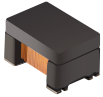


APPLICATION NOTE

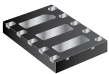
Circuit Protection Solution for ONT CPE (Gateway/Router/Switch)



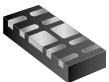
Model SM453229-381N7Y



Model SRF2012A-801Y



Model CDDFN10-2574N



Model CDDFN10-3324P



Model MF-SM013/250



Model TISP61089BDR-S



Model MF-SD013/250



Model CMF-SDP



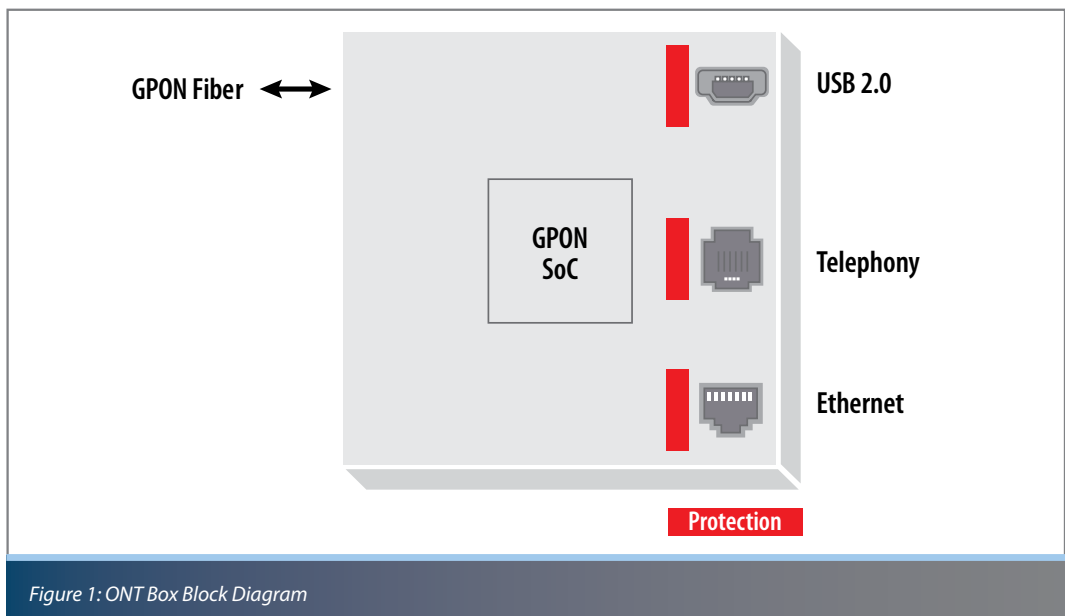
Model CGF0804TFH-R900-2L

BACKGROUND

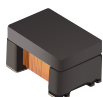
To meet the seemingly insatiable demand for streaming video programming and other video applications in the consumer home, many Telco providers are installing Fiber to the Home (FTTH) from the CO (central office). Fiber connectivity is growing at a rapid pace in developed and developing countries alike. Compared to Cable and xDSL, fiber provides almost limitless bandwidth that holds the promise to serve broadband customers for many years to come.

FTTH utilizes Gigabit Passive Optical Network (GPON) technology, which supports a data rate of 2.4 Gbps downstream and 1.2 Gbps upstream for up to 128 subscribers. In consumer premises equipment (CPE), the fiber is terminated with an Optical Network Terminal (ONT) that is typically placed in the garage or basement of homes or in the office and powered by the consumer. The sole purpose of the ONT box is to convert the optical signal in the fiber to an electrical signal.

Typical ONT input/output ports are shown in Figure 1. The ONT is connected to the CO with a fiber cable and equipped with popular high-speed serial data ports such as Gigabit Ethernet (GbE) or USB and also supports telephony via an RJ11 connector. A CPE ONT may support Wi-Fi if it is designed to be placed in a consumer living space. However, when an ONT is designed for remote placement, such as in the garage or basement, Wi-Fi is typically not provided. A separate home gateway router is then used to connect to the ONT via the Ethernet port to support Wi-Fi.



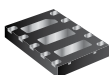
Circuit Protection Solution for ONT CPE (Gateway/Router/Switch)



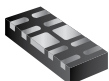
Model SM453229-381N7Y



Model SRF2012A-801Y



Model CDDFN10-2574N



Model CDDFN10-3324P



Model MF-SM013/250



Model TISP61089BDR-5



Model MF-SD013/250



Model CMF-SDP



Model CGF0804TFH-R900-2L

CHALLENGE

To minimize costly home repair visits by the ONT service provider, ONT boxes must be well protected from electrical line disturbances and also comply with all local surge requirements specified by standards like ITU-T, IEC and GR-1089. Adding surge protection to the ONT increases its cost and could increase its size; hence, critical trade-off decisions have to be made between the protection level afforded in the product and the acceptable size and cost of the ONT solution. Various protection solutions can be employed depending upon the type of port interface used.

ONT PORT PROTECTION SOLUTIONS

Gigabit Ethernet:

Protection of Ethernet PHY within the Ethernet port is commonly provided by an isolated transformer and PHY-side TVS diode array. Conventionally, the transformer is made by manual windings on the Toroidal core which add to the size of the design. The latest Chip LAN transformers are machine-wound on the H-Core winding and feature a low profile design, while offering the same isolation level. A low-profile Chip LAN transformer is preferable for a space-constrained ONT design. For PHY-side protection against differential (a.k.a. Transverse/Metallic) surges, a TVS diode array with a high peak pulse rating (I_{pp}) and low clamping voltage (V_C) is recommended.

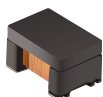
As shown in Figure 2, Bourns® Model SM453229-381N7Y is a one-pair Chip LAN transformer in a low-profile (2.9 mm height) and withstands the same 1500 V Hi-Pot level of conventional transformers. It also delivers a flexible PCB layout. Four Chip LAN transformers are needed for a Gigabit Ethernet (GbE) port.

Helping to reduce EMI, the Bourns® Model SRF2012A-801Y common mode chip inductor features a compact package (2 x 1.2 x 1.2 mm). To reject common mode noise, its common mode impedance of 1K ohms is reached at 250 MHz. Four devices are needed per Gigabit Ethernet port.

Likewise, the Model CDDFN10-2574N TVS diode array is well-suited for GbE, featuring extremely low clamping voltage (V_C) of 11 V maximum at a peak pulse current (I_{pp}) of a 45 A, 8/20 μ s surge waveform. Available in a small DFN package (3 x 2 mm), this TVS diode array allows flow-through routing to help maintain matched impedances of the high-speed data lines. Two devices are required for a GbE port.

An alternative for ESD protection if a surge test is not required is the Bourns® Model CDDFN10-3324P TVS diode array. It is available in a very compact feed-through SMD package (2.5 x 1 mm). Usage is also two per GbE port. Please see the [Bourns Ethernet - ESD Protection PortNote®](#) for additional information.

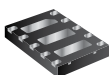
Circuit Protection Solution for ONT CPE (Gateway/Router/Switch)



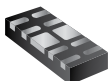
Model SM453229-381N7Y



Model SRF2012A-801Y



Model CDDFN10-2574N



Model CDDFN10-3324P



Model MF-SM013/250



Model TISP61089BDR-S



Model MF-SD013/250



Model CMF-SDP



Model CGF0804TFH-R900-2L

ONT PORT PROTECTION SOLUTIONS (CONTINUED)

Telephony:

Telephony or VoIP/SLIC port protection is relatively mature, having been used for more than a few decades. Typically, a thyristor-based overvoltage protector along with a PTC-based overcurrent protector is used. A radial-leaded PTC (Positive Temperature Coefficient) resettable fuse is commonly used due to its low cost, but it requires manual insertion during the PCB soldering process, thereby increasing production costs. With the continuous drive to reduce product cost, the trend is to steer away from leaded components in favor of surface mount devices (SMDs) that can be handled and placed on the PC board by automation.

Bourns offers industry leading telephony port protection that helps to comply with telecom industry safety standards. Bourns® Model MF-SM013/250 telecom PTC resettable fuse is offered in a low-profile (3.7 mm height) SMD package; it not only fits in space-constrained designs but also facilitates factory automation. Two devices are needed for a telephony port.

Another optimal solution is the Model TISP61089BDR-S dual programmable thyristor surge protector offered in an 8-SOIC SMD package. Bourns designed this device to protect monolithic SLICs (Subscriber Line Interface Circuits) against overvoltage on the telephone line caused by lightning, AC power contact and induction. One thyristor is used for a telephony port.

Alternative solutions are the Bourns® Model MF-SD013/250 and CMF-SDP series. These telecom PTC resettable fuses with “dual” resistance-matched PTCs are available in SMD packages (10.2 mm height). They offer a space-saving PCB solution if height is not a constraint. Only one device is required for a telephony port. For the implementation of above solution please see Figure 2.

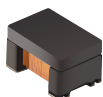
USB:

A USB port is normally equipped with ESD protection to safeguard and superspeed it from surge events that can take place during plugging and unplugging event. New high-speed USB ports also need to be protected against excessive electromagnetic emission (EMI). To keep the added protection cost and size for USB port to acceptable limits, ONT CPE suppliers usually integrate an ESD diode with common mode filters.

Bourns® Model CGF0804TFH-R900-2L protector integrates both ESD and a common mode filter in a space-saving package (0.65 x 0.85 mm). It features very low capacitance (3 GHz cut-off frequency) and superior common mode noise rejection (around 200 Ω common mode impedance at 240 MHz).

APPLICATION NOTE

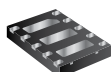
Circuit Protection Solution for ONT CPE (Gateway/Router/Switch)



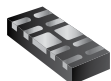
Model SM453229-381N7Y



Model SRF2012A-801Y



Model CDDFN10-2574N



Model CDDFN10-3324P



Model MF-SM013/250



Model TISP61089BDR-S



Model MF-SD013/250



Model CMF-SDP



Model CGF0804TFH-R900-2L

ONT PORT PROTECTION SOLUTIONS (CONTINUED)

The full range of ESD protection solutions offered by Bourns for common ONT ports, including Ethernet, telephony and USB, are shown in Figure 2. All shown products comply with the following standards:

- IEC 61000-4-2: USB 2.0 and Gigabit Ethernet ports
- ITU-T K.21 Basic Level: Gigabit Ethernet port
- ITU-T K.21 Internal Ports Enhanced Level: Telephony port

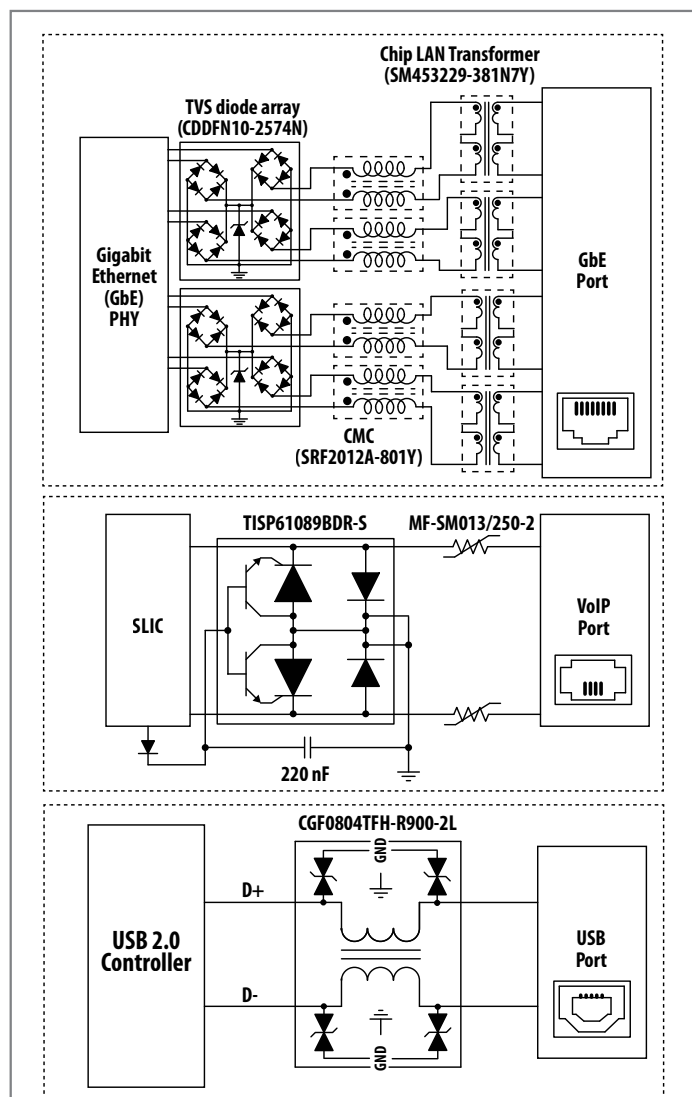
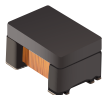


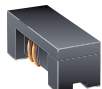
Figure 2: Ethernet, Telephony and USD Protection Recommendations*

APPLICATION NOTE

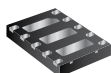
Circuit Protection Solution for ONT CPE (Gateway/Router/Switch)



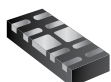
Model SM453229-381N7Y



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Model CDDFN10-3324P



Model MF-SM013/250



Model TISP61089BDR-S



Model MF-SD013/250



Model CMF-SDP



Model CGF0804TFH-R900-2L

HELPFUL PORTNOTE® SOLUTIONS

- [Ethernet - ESD Protection](#)
- [USB 2.0 - ESD & Overcurrent Protection](#)
- [USB 3.0 - ESD & Overcurrent Protection](#)
- [USB 3.1 - ESD & Overcurrent Protection](#)
- [USB - Power Delivery Protection](#)
- [SLIC Protection - GR-1089-CORE Intra-building Negative Voltage Tracking](#)
- [RJ11 SLIC Protection - ITU-T Negative Voltage Tracking](#)
- [RJ11 SLIC Protection - ITU-T Enhanced 6 kV, Negative Voltage Tracking](#)

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