

PROTECTION PRODUCTS

PRELIMINARY

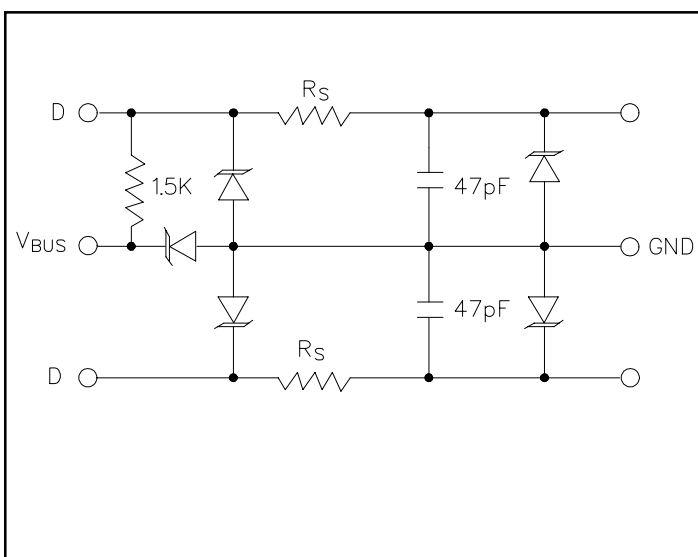
Description

The STF203-22 is a combination EMI filter and line termination device with integrated TVS diodes for use on upstream USB ports. It is constructed using a proprietary technology that allows passive components and TVS diodes to be integrated in the same package. Each device will provide **termination, filtering, and ESD protection** for one upstream USB port. The STF203-22 is an easily implemented solution for meeting the requirements of revision 1.1 of the Universal Serial Bus specification.

USB line termination is achieved with 22Ω series resistors on both the D+ and D- USB lines. These resistors preserve signal integrity by matching the cable impedance to that of the differential driver. The $1.5k\Omega$ pull-up resistor completes the termination circuit on each line. This resistor is required by the USB specification to identify the equipment as either a full-speed (connected to D+ line) or low-speed (connected to D- line) device. The $47pF$ capacitors are used to bypass high frequency energy to ground and for edge rate control of the USB signals. Finally, the STF203-22 contains TVS diodes for ESD protection of both (D+ & D-) data lines and the voltage bus (V_{BUS}). The TVS diodes provide effective suppression of ESD voltages in excess of $15kV$ (air discharge) and $8kV$ (contact discharge) per IEC 61000-4-2, level 4.

The small size and integrated feature of the STF203-22 minimizes required board space and increases system reliability. The STF203-22 is suitable for use in USB hubs, computers, peripherals, and portable devices.

Circuit Diagram



Features

- ◆ Bidirectional EMI/RFI filtering and line termination with integrated ESD protection
- ◆ ESD protection for USB power (V_{BUS}) and data lines (D+ & D-) to **IEC 61000-4-2 Level 4**
- ◆ Filtering and termination for two USB data lines
- ◆ Series resistors for impedance matching
- ◆ Low TVS operating voltage (5.25V)
- ◆ Low leakage current
- ◆ Small SC70-6L package
- ◆ Solid-state technology

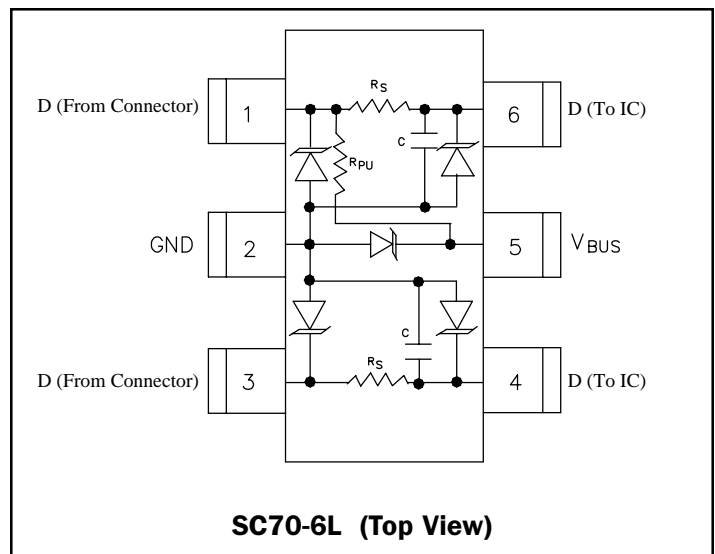
Mechanical Characteristics

- ◆ EIAJ SC70-6L package
- ◆ Molding compound flammability rating: UL 94V-0
- ◆ Marking : Marking Code
- ◆ Packaging : Tape and Reel per EIA 481

Applications

- ◆ USB Ports
- ◆ Portable electronics
- ◆ Cellular Handsets
- ◆ PDA
- ◆ Pagers
- ◆ Digital Cameras
- ◆ Peripherals
- ◆ Notebook, and Handheld Computers

Schematic & PIN Configuration



Absolute Maximum Rating

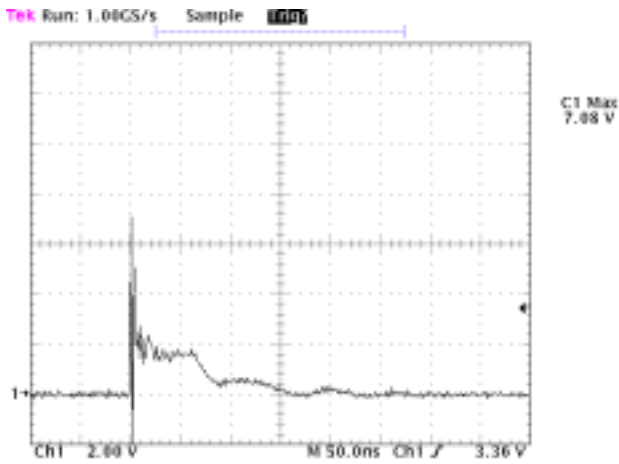
Rating	Symbol	Value	Units
Steady-State Power	P_{pk}	100	Watts
ESD Air Discharge per IEC 61000-4-2	V_{pp}	16	kV
ESD Contact Discharge per IEC 61000-4-2	V_{FP}	10	kV
Lead Soldering Temperature	T_L	260 (10 sec.)	°C
Operating Temperature	T_J	-40 to +125	°C
Storage Temperature	T_{STG}	-55 to +150	°C

Electrical Characteristics

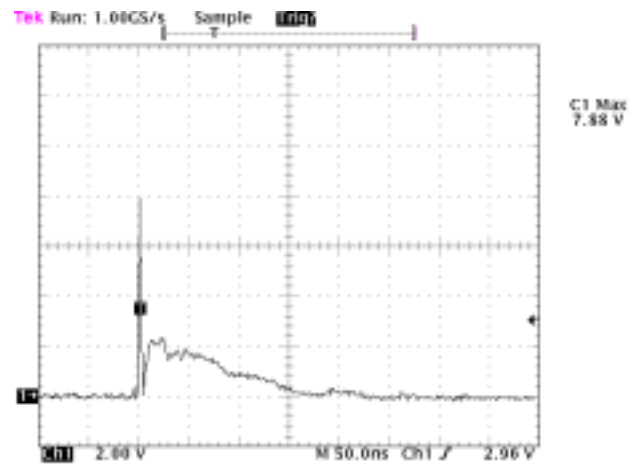
STF203						
Parameter	Symbol	Conditions	Minimum	Typical	Maximum	Units
TVS Reverse Stand-Off Voltage	V_{RWM}				5.25	V
TVS Reverse Breakdown Voltage	V_{BR}	$I_t = 1mA$	6			V
TVS Reverse Leakage Current	I_R	$V_{RWM} = 5.25V, T=25^\circ C$ Between V_{BUS} pin and Ground			5	μA
TVS Reverse Leakage Current	I_R	$V_{RWM} = 3.3V, T=25^\circ C$ Between any data (D+, D-) pin and Ground.			1	μA
TVS Junction Capacitance	C_J	Between I/O pins and Ground, each device $V_R = 0V, f = 1MHz$		10		pF
Series Resistance (STF203-22)	R_S	Each Line	20	22	24	Ω
Pull Up Resistance	R_{UP}	Each Line	1.35	1.5	1.65	k Ω
Capacitor	C	Each Line		47		pF
Total Capacitance	C_{TOT}	Between Input or Output to Ground $V_R = 0V, f = 1MHz$		60		pF

Typical Characteristics

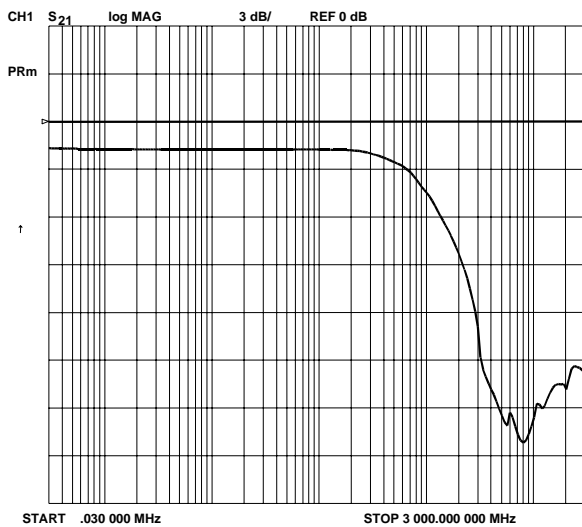
ESD Clamping (8kV Contact)



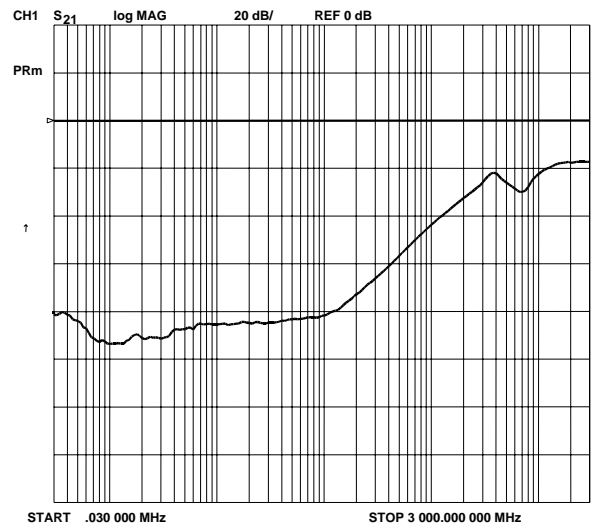
ESD Clamping (15kV Air)



Typical Insertion Loss



Analog Crosstalk (D+ to D-)



Device Connection

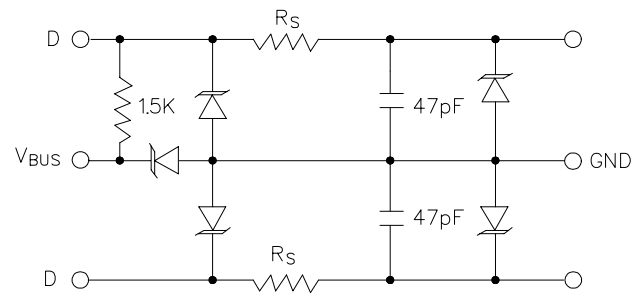
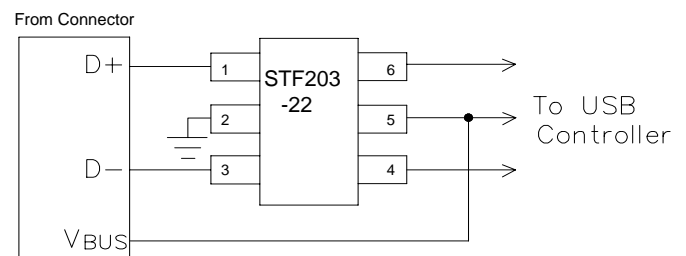
The STF203-22 is designed to provide termination, EMI filtering and ESD protection for two USB I/O lines. The equivalent circuit diagram is shown in Figure 1. The device is connected as follows:

1. **Full-Speed Devices:** For full-speed devices the pull-up resistor is connected to the D+ line. Pin 5 is connected to the voltage supply line (V_{BUS}). Route the D+ line from the connector to pin 1 and pin 6 to the D+ line of the IC. Route the D- line from the connector to pin 3 and pin 4 to the D- line of the IC. Pin 2 is connected to ground.
2. **Low-Speed Devices:** For low speed devices the pull-up resistor is connected to the D- line. Pins 5 is connected to the voltage supply line (V_{BUS}). Route the D- line from the connector to pin 1 and pin 6 to the D- line of the IC. Route the D+ line from the connector to pin 3 and pin 4 to the D+ line of the IC. Pin 2 is connected to ground.

USB Port Design Considerations

The Universal Serial Bus (USB) specification requires termination and filtering components for proper operation. In addition, an open USB socket is vulnerable to hazardous ESD discharges in excess of 15kV. These discharges can may occur on the data lines or the voltage bus. The STF203-22 is an easily implemented solution designed to meet the termination & EMI filter requirements of the USB specification revision 1.1. It also provides ESD protection to IEC 61000-4-2, level 4.

USB line termination is achieved with series resistors on both the D+ and D- lines. These resistors preserve signal integrity by matching the cable impedance to that of the differential driver. 15k Ω pull-down resistors are used to identify a downstream port while an upstream port is identified with a 1.5K Ω pull up resistor on either the D+ (full speed devices) or the D- (low speed devices) data line. Capacitors are used to bypass high frequency energy to ground and for edge rate control of the USB signals. TVS diodes are added for ESD protection of both (D+ & D-) data lines and the voltage bus (V_{BUS}). A power distribution switch and voltage regulator provide the power management functions of the port. Semtech provides a complete solution to simplify USB port design. The STF201 &

Figure 1 - STF203-22 Circuit Diagram

Figure 2 - STF203-22 Connection Diagram (Full Speed Devices)


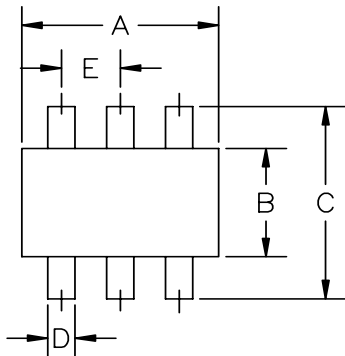
STF202 or STF203-22 integrate all of the components necessary for line termination, bidirectional EMI filtering, and ESD protection on downstream (STF201) or upstream (STF202 or STF203-22) ports. The SC5826 is a dual port power switch that provides individual or ganged port switching, fault reporting, and inrush current limiting as required by the USB specification. The SC5205 ULDO provides a stable voltage to the USB controller.

Board Placement & Layout Guidelines.

Designing a USB hub to meet EMI & ESD immunity requirements requires a combination of optimum component placement, trace routing, and good circuit design practices. Some general guidelines are given below:

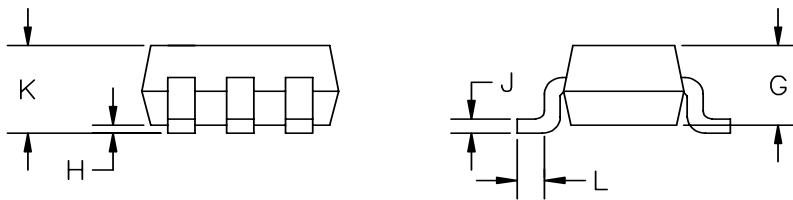
- Avoid running D+ & D- signal line traces near high speed clock lines or similar signal lines.
- Avoid running critical signal lines near board edges.
- Locate the USB controller chip near the USB connectors.
- Place the STF203-22 near the USB connector to restrict transient coupling.
- Minimize the path length between the USB connector and the STF203-22

Outline Drawing



DIM ^N	DIMENSIONS ^①				NOTE
	INCHES		MM		
	MIN	MAX	MIN	MAX	
A	.071	.087	1.80	2.20	—
B	.045	.053	1.15	1.35	—
C	.071	.094	1.80	2.40	—
D	.006	.012	.150	.300	—
E	.026	BSC	.650	BSC	—
G	.031	.039	.800	1.00	—
H	0.00	.004	0.00	.100	—
J	.004	.007	.100	.180	—
K	.031	.043	.800	1.10	—
L	.004	.012	.100	.300	—

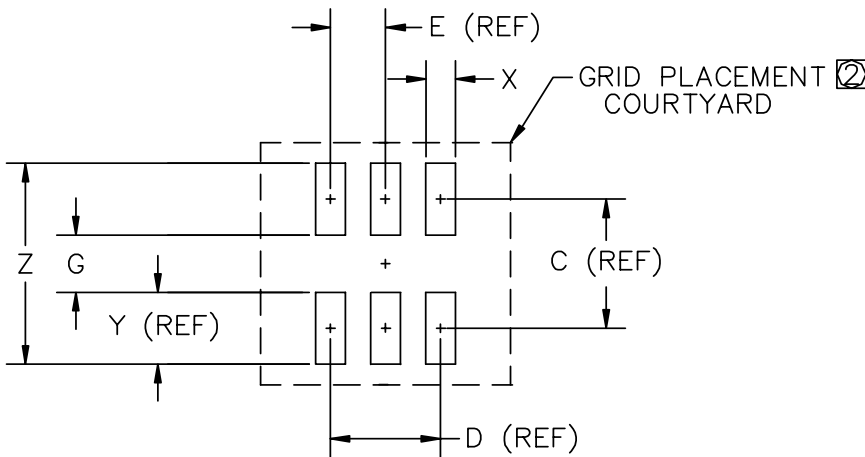
JEDEC EIAJSC70



② PACKAGE OUTLINE EXCLUSIVE OF MOLD FLASH AND METAL BURR.

① CONTROLLING DIMENSIONS: MILLIMETERS.

Land Pattern

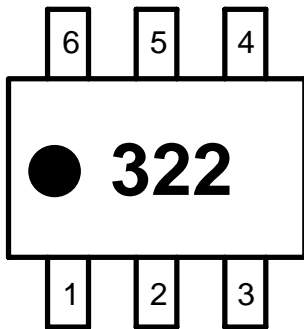


DIM ^N	DIMENSIONS ^①				NOTE
	INCHES		MM		
	MIN	MAX	MIN	MAX	
C	—	.063	—	1.60	—
D	—	.052	—	1.30	—
E	—	.026	—	.65	—
G	—	.028	—	.70	—
X	—	.014	—	.35	—
Y	—	.035	—	.90	—
Z	—	.098	—	2.50	—

② GRID PLACEMENT COURTYARD IS 6 x 6 ELEMENTS (3 mm X 3 mm) IN ACCORDANCE WITH THE INTERNATIONAL GRID DETAILED IN IEC PUBLICATION 97.

① CONTROLLING DIMENSION: MILLIMETERS

Marking Codes



Ordering Information

Part Number	Series Resistor	Qty per Reel	Reel Size
STF203-22.TC	22 Ω	3,000	7 Inch

Contact Information

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 Protection Products Division
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