



# Approval Sheet

## Customer Information

Customer			
Part Name			
Part No.			
Model No.			
<b>COMPANY</b>	<b>PURCHASE</b>	<b>R&amp;D</b>	




## Vendor Information

Name	SFI Electronics Technology Inc.
Part Name	Chip Surge Protection Device (CSPD) Series
Part No.	Super High Voltage (SHV) Series
Lot No.	

## SFI Electronics Technology Inc.

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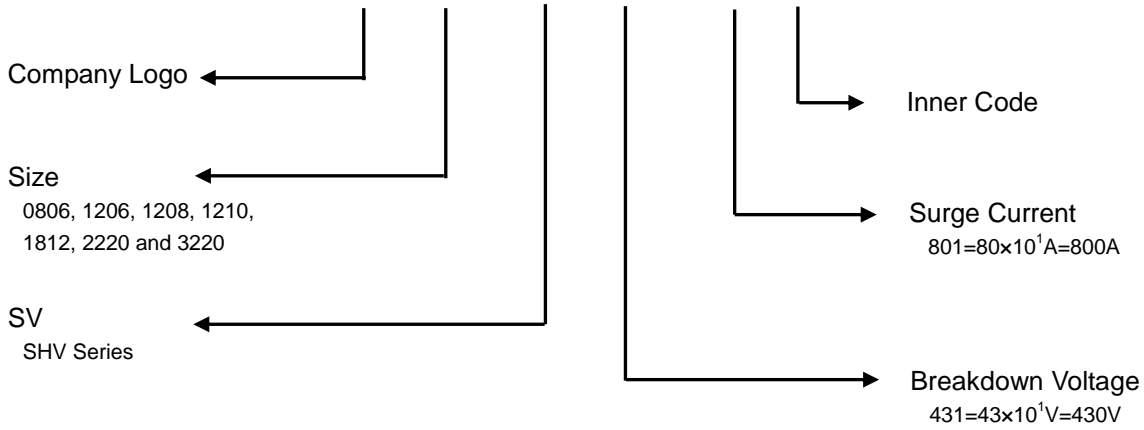
Quality Control	Document Control	Business Issue	
 <p>ISO 9001:2008 ISO 14001:2004 ISO/TS 16949:2009 Management System www.tuv.com ID 1100008833</p> 	REV : H	Prepared	Check
			

Part No.	<b>SHV Series</b>	Document No.	<b>AS-RDSHV-S01</b>	REV.	<b>H</b>
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### 1. Part Number Identification

#### SFI 2220 SV 431 -801 A

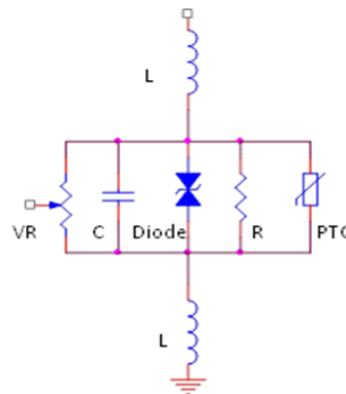


### 1.1 Features of SHV Series

1. RoHS compliant
2. SMD type body size 0806, 1206, 1208, 1210, 1812, 2220 and 3220
3. Meet IEC61000-4-5 and UL1449 standards
4. Meet CSA C22.2 No.8 and CSA Electrical Notice No. 516
4. Bidirectional and symmetrical V/I characteristics
5. Large withstanding surge voltage capability : 0.5~2KV (@1.2/50 $\mu$ s, 2 $\Omega$ )
6. Large withstanding surge current capability : 200~1000A (@8/20 $\mu$ s)
7. Operating temperature range : -55~+85 $^{\circ}$ C
8. Multi-Layers construction provides higher power dissipation

### Equivalent Circuit

- ☆L Body Inductance
- ☆C Device Capacitance
- ☆VR Voltage Variable Resistor
- ☆R Insulation Resistor
- ☆Diode Voltage Clamped
- ☆PTC for Low Leakage Current



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### 1.2 Performance Characteristics

Part Number	Working Voltage (Max.)		Breakdown Voltage	Clamping Voltage (Max.)	Surge Voltage (1.2/50 $\mu$ s, 2 $\Omega$ ) (1 time) (Max.)	Surge Current (8/20 $\mu$ s) (1 time) (Max.)	Surge Current (8/20 $\mu$ s) (15 time) (Max.)	Safety Approvals (UL File No. E334409)	Safety Approvals (CSA File No. E334409)
	V <sub>AC</sub>	V <sub>DC</sub>							
Symbol	V <sub>AC</sub>	V <sub>DC</sub>	V <sub>B</sub>	V <sub>C</sub>	V <sub>Surge</sub>	I <sub>Peak</sub>	I <sub>Peak</sub>	UL	CSA
Unit	V	V	V	V	KV	A	A		
SFI0806SV241-201A	150	200	240( $\pm$ 10%)	395	0.5	200	100	√	
SFI0806SV431-101A	275	350	430( $\pm$ 10%)	705	0.5	100	100	√	
SFI1206SV241-351A	150	200	240( $\pm$ 10%)	395	0.5	350	200	√	
SFI1206SV431-201A	275	350	430( $\pm$ 10%)	705	0.5	200	100	√	
SFI1210SV171-251S	95	135	170( $\pm$ 10%)	250	0.5	250	150	√	
SFI1210SV241-201A	139	195	240( $\pm$ 10%)	395	0.5	200	150	√	
SFI1210SV391-201A	250	320	390( $\pm$ 10%)	647	0.5	200	100	√	
SFI1210SV471-251A	300	385	470( $\pm$ 10%)	775	0.5	250	150	√	
SFI1210SV471-501A	300	385	470( $\pm$ 10%)	775	1.0	500	250	√	√
SFI1812SV271-501A	175	225	270( $\pm$ 10%)	450	1.0	500	250	√	
SFI1812SV471-501A	300	385	470( $\pm$ 10%)	775	1.0	500	250	√	√
SFI1812SV431-801A	275	350	430( $\pm$ 10%)	705	2.0	800	500	√	√
SFI1812SV471-801A	300	385	470( $\pm$ 10%)	775	2.0	800	500	√	√
SFI1812SV271-102A	175	225	270( $\pm$ 10%)	450	2.0	1000	500	√	√
SFI2220SV241-801A	139	195	240( $\pm$ 10%)	395	2.0	800	500	√	√
SFI2220SV271-501A	175	225	270( $\pm$ 10%)	450	1.0	500	250	√	
SFI2220SV391-501A	250	320	390( $\pm$ 10%)	647	1.0	500	250	√	
SFI2220SV431-501A	275	350	430( $\pm$ 10%)	705	1.0	500	250	√	
SFI2220SV471-501A	300	385	470( $\pm$ 10%)	775	1.0	500	250	√	
SFI2220SV391-801A	250	320	390( $\pm$ 10%)	647	2.0	800	500	√	
SFI2220SV431-801A	275	350	430( $\pm$ 10%)	705	2.0	800	500	√	√
SFI2220SV471-801A	300	385	470( $\pm$ 10%)	775	2.0	800	500	√	√
SFI3220SV271-801A	175	225	270( $\pm$ 10%)	450	2.0	1000	500	√	√
SFI3220SV431-801A	275	350	430( $\pm$ 10%)	705	2.0	1000	500	√	√
SFI3220SV471-801A	300	385	470( $\pm$ 10%)	775	2.0	1000	500	√	√
SFI3220SV681-102A	420	560	680( $\pm$ 10%)	1120	2.0	1000	500	√	√



### 1.3 Reference Data

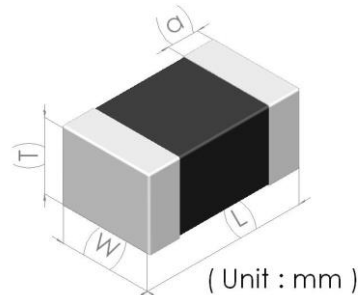
Part Number	Energy (10/1000 $\mu$ s) (Max.)	Capacitance (1KHz)	Body	End Termination	Packaging	Marking	Lead Content
Symbol	E	C					
Unit	J	pF					
SFI0806SV241-201A	4.4	95	Nano special ceramic	Ag/Ni/Sn	Reel	None	<1000ppm
SFI0806SV431-101A	4.3	45					
SFI1206SV241-351A	7.7	180					
SFI1206SV431-201A	8.6	60					
SFI1210SV171-251S	3.8	195					
SFI1210SV241-201A	4.4	110					
SFI1210SV391-201A	7.2	105					
SFI1210SV471-251A	11.9	100					
SFI1210SV471-501A	23.8	190					
SFI1812SV271-501A	13.8	275					
SFI1812SV471-501A	23.8	200					
SFI1812SV431-801A	37.5	340					
SFI1812SV471-801A	41.2	310					
SFI1812SV271-102A	29.9	600					
SFI2220SV241-801A	21.0	430					
SFI2220SV271-501A	13.8	390					
SFI2220SV391-501A	19.9	235					
SFI2220SV431-501A	21.7	215					
SFI2220SV471-501A	23.8	195					
SFI2220SV391-801A	34.4	320					
SFI2220SV431-801A	37.5	305					
SFI2220SV471-801A	41.2	290					
SFI3220SV271-801A	29.9	550					
SFI3220SV431-801A	46.8	490					
SFI3220SV471-801A	51.5	450					
SFI3220SV681-102A	74.4	1300					

Notes :

- \* 1 The breakdown voltage was measured at 1mA.
- \* 2 The clamping voltage was measured at 8/20 $\mu$ s standard current, 0806(1A), 1206(1A), 1208(1A), 1210(2.5A), 1812(5A), 2220(10A) and 3220(10A).
- \* 3 The surge voltage was tested at 1.2/50 $\mu$ s and 2 $\Omega$ . The surge current was tested at 8/20 $\mu$ s waveform.
- \* 4 The UL safety approval complies with standard UL1449<sup>3rd</sup>.
- \* 5 The CSA safety approval complies with standard CSA C22.2 No. 8.
- \* 6 The components shall be employed within 1 year, in the nitrogen condition.
- \* 7 The capacitance value only for customer reference, it's not formal specification.

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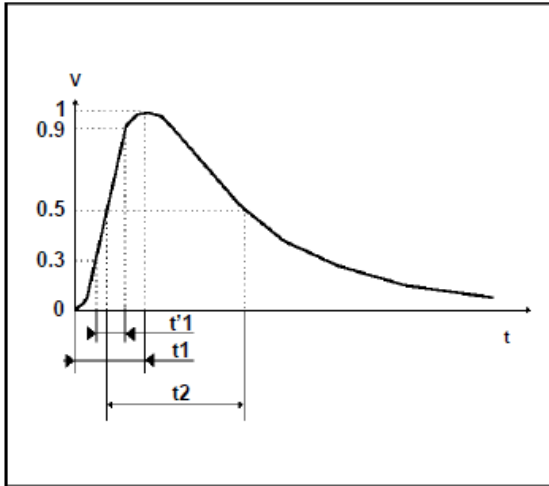
### 2. Mechanical Characteristics



Model	0806 Series	1206 Series	1208 Series
Length(L)	2.20±0.20	3.20 +0.60/-0.20	3.20 +0.60/-0.20
Width(W)	1.70±0.20	1.60 +0.40/-0.20	2.20 +0.40/-0.20
Thickness(T)	1.80 max.	1.90 max.	2.40 max.
Termination(a)	0.25±0.10	0.50±0.20	0.50±0.20

Model	1210 Series	1812 Series	2220 Series	3220 Series
Length(L)	3.20 +0.60/-0.20	4.50 +0.60/-0.20	6.00 +0.70/-0.30	8.10 +0.70/-0.30
Width(W)	2.50 +0.40/-0.20	3.20 +0.50/-0.20	5.30 +0.50/-0.30	5.30 +0.60/-0.30
Thickness(T)	2.60 max.	3.50 max.	3.60 max.	3.70 max.
Termination(a)	0.50±0.25	0.50 +0.35/-0.10	0.50 +0.35/-0.10	0.80 +0.50/-0.10

### 3. Surge Wave Form



#### IEC61000-4-5 Standards

SEVERITY LEVEL	t1 (=1.67t'1)	t2
1	10μs	1000μs
2	8μs	20μs

**8/20μs waveform current**

### 4. Environmental Reliability Test

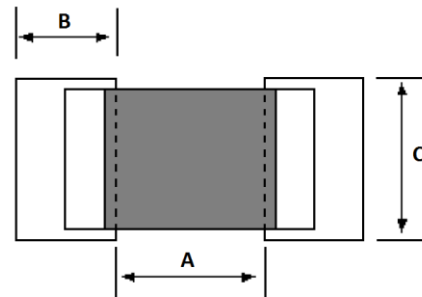
Item	Requirement	Test condition
High Temperature Storage	1. Breakdown voltage change : within ±10% 2. No mechanical damage	1. Temperature : 125±2°C 2. Time : 1000±2 hours 3. Test after placing in ambient temperature for 24 hours.
Low Temperature Storage	1. Breakdown voltage change : within ±10% 2. No mechanical damage	1. Temperature : -40±2°C 2. Time : 1000±2 hours 3. Test after placing in ambient temperature for 24 hours.
Temperature Cycle	1. Breakdown voltage change : within ±10% 2. No mechanical damage	1. Step 1 : -40±3°C; time : 30±3min 2. Step 2 : 25°C; time : 1 hour 3. Step 3 : 125±3°C; time : 30±3min 4. Step 4 : 25°C; time : 1 hour 5. Number of cycle : 5 times 6. Test after placing in ambient temperature for 24 hours.
High Temperature Load	1. Breakdown voltage change : within ±10% 2. No mechanical damage	1. Temperature : 85±2°C 2. Rated working voltage applied 3. Time : 1000±2 hours 4. Test after placing in ambient temperature for 24 hours.
Damp Heat Load/ Humidity Load	1. Breakdown voltage change : within ±10% 2. No mechanical damage	1. Temperature : 40±2°C 2. Humidity : 90~95% RH 3. Rated working voltage applied 4. Time : 500±2 hours 5. Test after placing in ambient temperature for 24 hours.

### 5. Soldering Recommendations

#### 5.1 Recommended solder pad layout

(Unit : mm)

	A	B	C
0806	1.2~1.6	0.8~1.2	1.6~2.2
1206	1.8~2.5	1.2~1.8	1.5~2.0
1208	1.8~2.5	1.2~1.8	2.1~2.9
1210	1.8~2.5	1.3~2.0	2.5~3.3
1812	2.5~3.3	1.5~2.2	3.4~4.2
2220	4.1~4.9	1.4~2.2	5.6~6.4
3220	6.2~7.0	1.6~2.6	6.0~6.8

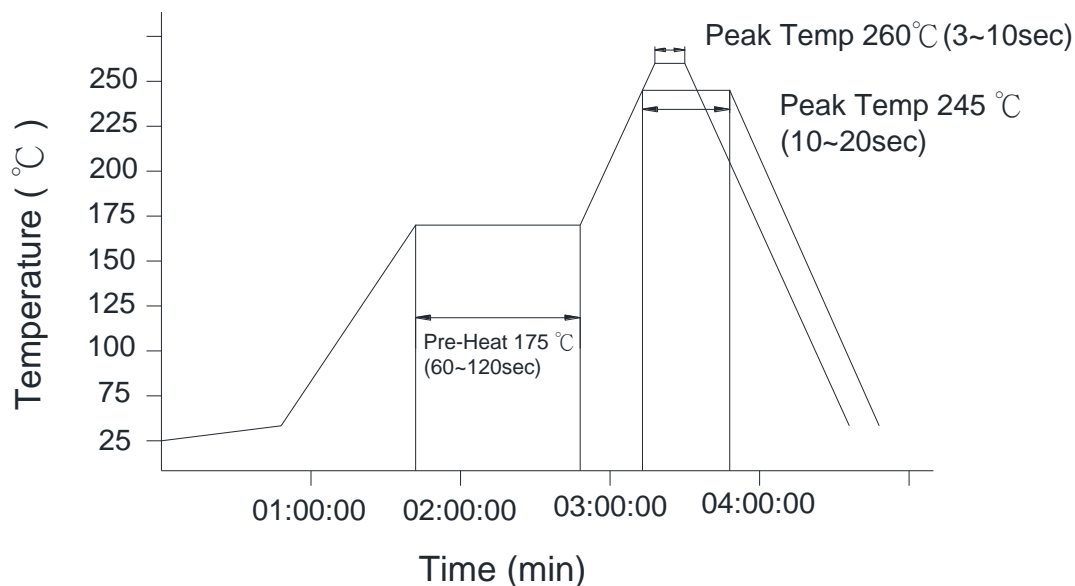


#### 5.2 The SIR test of the solder paste shall be done (Based on JIS-Z-3284)

#### 5.3 Steel plate and foot distance printing

Foot distance printing (mm)	Steel plate thickness (mm)
$\geq 0.65$ mm	0.18mm
0.50~0.65mm	0.15mm
0.40~0.50mm	0.12mm
$\leq 0.40$ mm	0.10mm

#### 5.4 The IR reflow and temperature of soldering for Pb free process



#### ☆ IR reflow Pb free process suggestion profile

- (1) The solder recommend is Sn96.5/Ag3.5, and thickness recommend as shown in table 5.3
- (2) Ramp-up rate (217°C to peak) +3°C/second max.

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- (3) Temp. maintain at 175±25°C 180 seconds max.
  - (4) Temp. maintain above 217°C 60~150 seconds
  - (5) Peak temperature range 245 +20°C/-10°C within 5°C of actually peak temperature (t<sub>p</sub>) 10~20 seconds
  - (6) Ramp down rate -6°C/second max.
- ※Perform adequate test in advance as the reflow temperature profile will vary according to the conditions of the manufacturing process and the specification of the reflow furnace.

### 5.5 Resistance to soldering heat and high temperature resistance : 260°C, 10sec 3 times

#### 5.6 Hand soldering

In hand soldering of the SHV devices, large temperature gradient between preheated the SHV devices and the tip of soldering iron may cause electrical failures and mechanical damages such as cracking or breaking of the devices. The soldering shall be carefully controlled and carried out, so that the temperature gradient is kept minimum with following recommended conditions for hand soldering.

##### 5.6.1 Recommended soldering condition 1 (with preheating)

- (1) Solder  
**0.12~0.18mm** thread solder (Sn96.5:Ag3.5) with soldering flux in the core, and rosin-based non-activated flux is recommended.
- (2) Preheating  
The SHV devices shall be preheated so that temperature gradient between the devices and the tip of soldering iron is 150°C or below.
- (3) Soldering iron  
Rated power of 20W max. with 3mm soldering tip in diameter.  
Temperature of soldering iron tip 380°C max., 3~5sec (The required amount of solder shall be melted in advance on the soldering tip.)
- (4) Cooling  
After soldering, the SHV devices shall be cooled gradually at room ambient temperature.

##### 5.6.2 Recommended soldering condition 2 (without preheating)

- (1) Solder iron tip shall not directly touch to ceramic dielectrics.
- (2) Solder iron tip shall be fully preheated before soldering while soldering iron tip to the external electrode of SHV devices.

#### 5.7 Post soldering cleaning

5.7.1 Residues of corrosive soldering fluxes on the PC board after cleaning may greatly have influences on the electrical characteristic and the reliability (such as humidity resistance) of the SHV devices which have been mounted on the board. It shall be confirmed that the characteristic and the reliability of the devices are not affected by the applied cleaning conditions.

5.7.2 When an ultrasonic cleaning is applied to the mounted SHV devices on PC boards. Following conditions are recommended for preventing failures or damages of the devices due to the large vibration energy and the resonance conditions caused by the ultrasonic waves.

- (1) Frequency 29MHz max.
- (2) Radiated power 20W/liter max.
- (3) Period 5minuets max.

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## 6. Standard Packaging

Size	0806	1206	1208	1210	1812	2220	3220
Pcs	2000 (7 inch reel)	2000 (7 inch reel)	2000 (7 inch reel)	1500 (7 inch reel)	500 (7 inch reel)	500 (7 inch reel)	500 (7 inch reel)