

# ALL Switch GaN Power Switch V150N65B

## Description

ALL-Switch is a System in Package (SIP) switch. A **Normally-Off** safety function is integrated within the package. ALL-Switch V150N65B provides a patented, high-density, lateral-layout GaN power transistor, within a product offering low  $R_{DS(ON)}$ , exceptionally fast switching performance and a conveniently small footprint. It is very effective in applications requiring high efficiency, high power density and low cost.

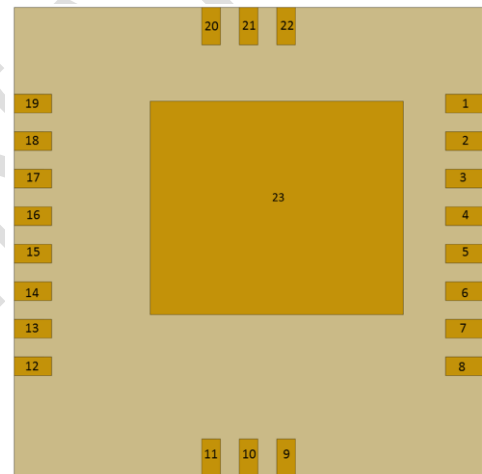
An internal Enable Circuit is responsible for operational sequencing of the All Switch device during system start up and shutdown. It verifies the proper status of the gate driver and supply voltages. During normal switching operation mode, the Enable Circuit has no impact on the switching performances of the GaN transistor.

## Key features

- Ultra-fast switching
- Kelvin connection to source
- Normally-Off
- High power density
- Fully isolated package (2.5KV)
- Bottom cooling SMD package
- High noise immunity
- Driven by standard 12V MOSFET driver

## Applications

- Solar Inverter
- AC-DC Power Supply
- AC motors
- Battery fast chargers
- Automotive
- Laser driver



Bottom view 10 x 10 mm

## Key Performance Parameters

| Parameter                  | Value |
|----------------------------|-------|
| $V_{DS}$ (V)               | 650   |
| $R_{DS(ON)}$ (m $\Omega$ ) | 150   |
| $Q_G$ (nC)                 | 9     |
| $I_{D,pulse}$ (A)          | 22    |
| $I_D$ (A)                  | 14    |

## Package Outline

| Pin   | Function   | Pin | Function     |
|-------|--|-----|--------------|
| 1-8   | Source   | 20  | (Not in use) |
| 9     | Com (Aux. power supply)                          | 21  | (Not in use) |
| 10    | $V_{DD}$ (Aux. power supply) & Kelvin connection | 22  | NC           |
| 11    | Gate   | 23  | Isolated PAD |
| 12-19 | Drain  |     |              |

| Maximum ratings ( $T_j = 25^\circ\text{C}$ unless otherwise specified) |                 |        |         |       |                           |                           |
|--|-----------------|--------|---------|-------|---------------------------|---------------------------|
| Parameter  | Symbol          | Values |         |       | Unit                      | Conditions                |
|  |                 | Min    | Typical | Max   |                           |                           |
| Continuous drain current   | $I_D$           | -      | -       | 14    | A                         | $T_C = 25^\circ\text{C}$  |
|  |                 | -      | -       | 12    |                           | $T_C = 150^\circ\text{C}$ |
| Pulsed drain current   | $I_{D,pulse}$   | -      | -       | 22    | A                         |                           |
| Gate voltage <sup>2)</sup>   | $V_{GS}$        | 0      | 12      | 15    | V                         |                           |
| Power dissipation  | $P_{TOT}$       | -      | -       | 63    | W                         |                           |
| Operating and storage temperature                                      | $T_j, T_{stg}$  | -55    | -       | + 150 | $^\circ\text{C}$          |                           |
| Continuous reverse current   | $I_s$           | -      | -       | 12    | A                         |                           |
| Reverse pulse current <sup>1)</sup>                                    | $I_{s,pulse}$   | -      | -       | 17    | A                         |                           |
| Thermal characteristics  |                 |        |         |       |                           |                           |
| Parameter  | Symbol          | Values |         |       | Unit                      | Conditions                |
|  |                 | Min    | Typical | Max   |                           |                           |
| Thermal resistance, junction-case                                      | $R_{\theta JC}$ | -      | -       | 2.1   | $^\circ\text{C}/\text{W}$ | Junction to thermal pad   |
| Soldering peak temperature   | $T_{sold}$      | -      | -       | 260   | $^\circ\text{C}$          | from case for 10s         |

- 1) Duty cycle =10% limited by  $T_j$   
2) Refers to driver GND, see typical operating circuit

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| Electrical characteristics ( $T_j = 25^\circ\text{C}$ unless otherwise specified) |              |        |         |      |            |  |
|---|--------------|--------|---------|------|------------|--|
| Parameter   | Symbol       | Values |         |      | Unit       | Conditions   |
|   |              | Min    | Typical | Max  |            |  |
| <b>Static</b>   |              |        |         |      |            |  |
| Drain-source breakdown voltage  | $V_{DS}$     | 650    | 750     | 850  | V          | $V_G = 0V$   |
| Gate threshold voltage <sup>3)</sup>  | $V_{(G)th}$  | -      | 5       | -    | V          | $I_D = 0.25mA$                                     |
| Drain source leakage current  | $I_{DSS}$    | -      | 2       | 3    | $\mu A$    | $V_G = 0V V_{DS} = 650V$ $T_j = 25^\circ\text{C}$  |
|   |              | -      | 19      | 50   |            | $V_G = 0V V_{DS} = 650V$ $T_j = 150^\circ\text{C}$ |
| Gate-source leakage current <sup>1)</sup>   | $I_{GSS}$    | -      | 3       | 5    | nA         | $V_{DS} = 0V$<br>$V_G = 0V$                        |
| Gate resistance   | $R_G$        | -      | 2.8     | -    | $\Omega$   | $f = 1MHz$   |
| Drain-source on state resistance  | $R_{DS(ON)}$ | -      | 150     | 200  | m $\Omega$ | $V_G = 12V I_D = 5A$<br>$T_j = 25^\circ\text{C}$   |
|   |              | -      | 300     | 360  |            | $V_G = 12V I_D = 5A$<br>$T_j = 150^\circ\text{C}$  |
| Reverse voltage drop-<br>GaN non conductive                                       | $V_R$        | -      | -       | 2.40 | V          | $I_D = 2.5A T_j = 25^\circ\text{C}$                |
|   |              | -      | -       | 2.65 |            | $I_D = 2.5A T_j = 150^\circ\text{C}$               |
| Reverse voltage drop-<br>GaN conductive   | $V_R$        | -      | -       | 0.4  | V          | $I_D = 2.5A T_j = 25^\circ\text{C}$                |
|   |              | -      | -       | 0.8  |            | $I_D = 2.5A T_j = 150^\circ\text{C}$               |
| Reverse recovery time   | $t_{rr}$     | -      | -       | 0    | nS         |  |
| Reverse recovery charge   | $Q_{rr}$     | -      | -       | 0    | nC         |  |
| Output Charge   | $Q_{OSS}$    | -      | -       | 5    | nC         | $V_G = 0V$<br>$V_{DS} = 400V$                      |
| <b>Dynamic</b>  |              |        |         |      |            |  |
| Input capacitance   | $C_{iss}$    | -      | 110     | 115  | pF         | $f = 1MHz$   |
| Output capacitance  | $C_{oss}$    | -      | 35      | 40   |            | $V_G = 0V$   |
| Reverse transfer capacitance  | $C_{rss}$    | -      | 0.2     | 0.5  |            | $V_{DS} = 400V$                                    |
| Effective Output Capacitance, Energy Related                                      | $C_{O(ER)}$  | -      | -       | 21   | pF         | $V_G = 0V$<br>$V_{DS} = 0$ to $400V$               |
| Turn-on delay time  | $t_{d(on)}$  | -      | 1.7     | -    | ns         | $V_{DS} = 400V$                                    |
| Fall time <sup>2)</sup>   | $t_f$        | -      | 3       | -    |            | $V_G = 0-12V$                                      |
| Turn-off delay time   | $t_{d(off)}$ | -      | 3.5     | -    |            | $R_G = 2.2 \Omega$                                 |
| Rise time <sup>2)</sup>   | $t_r$        | -      | 2.5     | -    |            | $I_D = 16A$  |

1) GaN transistor

2) Rise, fall and delay time should be measured, from application and reliability point of view we will limit it by 100V/ns

3) Refers to driver GND, see typical operating circuit

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| Electrical characteristics ( $T_c = 25^\circ\text{C}$ unless otherwise specified) |                      |        |         |     |      |  |
|---|----------------------|--------|---------|-----|------|--|
| Parameter   | Symbol               | Values |         |     | Unit | Conditions   |
|   |                      | Min    | Typical | Max |      |  |
| <b>Gate charge characteristics</b>  |                      |        |         |     |      |  |
| Gate to source charge   | $Q_{GS}$             | -      | 1       | -   | nC   | $V_G = 0\text{V to } 10\text{V}$<br>$V_{DS} = 400\text{V } I_D = 16\text{A}$ |
| Gate to drain charge  | $Q_{GD}$             | -      | 5       | -   |      |  |
| Total gate charge   | $Q_G$                | -      | 9       | -   |      |  |
| Gate plateau voltage  | $V_{\text{plateau}}$ | 6      | -       | 6.8 | V    |  |
| <b>Case to drain Capacitance</b>  |                      |        |         |     |      |  |
| Capacitance   | $C_C$                | -      | 0.4     | -   | pF   | @ 1 MHz 0.1V RMS   |

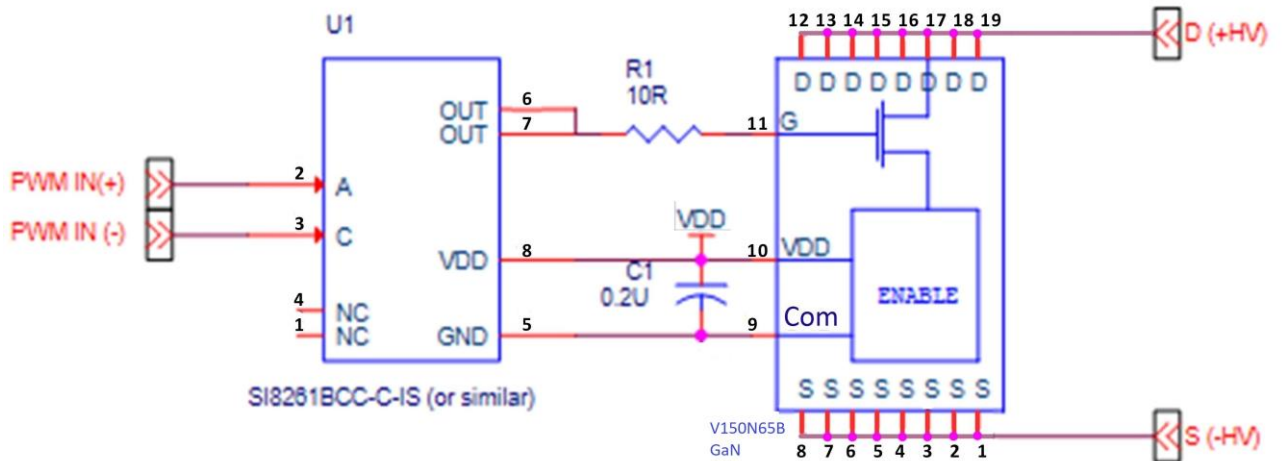
| Pin Characteristics                        |        |        |         |     |      |                        |
|--|--------|--------|---------|-----|------|------------------------|
| Parameter                                  | Symbol | Values |         |     | Unit | Conditions             |
|  |        | Min    | Typical | Max |      |                        |
| <b>Pin 10 VDD (Kelvin to GaN Source)</b>   |        |        |         |     |      |                        |
| Voltage at disable mode                    | Pin 10 | 0      | -       | 9.2 | V    | $V_{DS} = 400\text{V}$ |
| <b>Pin 11 Gate (Refers to driver GND )</b> |        |        |         |     |      |                        |
| Gate Voltage for non-Conducting mode       | Pin 11 | 0      | -       | 4.5 | V    | $V_{DS} = 400\text{V}$ |
| Gate Voltage for conducting mode           | Pin 11 | 5.5    | -       | 12  |      |                        |
| <b>Pin 20 Substrate</b><br>(do not use!)   | Pin 20 |        |         |     |      |                        |
| <b>Pin 21 Common</b><br>(do not use!)      | Pin 21 |        |         |     |      |                        |



# ALL Switch GaN Power Switch V150N65B



## Typical Operating Circuit



PRELIMINARY

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PRELIMINARY

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