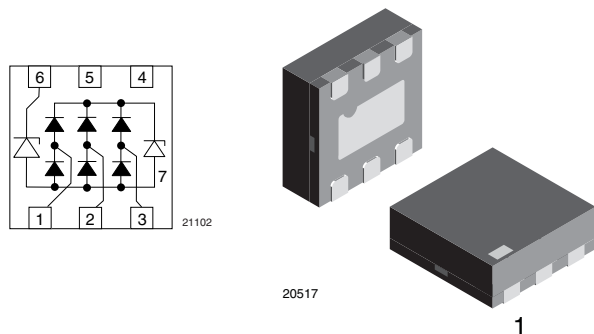


# USB-OTG BUS-Port ESD Protection for $V_{BUS} = 12\text{ V}$



## MARKING (example only)



Dot = pin 1 marking

XX = date code

YY = type code (see table below)

## DESIGN SUPPORT TOOLS

[click logo to get started](#)



## FEATURES

- Ultra compact LLP75-7L package
- Low package height < 0.6 mm
- 3-line USB ESD protection with max. working range = 5.5 V
- $V_{BUS}$  - protection with 12 V working range
- Low leakage current
- Low load capacitance  $C_D = 0.7\text{ pF}$
- ESD immunity to IEC 61000-4-2  
± 15 kV contact discharge  
± 15 kV air discharge
- Surge current acc. IEC 61000-4-5  $I_{PP} > 3\text{ A}$
- e4 - precious metal (e.g. Ag, Au, NiPd, NiPdAu) (no Sn)
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



## ORDERING INFORMATION

DEVICE NAME	ORDERING CODE	TAPED UNITS PER REEL (8 mm TAPE ON 7" REEL)	MINIMUM ORDER QUANTITY
VBUS053AZ-HAF	VBUS053AZ-HAF-GS08	15 000	15 000

## PACKAGE DATA

DEVICE NAME	PACKAGE NAME	TYPE CODE	WEIGHT	MOLDING COMPOUND FLAMMABILITY RATING	MOISTURE SENSITIVITY LEVEL	SOLDERING CONDITIONS
VBUS053AZ-HAF	LLP75-7L	U9	4.2 mg	UL 94 V-0	MSL level 1 (according J-STD-020)	Peak temperature max. 260 °C

## ABSOLUTE MAXIMUM RATINGS VBUS053AZ-HAF

PARAMETER	TEST CONDITIONS	SYMBOL	VALUE	UNIT
Data line D+, D-, ID: Pin 1, 2 and 3 to ground (pin 7)				
Peak pulse current	acc. IEC 61000-4-5; t <sub>p</sub> = 8/20 μs; single shot	I <sub>PPM</sub>	3	A
Peak pulse power	acc. IEC 61000-4-5; t <sub>p</sub> = 8/20 μs; single shot	P <sub>PP</sub>	36	W
ESD immunity	Contact discharge acc. IEC 61000-4-2; 10 pulses	V <sub>ESD</sub>	± 15	kV
	Air discharge acc. IEC 61000-4-2; 10 pulses		± 15	
V <sub>BUS</sub> : Pin 6 to ground (pin 7)				
Peak pulse current	acc. IEC 61000-4-5; t <sub>p</sub> = 8/20 μs/single shot	I <sub>PPM</sub>	8	A
Peak pulse power	acc. IEC 61000-4-5; t <sub>p</sub> = 8/20 μs/single shot	P <sub>PP</sub>	240	W
ESD immunity	Contact discharge acc. IEC 61000-4-2; 10 pulses	V <sub>ESD</sub>	± 30	kV
	Air discharge acc. IEC 61000-4-2; 10 pulses		± 30	
Operating temperature	Junction temperature	T <sub>J</sub>	-40 to +125	°C
Storage temperature		T <sub>STG</sub>	-55 to +150	°C



<b>ELECTRICAL CHARACTERISTICS VBUS053AZ-HAF</b> All inputs (pin 1, 2, and 3) to ground (pin 7)						
PARAMETER	TEST CONDITIONS/REMARKS	SYMBOL	MIN.	TYP.	MAX.	UNIT
Protection paths	Number of lines which can be protected	$N_{\text{channel}}$	-	-	3	lines
Reverse stand-off voltage	at $I_R = 0.1 \mu\text{A}$	$V_{\text{RWM}}$	-	-	5.5	V
Reverse current	at $V_R = V_{\text{RWM}} = 3.3 \text{ V}$ ; $T = 65^\circ\text{C}$	$I_R$	-	-	0.085	$\mu\text{A}$
	at $V_R = V_{\text{RWM}} = 5.5 \text{ V}$	$I_R$	-	-	1	$\mu\text{A}$
Forward voltage	at $I_F = 15 \text{ mA}$	$V_F$	0.7	-	1.2	V
Reverse breakdown voltage	at $I_R = 1 \text{ mA}$	$V_{\text{BR}}$	6.5	-	10	V
Reverse clamping voltage	at $I_{\text{PP}} = 1 \text{ A}$ ; acc. IEC 61000-4-5; $T = 25^\circ\text{C}$	$V_C$	-	10	12	V
	at $I_{\text{PP}} = 3 \text{ A}$ ; acc. IEC 61000-4-5; $T = 25^\circ\text{C}$	$V_C$	-	15	18	V
Forward clamping voltage	at $I_F = 3 \text{ A}$ ; acc. IEC 61000-4-5	$V_F$	-	3.4	4.1	V
Line capacitance	Test pin at $V_R = 0 \text{ V}$ ; any other I/O pin at $V_R = 3.3 \text{ V}$ , $f = 1 \text{ MHz}$	$C_D$	-	0.7	1	pF
Line symmetry	Difference of the line capacitance	$dC_D$	-	-	0.1	pF
Line to line capacitance	Among pins 1, 2 and 3 at $V_R = 0 \text{ V}$ ; $f = 1 \text{ MHz}$	$C_{\text{DD}}$	-	0.35	0.5	pF

**Note**

- $T_{\text{amb}} = -40^\circ\text{C}$  to  $85^\circ\text{C}$ , unless otherwise specified

<b>ELECTRICAL CHARACTERISTICS VBUS</b> (pin 6) to ground (pin 7)						
PARAMETER	TEST CONDITIONS/REMARKS	SYMBOL	MIN.	TYP.	MAX.	UNIT
Protection paths	Number of line which can be protected	$N_{\text{channel}}$	-	-	1	line
Reverse working voltage	at $I_R = 100 \text{ nA}$	$V_{\text{RWM}}$	12	-	-	V
Reverse current	at $V_R = V_{\text{RWM}} = 12 \text{ V}$	$I_R$	-	-	100	nA
Forward voltage	at $I_F = 10 \text{ mA}$	$V_F$	0.6	0.75	0.9	V
Reverse breakdown voltage	at $I_R = 1 \text{ mA}$	$V_{\text{BR}}$	15	-	18	V
Reverse clamping voltage	at $I_{\text{PP}} = 1 \text{ A}$ ; acc. IEC 61000-4-5; $T = 25^\circ\text{C}$	$V_C$	-	17.5	20	V
	at $I_{\text{PP}} = 8 \text{ A}$ ; acc. IEC 61000-4-5; $T = 25^\circ\text{C}$	$V_C$	-	25	30	V
Forward clamping voltage	at $I_F = 8 \text{ A}$ ; acc. IEC 61000-4-5	$V_F$	-	-	2.2	V
Line capacitance	at $V_R = 0 \text{ V}$ , $f = 1 \text{ MHz}$	$C_D$	-	70	85	pF

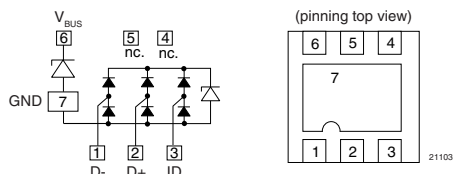
**Note**

- $T_{\text{amb}} = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ , unless otherwise specified

## APPLICATION NOTE

The VBUS053AZ-HAF is intended as an ESD protection and transient voltage suppressor for one USB-OTG port. The LLP75-7L package contains two separate dies which are mounted on a common ground plane (pin 7). The high-speed data lines D-, D+ and ID, are connected to any of the pins no. 1 to 3. As long as the signal voltage on the data lines is between the ground- and the 5 V working range, the low capacitance PN-diodes offer a very high isolation to ground and to the other data lines. But as soon as any transient signal like an ESD signal, exceeds this working range of 5 V in either the positive or negative direction, one of the PN-diodes gets into the forward mode and clamps the transient either to ground or to the avalanche break through level. An extra avalanche diode (separate die) clamps the supply line voltage ( $V_{BUS}$  at pin 6) above the 12 V working range to ground (pin 7).

Due to the “two die construction” the  $V_{BUS}$  line has a very high isolation to the data lines. In case of a destructive transient signal, i.e. coming from a charger, the data lines will not be influenced.



### Remark:

The input pins no. 1, 2 and 3 are symmetrical. Each of the data signals D-, D+ and ID can be connected to pin 1, 2 or 3

## TYPICAL CHARACTERISTICS ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)

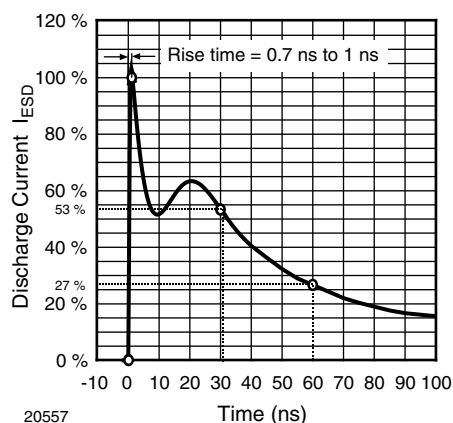


Fig. 1 - ESD Discharge Current Wave Form acc. IEC 61000-4-2 (330  $\Omega$ /150 pF)

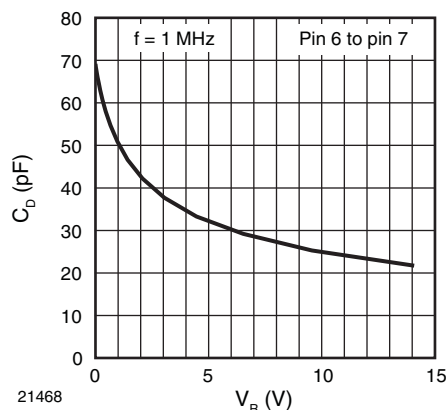


Fig. 3 - Typical Capacitance  $C_D$  vs. Reverse Voltage  $V_R$

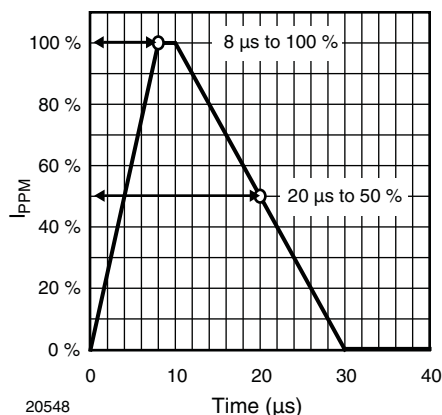


Fig. 2 - 8/20  $\mu$ s Peak Pulse Current Wave Form acc. IEC 61000-4-5

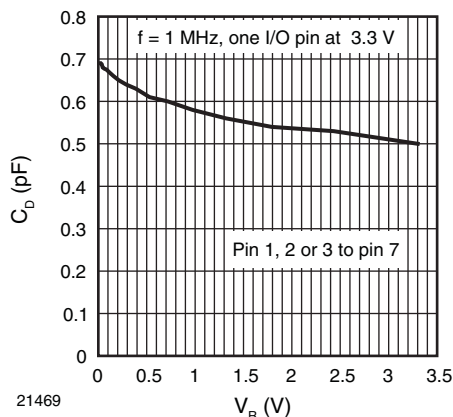
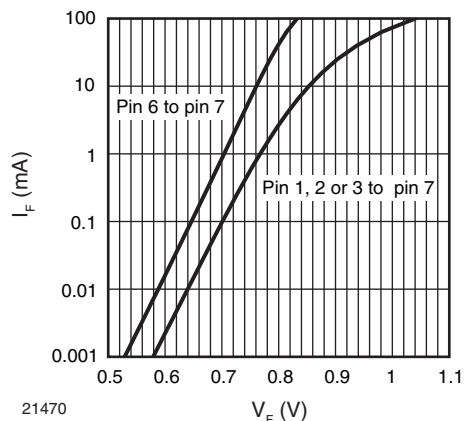
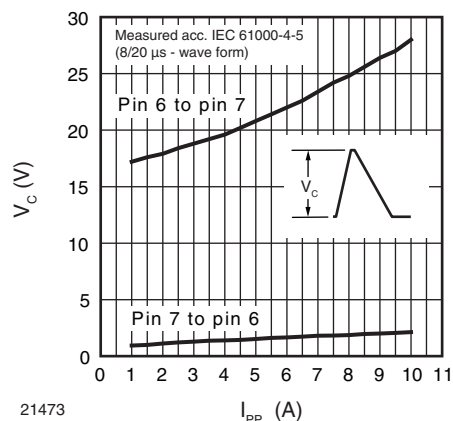
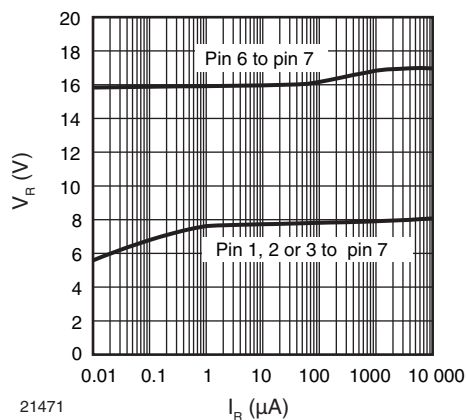
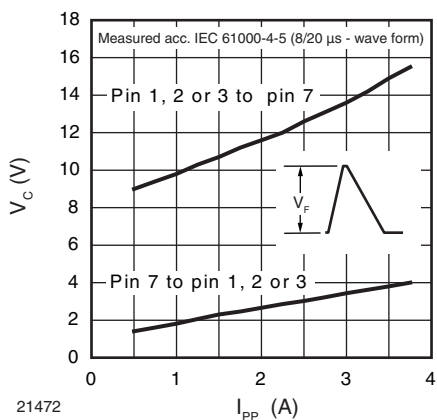
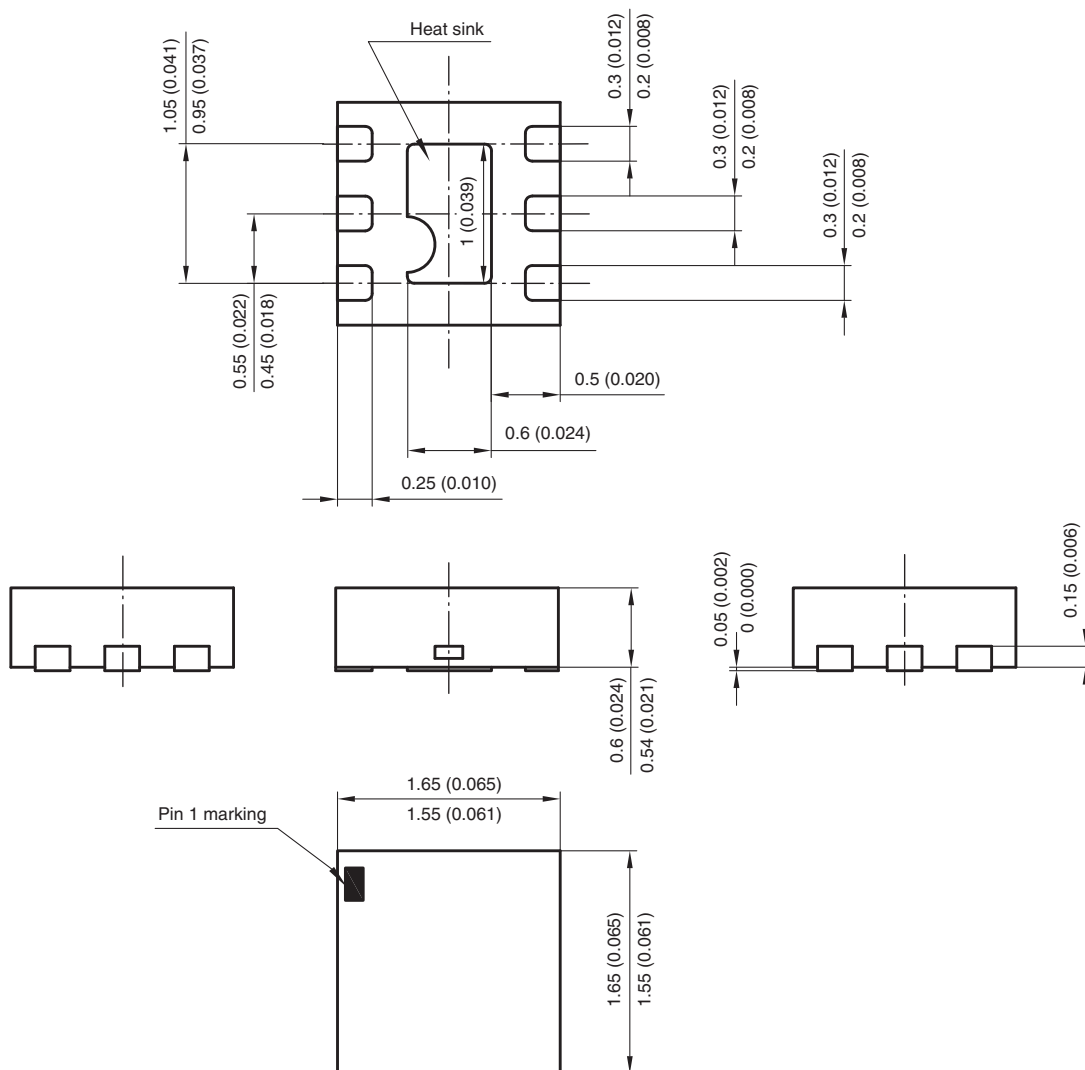
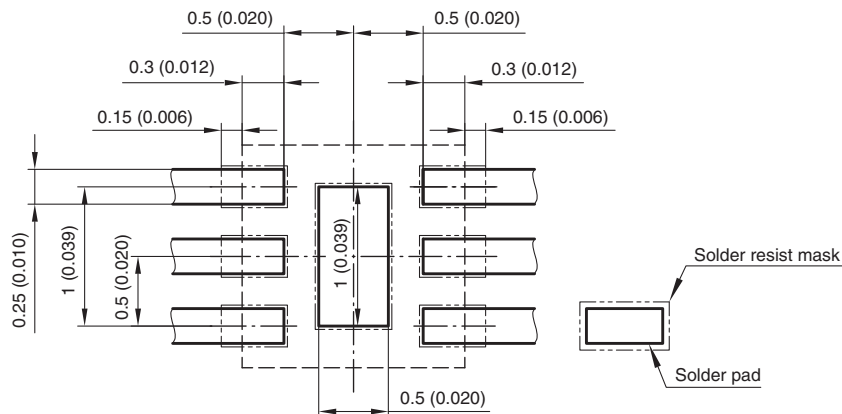


Fig. 4 - Typical Capacitance  $C_D$  vs. Reverse Voltage  $V_R$


Fig. 5 - Typical Forward Current  $I_F$  vs. Forward Voltage  $V_F$ 

Fig. 8 - Typical Peak Clamping Voltage  $V_C$  vs. Peak Pulse Current  $I_{PP}$ 

Fig. 6 - Typical Reverse Voltage  $V_R$  vs. Reverse Current  $I_R$ 

Fig. 7 - Typical Peak Clamping Voltage  $V_C$  vs. Peak Pulse Current  $I_{PP}$

**PACKAGE DIMENSIONS** in millimeters (inches): **LLP75-7L**


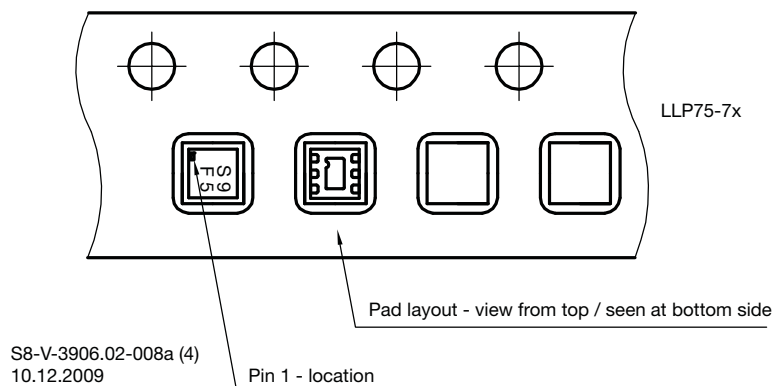
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