

## Description

The VST06N020 uses **Super Trench II** technology that is uniquely optimized to provide the most efficient high frequency switching performance. Both conduction and switching power losses are minimized due to an extremely low combination of  $R_{DS(ON)}$  and  $Q_g$ . This device is ideal for high-frequency switching and synchronous rectification.

## Application

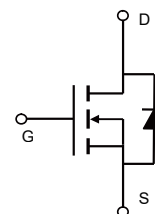
- DC/DC Converter
- Ideal for high-frequency switching and synchronous rectification

## General Features

- $V_{DS} = 60V, I_D = 165A$
- $R_{DS(ON)} = 2.0m\Omega$  (typical) @  $V_{GS} = 10V$
- $R_{DS(ON)} = 2.5m\Omega$  (typical) @  $V_{GS} = 4.5V$
- Excellent gate charge x  $R_{DS(on)}$  product(FOM)
- Very low on-resistance  $R_{DS(on)}$
- 150 °C operating temperature
- Pb-free lead plating



DFN5x6



Schematic

## Package Marking and Ordering Information

| Device Marking | Device        | Device Package | Reel Size | Tape width | Quantity |
|----------------|---------------|----------------|-----------|------------|----------|
| VST06N020      | VST06N020-D56 | DFN5x6         | -         | -          | -        |

## Absolute Maximum Ratings ( $T_c = 25^\circ C$ unless otherwise noted)

| Parameter                                         | Symbol              | Limit      | Unit          |
|---------------------------------------------------|---------------------|------------|---------------|
| Drain-Source Voltage                              | $V_{DS}$            | 60         | V             |
| Gate-Source Voltage                               | $V_{GS}$            | $\pm 20$   | V             |
| Drain Current-Continuous (Silicon Limited)        | $I_D$               | 165        | A             |
| Drain Current-Continuous( $T_c = 100^\circ C$ )   | $I_D (100^\circ C)$ | 115        | A             |
| Pulsed Drain Current                              | $I_{DM}$            | 660        | A             |
| Maximum Power Dissipation                         | $P_D$               | 200        | W             |
| Derating factor                                   |                     | 1.16       | W/ $^\circ C$ |
| Single pulse avalanche energy <sup>(Note 5)</sup> | $E_{AS}$            | 540        | mJ            |
| Operating Junction and Storage Temperature Range  | $T_J, T_{STG}$      | -55 To 150 | $^\circ C$    |

## Thermal Characteristic

|                                                          |                 |       |              |
|----------------------------------------------------------|-----------------|-------|--------------|
| Thermal Resistance, Junction-to-Case <sup>(Note 2)</sup> | $R_{\theta JC}$ | 0.625 | $^\circ C/W$ |
|----------------------------------------------------------|-----------------|-------|--------------|

**Electrical Characteristics (T<sub>c</sub>=25°C unless otherwise noted)**

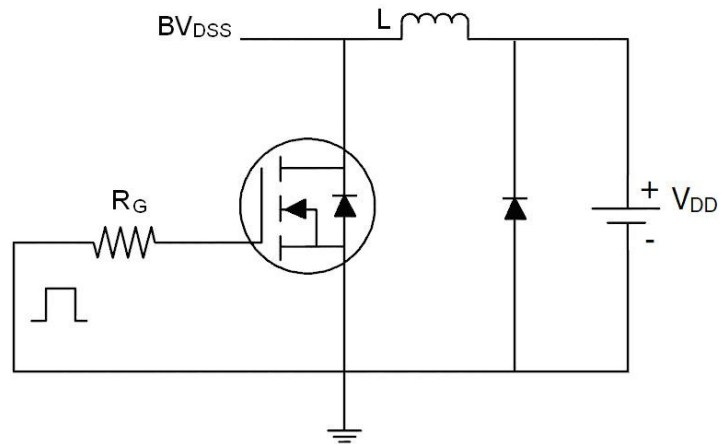
| Parameter                          | Symbol              | Condition                                                                                 | Min | Typ  | Max  | Unit |
|------------------------------------|---------------------|-------------------------------------------------------------------------------------------|-----|------|------|------|
| Off Characteristics                |                     |                                                                                           |     |      |      |      |
| Drain-Source Breakdown Voltage     | BV <sub>DSS</sub>   | V <sub>GS</sub> =0V I <sub>D</sub> =250μA                                                 | 60  |      | -    | V    |
| Zero Gate Voltage Drain Current    | I <sub>DSS</sub>    | V <sub>DS</sub> =60V, V <sub>GS</sub> =0V                                                 | -   | -    | 1    | μA   |
| Gate-Body Leakage Current          | I <sub>GSS</sub>    | V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V                                                | -   | -    | ±100 | nA   |
| On Characteristics (Note 3)        |                     |                                                                                           |     |      |      |      |
| Gate Threshold Voltage             | V <sub>GS(th)</sub> | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA                                  | 1.0 | 1.7  | 2.4  | V    |
| Drain-Source On-State Resistance   | R <sub>DS(ON)</sub> | V <sub>GS</sub> =10V, I <sub>D</sub> =82.5A                                               | -   | 2.0  | 2.5  | mΩ   |
|                                    |                     | V <sub>GS</sub> =4.5V, I <sub>D</sub> =82.5A                                              | -   | 2.5  | 3.7  | mΩ   |
| Forward Transconductance           | g <sub>FS</sub>     | V <sub>DS</sub> =5V, I <sub>D</sub> =82.5A                                                | 45  | -    | -    | S    |
| Dynamic Characteristics (Note4)    |                     |                                                                                           |     |      |      |      |
| Input Capacitance                  | C <sub>iss</sub>    | V <sub>DS</sub> =30V, V <sub>GS</sub> =0V,<br>F=1.0MHz                                    | -   | 6540 | -    | PF   |
| Output Capacitance                 | C <sub>oss</sub>    |                                                                                           | -   | 900  | -    | PF   |
| Reverse Transfer Capacitance       | C <sub>rss</sub>    |                                                                                           | -   | 65   | -    | PF   |
| Switching Characteristics (Note 4) |                     |                                                                                           |     |      |      |      |
| Turn-on Delay Time                 | t <sub>d(on)</sub>  | V <sub>DD</sub> =30V, I <sub>D</sub> =82.5A<br>V <sub>GS</sub> =10V, R <sub>G</sub> =4.7Ω | -   | 16   | -    | nS   |
| Turn-on Rise Time                  | t <sub>r</sub>      |                                                                                           | -   | 9    | -    | nS   |
| Turn-Off Delay Time                | t <sub>d(off)</sub> |                                                                                           | -   | 58   | -    | nS   |
| Turn-Off Fall Time                 | t <sub>f</sub>      |                                                                                           | -   | 12   | -    | nS   |
| Total Gate Charge                  | Q <sub>g</sub>      | V <sub>DS</sub> =30V, I <sub>D</sub> =82.5A,<br>V <sub>GS</sub> =10V                      | -   | 105  |      | nC   |
| Gate-Source Charge                 | Q <sub>gs</sub>     |                                                                                           | -   | 17.5 |      | nC   |
| Gate-Drain Charge                  | Q <sub>gd</sub>     |                                                                                           | -   | 17   |      | nC   |
| Drain-Source Diode Characteristics |                     |                                                                                           |     |      |      |      |
| Diode Forward Voltage (Note 3)     | V <sub>SD</sub>     | V <sub>GS</sub> =0V, I <sub>S</sub> =82.5A                                                | -   |      | 1.2  | V    |
| Diode Forward Current (Note 2)     | I <sub>S</sub>      |                                                                                           | -   | -    | 165  | A    |
| Reverse Recovery Time              | t <sub>rr</sub>     | T <sub>J</sub> = 25°C, I <sub>F</sub> = I <sub>S</sub><br>di/dt = 100A/μs (Note3)         | -   | 56   |      | nS   |
| Reverse Recovery Charge            | Q <sub>rr</sub>     |                                                                                           | -   | 80   |      | nC   |

**Notes:**

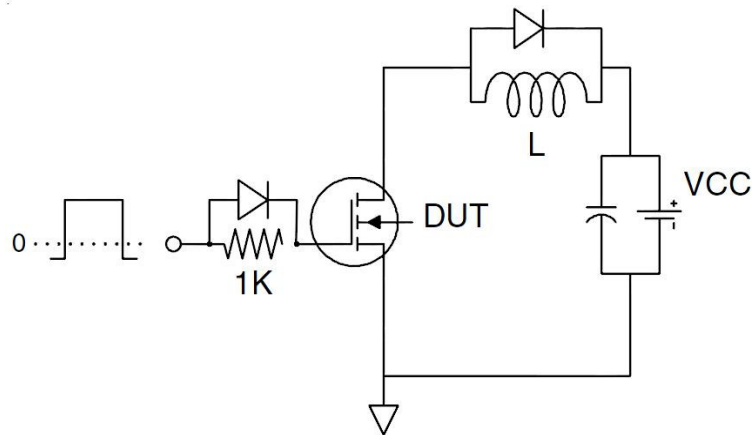
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board, t ≤ 10 sec.
3. Pulse Test: Pulse Width ≤ 300μs, Duty Cycle ≤ 2%.
4. Guaranteed by design, not subject to production
5. EAS condition : T<sub>J</sub>=25°C, V<sub>DD</sub>=30V, V<sub>G</sub>=10V, L=0.5mH, R<sub>G</sub>=25Ω

## Test Circuit

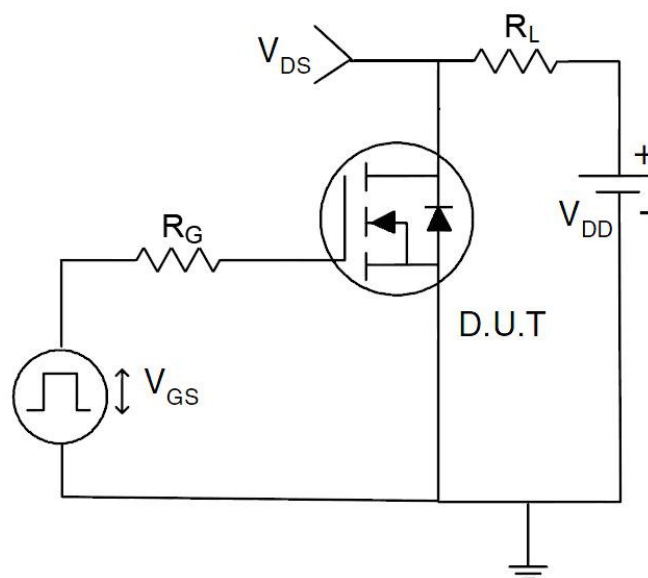
### 1) $E_{AS}$ test Circuit



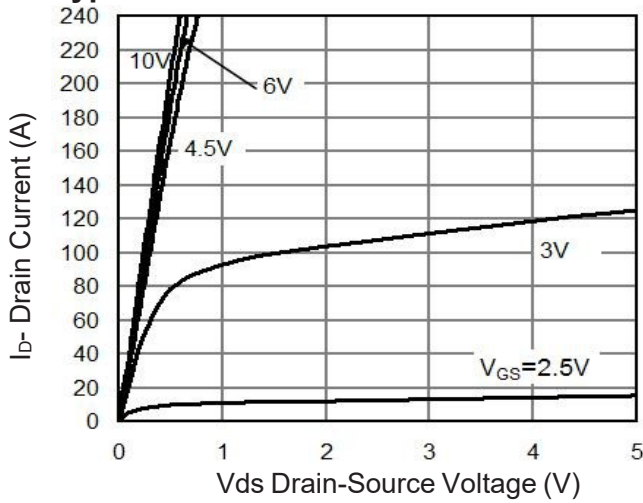
### 2) Gate charge test Circuit



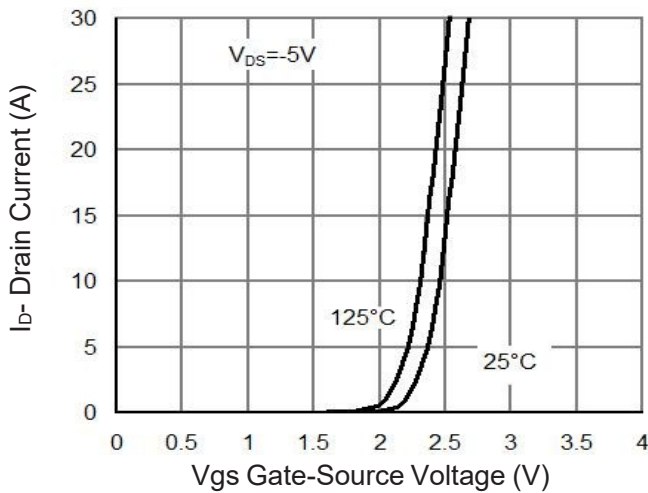
### 3) Switch Time Test Circuit



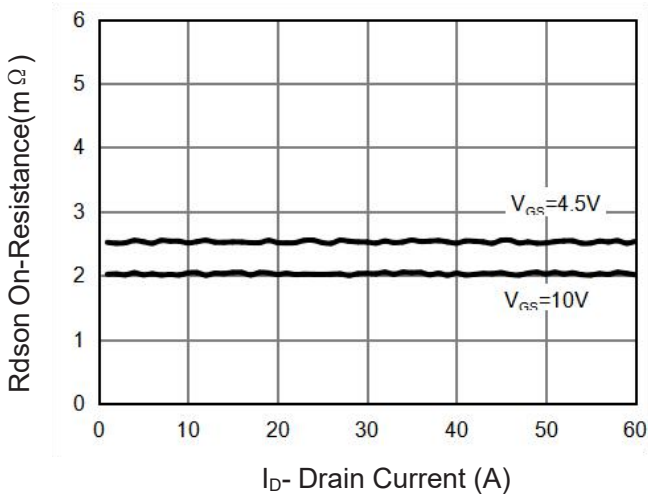
## Typical Electrical and Thermal Characteristics



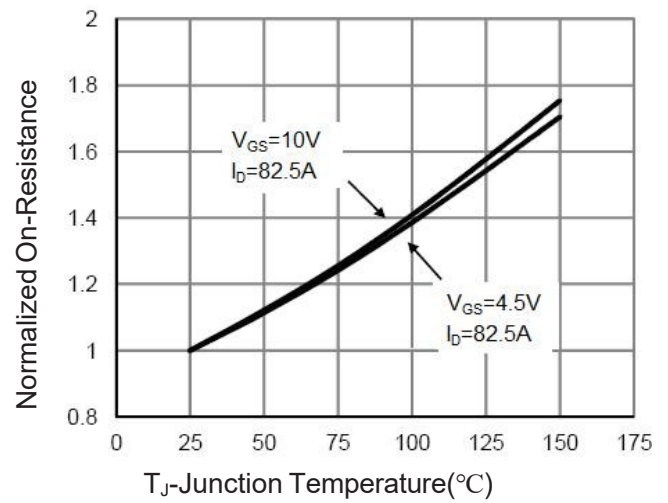
**Figure 1 Output Characteristics**



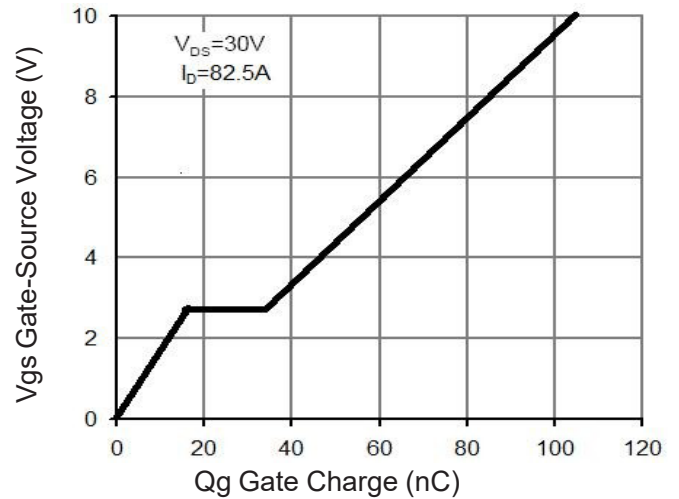
**Figure 2 Transfer Characteristics**



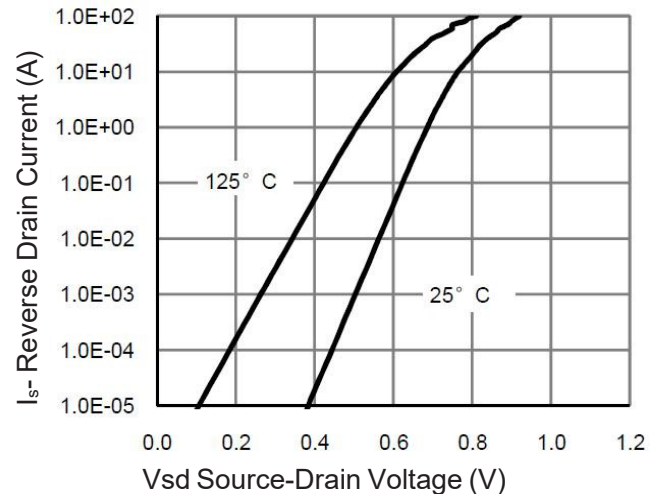
**Figure 3 Rdson- Drain Current**



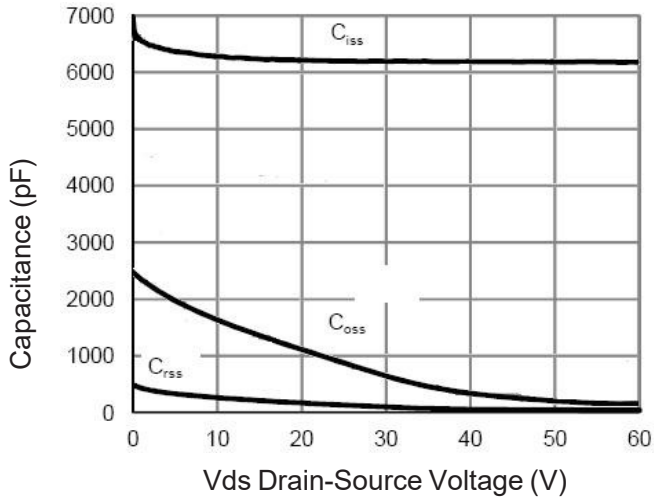
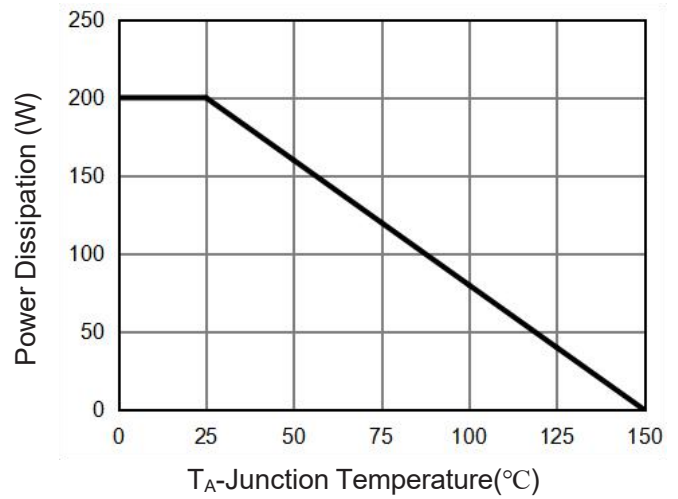
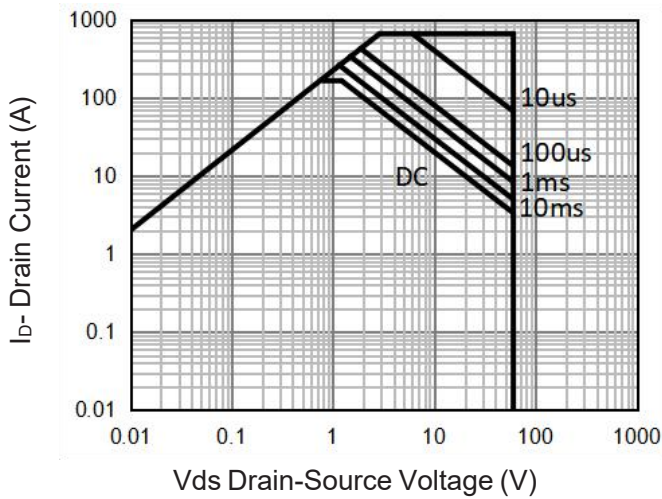
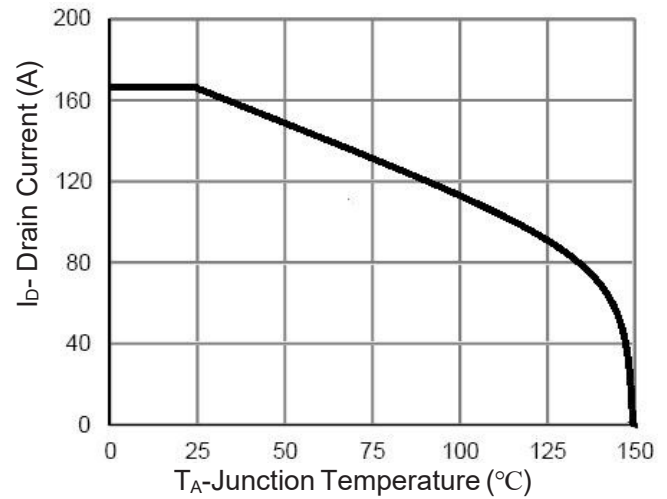
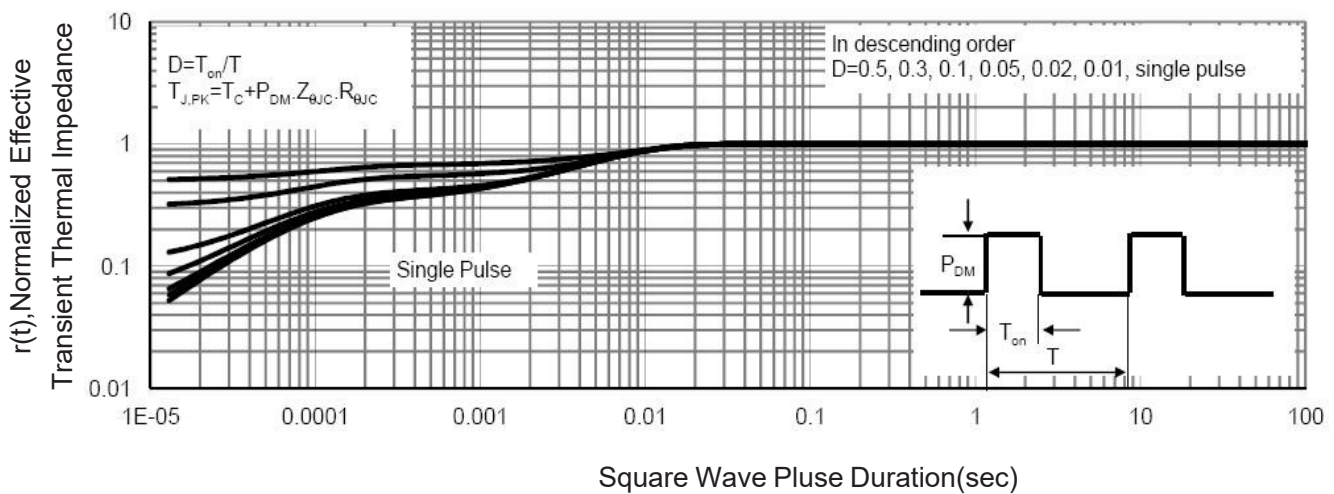
**Figure 4 Rdson-Junction Temperature**



**Figure 5 Gate Charge**



**Figure 6 Source- Drain Diode Forward**


**Figure 7 Capacitance vs Vds**

**Figure 9 Power De-rating**

**Figure 8 Safe Operation Area**

**Figure 10 Current De-rating**

**Figure 11 Normalized Maximum Transient Thermal Impedance**