USB-OTG BUS-Port ESD-Protection for V_{BUS} = 28 V

Features

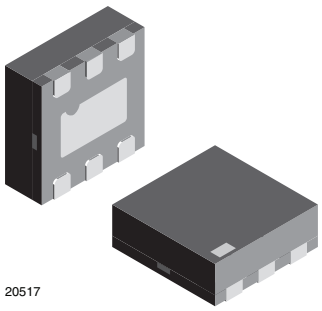
- Ultra compact LLP75-7L package
- Low package height < 0.6 mm
- 3-line USB ESD-protection with max. working range = 5.5 V
- V_{BUS}-protection with 28 V working range
- Low leakage current
- Low load capacitance C_D = 0.7 pF
- ESD-protection to IEC 61000-4-2
  - ± 8 kV contact discharge
  - ± 15 kV air discharge
- Surge current acc. IEC 61000-4-5 I_{PP} > 3 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

Pb-free

e4

RoHS COMPLIANT

GREEN (5-2008)**



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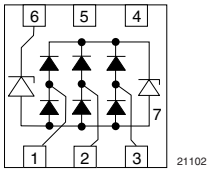
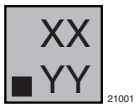


Marking (example only)



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
VBUS053CZ-HAF	VBUS053CZ-HAF-G-08	15 000	15 000

Package Data

Device name	Package name	Marking code	Weight	Molding compound flammability rating	Moisture sensitivity level	Soldering conditions
VBUS053CZ-HAF	LLP75-7L	UA	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
Data line D+, D-, ID: Pin 1, 2 and 3 to ground (pin 7)				
Peak pulse current	Acc. IEC 61000-4-5; t_p = 8/20 µs/single shot	I_{PPM}	3	A
Peak pulse power	Acc. IEC 61000-4-5; t_p = 8/20 µs/single shot	P_{PP}	36	W
ESD immunity	Contact discharge acc. IEC 61000-4-2; 10 pulses	V_{ESD}	± 15	kV
	Air discharge acc. IEC 61000-4-2; 10 pulses	V_{ESD}	± 15	kV
V_{BUS}: Pin 6 to ground (pin 7)				
Peak pulse current	Acc. IEC 61000-4-5; t_p = 8/20 µs/single shot	I_{PPM}	3	A
Peak pulse power	Acc. IEC 61000-4-5; t_p = 8/20 µs/single shot	P_{PP}	180	W
ESD immunity	Contact discharge acc. IEC 61000-4-2; 10 pulses	V_{ESD}	± 8	kV
	Air discharge acc. IEC 61000-4-2; 10 pulses	V_{ESD}	± 15	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

Electrical Characteristics

Ratings at 25 °C ambient temperature unless otherwise specified

VBUS053CZ-HAF

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

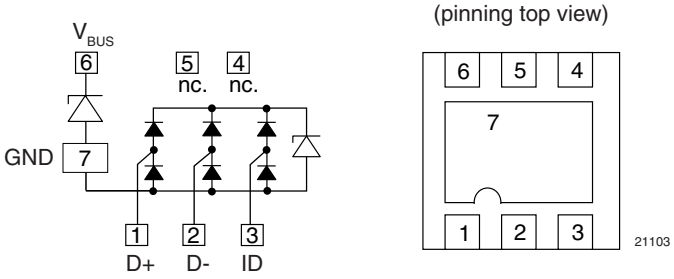
Parameter	Test conditions/remarks	Symbol	Min.	Typ.	Max.	Unit
Protection paths	Number of line which can be protected	N lines			3	lines
Reverse working voltage	at I_R = 0.1 µA	V_{RWM}	5.5			V
Reverse current	at $V_R = V_{RWM}$ = 3.3 V; T = 65 °C	I_R			0.085	µA
	at $V_R = V_{RWM}$ = 5.5 V	I_R			1	µA
Forward 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	V_C		10	12	V
	at I_{PP} = 3 A; acc. IEC 61000-4-5	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}	28			V
Reverse current	at $V_R = V_{RWM}$ = 28 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}	32		40	V
Reverse clamping voltage	at I_{PP} = 1 A; acc. IEC 61000-4-5; T = 25 °C	V_C		41	48	V
	at I_{PP} = 3 A; acc. IEC 61000-4-5; T = 25 °C	V_C		53	60	V
Forward clamping voltage	at I_F = 3 A; acc. IEC 61000-4-5	V_F			2.2	V
Line capacitance	at V_R = 0 V; f = 1 MHz	C_D		40	50	pF

Application Note

The VBUS053CZ-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 28 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 °C, unless otherwise specified)

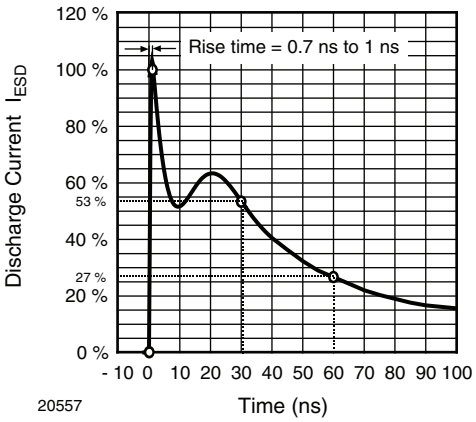


Figure 1. ESD Discharge Current Wave Form acc. IEC 61000-4-2 (330 Ω/150 pF)

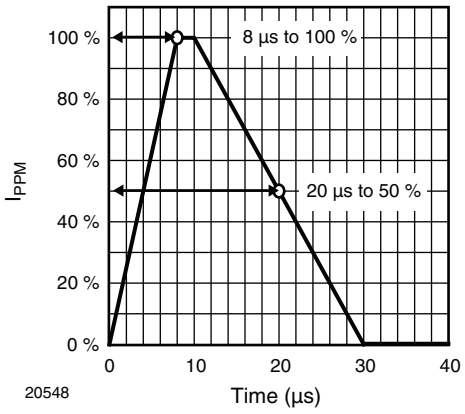


Figure 2. 8/20 µs Peak Pulse Current Wave Form acc. IEC 61000-4-5

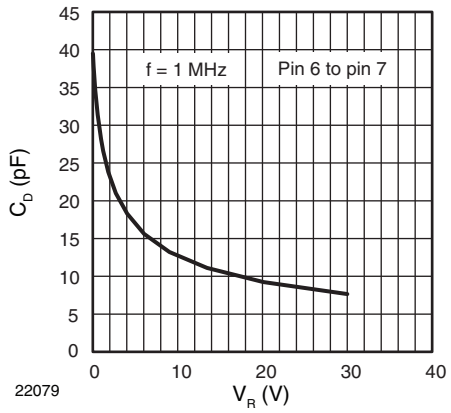


Figure 3. Typical Capacitance C_D vs. Reverse Voltage V_R

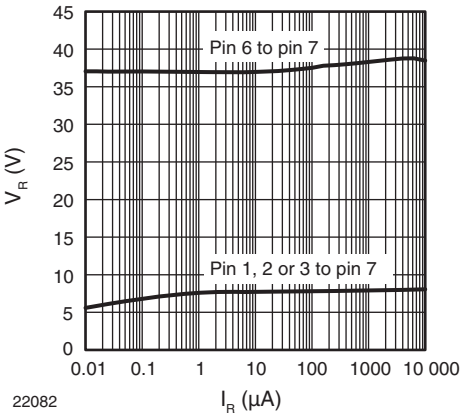


Figure 6. Typical Reverse Voltage V_R vs. Reverse Current I_R

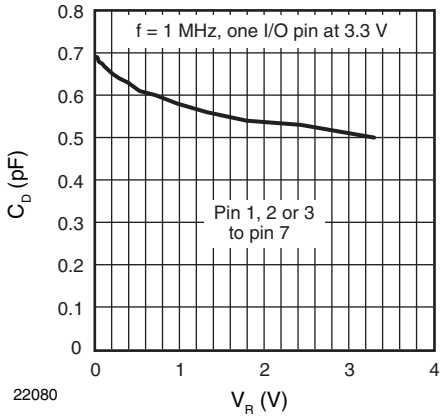


Figure 4. Typical Capacitance C_D vs. Reverse Voltage V_R

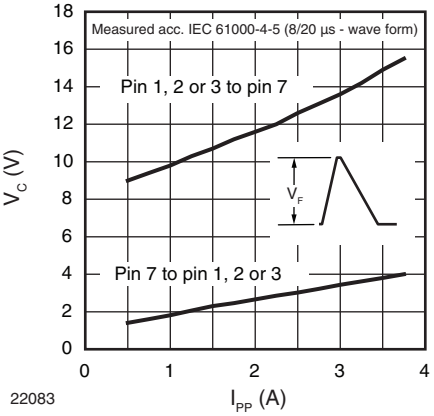


Figure 7. Typical Peak Clamping Voltage V_C vs. Peak Pulse Current I_{PP}

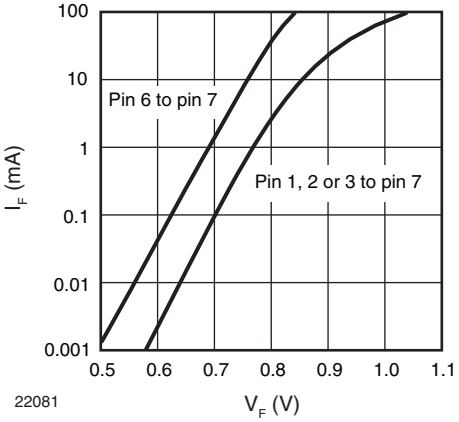


Figure 5. Typical Forward Current I_F vs. Forward Voltage V_F

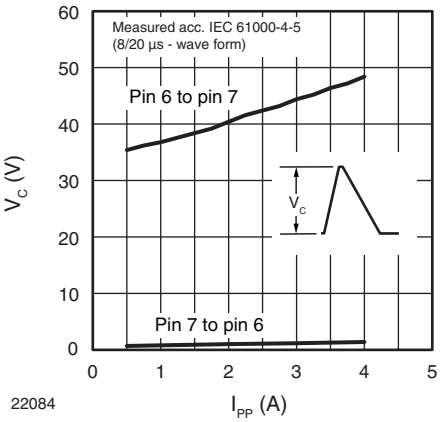


Figure 8. Typical Peak Clamping Voltage V_C vs. Peak Pulse Current I_{PP}

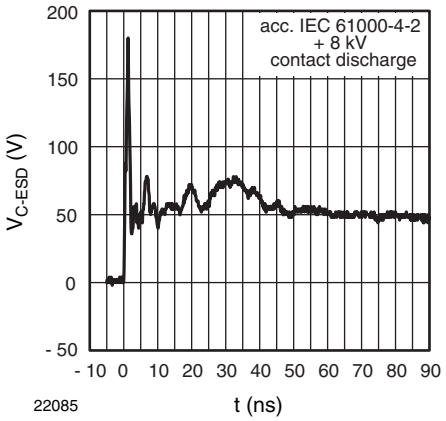
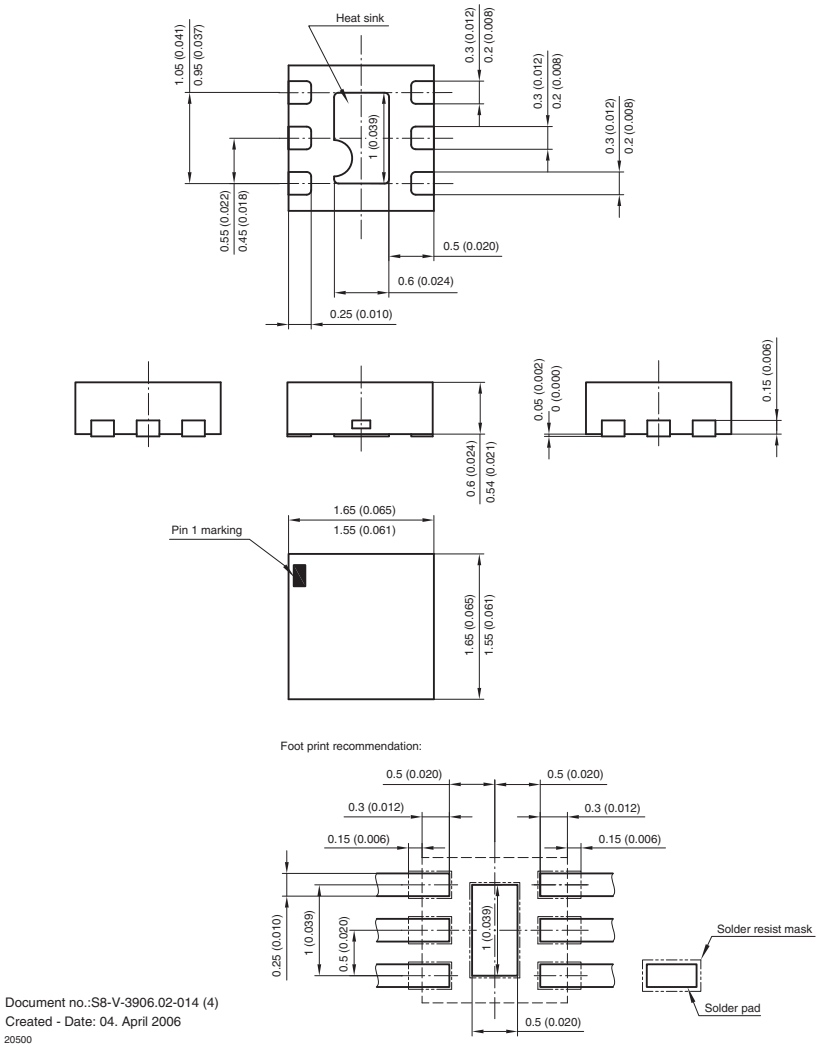


Figure 9. Typical Clamping Performance at + 8 kV Contact Discharge (acc. IEC 61000-4-2)

Package Dimensions in millimeters (inches): **LLP75-7L**



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