

ESD and EMI Filtering Solution for Large Data Arrays

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APPLICATION NOTE

Overview

The demand for greater integration and more functionality in consumer electronics, such as cell phones and other hand-held products, has caused an increase in the number of data lines being used. These data lines could be from a PDA's CPU to the display, or a cell phone's connector to the rest of the phone. Because of the size constraints on many of these products, it is advantageous to have as many components as possible integrated into a single component. When large numbers of data lines are required, integration can reduce part count significantly. For Electrostatic Discharge (ESD) and Electromagnetic Interference (EMI), filtering the NUF9001FC offers the capability to provide protection to ten data lines in a single flip-chip package. By integrating ESD and EMI protection into a single flip-chip component, the number of discrete components is reduced by at least twenty. The size advantage of the NUF9001FC with its ten lines, enables it to be used across many platforms. The same part can be used to provide ESD protection and EMI filtering whether or not all ten lines are used.

Functionality

The NUF9001FC utilizes two TVS diodes to provide ESD protection on each data line. The junction capacitance of the TVS diodes provides the capacitance element of the RC low pass filter. By using an integrated TVS diode, rather than a discrete varistor, or similar ESD protection remains consistent over repeated ESD events. The variation in clamping voltage with respect to the surge magnitude is also less when using a TVS diode. Further explanation of the TVS can be found in AND8026/D. The combination of the 200 Ω in series with 45 pF (Figure 1) of line capacitance to ground, gives the filter an attenuation of over -35 dB at 800 MHz to 3.0 GHz (Figure 2), and a cut-off frequency of 100 MHz under 50 Ω loads. This frequency response makes the NUF9001FC ideal for applications with data rates up to 25 Mbps.

To ensure proper functionality, all of the ground bumps must be attached to a well-defined ground plane. Not doing so will change the behavior of the EMI filter. It is very

important that all of the ground bumps be properly attached, even when all of the filter lines are not being used. Omitting any of the ground bumps will cause a significant increase in the inductance in the ground path. This, in turn, changes the frequency response of the filters.

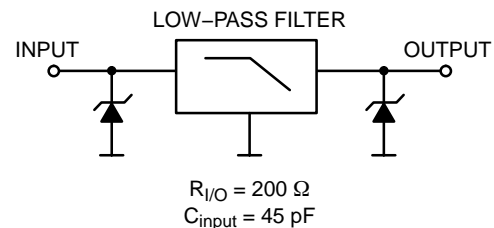


Figure 1. Functional Schematic of the NUF9001FC

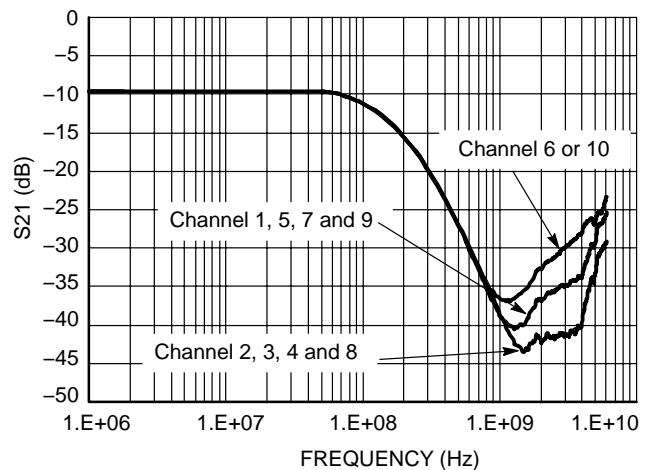


Figure 2. Insertion loss for each channel of the NUF9001FC. The graph shows a comparison of the insertion loss for each channel.

Another benefit the NUF9001FC offers, is the ten independent bidirectional lines can be used for more than one set of data lines. If for example, there are two sets of data lines, one with four lines and the other with six lines, near a data port connector, the NUF9001FC has the capability to handle the data. With more than -60 dB of isolation between

adjacent data lines in the pass band, there is no issue with analog cross talk. This means multiple sets of data sharing the NUF9001FC will not interfere with each other.

The layout of the NUF9001FC is optimized for the ease of routing large data arrays. With each line of the filter array, such that the input and output pins are on the mirrored side of the device (Figure 3), a series of ground bumps are located down the center line of the NUF9001FC to achieve maximum grounding and routing convenience (Figure 4).

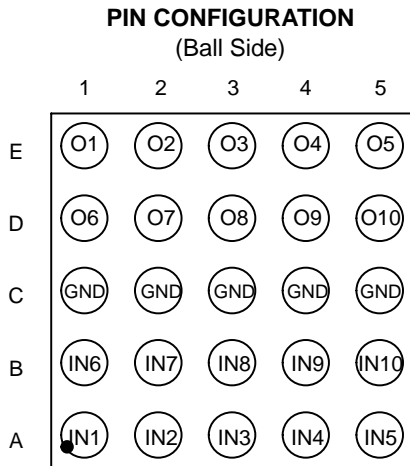


Figure 3. Bump and I/O Configuration

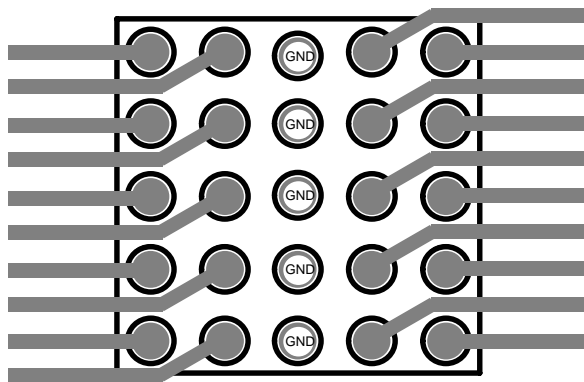


Figure 4. Typical routing for the NUF9001FC. All lines can be routed on single layer if line tolerances are fine enough. On multi-layer boards, bumps can be placed on solderable vias.

The NUF9001FC can be used in a number of configurations. Two common configurations are as an inline ESD/EMI filter between a digital logic transceiver and data port connector as in Figure 5, or providing filtering and protection between a video display driver and the display (Figure 6). When used with data port connectors, the NUF9001FC should be as electrically close to the connector as possible. This is done to protect the phone or other

electronic devices from any ESD that may come from the connector. The other typical use for the NUF9001FC is as an inline EMI filter for data lines to LCD displays. The NUF9001FC would be located next to the output of the display driver.

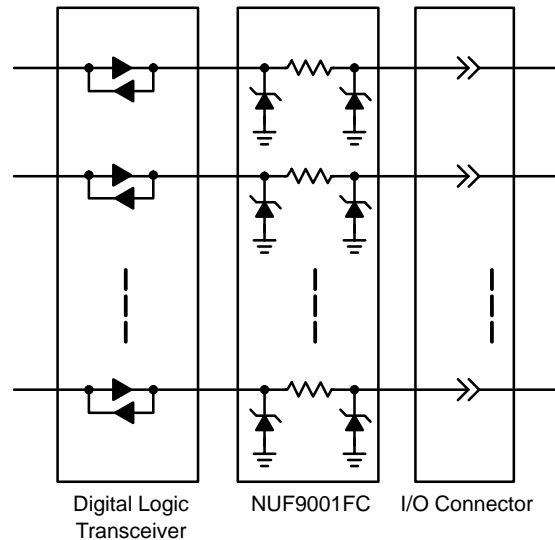


Figure 5. The NUF9001FC used as an ESD/EMI filter located between an I/O connector and the digital transceiver.

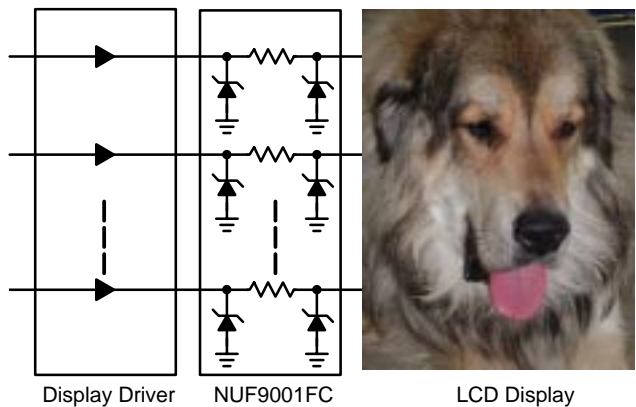


Figure 6. The NUF9001 used as an EMI filter for an LCD display. Protection is particularly needed for “flip” phones where data lines are susceptible ESD at the folding joint.

NUF9001FC is not limited to ESD and EMI filtering at data connectors and data displays, but can be used anywhere space is limited with a number data line that needs to be protected. It should be remembered that whenever ESD or EMI protection is needed, the protection device should be placed as near as possible to the source. The NUF9001FC’s size and form factor makes it a good choice for applications with a large number of data lines.

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