

## Description

The VST12N030 uses **Super Trench** 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.

## General Features

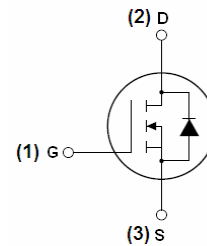
- $V_{DS} = 120V, I_D = 180A$   
 $R_{DS(ON)} < 3.0m\Omega @ V_{GS} = 10V$
- Excellent gate charge x  $R_{DS(on)}$  product(FOM)
- Very low on-resistance  $R_{DS(on)}$
- 175 °C operating temperature
- Pb-free lead plating
- 100% UIS tested

## Application

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



TO-220C



Schematic Diagram

## Package Marking and Ordering Information

| Device Marking | Device    | Device Package | Reel Size | Tape width | Quantity |
|----------------|-----------|----------------|-----------|------------|----------|
| VST12N030-TC   | VST12N030 | TO-220C        | -         | -          | -        |

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

| Parameter   | Symbol              | Limit    | Unit          |
|---|---------------------|----------|---------------|
| Drain-Source Voltage                              | $V_{DS}$            | 120      | V             |
| Gate-Source Voltage                               | $V_{GS}$            | $\pm 20$ | V             |
| Drain Current-Continuous                          | $I_D$               | 180      | A             |
| Drain Current-Continuous( $T_C = 100^\circ C$ )   | $I_D (100^\circ C)$ | 128      | A             |
| Pulsed Drain Current                              | $I_{DM}$            | 720      | A             |
| Maximum Power Dissipation                         | $P_D$               | 300      | W             |
| Derating factor                                   |                     | 2        | W/ $^\circ C$ |
| Single pulse avalanche energy <sup>(Note 5)</sup> | $E_{AS}$            | 1800     | mJ            |

|  |                |            |    |
|--|----------------|------------|----|
| Operating Junction and Storage Temperature Range | $T_J, T_{STG}$ | -55 To 175 | °C |
|--|----------------|------------|----|

**Thermal Characteristic**

|  |                 |     |      |
|--|-----------------|-----|------|
| Thermal Resistance, Junction-to-Case <sup>(Note 2)</sup> | $R_{\theta JC}$ | 0.5 | °C/W |
|--|-----------------|-----|------|

**Electrical Characteristics ( $T_C=25^{\circ}\text{C}$  unless otherwise noted)**

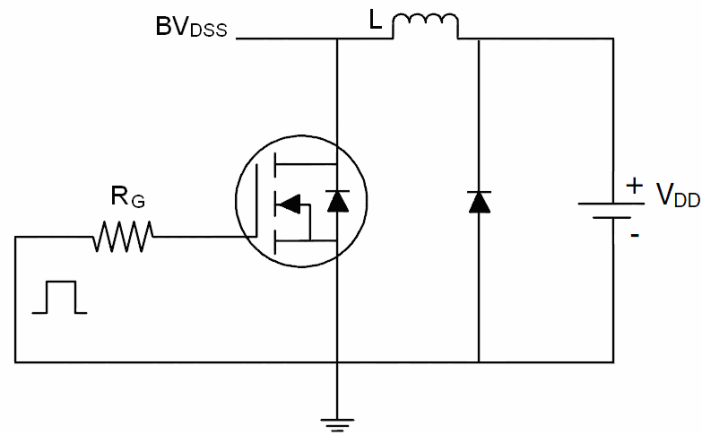
| Parameter                                     | Symbol              | Condition  | Min | Typ   | Max  | Unit |
|---|---------------------|--|-----|-------|------|------|
| Off Characteristics                           |                     |  |     |       |      |      |
| Drain-Source Breakdown Voltage                | BV <sub>DSS</sub>   | V <sub>GS</sub> =0V I <sub>D</sub> =250μA  | 120 |       | -    | V    |
| Zero Gate Voltage Drain Current               | I <sub>DSS</sub>    | V <sub>DS</sub> =120V, 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 <sup>(Note 3)</sup>        |                     |  |     |       |      |      |
| Gate Threshold Voltage                        | V <sub>GS(th)</sub> | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA                                 | 2.5 | -     | 4.5  | V    |
| Drain-Source On-State Resistance              | R <sub>DS(ON)</sub> | V <sub>GS</sub> =10V, I <sub>D</sub> =100A   | -   | 3.0   | 3.2  | mΩ   |
| Forward Transconductance                      | g <sub>FS</sub>     | V <sub>DS</sub> =10V, I <sub>D</sub> =100A   | 40  | -     | -    | S    |
| Dynamic Characteristics <sup>(Note4)</sup>    |                     |  |     |       |      |      |
| Input Capacitance                             | C <sub>iss</sub>    | V <sub>DS</sub> =50V, V <sub>GS</sub> =0V,<br>F=1.0MHz                                   | -   | 11500 | -    | PF   |
| Output Capacitance                            | C <sub>oss</sub>    |  | -   | 2480  | -    | PF   |
| Reverse Transfer Capacitance                  | C <sub>rss</sub>    |  | -   | 75    | -    | PF   |
| Switching Characteristics <sup>(Note 4)</sup> |                     |  |     |       |      |      |
| Turn-on Delay Time                            | t <sub>d(on)</sub>  | V <sub>DD</sub> =60V, I <sub>D</sub> =100A<br>V <sub>GS</sub> =10V, R <sub>G</sub> =1.6Ω | -   | 25    | -    | nS   |
| Turn-on Rise Time                             | t <sub>r</sub>      |  | -   | 75    | -    | nS   |
| Turn-Off Delay Time                           | t <sub>d(off)</sub> |  | -   | 89    | -    | nS   |
| Turn-Off Fall Time                            | t <sub>f</sub>      |  | -   | 29    | -    | nS   |
| Total Gate Charge                             | Q <sub>g</sub>      | V <sub>DS</sub> =60V, I <sub>D</sub> =100A,<br>V <sub>GS</sub> =10V                      | -   | 158   |      | nC   |
| Gate-Source Charge                            | Q <sub>gs</sub>     |  | -   | 52    |      | nC   |
| Gate-Drain Charge                             | Q <sub>gd</sub>     |  | -   | 29    |      | nC   |
| Drain-Source Diode Characteristics            |                     |  |     |       |      |      |
| Diode Forward Voltage <sup>(Note 3)</sup>     | V <sub>SD</sub>     | V <sub>GS</sub> =0V, I <sub>S</sub> =180A  | -   |       | 1.2  | V    |
| Diode Forward Current <sup>(Note 2)</sup>     | I <sub>S</sub>      |  | -   | -     | 180  | A    |
| Reverse Recovery Time                         | t <sub>rr</sub>     | T <sub>J</sub> = 25°C, I <sub>F</sub> = I <sub>S</sub>                                   | -   | 75    |      | nS   |
| Reverse Recovery Charge                       | Q <sub>rr</sub>     | di/dt = 100A/μs <sup>(Note3)</sup>   | -   | 185   |      | nC   |

**Notes:**

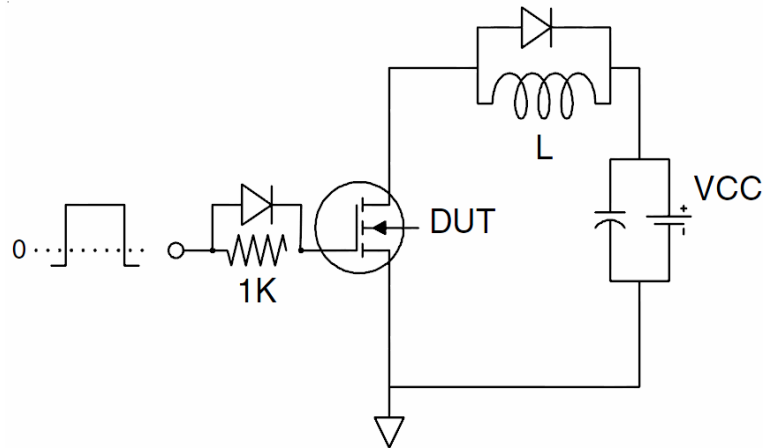
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production
5. EAS condition :  $T_J=25^{\circ}\text{C}, V_{DD}=50V, V_G=10V, L=0.5\text{mH}, R_g=25\Omega$

## Test Circuit

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



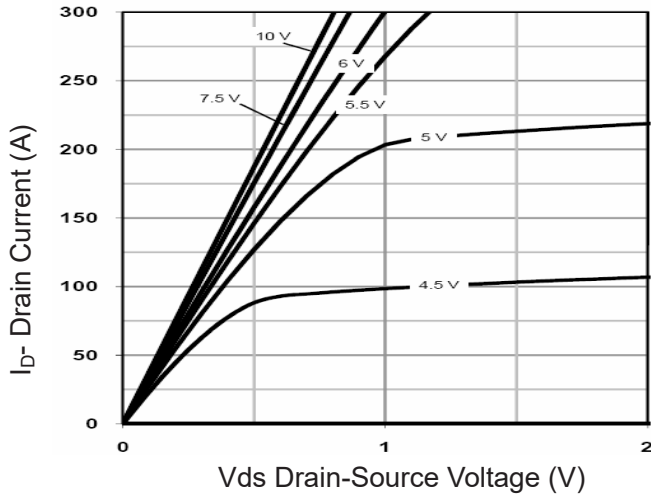
### 2) Gate charge test Circuit



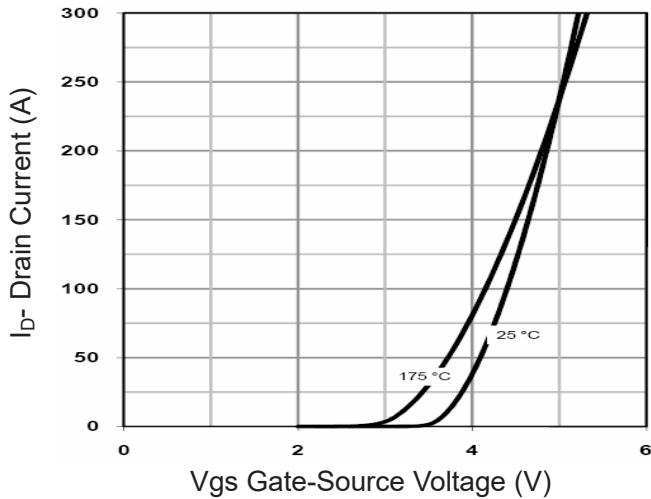
### 3) Switch Time Test Circuit



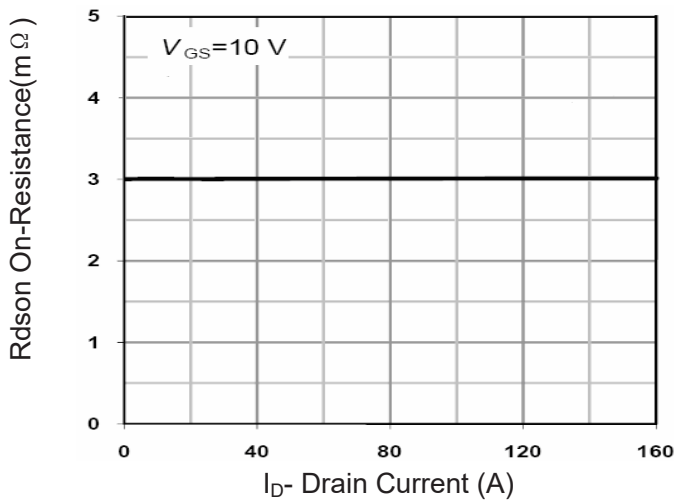
## Typical Electrical and Thermal Characteristics



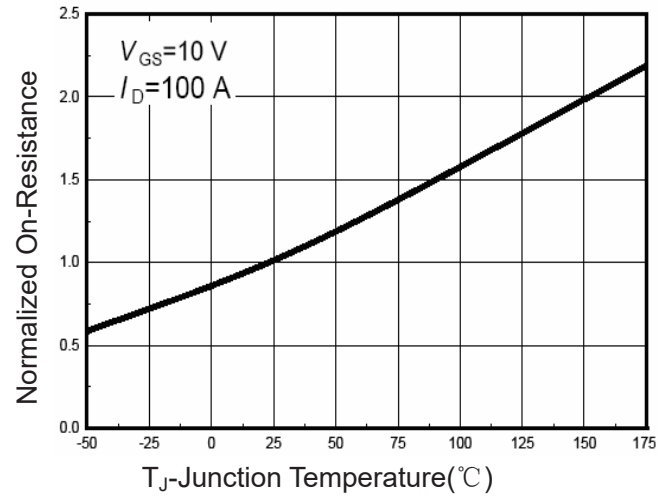
**Figure 1 Output Characteristics**



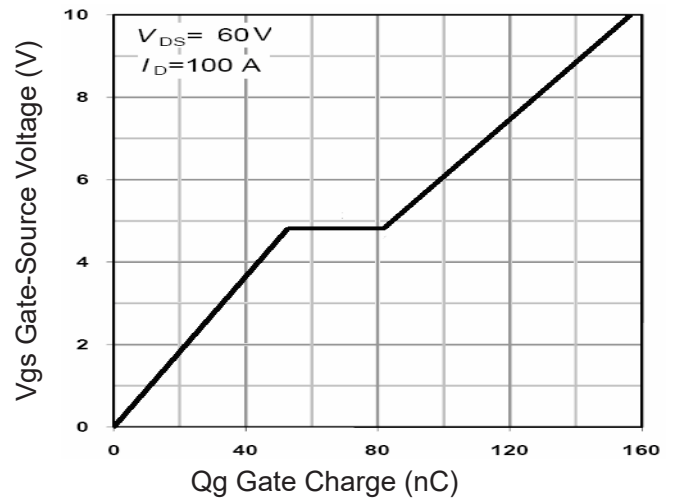
**Figure 2 Transfer Characteristics**



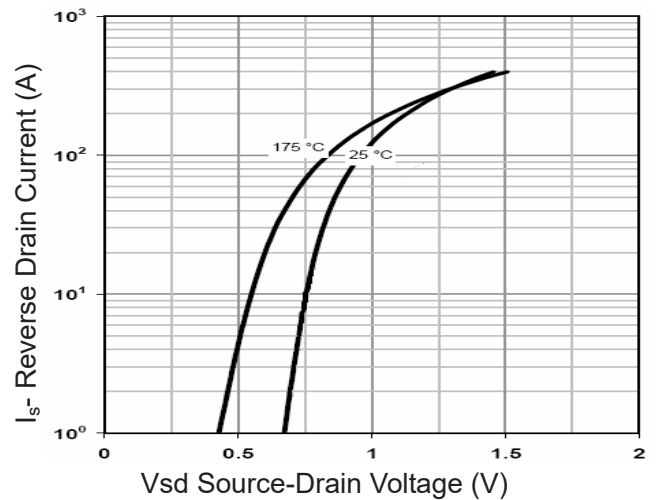
**Figure 3 Rdson- Drain Current**



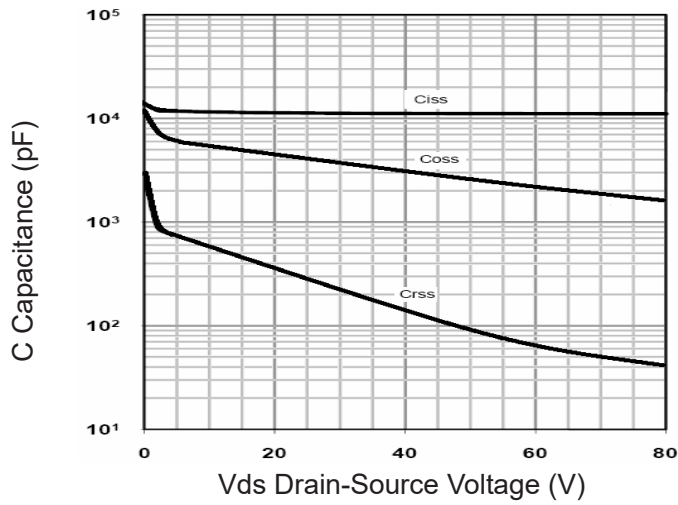
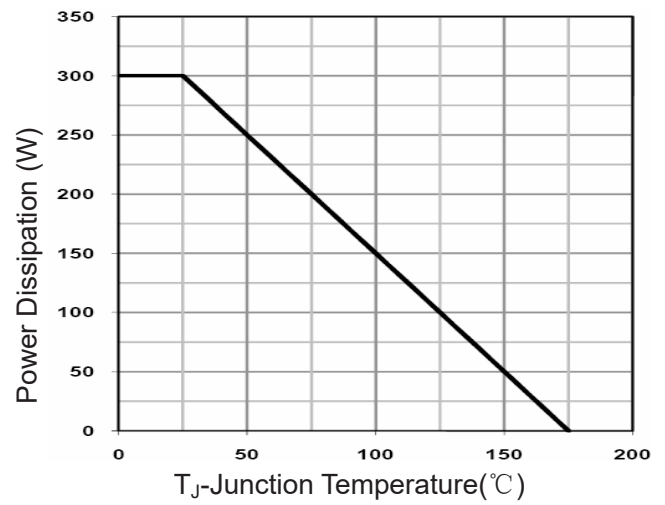
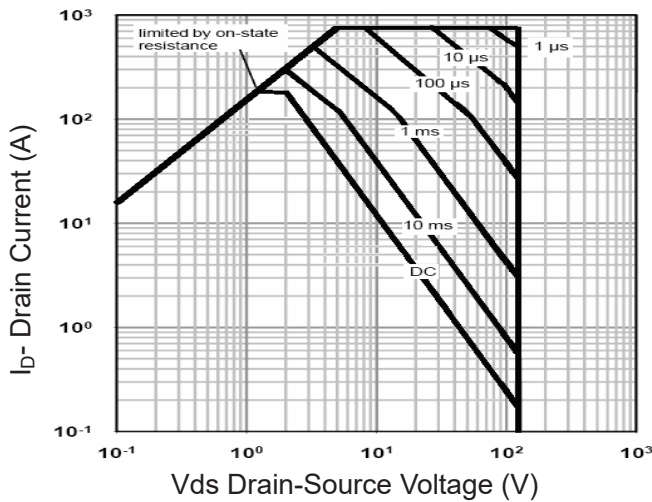
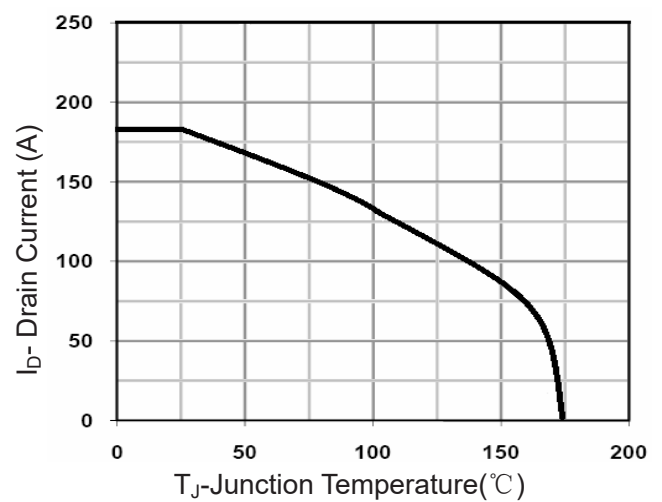
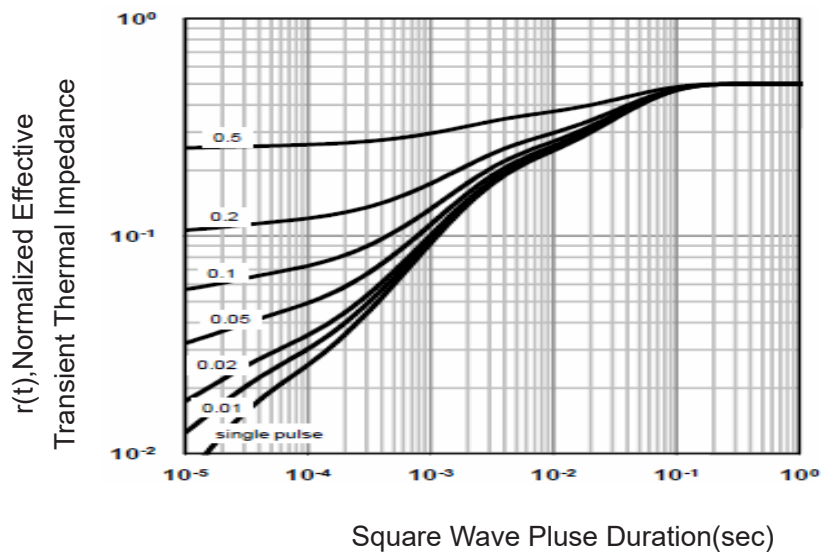
**Figure 4 Rdson-Junction Temperature**



**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**