

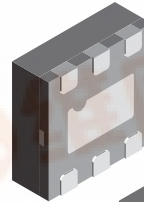
## USB-OTG BUS-Port ESD-Protection for $V_{BUS} = 12\text{ V}$

### Features

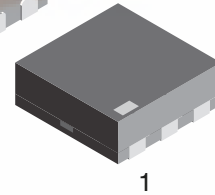
- Ultra compact LLP75-7L package
- Low package height < 0.6 mm
- 3-line USB ESD- protection with max. working range = 5.5 V
- $V_{BUS}$  - protection with 12 V working range
- Low leakage current
- Low load capacitance  $C_D = 0.7\text{ pF}$
- ESD-protection to IEC 61000-4-2  
 $\pm 15\text{ kV}$  contact discharge  
 $\pm 15\text{ kV}$  air discharge
- Surge current acc. IEC 6100-4-5  $I_{PP} > 3\text{ A}$
- e4 - precious metal (e.g. Ag, Au, NiPd, NiPdAu) (no Sn)
- Compliant to RoHS directive 2002/95/EC and in accordance to WEEE 2002/96/EC



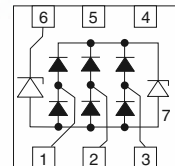
**RoHS**  
COMPLIANT  
**GREEN**  
(S-2008)\*\*



20517



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21102

### Marking (example only)



Dot = Pin 1 marking

XX = Date code

YY = Type code (see table below)

### 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	Marking 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)	260 °C/10 s at terminals

### Absolute Maximum Ratings

Parameter	Test conditions	Symbol	Value	Unit
<b>Data line D+, D-, ID: Pin 1, 2 and 3 to ground (pin 7)</b>				
Peak pulse current	Acc. IEC 61000-4-5; $t_p = 8/20\text{ }\mu\text{s}$ /single shot	$I_{PPM}$	3	A
Peak pulse power	Acc. IEC 61000-4-5; $t_p = 8/20\text{ }\mu\text{s}$ /single shot	$P_{PP}$	36	W
ESD immunity	Contact discharge acc. IEC 61000-4-2; 10 pulses	$V_{ESD}$	$\pm 15$	kV
	Air discharge acc. IEC 61000-4-2; 10 pulses	$V_{ESD}$	$\pm 15$	kV
<b><math>V_{BUS}</math>: Pin 6 to ground (pin 7)</b>				
Peak pulse current	Acc. IEC 61000-4-5; $t_p = 8/20\text{ }\mu\text{s}$ /single shot	$I_{PPM}$	8	A
Peak pulse power	Acc. IEC 61000-4-5; $t_p = 8/20\text{ }\mu\text{s}$ /single shot	$P_{PP}$	240	W
ESD immunity	Contact discharge acc. IEC 61000-4-2; 10 pulses	$V_{ESD}$	$\pm 30$	kV
	Air discharge acc. IEC 61000-4-2; 10 pulses	$V_{ESD}$	$\pm 30$	kV
Operating temperature	Junction temperature	$T_J$	- 40 to + 125	°C
Storage temperature		$T_{STG}$	- 55 to + 150	°C

\*\* Please see document "Vishay Material Category Policy": [www.vishay.com/doc?99902](http://www.vishay.com/doc?99902)



## Electrical Characteristics

Ratings at - 40 °C to 85 °C, ambient temperature unless otherwise specified

### VBUS053AZ-HAF

All inputs (pin 1, 2, and 3) to ground (pin 7)

Parameter	Test conditions/remarks	Symbol	Min.	Typ.	Max.	Unit
Protection paths	Number of line which can be protected	N lines			3	lines
Reverse working voltage	at $I_R = 0.1 \mu A$	$V_{RWM}$	5.5			V
Reverse current	at $V_R = V_{RWM} = 3.3 V$ ; $T = 65 ^\circ C$	$I_R$			0.085	$\mu A$
	at $V_R = V_{RWM} = 5.5 V$	$I_R$			1	$\mu A$
Forward voltage	at $I_F = 15 mA$	$V_F$	0.7		1.2	V
Reverse breakdown voltage	at $I_R = 1 mA$	$V_{BR}$	6.5		10	V
Reverse clamping voltage	at $I_{PP} = 1 A$ ; acc. IEC 61000-4-5; $T = 25 ^\circ C$	$V_C$		10	12	V
	at $I_{PP} = 3 A$ ; acc. IEC 61000-4-5; $T = 25 ^\circ C$	$V_C$		15	18	V
Forward clamping voltage	at $I_F = 3 A$ ; acc. IEC 61000-4-5	$V_F$		3.4	4.1	V
Line capacitance	Test pin at $V_R = 0 V$ ; any other I/O pin at $V_R = 3.3 V$ , $f = 1 MHz$	$C_D$		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 $V_R = 0 V$ ; $f = 1 MHz$	$C_{DD}$		0.35	0.5	pF

$V_{BUS}$  (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 lines			1	line
Reverse working voltage	at $I_R = 100 nA$	$V_{RWM}$	12			V
Reverse current	at $V_R = V_{RWM} = 12 V$	$I_R$			100	nA
Forward voltage	at $I_F = 10 mA$	$V_F$	0.6	0.75	0.9	V
Reverse breakdown voltage	at $I_R = 1 mA$	$V_{BR}$	15		18	V
Reverse clamping voltage	at $I_{PP} = 1 A$ ; acc. IEC 61000-4-5; $T = 25 ^\circ C$	$V_C$		17.5	20	V
	at $I_{PP} = 8 A$ ; acc. IEC 61000-4-5; $T = 25 ^\circ C$	$V_C$		25	30	V
Forward clamping voltage	at $I_F = 8 A$ ; acc. IEC 61000-4-5	$V_F$			2.2	V
Line capacitance	at $V_R = 0 V$ ; $f = 1 MHz$	$C_D$		70	85	pF

## Application Note

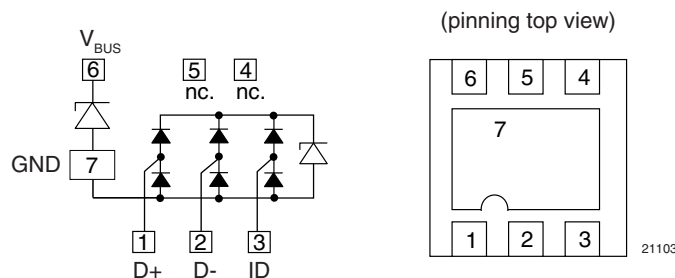
The VBUS053AZ-HAF is intended as an ESD-protection and transient voltage suppressor for one USB-OTG port.

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 pins 1, 2, and 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.



## Typical Characteristics

$T_{amb} = 25^\circ\text{C}$ , unless otherwise specified

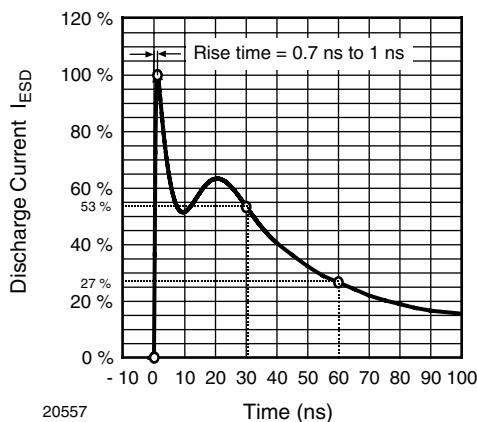


Figure 1. ESD Discharge Current Wave Form  
 acc. IEC 61000-4-2 (330  $\Omega$ /150 pF)

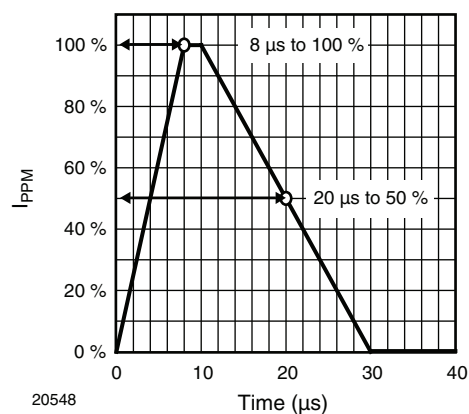


Figure 2. 8/20  $\mu\text{s}$  Peak Pulse Current Wave Form  
 acc. IEC 61000-4-5

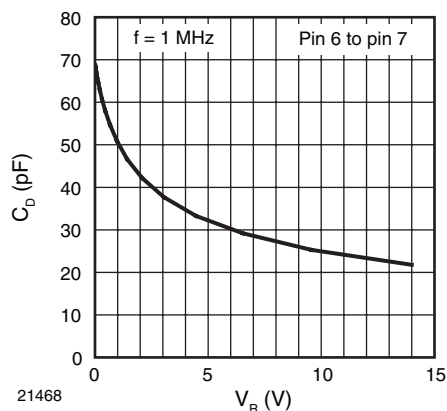


Figure 3. Typical Capacitance  $C_D$  vs. Reverse Voltage  $V_R$

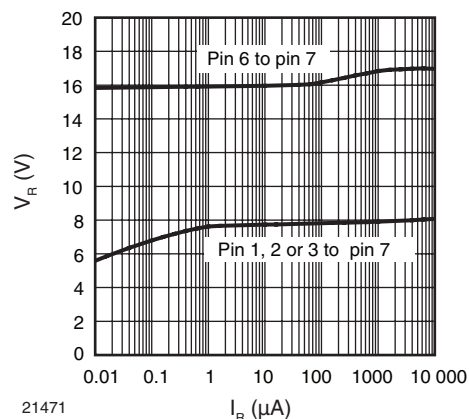


Figure 6. Typical Reverse Voltage  $V_R$  vs. Reverse Current  $I_R$

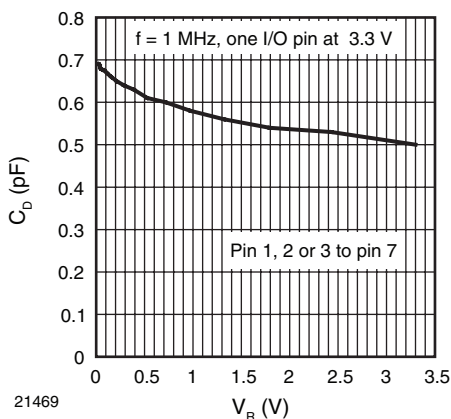


Figure 4. Typical Capacitance  $C_D$  vs. Reverse Voltage  $V_R$

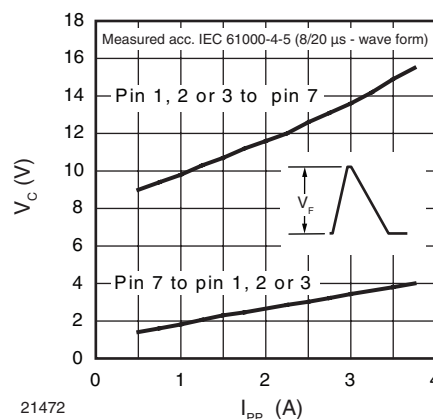


Figure 7. Typical Peak Clamping Voltage  $V_C$  vs. Peak Pulse Current  $I_{PP}$

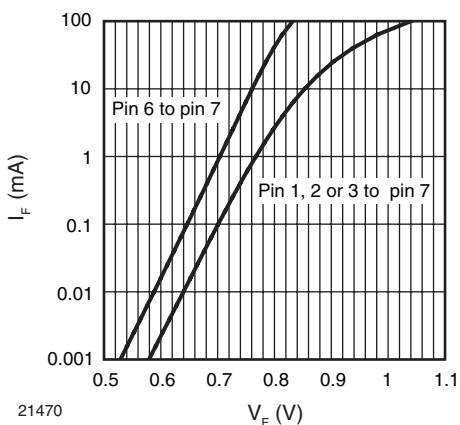


Figure 5. Typical Forward Current  $I_F$  vs. Forward Voltage  $V_F$

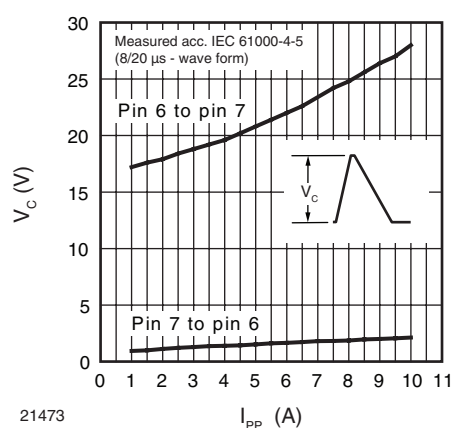


Figure 8. Typical Peak Clamping Voltage  $V_C$  vs. Peak Pulse Current  $I_{PP}$



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