



# Product Installation & Application Manual

**EXTREME**<sup>TM</sup>  
**BROADBAND ENGINEERING**

Your Best Connection For Broadband Innovation.

## Introduction

### **The Extreme Total Support Program**

The Extreme Product Installation and Application Manual is part of our commitment to providing unmatched support through our Total Support Program. Our program begins in our factory with innovative design and unsurpassed quality and then follows the product into your warehouse through the Extreme inventory control system. This training guide completes the program by ensuring that we are right there with the product on your network. The Total Support Program makes every Extreme product more than just a component in your network- you are not getting an Extreme product, but an Extreme program.

### **An Increased Need for Manufacturer Support**

In-home subscriber devices, both active and passive, have evolved from simple devices used exclusively for feeding video services to multiple locations to complex devices that have the capability to feed video and digital services that use both high and low signal levels. In keeping with our commitment to provide

total support, we are pleased to present this Product Installation and Application Manual as a Training Guide. By having a training guide written directly by the manufacturer, you are given a unique insight of the product. This insight allows you to best utilize every Extreme product on your network.

### **The Extreme Product Installation and Application Manual Training Guide**

The Training Guide is divided into four major areas, each of which serves as a "building block" in order to train in a logical sequence. When all of the building blocks are in place, you will be better prepared to select the correct product and then properly install it for a perfect hardened drop to best deliver today's most advanced technology.

### **Building Blocks:**

- Understanding basic system design
- Types and system design
- Electrical characteristics
- Product applications

## Drop Passive Devices

Drop passives are used in a cable network to split the signal into multiple directions to feed several TV's or computers at the customer's premises. Passive devices do not require AC or DC to operate and do not provide gain or amplification.

## Types of Passive Devices

### Splitters

Splitters are devices that divide the signal into 2 equal parts to create what is commonly called a 2-way splitter (Fig. 1). When a signal is split equally through a 2-way splitter the signal will be approximately 3.5 dB lower in level. Multiple output splitters are possible by combining several 2-way splitters to produce 3-way (Fig. 2), 4-way (Fig. 3), 8-way and 16-way splitters.

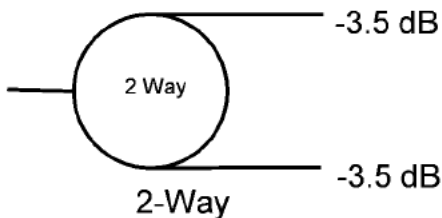


Fig. 1

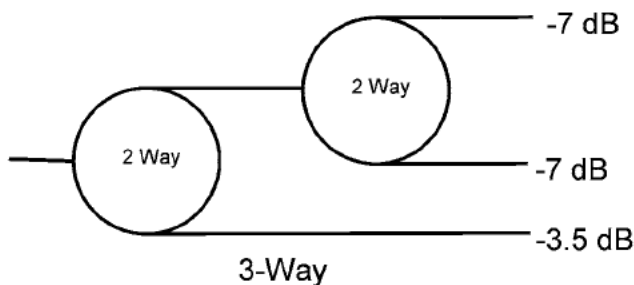


Fig. 2

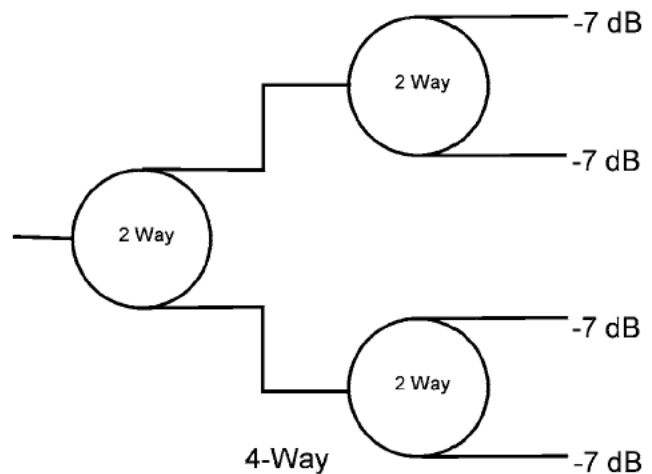


Fig. 3

### Directional Couplers

Directional Couplers (DC) are devices that split the signal into 2 unequal parts (Fig. 4), one port will have more signal than the other. The port with the least amount of loss is called the "thru" or "out" port, and the high loss port is called the "tap" or the "down" leg. The common use for DC's in the drop system is to feed digital services such as cable modems. Digital services do not require as much signal level as analog services, so the DC port with the most loss can feed the digital service, and the port with the most signal feeds the analog services. Directional couplers come in several values such as 6dB, 9dB and 12dB, the value indicates the loss of the "down" or "tap" leg.

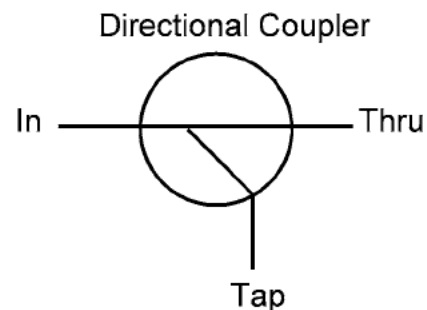


Fig. 4

## Directional Coupler and Splitter Combination

The newest type of passive device is a directional coupler and splitter combined into one package (Fig. 5). This is ideal for cable modem installations since it reduces the number of components required for a data installation, improves the reliability of the drop system and provides dedicated data and RF ports. This type of device can also have a built-in high pass filter (Fig. 6) to reduce ingress and noise that could interfere with services using the return bandwidth.

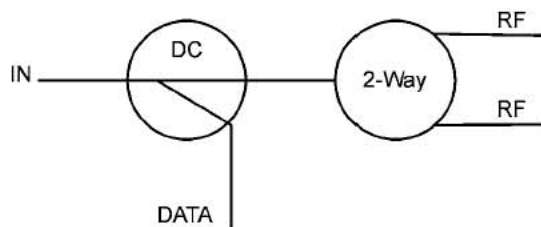


Fig. 5

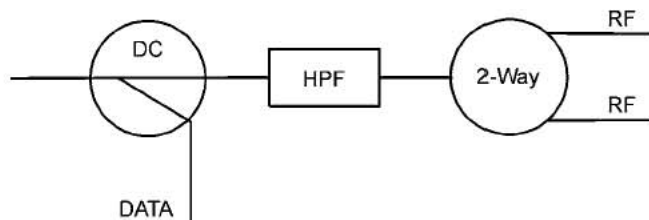


Fig. 6

## Electrical Characteristics

### Insertion Loss

Insertion Loss is the attenuation the passive device has to the signal as it passes through it (Fig. 7). The insertion loss is the same if the signal is traveling from input to output or from output to input. Typically the insertion loss is considered a flat loss, meaning that the loss would be the same at all frequencies. In reality,

the insertion loss varies slightly as the frequency changes, and increases as the frequency increases. Ideally, the insertion loss should be as low as possible, the lower the dB value, the better.

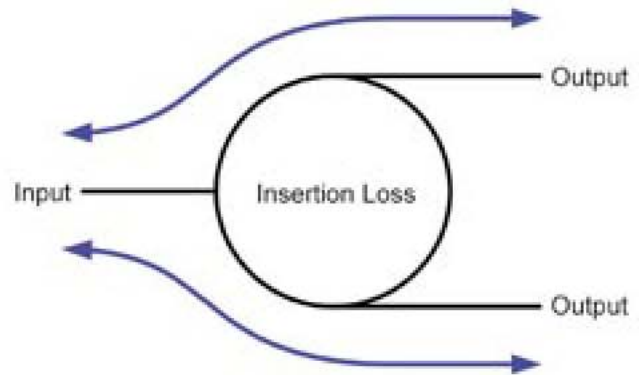


Fig. 7

### Isolation

Isolation is the amount of signal separation that a device has between any two output ports (Fig. 8). Good isolation is important to prevent signals from one port interfering with signals from another port. Isolation ensures that the signals only travel through the device in the direction they are intended to travel. This is especially important with the high signal levels on the return path that are generated by the cable modems and the set-top boxes so they do not interfere with other services. A well-designed splitter will have very high isolation at the return frequencies, the higher the dB value the better the isolation.

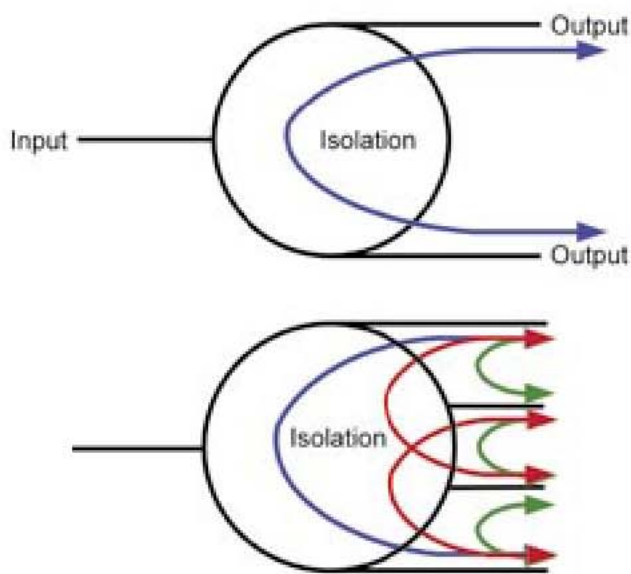


Fig. 8

### Return Loss

Return Loss is the amount of signal that is reflected back toward the signal source by a device, due to an impedance mismatch (Fig. 9). All devices exhibit some impedance mismatch, no matter how well they are built. Return loss is represented by a dB figure, the higher the dB value, the less signal that is reflected back. A return loss of 20dB would reflect back 10% of the signal, where a 30dB return loss would reflect back only 3% of the signal. The more signal that is reflected back the less signal that gets to its original destination. Also, the reflected signal can result in ghosting on the subscriber's TV, or high Bit Error Rate of data.

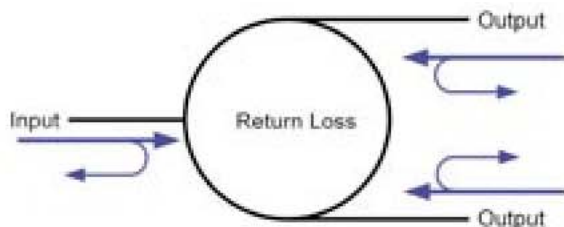


Fig. 9

### Radio Frequency Interference

Radio Frequency Interference (RFI) and Electromagnetic Interference (EMI) rating is the amount of egress/ingress that a device allows. This is looking at how well a device is shielded and how well it prevents interference to and from outside sources such as aircraft communications, CB's, short wave, electrical motors, etc. The two parts of a splitter that affect RFI/EMI, are how the back plate of the splitter is attached and the type of F-ports that are used (Fig. 10). Some back plates are made of thin metal and compress fitted to the main housing; this is not the best method, as it has poor RFI performance. The best method to provide RFI protection is to have a back plate that is made of the same material as the housing and then soldered 100% to the housing. The shape of the end of the F-port is important in order for the mating connector to make good electrical and mechanical contact. By providing a flat top to the F-port, it provides the maximum amount of surface for a good contact, which eliminates any RFI from the F-port.

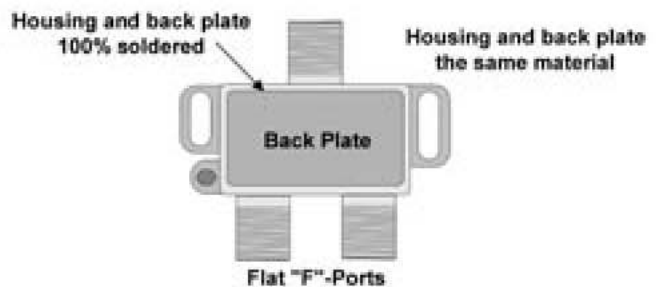


Fig. 10

## Passive Applications

Passive devices are normally used as splitting devices to feed multiple TV's, digital music services, computers, etc. They can also be used in applications that require two or more signals to be combined, such as in the headends.

## Installation Considerations

The most common use of a splitter is to feed multiple outlets in a cable subscriber's home. Some items that need to be considered are, the FCC's signal level requirements and the signal level requirements of the equipment that will be connected. The FCC requires that any analog signal carrier be at least 0dBmV behind the TV set. Digital levels in a cable system are set at a lower level than the analog carries, usually by -6dB to -10dB. The FCC minimum level may not always be the ideal level for the equipment that is being connected. Digital set-top boxes normally do not like to see more than 10dBmV and the optimum level is around 5dBmV. Check with your particular set-top manufacturer for the proper level.

Most cable system designs will accommodate up to 4 outlets when fed by 150' of RG-6 cable. If more than 4 outlets are required or the drop length is extremely long there are two things that could be done:

1. Redesign of the cable plant feeding that particular location.
2. Adding a subscriber type of amplifier to boost the signal.

Usually the most cost-effective solution is to add a subscriber type of amplifier, check with your system for their recommendations.

Always make sure that you use a splitter that has the proper bandwidth for your particular system. By putting in a 1GHz bandwidth splitter you will be assured that all of the signals will

pass through it today and as new services are added in the future.

Additional considerations are the length the individual outlets from the main splitter connection location and the type of service that is being connected. If one outlet is 25' and another is 125', the outlet 125' away will require more signal than the 25' outlet, due to the attenuation of the coaxial cable being used. Cable modem and pure digital services do not require as much signal as analog services to operate properly.

## Installation Scenarios

### 2 Outlets, Equal Distance

One of the least complicated installations would be the requirement for two outlets where both of the outlets are equal in length. By installing a 2-way splitter, both outlets would receive approximately the same amount of signal (Fig. 11)

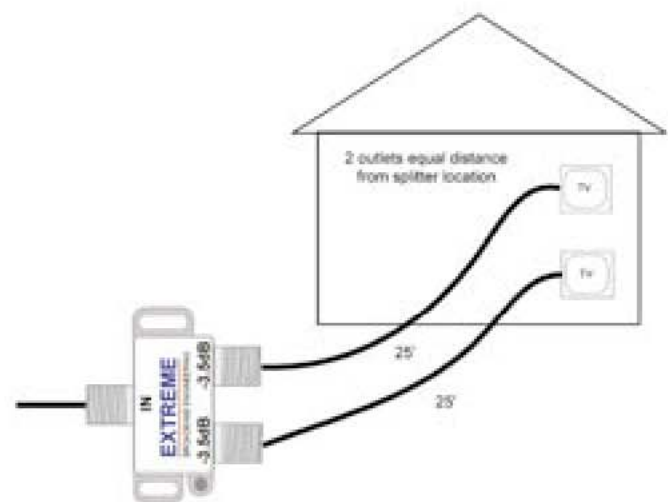


Figure 11

### 2 Outlets, Unequal Distance

In situations where it calls for two outlets and one outlet is much farther than the other, the

outlet at the greatest distance may require more signal to feed it in order to provide adequate signal to the TV, due to the attenuation of the coaxial cable. This may require the use of a directional coupler. By using a directional coupler, the TV that is further away would be fed with the out (thru) leg, which has the least amount of signal attenuation, thus providing the most signal in that direction. The tap (down) leg would feed the outlet that is closest since it has less coaxial attenuation and does not need as much signal to feed it (Fig. 12).

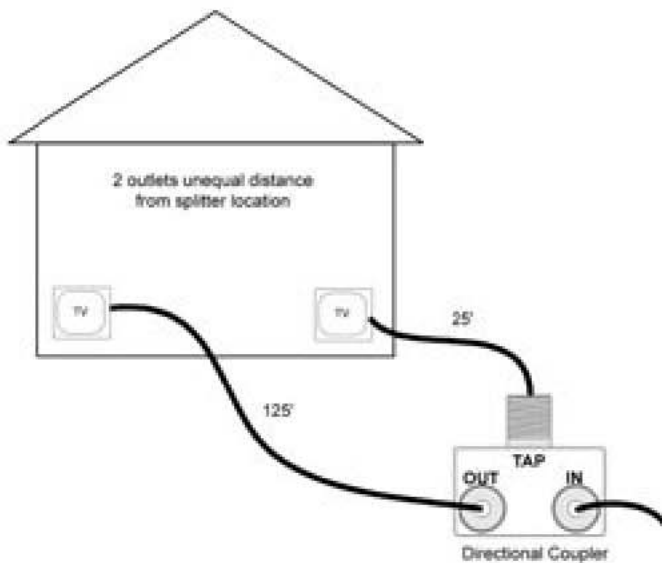


Fig. 12

### 3 Outlets

Three-way splitters come in two styles, balanced and unbalanced. The balanced 3-way splits the signal equally to all three RF ports; typically the attenuation at each RF port is 5.5dB. The unbalanced 3-way has two RF ports that have 7dB of attenuation and one that has 3.5dB of attenuation. The balanced 3-way would be used where all three of the outlets are equal distance from the splitter location and have about the same amount of coaxial cable loss. The unbalanced 3-way would be used in situations where one outlet is much farther away from the splitter location

than the other two outlets; the outlet at the greatest distance would be fed from the 3.5dB port (Fig. 13). Some cable systems will use an unbalanced splitter, even if all the outlets are equal distances; the main viewing outlet is connected to the RF port with the 3.5dB attenuation.

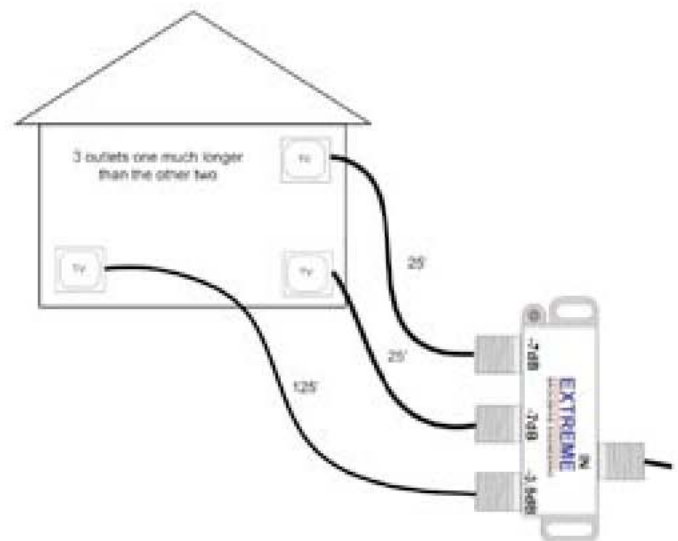


Fig. 13

### 4 Outlets

A 4-way splitter would be used in a standard four-outlet installation (Fig. 14). A 4-way splitter has equal attenuation to each port, which typically is 11dB.

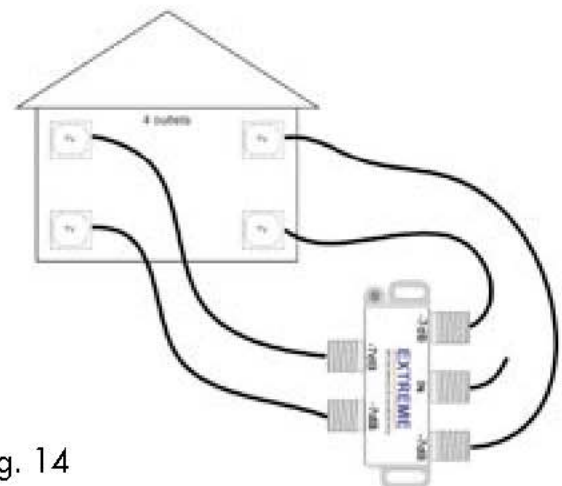


Fig. 14

## Amplifiers

As mentioned earlier, most systems are designed to accommodate up to four outlets. If the number of outlets is greater than four, or the length of the drop exceeds the designed specifications, the installation of a subscriber amplifier may be required (Fig. 15). Subscriber amplifiers come in a several configurations, 1-output providing 15dB of gain, 2-output providing 11dB of gain or 4-outputs that provide 7.5dB of gain. The 1-output version is used where only one output is required or it can be connected to external passive devices to provide any desired output configuration. The 2-output amplifier is a 15dB gain amplifier that has a 2-way splitter built into it. The 4-output amplifier is a 15dB gain amplifier with a 4-way splitter built into it.

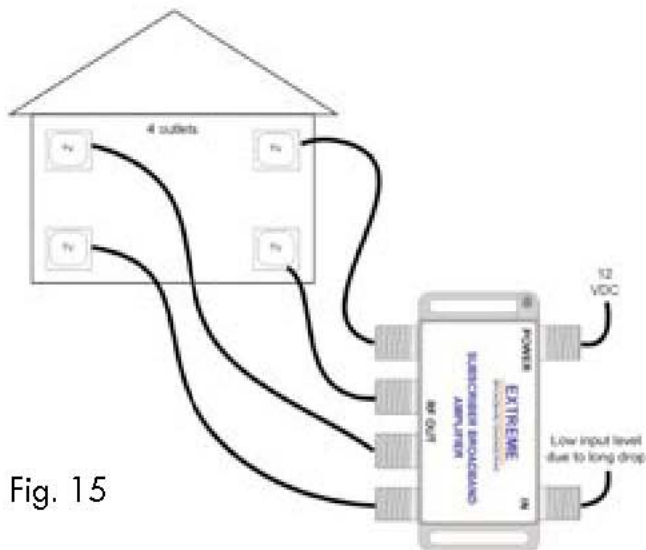


Fig. 15

## Cable Modem Installations

Most cable systems are now providing cable modem service. A directional coupler can be used when a cable modem and video services are required. The cable modem does not require as much signal in the forward direction to operate, since it is a digital signal and is attached to the tap (down) leg. The video service, which requires more signal, is attached

to the out (thru) leg, which has less attenuation and is provided adequate signal (Fig. 16). Another benefit of using the directional coupler tap leg to feed the cable modem is that it forces the cable modem to operate at a higher output level. By operating at a higher level in the return direction, the cable modem carrier is that much higher above the noise floor and ingress of the system. Caution needs to be used when using a directional coupler to feed the cable modem. If the tap that is feeding the drop is of a high value, the cable modem may not be able to provide enough output level to get back to the headend properly. Always check the level that the headend is receiving.

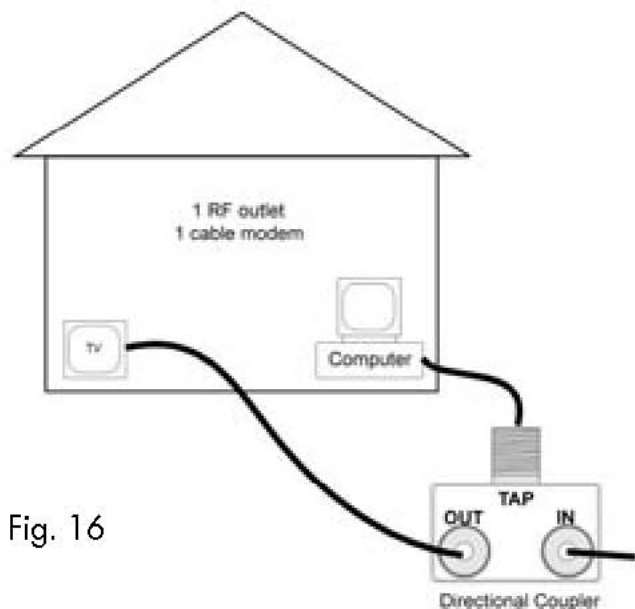


Fig. 16

## Data Plus™ Splitters

In cable modem installations that require more than one video outlet, a *Data Plus™* splitter can be used (Fig. 17). A *Data Plus™* splitter has a directional coupler and splitter built into one package and provides dedicated data and RF ports. This makes for an easy installation and eliminates connections that could fail. *Data Plus™* splitters also come in versions that have built-in high pass filters on the input of the internal splitter, which prevents ingress and noise from traveling into the distribution system.



## Multiple Output Directional Couplers

In installations, such as multiple dwelling units, it may be necessary to provide signal to multiple locations, which would serve several apartments or outlets. In these situations these locations can be installed by using a directional coupler that has multiple tap ports. Multiple output directional couplers are standard directional couplers whose tap port is feeding either a 2-way, 4-way or 8-way to produce several tap ports, which are constructed in a single housing. This is similar in function to a distribution tap, only it is in a smaller housing and it does not pass AC. Each location would be fed from the output (thru port) of the previous location. Multiple output directional couplers come in many values, which enables each location to have approximately the same levels at the tap ports by compensating for the coaxial cable that is feeding it (Fig. 18).

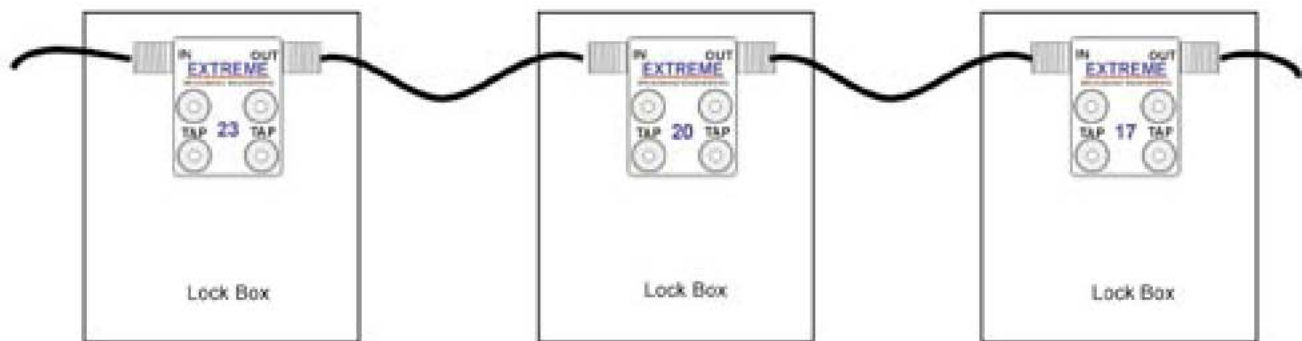
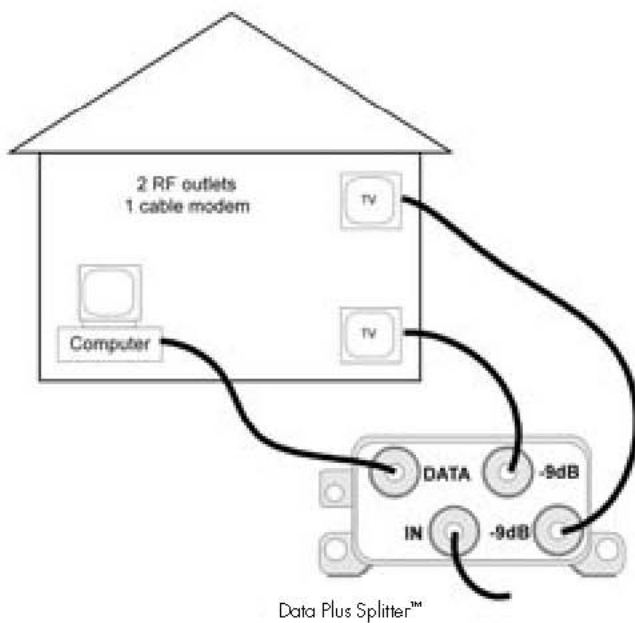


Fig. 18

## Weather Protection

Quality splitters are built with weather sealed ports and flat F-ports to provide a good mechanical connection. This, in itself, provides good weather protection, but more is required to ensure proper weather protection. Buy using F-connectors that offer weather sealing and with the use of an additional weather seal, the cable operator helps to ensure a lifetime of good performance. There are two time-proven methods of external weather sealing--the use of a sealing sleeve or a weather boot.

### Sealing Sleeve

The weather-sealing sleeve is a small rubber donut-shaped device that fits over the F-port. Before inserting on the F-port, a thin layer of silicone grease is applied to the threads of the F-port. This helps the sleeve slide on easier and provides additional weather protection. Never get the silicone grease into the F-connector, as it will change the electrical characteristics of the connection. Once the fitting is tightened against the weather-sealing sleeve, the sleeve will compress against the fitting and the housing providing a tight seal (Fig. 19). Also, the sleeve acts like a lock washer providing tension against the fitting, preventing it from loosening.

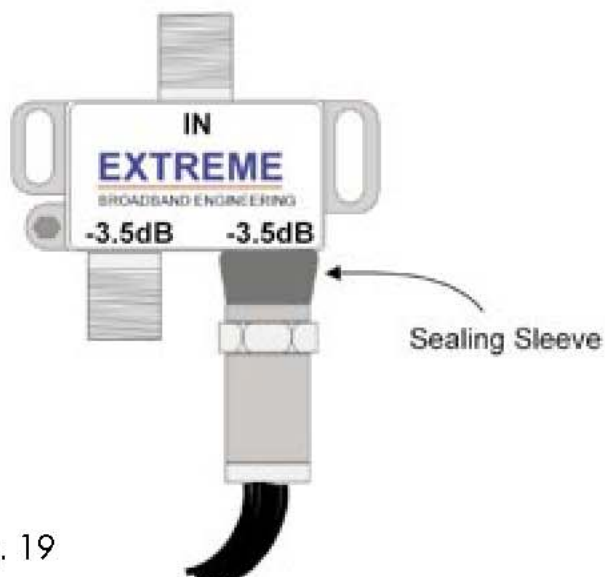


Fig. 19

## Weather Boot

A weather boot is a device that completely covers the fitting and the F-port (Fig. 20). It looks like and serves a similar purpose as a spark plug boot. The boot is installed on the coaxial cable before the F-fitting is installed on the end of the coaxial cable. Before the F-connector is installed, a thin layer of silicone grease is applied to the threads of the F-port. The Fitting is then installed and tightened on the F-port. The weather boot is then filled with silicone grease and slid up over the fitting and F-port using a twisting motion; this ensures a good coating of silicone grease around the connection.

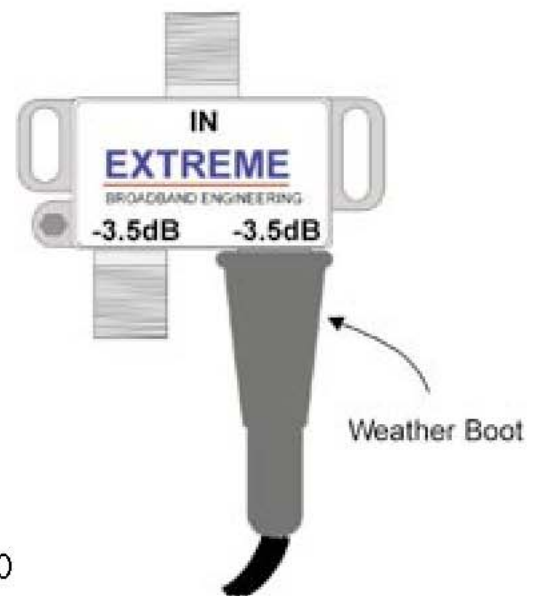


Fig. 20

## THE MISSION OF EXTREME BROADBAND ENGINEERING

The mission of Extreme Broadband Engineering is to set the industry standard for delivering innovative broadband technology while providing unmatched customer service. We will achieve our Mission by drawing upon decades of industry experience to develop the most advanced broadband products while providing the highest level of attention to our customers.

## A TRADITION OF INDUSTRY LEADERSHIP

Extreme Broadband Engineering offers a depth of experience unmatched by any other manufacturing company in the broadband market. We bring over two decades of industry knowledge to our products.

## A FOCUS ON DELIVERING ADVANCED BROADBAND TECHNOLOGY

In today's rapidly changing technological marketplace, it is essential that a broadband network use the most advanced state-of-the-art components. Extreme Broadband Engineering is dedicated to delivering innovative products engineered to power the most advanced broadband networks.

## THE EXTREME TOTAL SUPPORT PROGRAM

Extreme Engineering ensures that the Extreme advantage is with you every step of the way. Our program begins at our factory with innovative design and unsurpassed quality. Then, we follow the product into your warehouse where the Extreme inventory control system helps you best utilize your stock. Finally, we ensure that we are right there with the product on your network through our training system. This program makes every Extreme product more than just a component in your network. Take the Extreme Advantage.

Total Support	What Is It?	What Does It Mean To You?	Who Is The Focus?
<b>Engineering</b>	Development of new designs such as the Unique <i>True Flex™</i> and <i>Data Plus™</i> Series	Meeting the future needs of the broadband provider	System engineering and system design
<b>Manufacturing Quality</b>	Factories have ISO 9000 Certification	System reliability	System maintenance personnel
<b>Inventory Control</b>	UPC coding and clearly labeled packaging	Accurate stock levels minimize inventory cost	Stock personnel and your bottom line
<b>Technical Support</b>	Unmatched customer support	Our Extreme Installation Manual	Installers

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