Bi-Directional P-Channel MOSFET/Power Switch

PRODUCT SUMMARY

<table>
<thead>
<tr>
<th>VGS (V)</th>
<th>RDS(on) (Ω)</th>
<th>ID (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>± 7</td>
<td>0.170 at VGS = - 4.5 V</td>
<td>± 2.4</td>
</tr>
<tr>
<td></td>
<td>0.240 at VGS = - 2.5 V</td>
<td>± 2.0</td>
</tr>
</tbody>
</table>

FEATURES

- Halogen-free According to IEC 61249-2-21 Definition
- Low RDS(on) Symmetrical P-Channel MOSFET
- Integrated Body Bias For Bi-Directional Blocking
- 2.5 V to 5.5 V Operation
- Exceeds ± 2 kV ESD Protected
- Solution for High-Side Battery Disconnect Switching (BDS)
- Supports Battery Switching in Multiple Battery Cell Phones, PDAs and PCS Products
- Low Profile, Small Footprint TSOP-6 Package
- Compliant to RoHS Directive 2002/95/EC

DESCRIPTION

The Si3831DV is a low on-resistance p-channel power MOSFET providing bi-directional blocking and conduction. Bi-directional blocking is facilitated by combining a 4-terminal symmetric p-channel MOSFET with a body bias selector circuit. Circuit operation automatically biases the p-channel body to the most positive source/drain potential thereby maintaining a reverse bias across the diode present between the source/drain terminals. Off-state device blocking characteristics are symmetric, facilitating bi-directional blocking for high-side battery switching in portable products. Gate drive is facilitated by negatively biasing the gate relative to the body potential. The off-state is achieved by biasing the gate to the most positive supply voltage or to the body potential. The Si3831DV is available in a 6-pin TSOP-6 package rated for the - 25 °C to 85 °C commercial temperature range.

APPLICATION CIRCUITS

Figure 1. Charger Demultiplexing

Note:

a. Patents pending.

Figure 2. Battery Multiplexing (High-Side Switch)
Si3831DV
Vishay Siliconix

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION

![Block Diagram and Pin Configuration](image)

**Notes:**
a. Bi-directional.
b. Surface Mounted on FR4 board, \( t \leq 5 \) s.
c. Surface Mounted on FR4 board, Steady-State.

**Figure 3.**

**Figure 4.**

**Ordering Information:**
Si3831DV-T1-E3 (Lead (Pb)-free)
Si3831DV-T1-GE3 (Lead (Pb)-free and Halogen-free)

### ABSOLUTE MAXIMUM RATINGSTACIÓN

\( T_A = 25 \) °C, unless otherwise noted

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Limit</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain-Source Voltage, Source-Drain Voltage</td>
<td>( V_{DS} )</td>
<td>- 7.0 to + 7.0</td>
<td>V</td>
</tr>
<tr>
<td>Source-Body, Drain-Body, Gate-Body Voltage</td>
<td>( V_{SB}, V_{DB}, V_{GB} )</td>
<td>0.3 to - 7.0</td>
<td></td>
</tr>
<tr>
<td>Body-Substrate Voltage</td>
<td>( V_{BSUB} )</td>
<td>+ 7.0 to - 0.3</td>
<td></td>
</tr>
<tr>
<td>Continuous Drain-to-Source Current (( T_J = 150 ) °C)</td>
<td>( I_D )</td>
<td>± 2.4</td>
<td>A</td>
</tr>
<tr>
<td>( T_J = 70 ) °C</td>
<td></td>
<td>± 2.0</td>
<td></td>
</tr>
<tr>
<td>Pulsed Drain-to-Source Current</td>
<td>( I_{DM} )</td>
<td>± 8</td>
<td></td>
</tr>
<tr>
<td>Maximum Power Dissipation</td>
<td>( P_D )</td>
<td>1.5</td>
<td>W</td>
</tr>
<tr>
<td>( T_J = 70 ) °C</td>
<td></td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Operating Junction and Storage Temperature Range</td>
<td>( T_J, T_{stg} )</td>
<td>- 55 to 150</td>
<td>°C</td>
</tr>
</tbody>
</table>

### RECOMMENDED OPERATING RANGE

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Range</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain-Source Voltage</td>
<td>( V_{DS} )</td>
<td>- 5.5 to 5.5</td>
<td>V</td>
</tr>
<tr>
<td>Gate-Drain, Gate-Source Voltage</td>
<td>( V_{GD}, V_{GS} )</td>
<td>0 to - 5.5</td>
<td></td>
</tr>
<tr>
<td>Source-Body, Drain-Body, Gate-Body Voltage</td>
<td>( V_{SB}, V_{DB}, V_{GB} )</td>
<td>0 to - 5.5</td>
<td></td>
</tr>
<tr>
<td>Drain-to-Source Current</td>
<td>( I_{DS} )</td>
<td>± 2.4</td>
<td>A</td>
</tr>
<tr>
<td>Body-Source Current</td>
<td>( I_{BS} )</td>
<td>0 to 10</td>
<td>µA</td>
</tr>
</tbody>
</table>

### THERMAL RESISTANCE RATINGS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Limit</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Junction-to-Ambient</td>
<td>( R_{JJA} )</td>
<td>80</td>
<td>°C/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>125</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
a. Bi-directional.
b. Surface Mounted on FR4 board, \( t \leq 5 \) s.
c. Surface Mounted on FR4 board, Steady-State.
### SPECIFICATIONS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Test Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Static</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gate Threshold Voltage</td>
<td>(V_{GS(th)})</td>
<td>(V_{DS} = V_{GS}, I_D = - 250 \mu A)</td>
<td>- 0.4</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Gate-Body Leakage</td>
<td>(I_{GSS})</td>
<td>(V_{DS} = 0 V, V_{GS} = - 5.5 V \text{ to } + 0.3 V)</td>
<td>(\pm 100 \text{ nA})</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zero Gate Voltage Drain Current</td>
<td>(I_{DSS})</td>
<td>(V_{DS} = - 5.5 V, V_{GS} = 0 V, V_{SB} = 0 V)</td>
<td>(- 1 \mu A)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(V_{DS} = - 5.5 V, V_{GS} = 0 V, V_{SB} = 0 V, T_J = 70 ^\circ C)</td>
<td>(- 5 \mu A)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-State Drain Current &amp;superscript{a}</td>
<td>(I_{D(on)})</td>
<td>(V_{DS} = - 3 V, V_{GS} = - 4.5 V)</td>
<td>8</td>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(V_{DS} = - 3 V, V_{GS} = - 2.5 V)</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drain-Source On-State Resistance &amp;superscript{a}</td>
<td>(R_{DS(on)})</td>
<td>(V_{GS} = - 4.5 V, I_D = - 2.4 A)</td>
<td>0.130</td>
<td>0.170</td>
<td></td>
<td>(\Omega)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(V_{GS} = - 2.5 V, I_D = - 2.0 A)</td>
<td>0.180</td>
<td>0.240</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Dynamic &amp;superscript{b}</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Gate Charge</td>
<td>(Q_g)</td>
<td>(V_{DS} = - 5 V, V_{GS} = - 4.5 V, I_D = - 2.4 A)</td>
<td>2.0</td>
<td>4.0</td>
<td></td>
<td>(\text{nC})</td>
</tr>
<tr>
<td>Gate-Source Charge</td>
<td>(Q_{gs})</td>
<td></td>
<td></td>
<td>0.23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gate-Drain Charge</td>
<td>(Q_{gd})</td>
<td></td>
<td></td>
<td>0.14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn-On Delay Time</td>
<td>(t_{(on)})</td>
<td>(V_{DD} = - 3 V, R_L = 3 \Omega)</td>
<td>12</td>
<td>25</td>
<td></td>
<td>(\text{ns})</td>
</tr>
<tr>
<td>Rise Time</td>
<td>(t_r)</td>
<td>(I_D = - 1.0 A, V_{GEN} = - 4.5 V, R_g = 6 \Omega)</td>
<td>55</td>
<td>110</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn-Off Delay Time</td>
<td>(t_{(off)})</td>
<td></td>
<td></td>
<td>90</td>
<td>180</td>
<td></td>
</tr>
<tr>
<td>Fall Time</td>
<td>(t_f)</td>
<td></td>
<td></td>
<td>85</td>
<td>170</td>
<td></td>
</tr>
</tbody>
</table>

Notes:

a. Pulse test; pulse width \(\leq 300 \mu s\), duty cycle \(\leq 2\%\).

b. Guaranteed by design, not subject to production testing.

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

### GATE BUFFER REFERENCE

**Figure 5. Gate Buffer Referenced to Most Positive Supply**

**Figure 6. Gate Buffer Referenced to Body Bias Pin**
TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

Output Characteristics

On-Resistance vs. Drain Current

Gate Charge

Transfer Characteristics

On-Resistance vs. Junction Temperature

Capacitance
TYPICAL CHARACTERISTICS  25 °C, unless otherwise noted

Source-Drain Diode Forward Voltage

Threshold Voltage

On-Resistance vs. Gate-to-Source Voltage

Single Pulse Power

Normalized Effective Transient Thermal Impedance, Junction-to-Ambient

Notes:
1. Duty Cycle, \( D = \frac{t_1}{t_2} \)
2. Per Unit Base = \( R_{\text{thJA}} = 80 \text{ °C/W} \)
3. \( T_{\text{JM}} \cdot T_{\text{A}} = P_{\text{DM}} \cdot T_{\text{A}} \)
4. Surface Mounted
TYPICAL CHARACTERISTICS  25 °C, unless otherwise noted

Bi-Directional Blocking Drain-Source Voltage

V_GS = -2.5 V
V_GS = 0 V

I_D - Drain Current (A)

V_DS - Drain-to-Source Voltage (V)

Bi-Directional Blocking Drain-Source Voltage
Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, “Vishay”), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay’s knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer’s responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer’s technical experts. Product specifications do not expand or otherwise modify Vishay’s terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.

© 2017 VISHAY INTERTECHNOLOGY, INC. ALL RIGHTS RESERVED