



Expertise Applied | Answers Delivered

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,
Meng Wang
Assistant Product Marketing Manager,
Tel: +86 510 85277701, extension 7955
Mwang3@littelfuse.com

Littelfuse Semiconductor (Wuxi) Co., Ltd.
 East 3# Zhen Fa 6 Road
 Shuo Fang Industrial Park
 Wuxi, China Jiangsu 214142

PCN Report

Prepared By : Changjun Tang, Production Engineer, Littelfuse Wuxi
 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				New			
Maximum Ratings and Thermal Characteristics (T_A=25°C unless otherwise noted)				Maximum Ratings and Thermal Characteristics (T_A=25°C unless otherwise noted)			
Parameter	Symbol	Value	Unit	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	Peak Pulse Power Dissipation at T _A =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 _A =50°C	P _{M(AV)}	3.3	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}	40	A	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	3.5V/6.5	V	Maximum Instantaneous Forward Voltage at 25A for Unidirectional Only (Note 4)	V _F	3.5/5.0	V
Operating Junction and Storage Temperature Range	T _J , T _{STG}	-55 to 150	°C	Operating Temperature Range	T _J	-65 to 150	°C
Typical Thermal Resistance Junction to Lead	R _{WJL}	30	°C/W	Storage Temperature Range	T _{STG}	-65 to 175	°C
Typical Thermal Resistance Junction to Ambient	R _{WJA}	120	°C/W	Typical Thermal Resistance Junction to Lead	R _{WJL}	30	°C/W
				Typical Thermal Resistance Junction to Ambient	R _{WJA}	120	°C/W
Notes:				Notes:			
1. Non-repetitive current pulse, per Fig.4 and derated above T _A =25°C per Fig. 3.				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.				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.				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.				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: Add new note to indicate the peak pulse power of stack dice parts. The affected product as below

TVS	Current	single	Stack	Example(400W SMAJ)
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	

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°C	-55~150°C	-65~150°C	-65~175°C
SMAJ/P4SMA/SMA6J/SMA6L	-55~150°C	-55~150°C	-65~150°C	-65~175°C
SMBJ/P6SMB/SACB/1KSMB	-55~150°C	-55~150°C	-65~150°C	-65~175°C
SMCJ/1.5SMC/3.0SMC/4.0SMDJ	-55~150°C	-55~150°C	-65~150°C	-65~175°C
SMDJ	-55~150°C	-55~150°C	-65~150°C	-65~175°C
5.0SMDJ	-55~150°C	-55~150°C	-65~150°C	-65~175°C

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”

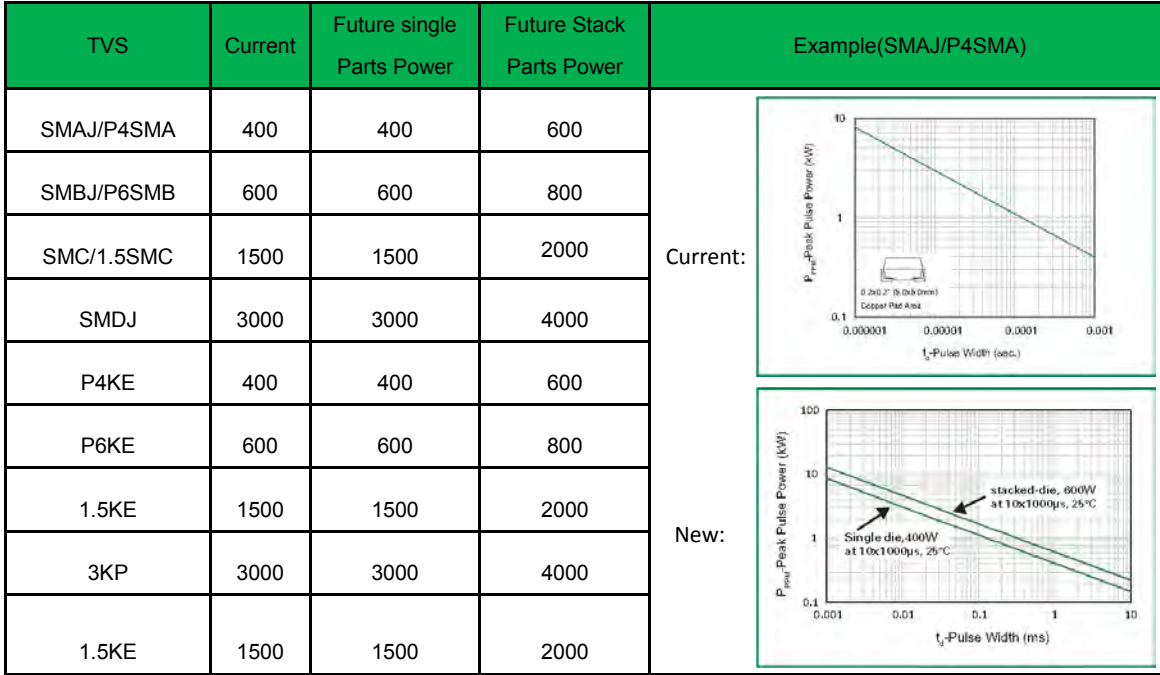
4.2 Features

Current		New	
<p>Features</p> <ul style="list-style-type: none"> • 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% 		<p>Features</p> <ul style="list-style-type: none"> • 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% 	
<ul style="list-style-type: none"> • 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 • $V_{BR} @T_j = V_{BR} @25°C \times (1 + \alpha T \times (T_j - 25))$ (αT:Temperature Coefficient) • Plastic package has underwriters laboratory flammability 94V-0 • Meet MSL level1, per J-STD-020, LF maximum 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 		<ul style="list-style-type: none"> • Fast response time: typically less than 1.0ps from 0V to BV min • High temperature to reflow soldering guaranteed: 260°C/40sec • $V_{BR} @T_j = V_{BR} @25°C \times (1 + \alpha T \times (T_j - 25))$ (αT:Temperature Coefficient, typical value is 0.1%) • Plastic package has underwriters laboratory flammability 94V-0 • Meet MSL level1, per J-STD-020, LF maximum 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 	

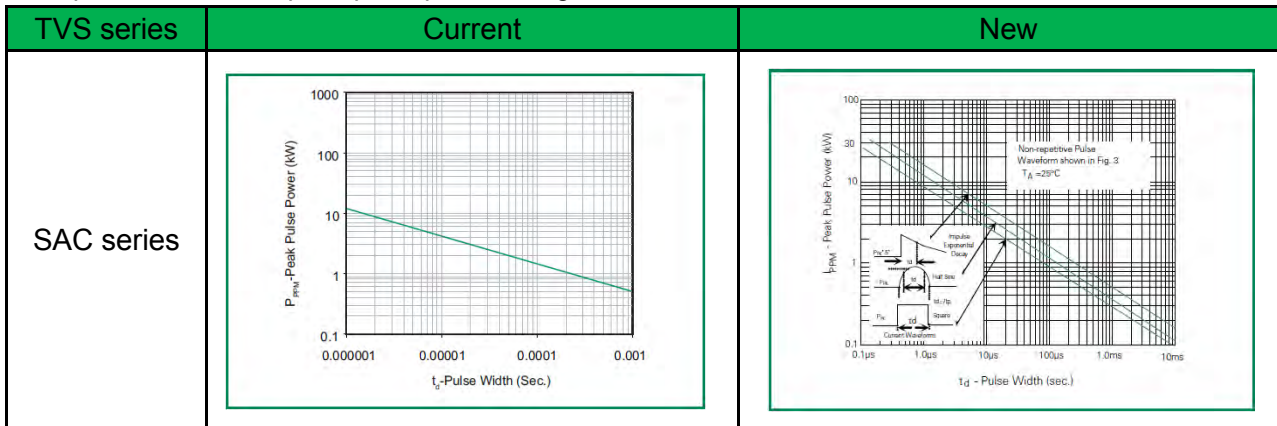
5. Figures

➤ Figure - Peak Pulse Power Rating Curve

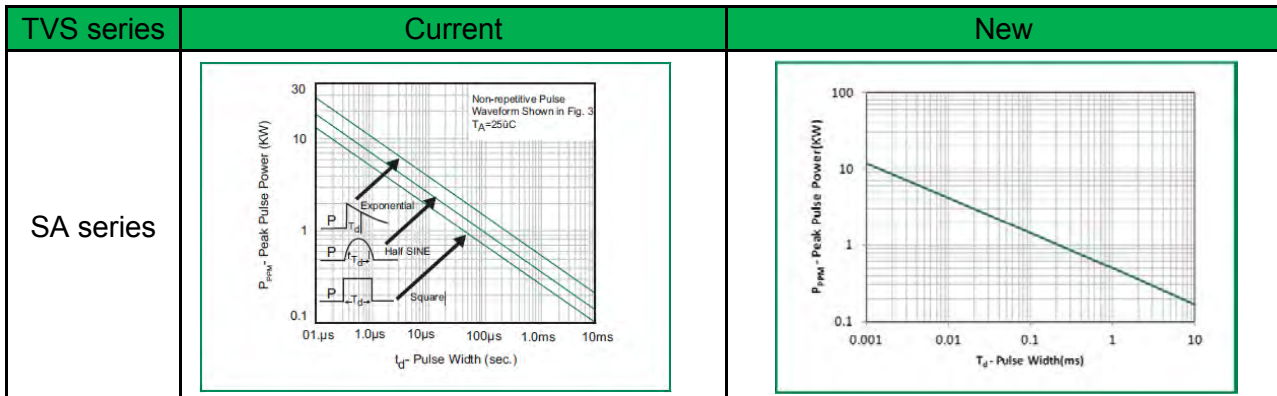
5.1 Add one curve to specify stack-die parts pulse power.



5.2 Update SAC series peak pulse power rating curve

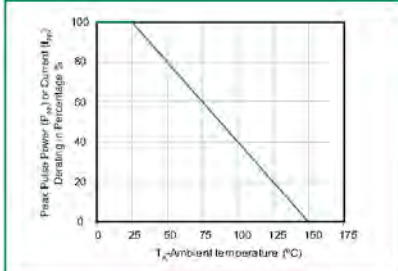
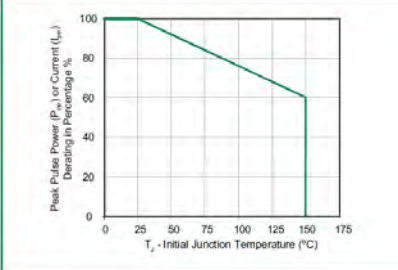


5.3 Update SA series peak pulse power rating curve.



➤ **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%	<p>Current:</p>  <p>New:</p> 
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%	
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%	

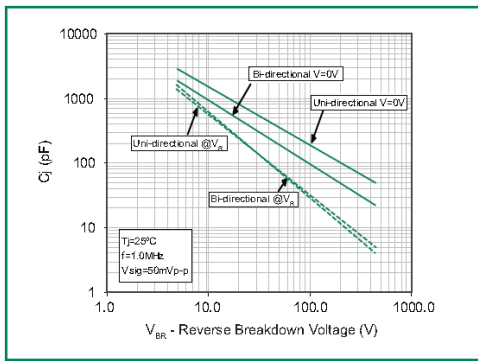
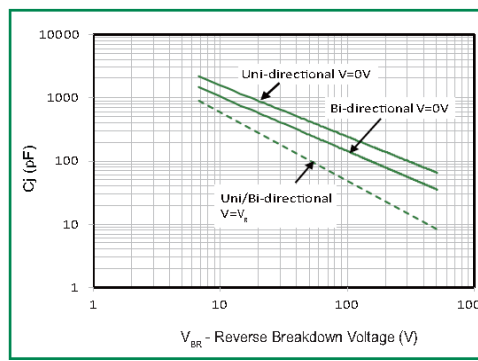
➤ **Figure - Typical Junction Capacitance**

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:

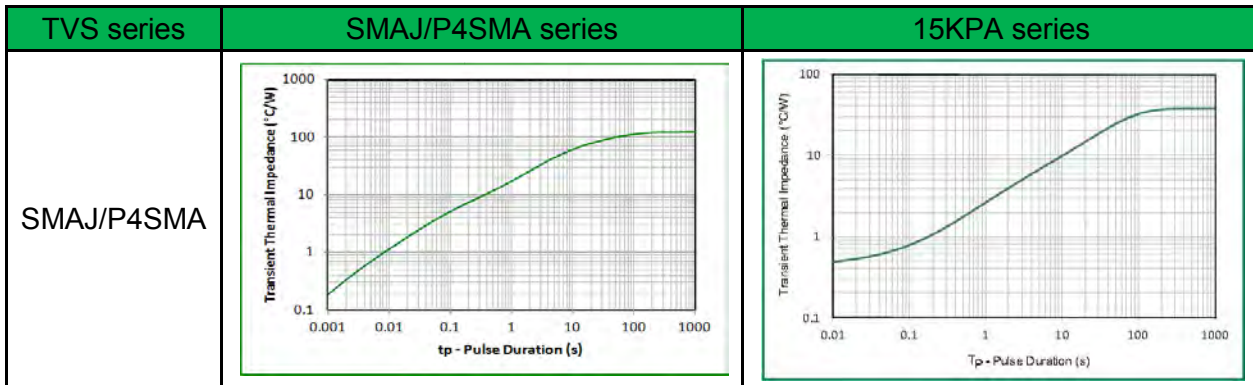
TVS	Package	Product series
Surface Mount TVS	SOD-123	SMF,
	DO-214AC	SMAJ,P4SMA,SMA6J,
	DO-221AC	SMA6L
	DO-214AA	SMBJ,P6SMB,1KSMB
	DO-214AB	SMCJ,1.5SMC,SMDJ,3.0SMC,4.0SMDJ,5.0SMDJ,
Axial Leads TVS	DO-41	P4KE,
	DO-15	SA,P6KE
	DO-201	1.5KE,LCE
	P600	3KP,5KP,15KPA,20KPA,30KPA

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:



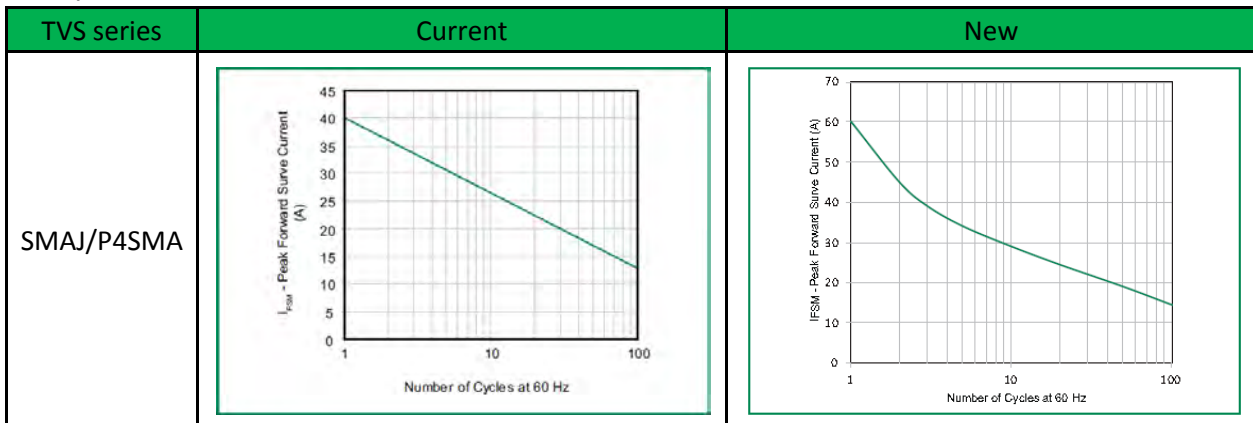
➤ Figure - Maximum Non-Repetitive Forward Surge Current Uni-Directional Only

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:



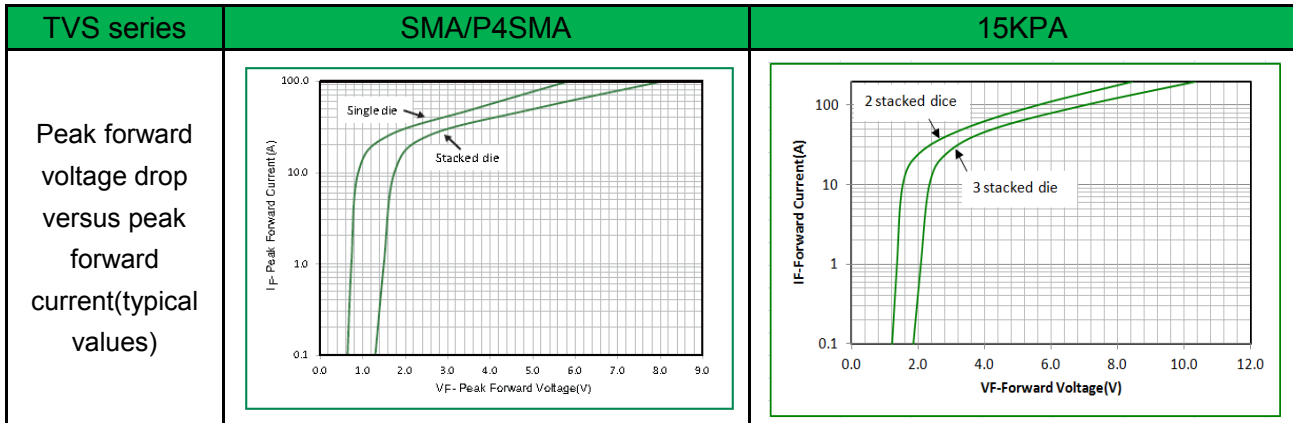
➤ **Figure - Peak forward voltage drop versus peak forward current (typical values)**

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:



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

Environmental Specifications		Environmental Specifications	
High Temp. Storage	JESD22-A103	High Temp. Storage	JESD22-A103
HTRB	JESD22-A108	HTRB	JESD22-A108
Temperature Cycling	JESD22-A104	Temperature Cycling	JESD22-A104
MSL	JEDEC-J-STD-020, Level 1	MSL	JEDEC-J-STD-020, Level 1
H3TRB	JESD22-A101	H3TRB	JESD22-A101
RSH	JESD22-B106	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 (mA)	Max. Clamping Voltage V _{CL} @ Peak Pulse Current (I _{PP})			Max. Temp Coefficient of V _{BR} (%/°C)	Max. Capacitance 0 Bias 10kHz (nF)	Agency Approval 
					Min Volts	Max Volts		V _{CL} Volts	I _{PP} (8/20μS) (A)	I _{PP} (10/350μS) (A)			
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
 TVS Product Engineer
 Littelfuse Semiconductor (Wuxi) Co., Ltd.

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