Features and Benefits

ANTRONIX®

E-Option Multi-taps
Conditioning at the Tap

As customers demand more channels and services, bandwidth requirements have continually increased. Balancing the system has been increasingly difficult due to higher gain amplifiers with increased tilt and full utilization of the return bandwidth for high-speed data/telephony. Additionally, higher bandwidths and new services push the requirement for tighter downstream and upstream signal tolerances. Such improvements are required to maintain quality service to the customer and meet FCC Technical Specifications, as well as DOCSIS 3.1 performance requirements.

With the use of the return band has come the challenge of equalizing the upstream communications channel. Conventional cable systems equalize the forward band but not the return band. Controlling ingress, noise and the return path response has become a determining factor for reliable upstream performance. E-Option Conditioning helps solve these design challenges. Patent No. 6,570,465 B2

E-Option Multi-taps

E-Option conditioning multi-taps accommodate a variety of plug-in modules that provide signal conditioning in either the downstream or upstream for optimum system performance. E-Option allows each tap location to be conditioned individually, affecting only the tap ports without impacting the through insertion loss (see fig. 1). E-Option solves design challenges such as high/low passive return loss, negative/positive tilt compensation, and return path ingress and noise reduction.

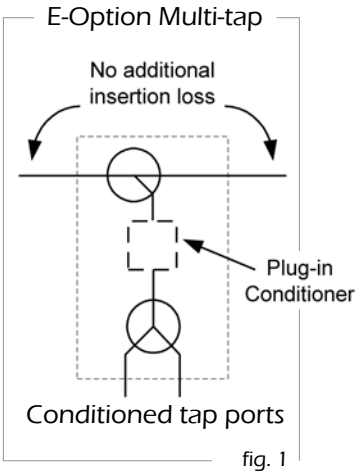

fig. 1

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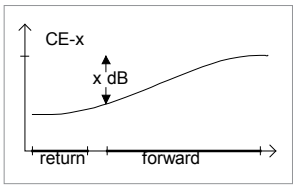
E-Option Plug-in Conditioner Summary

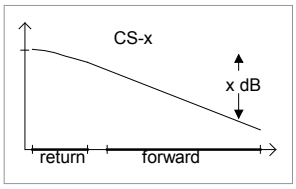
Cable Equalizer (CE): The cable equalizer is used to equalize the entire bandwidth from 5 to 1002 MHz. The cable equalizer is normally used on taps toward the end of the lines. The advantages of this equalizer are:

- It allows the system to have full equalization from 5 to 1002 MHz independent of the return bandwidth or split.
- It equalizes the forward bandwidth to overcome excessive negative tilt associated with long coaxial lines allowing the distribution line to be extended.
- It adds attenuation on the return path allowing cable modems to operate at a higher output and lowers the noise/ingress coming from the customers premise, achieving a greater signal to noise/ingress on the return path.
- It conditions the tap ports for the correct signal levels for proper set-top operation and to meet FCC Technical specifications.
- It is available in a variety of values to meet your design criteria.



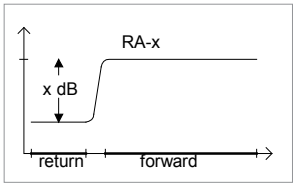
Cable Simulator (CS): The cable simulator is used in the latest system designs that incorporate high output amplifiers allowing the full use of the amplifier gain and large positive tilts. The cable simulator is normally used in the first few taps after an amplifier. The advantages of the cable simulator are:

- It simulates a fixed amount of cable thus overcoming excessive positive tilts.
- It provides lower return path attenuation in high value taps so cable modems can overcome the large passive loss associated with high value taps.
- It conditions the tap ports for correct signal levels for proper set-top operation and to meet FCC Technical Specifications.
- It is available in a variety of values to meet your design criteria.



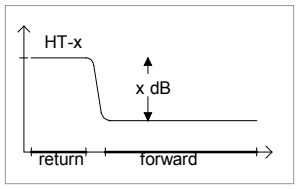
Return Path Attenuation (RA): The return path attenuator is used in systems deploying high-speed data services that are utilizing the return path. The return path attenuator is normally used in low value taps toward the end of the distribution system that have low loss in the return path. The advantages of the return path attenuator are:

- It adds attenuation in the return path without affecting the forward path allowing the cable modem to operate at a higher output level increasing the carrier to noise/ ingress ratio.
- It attenuates any ingress or noise coming from the subscriber premise thus improving the reliability of the return path.
- It prevents the return fiber transmitters from clipping.
- It is available in a variety of values to meet your design criteria.



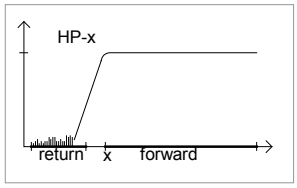
High Tap Value Plug-in (HT): The High Tap Value Plug-in is used in system designs that are utilizing amplifiers with high outputs, high value taps and cable modems. The advantages of the High Tap Value Plug-in are:

- It provides lower return path attenuation in high value taps so cable modems can overcome the large passive loss associated with high value taps.
- It increases the carrier to noise/ingress of the cable modem signal.
- It is available in a variety of values to meet your design criteria.



High Pass Filter (HP): The high pass filter is used to eliminate ingress generated from the subscriber premise from entering the system. The advantages of the high pass filter are:

- It allows high pass filtering on all tap ports using one filter.
- Cost savings, one filter verses 2, 4 or 8.
- Can be used as a troubleshooting tool to locate and eliminate ingress.



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Cable Equalizer Plug-in (CE)

The cable equalizer CE option is used to compensate for the different loss of coaxial cable between the high and low frequencies. Depending on the distribution system's length of the coaxial cable, negative tilt may occur at the taps towards the end of the distribution lines (see fig. 2).

Conventional Distribution System Without E-Option

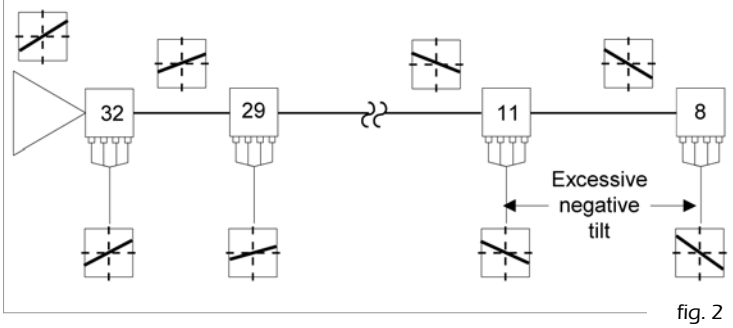
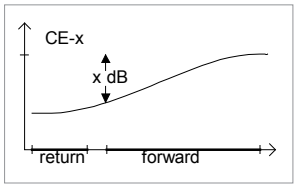


fig. 2

The resultant tilt can cause problems with set-top converters, which can have tight input level and tilt requirements. To overcome this problem the E-Option tap has plug-in cable equalizers available in several values to provide the optimum tilt for each location (see fig. 3). By equalizing at each tap location you can extend your distribution line further without adding additional expensive amplifiers or inline equalizers to control the tilt.

Conventional Distribution System Using E-Option Cable Equalizer



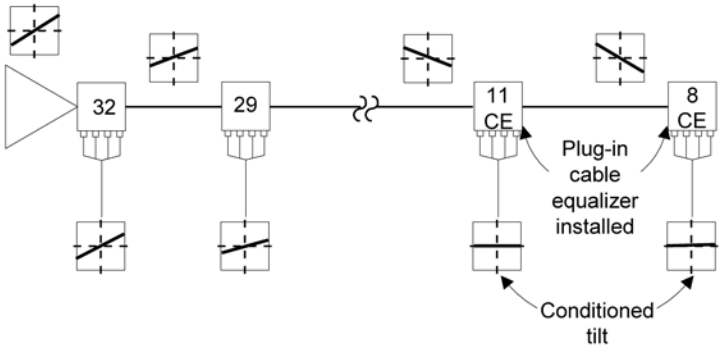


fig. 3

The cable equalizer is a full-bandwidth equalizer from 5 to 1002 MHz. Cable equalizers have more attenuation at the lower frequencies and therefore, allow the cable modem to transmit at a higher level, while attenuating the ingress and noise generated at the customers' premises. This results in an increased carrier to noise/ ingress ratio.

Depending on the design of the system there could be a cost savings using the E-Option Cable Equalizer verses additional amplifiers or in-line equalizers.

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Cable Simulator Plug-in (CS)

The cable simulator CS option is used in situations where there is a large positive tilt on the output of amplifiers and very low cable loss before the tap. This situation usually occurs within the first few taps following an amplifier (see fig. 4).

The large positive tilt can cause problems with set-top converters, which can have tight input level and tilt requirements. Depending on the bandwidth of the system, this tilt and the corresponding system response could be out of FCC specifications. To overcome these problems the E-Option tap has plug-in cable simulators that come in several values to provide the optimum tilt for each tap location (see fig. 5). Depending on the system design, this can increase the length of the distribution line without using additional amplifiers.

Distribution System Using Large Tilt Without E-Option

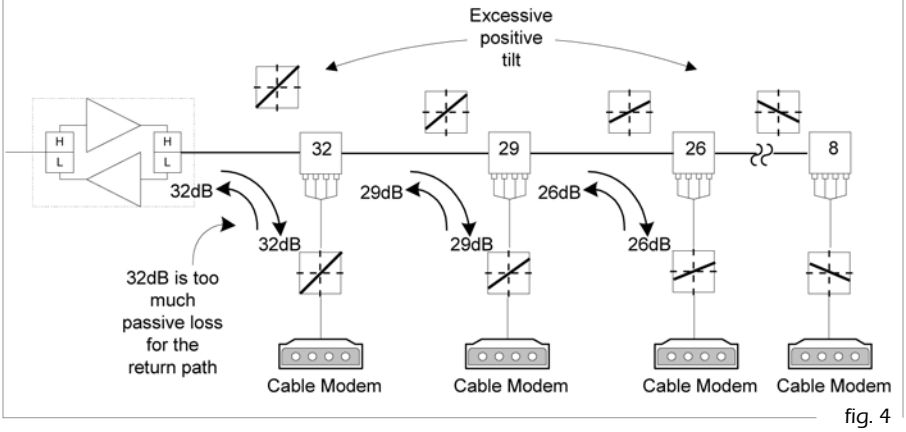


fig. 4

Distribution System Using Large Tilt With E-Option Cable Simulator

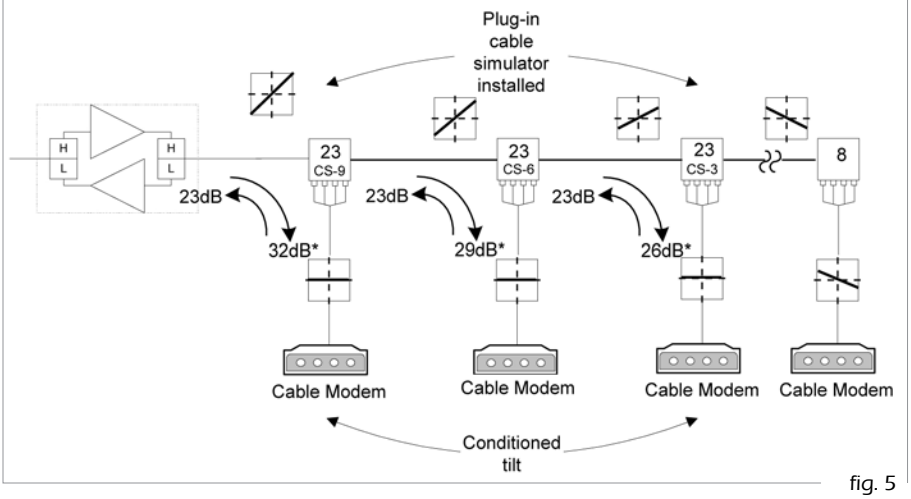
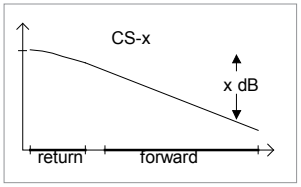


fig. 5



Another application of the cable simulator plug-in filter is to overcome the high passive loss associated with high tap values by lowering return band attenuation while providing tighter tolerances on downstream signal's positive tilt. In the example above, a CS-9 is added to a 23dB tap; the first tap off the amplifier. This effectively reduces the forward signal's positive tilt on the tap ports by 9dB with additional attenuation at the higher frequencies and also reduces the return path attenuation for homes serviced by this tap. Thus the 23dB tap looks like a 32dB tap in the forward band (23dB + 9dB tilt = 32dB) and 23dB (value of the tap) in the return band.

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Return Path Attenuator Plug-in (RA)

The return path attenuator RA is used in systems deploying high-speed data services that are utilizing the return path. Traditional taps have the same amount of tap loss in both the forward and return direction. In a typical downstream system, a tap that is further from the amplifier has a lower tap value. This configuration provides the optimum signal levels in the downstream at each tap location but can cause problems in the upstream since low tap values will cause cable modem levels to turn down, resulting in a reduced signal to noise ratio (see fig 6).

By adding additional return path attenuation in low tap values using the E-Option Return Path Attenuator, cable modems can operate at higher output levels without clipping the upstream optical transmitter. This results in higher signal to noise at the cable modem source. Additionally, the Return Path Attenuator reduces ingress and noise coming from the customer's premise thus improving the carrier to noise/ingress ratio in the return system (see fig. 7).

Conventional Distribution System Using Cable Modems Without E-Option

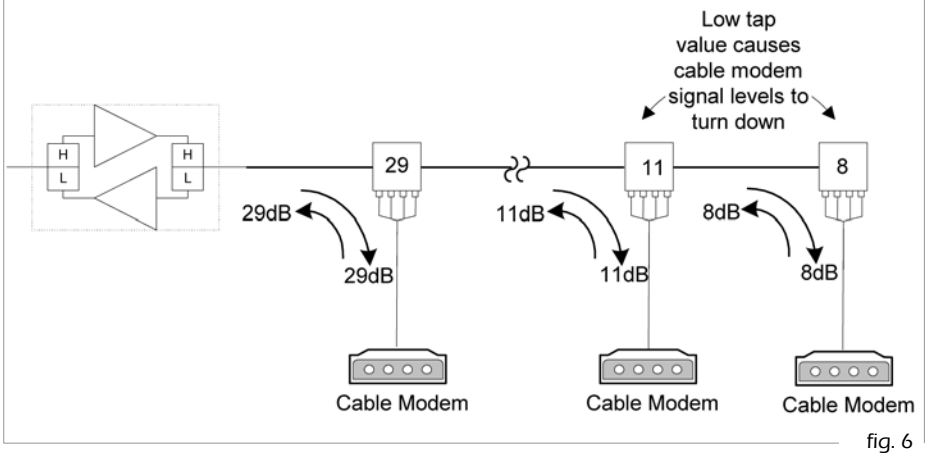


fig. 6

Conventional Distribution System Using Cable Modems With E-Option Return Path Attenuation

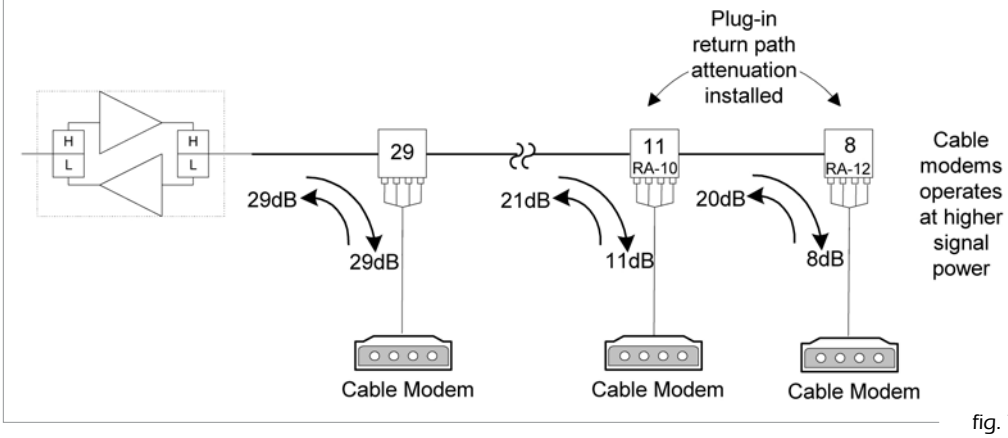
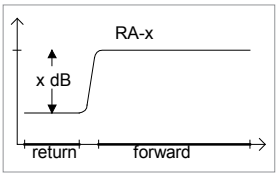
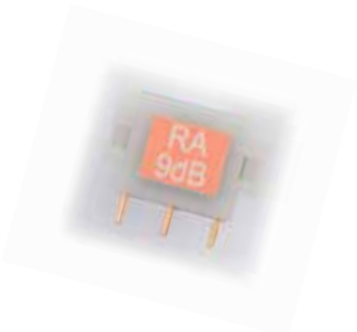


fig. 7





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High Tap Value Plug-in (HT)

The High Tap Value HT plug-in is used in system designs that are utilizing amplifiers with high output levels, high value taps and cable modems. With the use of high value taps, cable modems do not have enough output level to overcome the large passive loss in the return path resulting in unreliable service (see fig. 8).

The plug-in E-Option High Tap Value plug-in overcomes the high passive loss associated with high value taps with lowered attenuation in the return path while maintaining the downstream loss. If the maximum desired return band is 23dB, the 32dB value tap is physically changed to a 23dB value. This effectively lowers the return path attenuation from the homes serviced by this tap from 32dB to 23dB. Next a HT-9 High Tap Value Filter is installed in the 23dB value tap, which adds 9dB of attenuation to the forward band only (23dB tap + 9dB attenuation = 32dB). The net result is a tap with 32dB of forward path loss and 23dB of return path loss (see fig. 9). The High Tap Value plug-in allows the use of high output amplifiers to extend the length of the distribution system and still provides reliable cable modem service at high tap value locations.

Distribution System Using High Output Amplifiers Without E-Option

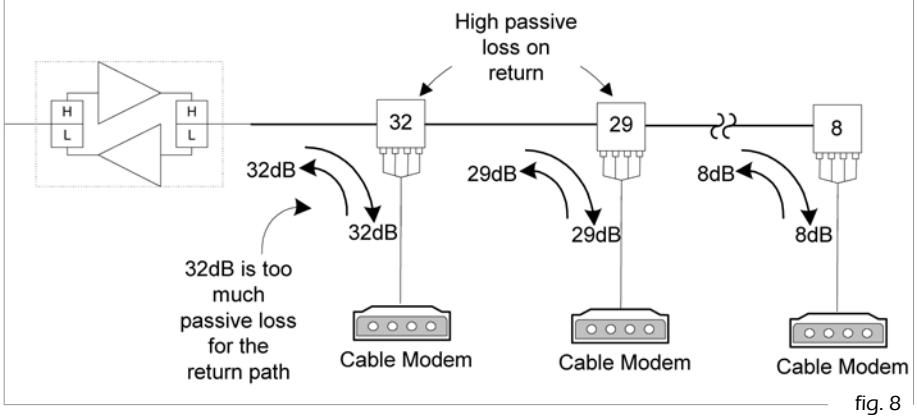


fig. 8

Distribution System Using High Output Amplifiers With E-Option High Tap Value Filter

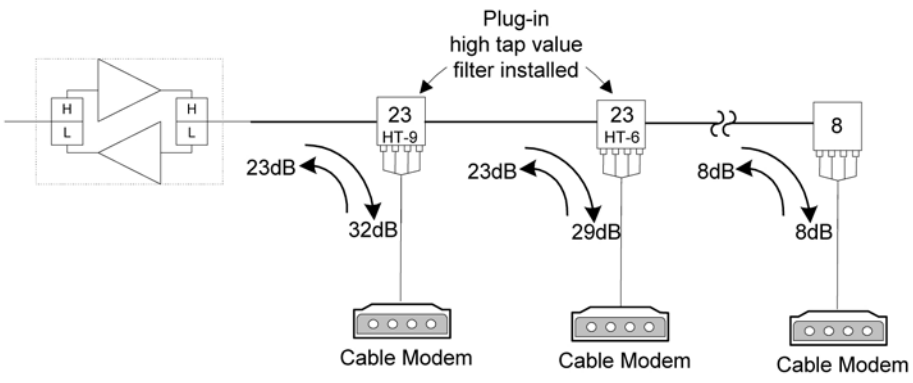
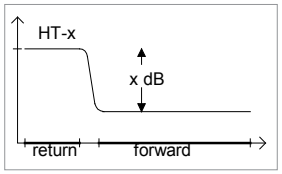
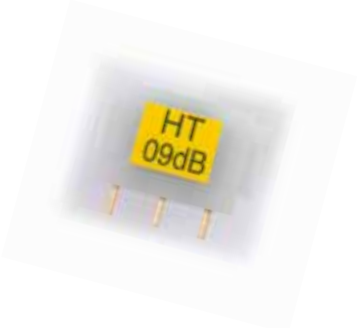


fig. 9





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High Pass Filter (HP)

The major problem associated with the return system is noise and ingress. It is estimated that drop systems generate 70% to 90% of noise and ingress. By using high pass HP filters at taps without data customers, any unwanted ingress in the drop return path is prevented from entering the distribution return path. This allows high pass filtering on all tap ports using only one plug-in conditioner (see fig. 10).

Distribution System Using E-Option High Pass Filters

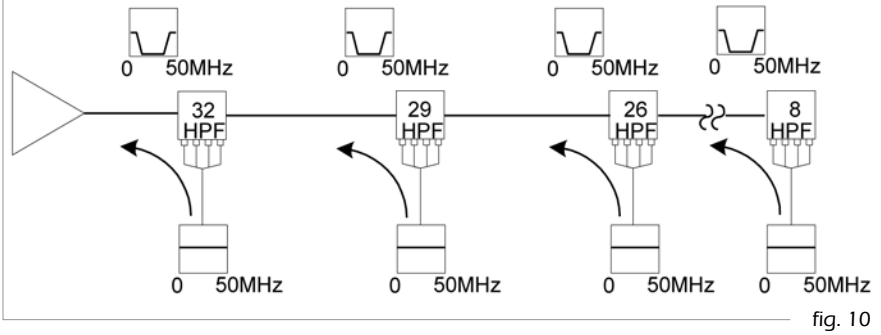
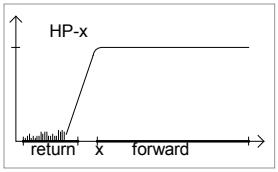
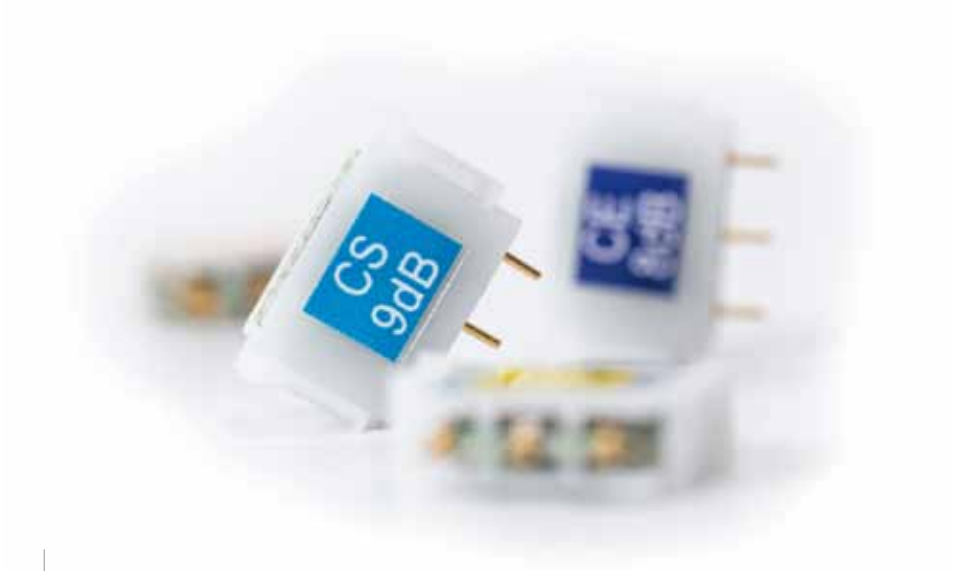


fig. 10



Mixing E-Option Plug-in Modules for Optimum System Performance

By combining the available E-Option plug-in modules the distribution system can be quickly and easily optimized to fit a variety of design applications that previously were a challenge to achieve. The E-Option can condition your entire distribution system giving each tap location the correct levels for optimum performance in both the downstream and upstream system. By conditioning at each tap location you assure reliable cable modem and set-top box performance and compliance with the FCC Technical Specifications.



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Excessive Tilt Example

With the use of amplifiers utilizing large gains and tilts, the design challenge is how to maintain the correct tilt at each tap location. The first few taps following the amplifier have excessive positive tilt and the taps toward the end of the line have excessive negative tilt (see fig. 11). This excessive tilt can cause problems with set-top converters that have a tight signal and tilt window for reliable performance.

Distribution System Tilt Without E-Option

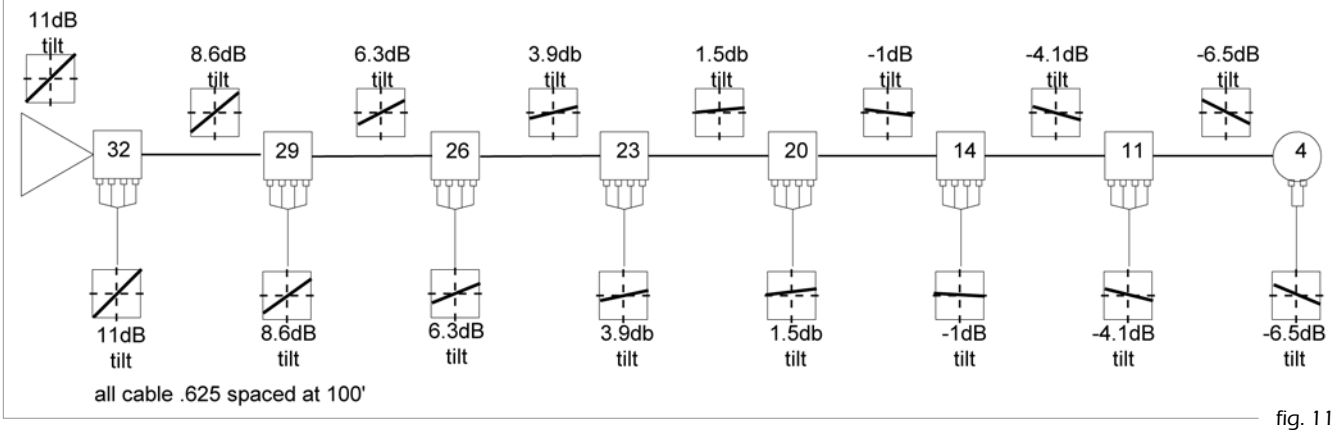

fig. 11

Adding E-Option plug-in cable simulators (CS) at the high tap value locations and cable equalizers (CE) at the low value tap locations the tilt can be controlled to meet any design specifications. The traditional design has a +11/-6.5dB tilt while the E-Option design maintains ±2dB tilt throughout the distribution system (see fig.12).

Distribution System Tilt With E-Option Cable Simulator and Cable Equalizer

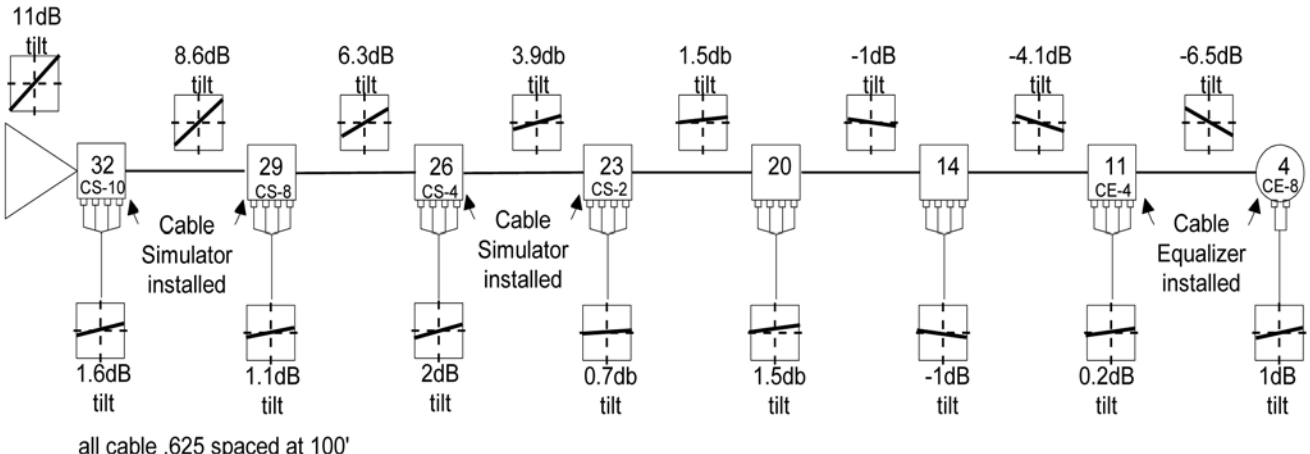

fig. 12

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Return Path Conditioning Example

With the advent of cable modem services, maintaining consistent cable modem carriers and controlling the signal to noise ratio on the return path has become a major challenge. Typical distribution systems are designed for optimum performance in the forward system leaving the return path with either too much or too little passive loss (see fig.13).

Conventional Distribution System Using Cable Modems

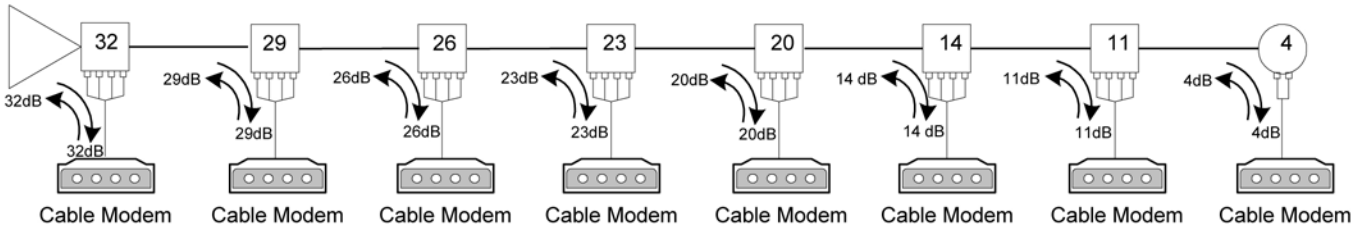

fig. 13

Since there is little coaxial cable loss in the return band, the ideal return path design would have an equal amount of passive loss at each tap location. This would equalize the return path and allow all cable modems to operate at a higher output level. This can be accomplished by using a combination of E-Option High Tap Value (HT) plug-in and return path attenuation (RA) plug-in. The High Tap Value plug-in lowers the amount of return path passive loss in high value taps and the return path attenuation plug-in adds attenuation in the lower value taps. By using this combination of HT and RA plug-in filters, each tap now has the same amount of attenuation in the return path, in this example 23dB, ±1dB (see fig. 14). By utilizing this combination of filters you can maintain the correct passive loss for any system design.

Conventional Distribution System Using Cable Modems With E-Option High Tap Value and Return Path Attenuation Filters

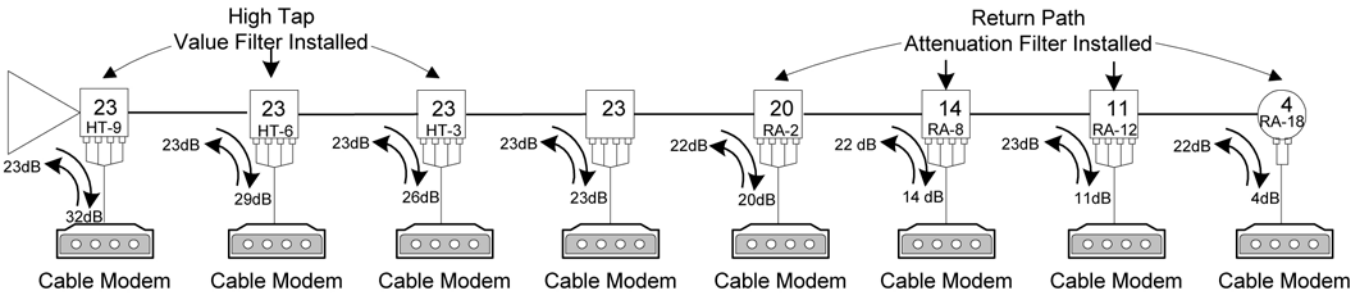

fig. 14

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