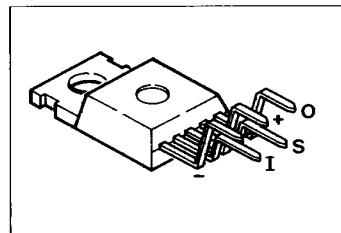


## PROFET

### Preliminary Data

- High-side switch
- Short-circuit protection
- Overtemperature protection
- Overload protection
- Load dump protection up to 80 V<sup>1)</sup>
- Undervoltage and overvoltage shutdown with auto-restart and hysteresis
- Reverse battery protection<sup>1)</sup>
- Input protection
- Inductive load generated negative voltage transient limit to -10 V
- Broken inductive load protection<sup>2)</sup>
- Open-load detection in on-condition
- Status output
- $R_{on}$  constant versus  $V_{bb}$
- Electrostatic discharge (**ESD**) protection



| Type      | Ordering code   |
|-----------|-----------------|
| BTS 412 B | C67078-S5300-A9 |

#### Maximum Ratings

| Parameter                               | Symbol             | Values         | Unit |
|---|--------------------|----------------|------|
| Active overvoltage protection           | $V_{bb(AZ)}$       | > 50           | V    |
| Short-circuit current                   | $I_{SC}$           | self-limited   | -    |
| Max. power dissipation                  | $P_{tot}$          | 75             | W    |
| Operating and storage temperature range | $T_j$<br>$T_{stg}$ | - 55 ... + 150 | °C   |
| Thermal resistance<br>Chip - case       | $R_{th\ JC}$       | 1.67           | K/W  |
| Chip - ambient                          | $R_{th\ JA}$       | 75             |      |

<sup>1)</sup> with 150 Ω resistor in GND connection

<sup>2)</sup> with 150 Ω resistor in GND connection or freewheel diode parallel to load.

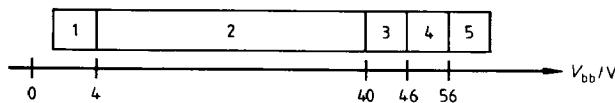
**Electrical Characteristics (continued)**  
at  $T_j = 25^\circ\text{C}$ , unless otherwise specified.

| Parameter   | Symbol  | Values      |        |            | Unit                   |
|---|---|-------------|--------|------------|------------------------|
|   |   | min.        | typ.   | max.       |                        |
| On-state resistance (pin 3 to 5)<br>$V_{bb} = 12 \text{ V}, I_L = 1 \text{ A}$  | $R_{on}$                                      | —           | 190    | 250        | $\text{m}\Omega$       |
| Operating voltage (pin 3 to 1)<br>$T_j = -40 \dots +150^\circ\text{C}$  | $V_{bb}$                                      | 4.9         | —      | 42         | V                      |
| Nominal current, calculated value (pin 5 to 1)<br>ISO-proposal: $V_{bb} - V_{out} \leq 0.5 \text{ V}, T_c = 85^\circ\text{C}$           | $I_L\text{-ISO}$                              | —           | —      | 1.4        | A                      |
| Load current, theoretical value (pin 5 to 1)<br>MOS-standard: $T_c = 25^\circ\text{C}, T_j = 150^\circ\text{C}$                         | $I_L\text{-MOS}$                              | —           | —      | 12         |                        |
| Short-circuit current, $V_{bb} = 12 \text{ V}$  | $I_{SC}$                                      | —           | 25     | —          |                        |
| Standby current (pin 3 to 1)<br>$V_{bb} = 12 \text{ V}$   | $I_R$   | —           | 25     | 80         | $\mu\text{A}$          |
| Short-circuit detection voltage<br>$V_{SC} = V_{bb} - V_{out}$  | $V_{SC}$                                      | —           | 8      | —          | V                      |
| Input voltage, (pin 2 to 1) $V_{bb} = 12 \text{ V}$   | $V_{in(off)}$<br>$V_{in(on)}$                 | -0.5<br>2.4 | —      | 1.5        |                        |
| Max. input current<br>at typ. $V_{in(on)} = 6.0 \text{ V}$  | $I_{in}$                                      | —           | —      | 2          | $\text{mA}$            |
| Input current (pin 2 to 1)<br>$V_{in(off)} = 0.4 \text{ V}$<br>$V_{in(on)} = 2.5 \text{ V}$   | $I_{in(off)}$<br>$I_{in(on)}$                 | 1<br>10     | —      | 30<br>70   | $\mu\text{A}$          |
| Trip temperature<br>automatic tripping when $T_j \geq 150^\circ\text{C}$  | $T_t$   | 150         | —      | —          | $^\circ\text{C}$       |
| Turn-on time<br>Turn-off time<br>$V_{bb} = 12 \text{ V}, 90\% V_{out}, I_L = 1 \text{ A}, 10\% V_{out}$                                 | $t_{on}$<br>$t_{off}$                         | 15<br>5     | —      | 60<br>50   | $\mu\text{s}$          |
| Switching edge on<br>Switching edge off<br>$V_{bb} = 12 \text{ V } 10 \dots 30\% V_{out}$<br>$I_L = 1 \text{ A } 70 \dots 40\% V_{out}$ | $dv/dt_{on}$<br>$dv/dt_{off}$                 | —<br>—      | —<br>— | 4<br>5     | $\text{V}/\mu\text{s}$ |
| Status (CMOS)<br>$I_{St} = 50 \mu\text{A}$ to GND.<br>Status valid > 300 $\mu\text{s}$ after switching edge                             | $V_{St\text{(high)}}$<br>$V_{St\text{(low)}}$ | 4.4<br>—    | —<br>— | 6.5<br>0.4 | V                      |
| Max. status current<br>$I_{St} = 50 \mu\text{A}$ to GND.<br>Status valid > 300 $\mu\text{s}$ after switching edge                       | $I_{St}$                                      | —           | —      | 5          | $\text{mA}$            |
| Inductive load switch-off energy dissipation<br>$T_j = 150^\circ\text{C}$   | $W_{ab}$                                      | —           | —      | 0.4        | J                      |

**Truth Table**

| L = "Low" level<br>H = "High" level | <b>Input voltage</b> | <b>Status</b> | <b>Output voltage</b> |
|-------------------------------------|----------------------|---------------|-----------------------|
| Normal operation                    | L                    | H             | L                     |
|                                     | H                    | H             | H                     |
| Open load                           | L                    | L             | H <sup>1)</sup>       |
|                                     | H                    | H             | H                     |
| Short-circuit                       | L                    | H             | L                     |
|                                     | H                    | L             | L                     |
| Overtemperature                     | L                    | L             | L                     |
|                                     | H                    | L             | L                     |
| Undervoltage                        | L                    | L             | L                     |
|                                     | H                    | L             | L                     |
| Overvoltage                         | L                    | L             | L                     |
|                                     | H                    | L             | L                     |

<sup>1)</sup> Power transistor off

**Operating Range (typ.)**

- 1 Undervoltage sensor causes the device to switch off
- 2 Normal operation
- 3 Reduction of load current limit to reduce the short-circuit power dissipation of the switch
- 4 Overvoltage sensor causes the device to switch off
- 5 Increase of current between pin 3 and 1 from Zener diode to protect the circuit against overvoltage spikes

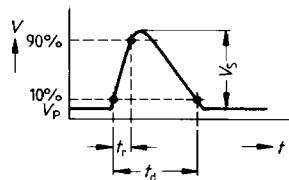
**Interference Immunity<sup>1)</sup>**

in acc. with DIN 40839, part 1 (12 V supply voltage)

| Test pulse | Interference levels          |    |     |    |   |    |     |    |
|------------|------------------------------|----|-----|----|---|----|-----|----|
|            | with 150 Ω in GND connection |    |     |    |   |    |     |    |
|            | I                            | II | III | IV | I | II | III | IV |
| 1          | A                            | A  | A   | A  | A | A  | A   | A  |
| 2          | A                            | A  | B   | B  | A | A  | A   | A  |
| 3 a        | A                            | A  | A   | A  | A | A  | A   | A  |
| 3 b        | A                            | A  | A   | A  | A | A  | A   | A  |
| 4          | A                            | A  | A   | A  | A | A  | A   | A  |
| 5          | A                            | A  | B   | B  | A | A  | A   | B  |

**Class A:** All functions of the device are performed as designed after exposure to disturbance.

**Class B:** One or more functions of the device are not performed as designed after exposure and cannot be returned to proper operation without replacing the device.

**Test pulse 5: load dump**Parameters:  $V_s = 50 \text{ V}$  (level 2) $V_p = 13.5 \text{ V}$  $R_j = 0.5 \dots 4 \Omega$  $t_d = 40 \dots 400 \text{ ms}$  $t_r = 0.1 \dots 10 \text{ ms}$ 

$I_{\text{Load}}$  (Pin 5 to 1) =  $I_{\text{L-ISO}}$  (see page 154)  
with 150 Ω in GND connection:  
 $V_s = 80 \text{ V}$  (level 3)

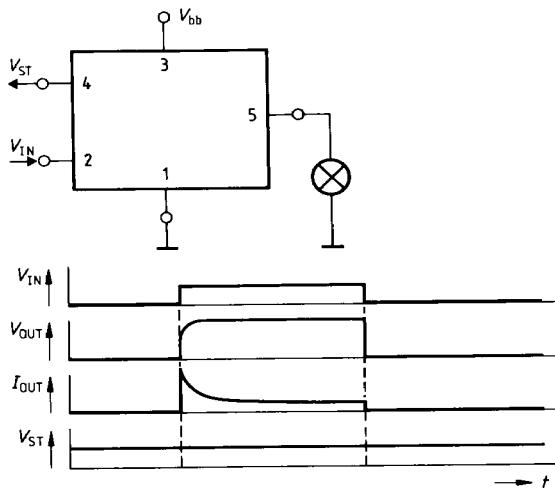
**Note:**

The conditions are related to each other in that the high setting values of  $V_s$ ,  $R_j$  and  $t_d$  belong together as do respectively the low values.

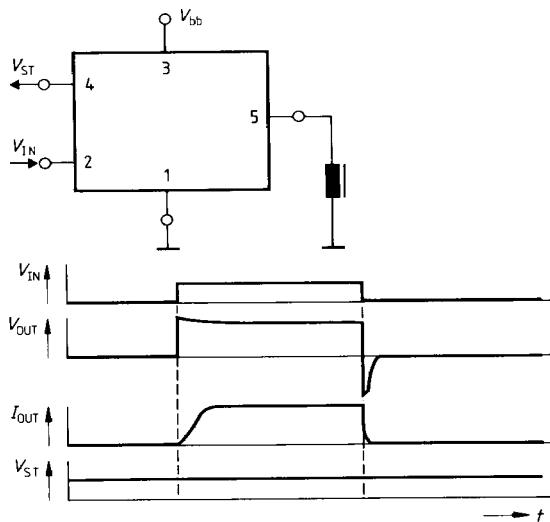
<sup>1)</sup> For detailed information refer to chapter Technical Information (DIN 40839: Electromagnetic compatibility (EMC) in motor vehicles; correlation with ISO-Technical Report 7637/0 and 7637/1).

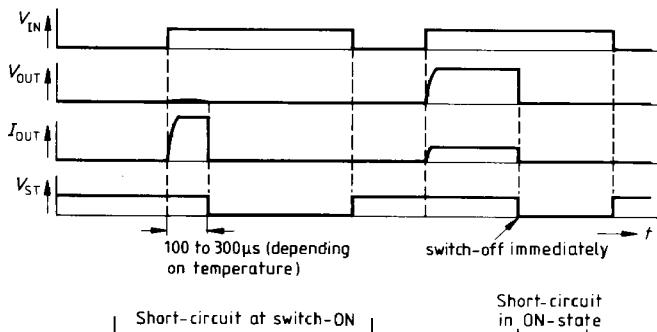
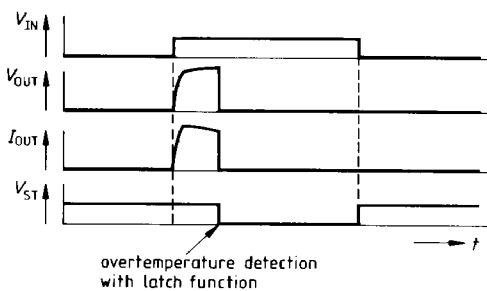
## Applications

**Figure 1:** Switching a lamp



**Figure 2:** Switching a solenoid



**Figure 3:** Operation with output short-circuited**Figure 4:** Operation with overload**Figure 5:** Operation with open load