Application Note

90V Multifuse® Positive Temperature Coefficient (PTC) Resettable Fuses in an HFC Network

The Design Challenge:

The continued development of new broadband services such as video and interactive programming is causing an ever-increasing demand for wider bandwidth. This quest for bandwidth has been responsible for the telecommunications industry's major step from copper based cabling to fiber optics. As fiber optics integrate themselves into most cable networks, they have now taken on a hybrid fiber/coax (HFC) style of architecture. HFC architecture has now become the leading choice of both Cable TV (CATV) companies and telephone service providers. Because of the similarity of the HFC architecture to their existing networks, cable companies in particular are embracing HFC as an affordable way to position themselves as telephony vendors in a competitive, multi-service future. CATV systems have a vision of providing a complete networked home package where video on demand (VOD), high speed internet and telephony will all be provided via one system: the HFC network.

HFC Architecture:

HFC architecture usually consists of a fiber trunk line carrying signals in the form of video or telephony from the headend or central office (CO), to feeder cables serving local neighborhoods. Optical nodes on the trunk line convert the signals from light in the fiber optics to radio frequencies (RF) for the copper cables. The feeder cable, a medium sized coaxial cable, provides the signals from the trunk cable to entire neighborhoods. Individual houses subscribing to the cable services have drop lines connected to the feeder cables via taps and network interface devices (NIDs) attached to the outside of their homes for cable telephony and set top boxes for video. Figure 1 below gives a basic layout of how an HFC network should look.

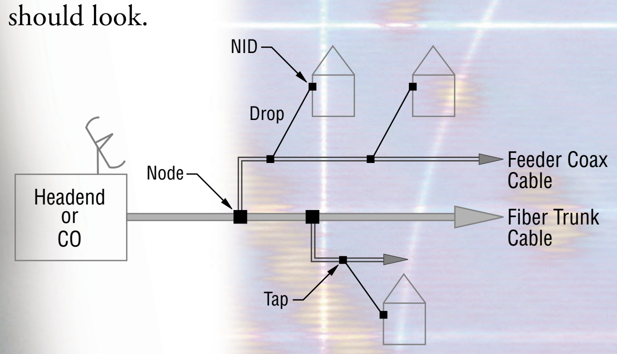

Figure 1. Hybrid fiber / coax (HFC) architecture

Cable Telephony:

Unlike cable TV where power to operate the TV is not transmitted along the cables, cable telephony requires applications power to operate the NIDs. In a cable telephony system, the cable transmits the signal information and in many cases the local operating power for the NIDs, in 60V to 90V form. Powering the local NID can be carried out in any of the following ways:

- Power can be transmitted across the center conductor of the drop cable from a power passing tap to the NID.

- Power can be transmitted on separate twisted pair wires that are bonded to the outside of the drop cable. This drop cable is sometimes called a Siamese cable, and also operates between the power passing tap and the NID.

- Powering can come from the ac supply in the home. In this case a back-up battery must also be used in order to provide emergency telephone access during power failures.

The first option above is the most common form of powering the NID. Coaxial power passing taps act as gateways from which a number of different subscribers can connect to the feeder coax cable. The power to operate the NIDs and the signals is usually separated at these taps.

The introduction of HFC has caused a shift downstream of some of the functions that were located in the headend or central office. One major example of this is the fact that the subscriber line interface card (SLIC) in an HFC is located in very close proximity to the end customer. The SLIC can be located in either the tap (on the pole), leaving the NID in the form of a passive device (see Figure 2.1), or it can be located in the NID itself, which is the most common form (see Figure 2.2). The location of the SLIC and ring generator so close to the customer causes a significant increase in power downstream. As all this equipment is located in the copper portion of the network, there is a strong potential for equipment damage if an electrical fault occurs due to a power cross on the coax.

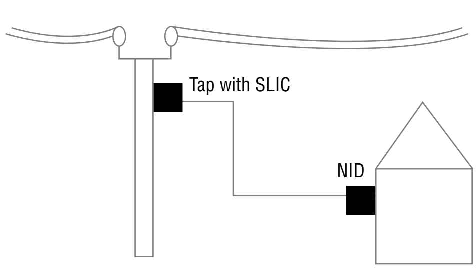

Figure 2.1. Tap with built in SLIC

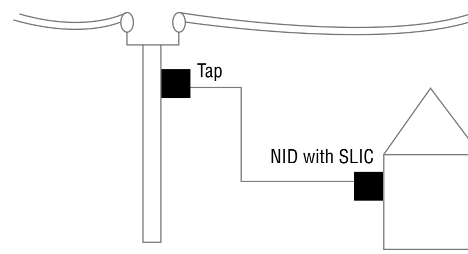

Figure 2.2. NID with built in SLIC

The Application:

Lightning strikes and power crosses are the major reasons for damage caused to telecommunications equipment. Both sources have been readily identified and various different standards exist to ensure that telecommunications equipment resists their damage. The evolution in the levels of protection is governed by international regulatory requirements including the International Telecommunication Union (ITU), UL, FCC and Telcordia GR-1089-CORE. In order to allow telecommunications equipment to comply with these standards, Bourns Inc. has introduced a wide range of overcurrent and overvoltage components including PTC resettable fuses, thyristors, gas discharge tubes, and line feed protection modules, which are designed to provide complete circuit protection against overstresses.

Article 830 in the 1999 National Electrical Code manages the network powered broadband equipment such as power passing taps. According to this code, the maximum power must be limited to 100VA within 60 seconds due to the risk high currents can pose to the unknowing subscriber. With this in mind, Bourns designed the Multifuse® MF-R/90 Series of 90V PTC resettable fuses to act as such a current limiter.

As central offices start to decentralize and shift their equipment downstream, the method of circuit protection needs some very careful consideration. PTC resettable fuses have been successful in central offices because of their unique method of resetting themselves after an overcurrent fault. As SLICs start to be found in remote locations, the cost benefit of a resettable fuse becomes amplified. The costs associated with the dispatch of service technicians to simply replace blown fuses due to transient overcurrents and the inconvenience this brings on service demanding customers can become unacceptable. Clearly if the obvious broadband benefits of the HFC network are to be realized, it must prove to be a reliable and efficient architecture. A PTC resettable fuse is an element to aid this reliability.

Bourns Multifuse® MF-R055/90 & MF-R075/90:

The potential for power crosses or induced high voltages are very real, and the network must provide adequate protection against such threats. Since each power passing tap must have power limited to 100VA within 60 seconds, the MF-R055/90 with its hold current of 550mA and maximum voltage rating of 90V, falls well within this requirement as does the MF-R075/90 with its hold current of 750mA and maximum voltage rating of 750mA.

A resettable polymer PTC fuse has some very obvious benefits in the area of cable telephony helping to protect devices from fault conditions. The fact that a PTC resets itself once the fault clears and the power cycles, eliminates the costly and timely calls of service technicians. The MF-R055/90 with its hold current of 550mA at room temperature and 350mA at 60°C suits power passing taps designed to supply single family homes. The MF-R075/90, with its hold current of 750mA at room temperature and 480mA at 60°C suits power passing taps designed to supply multi-dwelling units (MDU). The power passing tap with drop cable and resettable current limiting ability offers self-extinguishing circuit protection and is rapidly becoming the market norm.

Conclusion:

Cable telephony is rapidly becoming an integral part of a networked home, and the market for telephony services is significantly larger than that for video. Market penetration in the home and businesses is approaching 100 percent, and demand is growing sharply, driven largely by data services such as the World Wide Web. Telephony is of enormous potential value to cable companies, as these companies already have much of the necessary infrastructure in place. The growth potential for the MF-R055/90 and MF-R075/90 should mirror these demands.

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