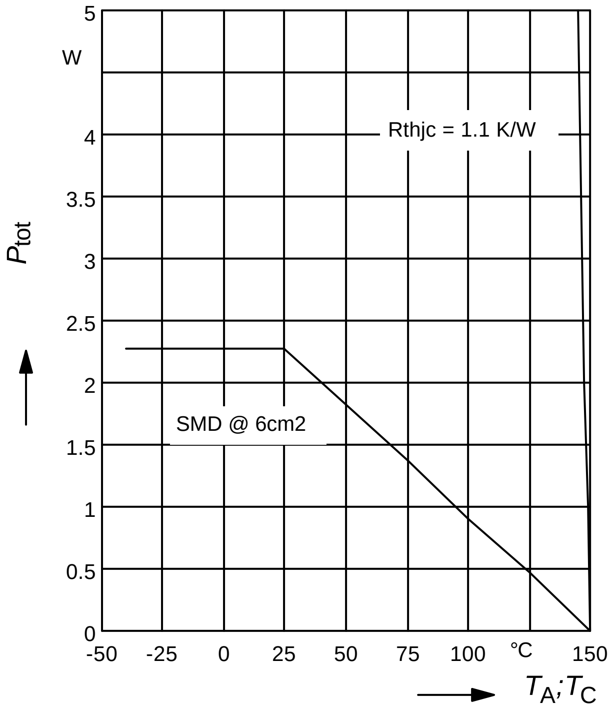
Short circuit behaviour



1 Maximum allowable power dissipation

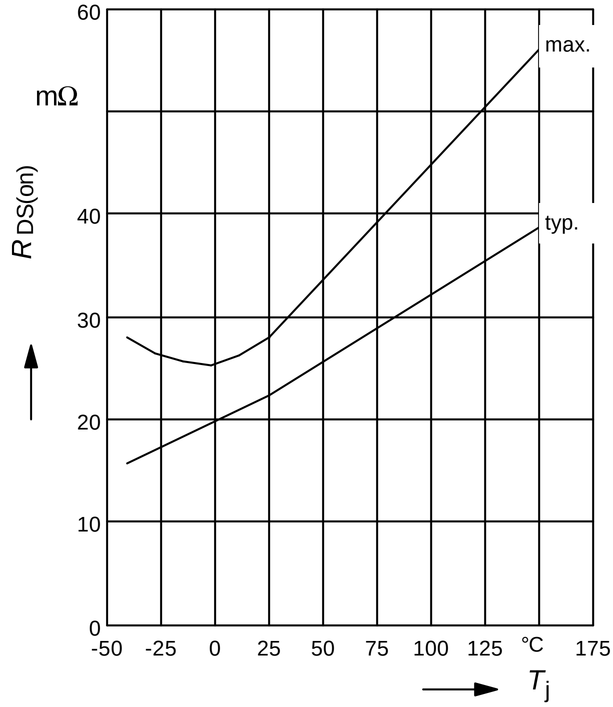
P_{tot} = f(T_C) resp.

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



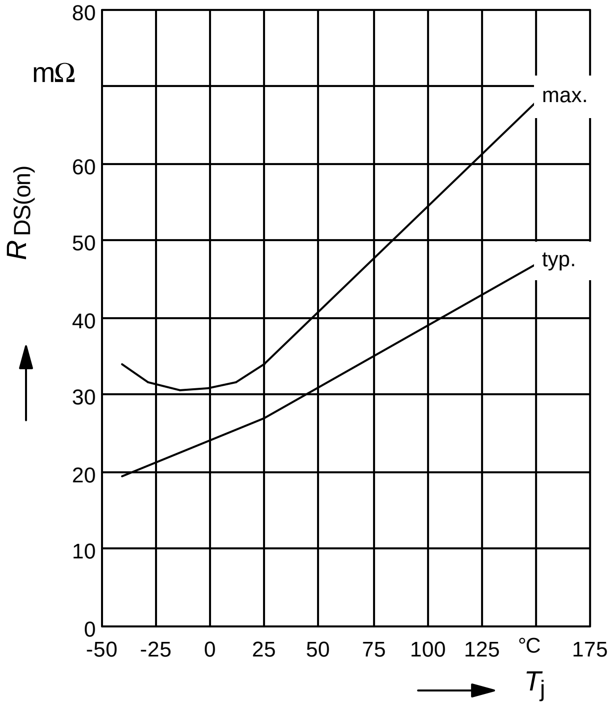
2 On-state resistance

R_{ON} = f(T_j); I_D=12.6A; V_{IN}=10V



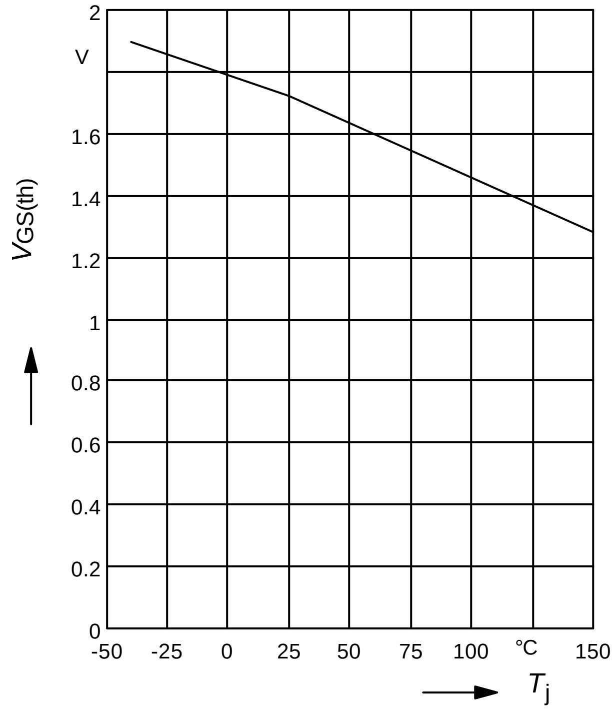
3 On-state resistance

R_{ON} = f(T_j); I_D= 12.6A; V_{IN}=5V



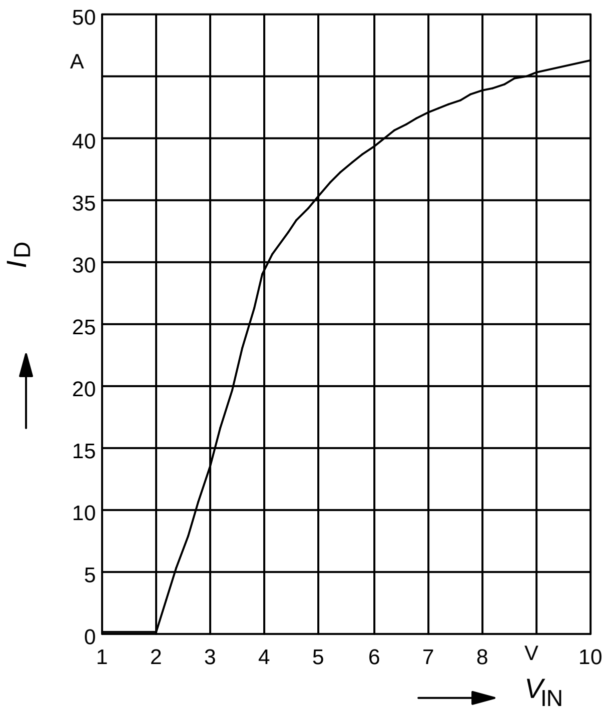
4 Typ. input threshold voltage

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



5 Typ. transfer characteristics

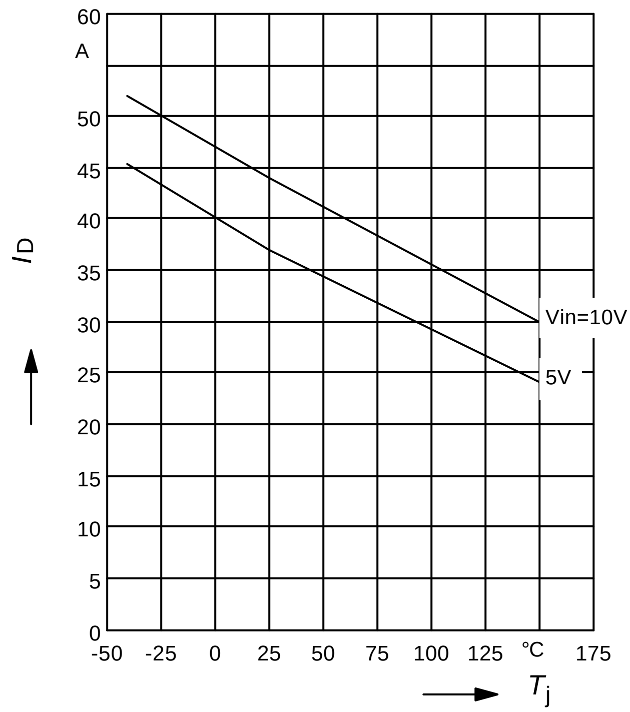
I_D=f(V_{IN}); V_{DS}=12V; T_{Jstart}=25°C



6 Typ. short circuit current

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

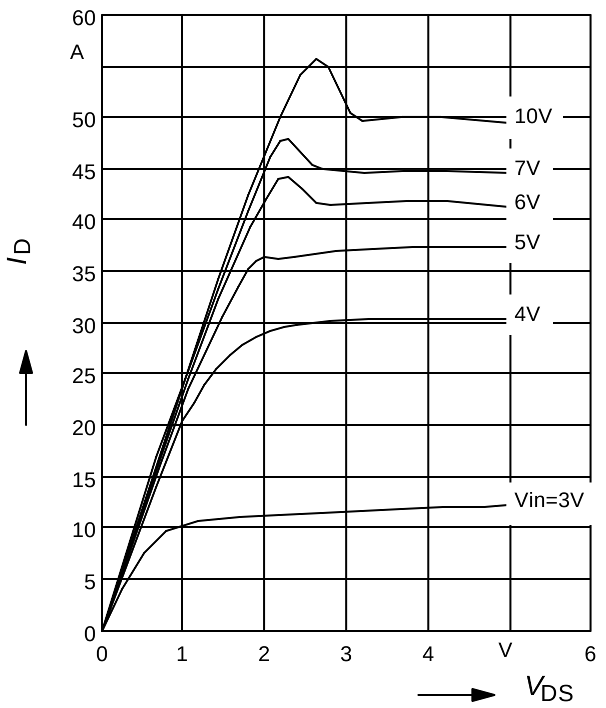
Parameter: V_{IN}



7 Typ. output characteristics

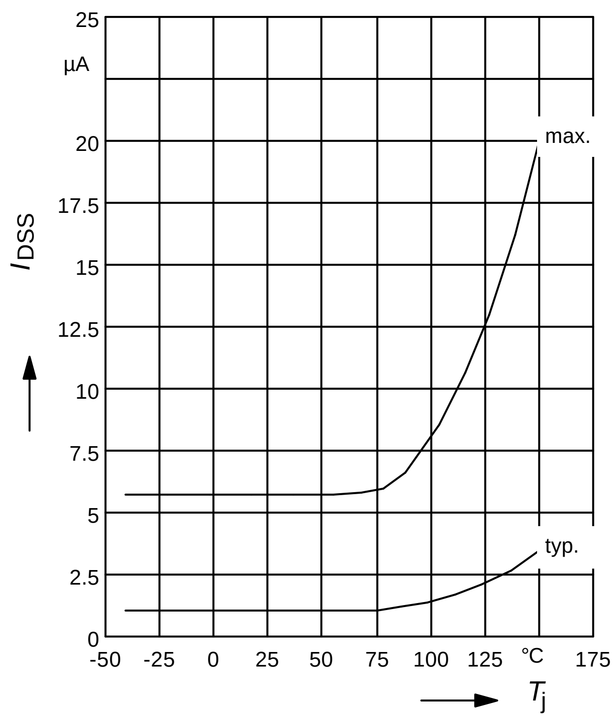
I_D=f(V_{DS}); T_{Jstart}=25°C

Parameter: V_{IN}



8 Typ. off-state drain current

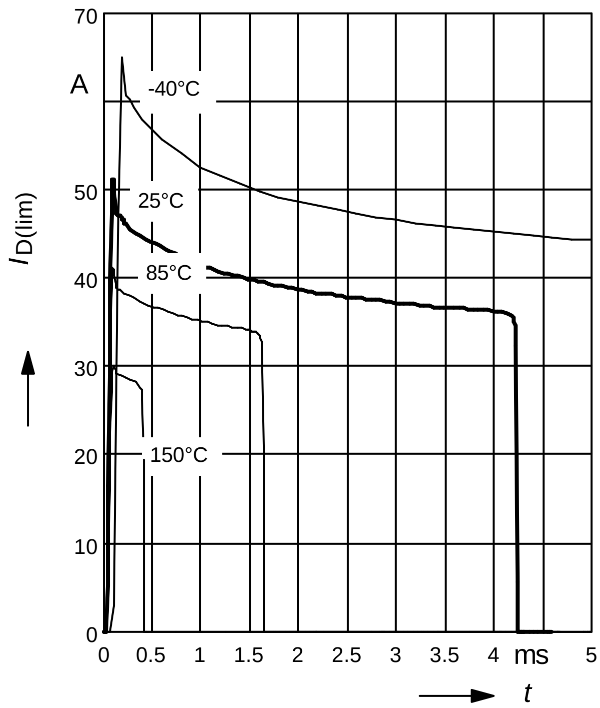
***I_{DSS}* = f(*T_j*)**



9 Typ. overload current

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

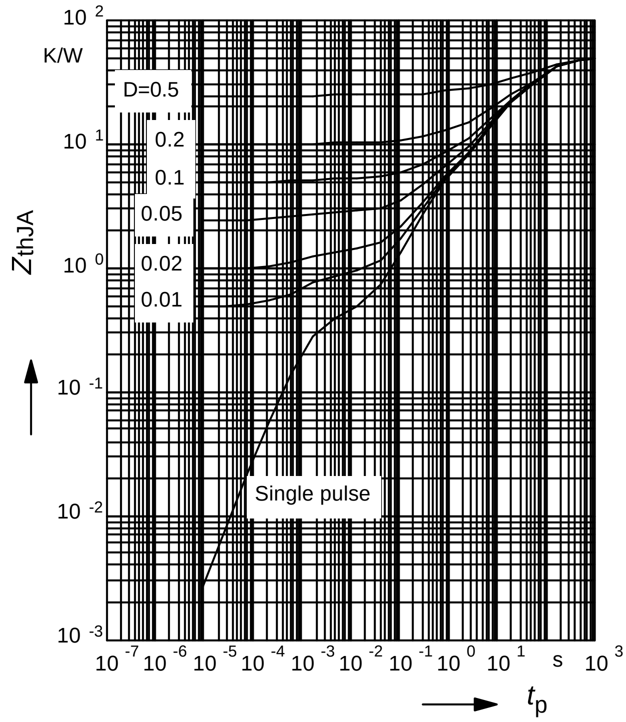
Parameter: T_{jstart}



10 Typ. transient thermal impedance

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

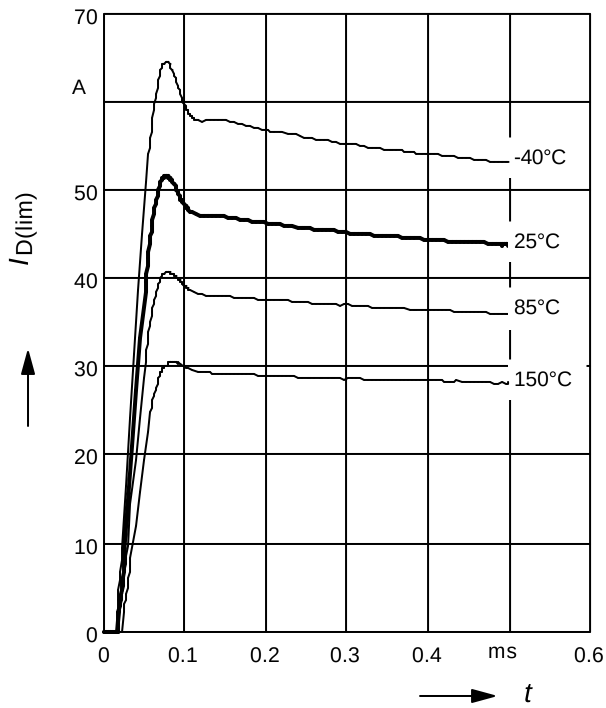
Parameter: D=t_p/T



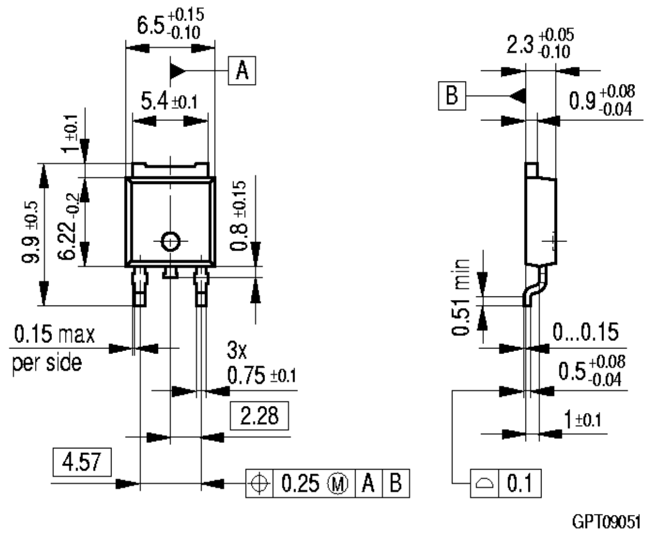
11 Determination of $I_{D(lim)}$

$I_{D(lim)}$ = f(*t*); t_m = 200µs

Parameter: T_{Jstart}



Package	Ordering Code
P-TO252-3-1	Q67060-S6087-A101



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