USB6B1

Data line protection

Applications

Where transient overvoltage protection in sensitive equipment is required, such as:

- Universal Serial Bus ports
- RS-423 interfaces
- RS-485 interfaces
- ISDN equipment
- T1/E1 line cards
- HDSL / ASDL interfaces

Features

- Full diode bridge with integrated clamping protection
- Breakdown voltage: V_{BR} = 6 V min.
- Peak pulse power dissipation: P_{PP} = 500 W (8/20 µs)
- Very low capacitance, compatible with high debit data or signal rates.

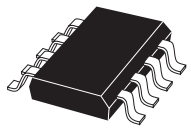
Description

In order to prevent fast transients from leading to severe damages in a high speed data system, a specific protection has been developed by STMicroelectronics.

The **USB6B1** protects the two input lines against overvoltage. Besides, this device also keeps the power rails in a safe limit thanks to the integrated Transil diode.

Benefits

- Provides protection for each line and between the supply voltage and GND: 25 A, 8/20 µs.
- High ESD protection level: up to level 3 per MIL STD 883C-Method 3015-6
- Separated inputs and outputs (so-called 4-point structure) to improve ESD susceptibility.
- Comprehensive package pin-out for immediate implementation.

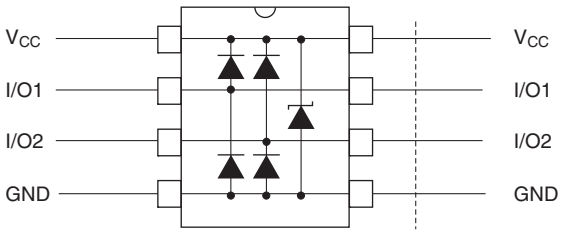


SO-8

Order Codes

Part Numbers	Marking
USB6B1	USB62
USB6B1RL	USB62

Functional diagram



Complies with the following standards:

MIL STD 883C - Method 3015-6

class 3 C = 100 pF R = 1500 Ω

3 positive strikes and 3 negative strikes (F = 1 Hz)

IEC 61000-4-2 level 4

15 kV (air discharge)

8 kV (contact discharge)

1 Characteristics

Table 1. Absolute maximum ratings

Symbol	Parameter		Value	Unit
V_{PP}	Peak pulse voltage	IEC61000-4-2 contact discharge IEC61000-4-2 air discharge MIL STD883C-Method 30 15-6	8 15 4	kV
P_{PP}	Peak pulse power	8/20 µs	500	W
I_{PP}	Peak pulse current	8/20 µs	25	A
		2/10 µs	40	
T_{stg} T_{op}	Storage temperature range Operating temperature range		- 55 to + 150 - 40 to + 85	° C ° C
T_L	Lead solder temperature (10 s duration)		260	° C

Table 2. Electrical characteristics (T_{amb} = 25° C)

Symbol	Parameter		Value			Unit
			Min	Typ	Max	
V_{BR}	Breakdown voltage between V_{BUS} and GND	I_R = 1 mA	6			V
I_{RM}	Leakage current	V_{RM} = 5.25 V			10	µA
C	Capacitance between pins D+ and D- V_{OSC} = 30 mV, F = 1 MHz, V_R = 0 V	V_{CC} not connected		15		pF
	Capacitance between pins D+(or D-) and GND V_{OSC} = 30 mV, F = 1 MHz, V_R = 5 V	V_{CC} = 5 V		25		pF

Figure 1. Peak power dissipation versus initial junction temperature

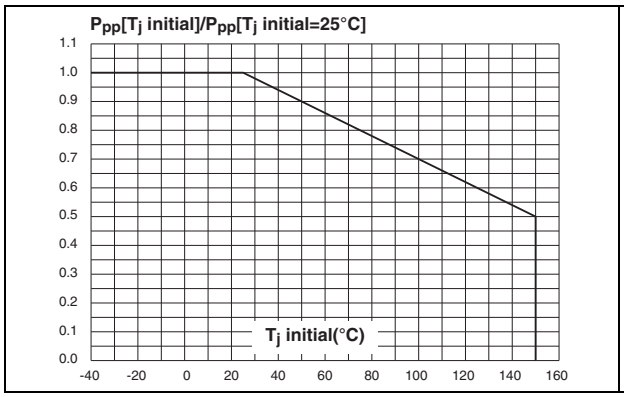


Figure 2. Relative variation of leakage current versus junction temperature (typical values)

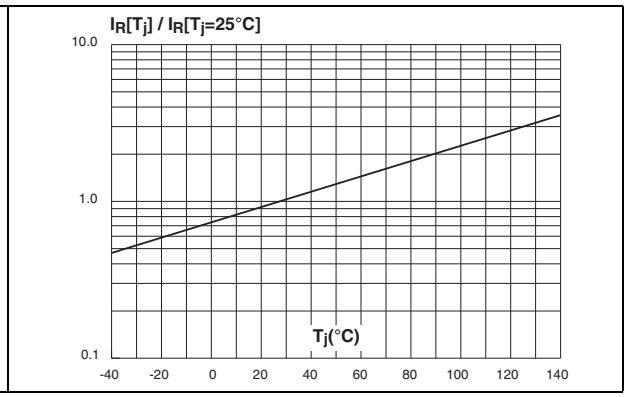
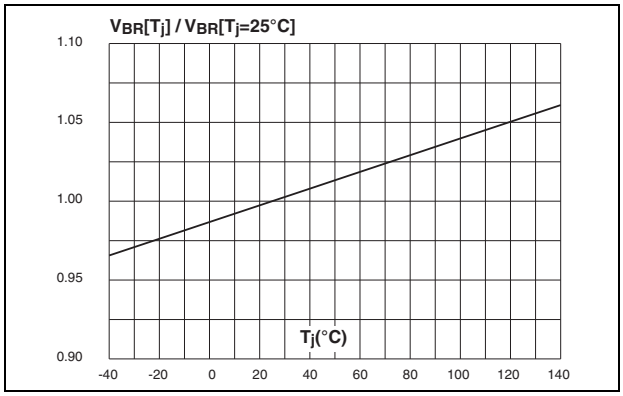


Figure 3. Relative variation of breakdown voltage versus junction temperature (typical values)



2 Technical information

2.1 Surge protection

The USB6B1 is optimized to perform surge protection based on the rail to rail topology.

The clamping voltage V_{CL} can be estimated as follow:

$V_{CL}+ = V_{CC} + V_F$ for positive surges

$V_{CL}- = - V_F$ for negative surges

with: $V_F = V_t + r_d.Ip$

V_F = forward drop voltage, V_t = forward drop threshold voltage

Note: The estimations do not take into account phenomena due to parasitic inductances.

Figure 4. Surge behavior

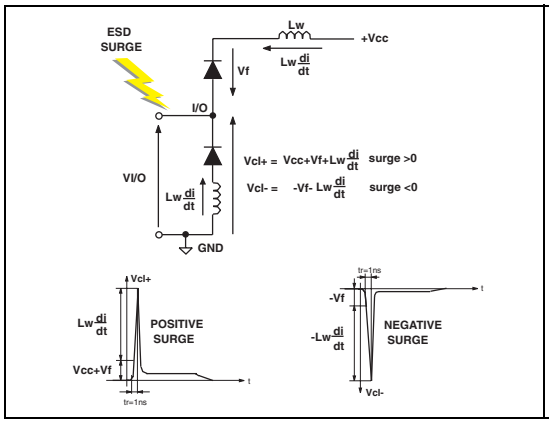
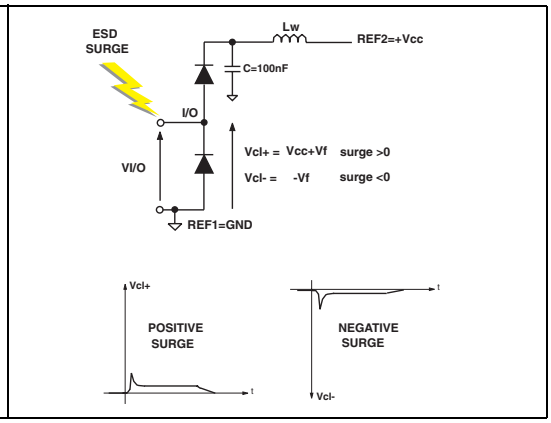


Figure 5. ESD behavior: optimized layout and addition of a 100 nF capacitor



2.2 How to ensure good ESD protection

While the USB6B1 provides a high immunity to ESD surge, an efficient protection depends on the layout of the board. In the same way, with the rail to rail topology, the track from the V_{CC} pin to the power supply and from the GND pin to GND voltage must be as short as possible to avoid overvoltages due to parasitic phenomena (see *Figure 4.*)

It's often harder to connect the power supply near to the USB6B1 unlike the ground thanks to the ground plane that allows a short connection. To ensure the same efficiency for positive surges when the connections can't be short enough, we recommend to putting a 100 nF c apacitor close to the USB6B1 between V_{CC} and ground to prevvent these kinds of overvoltage disturbances (see *Figure 5.*) The addition of this capacitor offers better protection by providing a constant voltage during the surge.

Figure 6. shows the improvement of the ESD protection according to the recommendations described above.

Important: An imortant precaution to take is to put the protection device closer to the disturbance source (generally the connection).

2.3 Universal Serial Bus

The data transmission standard, Universal Serial Bus (USB) is being driven by market leaders in the world of Computer and Telecommunications, including Compaq, DEC, IBM, Intel, Microsoft, NEC and Nortel, and has become a leading transmission protocol.

This standard mainly provides simplified interconnectivity. Specialized ports on the back of the present PC will largely be replaced by USB ports. Many peripherals such as printers, key-boards, monitors and joysticks use USB ports.

The USB offers high speed communication rates up to 480 Mbit/s. Only two wires (D+, D-) are required for data transfer. Additionally, limited amount of power for USB devices located on the downstream can also be transmitted on two separate conductors within the same cable.

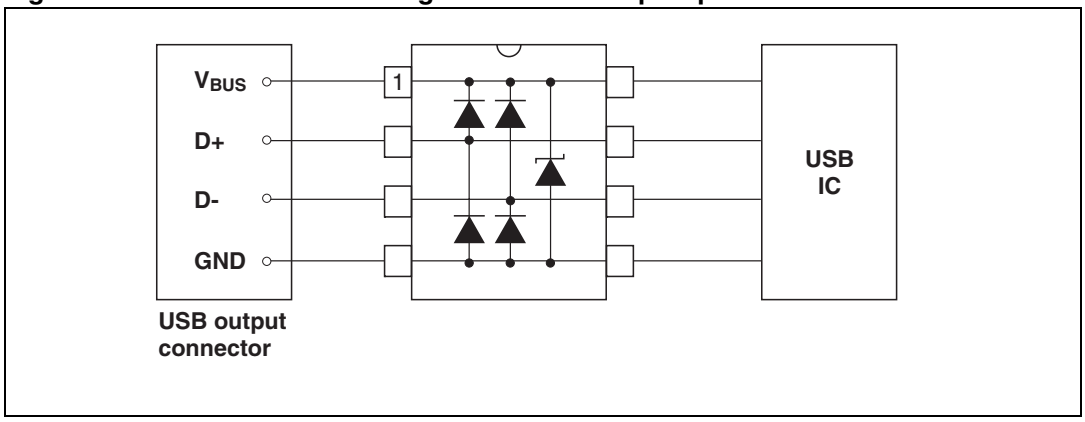
2.4 Protection to support USB

Designers dealing with the USB chips are concerned about electrostatic discharge sensitivity (ESD) of their USB controller ICs.

The USB controller is more than just a driver / receiver; it acts as a microcontroller which manages power and direct signal traffic. This complexity increases its cost over conventional devices. Therefore, a failure of a USB port could result in costly computer failure.

In order to prevent these fast transients from leading to severe damages in a system, a specific protection has been developed by STMicroelectronics. The USB6Bx protects not only the two wires of data transmission, but also keep the power rails in a safe limit.

Figure 6. Recommended configuration for USB port protection



The capacitance between the I/O transmission wires provides no significant signal distortion at the 12 Mbit/s data rate, thus allowing compatibility with USB standard.

Available in a compact SO-8 this protective element requires minimal board space and eases the PCB layout thanks to its direct compatibility with the USB connector pin-out.

3 Telecom and datacom applications

Figure 7. ISDN U interface protection

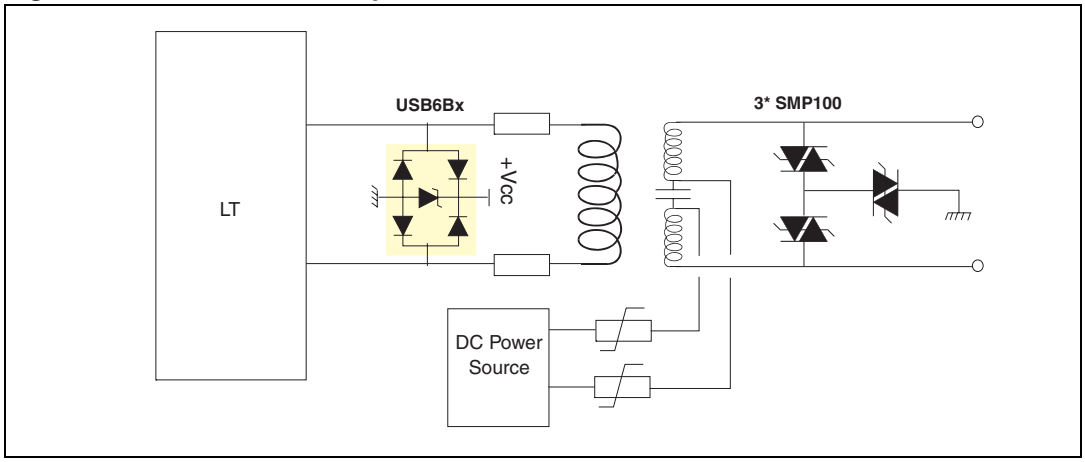


Figure 8. T1 / E1 Line Card Protection.

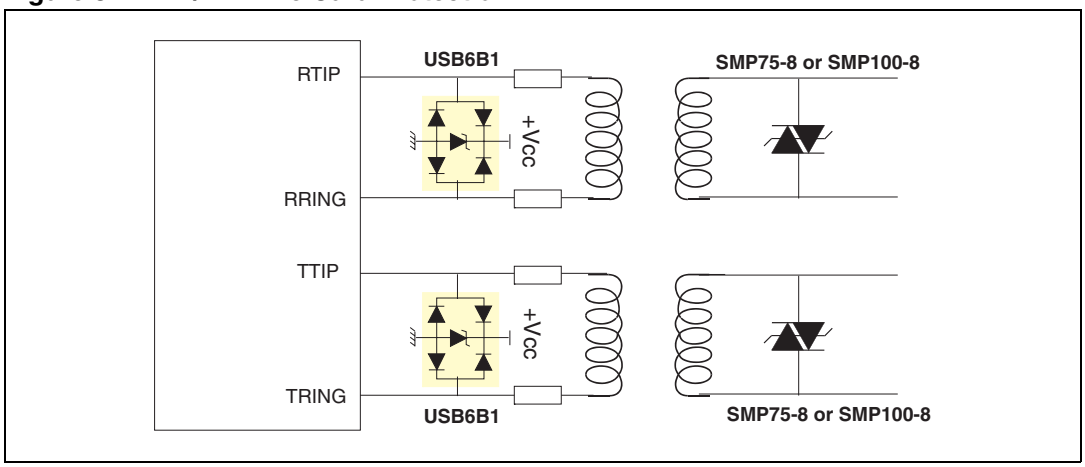
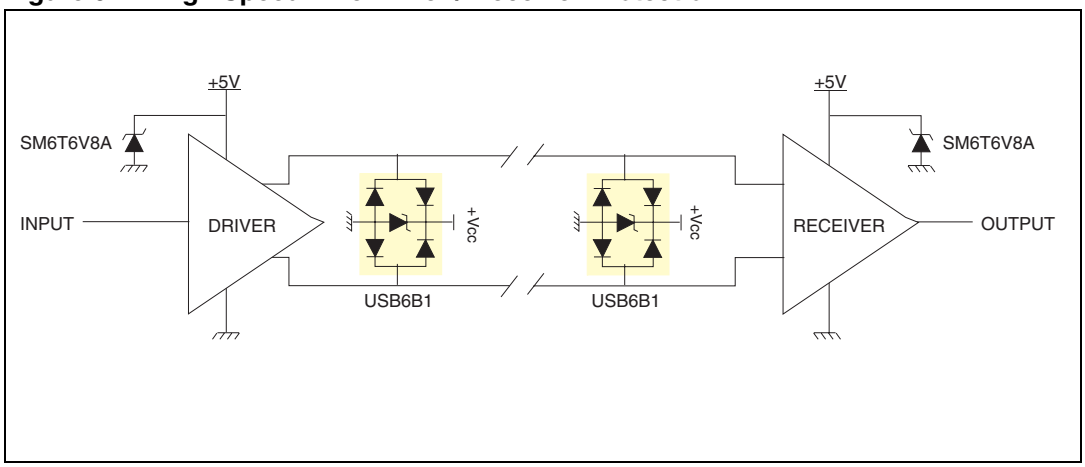
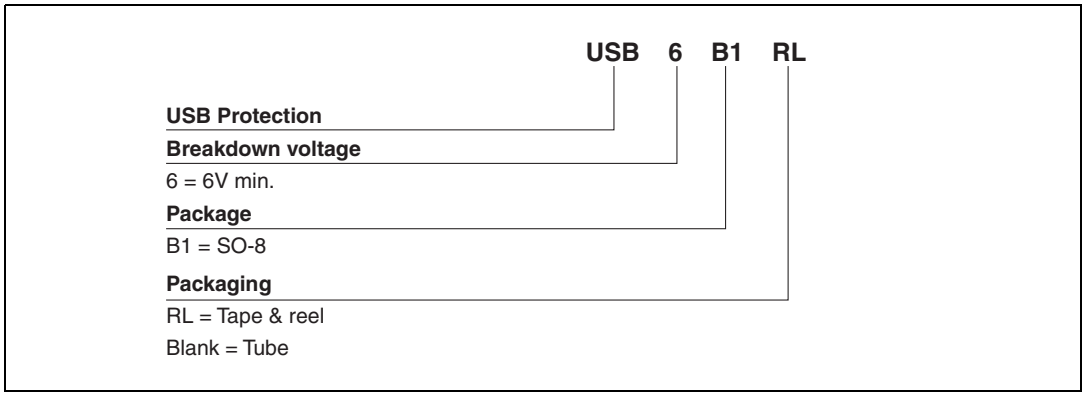


Figure 9. High Speed Line Driver / Receiver Protection



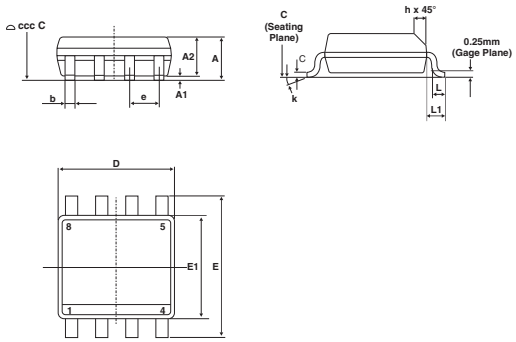
4 Ordering information scheme



5 Package information

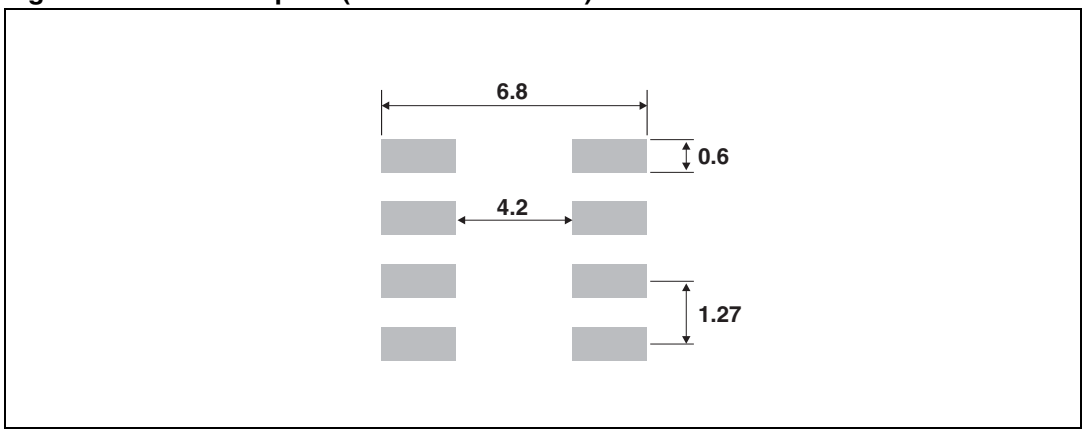
Epoxy meets UL94, V0

Table 3. SO-8 dimensions



Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
A1	0.1		0.25	0.004		0.010
A2	1.25			0.049		
b	0.28		0.48	0.011		0.019
C	0.17		0.23	0.007		0.009
D	4.80	4.90	5.00	0.189	0.193	0.197
E	5.80	6.00	6.20	0.228	0.236	0.244
E1	3.80	3.90	4.00	0.150	0.154	0.157
e		1.27			0.050	
h	0.25		0.50	0.010		0.020
L	0.40		1.27	0.016		0.050
L1		1.04			0.041	
k°	0		8	0		8
ccc			0.10			0.004

Figure 10. SO-8 footprint (dimensions in mm)



In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com.

6 Ordering information

Ordering code	Marking	Package	Weight	Base qty	Delivery mode
USB6B1	USB62	SO-8	0.077 g	100	Tube
USB6B1RL	USB62			2500	Tape and reel

7 Revision history

Date	Revision	Description of Changes
Oct-2003	6A	Previous issue.
03-May-2005	7	Figure 1 on page 1: dots connection corrected.
22-Feb-2006	8	Marking typing error corrected on page 1 and 7.
16-Aug-2006	9	Reformated to current standard. ECOPACK statement added. SO-8 package dimensions corrected.

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