

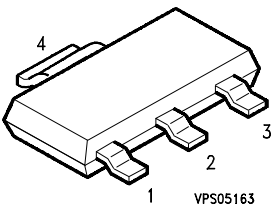
Smart Lowside Power Switch

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 | $V_{DS}$     | 40  | V  |
| On-state resistance  | $R_{DS(on)}$ | 50  | mΩ |
| Nominal load current | $I_{D(Nom)}$ | 3   | A  |
| Clamping energy      | $E_{AS}$     | 500 | mJ |



Application

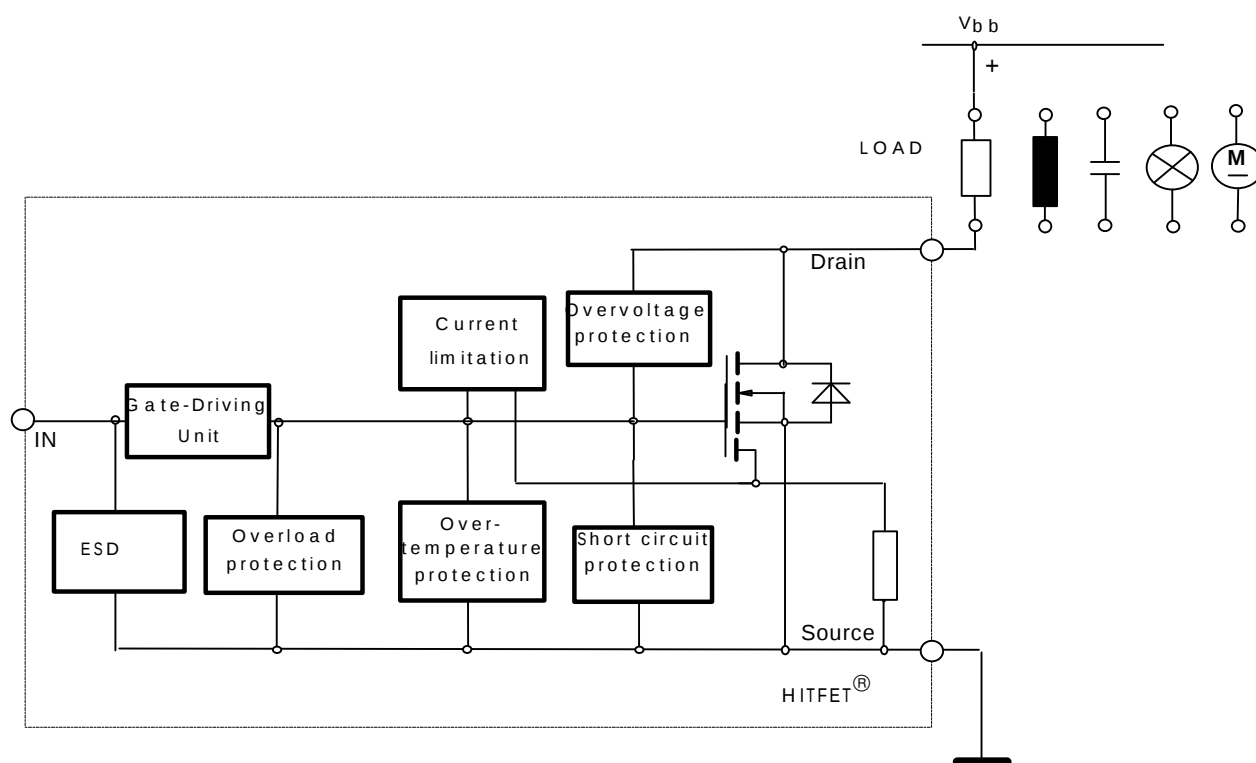
- All kinds of resistive, inductive and capacitive loads in switching or linear applications
- $\mu$ C compatible power switch for 12 V and 24 V DC applications
- Replaces electromechanical relays and discrete circuits

General Description

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

| Pin | Symbol |  | Function           |
|-----|--------|--|--------------------|
| 1   | IN     |  | Input              |
| 2   | DRAIN  |  | Output to the load |
| 3   | SOURCE |  | Ground             |
| TAB | DRAIN  |  | Output to the load |

## Block Diagram



## Maximum Ratings at $T_j = 25^\circ\text{C}$ , unless otherwise specified

| Parameter                                                                                                                          | Symbol         | Value             | Unit             |
|------------------------------------------------------------------------------------------------------------------------------------|----------------|-------------------|------------------|
| Drain source voltage                                                                                                               | $V_{DS}$       | 40                | V                |
| Drain source voltage for short circuit protection                                                                                  | $V_{DS(SC)}$   | 40                |                  |
| 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, $T_C = 85^\circ\text{C}$                                                                                        | $P_{tot}$      | 1.7               | W                |
| Unclamped single pulse inductive energy <sup>F)</sup>                                                                              | $E_{AS}$       | 500               | mJ               |
| Electrostatic discharge voltage (Human Body Model) according to MIL STD 883D, method 3015.7 and EOS/ESD assn. standard S5.1 - 1993 | $V_{ESD}$      | 2000              | kV               |
| DIN humidity category, DIN 40 040                                                                                                  |                | E                 |                  |
| IEC climatic category; DIN IEC 68-1                                                                                                |                | 40/150/56         |                  |

## Thermal resistance

|                                                |            |     |     |
|------------------------------------------------|------------|-----|-----|
| junction - ambient:                            | $R_{thJA}$ |     | K/W |
| @ min. footprint                               |            | 125 |     |
| @ 6 cm <sup>2</sup> cooling area <sup>F)</sup> |            | 72  |     |
| junction-soldering point:                      | $R_{thJS}$ | 17  | K/W |

<sup>1</sup>not tested, specified by design

<sup>2</sup>Device on 50mm+50mm\*1.5mm epoxy PCB FR4 with 6 cm<sup>2</sup> (one layer, 70µm thick) copper area for Drain connection. PCB is vertical without blown air.

## Electrical Characteristics

| Parameter<br>at $T_j = 25^{\circ}\text{C}$ , unless otherwise specified                                                                                                                                          | Symbol              | Values |          |           | Unit             |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|--------|----------|-----------|------------------|
|                                                                                                                                                                                                                  |                     | min.   | typ.     | max.      |                  |
| Characteristics                                                                                                                                                                                                  |                     |        |          |           |                  |
| Drain source clamp voltage<br>$T_j = -40 \dots +150$ , $I_{\text{mess}} = 10 \text{ mA}$                                                                                                                         | $V_{\text{DS(AZ)}}$ | 40     | -        | 55        | V                |
| Off-state drain current $T_j = -40 \dots +150^{\circ}\text{C}$<br>$V_{\text{IN}} = 0 \text{ V}$ , $V_{\text{DS}} = 32 \text{ V}$                                                                                 | $I_{\text{DSS}}$    | -      | -        | 10        | $\mu\text{A}$    |
| Input treshold voltage<br>$I_{\text{D}} = 0.7 \text{ mA}$                                                                                                                                                        | $V_{\text{IN(th)}}$ | 1.3    | 1.7      | 2.2       | V                |
| On state input current                                                                                                                                                                                           | $I_{\text{IN(on)}}$ | -      | 10       | 30        | $\mu\text{A}$    |
| On-state resistance<br>$I_{\text{D}} = 3 \text{ A}$ , $V_{\text{IN}} = 5 \text{ V}$ , $T_j = 25^{\circ}\text{C}$<br>$I_{\text{D}} = 3 \text{ A}$ , $V_{\text{IN}} = 5 \text{ V}$ , $T_j = 150^{\circ}\text{C}$   | $R_{\text{DS(on)}}$ | -<br>- | 45<br>75 | 60<br>120 | $\text{m}\Omega$ |
| On-state resistance<br>$I_{\text{D}} = 3 \text{ A}$ , $V_{\text{IN}} = 10 \text{ V}$ , $T_j = 25^{\circ}\text{C}$<br>$I_{\text{D}} = 3 \text{ A}$ , $V_{\text{IN}} = 10 \text{ V}$ , $T_j = 150^{\circ}\text{C}$ | $R_{\text{DS(on)}}$ | -<br>- | 35<br>65 | 50<br>100 |                  |
| Nominal load current<br>$V_{\text{DS}} = 0.5 \text{ V}$ , $T_{\text{S}} = 85^{\circ}\text{C}$ , $T_j < 150^{\circ}\text{C}$ ,<br>$V_{\text{IN}} = 10 \text{ V}$                                                  | $I_{\text{D(Nom)}}$ | 3      | -        | -         |                  |
| Current limit (active if $V_{\text{DS}} > 2.5 \text{ V}$ )<br>$V_{\text{IN}} = 10 \text{ V}$ , $V_{\text{DS}} = 12 \text{ V}$                                                                                    | $I_{\text{D(lim)}}$ | 16     | 24       | 32        | A                |

## Dynamic Characteristics

|                                                                                                                                                             |                                  |   |     |     |                        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|---|-----|-----|------------------------|
| Turn-on time $V_{\text{IN}}$ to 90% $I_{\text{D}}$ :<br>$R_{\text{L}} = 5 \Omega$ , $V_{\text{IN}} = 0$ to $10 \text{ V}$ , $V_{\text{bb}} = 12 \text{ V}$  | $t_{\text{on}}$                  | - | 60  | 150 | $\mu\text{s}$          |
| Turn-off time $V_{\text{IN}}$ to 10% $I_{\text{D}}$ :<br>$R_{\text{L}} = 5 \Omega$ , $V_{\text{IN}} = 10$ to $0 \text{ V}$ , $V_{\text{bb}} = 12 \text{ V}$ | $t_{\text{off}}$                 | - | 60  | 150 |                        |
| Slew rate on 70 to 50% $V_{\text{bb}}$ :<br>$R_{\text{L}} = 5 \Omega$ , $V_{\text{IN}} = 0$ to $10 \text{ V}$ , $V_{\text{bb}} = 12 \text{ V}$              | $-dV_{\text{DS}}/dt_{\text{on}}$ | - | 0.4 | 1   | $\text{V}/\mu\text{s}$ |
| Slew rate off 50 to 70% $V_{\text{bb}}$ :<br>$R_{\text{L}} = 5 \Omega$ , $V_{\text{IN}} = 10$ to $0 \text{ V}$ , $V_{\text{bb}} = 12 \text{ V}$             | $dV_{\text{DS}}/dt_{\text{off}}$ | - | 0.7 | 1   |                        |

## Electrical Characteristics

| Parameter<br>at $T_j = 25^\circ\text{C}$ , unless otherwise specified | Symbol | Values |      |      | Unit |
|-----------------------------------------------------------------------|--------|--------|------|------|------|
|                                                                       |        | min.   | typ. | max. |      |

## Protection Functions

|                                                                                                                                                                                                            |                 |            |        |        |                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------------|--------|--------|------------------|
| Thermal overload trip temperature                                                                                                                                                                          | $T_{jt}$        | 150        | 165    | -      | $^\circ\text{C}$ |
| Thermal hysteresis                                                                                                                                                                                         | $\Delta T_{jt}$ | -          | 10     | -      | K                |
| Input current protection mode                                                                                                                                                                              | $I_{IN(Prot)}$  | -          | -      | 300    | $\mu\text{A}$    |
| Unclamped single pulse inductive energy <sup>F)</sup><br>$I_D = 3\text{ A}$ , $T_j = 25^\circ\text{C}$ , $V_{bb} = 12\text{ V}$<br>$I_D = 3\text{ A}$ , $T_j = 150^\circ\text{C}$ , $V_{bb} = 12\text{ V}$ | $E_{AS}$        | 500<br>300 | -<br>- | -<br>- | mJ               |

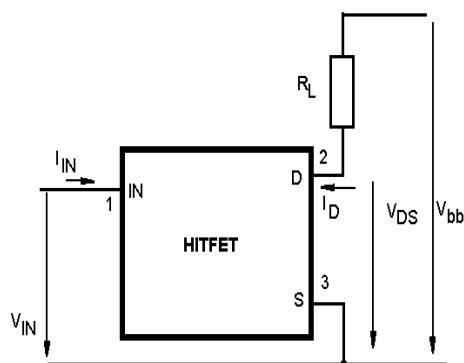
## Inverse Diode

|                                                                                                                          |          |   |     |   |   |
|--------------------------------------------------------------------------------------------------------------------------|----------|---|-----|---|---|
| Continuous source drain voltage<br>$V_{IN} = 0\text{ V}$ , $-I_D = 5 \times 3\text{ A}$ , $t_p = 300\text{ }\mu\text{s}$ | $V_{SD}$ | - | 1.1 | - | V |
|--------------------------------------------------------------------------------------------------------------------------|----------|---|-----|---|---|

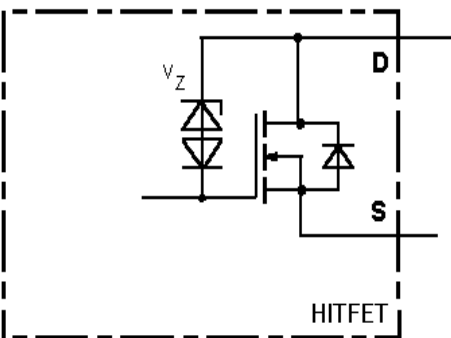
<sup>1</sup>not tested, specified by design

## Block diagram

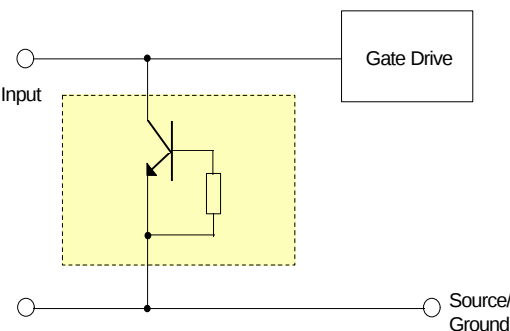
### Terms



### Inductive and overvoltage output clamp

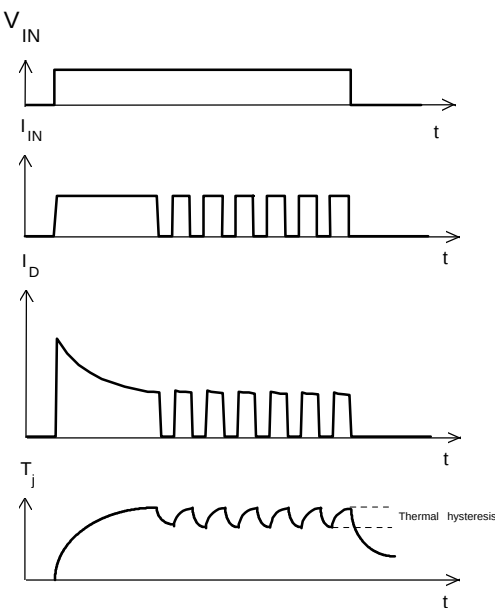


### Input circuit (ESD protection)



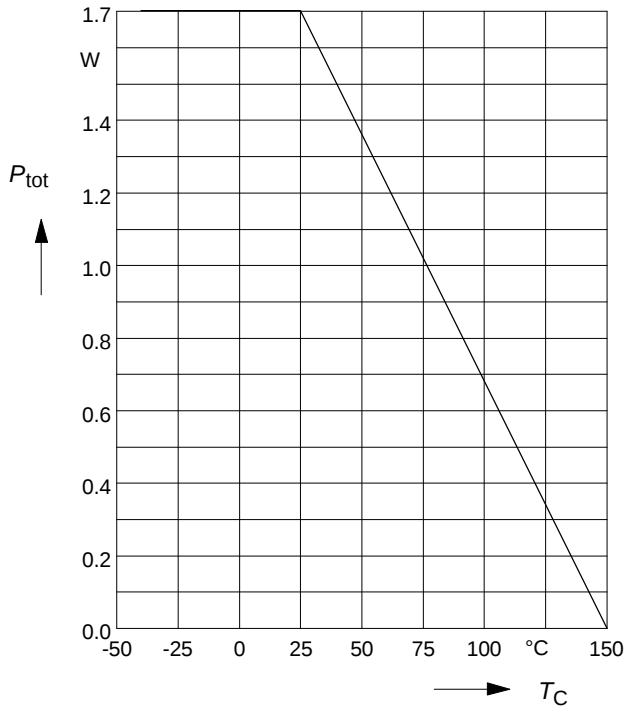
Input is not designed for DC current > 2 mA

### Short circuit behaviour



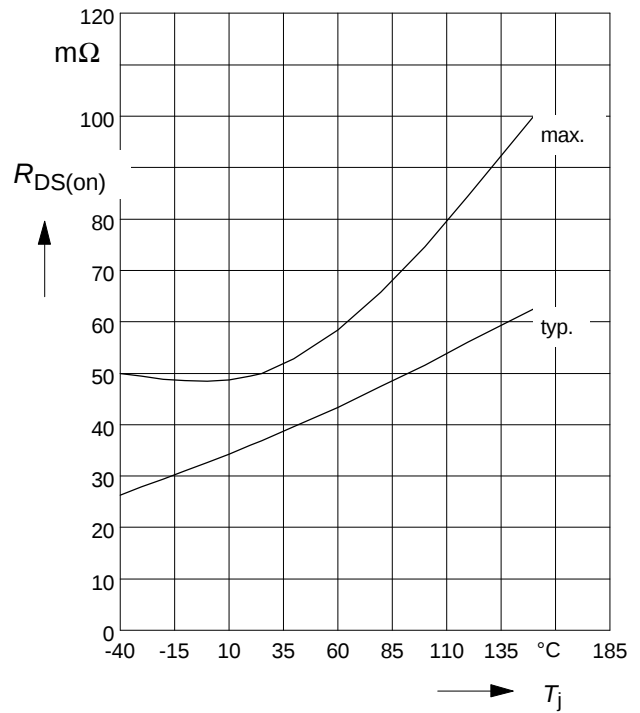
## Maximum allowable power dissipation

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



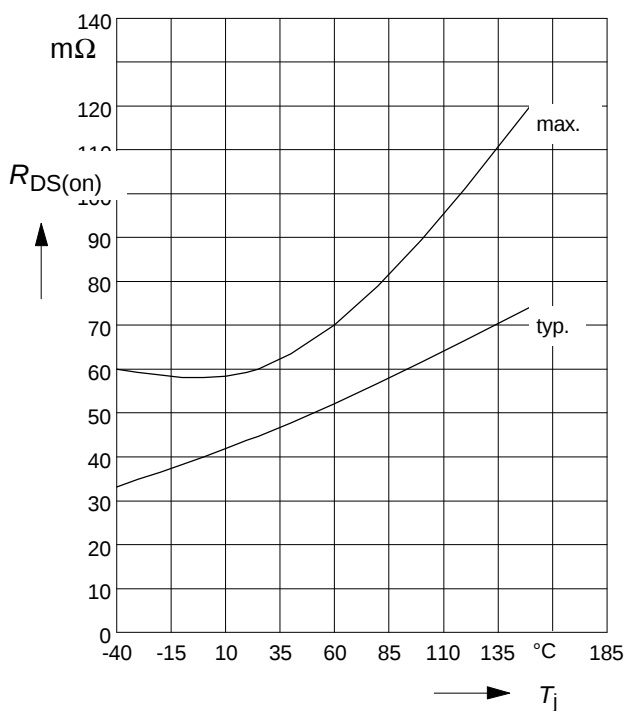
## On-state resistance

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



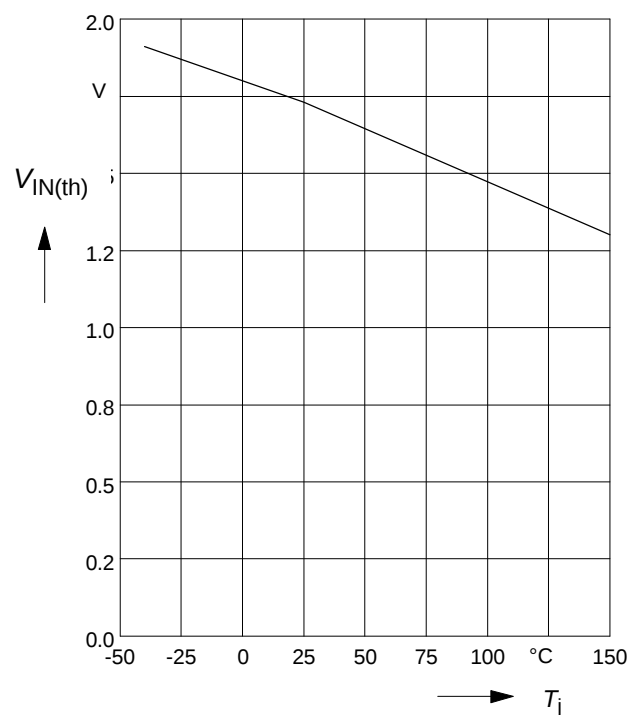
## On-state resistance

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



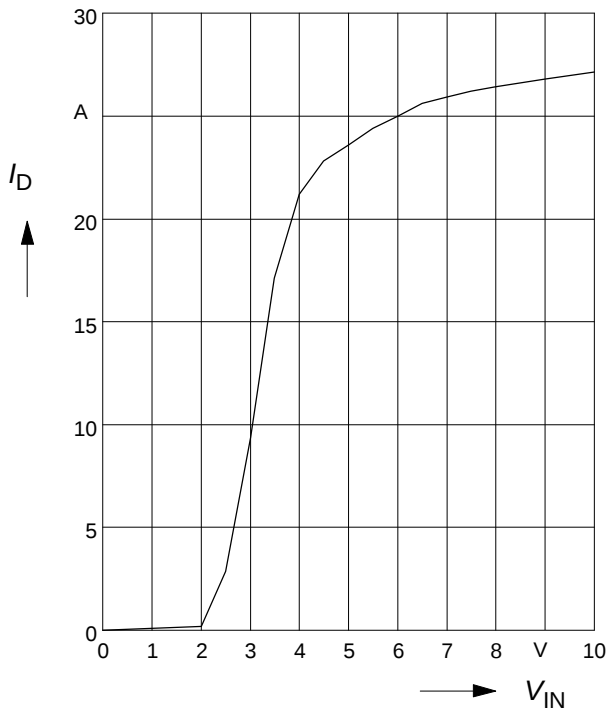
## Typ. input threshold voltage

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



## Typ. transfer characteristics

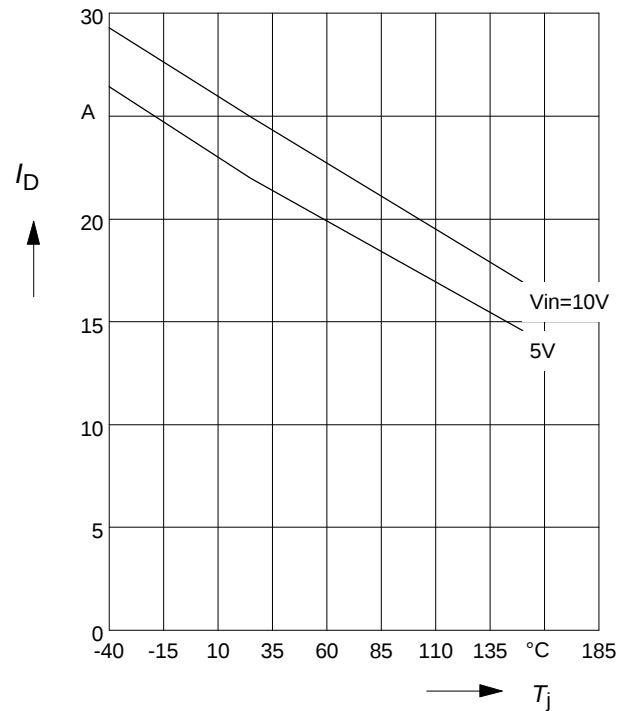
$I_D = f(V_{IN}); V_{DS}=12V; T_j=25^\circ C$



## Typ. short circuit current

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

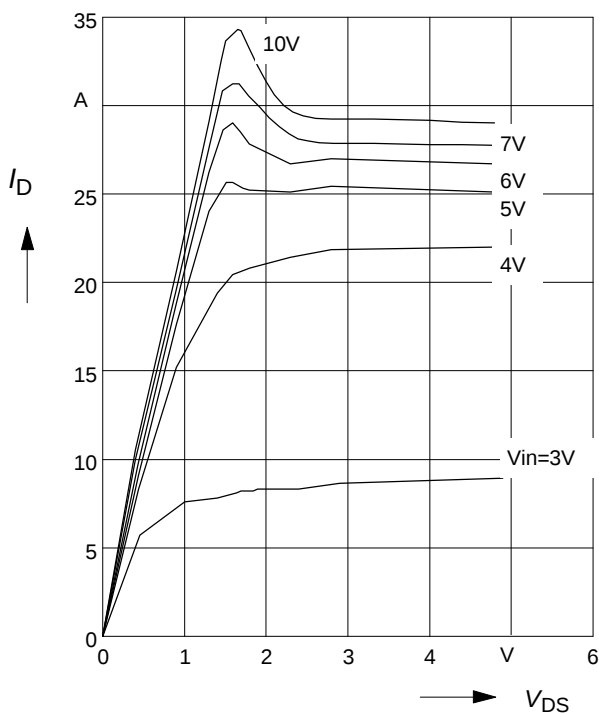
Parameter:  $V_{IN}$



## Typ. output characteristic

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

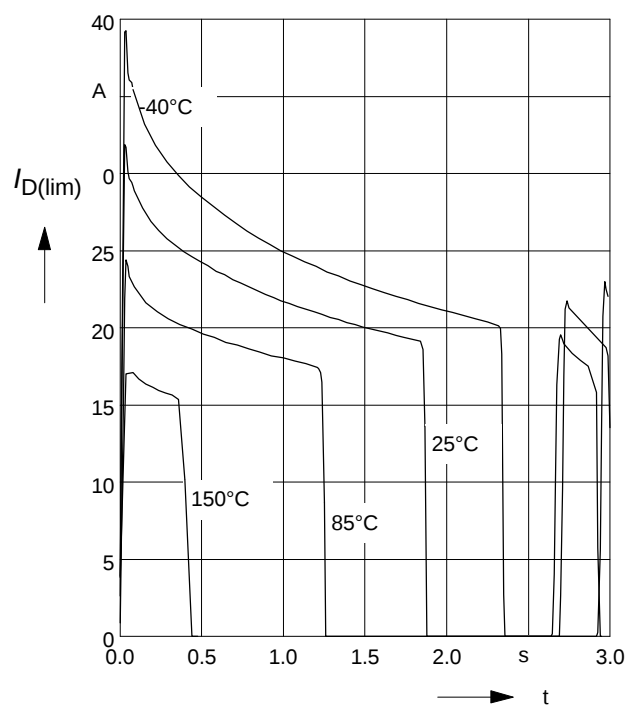
Parameter:  $V_{IN}$



## Typ. overload current

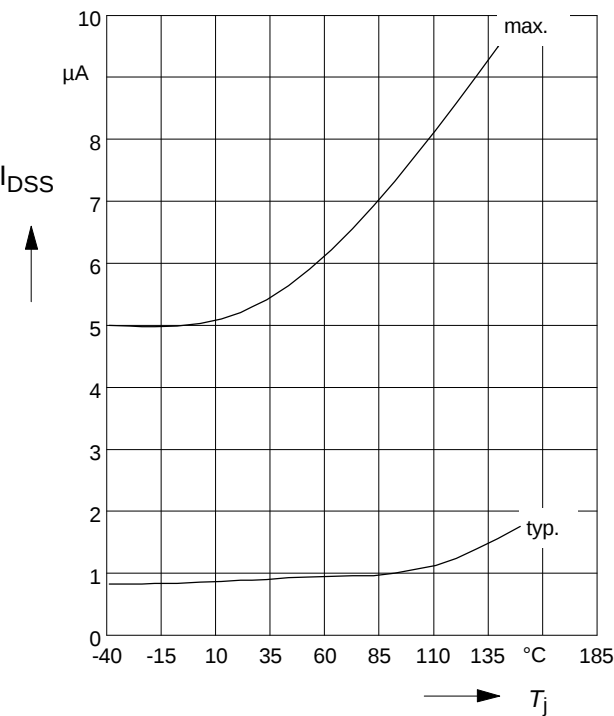
$I_{D(lim)} = f(t), V_{bb}=12V, \text{no heatsink}$

Parameter:  $T_{jstart}$



Typ. off-state drain current

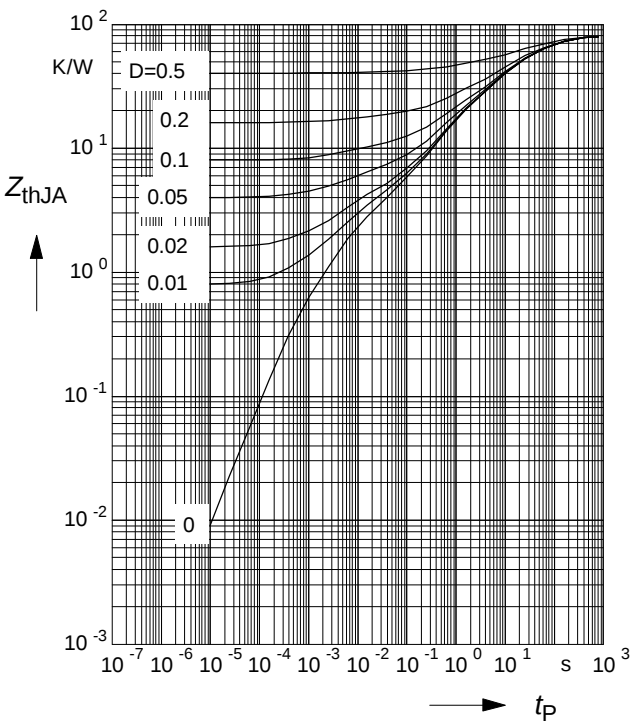
$I_{DSS} = f(T_j)$



Transient thermal impedance

$Z_{thJC} = f(t_p)$

Parameter:  $D = t_p / T$



## Package and ordering code

all dimensions in mm

Ordering code: Q67060-S7203-A2

