

### Description

The series of devices 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

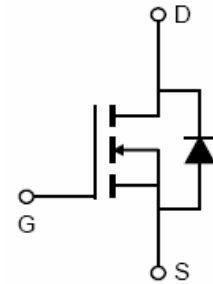
- $V_{DS} = 120V, I_D = 215A$   
 $R_{DS(ON)} = 2.4m\Omega$ , typical (TO-220) @  $V_{GS} = 10V$   
 $R_{DS(ON)} = 2.2m\Omega$ , typical (TO-263) @  $V_{GS} = 10V$
- Excellent gate charge x  $R_{DS(on)}$  product(FOM)
- Very low on-resistance  $R_{DS(on)}$
- 175 °C operating temperature
- Pb-free lead plating



TO-220C



TO-263



Schematic Diagram

### Package Marking and Ordering Information

Device Marking	Device	Device Package	Reel Size	Tape width	Quantity
VST12N022-TC	VST12N022	TO-220C	-	-	-
VST12N022-T3	VST12N022	TO-263			

### 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	$I_D$	215	A
Drain Current-Continuous( $T_C = 100^\circ C$ )	$I_D(100^\circ C)$	150	A
Pulsed Drain Current	$I_{DM}$	860	A
Maximum Power Dissipation	$P_D$	340	W
Derating factor		2.27	W/ $^\circ C$
Single pulse avalanche energy <sup>(Note 4)</sup>	$E_{AS}$	2332	mJ
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 To 175	$^\circ C$

**Thermal Characteristic**

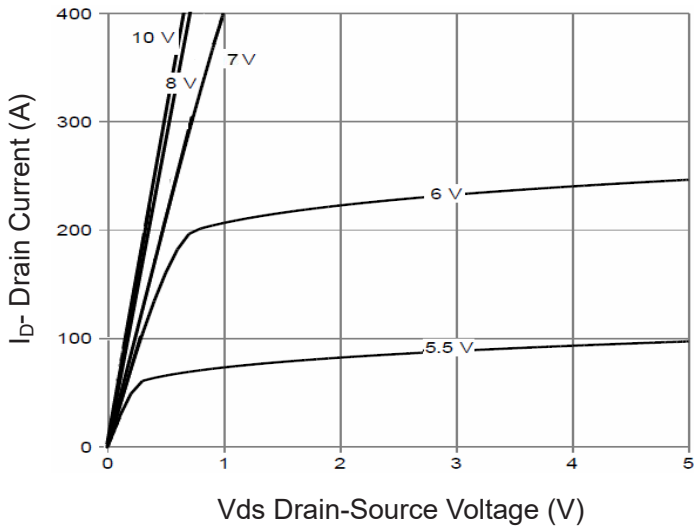
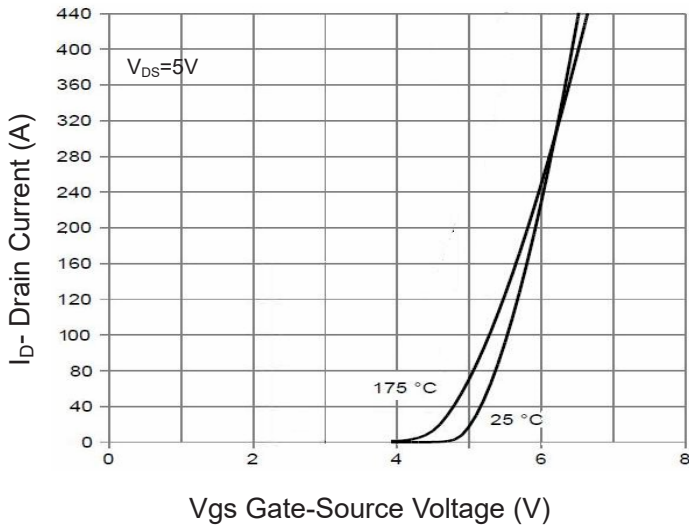
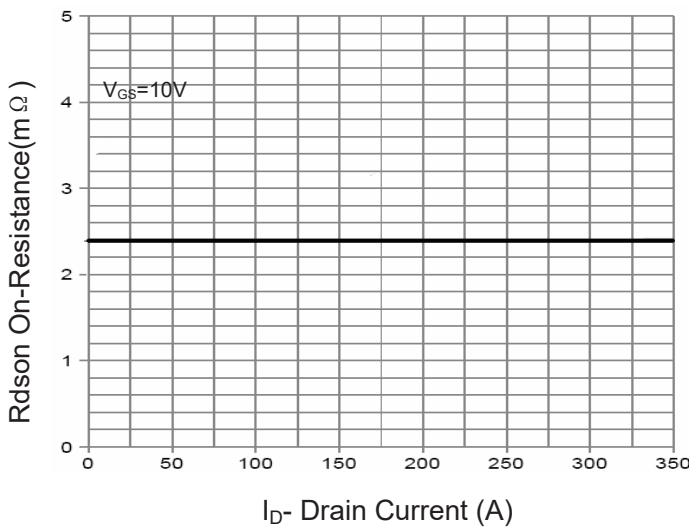
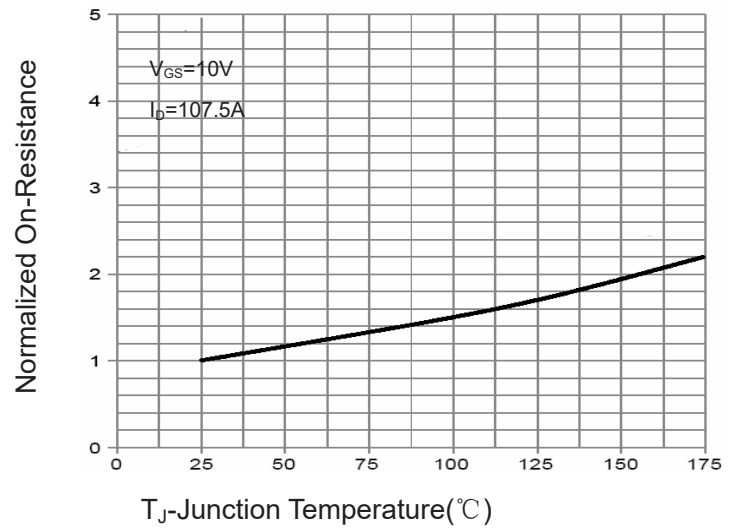
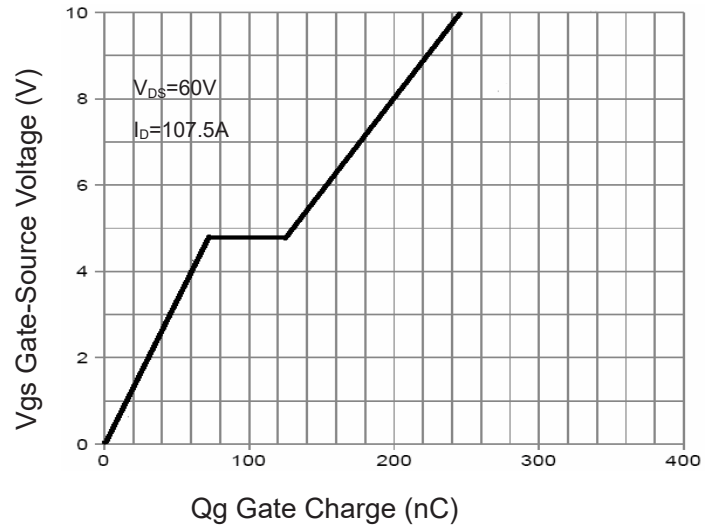
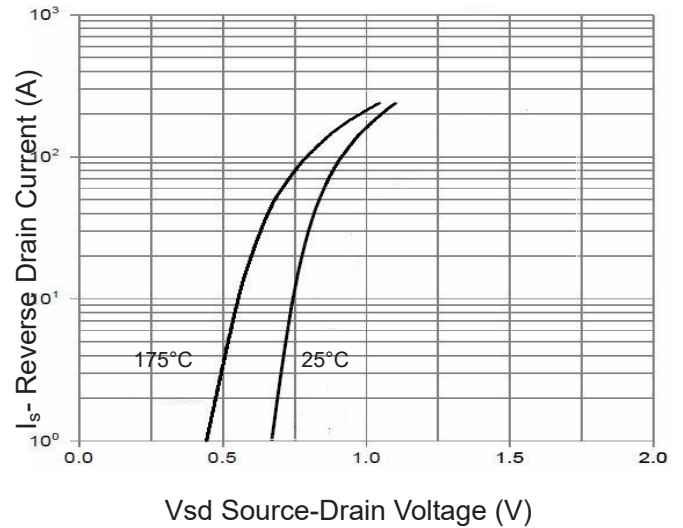
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	0.44	$^{\circ}\text{C}/\text{W}$
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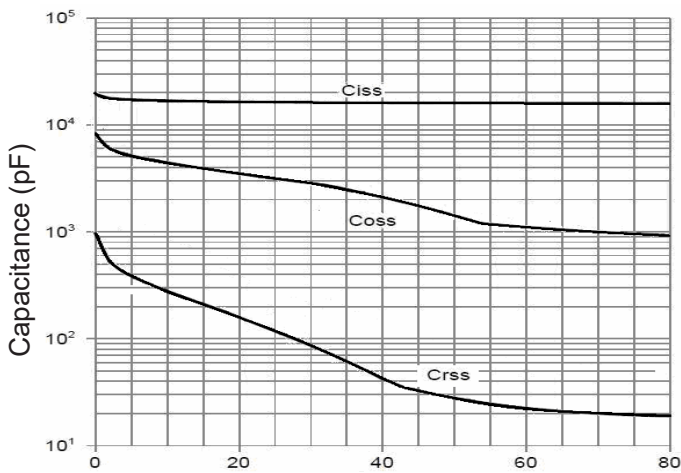
**Electrical Characteristics ( $T_C=25^{\circ}\text{C}$  unless otherwise noted)**

Parameter	Symbol	Condition	Min	Typ	Max	Unit	
<b>Off Characteristics</b>							
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0V, I_D=250\mu A$	120		-	V	
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS}=120V, V_{GS}=0V$	-	-	1	$\mu A$	
Gate-Body Leakage Current	$I_{GSS}$	$V_{GS}=\pm 20V, V_{DS}=0V$	-	-	$\pm 100$	nA	
<b>On Characteristics</b> (Note 2)							
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	2.0	3.0	4.0	V	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS}=10V, I_D=107.5A$	TO-220	-	2.4	3.0	m $\Omega$
			TO-263		2.2	3.0	
Forward Transconductance	$g_{FS}$	$V_{DS}=5V, I_D=107.5A$		200	-	S	
<b>Dynamic Characteristics</b> (Note 3)							
Input Capacitance	$C_{iss}$	$V_{DS}=60V, V_{GS}=0V,$ $F=1.0\text{MHz}$	-	15500	-	PF	
Output Capacitance	$C_{oss}$		-	1020	-	PF	
Reverse Transfer Capacitance	$C_{riss}$		-	23	-	PF	
<b>Switching Characteristics</b> (Note 3)							
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=60V, I_D=107.5A$ $V_{GS}=10V, R_G=1.6\Omega$	-	37	-	nS	
Turn-on Rise Time	$t_r$		-	29	-	nS	
Turn-Off Delay Time	$t_{d(off)}$		-	82	-	nS	
Turn-Off Fall Time	$t_f$		-	34	-	nS	
Total Gate Charge	$Q_g$	$V_{DS}=60V, I_D=107.5A,$ $V_{GS}=10V$	-	225	-	nC	
Gate-Source Charge	$Q_{gs}$		-	73	-	nC	
Gate-Drain Charge	$Q_{gd}$		-	50	-	nC	
<b>Drain-Source Diode Characteristics</b>							
Diode Forward Voltage (Note 3)	$V_{SD}$	$V_{GS}=0V, I_S=107.5A$	-		1.2	V	
Diode Forward Current (Note 2)	$I_S$		-	-	215	A	
Reverse Recovery Time	$t_{rr}$	$T_J = 25^{\circ}\text{C}, I_F = 107.5A$ $di/dt = 100A/\mu s$ (Note 2)	-	105	-	nS	
Reverse Recovery Charge	$Q_{rr}$		-	290	-	nC	

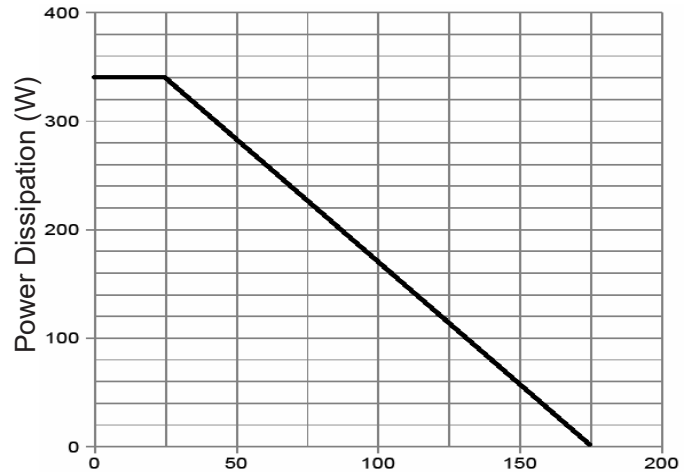
**Notes:**

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

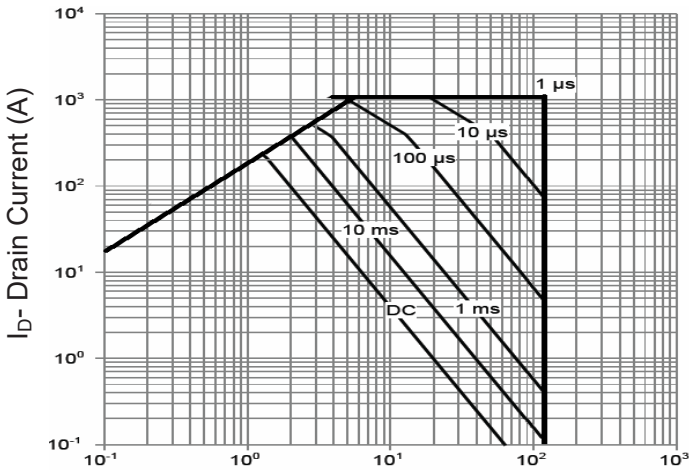
**Typical Electrical and Thermal Characteristics**

**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**



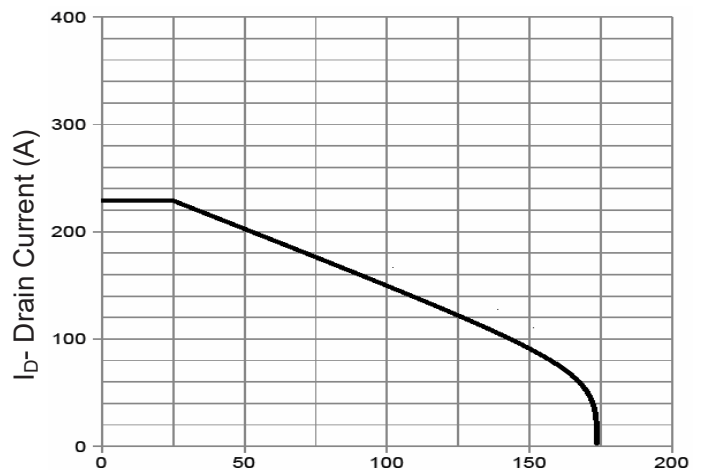
Vds Drain-Source Voltage (V)  
**Figure 7 Capacitance vs Vds**



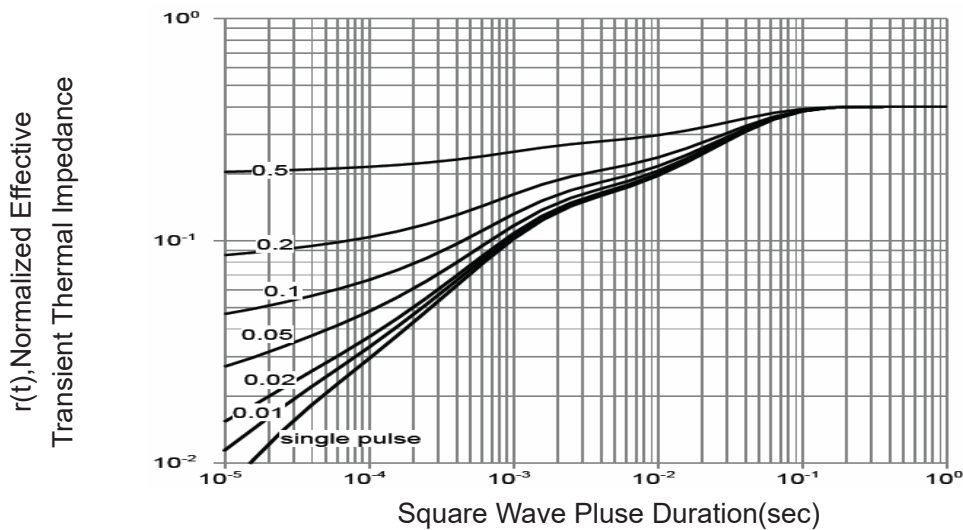
T<sub>J</sub>-Junction Temperature(°C)  
**Figure 9 Power De-rating**



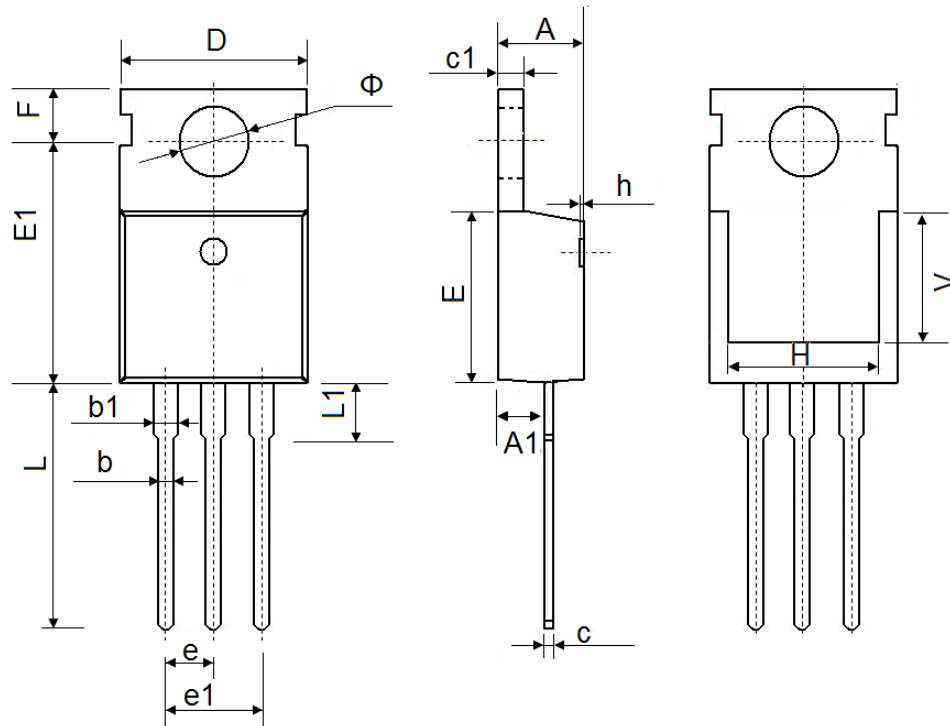
Vds Drain-Source Voltage (V)  
**Figure 8 Safe Operation Area**



T<sub>J</sub>-Junction Temperature (°C)  
**Figure 10 Current De-rating**



**Figure 11 Normalized Maximum Transient Thermal Impedance**

**TO-220-3L Package Information**


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.400	4.600	0.173	0.181
A1	2.250	2.550	0.089	0.100
b	0.710	0.910	0.028	0.036
b1	1.170	1.370	0.046	0.054
c	0.330	0.650	0.013	0.026
c1	1.200	1.400	0.047	0.055
D	9.910	10.250	0.390	0.404
E	8.9500	9.750	0.352	0.384
E1	12.650	12.950	0.498	0.510
e	2.540 TYP.		0.100 TYP.	
e1	4.980	5.180	0.196	0.204
F	2.650	2.950	0.104	0.116
H	7.900	8.100	0.311	0.319
h	0.000	0.300	0.000	0.012
L	12.900	13.400	0.508	0.528
L1	2.850	3.250	0.112	0.128
V	6.900 REF.		0.276 REF.	
Φ	3.400	3.800	0.134	0.150