Infineon ESD Review

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August 2019

Agenda

1. IFX ESD Infrastructure
2. CSP Packaging Overview
3. ESD Portfolio and Product Roadmap
4. ESD Technology Concepts
5. Simulation/ Modelling
6. Linearity of ESD Introduction
7. Appendix: Product Briefs

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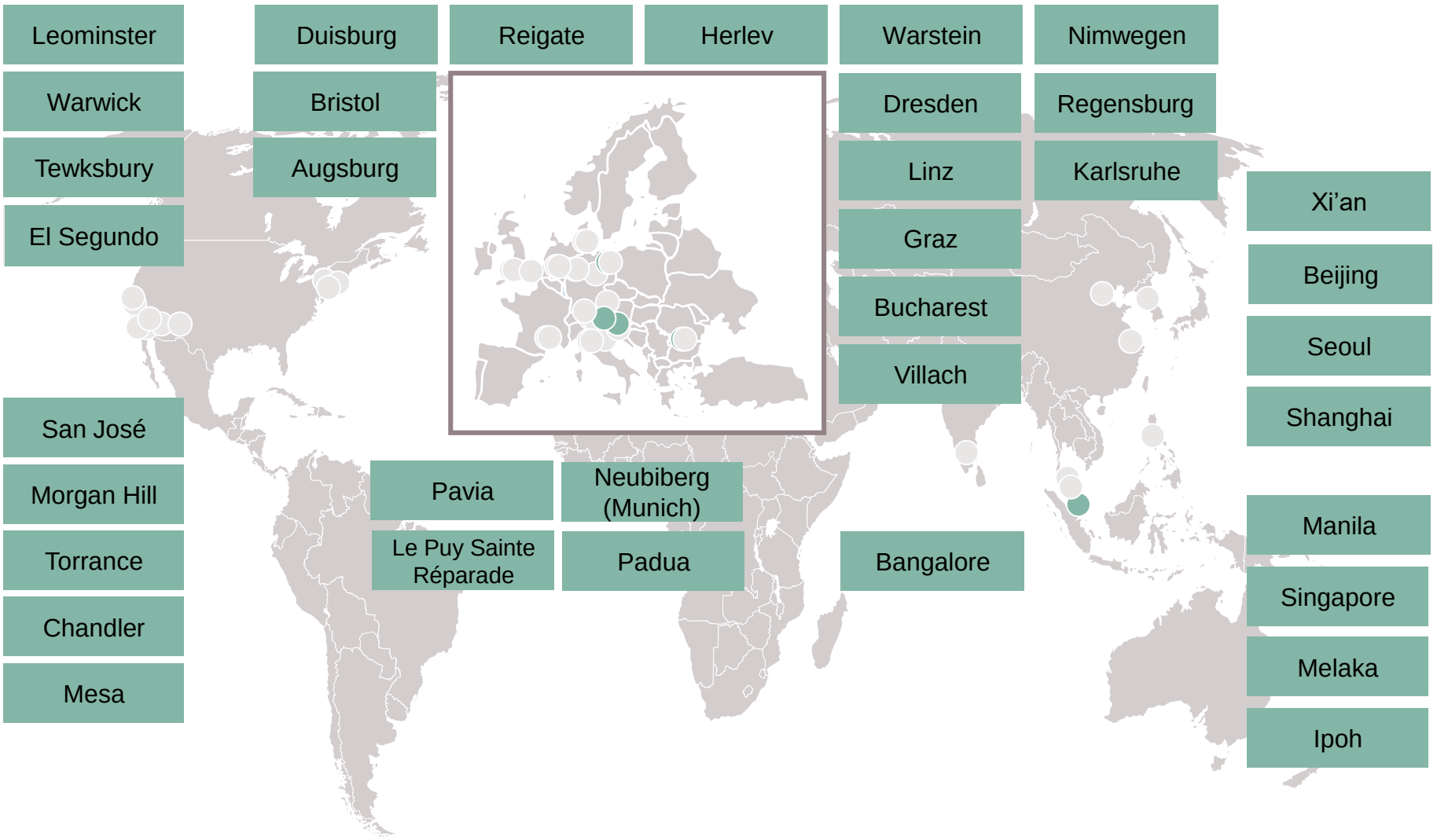
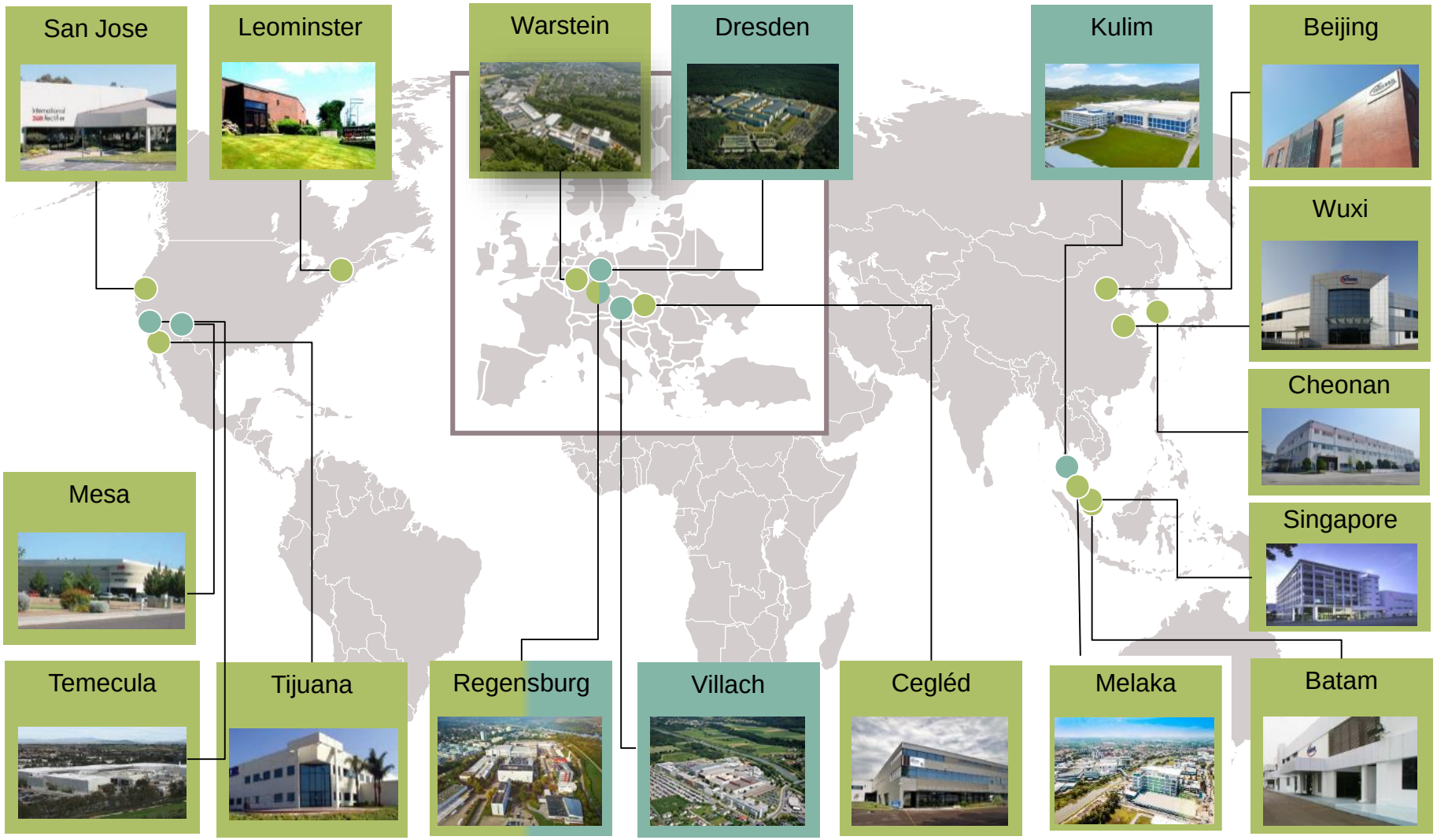
Our global R&D network



Status: April 2019

Worldwide manufacturing sites frontend and backend



Status: 30 April 2018

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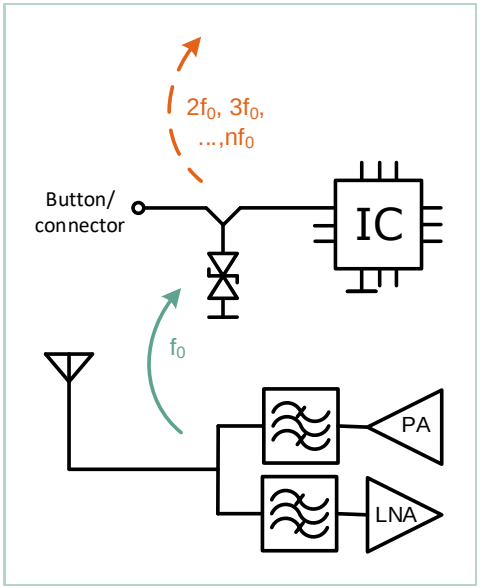
Infineon Protection Technology

Core Principals

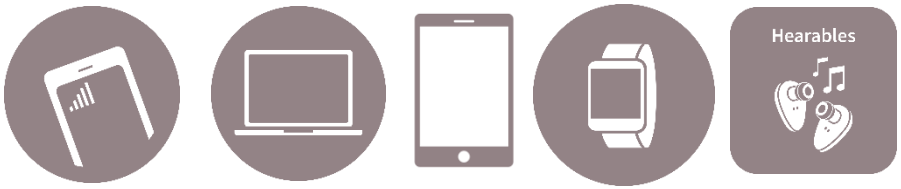
- Strong Clamping performance
- Strong technology competence
- High Volume Capacity / Industry Leading Quality
- Strong Customer Support
- Focus on Mobile Application requirements
  - E.g.- linearity almost exclusively of concern in mobile applications for protection
  - E.g.- emerging need for strong protection on Main Antenna



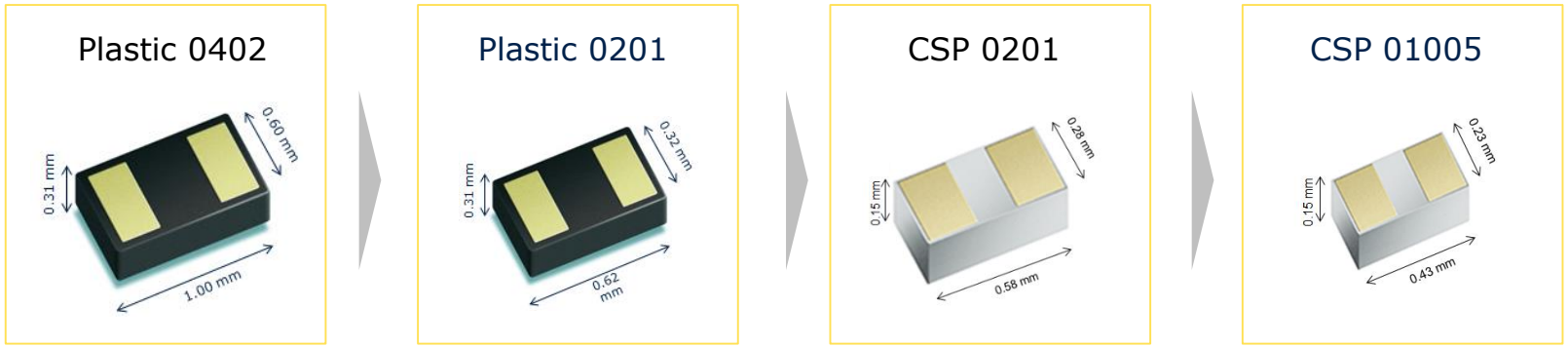
Mobile Technology Development Focus

- Super small packaging : 01005
- New Surge Developments
- Performance innovation
  - For USB 3.x and beyond

SUPERSPEED+ CERTIFIED USB 10 Gbps



Infineon Commitment to CSP

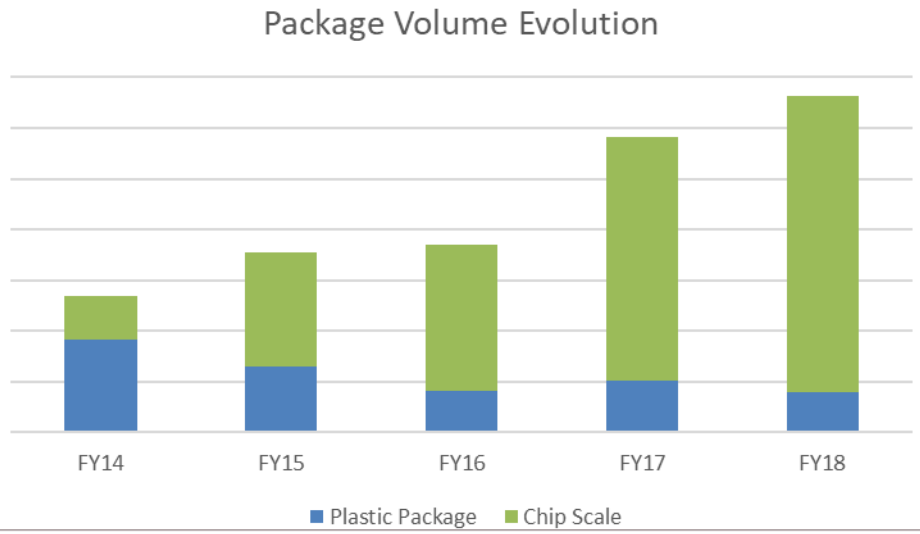


From Zero to 9B pcs / Year Production in under 6 Years

Introduced 2 devices in 2013 and entered Mass Production

Transition from plastic to CSP accelerates

~90% Infineon Volume now in CSP with over 40 part numbers



Next Steps for ChipScale Package

Miniaturisation & High Volume Supply

From Plastic to CSP

Kaizen Next Steps

- Increased break strength
- Reduced Thickness
- Reduced Waste & Storage Space
- Increased # I/O (3,4, etc pads)
- Topside Identification

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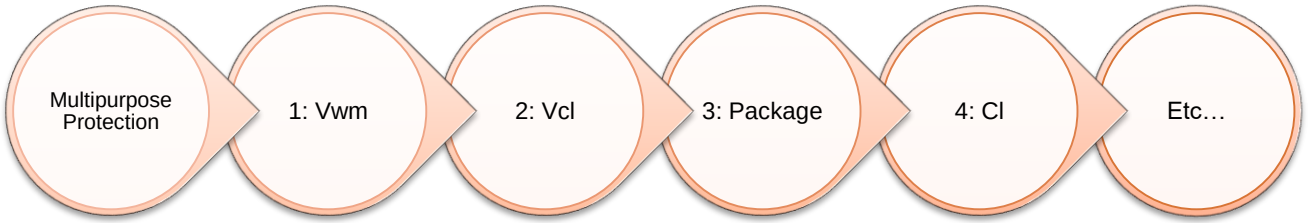
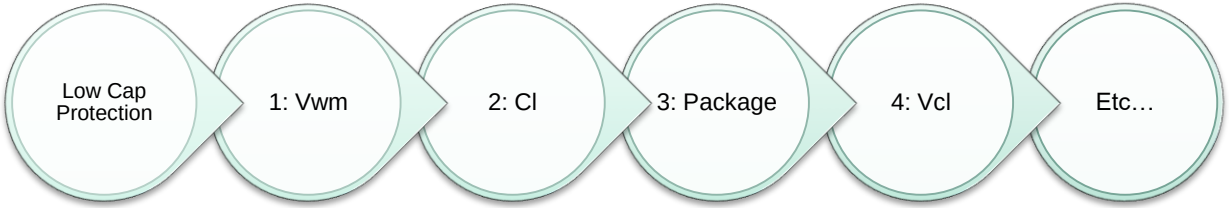
Infineon ESD Protection… High Level View

Two Main Categories
… and key specs



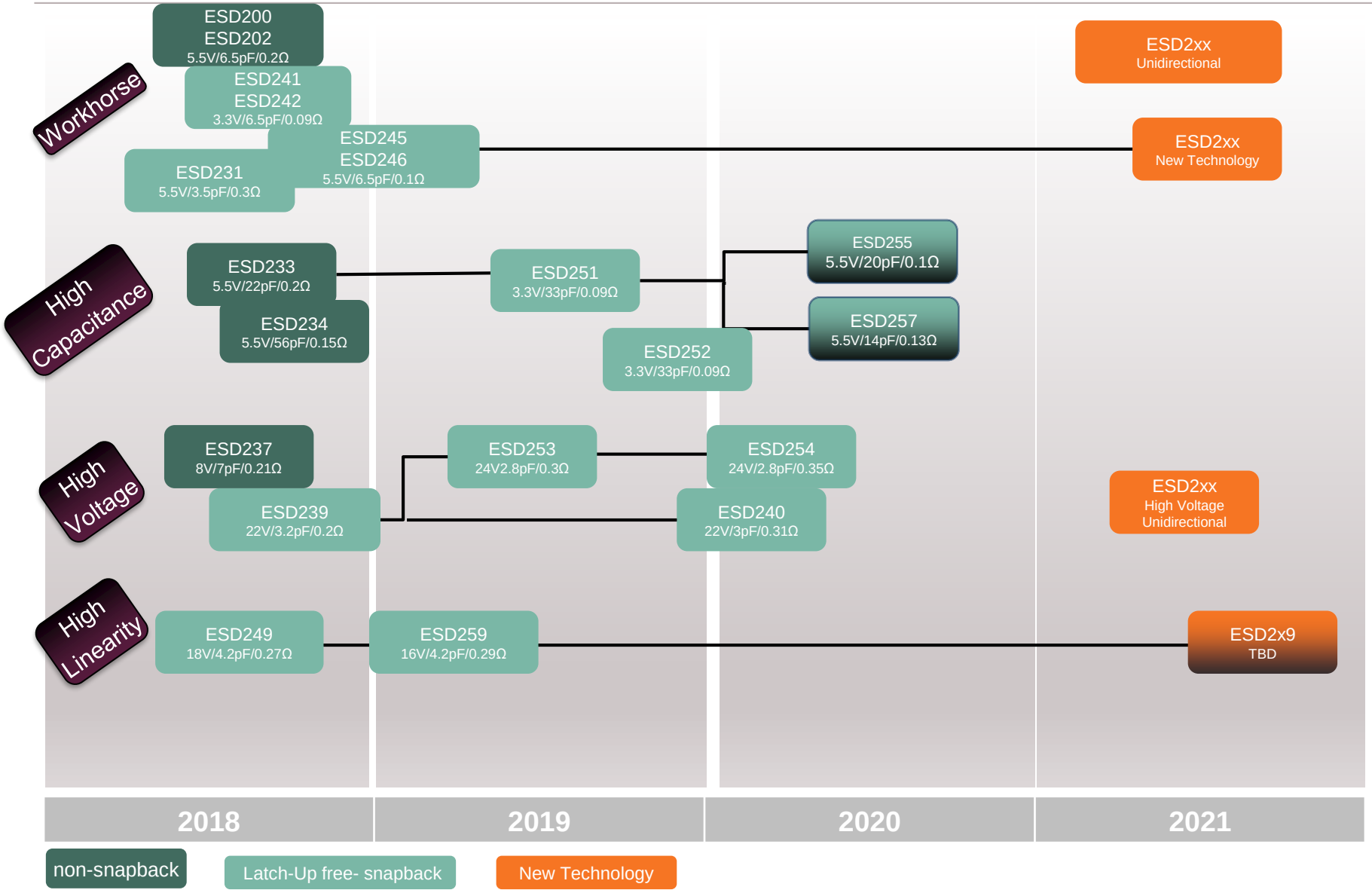
Buttons, switches, low speed I/O, touch panel, audio, etc…

High Speed I/O (USB 3, TBT, HDMI, DisplayPort… RF Antenna port

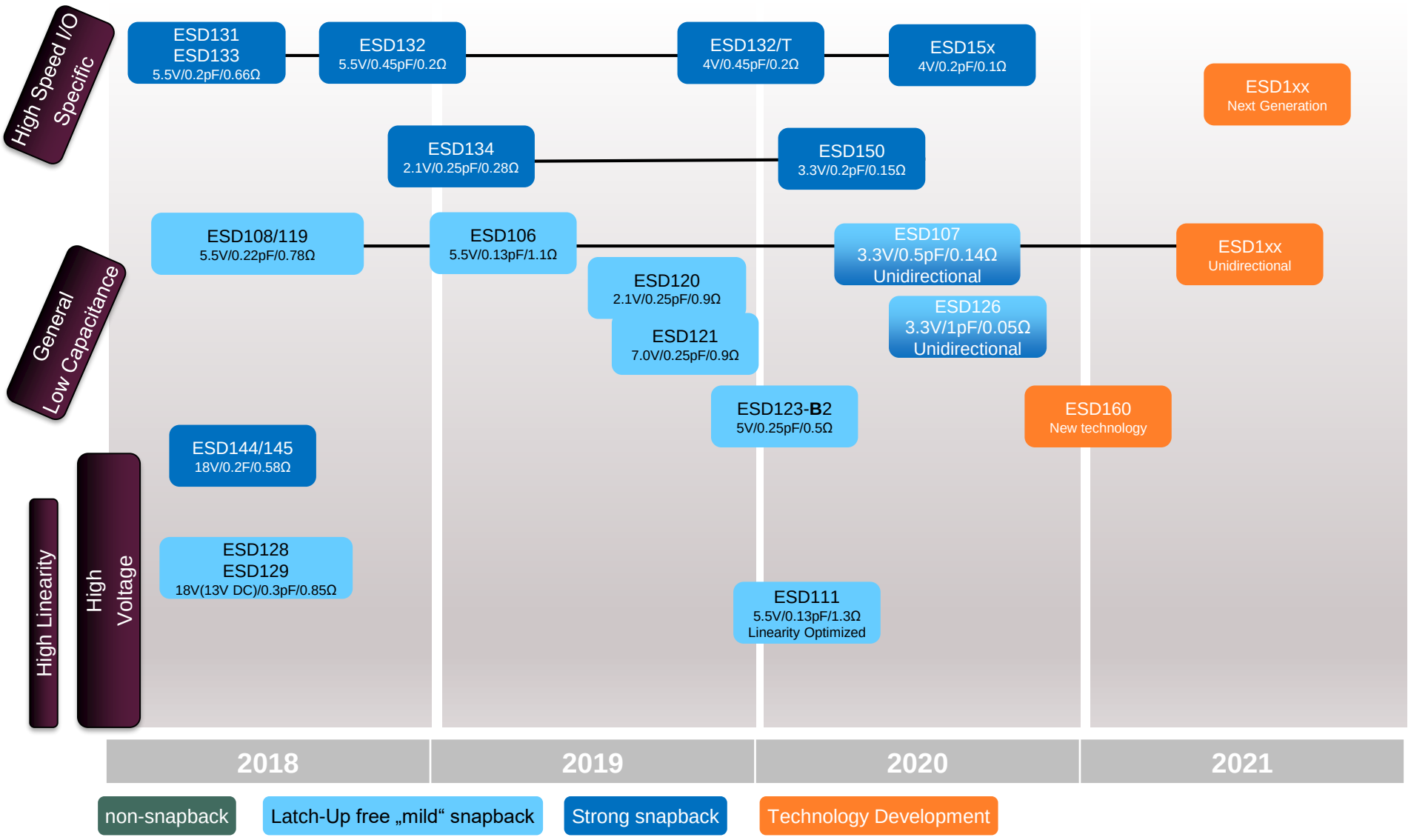


Etc… = polarity, leakage, linearity, snapback, surge…

Multipurpose Protection Roadmap



Low Cap Protection Roadmap



IFX TVS protection solutions-
Attractive expanded portfolio: Low Cap Products

	Infineon Part Name	Package Size	lines	V_{WM} [V]	V_{clamp} [V]	R_{Dyn} [Ω]	C_L [pF]	ESD contact [kV]	I_{surge} [A]	$I_{L,max}$ [nA]	QS	RU	Remark
Low Cap	ESD106-B1-W0201	0201	1	±5.5	25	1.1	0.13	±12	2	20	✓	✓	ESD101 replace
	ESD108-B1-CSP0201	0201	1	±5.5	20	0.78	0.28	±18	2.5	20	✓	✓	
	ESD111-B1-W0201	0201	1	±5.5	30	1.3	0.13	±12	2	20		tbd	
	ESD119-B1-W01005	01005	1	±5.5	20	0.80	0.2	±25	2.5	20	✓	✓	Mini ESD108
	ESD128-B1-W0201	0201	1	±18	32	0.85	0.3	±15	2	30	✓	✓	
	ESD129-B1-W01005	01005	1	±18	32	0.82	0.3	±15	2	30	✓	✓	
	ESD120-B1-W0201	0201	1	±2.1	24	0.9	0.25	±15	tbd	10	✓	✓	
	ESD121-B1-W0201	0201	1	±7	24	0.9	0.25	±15	tbd	200	✓	✓	
	ESD123-B2-W0201	0201	1	±5	15	0.5	0.25	±20	tbd	200	tbd	tbd	0201 array
	ESD131-B1-W0201	0201	1	±5.5	13	0.66	0.23	±20	3	100	✓	✓	
	ESD132-B1-W0201	0201	1	±5.5	7	0.2	0.45	±20	10	100	✓	✓	Low Vcl, Low C
	ESD132-B1-T0201	0201	1	±4	7	0.2	0.45	±20	10	50	Mid 19	Tbd	Thick CSP
	ESD133-B1-W01005	01005	1	±5.5	13	0.56	0.2	±20	3	100	✓	✓	Mini ESD131
	ESD134-B1-W0201	0201	1	±2.1	8.3	0.28	0.3	±20	8	100	✓	✓	USB 3.1
	ESD144-B1-W0201	0201	1	±18	12.5	0.58	0.2	±18	3.5	20	✓	✓	NFC
	ESD145-B1-W01005	01005	1	±18	12.5	0.58	0.2	±18	3.5	20	✓	✓	NF
	ESD107-U1-W0201	0201	1	3.3	3.7	0.14/0.14	0.45	±15	tbd	10	1Q 2020	2Q 2020	0.45pF Unidirectional
	ESD126-U1-W0201	0201	1	3.3	2.8	0.05 / 0.05	1	±30	tbd	100	1Q 2020	2Q 2020	1pF unidir. Deep snapback
	ESD150-B1-W0201	0201	1	±3.3	5.3	0.15	0.2	±15	tbd	10	1Q 2020	2Q 2020	USB3.1, deep snapback, new

IFX TVS protection solutions-
Attractive expanded portfolio: Multi-Purpose Products

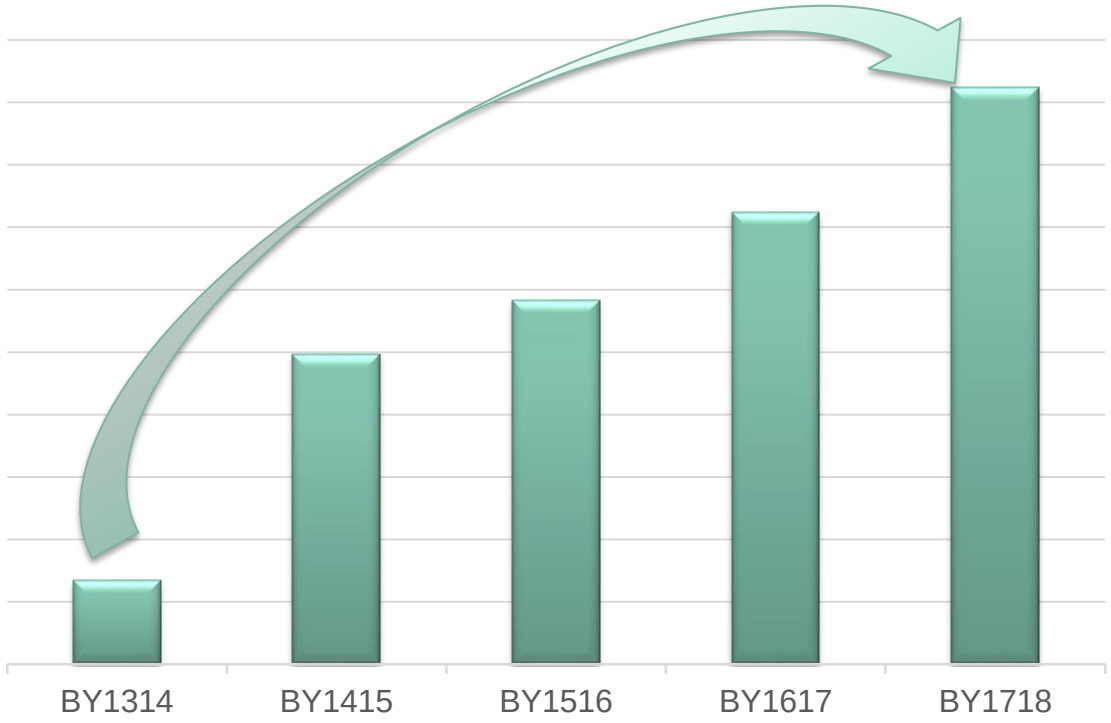
	Infineon Part Name	Package Size	Lines	V_{WM} [V]	V_{clamp} [V]	R_{Dyn} [Ω]	C_L [pF]	ESD contact [kV]	Isurge [A]	$I_{L,max}$ [nA]	QS	RU	Remark
Multi-Purpose	ESD200-B1-CSP0201	0201	1	±5.5	13	0.20	6.5	±17	3	100	✓	✓	
	ESD202-B1-CSP01005	01005	1	±5.5	13	0.20	6.5	±15	3	100	✓	✓	
	ESD231-B1-W0201	0201	1	±5.5	12	0.30	3.5	±30	12	20	✓	✓	
	ESD233-B1-W0201	0201	1	±5.5	13	0.20	33	±20	5	100	✓	✓	High Cap
	ESD234-B1-W0201	0201	1	±5.5	13	0.20	56	±25	3	100	✓	✓	High Cap
	ESD237-B1-W0201	0201	1	±8	13	0.21	7	±16	3	100	✓	✓	High Vrwm
	ESD239-B1-W0201	0201	1	±22	27	0.27	3.2	±16	3	100	✓	✓	
	ESD240-B1-W01005	01005	1	±22	27	0.3	3	±16	3	100	✓	10/19	Mini ESD239
	ESD241-B1-W0201	0201	1	±3.3	6.5	0.09	6.5	±18	4.5	30	✓	✓	
	ESD242-B1-W01005	01005	1	±3.3	6	0.09	6	±18	4.5	30	✓	✓	
	ESD245-B1-W0201	0201	1	±5.5	7.5	0.1	5.8	±15	5.5	30	✓	✓	
	ESD246-B1-W01005	01005	1	±5.5	7.5	0.1	5.5	±15	5.5	30	✓	✓	
	ESD249-B1-W0201	0201	1	±18	23.5	0.27	4.2	±16	3	100	✓	✓	
	ESD251-B1-W0201	0201	1	±3.3	6	0.09	33	±25	8	100	✓	✓	Low Vcl, High C
	ESD251-B1-T0201	0201	1	±3.3	6	0.09	33	±25	8	100	Mid 19	Tbd	Thick CSP
	ESD252-B1-W01005	01005	1	±3.3	6	0.09	33	±25	8	100	✓	3Q/19	Low Vcl, High C
	ESD253-B1-W0201	0201	1	±24	31	0.35	2.8	±15	3	100	✓	✓	ESD218 replace
	ESD254-B1-W01005	01005	1	±24	31	0.35	2.7	±15	3	100	tbd	tbd	Small ESD253
	ESD255-B1-W0201	0201	1	±3.3	6	0.09	20	±25	7	100	Mid 19	Tbd	Low Vcl, High C
	ESD259-B1-W0201	0201	1	±16	24	0.27	4.2	±16	3	500	✓	✓	
	ESD257-B1-W0201	0201	1	±5.5	7.5	0.1	14	±30	Tbd	Tbd	Tbd	Tbd	
	ESD2xx-U1-W0201	0201	2	5.5	7.5	0.1	5.0	±15	5.5	30	1H 2020	2H 2020	Unidirectional

Low Speed I/O, Audio, Buttons, Touch Screen, etc…

CSP Capacity Historical Development

Production Volume Requirements for Protection Devices can …

- Be Rather Large
- Have Short Lead Times



Huge increase in dedicated Protection CSP capacity since introduction

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Next Gen CSP

Key Performance Leap

Capacitance (C_L):

- Low ohmic path introduction
- Active device thickness reduction

Clamping (V_{CL})

- Precise control of critical geometry

No SMT process impact
Proof of concept in hand

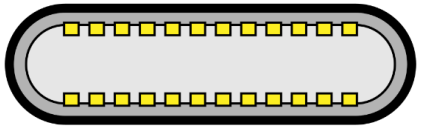
USB-C 3.1 > 3.2 > 4 (Thunderbolt 3)
Specs & Products

	USB3.1 system requirements (for hubs)	TBT 3 - USB 4	ESD131	ESD134	ESD150
C_L [pF]@2.5GHz	≤ 0.3	Tbd	0.22	0.26	0.2
V_{Cl} [V] @ 8A	<5	Tbd	8.5	5.8	4.2
V_{Cl} [V] @ 16A		Tbd	13	7.7	5.3
V_{wm} [V]	>0.6	Tbd	±5.5	±2.1	±3.3
Overshoot [V] @16A			62	68	42
Availability			MP	MP	Q2/2020

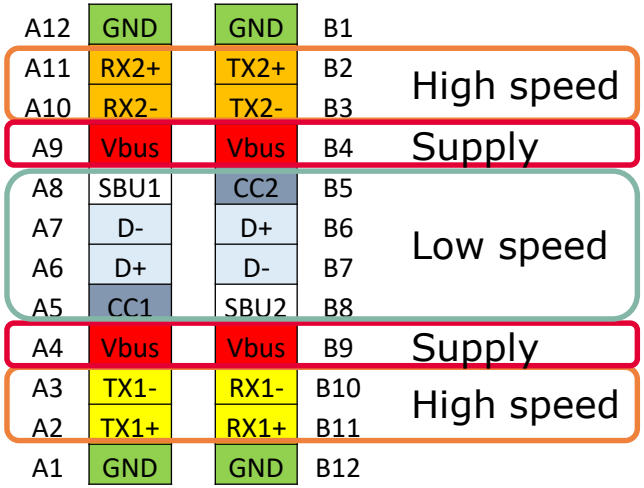
Application Implementation Topics

- Spec confirmation (C_L, V_{Cl}, V_{wm}, current for V_{Cl}, Overshoot, others)
- Future USB Generations- when ….

Focus Application
USB type-C (USB 3.2, Thunderbolt 3)



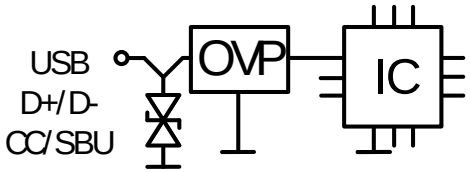
- CC – Configuration Channel used in the discovery, configuration and management of connections across a USB Type-C cable
- SBU – sideband use pins, used in in *Alternate* Modes and *Accessory* Modes (Audio Adapter, ...)
- V_{bus} – supply lines, with up to 22-24V voltage and up to 5A current capability
  - Risk of high voltage DC event on data lines due to malfunction
  - Overvoltage protection can be a requirement



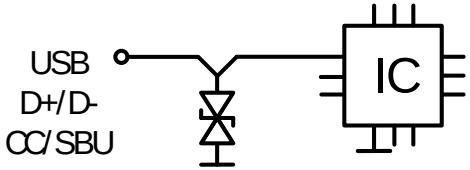
	Signaling	TVS requirements
High speed (Rx, Tx)	USB 3.2 G2: **10 Gbps, 1.2 V max** TBT 3: **20 Gbps, <1V**	lowest capacitance lowest clamping
Low Speed (D+, D-, CC, SBU)	USB 2.0: **480 Mbps, 5.5V** Audio Adapter Accessory: **-3..+3V**	high robustness (increasingly: surge) capacitance less important
Supply (Vbus)	**5.5V** typical up to **22V** for fast charging/power delivery	capacitance unimportant high surge robustness high operating voltage for PD

USB type-C protection trends: Low-Speed lines

- USB Power Delivery/Fast charging becomes mainstream
- Claimed correlation between surge robustness and failure rates
  - **I_{PP} requirement increase**: 10A → 20A → 30A in 0201 package
- Voltage up to 22-24V in same cable as data lines, with up to 5A current capability
  - **Risk of high voltage DC event on data lines due to malfunction**
  - Overvoltage protection can be a requirement



- TVS must “ignore” overvoltage
- $V_{WM} > V_{bus}$
  - 18V, 24V

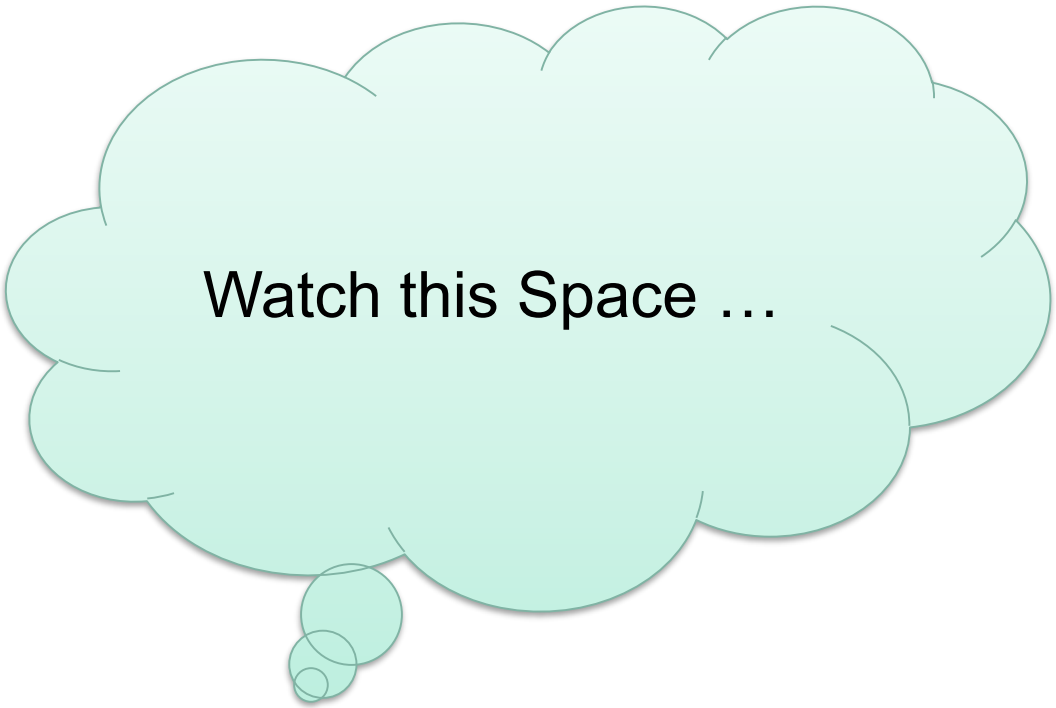


- Overvoltage handled by TVS
- V_{WM} tailored to signal
  - 3.3V, 5.5V

USB type-C protection trends
High-Speed lines: SSRx/SSTx

- Extremely sensitive to ESD strikes/overvoltage
  - Clamping voltage requirement down to 6-5V
- Very tight margin for load capacitance
  - C_L down to 0.3-0.2pF
  - For USB4, possibly even lower
- Surge/OVP considerations secondary to clamping and capacitance

Dedicated high Surge Lineup



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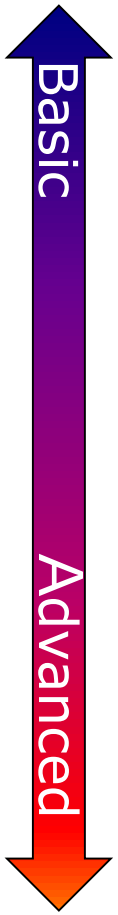
TVS Spice modeling

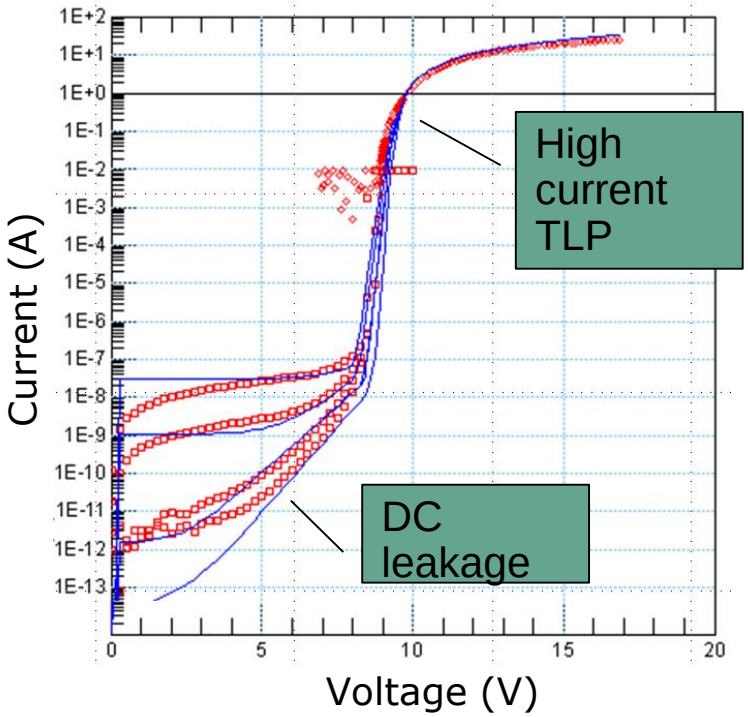
Modeled property:	Purpose:
Low current IV characteristics, incl. temperature dependence	ESD design check, leakage current requirements
CV characteristics	Insertion loss, signal integrity, EMC/EMI



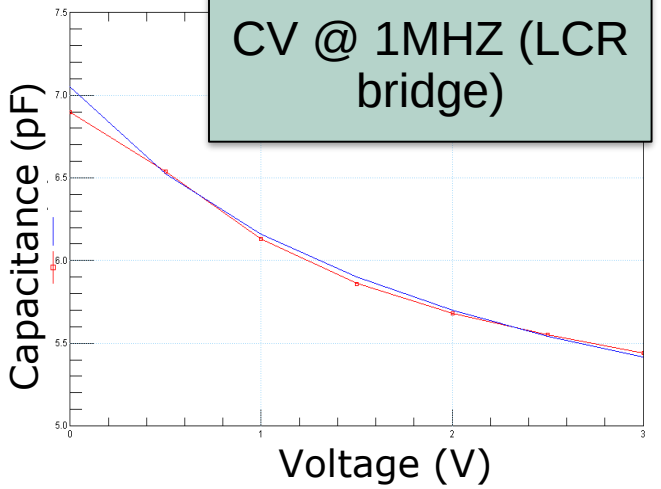
Ideally a TVS Spice model includes all!

Modeling using subcircuit models

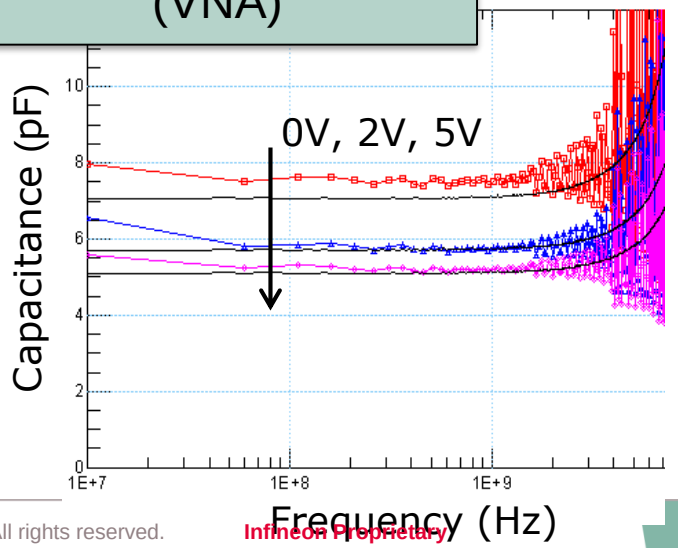
IV incl. T-dep. leakage current and high current TLP



CV @ 1MHZ (LCR bridge)

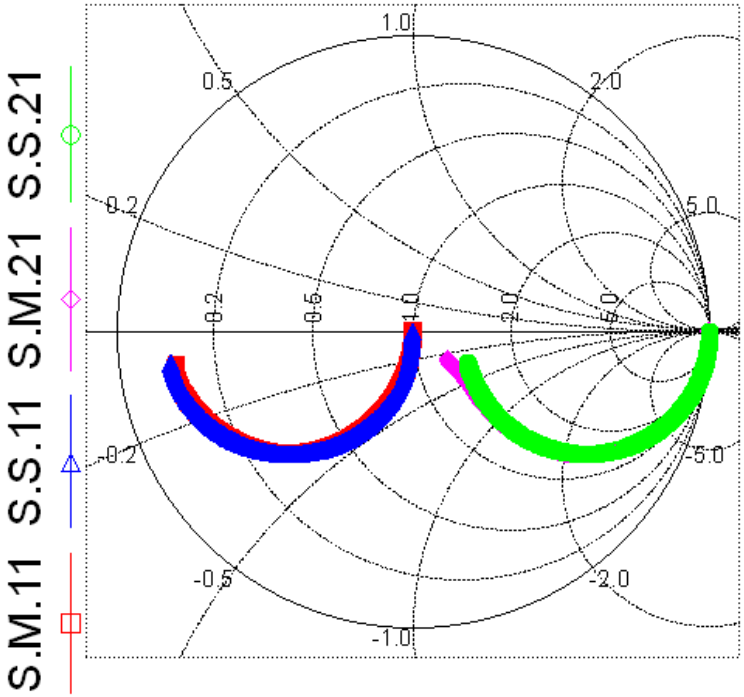


C vs. freq and V (VNA)

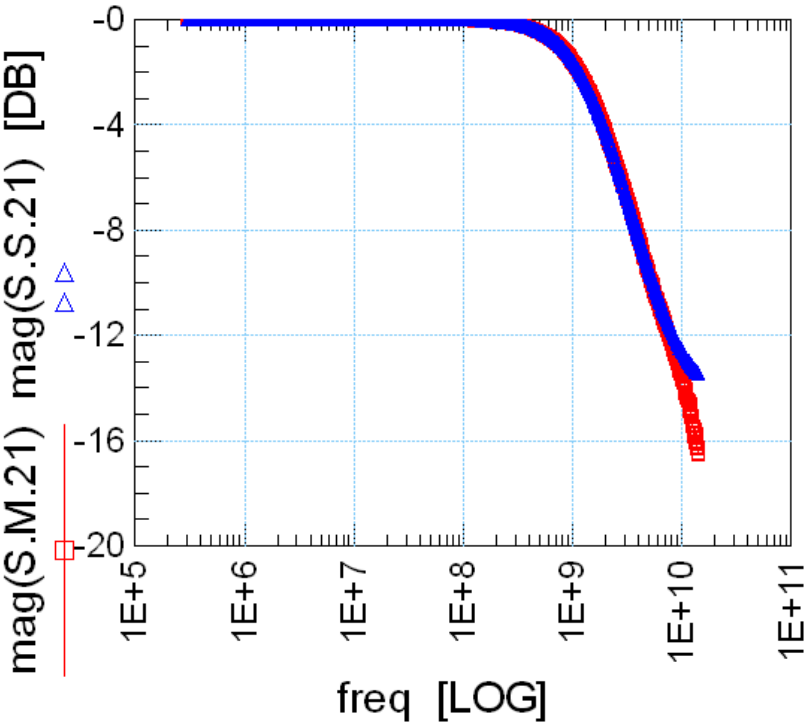


Modeling using subcircuit models

S11/S21 of TVS in shunt configuration



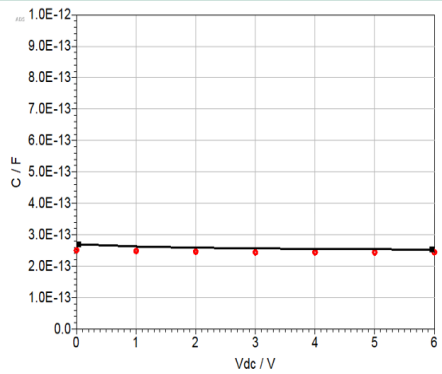
Insertion loss of TVS in shunt configuration



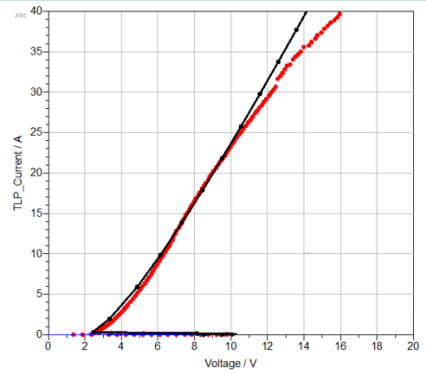
Advanced TVS modelling

Low Cap Thyristors ESD131, 133, 134 (strong snap back)

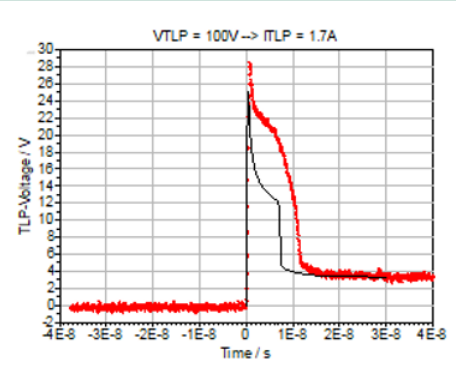
Simulation vs. Measurement (examples from ESD134-B1-W0201)

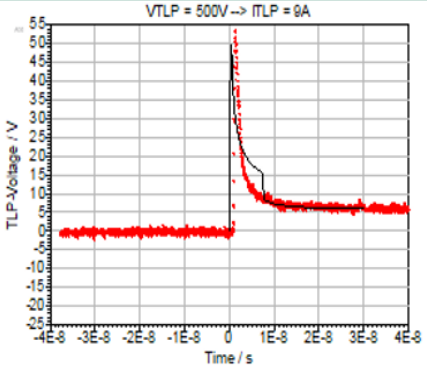


C-V



TLP I-V

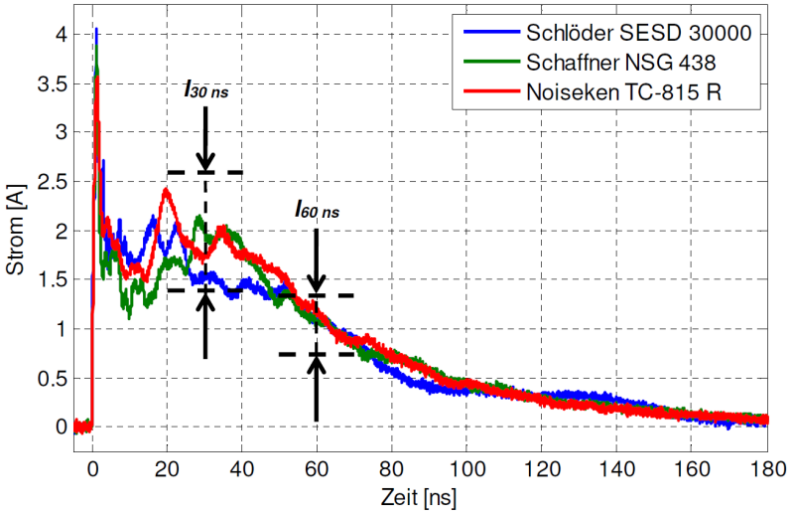


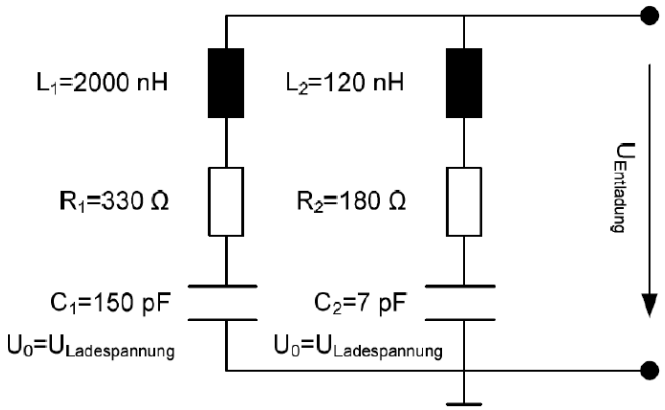


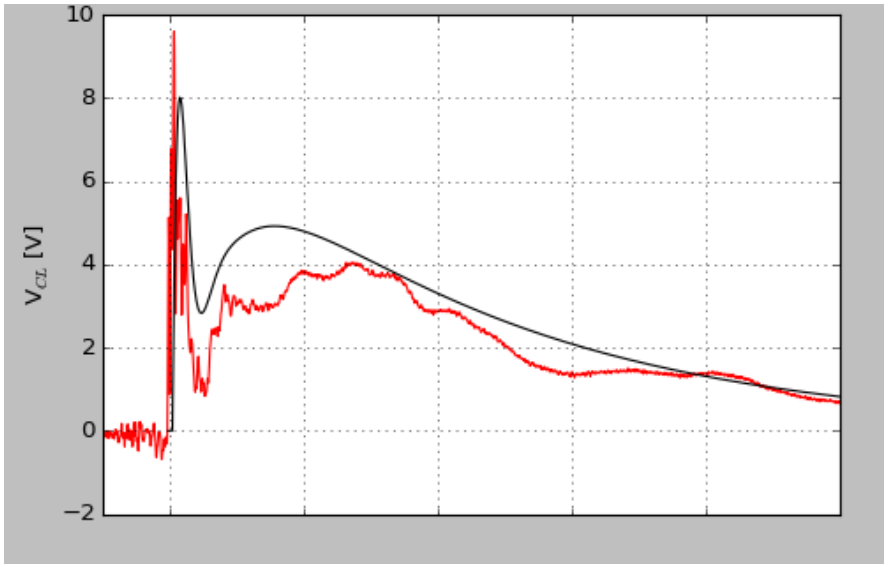
TLP Voltage Overshoot

Type (version)	DC I-V	TLP I-V	TLP Over-shoot	RF S-Para.	C-V	Thermal behavior	Linearity	Rise / Fall Time	Eye diagram
ESD134 (09/18)	good	good	bad	medium	medium	open	open	open	open
ESD134 (03/19)	good	good	medium	good	good	medium	medium	open	open
ESD131 (03/19)	medium	good	good	medium	good	medium	medium	open	open
ESD133 (03/19)	medium	medium	good	good	good	medium	medium	open	open

IEC61000-4-2 ESD Gun model



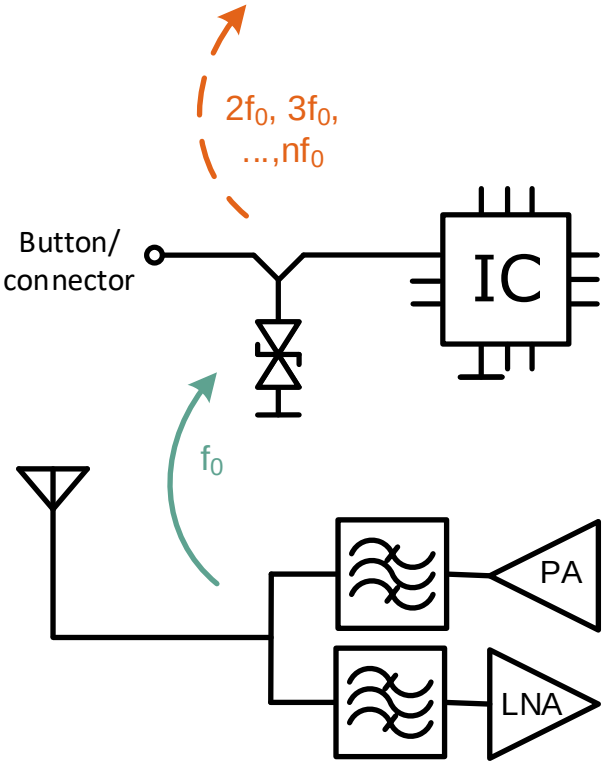




Agenda

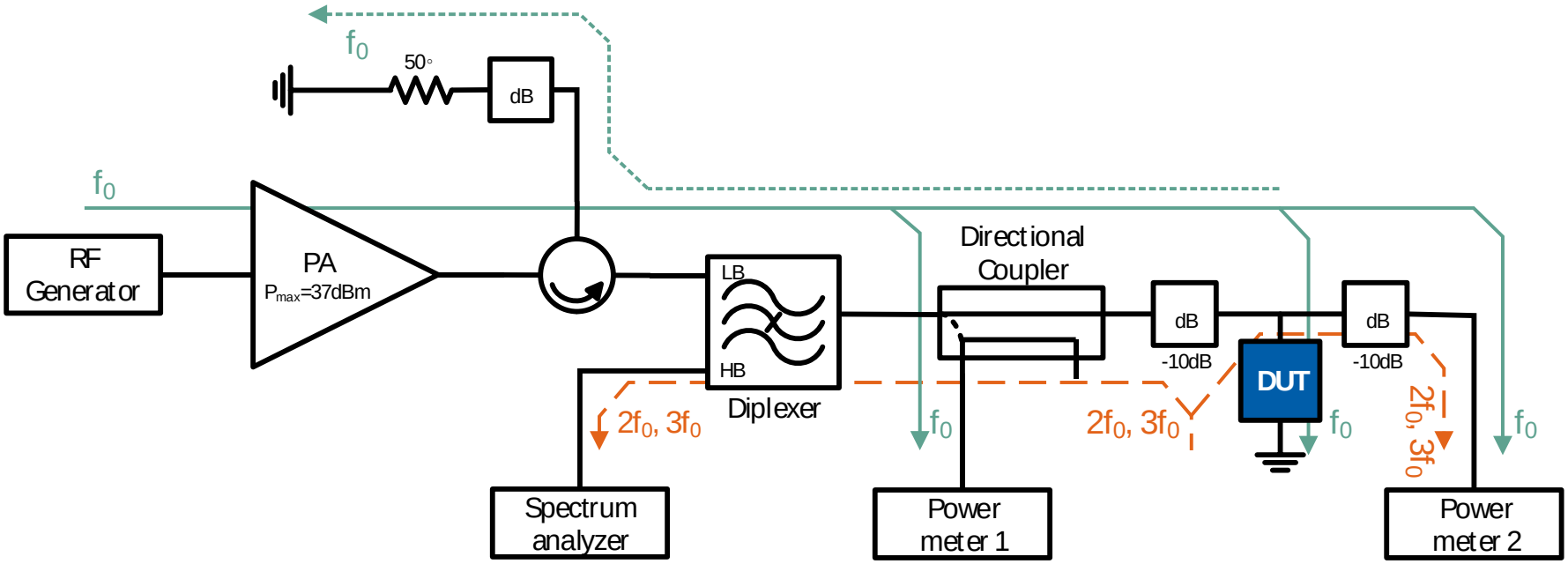
1. IFX ESD Infrastructure
2. CSP Packaging Overview
3. ESD Portfolio and Product Roadmap
4. ESD Technology Concepts
5. Simulation/ Modelling
6. Linearity of ESD Introduction
7. Appendix: Product Briefs

Introduction

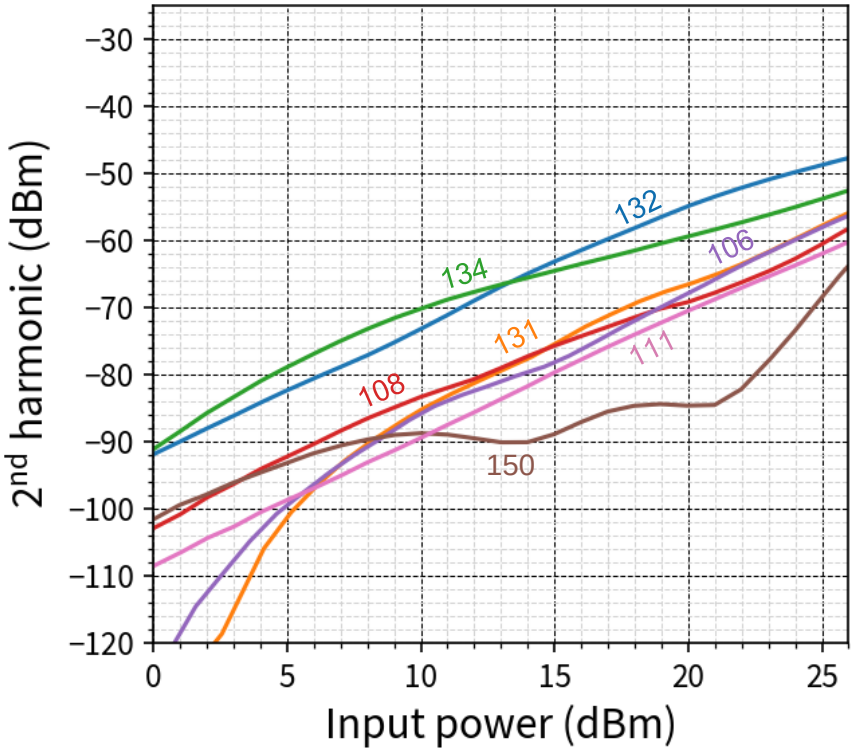


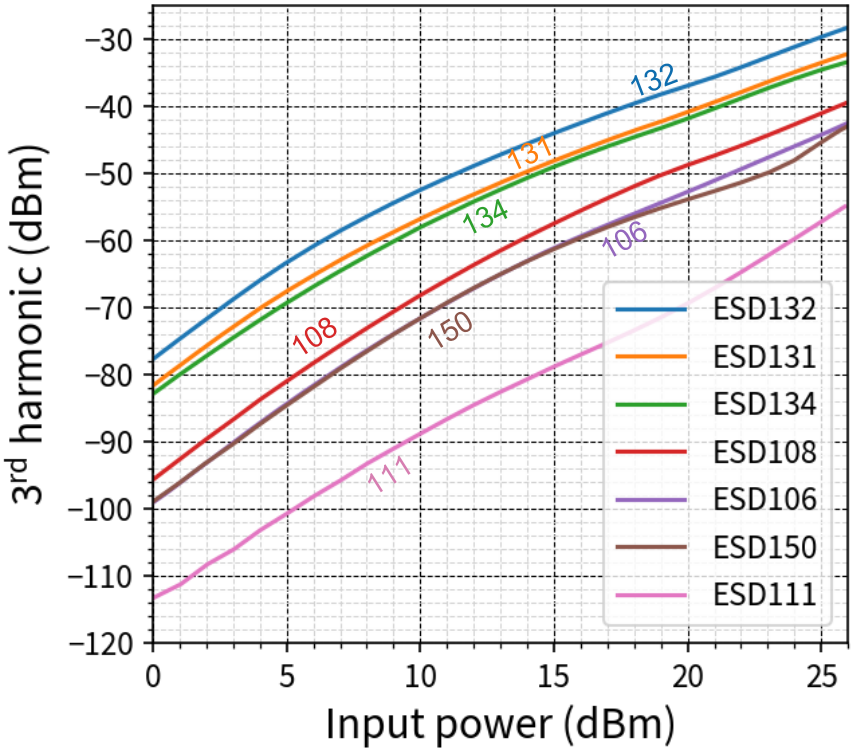
- Multi-band transmitters and receivers become commonplace in mobile devices
- Electromagnetic interference (EMI) and compatibility (EMC) grow in importance
- Requirements for harmonic generation get stricter
- Highly linear ESD protection devices from Infineon
  - Keep harmonic generation low
  - Protect sensitive components

Measurement setup

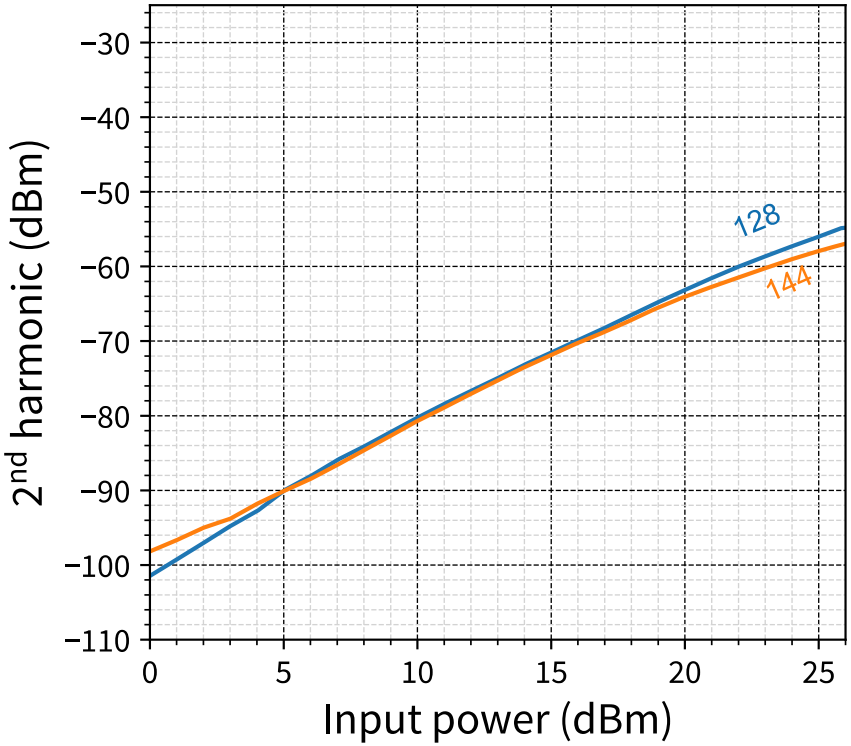


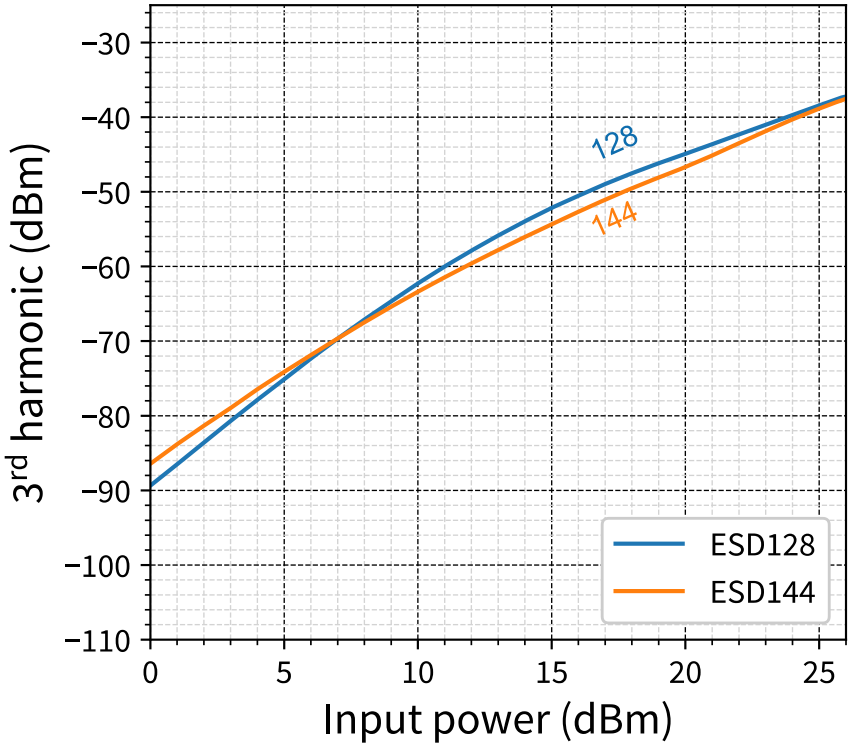
Low capacitance ESD protection devices with $V_{WM} \leq 5.5V$



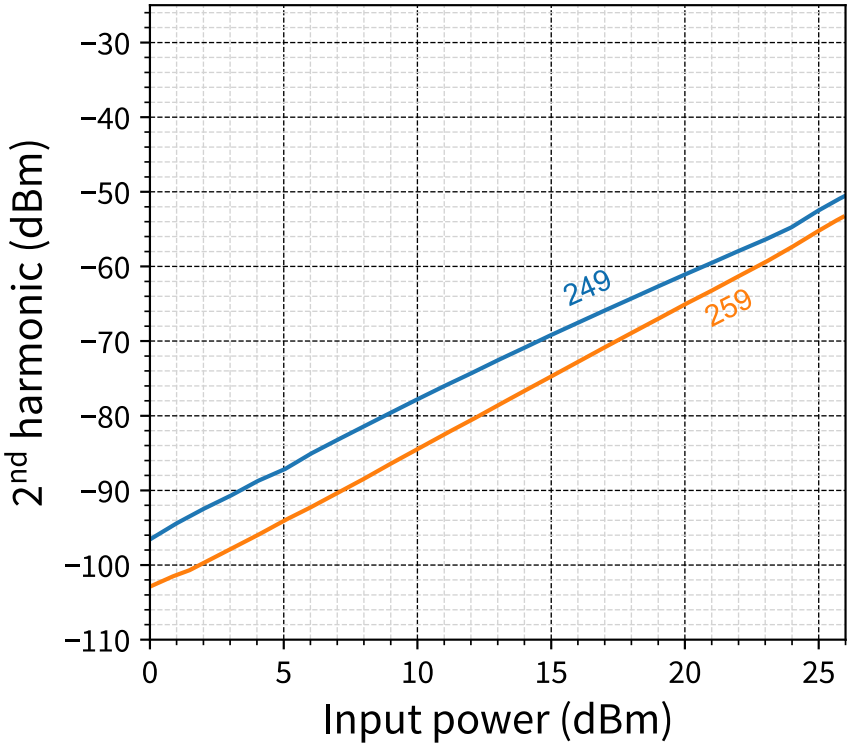


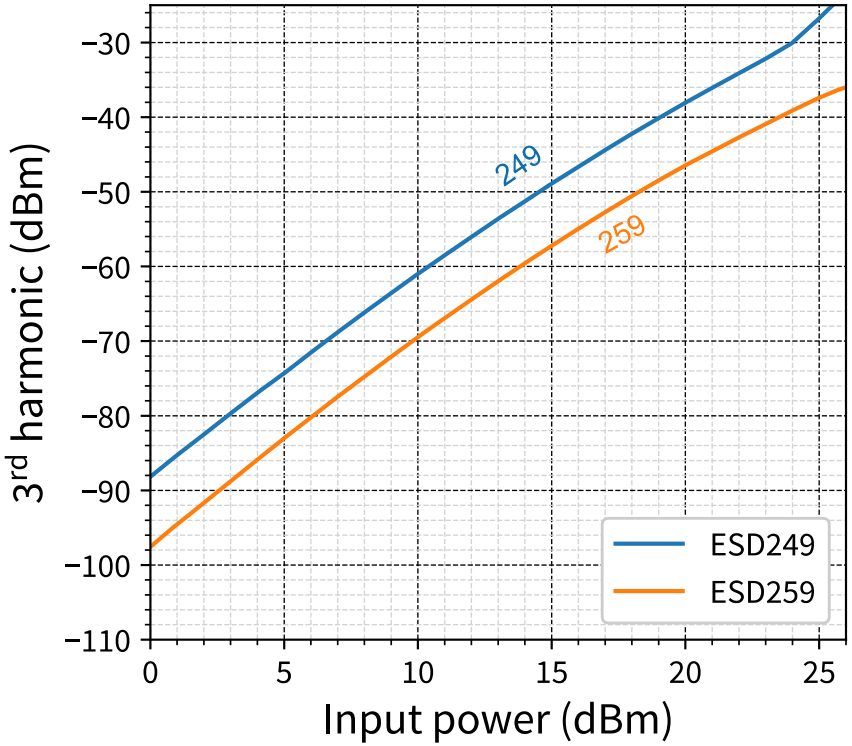
Low capacitance ESD protection devices with V_{WM}=18V





Multi-purpose ESD protection devices with $16V \leq V_{WM} \leq 18V$





ESD Linearity Study for 5G Main Antenna Protection

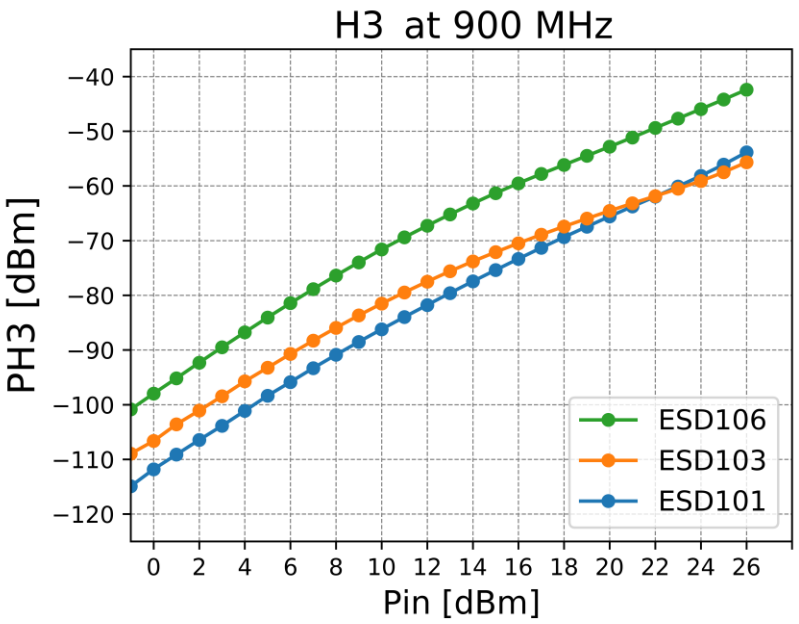
Starting from some known requirements:

P_{H3}= -40 dBm at P_{in}= 33 dBm (GSM)

P_{H3}= -50 dBm at P_{in}= 25 dBm (LTE band)

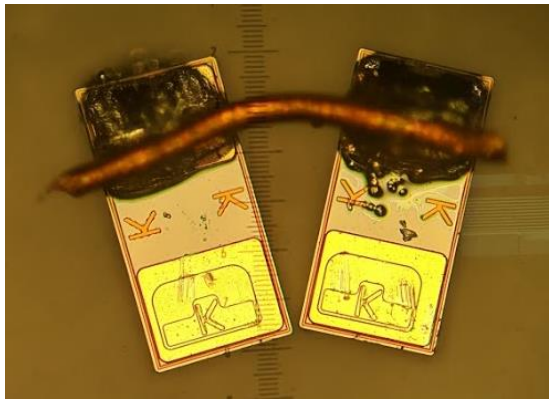
Improve linearity for existing technologies

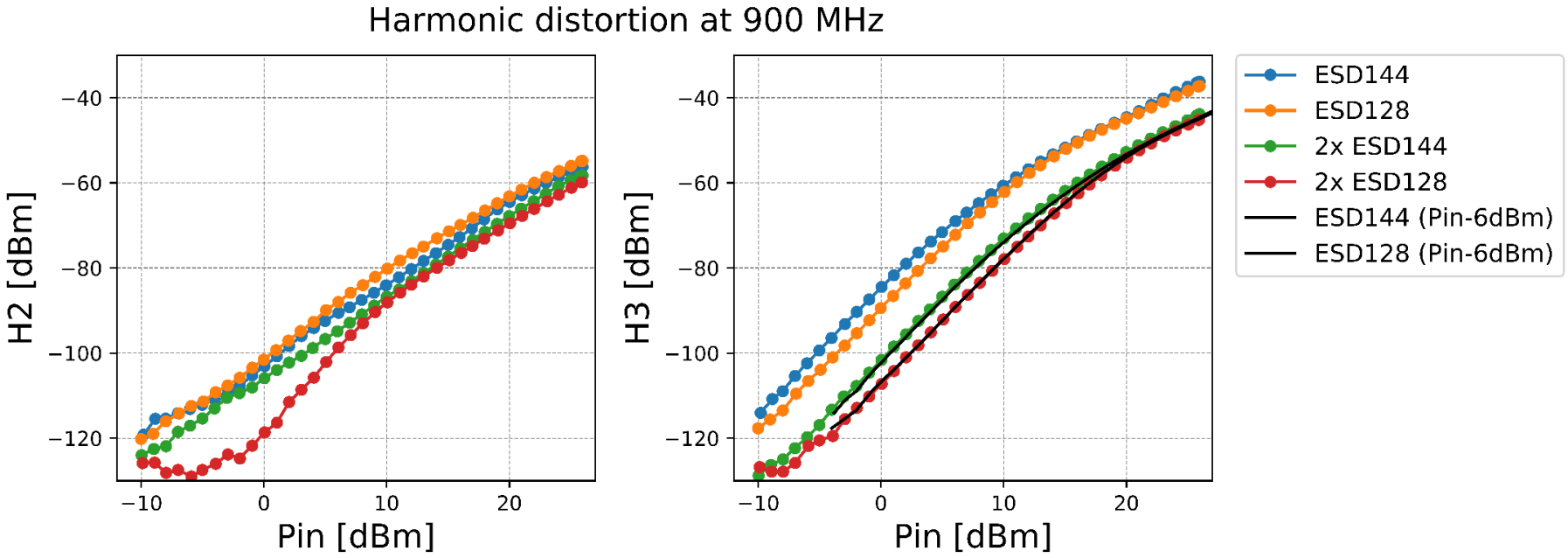
- Investigate packaging influence (plastic, Esipac, next generation packaging).
- Optimise packaging and parasitic capacitance.
- By fundamental device structure engineering (e.g. ESD259 P_{H3} was reduced by 10dB compared to ESD249).



Meeting requirements using existing portfolio

- For two devices in series the excitation voltage is ½V_{in}, and so P_{in} is reduced by 6dBm (curves are shifted to the right, see black lines in the figure).
- Good agreement with the measurement data, improvement to 2nd harmonic less significant.
- Working to apply lessons learned to next generation technology





Agenda

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New and Recent Development

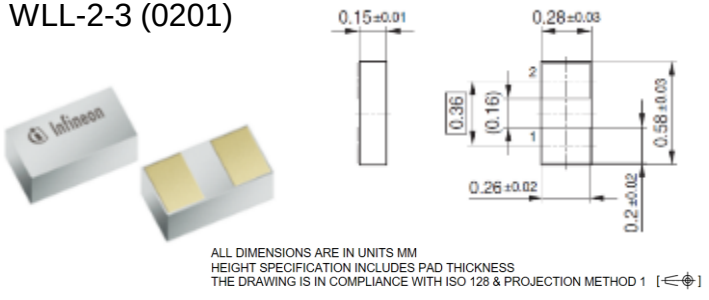
Multi-Purpose High Capa introduction: ESD251-B1-W0201

Main features

- ESD acc. to IEC61000-4-2: ±25 kV
- V_{WM} = ±3.3 V
- Line Capacitance: C_L = 30 pF (I/O to GND)
- Leakage current: I_L < 100 nA
- Clamping Voltage: V_{CL} = 6V @ I_{TLP} = 16 A
- Dynamic resistance: R_{DYN} = 0.1 Ω
- Remark: Higher Capacitance strong protection

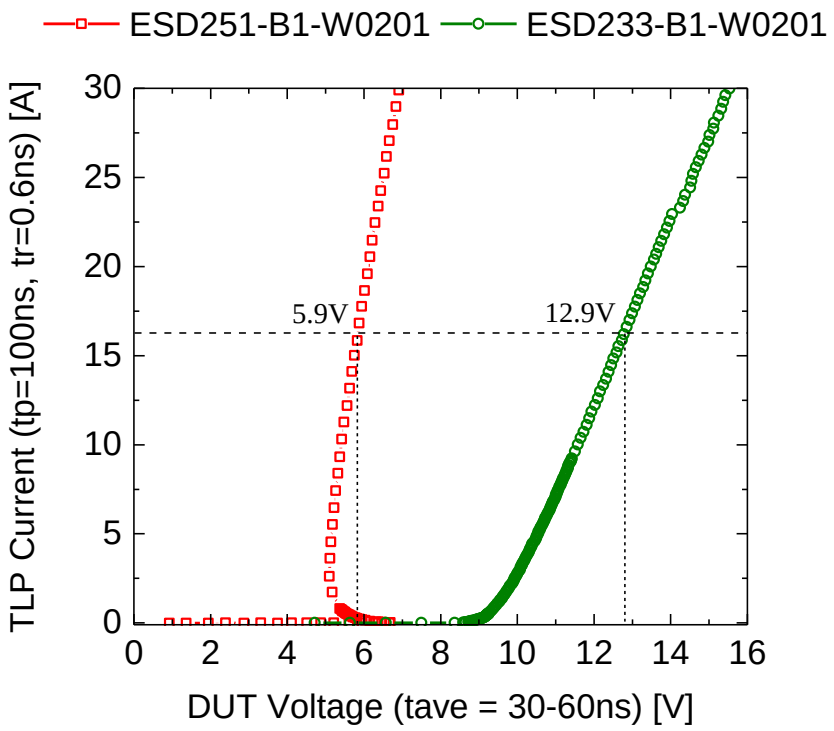
Package

WLL-2-3 (0201)



ESD251 is Infineon's entry in to higher capacitance TVS devices in CSP packaging.

› Excellent clamping performance



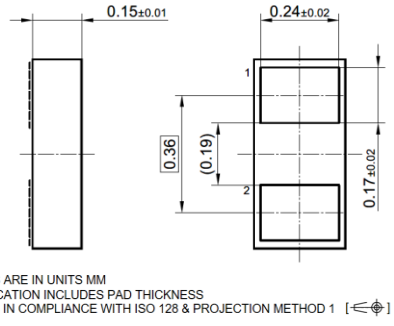
Low Cap performance improvement: ESD132-B1-W0201

Main features

- ESD acc. to IEC61000-4-2: ±30 kV
- V_{WM} = ±5.5 V
- Line Capacitance: C_L = .45 pF (I/O to GND)
- Leakage current: I_L < 100 nA
- Clamping Voltage: V_{CL} ≤ 7V @ I_{TLP} = 16 A
- Dynamic resistance: R_{DYN} = 0.2 Ω
- Remark: Robust(surge), deep snapback high speed protection device

Package

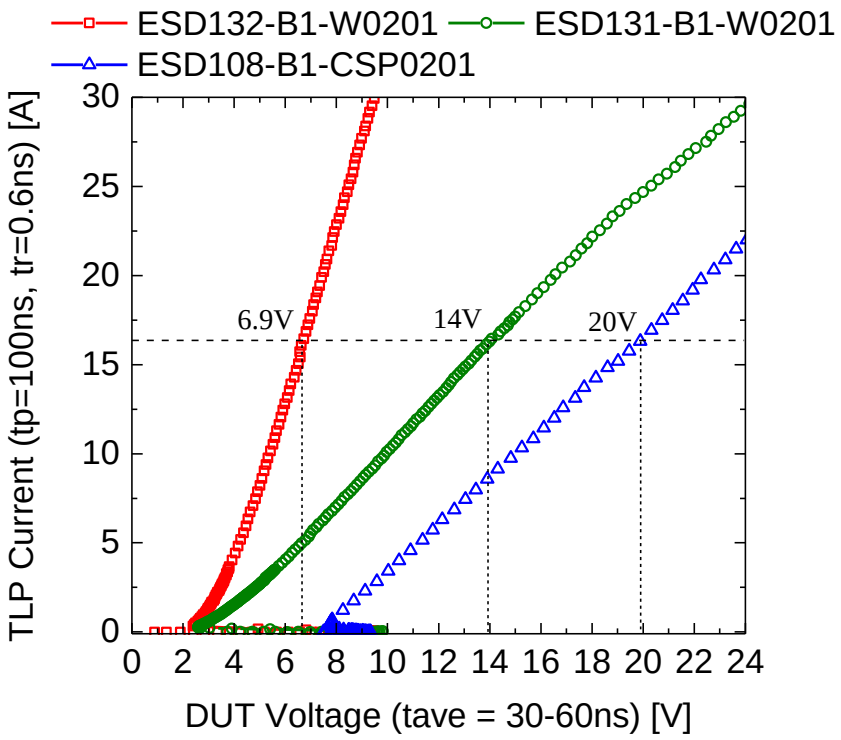
WLL-2-3 (0201)



ALL DIMENSIONS ARE IN UNITS MM
HEIGHT SPECIFICATION INCLUDES PAD THICKNESS
THE DRAWING IS IN COMPLIANCE WITH ISO 128 & PROJECTION METHOD 1

ESD132 snapback offers improved clamping performance for LVDS signals

› V_{CL} reduced by 70% against our non-snapback option ESD108



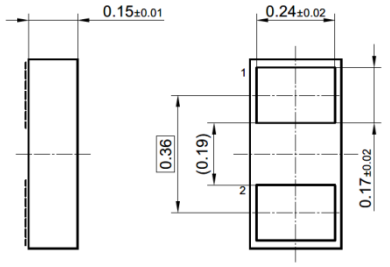
Low Cap performance optimization: ESD134-B1-W0201

Main features

- ESD acc. to IEC61000-4-2: ±20 kV
- V_{WM} = ±2.1 V
- Line Capacitance: C_L = .25 pF (I/O to GND)
- Leakage current: I_L < 20 nA
- Clamping Voltage: V_{CL} ≤ 8V @ I_{TLP} = 16 A
- Dynamic resistance: R_{DYN} = 0.28 Ω
- Remark: Lower Voltage, Lower Capacitance option for High Speed I/O

Package

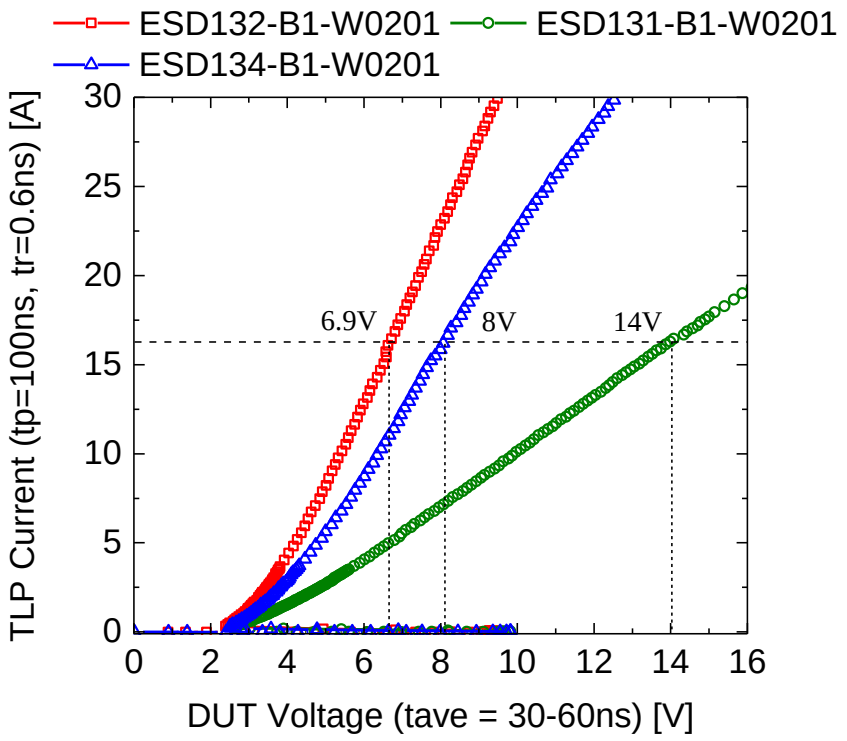
WLL-2-3 (0201)



ALL DIMENSIONS ARE IN UNITS MM
HEIGHT SPECIFICATION INCLUDES PAD THICKNESS
THE DRAWING IS IN COMPLIANCE WITH ISO 128 & PROJECTION METHOD 1

ESD134 snapback offers improved clamping performance for LVDS signals
Lower capacitance option from ESD132

› Lower operating voltage offsets the expected clamping degradation associated with lowering the Capacitance



Low Cap for accessories w/ increased Vwm 7V ESD121-B1-W0201

Main features

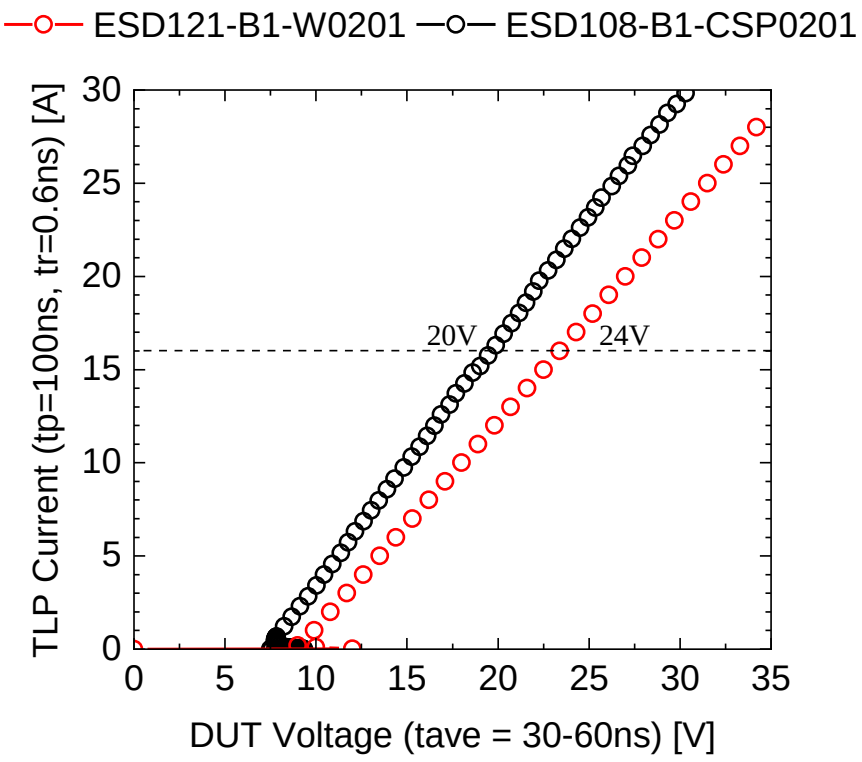
- Max. ESD contact discharge: ±15 kV
- Max. working voltage: **±7 V**
- Trigger voltage: **12 V**
- Holding voltage: **9 V**
- Leakage current: 1 nA typ. @ 7V
- Line capacitance: **0.25 pF** @ f = 1 MHz
- Clamping voltage: 24 V @ I_{TLP} = 16 A
- Dynamic resistance: 0.9 Ω
- Package: WLL-2-3 (0201)
- Remark: Latch-up free (Mild snap-back)

Schedule

›	E-Samples	Done
›	Qualification	Done
›	Mass Production	Done

ESD121 v ESD108

› V_{WM} increased to 7V coming vs ESD108
› At the same time C_L level kept similar to ESD108
› ESD121 simulated



22V Multi-Purpose in small form factor ESD240-B1-W01005

Main features

- **Miniaturized version of ESD239**
- Max. ESD Contact Discharge: ±15 kV
- Max. Working Voltage: **±22 V**
- Trigger Voltage: 33 V
- Holding Voltage: 27 V
- Leakage Current: <0.1 nA typ. @ 22V
- Line Capacitance: **3 pF** @ f=1 MHz
- Clamping Voltage: **28 V** @ I_{TLP} = 16 A
- Dynamic Resistance: 0.35 Ω
- Package: **WLL-2-2 (01005)**
- Remark: Latch-Up Free, Mild Snap-Back

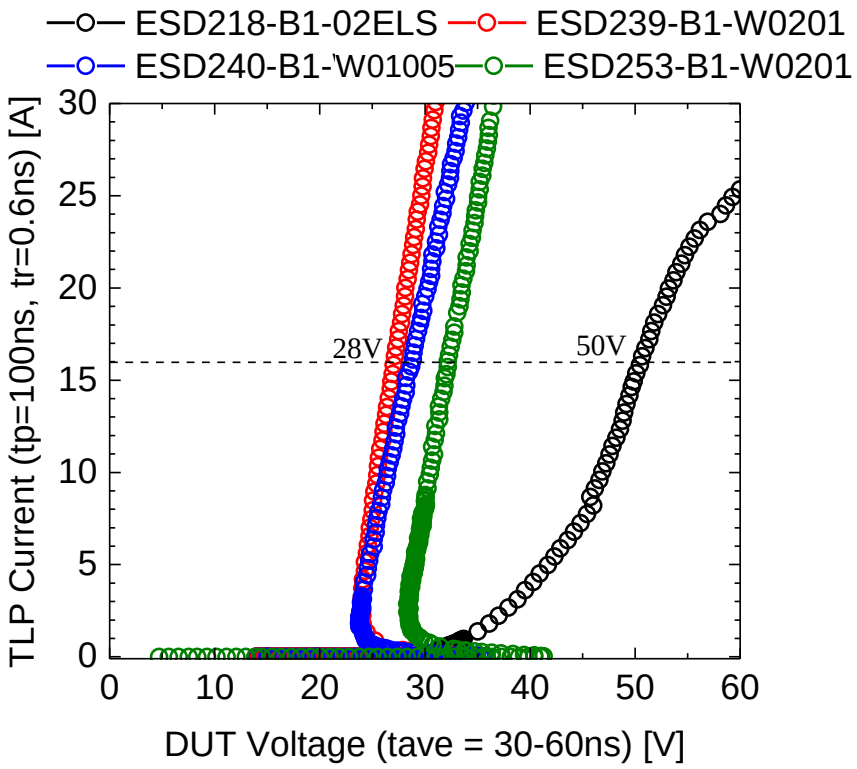
Schedule

›	E-Samples	available
›	Qualification	started
›	RU Readiness	Q3/2019 ***on request***

ESD240 vs ESD218, ESD253, ESD239

› V_{Cl} increased marginally against 0201 ESD239

› Other key characteristics remain almost unchanged vs. ESD239 with 0201 form factor



24V Multi-Purpose in small form factor ESD254-B1-W01005

Main features

- **Miniaturized version of ESD253**
- **Replacement for plastic ESD218**
- Max. ESD Contact Discharge: ±15 kV
- Max. Working Voltage: **±24 V**
- Trigger Voltage: 40 V
- Holding Voltage: 28 V
- Leakage Current: <0.1 nA typ. @ 24 V
- Line Capacitance: **2.5 pF** @ f=1 MHz
- Clamping Voltage: **32 V** @ I_{TLP} = 16 A
- Dynamic Resistance: 0.32 Ω
- Package: **WLL-2-2 (01005)**
- Remark: Latch-Up Free

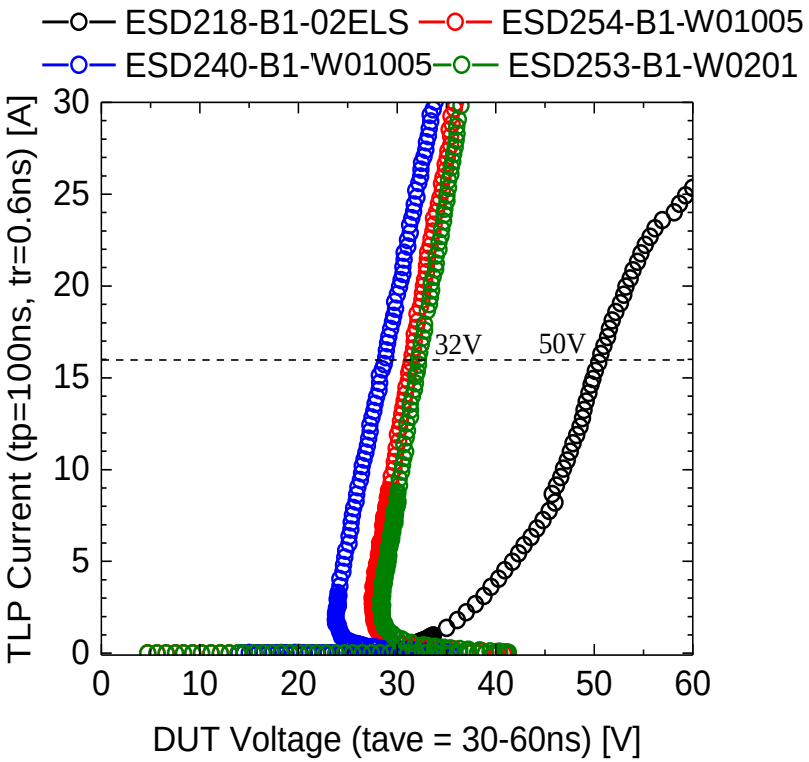
Schedule

› E-Samples	**available**
› Qualification	in preparation
› RU Readiness	Q4/2019 ***on request***

ESD254 vs ESD218, ESD253, ESD240

› V_{Cl} reduced by 18V@16A compared to plastic ESD218

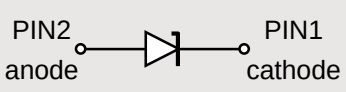
› Key characteristics remain almost unchanged vs. ESD253 with 0201 form factor

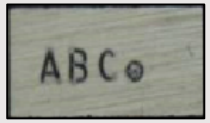


Uni-directional Low Cap for high speed I/O ESD107-U1-W0201 (Deep Snapback)

Main features

- **ESD102 replacement in CSP**
- Improved ESD102-U1-02ELS
- ESD contact discharge: ±15 kV
- Working voltage: V_{WM} = 3.3 V
- Line capacitance: C_L = 0.45pF
- Leakage current: I_L < 10 nA
- Clamping voltage: V_{Cl} ≤ 3.7V @ I_{TLP} = 16A
  V_{Cl} ≤ -3.3V @ I_{TLP} = -16A
- Dynamic resistance:
  - R_{DYN+} = 0.14 Ω / R_{DYN-} = 0.14 Ω
- WLL-2-5 (0201)





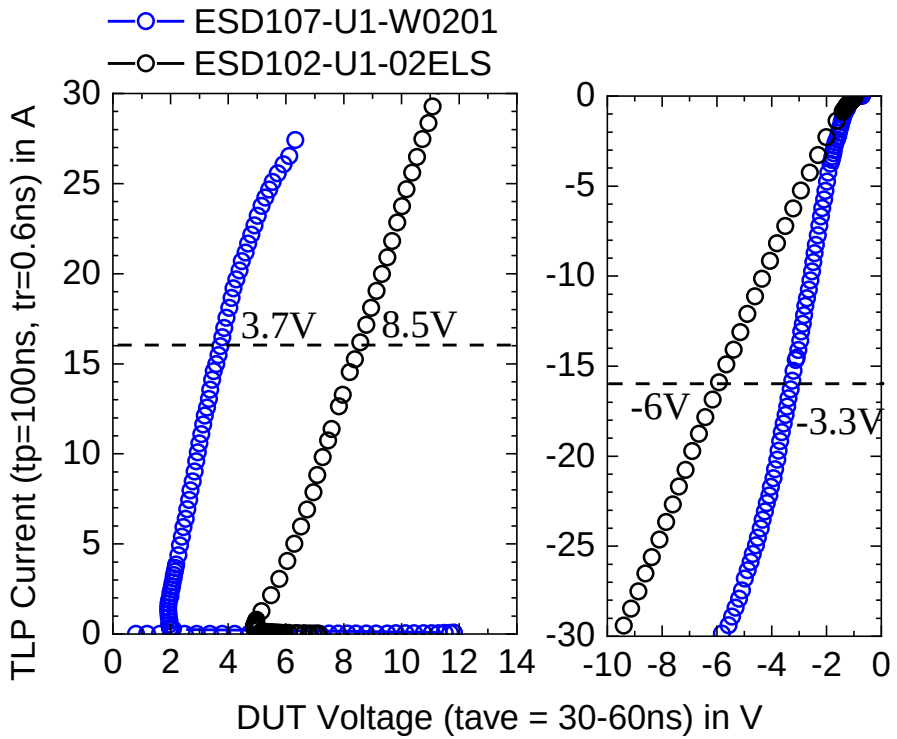
Schedule

›	Alpha Samples	available (no marking)
›	E-Samples	Jan. 2019 (marking)
›	Qualification	Apr. 2020 (500h)
›	RU target	Jun. 2020 (EPR)

ESD107 vs. ESD102

› ~56% reduced positive V_{Cl} compared to ESD102

› ~45% reduced negative V_{Cl} compared to ESD102



Deep Snapback: Y/N

Existing Parts (selection of highlight parts)

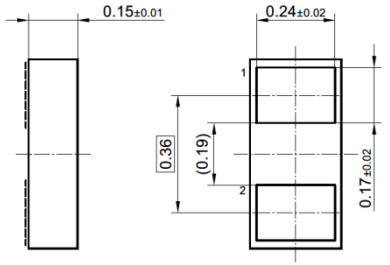
CSP super low capacitance ESD Protection ESD106-B1-W0201

Main features

- Max. ESD contact discharge: ±12 kV
- Max. ESD air discharge: ±14 kV
- Max. working voltage: ±5.5 V
- Trigger voltage: **10 V**
- Holding voltage: **7.5 V**
- Leakage current: < 1 nA typ @ 5.5V
- Line capacitance: **0.19 pF** @ f = 1 MHz
  0.13 pF @ f = 2.5 GHz
- Clamping voltage: 25 V @ I_{TLP} = 16 A
- Dynamic resistance: 1.1 Ω
- Remark: Latch-up free (Mild snap-back)

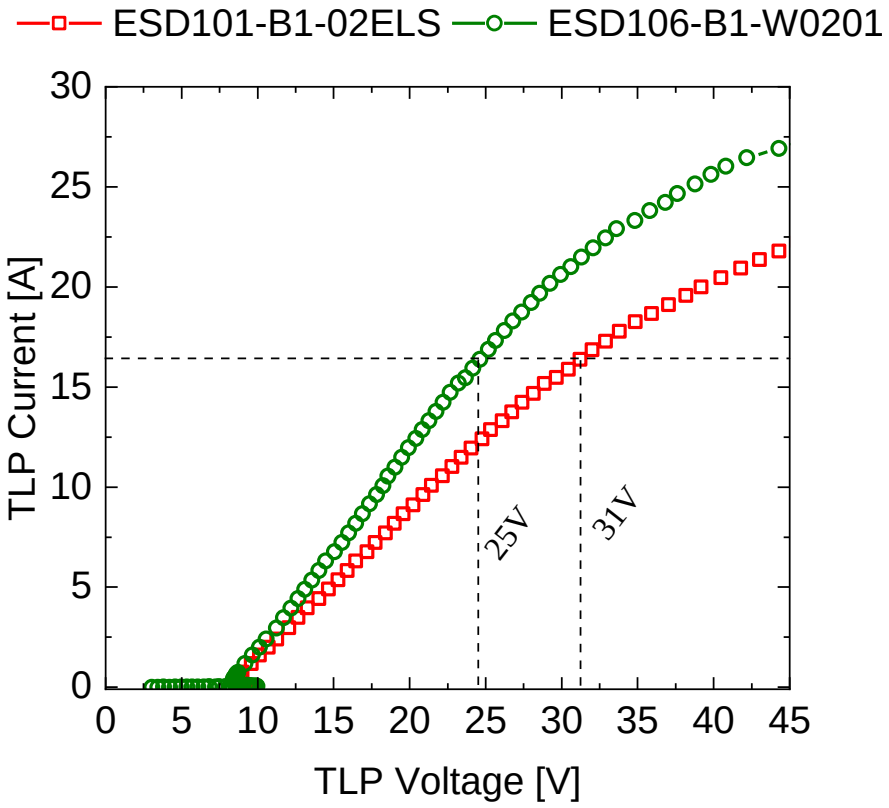
Package

WLL-2-3 (0201)



ALL DIMENSIONS ARE IN UNITS MM
HEIGHT SPECIFICATION INCLUDES PAD THICKNESS
THE DRAWING IS IN COMPLIANCE WITH ISO 128 & PROJECTION METHOD 1

ESD106 replaces ESD101 as super low cap diode in a CSP while offering improved ESD protection performance (20% lower Vcl)



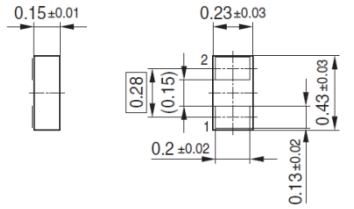
Low Capacitance performance improvement: ESD133-B1-W01005

Main features

- ESD acc. to IEC61000-4-2: ±20 kV
- V_{WM} = ±5.5 V
- Line Capacitance: C_L = 0.25pF (I/O to GND)
- Leakage current: I_L < 100 nA
- Clamping Voltage: V_{CL} ≤ 13V @ I_{TLP} = 16 A
- Dynamic resistance: R_{DYN} = 0.6 Ω
- Remark: Reduced size version of ESD131

Package

WLL-2-2 (01005)



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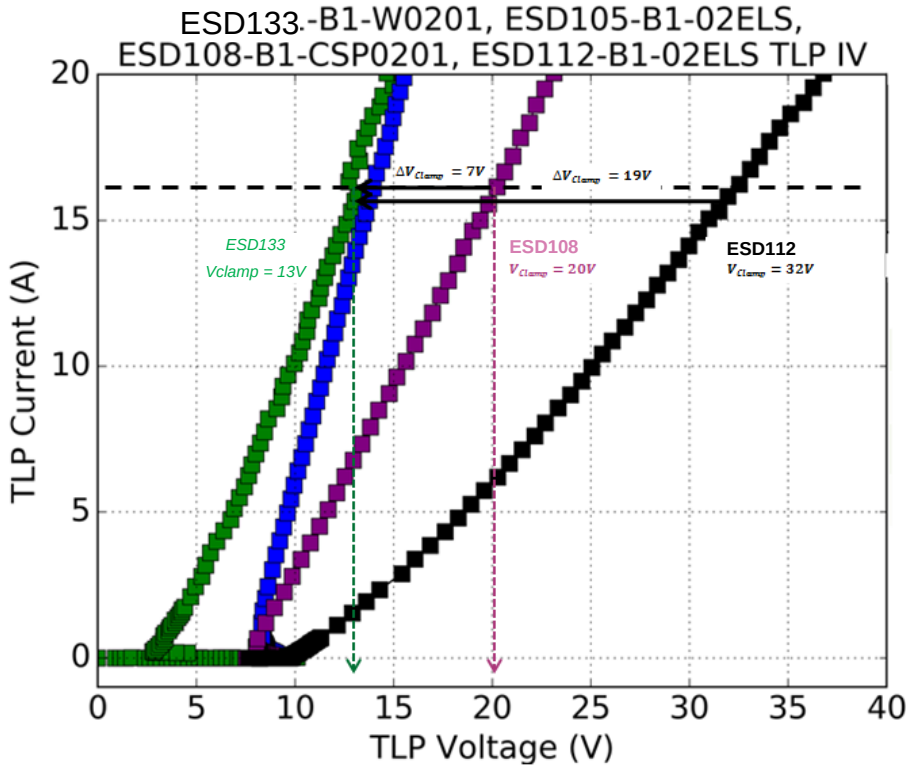
ESD133 benefits vs. ESD105, ESD108 & ESD112

› V_{CL} reduced by ≥ 35%

› C_L reduced to 0.25pF (vs. C_L = 0.28pF)



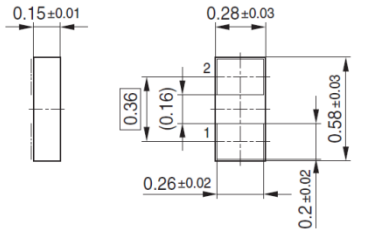
Low Capacitance High Voltage : ESD144-B1-W0201

Main features

- ESD acc. to IEC61000-4-2: ±18 kV
- V_{WM} = ±18 V
- Line Capacitance: C_L = 0.2 pF (I/O to GND)
- Leakage current: I_L < 50 nA
- Clamping Voltage: V_{CL}= 12.5V @ I_{TLP} = 16 A
- Dynamic resistance: R_{DYN} = 0.58 Ω
- Remark: Improved clamping for NFC application protection (vs ESD110-B1-02ELS & ESD128-B1-W0201)

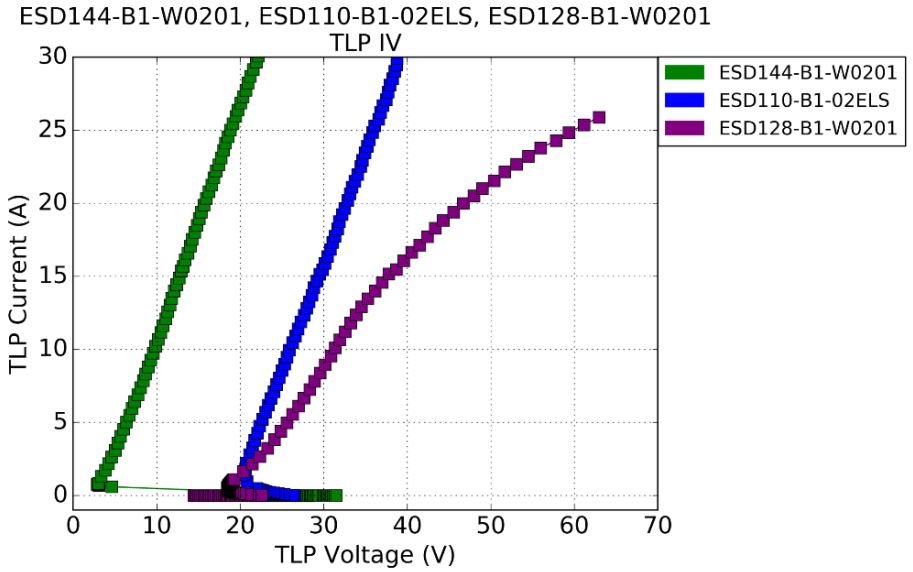
Package

WLL-2-3 (0201)



ALL DIMENSIONS ARE IN UNITS MM
HEIGHT SPECIFICATION INCLUDES PAD THICKNESS
THE DRAWING IS IN COMPLIANCE WITH ISO 128 & PROJECTION METHOD 1

ESD144 is Infineon's deep snapback protection device for best clamping performance for the protection of NFC antenna. Improved clamping versus predecessor parts ESD110 and ESD128.



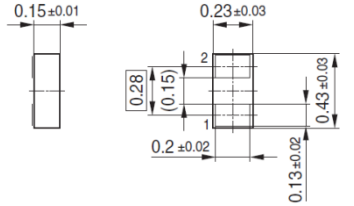
Low Capacitance High Voltage: ESD145-B1-W01005

Main features

- ESD acc. to IEC61000-4-2: ±18 kV
- V_{WM} = ±18 V
- Line Capacitance: C_L = 0.2 pF (I/O to GND)
- Leakage current: I_L < 50 nA
- Clamping Voltage: V_{CL}= 12.5V @ I_{TLP} = 16 A
- Dynamic resistance: R_{DYN} = 0.58 Ω
- Remark: Reduced size version of ESD144-B1-W0201 with improved clamping for NFC application protection (vs ESD110-B1-02ELS & ESD128-B1-W0201)

Package

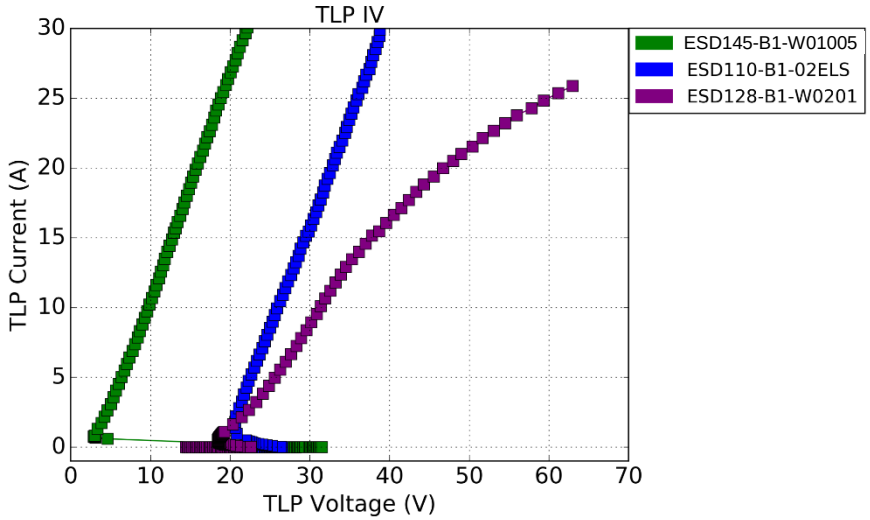
WLL-2-2 (01005)



ALL DIMENSIONS ARE IN UNITS MM
HEIGHT SPECIFICATION INCLUDES PAD THICKNESS
THE DRAWING IS IN COMPLIANCE WITH ISO 128 & PROJECTION METHOD 1

ESD145 is the size reduced version of the ESD144 offering now a smaller deep snapback protection device for best clamping performance for the protection of NFC antenna. Improved clamping versus predecessor parts ESD110 and ESD128.

ESD145-B1-W01005 , ESD110-B1-02ELS, ESD128-B1-W0201



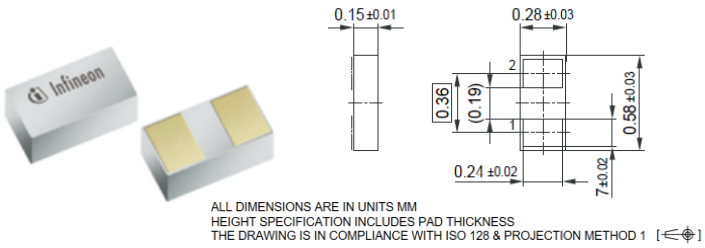
High Capacitance CSP TVS Device ESD234-B1-W0201

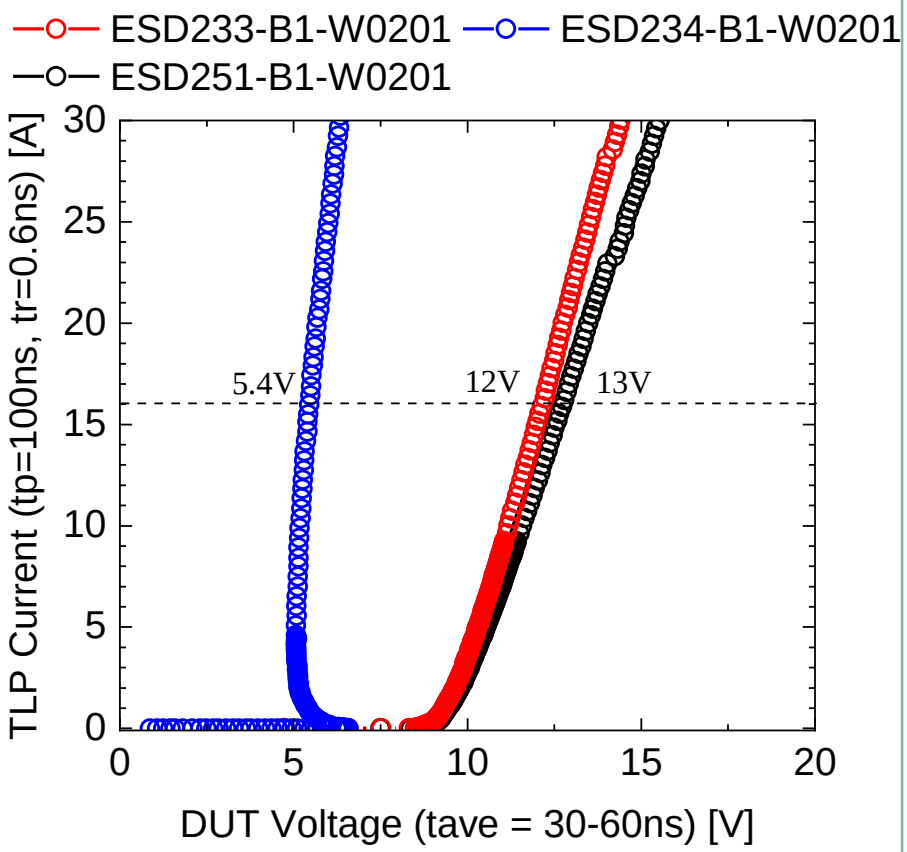
Main features

- ESD acc. to IEC61000-4-2: ±19 kV
- V_{WM} = ±5.5 V
- Line Capacitance: C_L = 56 pF (I/O to GND)
- Leakage current: I_L < 100 nA
- Clamping Voltage: V_{CL}= 12.5V @ I_{TLP} = 16 A
- Dynamic resistance: R_{DYN} = 0.15 Ω
- Remark: High capacitance for built-in line filtering, e.g. TVS protected audio lines

Package

WLL-2-1 & WLL-2-3 (0201)





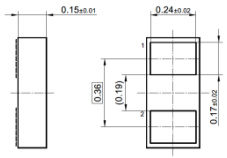
* calculated values

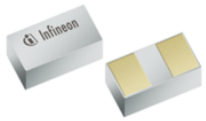
Multi-Purpose performance improvement: ESD253-B1-W0201

Main features

- ESD acc. to IEC61000-4-2: ±15 kV
- V_{WM} = ±24 V
- Line Capacitance: C_L = 2.8pF (I/O to GND)
- Leakage current: I_L < 1 nA
- Clamping Voltage: V_{CL} ≤ 31V @ I_{TLP} = 16 A
- Dynamic resistance: R_{DYN} = 0.3 Ω
- Remark: CSP and miniaturized versions of ESD218-B1-02ELS

Package





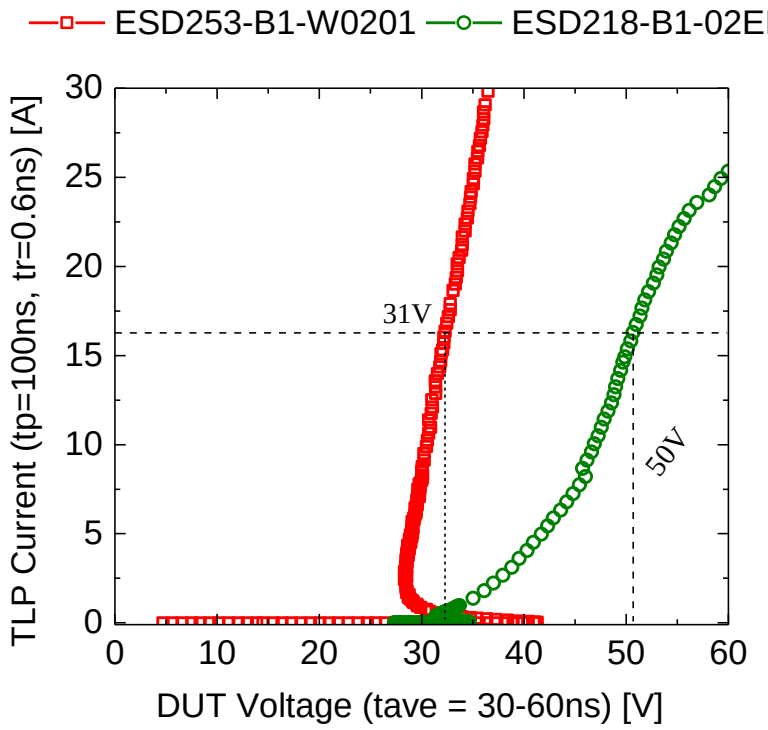
WLL-2-3 (0201)

ALL DIMENSIONS ARE IN UNITS MM
HEIGHT SPECIFICATION INCLUDES PAD THICKNESS
THE DRAWING IS IN COMPLIANCE WITH ISO 128 & PROJECTION METHOD 1

ESD253 vs ESD218

› V_{CL} reduced by 19V@16A

› Other characteristics remain almost unchanged



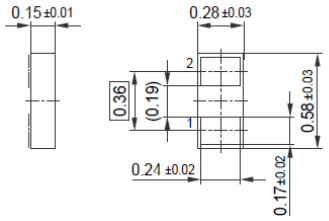
ESD259-B1-W0201
H3 linearity improvement

Main features

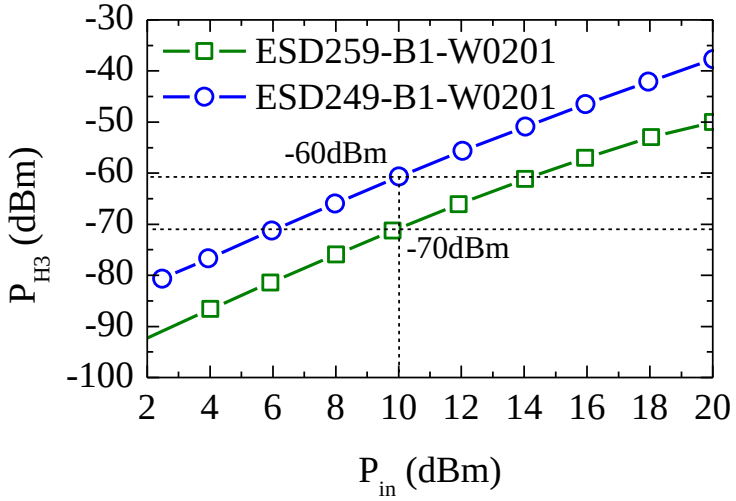
- Optimized RF-linearity performance
- ESD acc. to IEC61000-4-2: ±15 kV
- V_{WM} = ±16 V
- Line Capacitance: C_L = 4.2pF (I/O to GND)
- Leakage current: I_L < 500 nA @ V_{WM}
- Clamping Voltage: V_{CL} = 24V @ I_{TLP} = 16 A
- Dynamic resistance: R_{DYN} = 0.29 Ω
- Remark: Special emphasis on Harmonic performance for use on signal lines near strong RF transmitters- improved version of ESD249.

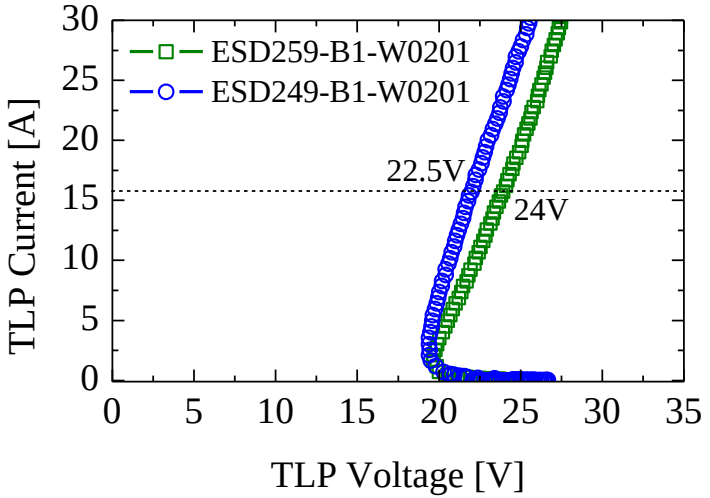
Package

WLL-2-3 (0201)



ALL DIMENSIONS ARE IN UNITS MM
HEIGHT SPECIFICATION INCLUDES PAD THICKNESS
THE DRAWING IS IN COMPLIANCE WITH ISO 128 & PROJECTION METHOD 1





Upcoming Developments

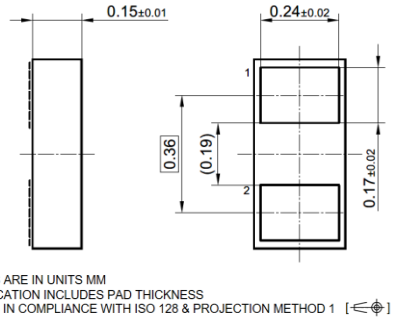
CSP super low capacitance ESD Protection... Linear style ESD111-B1-W0201

Main features

- Max. ESD contact discharge: ±12 kV
- Max. working voltage: ±5.5 V
- Trigger voltage: 9.7 V
- Holding voltage: 8.6 V
- Leakage current: < 1nA typ @ 5.5V
- Line capacitance: 0.11 pF @ f = 2.5 GHz
- Clamping voltage: 29 V @ I_{TLP} = 16 A
- Dynamic resistance: 1.3 Ω
- Remark: Latch-up free (Mild snap-back)

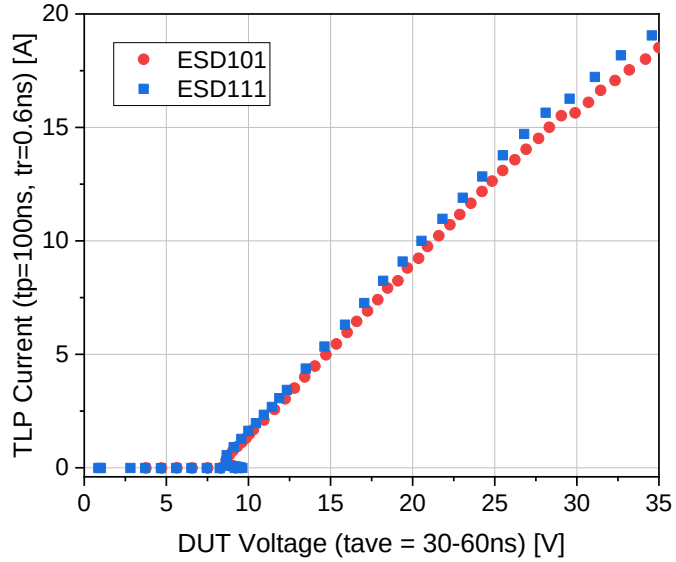
Package

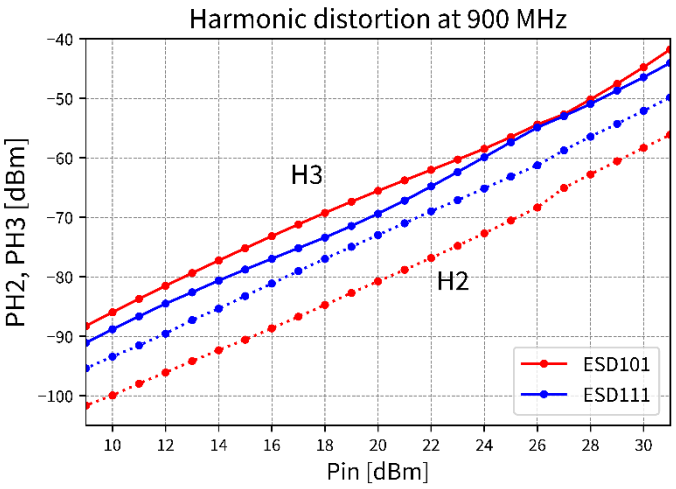
WLL-2-3 (0201)



ALL DIMENSIONS ARE IN UNITS MM
HEIGHT SPECIFICATION INCLUDES PAD THICKNESS
THE DRAWING IS IN COMPLIANCE WITH ISO 128 & PROJECTION METHOD 1

ESD101 v ESD111





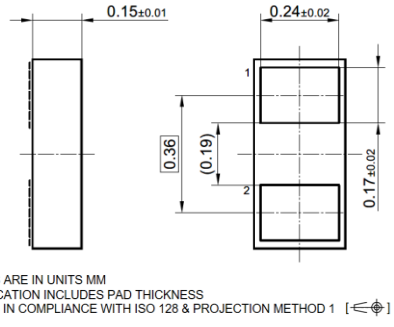
USB 3.1/3.2 Clamping Optimized Protection ESD150-B1-W0201

Main features

- Max. ESD contact discharge: ±15 kV
- Max. working voltage: ±3.3 V
- Trigger voltage: **12 V**
- Holding voltage: **2.5 V**
- Leakage current: 1 nA typ @ 3.3V
- Line capacitance: **0.20 pF** @ f = 2.5 GHz
- Clamping voltage: 5.3 V @ I_{TLP} = 16 A
- Dynamic resistance: 0.15 Ω
- Remark: USB3.1 Protection (Deep snap-back)

Package

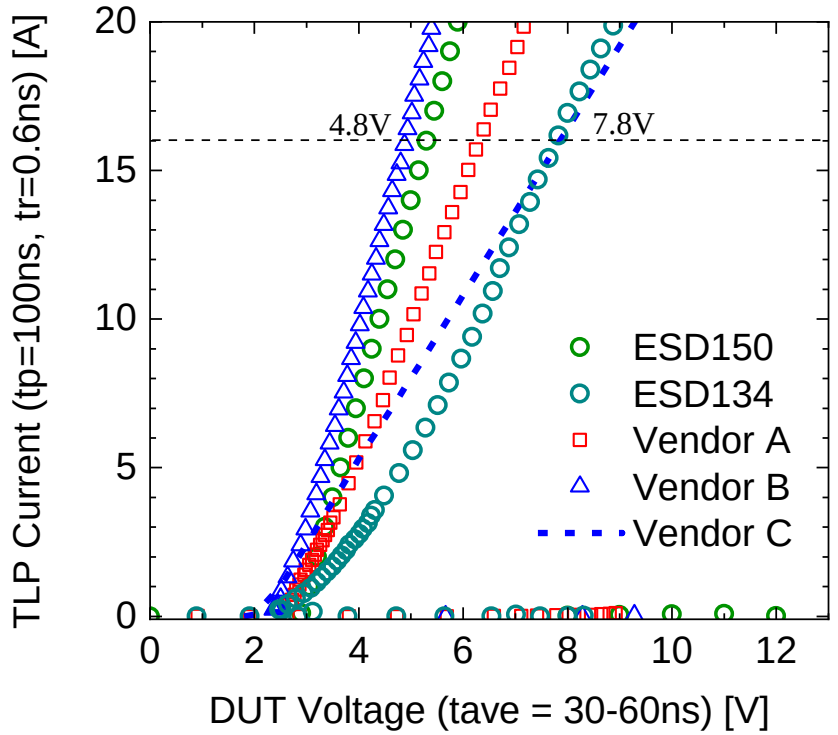
WLL-2-3 (0201)



ALL DIMENSIONS ARE IN UNITS MM
HEIGHT SPECIFICATION INCLUDES PAD THICKNESS
THE DRAWING IS IN COMPLIANCE WITH ISO 128 & PROJECTION METHOD 1

ESD150 deep snapback offers improved clamping performance for LVDS signals

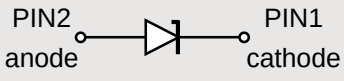
- Specifically designed for USB3.1/2 protection
- V_{clamp} reduced by 30% compared to ESD134
- C_{line} reduced by 20% compared to ESD134

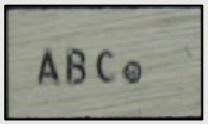


1pF Unidirectional ESD protection – clamping optimized
ESD126-B1-W0201

Main features

- **ESD102 replacement in CSP**
- Improved ESD107-U1-W0201
- ESD contact discharge: ±25 kV
- Working voltage: V_{WM} = 3.3 V
- Line capacitance: C_L = 1pF max.
- Leakage current: I_L < 10 nA
- Clamping voltage: V_{Cl} ≤ 2.8V @ I_{TLP} = 16A
  V_{Cl} ≤ -2.3V @ I_{TLP} = -16A
- Dynamic resistance:
  - R_{DYN+} = 0.05 Ω / R_{DYN-} = 0.05 Ω
- WLL-2-5 (0201)





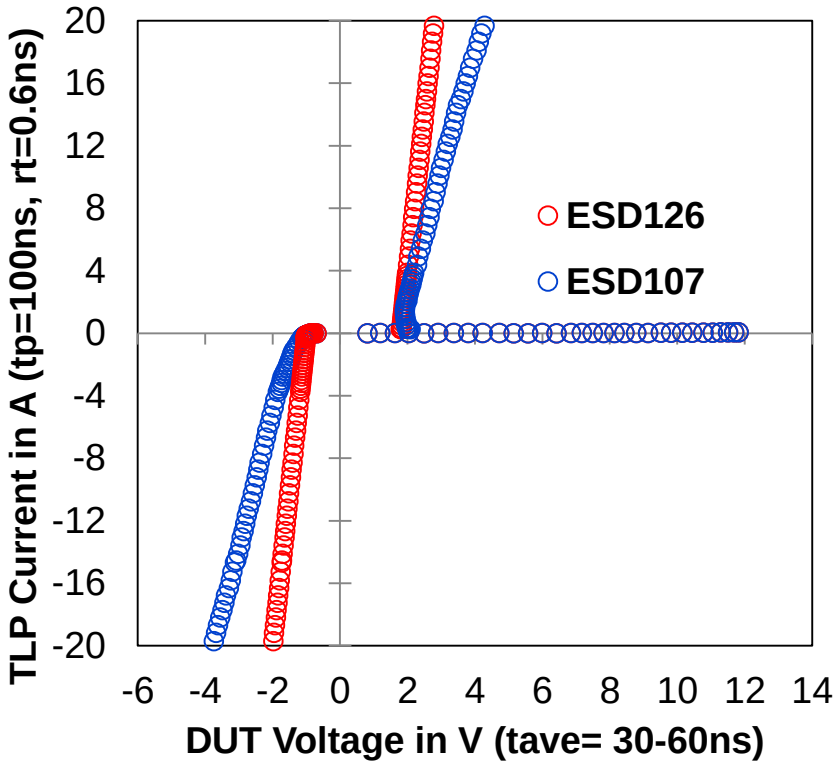
Schedule

›	E-Samples	Oct 2019
›	Qualification	Apr. 2020 (500h)
›	RU target	Jun. 2020 (EPR)

ESD126 vs. ESD107

› ~26% reduced positive V_{Cl} compared to ESD107

› ~26% reduced negative V_{Cl} compared to ESD107



Deep Snapback: Y/N

Part of your life. Part of tomorrow.

Infineon