

## Description

The VST15N590 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

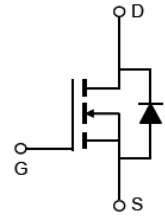
- $V_{DS} = 150V, I_D = 20A$   
 $R_{DS(on)} = 59m\Omega$  (typical) @  $V_{GS} = 10V$
- Excellent gate charge x  $R_{DS(on)}$  product (FOM)
- Very low on-resistance  $R_{DS(on)}$
- 175 °C operating temperature
- Pb-free lead plating
- 100% UIS tested

## Application

- LED backlighting
- 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
VST15N590-TC	VST15N590	TO-220C	-	-	-

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

Parameter	Symbol	Limit	Unit
Drain-Source Voltage	$V_{DS}$	150	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	V
Drain Current-Continuous	$I_D$	20	A
Drain Current-Continuous ( $T_C = 100^\circ C$ )	$I_D (100^\circ C)$	14	A
Pulsed Drain Current	$I_{DM}$	80	A
Maximum Power Dissipation	$P_D$	68	W
Derating factor		0.45	W/ $^\circ C$
Single pulse avalanche energy <sup>(Note 5)</sup>	$E_{AS}$	65	mJ
Drain Source voltage slope, $V_{DS} \leq 120 V$ ,	$dv/dt$	50	V/ns
Drain Source voltage slope, $V_{DS} \leq 120 V, I_{SD} < I_D$	$dv/dt$	50	V/ns
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 To 175	$^\circ C$

## Thermal Characteristic

Thermal Resistance, Junction-to-Case <sup>(Note 2)</sup>	$R_{\theta JC}$	2.2	$^{\circ}\text{C/W}$
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## Electrical Characteristics ( $T_A=25^{\circ}\text{C}$ unless otherwise noted)

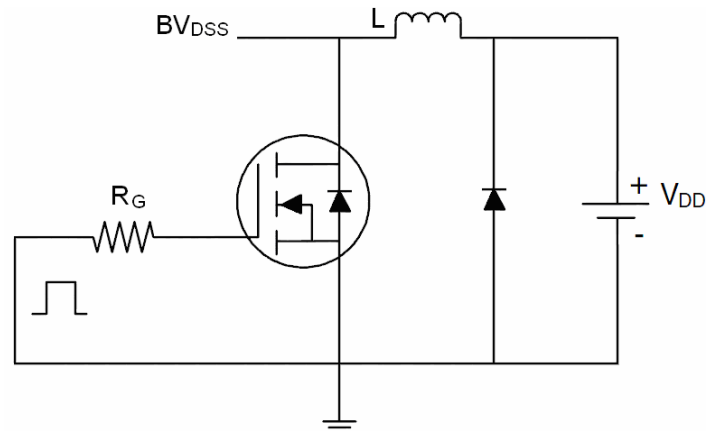
Parameter	Symbol	Condition	Min	Typ	Max	Unit
Off Characteristics						
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	V <sub>GS</sub> =0V I <sub>D</sub> =250μA	150	-	-	V
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> =150V, V <sub>GS</sub> =0V	-	-	1	μA
Gate-Body Leakage Current	I <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	3.3	4.5	V
Drain-Source On-State Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> =10V, I <sub>D</sub> =10A	-	59	65	mΩ
Gate resistance	R <sub>G</sub>		-	4.5	-	Ω
Forward Transconductance	g <sub>FS</sub>	V <sub>DS</sub> =5V, I <sub>D</sub> =10A	15	-	-	S
Dynamic Characteristics <sup>(Note4)</sup>						
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> =75V, V <sub>GS</sub> =0V, F=1.0MHz	-	600		PF
Output Capacitance	C <sub>oss</sub>		-	74.7		PF
Reverse Transfer Capacitance	C <sub>rss</sub>		-	10.8		PF
Switching Characteristics <sup>(Note 4)</sup>						
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> =75V, R <sub>L</sub> =7.5Ω V <sub>GS</sub> =10V, R <sub>G</sub> =3Ω	-	9.5	-	nS
Turn-on Rise Time	t <sub>r</sub>		-	5.5	-	nS
Turn-Off Delay Time	t <sub>d(off)</sub>		-	12.5	-	nS
Turn-Off Fall Time	t <sub>f</sub>		-	3	-	nS
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> =75V, I <sub>D</sub> =10A, V <sub>GS</sub> =10V	-	12	-	nC
Gate-Source Charge	Q <sub>gs</sub>		-	2.8	-	nC
Gate-Drain Charge	Q <sub>gd</sub>		-	1.8	-	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> =10A	-	-	1.2	V
Diode Forward Current <sup>(Note 2)</sup>	I <sub>S</sub>		-	-	20	A
Reverse Recovery Time	t <sub>rr</sub>	T <sub>J</sub> = 25°C, I <sub>F</sub> = I <sub>S</sub> di/dt = 100A/μs <sup>(Note3)</sup>	-	29	-	nS
Reverse Recovery Charge	Q <sub>rr</sub>		-	130	-	nC

## Notes:

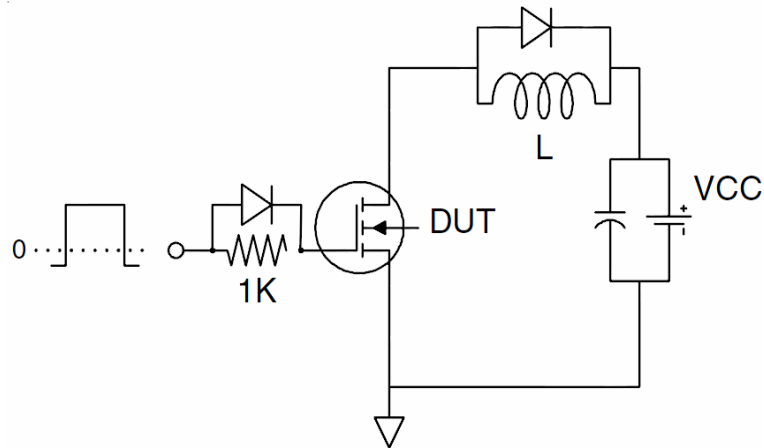
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production
5. EAS condition :  $T_J=25^{\circ}\text{C}, V_{DD}=50V,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

## Test Circuit

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



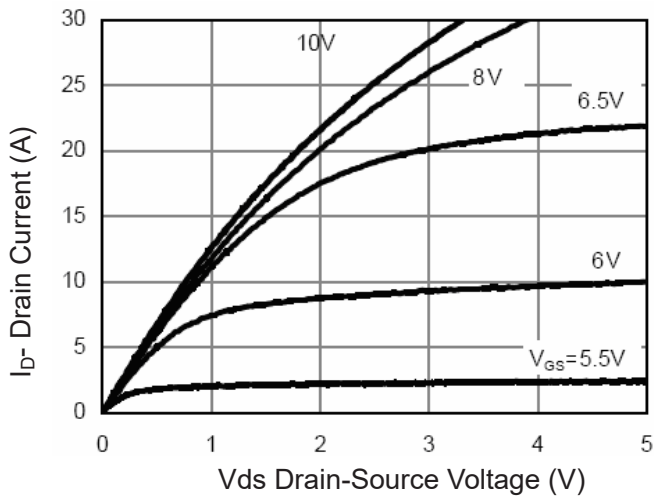
### 2) Gate charge test Circuit



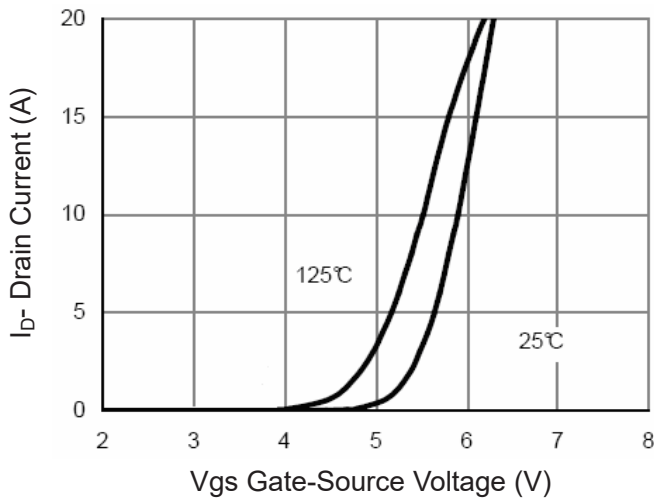
### 3) Switch Time Test Circuit



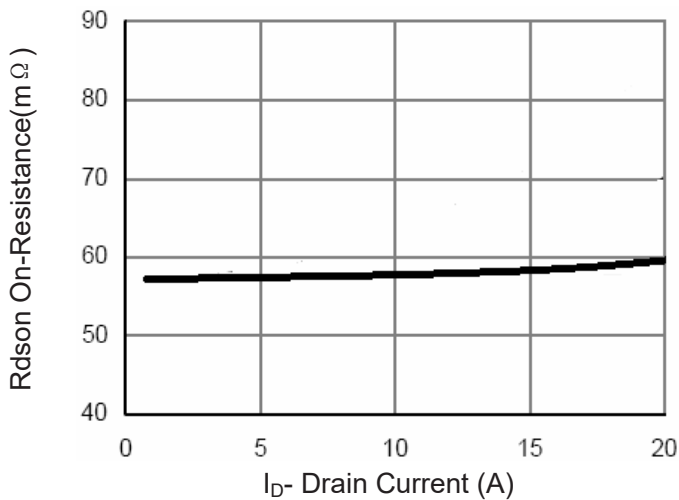
## Typical Electrical and Thermal Characteristics



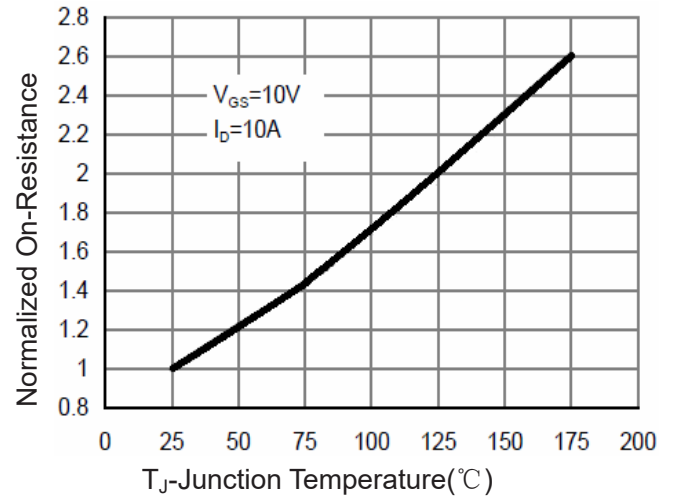
**Figure 1 Output Characteristics**



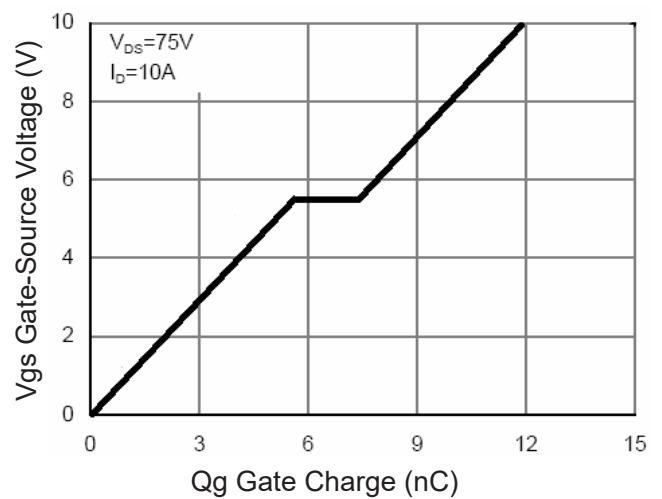
**Figure 2 Transfer Characteristics**



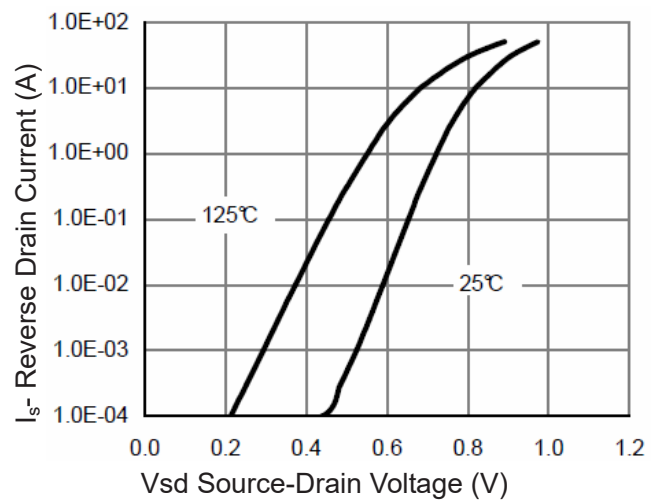
**Figure 3 Rdson- Drain Current**



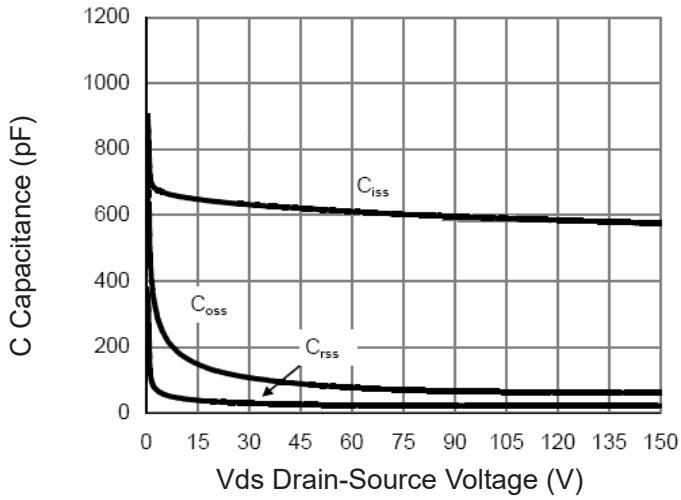
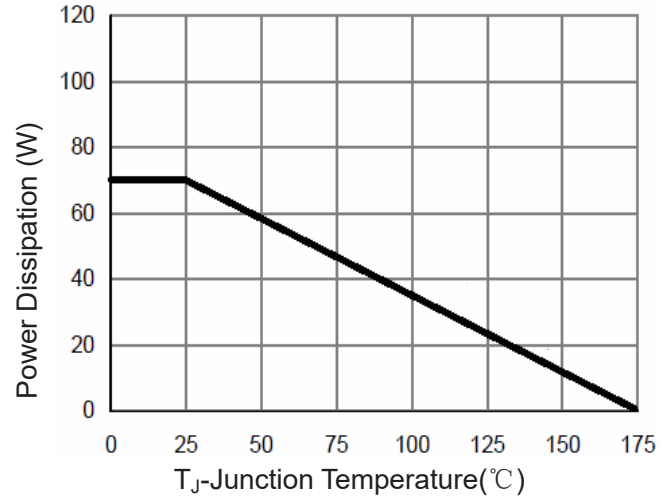
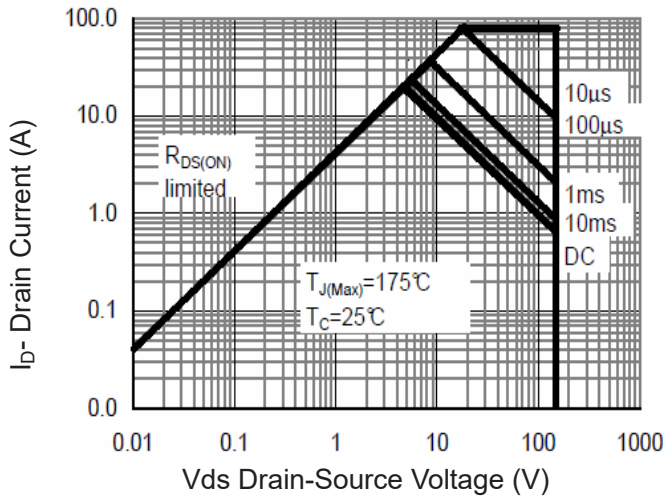
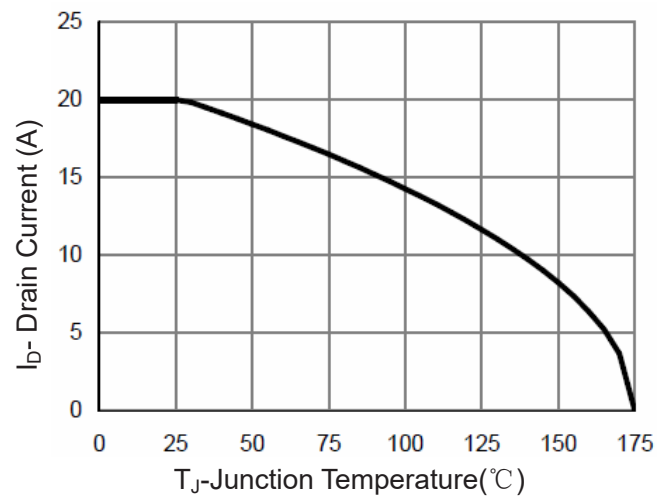
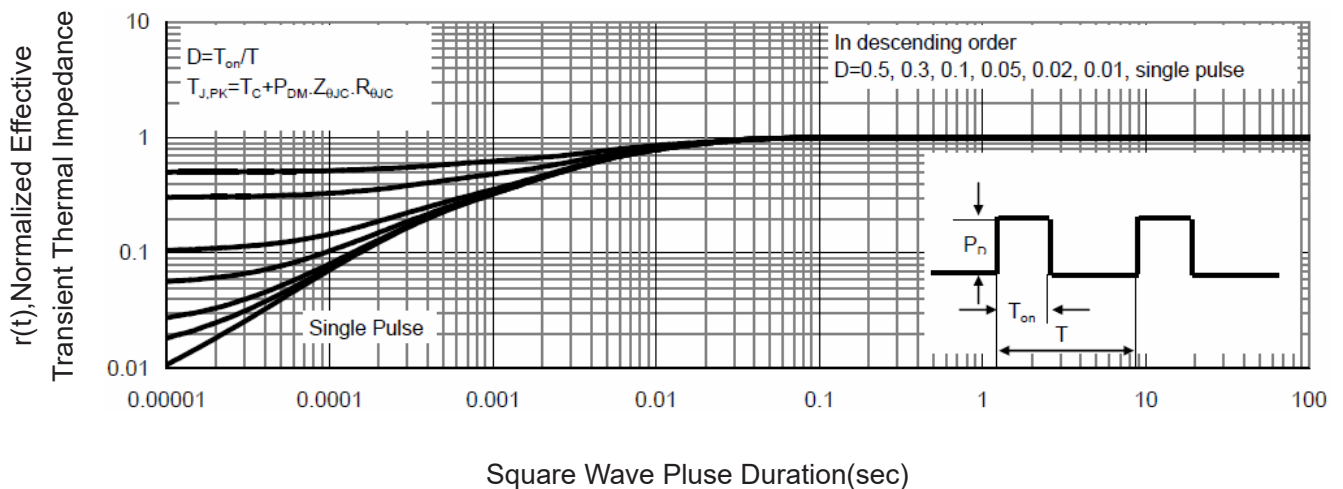
**Figure 4 Rdson-Junction Temperature**



**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**