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Aug 1st , 2015

RE: LFPCN41226

To: Our Valued Customers

From: Littelfuse Product Management Team

Subject : LFPCN41226- Commercial TVS Datasheet Characterization

The existing TVS Diode datasheets have been showed in pdf on Littelfuse website or in printed version for years.

To describe the product's electrical parameters and performance more precisely, Littelfuse lab spent efforts to characterize the products and now include more information frequently being enquired in our datasheets. The released High Reliability and Automotive TVS Diode are excluded from these updates.

This is only datasheet update, and there is no change in the product itself.
Design, manufacturing, testing, packing and all stay identical to before.

Thus no any changes to fit, form, shape and function of the finished product itself

The updated datasheet will be published to website In Oct 1st

Form, fit, function changes: None
Part number changes: None
Effective date: Oct 1st 2015
Replacement products: N/A
Last time buy: N/A

This notification is for your information and acknowledgement. If you have any other questions or concerns, please contact Meng Wang, Assistant Product Manager.

We value your business and look forward to assisting you

Best Regards,
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PCN Report

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Date : July 10, 2015

Device : All Commercial TVS product (except AK1, AK3, AK6, AK10)

1.0 Objective:

Re- characterizes the TVS products and update datasheet accordingly (Note: the products themselves do not have any change).

2.0 Scope:

TVS	Package	Product series
Surface Mount TVS	SOD-123	SMF,
	DO-214AC	SMAJ,P4SMA,SMA6J
	DO-221AC	SMA6L
	DO-214AA	SMBJ,P6SMB,1KSMB,SACB
	DO-214AB	SMCJ,1.5SMC,SMDJ,3.0SMC,4.0SMDJ,5.0SMDJ,
Axial Leads TVS	DO-41	P4KE,
	DO-15	SA,SAC,P6KE
	DO-201	1.5KE,LCE
	P600	3KP,5KP,15KPA,20KPA,30KPA
		AK15

3.0 Update Description:

There are no any changes on TVS products themselves, just characterize the products and update the datasheet.

4.0 Electrical Characteristic Update Summary:

4.1 Parameter verification

Current

Maximum Ratings and Thermal Characteristics (T_A=25°C unless otherwise noted)

Parameter	Symbol	Value	Unit
Peak Pulse Power Dissipation at T_A=25°C by 10/1000µs Waveform (Fig.2)(Note 1), (Note 2)	P_{PPM}	400	W
Power Dissipation on Infinite Heat Sink at T_A=50°C	$P_{M(AV)}$	3.3	W
Peak Forward Surge Current, 8.3ms Single Half Sine Wave (Note 3)	I_{FSM}	40	A
Maximum Instantaneous Forward Voltage at 25A for Unidirectional Only (Note 4)	V_F	3.5V/6.5	V
Operating Junction and Storage Temperature Range	T_J, T_{STG}	-55 to 150	°C
Typical Thermal Resistance Junction to Lead	$R_{\theta JL}$	30	°C/W
Typical Thermal Resistance Junction to Ambient	$R_{\theta JA}$	120	°C/W

Notes:
1. Non-repetitive current pulse, per Fig.4 and derated above T_A=25°C per Fig. 3.
2. Mounted on 5.0x5.0mm copper pad to each terminal.
3. Measured on 8.3ms single half sine wave or equivalent square wave for unidirectional device only.
4. V_F < 3.5V for V_{BR} ≤ 200V and V_F< 6.5V for V_{BR} ≥ 201V.

New

Maximum Ratings and Thermal Characteristics (T_A=25°C unless otherwise noted)

Parameter	Symbol	Value	Unit
Peak Pulse Power Dissipation at T_L=25°C by 10/1000µs Waveform (Fig.2)(Note 1), (Note 2), (Note 5)	P_{PPM}	400	W
Power Dissipation on Infinite Heat Sink at T_L=50°C	P_D	3.3	W
Peak Forward Surge Current, 8.3ms Single Half Sine Wave (Note 3)	I_{FSM}	60	A
Maximum Instantaneous Forward Voltage at 25A for Unidirectional Only (Note 4)	V_F	3.5/5.0	V
Operating Temperature Range	T_J	-65 to 150	°C
Storage Temperature Range	T_{STG}	-65 to 175	°C
Typical Thermal Resistance Junction to Lead	$R_{\theta JL}$	30	°C/W
Typical Thermal Resistance Junction to Ambient	$R_{\theta JA}$	120	°C/W

Notes:
1. Non-repetitive current pulse, per Fig.4 and derated above T_J (initial) =25°C per Fig. 3.
2. Mounted on 5.0x5.0mm copper pad to each terminal.
3. Measured on 8.3ms single half sine wave or equivalent square wave for unidirectional device only.
4. V_F < 3.5V for single die parts and V_F< 5.0V for stacked-die parts.
5. The P_{PPM} of stacked-die parts is 600W and please contact littelfuse® for the detail stacked-die parts.

A

B

C

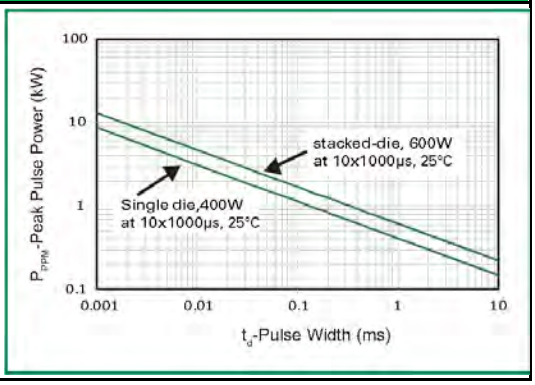
D

E

A: Add new note to indicate the peak pulse power of stack dice parts. The affected product as below

TVS	Current	single	Stack
SMAJ/P4SMA	400	400	600
SMB/P6SMB	600	600	800
SMC/1.5SMC	1500	1500	2000
SMD	3000	3000	4000
P4KE	400	400	600
P6KE	600	600	800
1.5KE	1500	1500	2000
3KP	3000	3000	4000

Example(400W SMAJ)



B: Update I_{FSM} level to 60A from 40A for SMA and P4KE.

Peak Forward Surge Current, 8.3ms Single Half Sine Wave		
TVS	Current datasheet	Future datasheet
SMA	40	60
P4KE	40	60

C: Update SMAJ/P4SMA VF to 3.5V/5V from 3.5V/6.5V

D: Separate surface mount products operating junction temperature and storage temperature (T_J: -65C~150C,T_{STG}:-65C~175C), the affected products as below:

TVS Series	Current Operating Temperature Range	Current Storage Temperature Range	New Operating Temperature Range	New Storage Temperature Range
SMF	-55~150℃	-55~150℃	-65~150℃	-65~175℃
SMAJ/P4SMA/SMA6J/SMA6L	-55~150℃	-55~150℃	-65~150℃	-65~175℃
SMBJ/P6SMB/SACB/1KSMB	-55~150℃	-55~150℃	-65~150℃	-65~175℃
SMCJ/1.5SMC/3.0SMC/4.0SMDJ	-55~150℃	-55~150℃	-65~150℃	-65~175℃
SMDJ	-55~150℃	-55~150℃	-65~150℃	-65~175℃
5.0SMDJ	-55~150℃	-55~150℃	-65~150℃	-65~175℃

E: Update SMAJ/P4SMA series note “VF<3.5V for devices of VBR ≤ 200V and VF<6.5V for devices of VBR ≥ 201V ” to “VF < 3.5V for single dice parts and VF< 5V for stacked dice parts”

Update the others series note “VF<3.5V for devices of VBR ≤ 200V and VF<5V for devices of VBR ≥ 201V ” to “VF < 3.5V for single dice parts and VF< 5V for stacked dice parts”

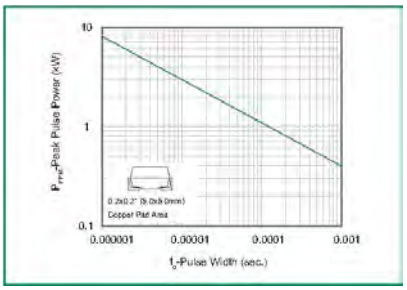
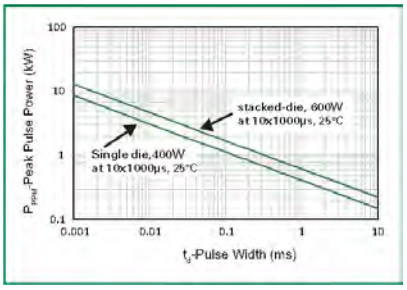
4.2 Features

Current	New
Features • Excellent clamping capability • Typical I_R less than 1μA above 12V • For surface mounted applications to optimize board space • Low profile package • Typical failure mode is short from over-specified voltage or current • Whisker test is conducted based on JEDEC JESD201A per its table 4a and 4c • IEC-61000-4-2 ESD 15kV(Air), 8kV (Contact) • ESD protection of data lines in accordance with IEC 61000-4-2 (IEC801-2) • EFT protection of data lines in accordance with IEC 61000-4-4 (IEC801-4) • Built-in strain relief • 400W Peak pulsepower capability at 10/1000μs waveform, repetition rate (duty cycle): 0.01% • Fast response time: typically less than 1.0ps from 0 Volts to V_{BR} min • Glass passivated junction • Low inductance • High temperature soldering: 260°C/40 seconds at terminals • V_{BR} @T_J= V_{BR}@25°C x (1+αT x (T_J- 25)) (αT:Temperature Coefficient) • Plastic package has underwriters laboratory flammability 94V-O • Meet MSL level1, per J-STD-020, LF maximun peak of 260°C • Matte tin lead–free Plated • Halogen free and RoHS compliant • 2nd level interconnect is Pb-free per IPC/JEDEC J-STD-609A.01	**Features** • Excellent clamping capability • Low incremental surge resistance • Typical I_R less than 1μA when V_{BR} min>12V • For surface mounted applications to optimize board space • Low profile package • Typical failure mode is short from over-specified voltage or current • Whisker test is conducted based on JEDEC JESD201A per its table 4a and 4c • IEC-61000-4-2 ESD 30kV(Air), 30kV (Contact) • ESD protection of data lines in accordance with IEC 61000-4-2 (IEC801-2) • EFT protection of data lines in accordance with IEC 61000-4-4 (IEC801-4) • Built-in strain relief • 400W peak pulse power capability at 10/1000μs waveform, repetition rate (duty cycles):0.01% • Fast response time: typically less than 1.0ps from 0V to BV min • High temperature to reflow soldering guaranteed: 260°C/40sec • V_{BR} @T_J= V_{BR}@25°C x (1+αT x (T_J - 25)) (αT:Temperature Coefficient, typical value is 0.1%) • Plastic package has underwriters laboratory flammability 94V-O • Meet MSL level1, per J-STD-020, LF maximun peak of 260°C • Matte tin lead–free Plated • Halogen-free and RoHS compliant • 2nd level interconnect is Pb-free per IPC/JEDEC J-STD-609A.01

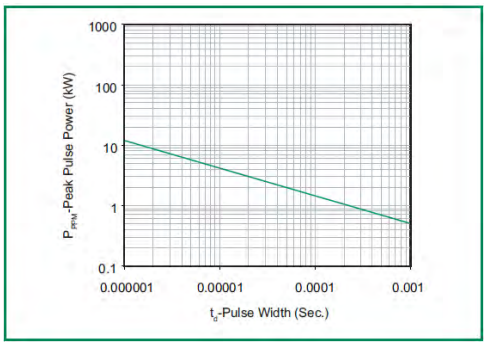
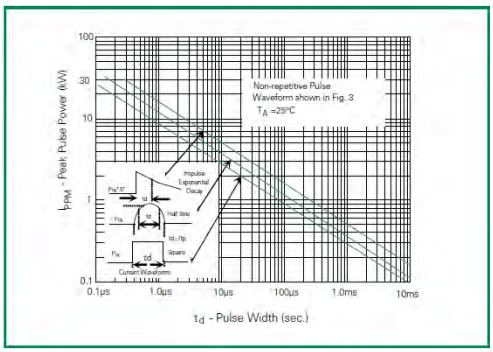
5. Figures

- **Figure - Peak Pulse Power Rating Curve**

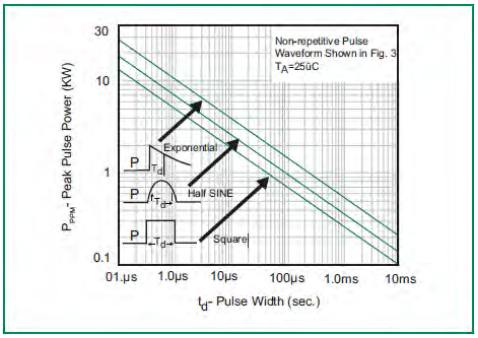
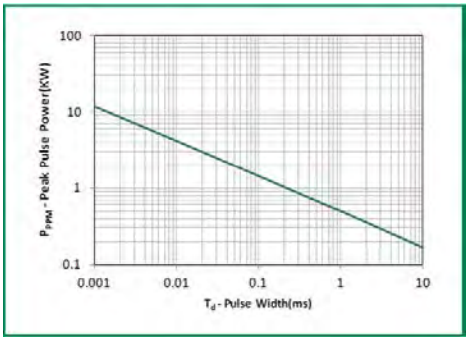
5.1 Add one curve to specify stack-die parts pulse power.

TVS	Current	Future single Parts Power	Future Stack Parts Power	Example(SMAJ/P4SMA)
SMAJ/P4SMA	400	400	600	Current: 
SMBJ/P6SMB	600	600	800	
SMC/1.5SMC	1500	1500	2000	
SMDJ	3000	3000	4000	
P4KE	400	400	600	
P6KE	600	600	800	
1.5KE	1500	1500	2000	
3KP	3000	3000	4000	New: 
1.5KE	1500	1500	2000	

5.2 Update SAC series peak pulse power rating curve

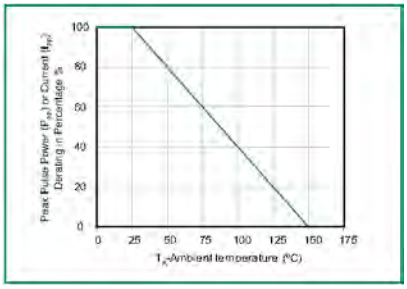
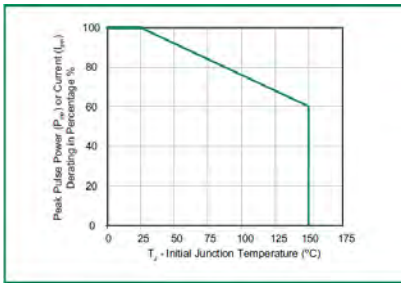
TVS series	Current	New
SAC series		

5.3 Update SA series peak pulse power rating curve.

TVS series	Current	New
SA series		

➢ **Figure - Pulse Derating Curve**

5.4 Update the derating curve.

Pulse Derating Curve			
TVS	Current Power Rating@Tjmax	New Power Rating@Tjmax	Example(SMAJ/P4SMA)
SMAJ/P4SMA	0%	60%	Current: 
SMA6J/SMA6L	0%	40%	
SACB	0%	60%	
SMBJ/P6SMB	0%	60%	
1KSMB	0%	60%	
SMCJ/1.5SMC	0%	60%	
SMDJ	0%	50%	
3.0SMC	0%	50%	
4.0SMDJ	0%	50%	
5.0SMDJ	0%	50%	New: 
P4KE	0%	50%	
SA	0%	50%	
SAC	0%	60%	
P6KE	0%	50%	
1.5KE	0%	50%	
LCE	0%	60%	
3KP	0%	50%	
5KP	0%	50%	
15KP	0%	50%	
20KP	0%	50%	
30KP	0%	50%	

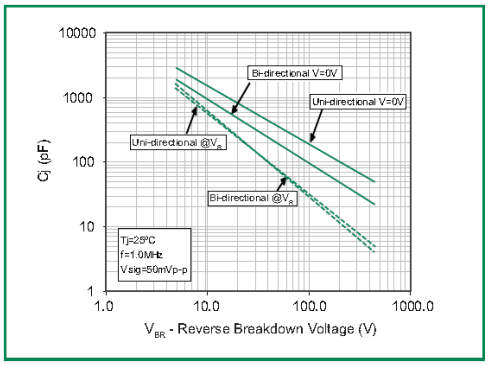
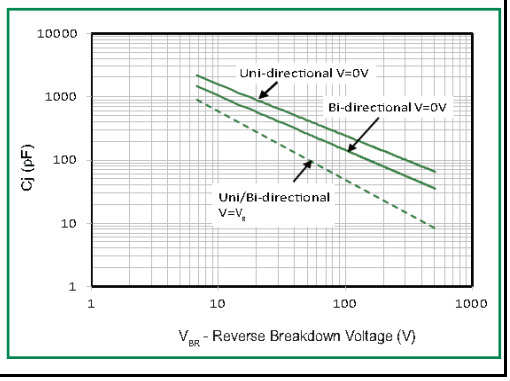
➢ **Figure - Typical Junction Capacitance**

5.5 Update capacitance curve

The affected TVS product list as below,

TVS	Package	Product series
Surface Mount TVS	SOD-123	SMF,
	DO-214AC	SMAJ,P4SMA,SMA6J
	DO-221AC	SMA6L
	DO-214AA	SMBJ,P6SMB,1KSMB
	DO-214AB	SMCJ,1.5SMC,SMDJ,3.0SMC,5.0SMDJ,
Axial Leads TVS	DO-41	P4KE,
	DO-15	SA,P6KE
	DO-201	1.5KE,
	P600	3KP,5KP,15KPA,20KPA,30KPA

Examples as below:

TVS Affected Series	Example-Current SMA series curve	Example-New SMA series curve
SMAJ/P4SMA		

5.6 Remove steady state power derating curve as the application is not recommended for TVS

The affected TVS product list as below:

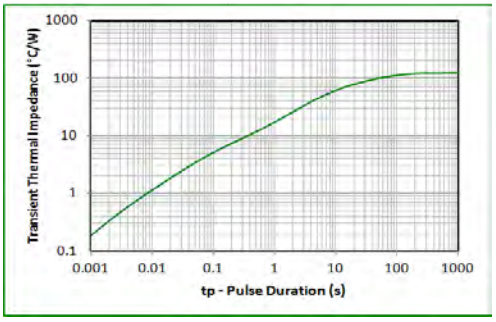
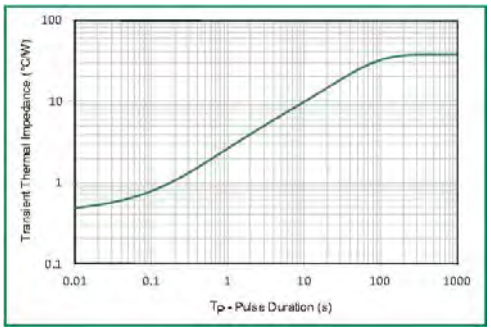
TVS	Package	Product series
Surface Mount TVS	SOD-123	SMF,
	DO-214AC	SMAJ,P4SMA,SMA6J,
	DO-221AC	SMA6L
	DO-214AA	SMBJ,P6SMB,1KSMB
	DO-214AB	SMCJ,1.5SMC,SMDJ,3.0SMC,4.0SMDJ,5.0SMDJ,
Axial Leads TVS	DO-41	P4KE,
	DO-15	SA,P6KE
	DO-201	1.5KE,LCE
	P600	3KP,5KP,15KPA,20KPA,30KPA

5.7 Add new figure - Typical Transient Thermal Impedance

The affected TVS product list as below:

TVS	Package	Product series
Surface Mount TVS	DO-214AC	SMAJ,P4SMA,SMA6J,
	DO-214AA	SMBJ,P6SMB,1KSMB
	DO-214AB	SMCJ,1.5SMC,SMDJ,3.0SMC,4.0SMDJ,5.0SMDJ,
Axial Leads TVS	DO-41	P4KE,
	DO-15	SA,P6KE
	DO-201	1.5KE,
	P600	3KP,5KP,15KPA,20KPA,30KPA

Examples as below:

TVS series	SMAJ/P4SMA series	15KPA series
SMAJ/P4SMA		

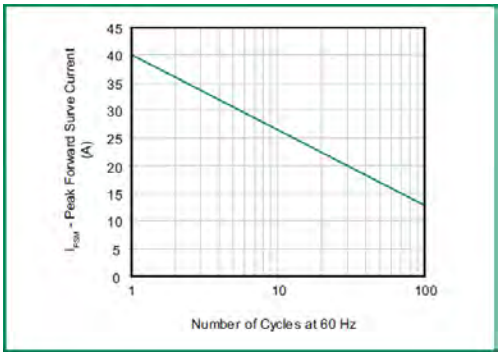
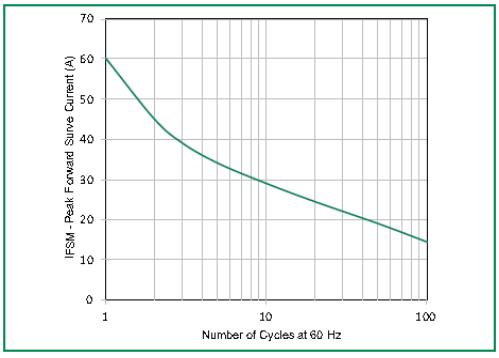
- **Figure - Maximum Non-Repetitive Forward Surge Current Uni-Directional Only**

5.8 Update maximum forward surge current (uni-directional only)

The affected TVS product list as below:

TVS	Package	Product series
Surface Mount TVS	SOD-123	SMF,
	DO-214AC	SMAJ,P4SMA,SMA6J,
	DO-214AB	SMCJ,1.5SMC,SMDJ,3.0SMC,4.0SMDJ,5.0SMDJ,
Axial Leads TVS	DO-41	P4KE,
	DO-15	SA,P6KE
	DO-201	1.5KE,
	P600	3KP,5KP,15KPA,20KPA,30KPA

Examples as below:

TVS series	Current	New
SMAJ/P4SMA		

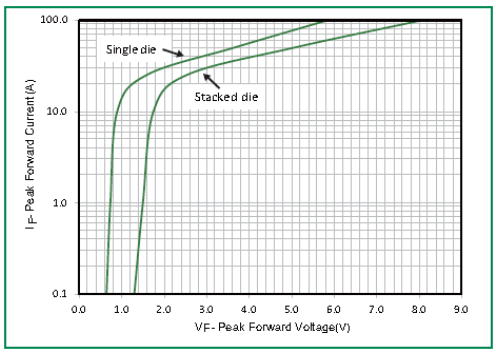
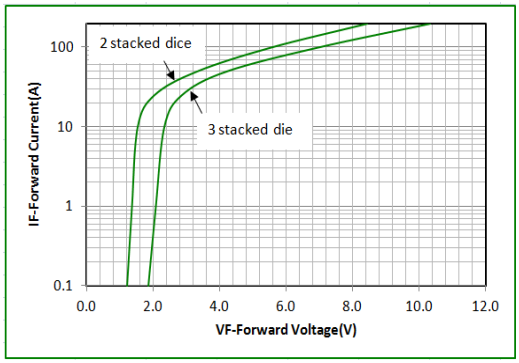
➢ **Figure - Peak forward voltage drop versus peak forward current(typical values)**

5.9 Add new figure (only apply to uni-directional TVS)

The affected TVS product list as below,

TVS	Package	Product series
Surface Mount TVS	SOD-123	SMF,
	DO-214AC	SMAJ,P4SMA,SMA6J
	DO-221AC	SMA6L
	DO-214AA	SMBJ,P6SMB,1KSMB
	DO-214AB	SMCJ,1.5SMC,SMDJ,3.0SMC,4.0SMDJ,5.0SMDJ,
Axial Leads TVS	DO-41	P4KE,
	DO-15	SA,P6KE
	DO-201	1.5KE
	P600	3KP,5KP,15KPA,20KPA,30KPA
		AK15

Examples as below:

TVS series	SMA/P4SMA	15KPA
Peak forward voltage drop versus peak forward current(typical values)		

6. Environmental Specification(Surface mount TVS RSH specification updated to JESD22-A111 from JESD22-B106.)

Environmental Specifications	
High Temp. Storage	JESD22-A103
HTRB	JESD22-A108
Temperature Cycling	JESD22-A104
MSL	JEDEC-J-STD-020, Level 1
H3TRB	JESD22-A101
RSH	JESD22-B106

Environmental Specifications	
High Temp. Storage	JESD22-A103
HTRB	JESD22-A108
Temperature Cycling	JESD22-A104
MSL	JEDEC-J-STD-020, Level 1
H3TRB	JESD22-A101
RSH	JESD22-A111

7. Add AK15 10x350us surge parameter

Part Numbers	Part Marking	Standoff Voltage (V_{SO}) Volts	Max. Reverse Leakage (I_R) @V_{SO} (μA)	Typical I_R @ 85°C (μA)	Reverse Breakdown Voltage (V_{BR}) @ I_T		Test Current I_T	Max. Clamping Voltage V_{CL} @ Peak Pulse Current (I_{PP})			Max. Temp Coefficient of V_{BR}	Max. Capacitance 0 Bias 10kHz	Agency Approval
					Min Volts	Max Volts	(mA)	V_{CL} Volts	I_{PP} (8/20μS) (A)	I_{PP} (10/350μS) (A)	(%/°C)	(nF)	
AK15 - 058C	15 - 058C	58	10	15	64	70	10	110	15,000	2,000	0.1	12	X
AK15 - 066C	15 - 066C	66	10	15	72	80	10	120	15,000	2,000	0.1	10	X
AK15 - 076C	15 - 076C	76	10	15	85	95	10	150	15,000	2,000	0.1	10	X

8. Approvals:

Changjun Tang
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Zhiwei Wang
Product Engineering Manager
Littelfuse Semiconductor (Wuxi) Co., Ltd.