Table of Content

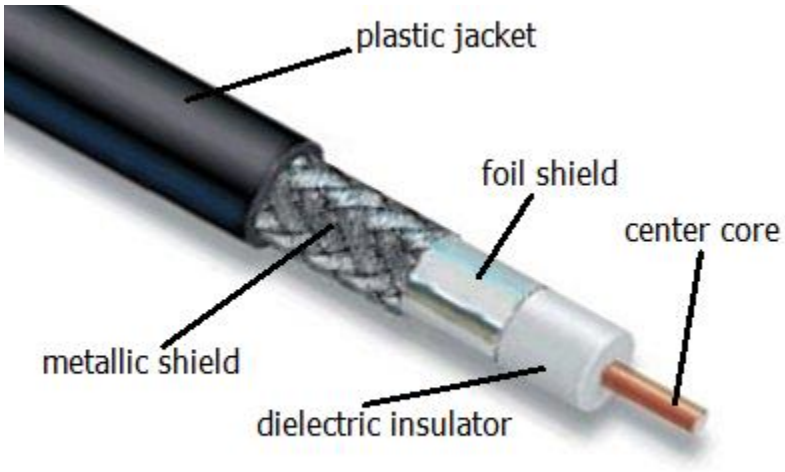
Cable Preparation and Aerial Drop

This lesson provides information on the various types of cable and their use in the cable plant. The lesson will also describe the importance of using the appropriate connector and installing the connector correctly for maintenance-free operation. Understanding these aspects will lead to greater customer satisfaction and increased network integrity. The lesson covers the following:

- Coaxial cable
- Connectors
- Aerial drop

Coaxial Cable
This section discusses the construction and physical characteristics of coaxial cable.

Construction
Coaxial cable (coax) is available in a variety of sizes. Large cables are used as feeder cables, while smaller cables are used for drop lines to the customer's home and TV. Regardless of size, coax is constructed the same. Coax is constructed of a metallic center conductor covered by a dielectric, a shield, and an outer protective jacket.



Center Conductor
The center conductor is a solid copper wire or copper-clad steel wire. Almost all cables used in cable television installation are constructed with copper-clad steel conductors. The steel provides strength and flexibility to the cable, while the copper cladding reduces the electrical resistance and improves signal capacity. Take care not to damage the copper cladding during installation.

Dielectric
The dielectric is used to prevent or reduce the attenuation or signal loss from the center conductor. The type of material used for the dielectric affects the attenuation differently.

The ideal dielectric material for a cable television coaxial cable is air; however, that is not possible. The most commonly used material is foam or solid polyethylene.

The foam material provides the mechanical properties needed while the air bubbles reduce the attenuation. The less air injected into the dielectric material, the stronger the cable, but the signal loss or attenuation is greater. Cables placed underground must be stronger than aerial drop cables, thus less air is used for the dielectric in cables manufactured for underground use than cable manufactured for aerial drop use.

Shielding

The function of the shielding in a coax is just as the name implies; it shields outside signals, such as television or two-way radios, from entering the cable. The shield also prevents leakage of cable signals out of the cable.

The shield consists of a thin aluminum foil that is bonded or simply placed around (non-bonded) the outer skin of the dielectric. A thin layer of aluminum braid covers the foil to complete the shield. Additional layers of foil and braid can be added to provide additional shielding. Most cable used for aerial drops is a single foil/braid design and should inhibit signal loss by 90% or greater.

Protective Jacket

The protective jacket keeps dirt, moisture, and other elements from damaging the cable. Again, a variety of materials are used for the cable jacket depending on the cable application.

Physical Characteristics

This section discusses the size of coax, the difference between cable that has messenger wire and cable that does not have messenger wire attached to the protective layer, and the uses of flooded and non-flooded cable.

Size

The RG number for coaxial cable refers to the Radio Grade or size of the cable. The relative size for these cables is shown in the table below. RG-11 and RG-6 cables are used for most CATV single-family dwelling installations. RG-11 cable is used for multiple-dwelling installation or single-family dwelling where a long drop line is used.

Cable RG Sizes

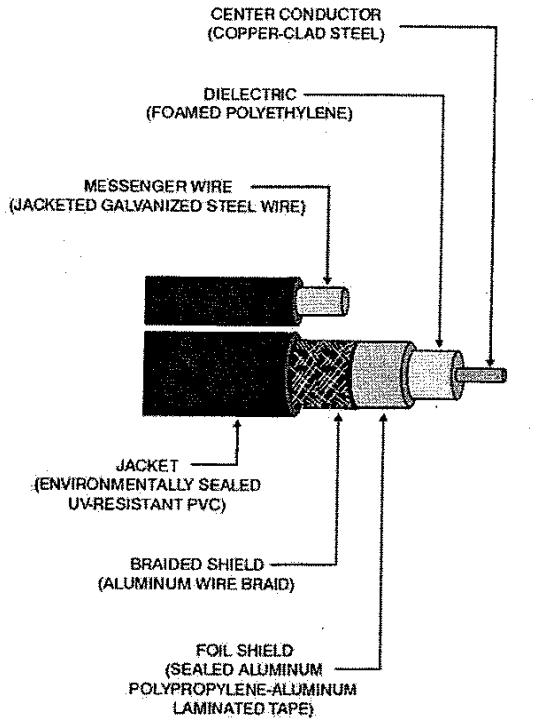
RG Number	Relative Sizes
RG-59	.242 inches O.D. *
RG-6	.272 inches O.D.
RG-7	.340 inches O.D. *
RG-11	.405 inches O.D.

**** Not used in most systems***

Messenger and Non-Messenger

Some drop cables are manufactured to include a messenger wire. The wire is molded to the protective jacket next to the cable. The messenger wire is a galvanized steel wire used to reduce the sagging and stretching of the drop cable due to wind, ice loading and temperature changes. Sagging and stretching of the drop cable can cause cracking of the aluminum foil shield. Cracks in the shield increase leakage of cable signals out of the cable. The figure below shows a messengered drop cable.

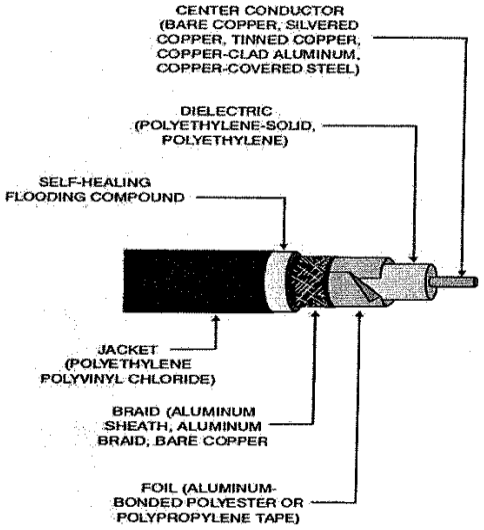
Non-messenger cable does not contain a messenger wire attached to the protective layer of the cable. Non-messenger cable is used from the grounding block to the customer's TV set and for underground drops.



Messengered Drop Cable

Flooded and Non-Flooded

In high moisture or underground applications the use of a flooded cable is desired. A flooded cable is a cable in which a flooding compound, usually a gooey liquid of moisture-repellent material, is injected between the outer shield and the protective jacket. If the protective jacket is damaged, the flooding compound will leak out and seal the damaged area, preventing moisture from entering the cable. Flooded cable is only used outside. Leakage from the cable can damage customer's property if used indoors.



Flooded Drop Cable

Connectors

Connectors provide the interface between the drop cable and other components in the cable system such as tap ports, splitters, grounding blocks, converters and the customer's TV set. Proper cable preparation and connector selection are important to avoid problems that may result from poor cable interfaces.

Virtually all connectors used for house drop installation are of the F-type. As we have previously discussed, there is a variety of cable sizes depending on its application. To ensure a proper fit, the correct connector must be selected for the cable size. Using the correct size connector and the correct compression tool is critical for obtaining a quality connection.

Connectors

Compression F-Connector

Most service problems associated with installations can be traced to improper application of fittings. F-fittings are designed to a tolerance of .001 inch and are carefully matched to the particular drop coax. The compression fittings currently in use have an inner radiation shield designed to slide between the braid and inner foil of drop cable. When the cable end is properly prepared, the fitting will slide into place effortlessly and bottom into place. Currently, we are using PPC® EX-series compression fittings.

RG-6 **RG-11** **RG-59**

PPC® Compression F-Connectors

PPC® Compression Fitting Installation

1. Straighten cable and cut the end squarely.
2. Pinch the end of the cable to round the end.
3. Prepare cable end to 5116" center conductor, 114" dielectric and braid, per instructions of commercially available drop cable preparation tool (Fig. 1).

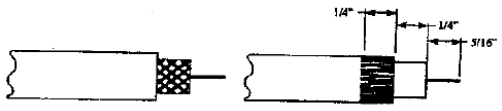


Fig 1

4. Ensure the center conductor is clean of any dielectric residue and the braid ends are not wrapped around the center conductor. If cable is messengered, remove webbing leaving cable jacket smooth for connection.
5. For tri-shield or quad-shield, remove the outer foil. Fold back braid(s) against the cable jacket ensuring all braid ends are uniform around the jacket and not bunched or clumped (Fig. 1).

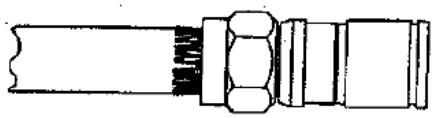


Fig 2

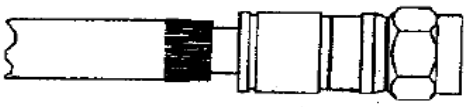


Fig 3

6. Apply the nut end of the connector to the prepared cable to smooth dielectric (Fig. 2).


Fig 4

7. Insert the prepared cable end into the connector until the post meets the fold in the braid of the cable (Fig. 3)
8. Rotate the connector back and forth while gently pushing it onto the cable. Continue this action until the dielectric of the cable is flush with the bottom of the connector nut (Fig. 4).
Note: If during the process, any braid wire becomes detached, remove to ensure proper connection.
9. With the compression tool in the open position, place the connector and cable into the tool by covering the plunger tip with the inside of the connector nut, while ensuring the center conductor goes into the clearance hole of the plunger tip.
10. Compress the connector by closing the tool handle completely).
11. Remove the compressed connector and Cable by opening the tool handle.
12. Hand-tighten the connector to the port, then wrench-tighten (30 inch per pounds, if using a torque wrench.

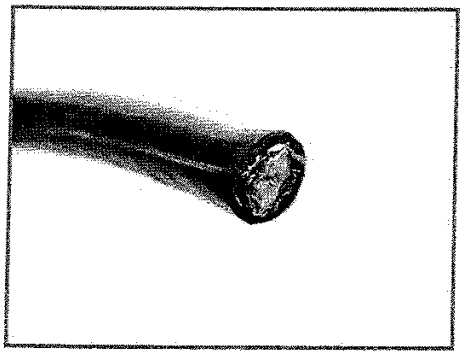
Common Errors

The next few pages will show the most common errors or mistakes that are made and the proper or correct way of preparing the cable for a fitting.

Messenger Removed (when applicable)

For proper prep tool function and connector sealing, a clean removal of the messenger is important.

Incorrect



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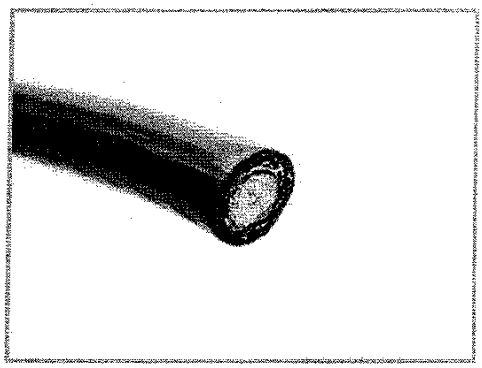
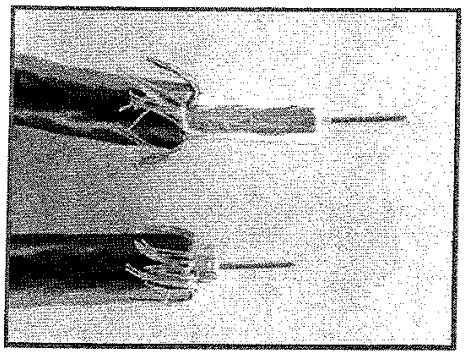


Dielectric Round

Proper cut of the dielectric is required to properly line up with the fitting.

Incorrect



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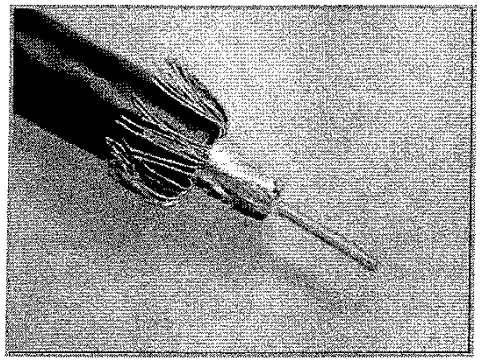
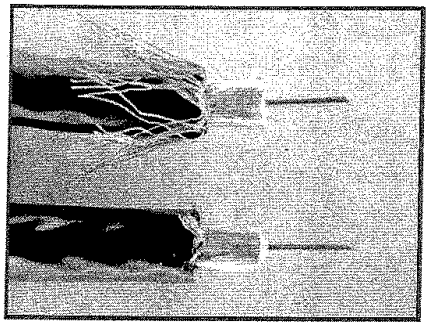


Braid Length

Allowing the ends of the braid to be cut off flush with the jacket or too long can cause the braid to bunch and shield to be defeated as the fitting is forced into place

Incorrect



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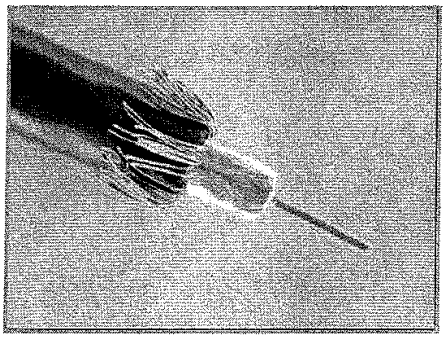

Center Conductor Length

A center conductor is too long it can damage or short the signal. A center conductor that is too short may not make contact allowing no signal to pass.

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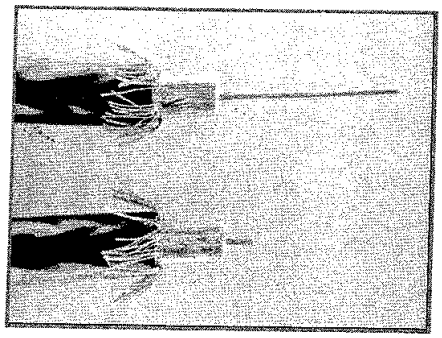

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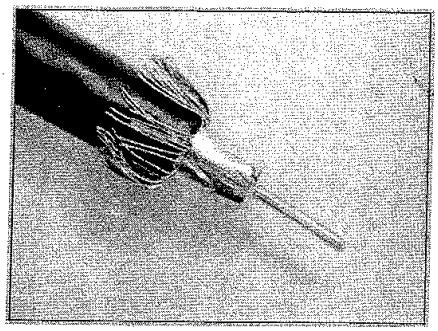
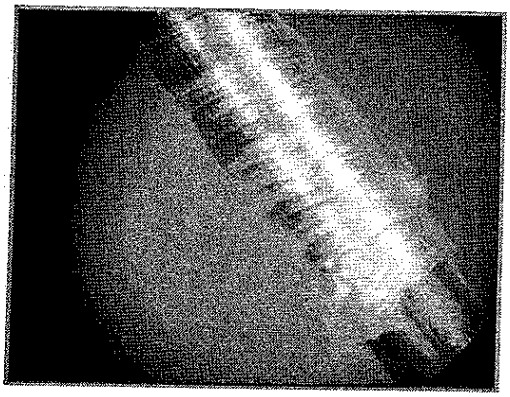


Center Conductor Condition

Foam on the center conductor can block the RF signal.

Incorrect



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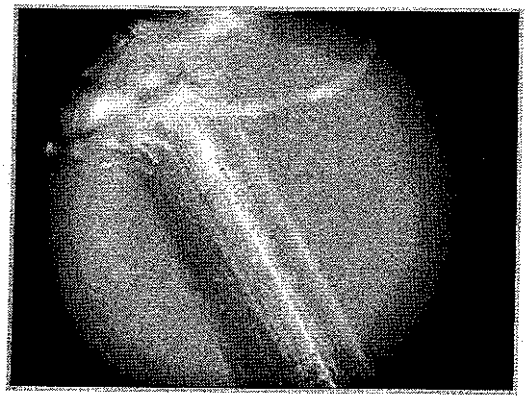
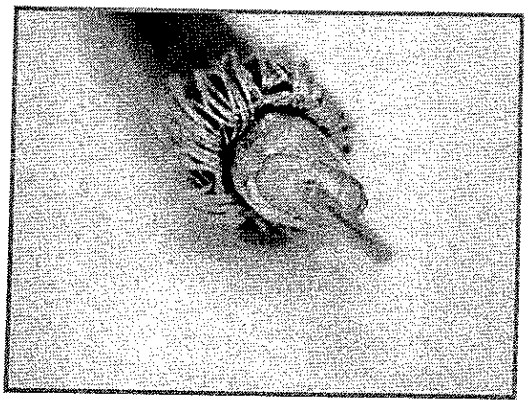


Dielectric Round

Proper cut of the dielectric is required to properly line up with the fitting.

Incorrect



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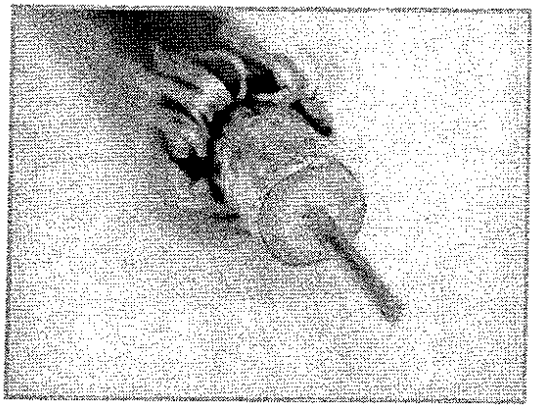
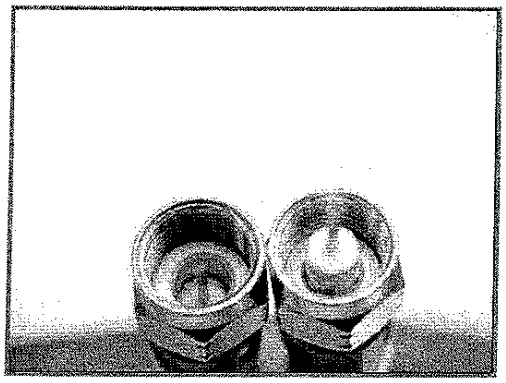


Dielectric Flush with Post

Failure to bottom the fitting so that the dielectric is flush with the interior shoulder. This causes an impedance mismatch that can cause picture problems.

Incorrect



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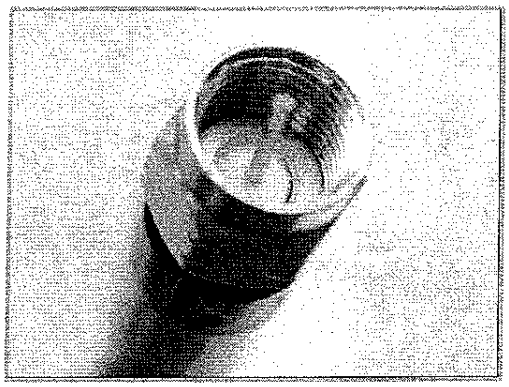
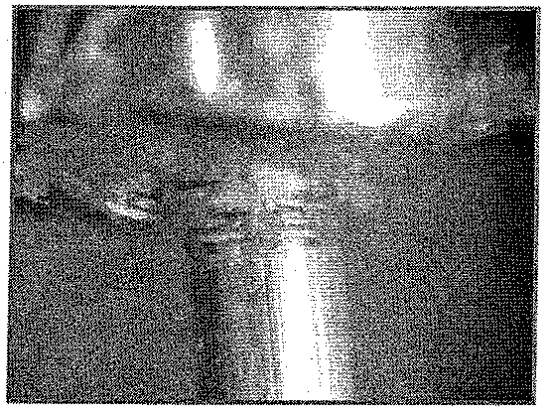


Center Conductor Unmarked (No Scoring)

Damage to the center conductor can interfere with the RF signals levels.

Incorrect



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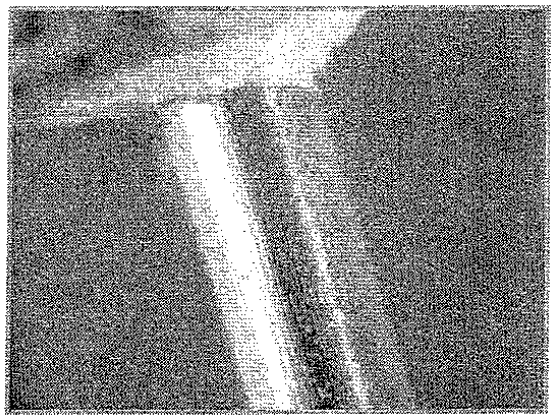
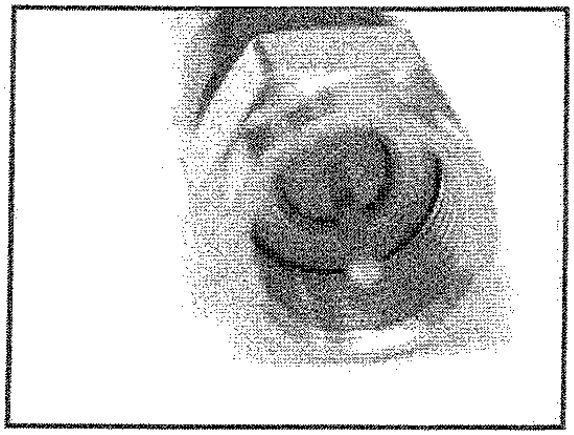


Center Conductor Clean of Foil

Allowing a piece of foil to short against the center conductor.

Incorrect



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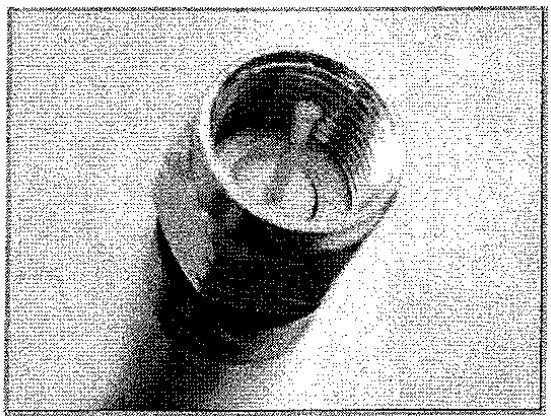
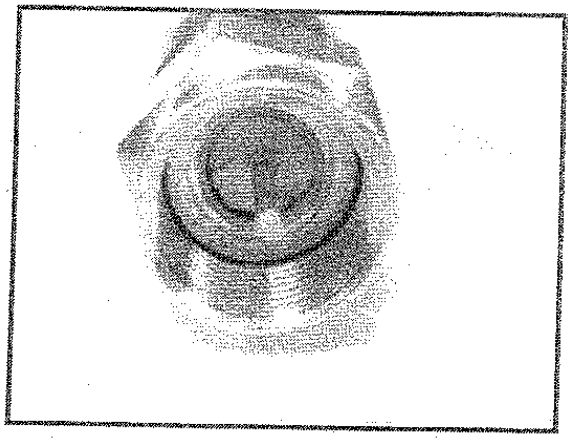


Center Conductor Clear of Braid

Allowing a piece of braid to short against the center conductor.

Incorrect



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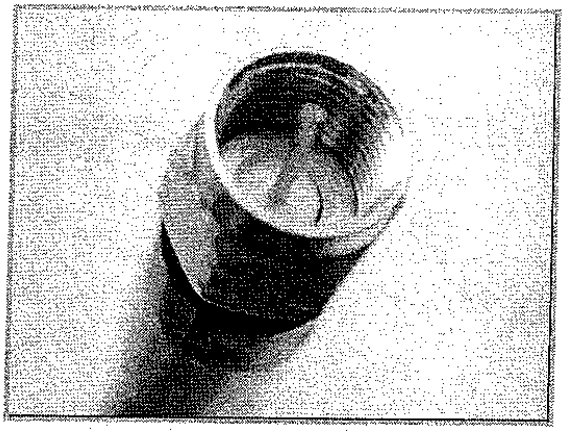


Aerial Drop

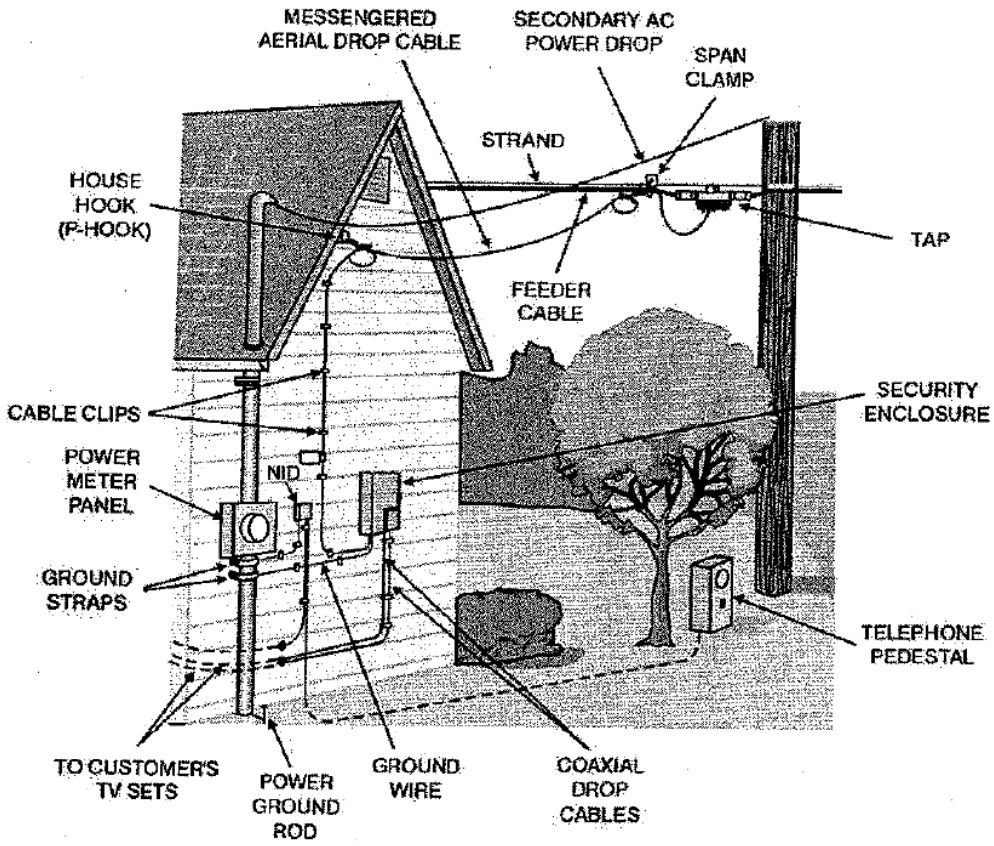
This section discusses assessing drop location and installing drop.

Assessing Drop Location

In planning the run of a drop, several things must be considered:

- Horizontal clearance at the pole to allow for adequate climbing space
- Vertical clearance over streets, driveways, alleys, and lawns
- Obstacles between the pole and the house that may require special routing around items such as trees, swimming pools, trampolines, or swing sets
- Remaining within the customer's property lines
- The location of TVs to be served
- Accessibility to an appropriate ground
- Power and phone drop locations
- Appearance of drop on the customer's house

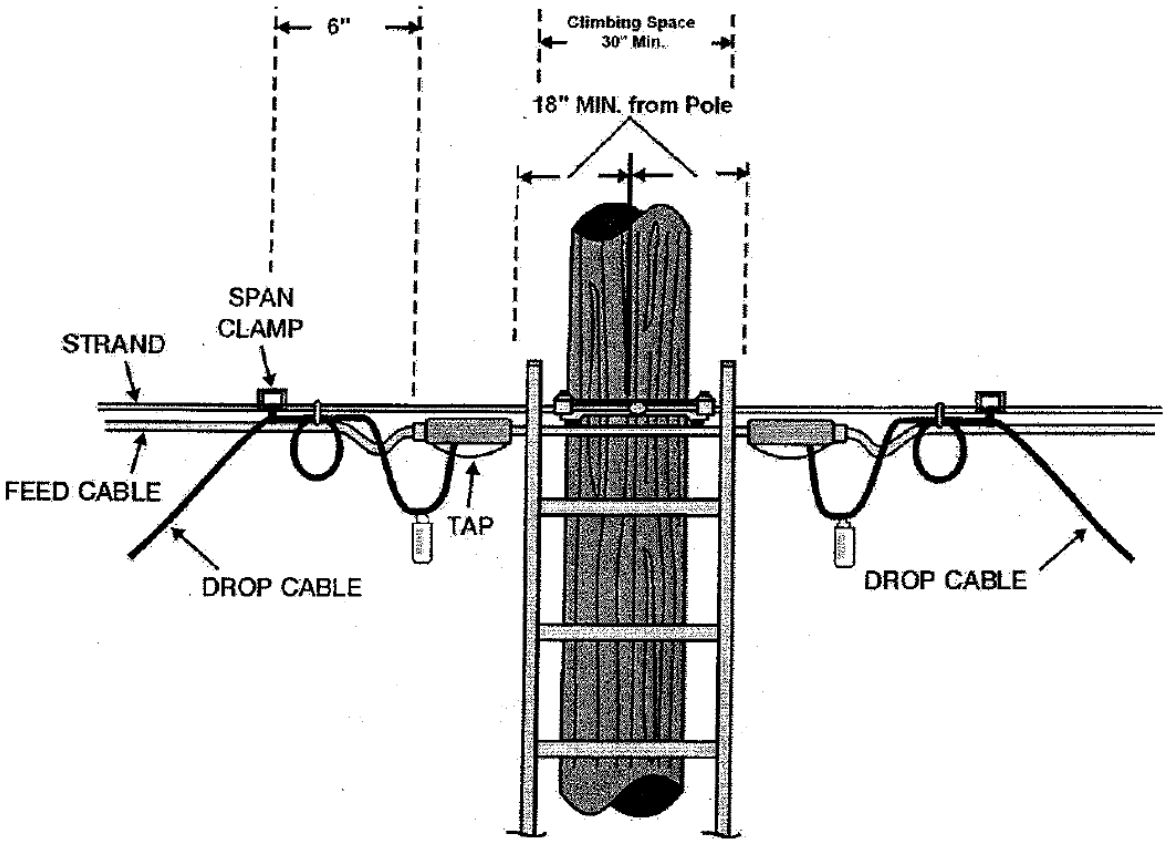
Any or all of these requirements can make planning a drop very difficult at times, but usually a solution presents itself. Few drops cannot be run at all.



Aerial Drops

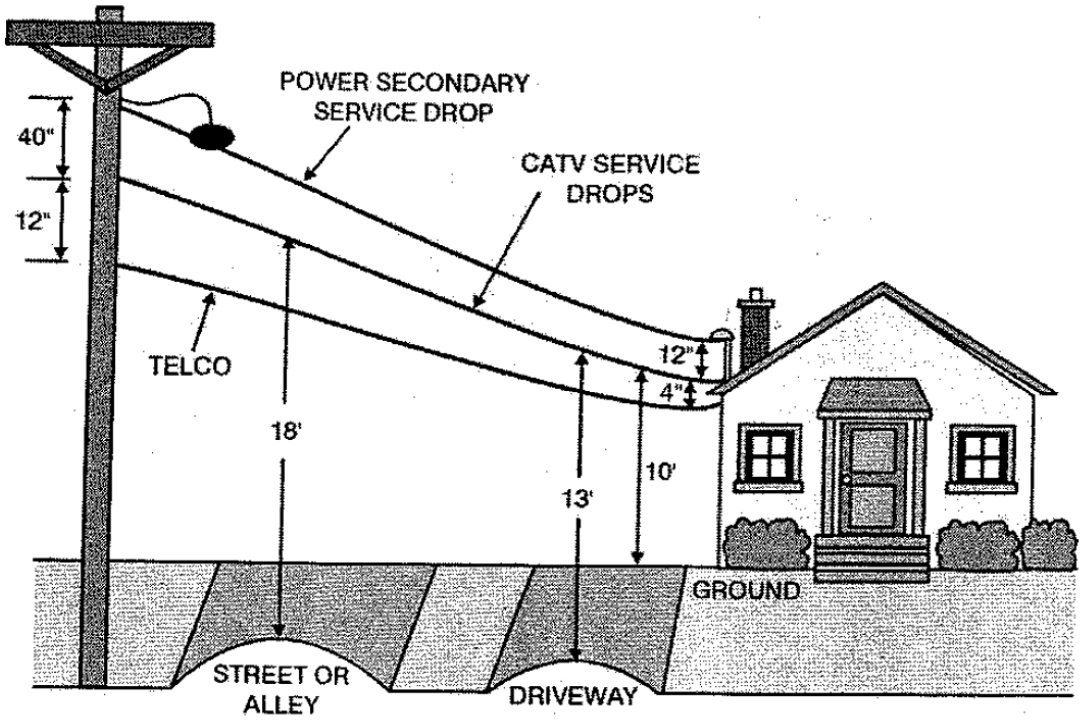
Horizontal Clearance

Horizontal clearance at the pole must be maintained so that adequate climbing space is afforded to those who must work on the pole. At a minimum, a 30-inch square climbing space should exist for a safe climb. As a rule, drops should always lead away from the pole and not cross its face.



Minimum Climbing Space

The figure below illustrates the minimum clearances that should be observed when routing a cable over objects. These clearances ensure that normal activities in the area do not disturb the drop.



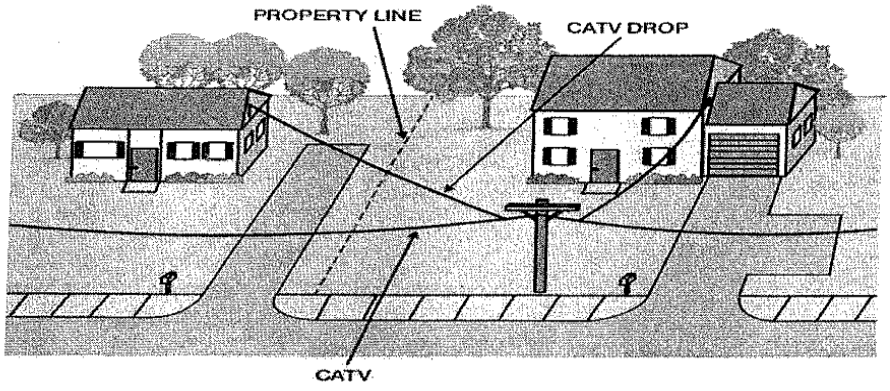
Crossing Above	Clearance
Railroad Tracks	25 feet
State Highway	20 feet
Public Roads	18 feet
Public Alley	18 feet
Commercial Driveways	18 feet
Water (No Sail Boat)	14 feet
Residential Driveways	13 feet
Walks and Lanes	10 feet
Flat Buildings (< 3% Slope)	8 feet
Lightning Rod Conductor	6 feet
Neon Signs	4 feet
Chimney, Radio and TV	4 feet
Peak Roofed Buildings (> 3% Slope)	3 feet
Billboards	2 feet

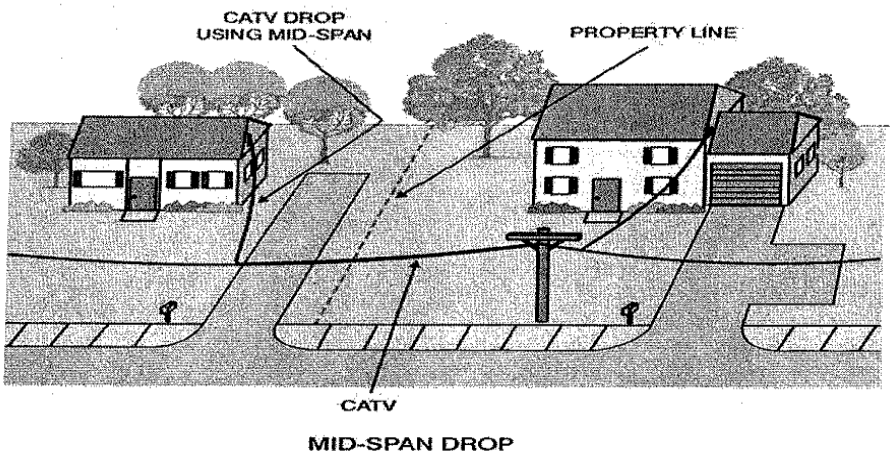
Vertical Clearances

When it is possible to follow the utilities with your drop, clearances with respect to the ground will be dictated by what is already there. At the pole, the strand will be placed no closer than 12 inches to telephone and 40 inches to secondary power. At the house, maintain 12 inches from power and 4 inches from telephone.

Property Line Concerns and Avoidance of Obstacles

When determining the route for the drop, be aware of obstacles in line between the tap and the house. Also, do not cross neighbors' property lines with the drop. This is known as "aerial trespass." Mid-span drops may be employed to avoid these obstacles.





Aerial Trespass and Mid-Span Drop

Determining House Attachment

As a general rule, keep in mind when determining the best location to attach to a house is to keep the drop run as short as possible. The best point of attachment at the house end of a drop is generally between the utilities. Phone and power will have been routed to the home in accordance with clearance guidelines and you will seldom have a problem if you run your drop between the two. Where phone and power go to opposite sides of the house, follow power to ensure an adequate ground. If, however, you must run a mid-span drop or depart from the utilities for some other reason, you will need to ensure that legal clearances are maintained to the ground and structures in the vicinity.

Installing a Drop
This section discusses the following:

- Expansion and drip loops
- Connecting drop at the tap
- Making the 2, 4, 4 wrap
- Mid-span drop
- House attachment
- Exterior drop wiring
- Ground block installation

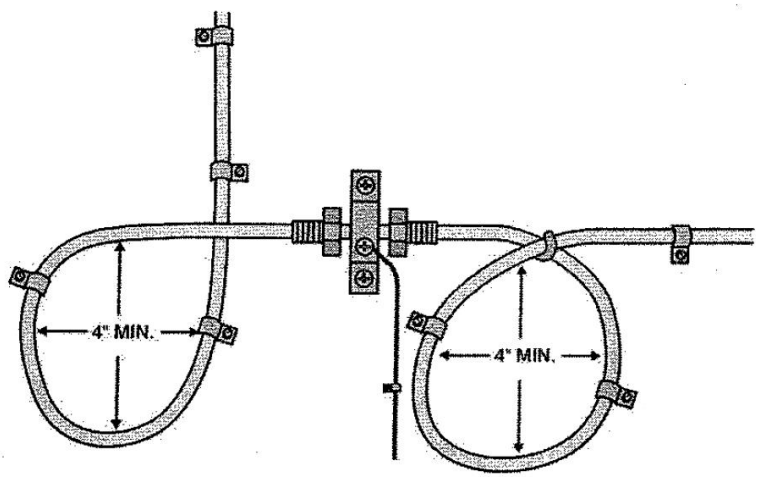
Expansion and Drip Loops

Loops are formed at almost every connection in the cable system. A loop is used to allow for expansion or contraction and/or to provide a means for water to drip from the cable rather than have it reach or penetrate the home or connector.

Expansion loops are used at each pole for trunk and feeder cable. Expansion loops are necessary because of differences in thermal expansion between the strand, the continuous shield, and the center conductor of the coax.

Loops in drop coax have little to do with expansion but are important. Drip loops are formed in the drop cable at the drop clamps, J-hooks, P-hooks, grounding blocks, splitter and entrance hole. Drip loops serve to:

- Provide slack for future service work, for example, replacing fittings.
- Provide slack at stress points (4-inch loops) where movement of the drop in the wind might cause damage to the cable.
- Allow water to run away from the connection, minimizing corrosion of the connection.



Drip Loops

Remember, care should be exercised when bending coax. Damage to the cable can result in loss of signal levels and signal leakage. All bends should be gradual.

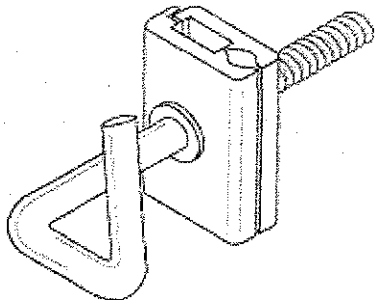
Connecting Drop at the Tap

After assessing the drop location, the drop can be installed starting at the tap. Pull enough cable from the cable reel to relieve stress as you climb to the tap. Follow all safety precautions while setting up and climbing the ladder to access the tap. The cable should be clipped to or tucked under the body belt while climbing the ladder.

Never tie off the cable to your body belt. If the cable snags on something while climbing, it could cause you to fall rather than just the cable falling.

Pay close attention to the cable during the climb. If loops form in the cable, stop and straighten the cable before continuing. If the cable becomes kinked, the signal quality will be affected and the cable will need to be replaced.

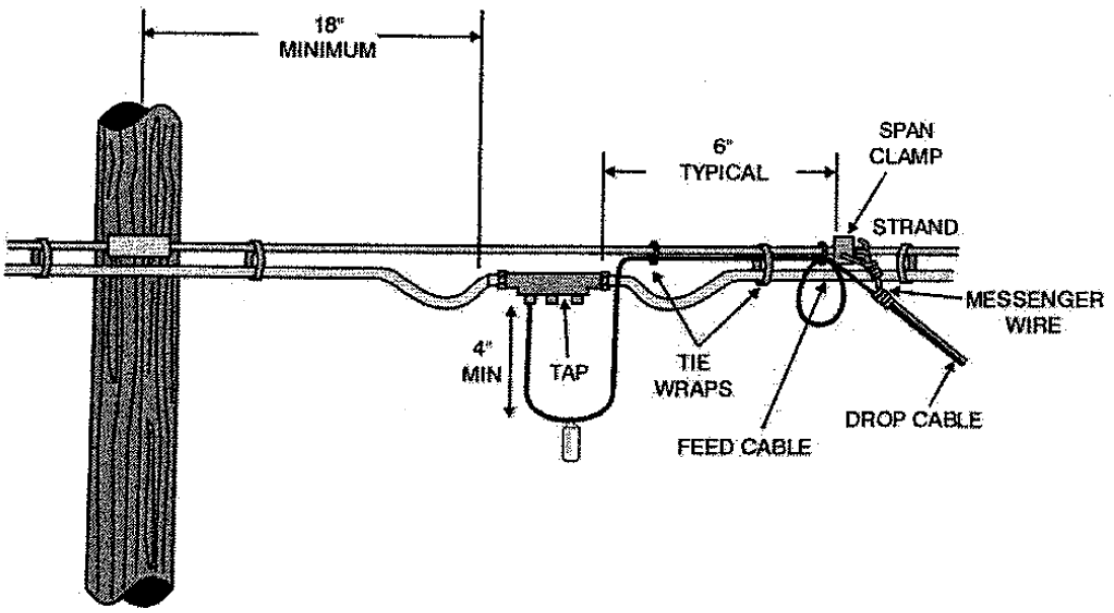
Attach a span clamp to the strand at the tap location facing up and toward the customer's home. The span clamp provides a mechanical connection to support the drop cable to the strand. The span clamp is typically installed 6 inches from the tap and a minimum of 18 inches from the centerline of the pole. Use care when attaching the span clamp so as not to damage the lashing wire or the protective jacket of the feed cable.



Span Clamp

Pull back the messenger wire from the end of the cable. Run the cable to the tap. Ensure enough cable is pulled to pass over the tap, form a drip loop under the tap, and attach to the farthest available tap. Because taps may need to be installed at some future time, it is important that an adequate loop be left at the tap. The cable should be run under the strand to reduce the chance of damage due to squirrels. Cable ties are used (about every 8 inches) to secure the drop along the strand to the span clamp. Do not over-tighten the ties. Over-tightening can damage the cable shielding, resulting in loss of signal quality.

Secure the drop to the strand and not to the feeder cable. If the drop is taken down, it could take the feeder with it. Another loop is included at the span clamp to reduce wind stress at this point.



Cable Routing

The cable is prepared and an F-connector installed on the end of the cable. The drop, Drop "ID" tag(s), any trap, and security sleeves are attached to the tap port using appropriate weatherproofing methods. The F-connector should be tightened to the proper torque value.

ID Tag Process

Write the apartment or street number on the tab lock, consistent with company and local facility policies and attach it to the drop.

Write the new tag number on the work order. Attach the barcode label over the hand written tag number on the top copy of the work order. This will provide a record of drop tag transactions on the local facility copy.

A good habit is to inspect other drops at the tap when installing a new drop. Problems such as damaged coax or loose connections may be repaired or reported to correct a future problem before the customer notices the problem.

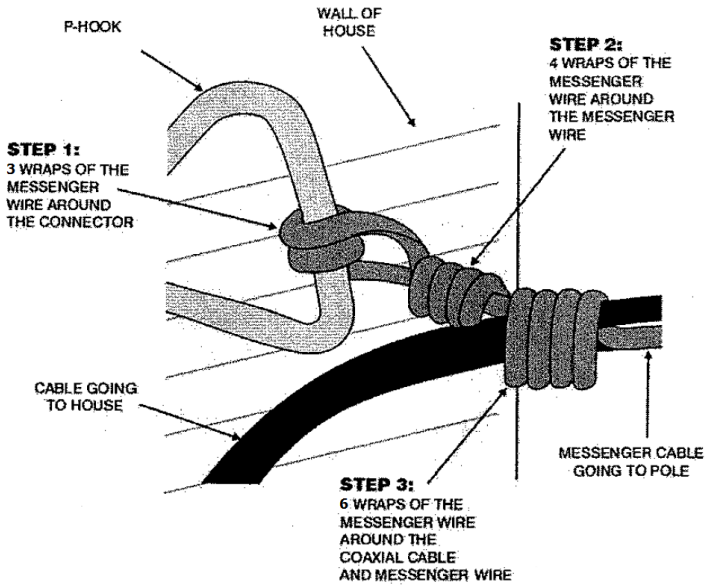
The drop line is connected to the span clamp using the messenger wire.

Making the 3, 4, 6 Wrap

The 3, 4, 6 is the method used by Connect/One for the attachment of messenger cable at the span clamp, P-hook and J-hook.

First, strip enough messenger wire back from the cable in order to tie the messenger to the clamp, back around itself and then back around the cable. Then perform the following steps for the 3, 4, 6 wrap method.

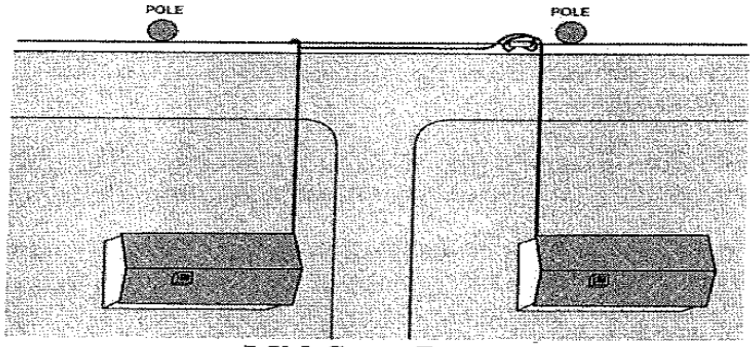
1. Wrap the messenger wire **three** (3) times around the U-shaped hook of the span clamp.
2. Wrap the messenger wire **four** (4) times around the messenger wire.
3. Wrap the messenger wire **six** (6) times around the coaxial/messenger wire.



Messenger Wrap for Attaching Aerial Drops

Mid-Span Drop

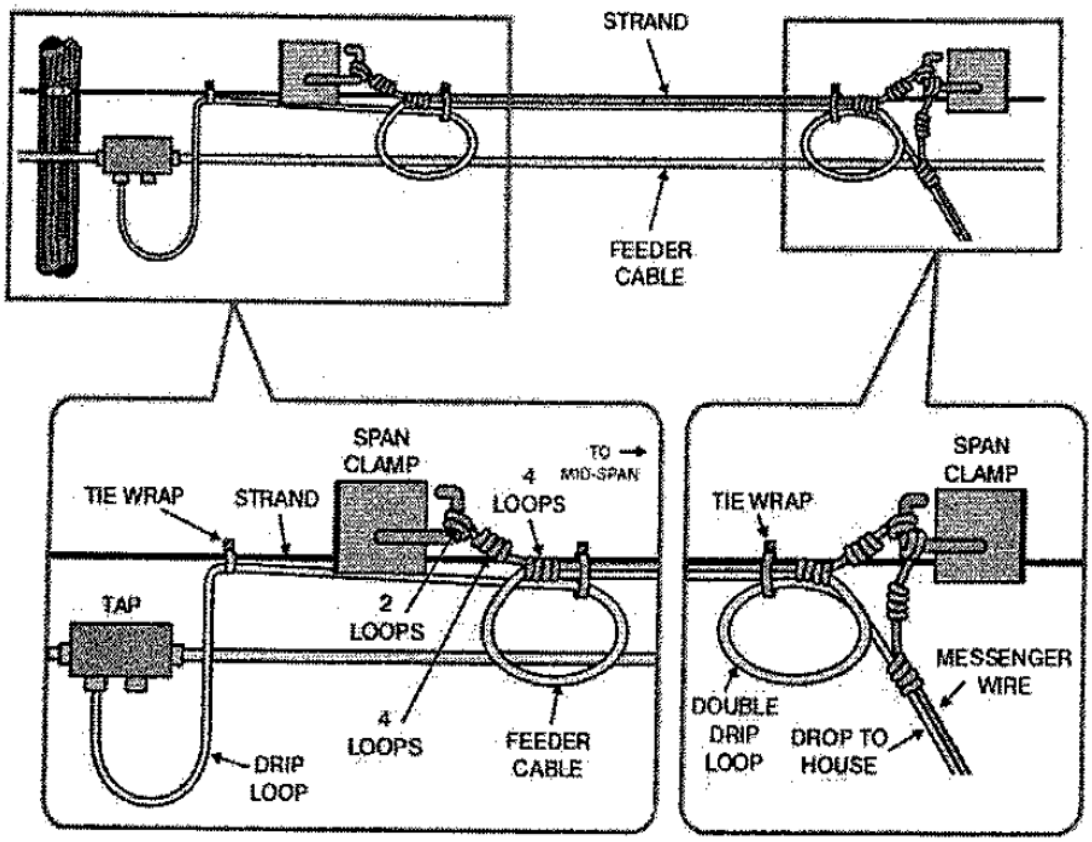
A mid-span drop is used to avoid crossing property lines or to get around obstacles. A mid-span drop consists of placing two span clamps on the strand: one as a take-off point away from the pole and the other to receive a run of drop wire parallel to the strand. This second clamp also provides a take-off point to the house.



Mid-Span Drop

Installing or removing mid-span drops can be one of the most dangerous aspects of your job. Always remove the drop from the house first. Always use proper climbing techniques, including belting-off, and survey the area above before climbing.

When installing the mid-span connection, place the ladder on the strand facing the house. Install the second span clamp on the strand at the mid-span connection. Raise the cable as you climb the ladder in the same manner as described for attaching to the tap. The cable is run parallel from the tap to the mid-span connection. Attach the drop line between the tap and the mid-span connection to the cable strand using tie wraps. There should be no more than 4 inches of sag from the strand to any part of the drop line. Connect the drop line to the span clamp using the messenger wire wrapping procedure or the drop clamp procedure. Ensure that a drip loop is installed at the span clamp.



Mid-Span Connection

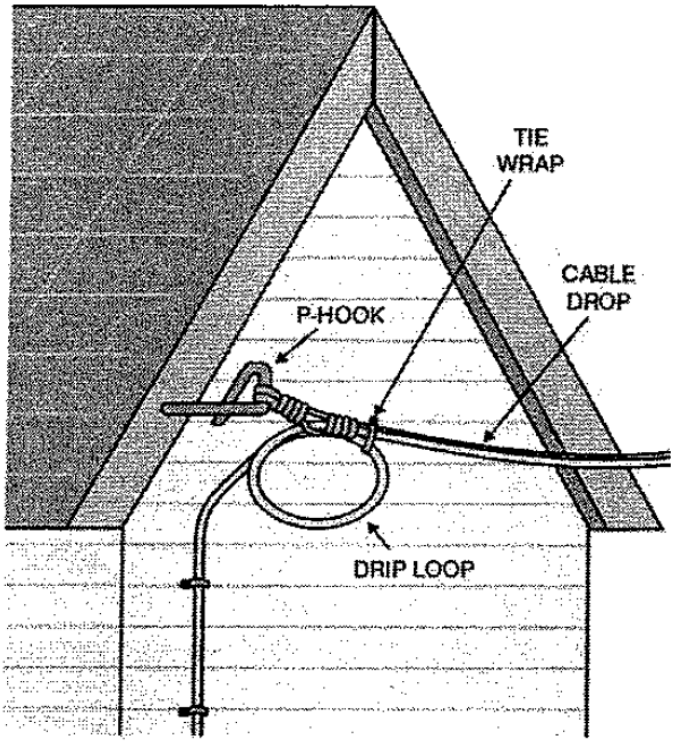
House Attachment

House attachments are made using a hook called a P-hook. When properly installed, the flat side of the P-hook is facing down and the curved side is facing up.

P-hooks must be screwed into solid material of the building to provide adequate support for the drop cable. Ideally, a P-hook is placed in the fascia board at the gable end of the house, but it may be placed at any location as long as it is screwed into a solid support such as a joist. Never screw the P-hook directly into vinyl or aluminum siding. The stress applied by the drop cable can pull the siding off the building.

It is not recommended to attach a drop under the eaves. Sliding ice in winter may damage the drop, and it is seldom possible to maintain sufficient height at this point.

A downward facing loop must be left before the first cable clip is installed. These loops function to relieve wind stress on the drop and also force any water running down the drop to drip away from the side of the house. Drip loops are especially important on houses with aluminum siding, since a constant drip at any point will cause discoloration.



P-Hook Attachment

When attaching to a brick, cinder block or stucco building, drill and install a lead anchor. The P-hook is screwed into the anchor and covered with RTV.

When pulling the cable to the house attachment, do not pull the cable tight. The cable should follow the sag of the other utility lines. Generally, the sag in the cable should not exceed 6 inches for every 50 feet of drop cable. Attach the cable to the P-hook using a drop clamp or messenger wrap method. Cut and discard any excess messenger wire.

Exterior Drop Wiring

When running the cable from the P-hook to the ground block and ultimately into the customer's house, use the following guidelines for exterior cable runs:

- Try to centralize the locations of the ground block and splitters with their associated loops. The area where the utilities hit the house is frequently concealed in the landscaping process; take advantage of this fact if you can.
- Conceal the cable whenever you can. Following the architectural features of the house will minimize the unsightliness of the cable by running it along trim boards, tucked under the bottom course of shingles or tucked under the comer trim of vinyl or aluminum siding.
- Make your runs as short and direct as possible from the ground block to the point where your cable enters through the outside wall of the home.
- Never run under or over doorways.
- Try to make ail long cable runs along the rear of the house or in the basement.

Cable Clips

The cable is attached to the house using cable clips. There are different clips depending on the exterior house siding. Use the proper clip for the siding to avoid drilling holes in aluminum or vinyl siding. Clips should be installed every 12 to 16 inches for horizontal runs to avoid sagging and every second or third shingle (24 to 30 inches) for vertical runs. Clips should also be installed facing in opposite directions to better secure the cable to the building. Cable clips are used on wooden siding, shingle or clapboard. The clip is designed to stay in place on the cable allowing one hand to keep the cable taut while the other hand is free to drive in the nail or screw. If used on asbestos siding, the nail or screw should be driven only in the cracks between shingles to avoid cracking the outer layer.

Cable clips (usually available in black and white) are normally only used to attach cable runs to the inside of the house. If used on the exterior of the home, the variations in temperature and humidity tend to cause the nail to work out of the siding.

Tap in clips are used to securely fasten wires to concrete and other hard surfaces. They can be used inside and outside to route wires along concrete, brick, mortar, cinder blocks and other hard surfaces without drilling. Two specially hardened drive pins securely fasten wires and prevent cord rotation.

Cable Clip and Tap in Clip

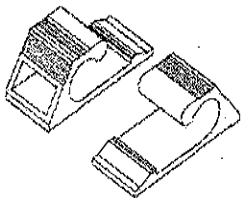
Another type of cable clip is a screw-type clip. This clip uses a screw to attach the cable to the house siding instead of a nail. These clips come in a string and are broken off one at a time and attached.

Screw-type cable clips can be used on brick. A small hole is drilled into the brick using a masonry bit. An anchor is installed in the hole and a screw-type clip is used to attach the cable to the brick siding. A nail-type clip may also be used to attach the cable to brick siding. It is recommended that if the nail bends in the process of driving into brick, replace the clip and try again. If possible, avoid brick attachment. Brick veneer homes frequently have wood trim that will serve as a route for the cable.

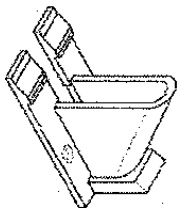
Screw-Type Cable Clips

Vinyl/Aluminum Siding Clips

Siding clips must be used for attachment to buildings with vinyl or aluminum siding. They are inserted into the existing seams between siding panels.



Horizontal Clip



Vertical Clip

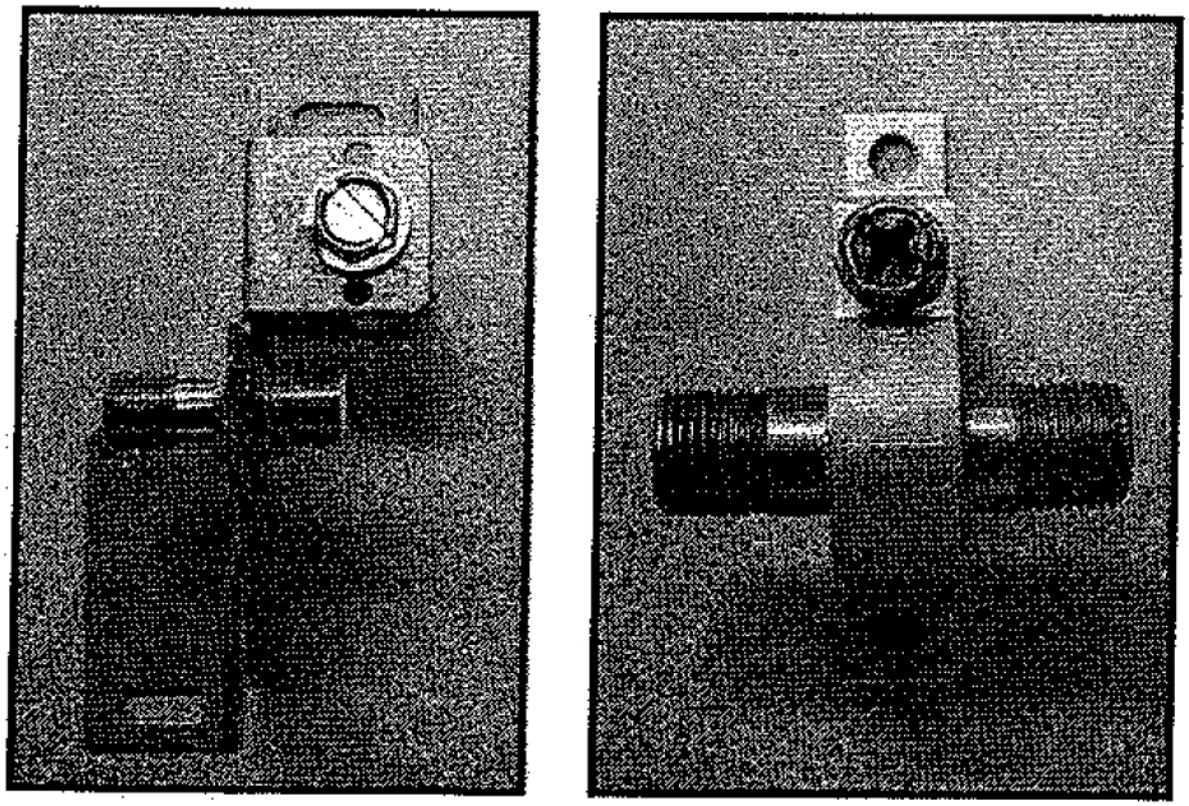
Combo Clip

Ground Block Installation

A ground block is installed at the end of the drop to ground the CATV shield at the customer's home. Grounding is performed to limit voltages that may be present due to contact with energized equipment on poles and to quickly dissipate voltages produced by lightning strikes.

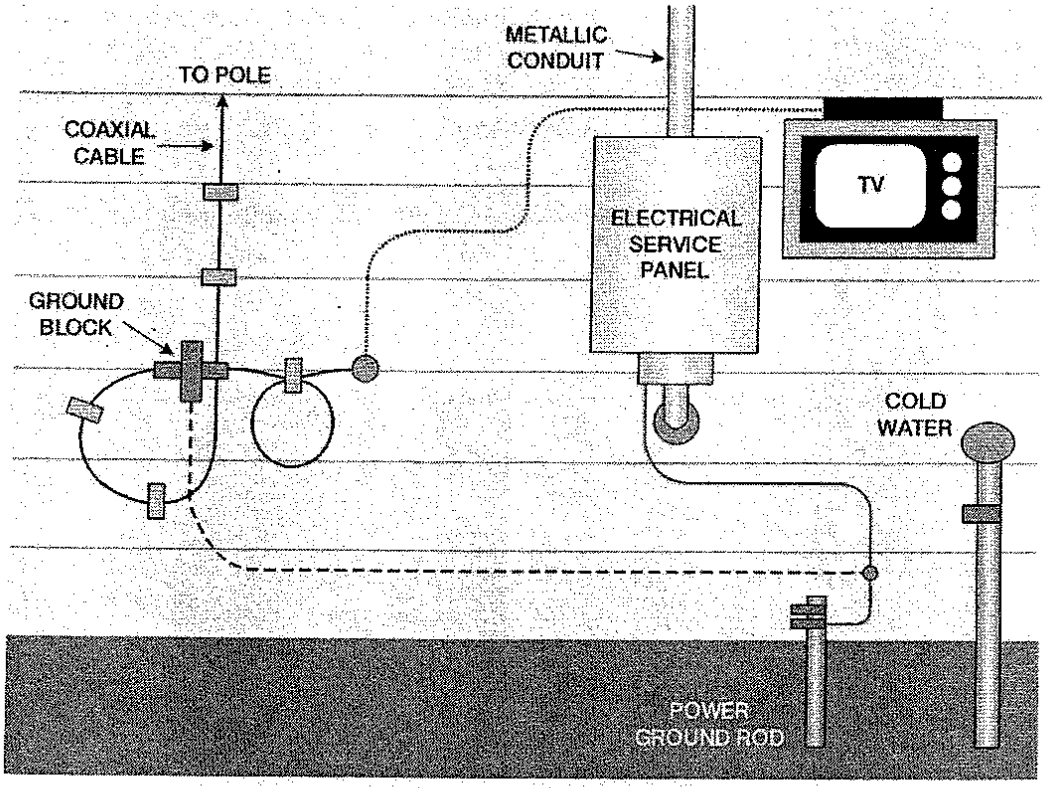
The grounding block is a piece of metal with an attached F-81 barrel splice, a screw connector for ground wire and two mounting holes. The grounding block is attached to the house using screws. On brick, stucco or cinder block surfaces, holes must be drilled and plastic anchors installed. The screws are then inserted into the anchors to attach the ground block to the house.

> Specific information related to bonding and grounding can be found in the next section, Bonding and Grounding.



Ground Blocks

The drop cable is prepared and an F-connector is installed on the end of the cable. A drip loop is formed and the drop is attached to the grounding block using appropriate weather proofing methods. The F-connector should be tightened to the proper torque value (30 inch per pound). The drop is then checked for signal leakage using a signal leakage detector.



Typical Grounding Block Installation

Additional information on exterior wiring can be found in the Exterior and Interior Wiring section of this manual.

Bonding and Grounding

This module provides information on bonding and grounding. The module describes the following:

- Definitions
- Reason for Bonding and Grounding
- Bonding and Grounding Codes
- Grounding Installations
- Components
- Safety Responsibilities
- Building Grounding Electrode System
- Service Problems

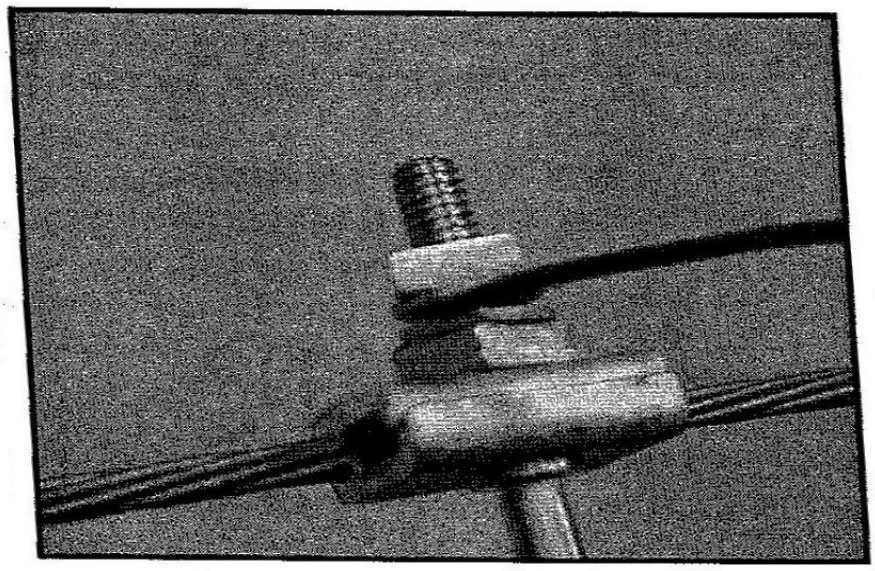
Definitions

This section uses some terminology that may be unfamiliar. This chapter provides definitions of the terms that are used in this section.

Bond

Bond is the permanent joining of metallic parts to form an electrically conductive path, which ensures electrical continuity and the capacity to conduct current safely.

The bond is an interconnection of different ground conductors made by using a bonding conductor. Two or more electrodes effectively bonded together are treated as a single electrode system.



Top View of Drop Bond Connection at Cable Strand Close-up

Common Ground
A common ground maintains all services entering a building at the same potential by bonding together at the ground facilities.

Ground
Ground means more than one thing when discussing grounding. The two definitions are as follows:

- The point of reference in an electrical circuit considered to be at nominal zero potential when other potentials within the circuit are compared to it.
- A connection to earth or a conductor serving as earth potential.

These connections can occur intentionally or accidentally.

- Effectively grounded is the intentional connecting to the earth through a ground connection(s) of low impedance and having current-carrying capacity to prevent the buildup of voltages.
- Accidentally grounding means a short or short circuit. In this situation, a path of little or no resistance between the circuit and the earth has been created unintentionally.

Ground Rod
A ground rod is a copper-clad galvanized steel rod, usually 8 feet long and 5/8 inch in diameter, driven into the ground at the point of electrical entry for grounding purposes.

Impedance
Impedance is the total resistance of an electrical circuit to current flow; the higher the impedance of a circuit, the less the current flow in the circuit.

Short Circuit
A short circuit is a circuit that offers very little resistance to current flow. A short circuit results in a sudden, high flow of current that can result in damage to the associated electrical equipment.

Wire Gauge
The term "wire gauge" is used to refer to the wire's current-carrying capacity. The smaller the number of the gauge means the larger the wire and the greater amount of current that it can carry. For example, the diameter of the #12 (or 12-gauge) wire is actually larger than the #14 (or 14-gauge) wire. This means a 12-gauge wire can carry more current than a 14-gauge wire.

Drop and Home Wiring Specifications

Signal Level Requirements

Receive (Rx, Downstream) Specifications

Frequency	Digital Level @ Tap		Target Level @ Ground Block	Digital Level @ CPE: Cable Box & Modem	
	Min	Max	Min	Min	Max
55MHz	+8 dBmV	+18 dBmV	+6 dBmV*	-10 dBmV	+12 dBmV
750MHz	+15 dBmV	+20 dBmV			

* +6 dBmV required at Ground Block for 4 or 5 outlet installation
+10 dBmV required at Ground Block for 6 to 9 outlet installation

Transmit (Tx, Upstream) Specifications

Total Outlets	Target Transmit (TX) Level @ Ground Block	CPE TX Level at:
3-5	≤41 dBmV	Modem <51 dBmV
6-9	≤38 dBmV	Cable Box <54 dBmV

Cable Type & Drop Length Requirements

As a general rule of thumb, the following table may be used to determine drop cable size (from the tap to the ground block):

For Drops of:	Use
0 to 150 feet	RG-6
151 to 250 feet	RG-11

For drops longer than 250 feet, a measurement of the actual tap levels would be appropriate. From this and the planned drop length, the technician can calculate what the ground block RF levels would be. If there is sufficient level using RG-11 then the drop may proceed as normal. If the levels are below 6.0 or 10.0 dBmV, the technician will have to consider a drop amplifier or suggest an outside plant extension*.

* Downstream levels specifications will be based on levels being 2 dB down from analog specification as node optimization is completed throughout our system.

Full node optimization is targeted for completion in all areas/regions by April/May 2013.

Calculating Loss Budget on the Drop Network

Based on the upstream and downstream level thresholds established in this document, and after establishing a reference at the ground block the maximum insertion loss allowed to any device in the house (Loss Budget) can be established.

Downstream (Rx)

1. Establish the reference level at the ground block by verifying the signal level of the highest and lowest frequencies on the system.
   - Signal level on those frequencies is the downstream reference.

2. Calculate the difference between the actual level and -10 dB.
   - -10 dB is the minimum allowed level on any frequency.

Example:	Reference level (actual level at ground block) =	6 dB
	Downstream level threshold =	-10 dB
	Loss budget on the downstream =	16 dB

Upstream (Tx)

1. Establish the reference level at the ground block by locking up the cable modem in a meter at the ground block.
   - The transmit level of the modem is the upstream reference.

2. Subtract the reference level from the maximum transmit threshold (54 dB).

Example:	Upstream Tx level threshold =	54 dB
	Reference level (actual Tx at ground block) =	- 36 dB
	Loss budget on the upstream =	18 dB

Internal Wiring

The internal wiring will consist of RG-6 coaxial cable being run to each device served plus any signal splitting required due to the number of devices. The loss of both the cable and splitters must be considered.

In general, most signal splitting will take place at the ground block. The only exception is where a pre-wiring or existing wring does not allow homerun wiring. In these cases a splitter is located at a different location. If multiple outlets are to be installed or if a modem is to be installed – each should have its own home run coaxial cable from the ground block splitting location to each area in the home.

3 - 5 Outlet Wiring/Splitter Configurations

- Average drop length is 150' of RG-6 = 8 dB loss @750 MHz
- Requires +6dBmV @ Ground Block
- Assumes longest outlet 70' of RG-6 = 4 dB loss @750 MHz

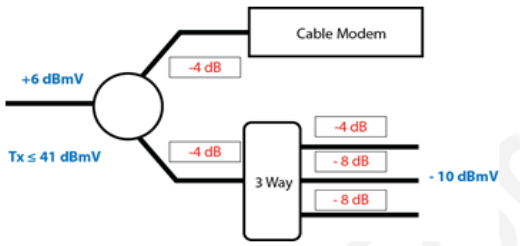


Figure 1

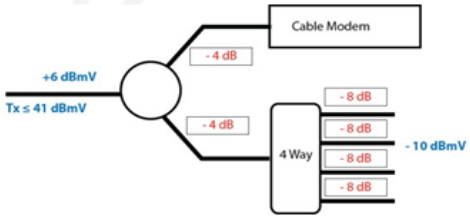


Figure 2

Figure 3

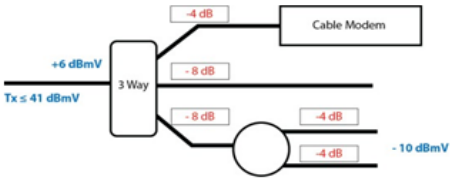


Figure 4

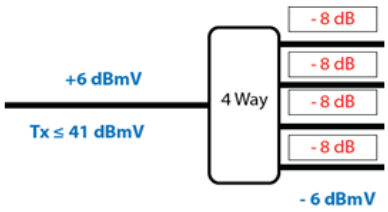


Figure 5

If you do not meet the signal specifications outlined above, then the installation of a house amplifier may be applicable*.

**Installation of a house amplifier needs supervisor approval.*

6 - 9 Outlet Wiring/Splitter Configurations

- Requires +10 dBmV @ Ground Block
- Assumes 4 dB of inside wiring loss

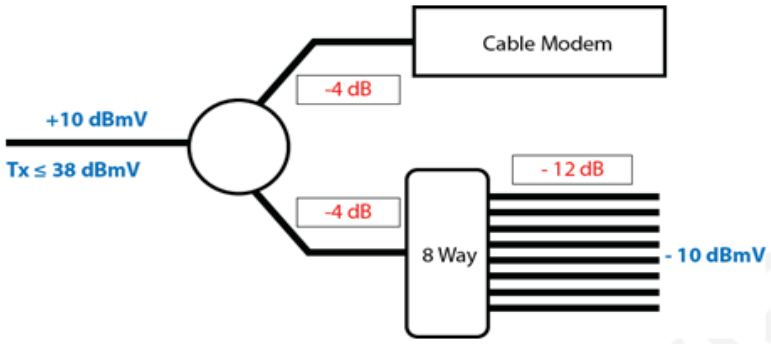


Figure 6

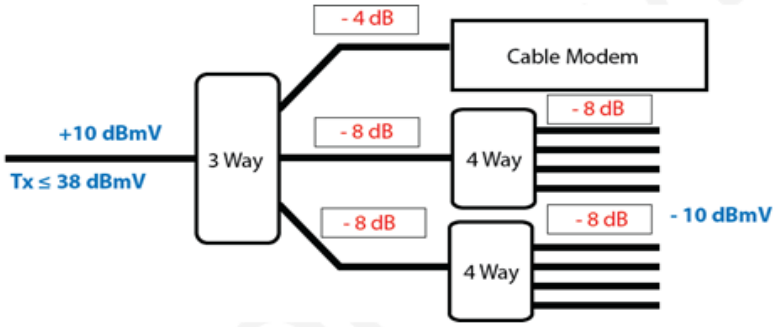


Figure 7

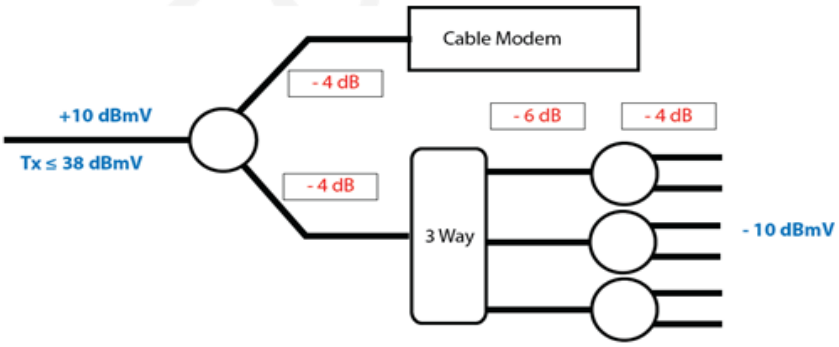


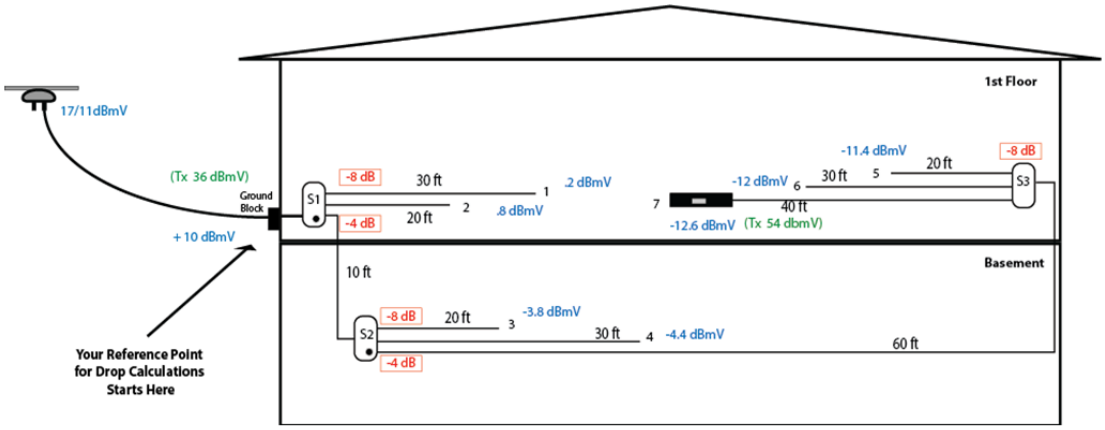
Figure 8

If you do not meet the Connect/One downstream and upstream signal specifications outlined above, then the installation of a house amplifier may be applicable*.

** Installation of a house amplifier needs supervisor approval.*

Examples: Common Existing Wiring

Example 1: Ranch Style House, 7 Outlets



Comments:

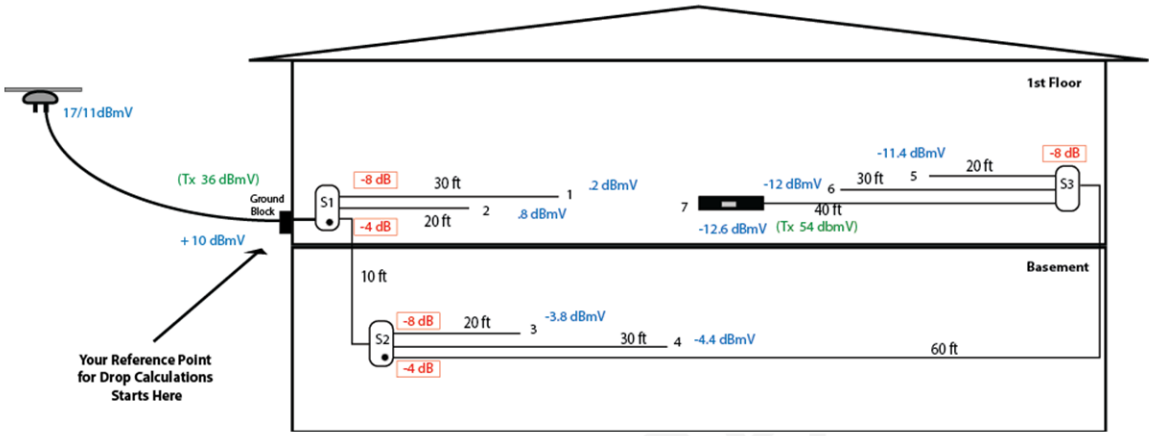
- The outlet connected to splitter 3 has low signal levels at cable box and max transmit.
- Transmit levels are low at ground block.
- If 3.0 cable modem, max transmit = 51, levels will be out of spec.
- Modem should always be connected of the first split.

Recommendation:

- Eliminate splitter 2 and 3.
  - Re-wire the outlets and homerun to the splitter 1 location.
- If unable to re-wire homerun.
  - Install House amplifier at splitter 1 location.
-

Note: These are just a few examples of different house wiring schemes that you will encounter in your daily work. Use these as a guideline for calculating forward and return signal level requirements.

Example 2: Two-story House, 9 Outlets



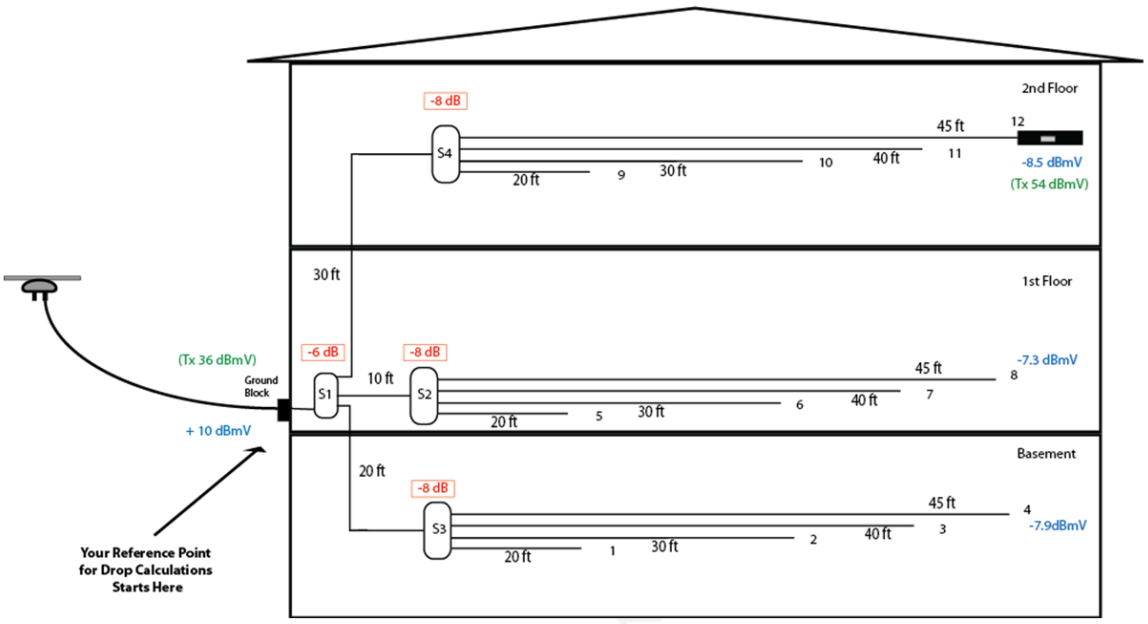
Comments:

- Outlet connected to splitter 4 has low signal levels at cable box and max transmit.
- Transmit levels are low at ground block.
- If 3.0 cable modem, max transmit = 51, levels will be out of spec.
- Modem should always be connected of the first split.

Recommendation:

- Eliminate splitter 2, 3, and 4.
    - Re-wire the outlets and homerun to the splitter 1 location.
- If unable to re-wire homerun.
    - Install House amplifier at splitter 1 location.

Example 3: Two-Story House, 12 Outlets



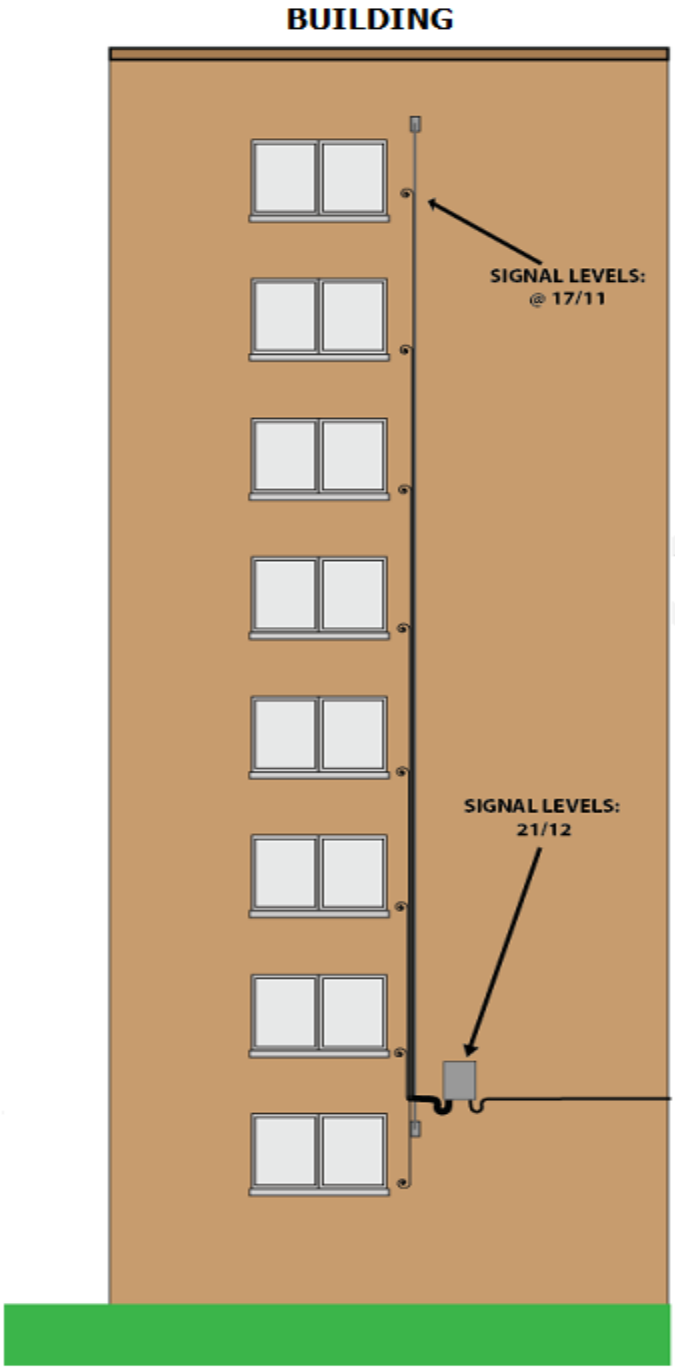
Comments:

- The outlet connected to splitter 4 has low signal levels at cable box and max transmit.
- Transmit levels are low at ground block.
- If 3.0 cable modem, max transmit = 51, levels will be out of spec.
- Modem should always be connected of the first split.

Recommendation:

- Eliminate splitter 2, 3, and 4.
    - Re-wire the outlets and homerun to the splitter 1 location.
- If unable to re-wire homerun.
    - Install House amplifier at splitter 1 location.

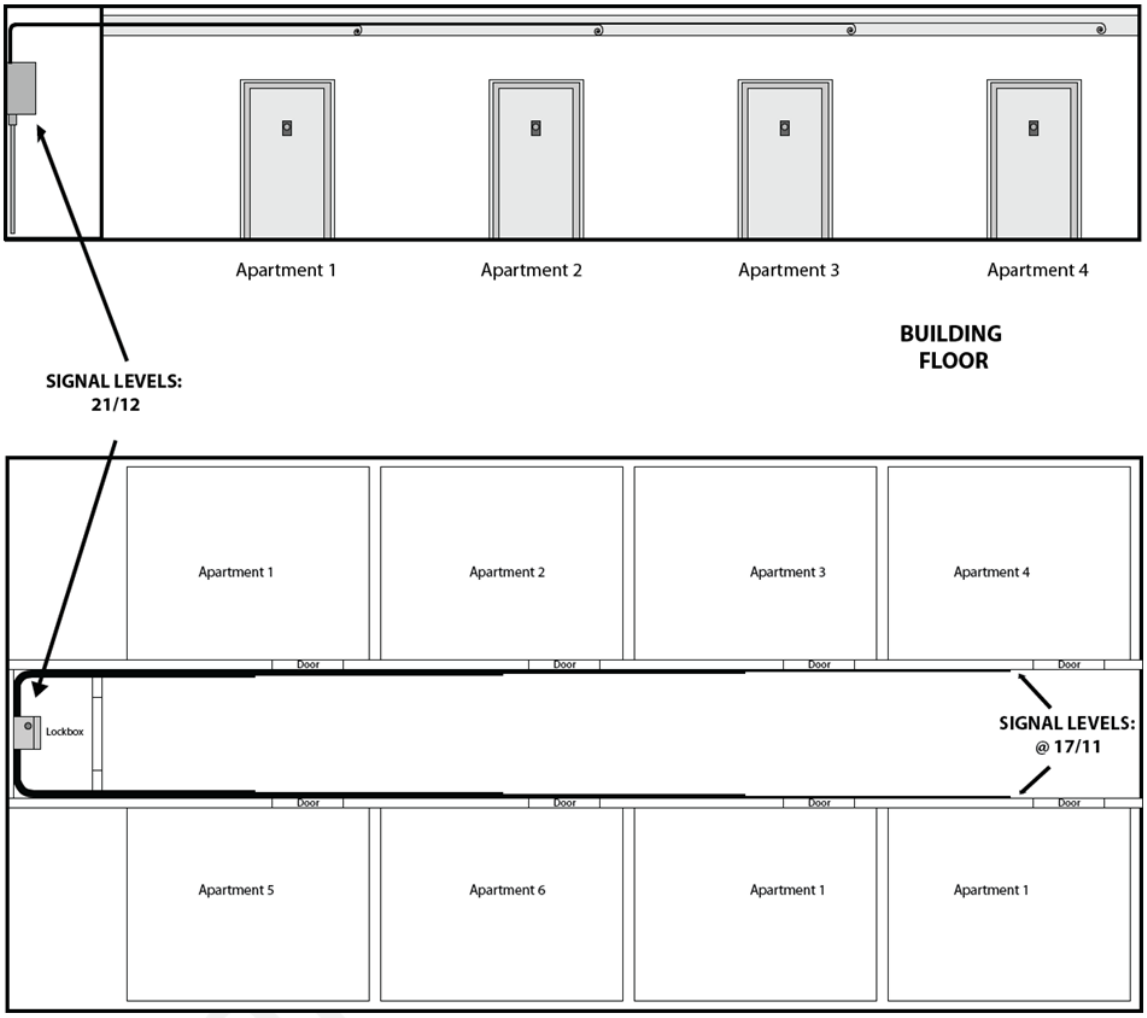
Example 4: Building/MDU



Comments:

- Follow standard installation guidelines for each floor.
- To determine the signal level at each floor, follow standard guidelines for drop loss calculation for the applicable coaxial cable.

Example 5: Building/MDU Floor



Comments:

- Follow standard installation guidelines for each floor.
- To determine the signal level at each apartment, follow standard guidelines for drop loss calculation for the applicable coaxial cable.
- Modem should always be connected of the first split within the apartment.
- If standard signals level per specification are not available per the number of outlets, contact you supervisor for possible use of a house amplifier.

Reason for Bonding and Grounding

The grounding of a CATV shield at the customer's home is performed to limit voltages that may be present by contact with energized equipment on poles or underground plant and to quickly dissipate voltages produced by lightning strikes, power surges or downed poles.

Safety Issue

A fire could result from improper grounding or insulation and electrical wiring. The resulting fire can cause property damage and/or injury.

A large potential voltage difference could occur between the electrical service in a customer's home and the cable television equipment or cables. The existence of the large potential voltage difference could cause serious injury or death for anyone who completes the circuit.

Bonding/grounding the cable system to the existing electrical system or common ground in the home protects the structure and its residents.

Equipment Failure Issue

Our cable system can experience high or transient currents resulting from power surges, lightning strikes or downed poles. Sometimes these currents result in major damage to our equipment or the home itself.

Bonding the cable system to an existing grounding electrode will help divert these surges of current or voltage.

Following all grounding bonding procedures is not a guarantee for protection. While it lessens the possibility of a failure, be aware that dangerous current could still exist. Always follow Connect/One's ground testing procedures and policy.

National Electric Code (NEC)

The National Electric Code (NEC) consists of a list of safety regulations and procedures for installing electrical wiring and equipment.

The NEC is implemented to protect people and property from hazards due to the use of electricity. The NEC is issued by the National Fire Protection Association (NFPA) and is updated every three years.

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The NEC is implemented to protect people and property from hazards due to the use of electricity. The NEC is used by the National Fire Protection Association (NFPA) and is updated every three years.

The NEC is code of practices. The legislature has not enacted the practices into law. If the state, county and/or community have adopted the NEC, then the NEC can be enforced.

It is important that the technician understands the local requirements because not all communities adopt the NEC as is. Some adopt only a portion of the code and enforce additional requirements. Some adopt an earlier version of the NEC. When an issue is raised about the bonding to be used, the local electrical inspector should be contacted.

The NEC is the standard for a variety of industries to ensure that homes and buildings are safe. This lesson focuses on the practices associated with the cable industry. The associated practices are the safety requirements of the house drop from the cable system tap port on the distribution system, to materials used throughout the building.

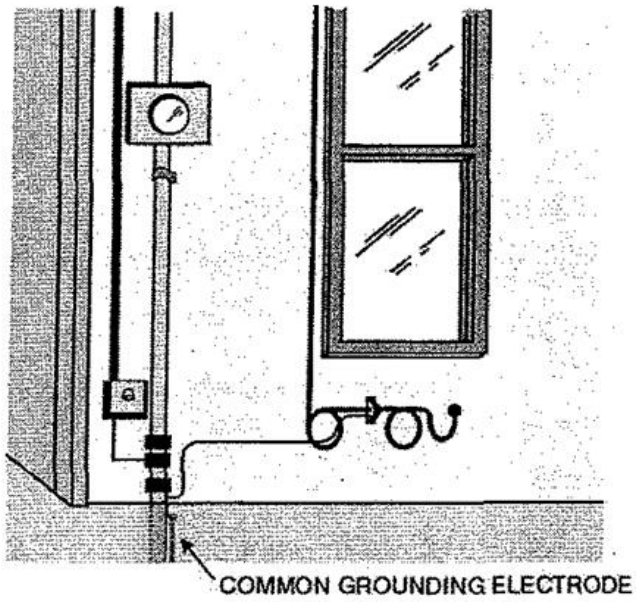
The specific articles are as follows:

- Article 250 is associated with the general requirements for grounding.
- Article 800 is associated with the communications circuits.
- Article 82t addresses coaxial cable distribution systems.

A complete and up-to-date NEC handbook and the National Electrical Safety Code (NESC) should be available at your office.

Application of the NEC

This section addresses some general NEC requirements associated with aerial installations and underground installations.



Approved Method for Grounding a CATV Drop

Aerial Installations

The following are some general NEC requirements associated with aerial installation:

- Attempt to bring the drop cable to the house from the same power pole as the power service.
- Attach to the dwelling near the power service attachment with a minimum clearance of 12 inches.
- Place the ground block as close as practical to the power company ground.
- Connect the shortest practical copper ground between your ground block and the building's grounding electrode as straight as possible.
- Make sure all bonding and grounding connections are clean and tight.

The copper ground is made using wire with sufficient current-carrying capacity.

National Electrical Safety Code (NESC)

The National Electrical Safety Code (NESC) is issued by the Institute of Electronic and Electrical Engineers (IEEE). This document addresses safety regulations and procedures to protect persons from the hazards resulting from the installation, operation and maintenance of electric supply and communication cables and their associated equipment located throughout the cable plant. This code does not address the coaxial cable or materials in the customer's house drop.

The state, county and/or local community must adopt this code for it to be enforced. As with the NEC, the organization may adopt or develop procedures stricter than those recommended in the NESC.

Underground Installations

The following are some general NEC requirements associated with underground installation:

- Attempt to bring cable within a few feet of the building's grounding electrode.
- Install the ground block as close as practical to the power company's grounding electrode.
- Connect the shortest practical copper ground between your ground block and the building's grounding electrode.
- Ground the drop cable upstream of (before) all splitters and subscriber terminal equipment.
- Make sure all bonding and grounding connections are clean and tight.

As a general guideline, the purpose of grounding is to find the lowest resistance path between the cable system and the power system on the outside of the house.

The copper ground is made using wire with sufficient current-carrying capacity.

Grounding Installations

All installations of CATV service will be grounded including, but not limited to, single-family homes, multiple family homes, apartment houses, condominiums, town houses, mobile homes, trailers, boats, campers, docks, offices, restaurants and bars.

CATV lines, which are disconnected from the RF service, must still be grounded, removed entirely from the building, or effectively isolated from the pole or pedestal ground.

Effective isolation may be accomplished by disconnecting the cable cutting off the fitting and tie wrapping the cable back to itself away from the strand.

All metal or electrically conductive apparatus or enclosures used in the installation of cable services must be bonded to the CATV shield.

Components

When grounding a CATV cable, you will be using a variety of components. This section describes some of the components that you will be using.

Bonding and Grounding Conductors

The grounding conductor used to ground the CATV shield to the grounding electrode system must be a minimum of #12 copper wire. The wire may be solid or stranded and must be insulated. This conductor size is used for CATV Cable RG-6 and RG-11.

Grounding Connectors

The only type of connectors to use on the CATV cabling is UL-approved connector. The connectors must be rated for the correct wire size and type (copper, aluminum) used. All connectors must be marked with all of the preceding information.

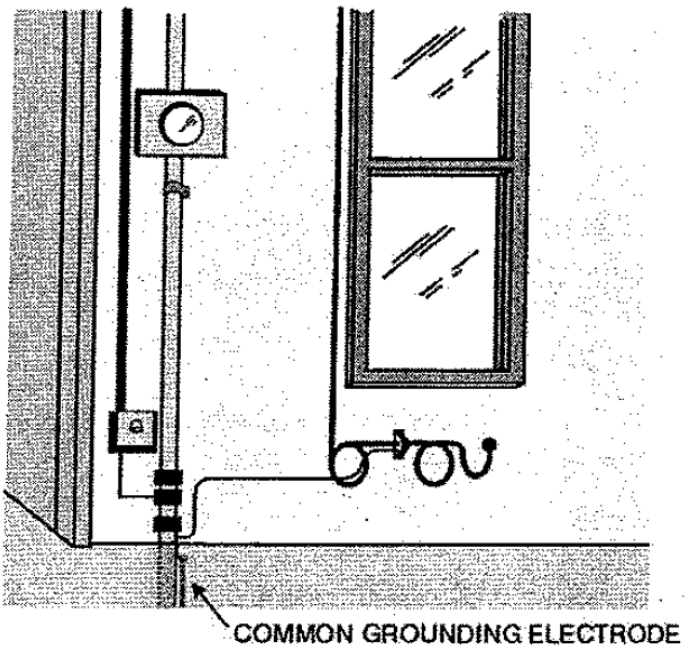
The proper connector must be used for the specific grounding attachment being made. A screw or bolt being used for another purpose is unacceptable for use.

Building Grounding System

This section discusses the requirements for bonding and grounding methods.

The residential grounding and bonding system is commonly referred to as the building grounding electrode system. This is the point at which the "common ground" is established.

All services entering the home must be bonded to the common building grounding electrode system to ensure that they maintain the same ground/voltage potential.



Common grounding location

Locating Grounding Electrodes

Use the following guidelines to determine where to place the cable-bonding electrode:

- The grounding electrode should be as close as practical to the point where the customer's drop contacts the residence.
- The grounding electrode should be as close as practical to the power ground of the residence.

Components

When grounding a CATV cable, you will be using a variety of components. This section describes some of the components that you will be using.

- Ground Block/Splitters
- Ground Wire
- Ground Connectors
- Ground Tag

Ground Blocks and Splitters

A ground block is a metallic device used in a drop system to bond its shielding to the building's ground system. Splitters can also be used at the point of termination as a ground connection and connection point for several outlets. If using a splitter, see the specification for splitter use section at the end of this section.

The following are guidelines for installing the ground block or splitter used to establish the bonding/grounding connection:

- The ground block/splitter should be installed in the same general area as the power company's entrance to the building/house. This will allow you to keep the ground wire as short and as straight as possible.
- If using a ground block, it should be connected before all splitters or customer equipment.
- All ground blocks or splitters should be placed in an upright position, as shown in figure 2 and 3, fastened securely.
- The ground block/splitter should be in an accessible location near the power meter outside the house.
- The ground block/splitter provides a test location outside the customer's house for signal-level reading and troubleshooting.
- Always check the condition of the ground block/splitter when you visit a customer's home.

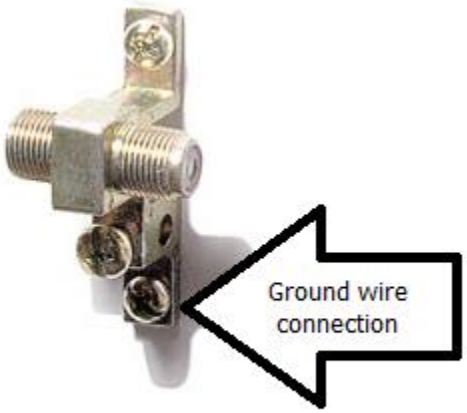


Figure 2: Sample Ground Block

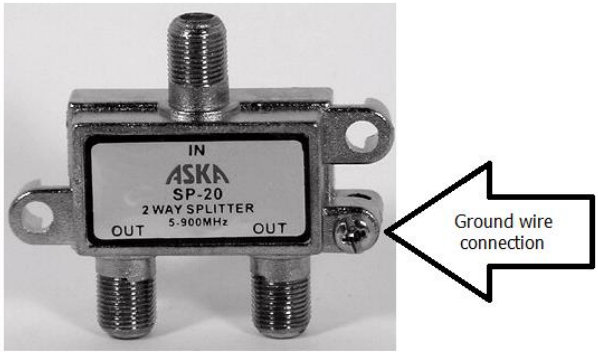


Figure 3: Sample Splitter

Ground Wire

Ground wire for cable television must meet the standards established by the NEC. The following guidelines should be followed when working with the cable:

- Attach ground wire to the drop cable using a ground block or splitter.
- Ensure that the ground wire is insulated with rubber or other suitable insulation. Typically the ground wire has insulation green in color.
- Ensure that the ground wire is made of copper or other corrosion-resistant conductive material. The wire may be solid or stranded.
- Ensure that no damage is done to the ground wire insulation during installation.
- Ensure that the ground wire is as short and straight as practical between the ground block and the building's grounding electrode. **Connect/One specification for ground wire length is not to exceed 15 feet.**
- Ensure that the connections are tight. Metal must touch metal for a good connection. The grounding conductors should be free of any paint or dirt.
- Ensure that the ground wire is greater than or equal to #14 AWG wire. This ensures that the current-carrying capacity equal to or greater than that of the outer conductor of the coaxial cable.

Bonding/Ground Connector

- Only one ground wire should be attached to one ground/bonding connector.
- An existing bonding connection is never disconnected to attach the cable television bond.
- The only type of connectors to use on the CATV cabling is a UL-approved connector. The connectors must be rated for the correct wire size and type (copper, aluminum) used.
- The proper connector must be sued for the specific grounding attachment being made. A screw or bolt being used for another purpose is unacceptable for use.

These connections may require maintenance over time and they should be checked periodically during repair calls.

- The surface that the clamp is applied to, must be clear of any paint, insulation or any other obstruction to make a good electrical connection.
- The area can be cleaned by wire brushing or scraping the selected connection area. The technician should be careful to ensure that the connector is properly fitted and seated and all connections are wrench-tight.

Split Bolts

Ground Strap

Meter Box Clamp

Ground Clamp

Material	Ground/Bond Connection
Split Bolt	Customer electrical service ground wire.
Ground Strap	Metallic conduit between load or line side of the electrical meter and the customer service panel.
Meter Box Clamp	Customer electrical meter box.
Ground Clamp	Metallic cold water pipe within 5 feet of the main water service entrance.

Ground Tag

A ground tag must be connected to the ground wire connection, advising the customer not to remove the tag. Slide the ground tag on the ground wire before connecting to the bonding/grounding connector.

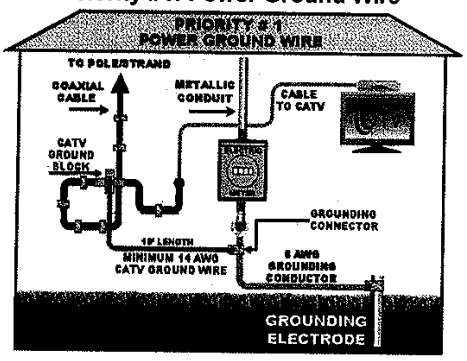
Connect/One Ground Installation Policy and Guidelines

- All installations of CATV service will be grounded including, but not limited to, single-family homes, multiple family homes, apartment houses, condominiums, town houses, mobile homes, trailers, boats, campers, docks, offices, restaurants and bars.
- On all new installations, the cable drop should follow the electrical company service drop to the building or home. Contact your supervisor with any questions or issues.
- If a cable drop is disconnected, it must still be properly grounded or removed entirely from the building. If a drop is disconnected, remove the connector and fold cable back and secure it away from the strand, following standard Connect/One disconnect procedure.
- Only one single ground block/splitter can be connected to a ground wire.
- Only one ground wire can be connected to a ground connector.
- All metal or electrically conductive apparatus or enclosures used in the installation of cable service must be bonded to the CATV shield.
- All connections on the ground block or splitter must be clean and wrench tight (should not be able to remove by hand).
- All connections on the ground connector must be clean and wrench tight (should not be able to remove by hand).
- If the conduit is painted or rusty, scrape up to ½ inch on the top and bottom on the conduit at the point of contact by the connector to maintain good contact and provide visual inspection of bond.
- It is not acceptable to bond to any removable pieces on the meter pan such as the meter lid or door.
- Do not interfere with another service's ground or bond.
- The ground wire must be straight as possible and not to exceed 15 feet in length.
- A Connect/One approved ground tag must be attached to the ground wire.
- Always follow the Connect/One Ground Priority. Contact your supervisor with any questions or issues.

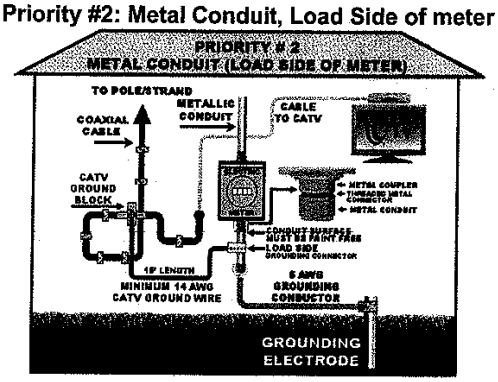
Grounding Priority Order

This section discusses the grounding options in their order of priority as mandated by Connect/One's grounding protocol. Always attempt to use the highest priority (e.g., priority #1), if available before descending to the next option or priority.

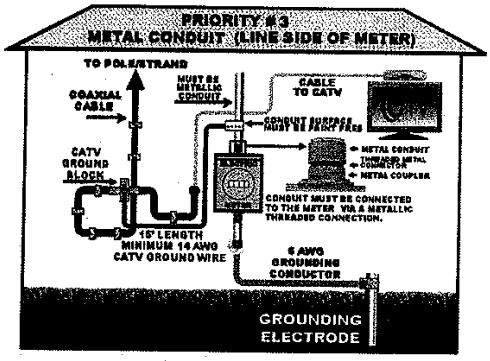
Priority #1: Power Ground Wire



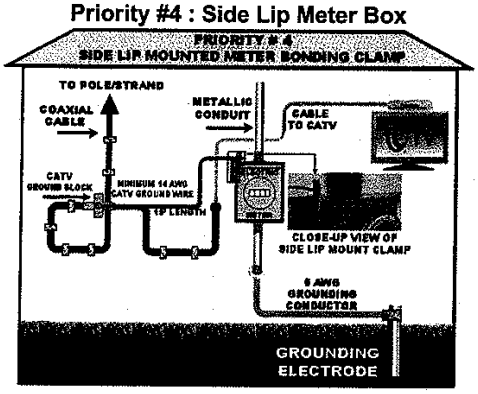
Priority #2: Metal Conduit, Load Side of meter



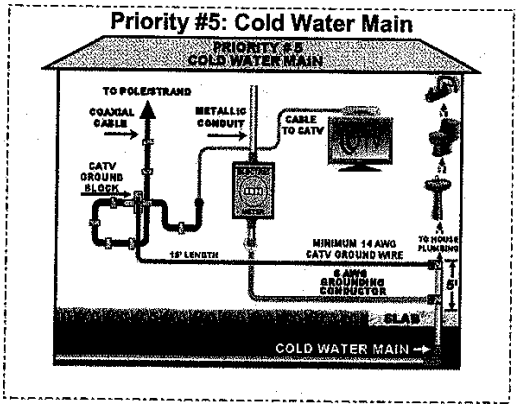
Priority #3: Metal Conduit, Line Side of Meter



Priority #4 : Side Lip Meter Box



Priority #5: Cold Water Main



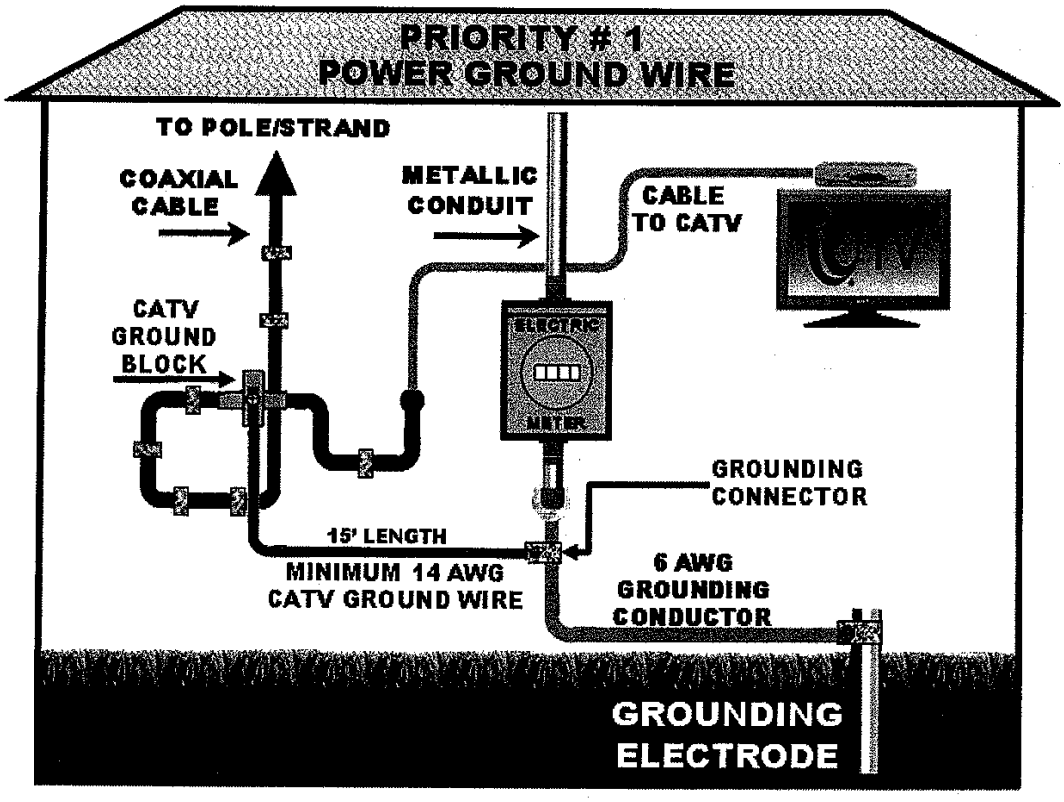
The following are the accepted grounding attachment locations in order of preference:

Priority	Acceptable Ground Attachment/Connector
1	Grounding through the use of an approved ground connector (i.e., UL-approved split bolt of the proper size and a minimum #14 AWG copper wire) to the customer's electrical service ground wire.
2	Attachment through the use of an approved grounding clamp (i.e., special clamp, UL-approved, for attachment to a 2-inch galvanized pipe and a minimum #14 AWG copper wire) to the continuous load side of a metallic conduit between the electrical meter housing and the electrical main breaker panel.
3	Attachment through the use of an approved grounding clamp (i.e., special clamp, UL-approved, for attachment to a 2-inch galvanized pipe and a minimum #14 AWG copper wire) to the continuous line side of a metallic conduit between the electrical service main line and the electrical meter housing.
4	Grounding through the use of an approved clamp connector (i.e., special UL-approved meter box clamp for attachment to the meter box and a minimum #14 AWG copper wire) to the side lip of the metallic box enclosure.
5	Attachment through the use of an accepted clamp (i.e., special UL-approved clamp for attachment and a minimum #14 AWG copper wire to a metal conduit) to the grounded interior metal main water pipe within 5 feet of its entrance to the building/house. • Must be approved by supervisor.

All bonds are to be made with a minimum #14 gauge wire. If proper grounding cannot be accomplished, then the installation must be terminated.

Priority 1: Bonding to Power Utility's Ground Wire

The power utility's ground wire is usually located on the outside of the single-family home near the power meter.

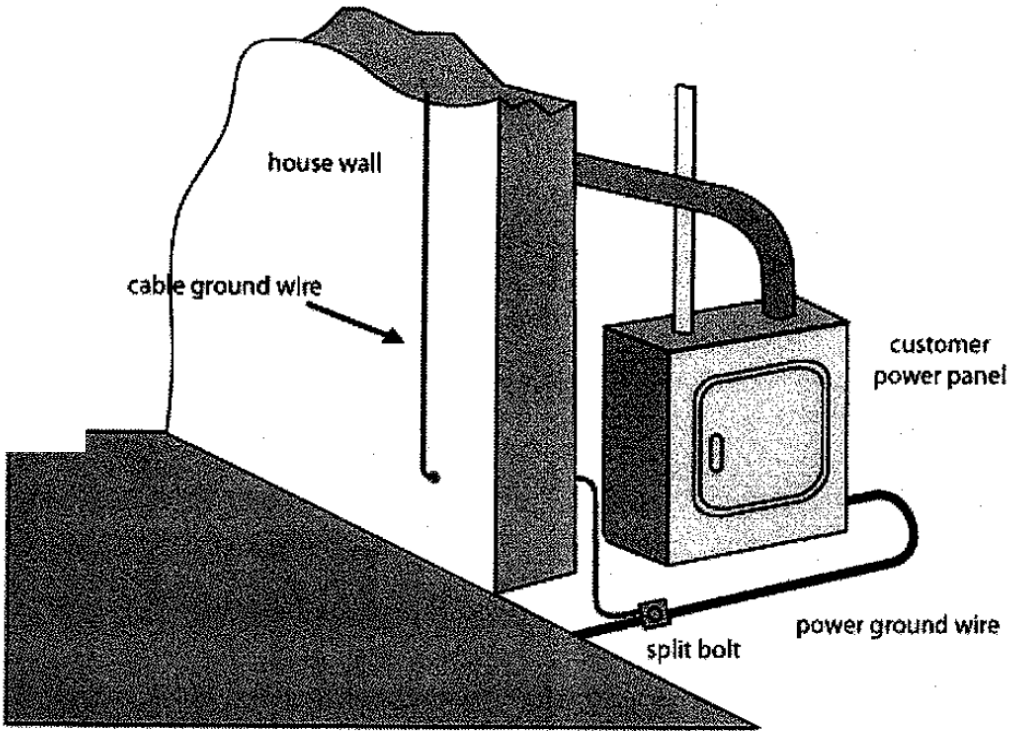


Grounding to the Power Ground Wire

The following actions are required to ground to a Power Ground Wire:

- Grounding of CATV service must be connected to the customer's 6 AWG **Grounding Conductor** with a split bolt connector.
- The maximum CATV ground wire length cannot exceed 15 feet.
- All connections must be wrench tight.
- A Connect/One approved ground tag must be attached to the ground wire.

In other homes, the power utility's ground wire may be located in the basement. If the power meter is located in the basement, then drill a small hole into the basement just through the sill plate and run the ground wire into the basement. The ground wire is then grounded to the power ground wire near the circuit breaker panel, as shown below.



Grounding to the Customer's Electrical Service Equipment

When the grounding is performed with the power utility's ground rod, the following actions need to be performed.

⚡	Do not work on circuits that have an amperage greater than or equal to 1 amp.

- Test for amperage with an ammeter clamp-on at the connection.

⚡	Do not assume that there is no voltage or amperage present.

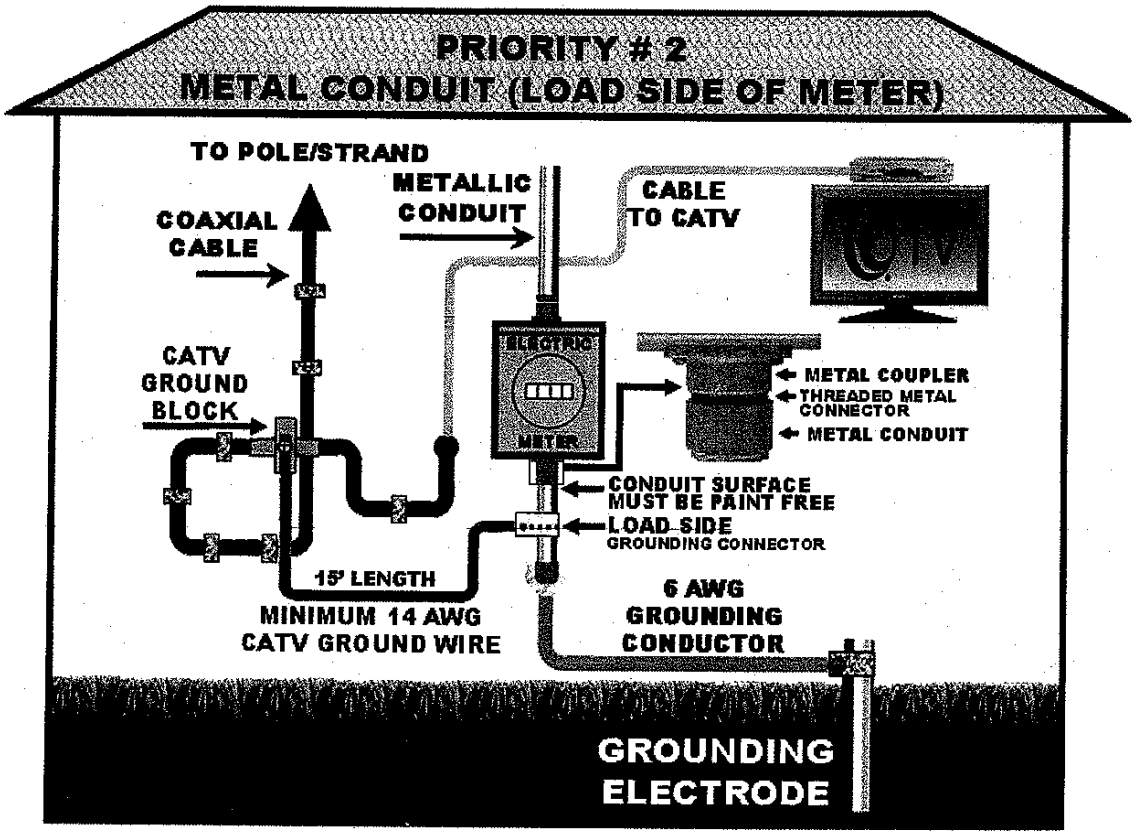
- Test the ground rod or wire for amperage with an ammeter clamp-on or tic tracer prior to making any type of connection.

⚡	The power utility's ground wire clamp must never be loosened.

When the grounding is performed with the power utility's ground wire, attach ground wire to the power utility ground wire using a clamp designed to attach the correct size ground wire to #6 AWG solid copper ground wire.

Priority 2: Grounding to the Power Service Load Conduit

The power service conduit (must be metal conduit) is located between the load side of the power meter and the input side of the service disconnect cabinet or circuit breaker panel.



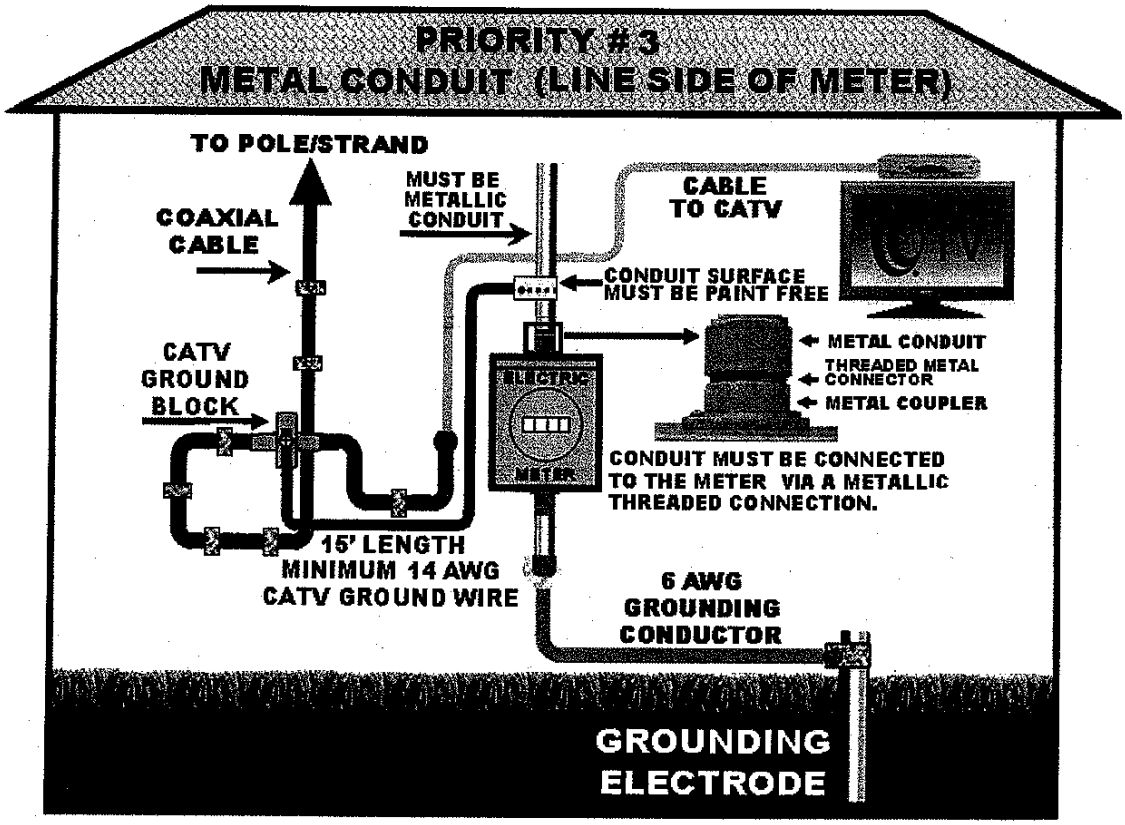
Grounding to Metal Conduit, Load Side of Meter

The following actions are required to ground to the metal Conduit, Load Side of meter:

- Grounding of CATV service is connected to the load side of the electrical meter's metallic conduit with a grounding strap.
- Metallic conduit must be connected to the meter by a metallic threaded connection that is wrench tightened.
- If paint or rust, clean up to ½ inch above and below the contact point. Rust and paint must be scraped off the surface of the metallic conduit beneath the grounding strap to ensure the integrity of electrical connection.
- The maximum CATV ground wire length cannot exceed 15 feet.
- Test the power service conduit for voltage with a tic tracer or ammeter clamp-on prior to making any connections.
- Ensure that the grounding strap is the correct size for the conduit, it is being installed on.
- Place the grounding strap in a position as close to the ground block as possible.
- All connections must be wrench tight.
- Ensure that the grounding connection is greater than or equal to 12 inches from any exposed electrical wire, such as the connections at the service weather head.

Priority 3: Grounding to the Power Service Line Conduit

The power service conduit (must be metal conduit) is located between the service weather head and the power meter base



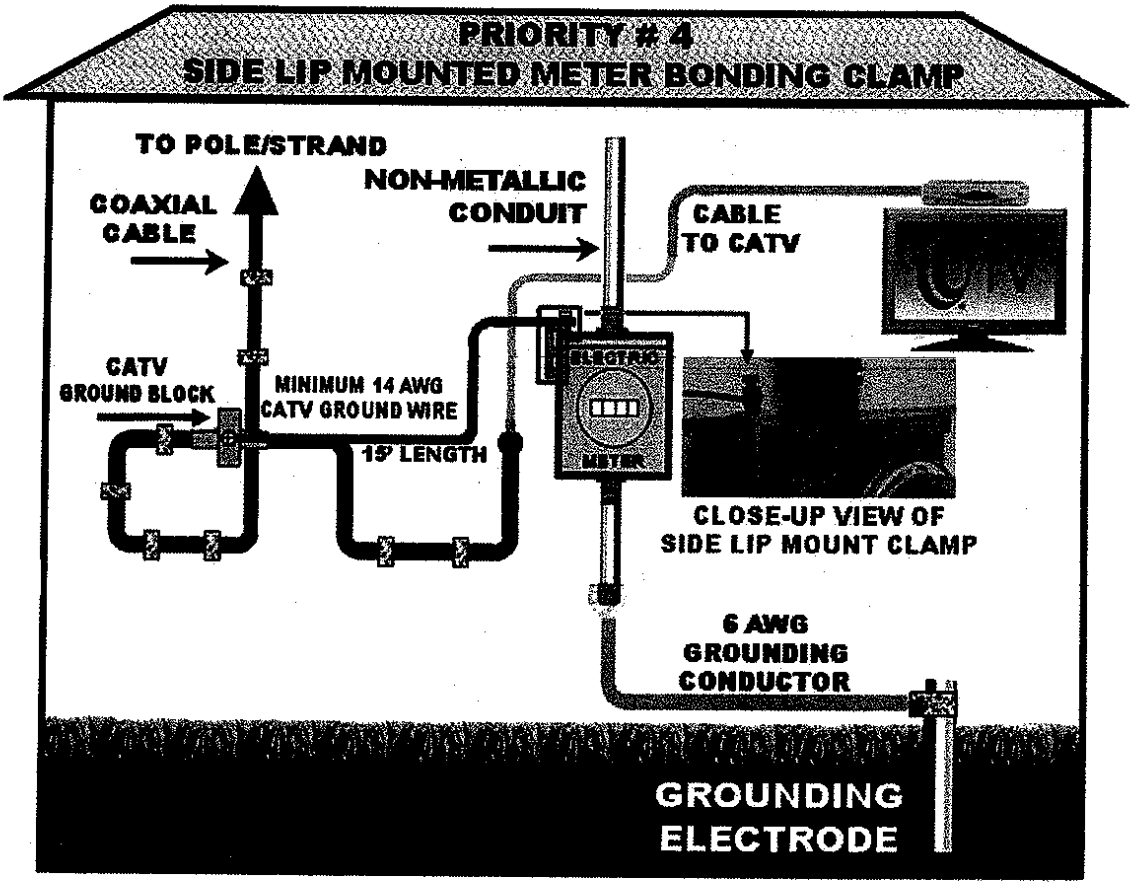
Grounding to Metal Conduit, Line Side of Meter

The following actions are required to ground to a power service conduit:

- Grounding of CATV service is connected to the line side of the electrical meter's metallic conduit. *Line Side Conduit must be metallic.*
- Metallic conduit must be connected to the meter by a metallic threaded connection that is wrench tightened.
- If paint or rust, clean up to ½ inch above and below the contact point. Rust and paint must be scraped off the surface of the metallic conduit beneath the grounding strap to ensure the integrity of electrical connection.
- The maximum CATV ground wire length cannot exceed 15 feet
- Test the power service conduit for voltage with a tic tracer or ammeter clamp-on prior to making any connections.
- Ensure that the grounding strap is the correct size for the conduit, it is being installed on.
- Place the grounding strap in a position as close to the ground block as possible.
- All connections must be wrench tight.
- Ensure that the grounding connection is greater than or equal to 12 inches from any exposed electrical wire, such as the connections at the service weather head.
- A Connect/One approved ground tag must be attached to the ground wire.

Priority 4: Grounding to the Side Lip Mounted Meter Bonding Clamp

The power service meter box PVC conduit is located between the service weather head and the input side of the service disconnect cabinet or circuit breaker panel.



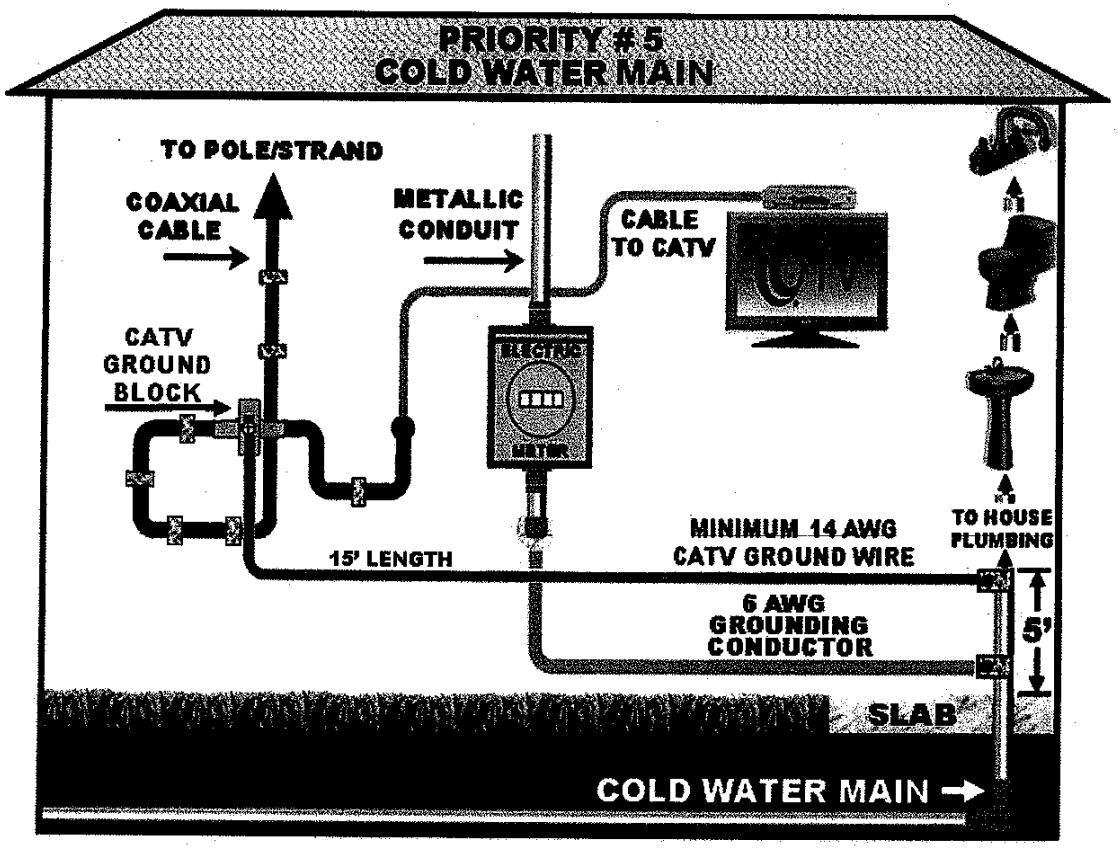
Grounding to Side Lip of Meter Box

The following actions are required to ground to the side of the meter box:

- Grounding of the CATV service must be connected to the side of the meter pan using the Side Lip Mounted Meter Bonding Clamp.
- The clamp must be attached as to not impede the function of any moveable component of the meter pan.
- The connection of the clamp must be checked to ensure the mounting screw has penetrated any surface paint and/or rust.
- The maximum CATV ground wire length cannot exceed 15 feet.
- All connections must be wrench tight.
- A Connect/One approved ground tag must be attached to the ground wire.

Priority 5: Grounding to a Main Cold Water Pipe

Grounding to an electrically conductive main cold water pipe is acceptable based on certain conditions. **This Option must be approved by a supervisor.**



Grounding to a Main Cold Water Pipe

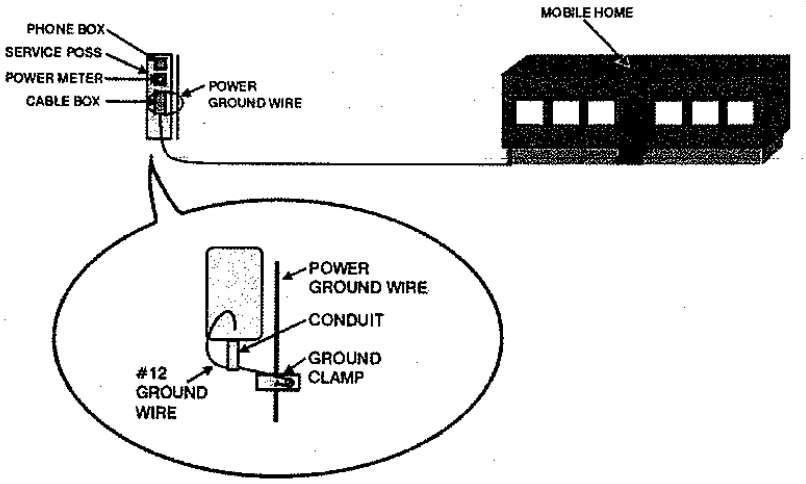
The conditions that must exist for a cold water pipe to be used as a grounding location include the following:

- Grounding of the CATV service must be connected to the metallic cold water main within 5 feet of the service main's entrance into the structure (i.e. house, building).
- Verification must be made to ensure that the cold water is a viable grounding electrode.
- Supervisor authorization is required before attempting to utilize cold water as a CATV ground.
- The maximum CATV ground wire length cannot exceed 15 feet.
- The pipe must be metal all the way to the ground. The metal underground water pipe must be in contact with the earth for greater than or equal to I 0 feet and is electrically continuous.
- A #6 solid ground wire or metal bar is used to bypass the water meter. This is necessary since some meters contain nonmetallic parts.
- A Connect/One approved ground tag must be attached to the ground wire.

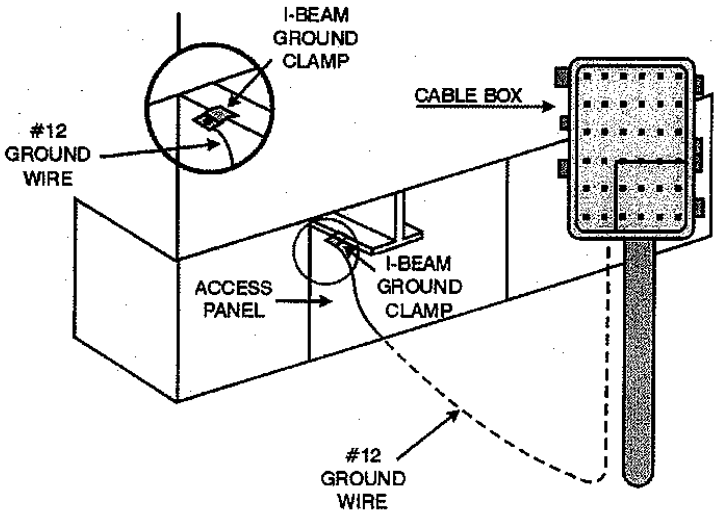
Mobile Homes

A mobile home presents some problems in trying to determine a grounding location. The best way to ground the cable service at a mobile home is at the service equipment location. Typically this location is within the sight of the mobile home and less than 30 feet from the exterior wall of the mobile home that it serves. The metal sides of a mobile home are unacceptable for grounding locations.

- If there is service equipment or disconnect switch is within less than 30 feet of the mobile home you bond to the service equipment or disconnect switch.
- If there is no service equipment within 30 feet, you ground/bond to the mobile home to an acceptable grounding point. The ground wire must be greater than or equal to #12. Grounding shall be accomplished with NEC Articles 820-40(b) (2) and 820-40 (B) (3).
- Contact your supervisor with any questions or issues.



Grounding to a Mobile Home using the service Utility Ground



Grounding to a Mobile Home at the Frame

Docked Boats

If a complex of docks and boats are being serviced from a common CATV entrance point, the drop from the pole must be grounded as soon as possible at its entrance. This ground must be the grounding electrode system of the complex being serviced.

In addition, if feeder labels are strung along the docks to feed multiple boats and are tapped or split, additional bonds are required. As a minimum, a bond should be placed at all ends. The bonding conductor should be a #6 and attached to the grounding terminal inside the entrance panel of the last service enclosure. Also, each drop must be grounded to the electrical panel grounding terminal for the customer's boat. If feeder or distribution lengths are greater than 500 feet, additional bonds should be made to an electrical service panel grounding terminal.

Unacceptable Ground Practices

The following are unacceptable grounding locations:

- Meter pan lid or door
- Natural gas piping systems
- Telephone ground rod, clamp, wire or equipment
- Outdated cable TV ground rod
- Service equipment cabinets and/or circuit breaker boxes
- Sharing power company's grounding clamp
- Grounding through the use of a clamp to an external cold water pipe or faucet

If you cannot find an approved grounding location, contact your Supervisor.

Safety Responsibilities

The Technician has the following responsibilities associated with safety:

- Protection from electrical ground fault current at each dwelling unit must be maintained by proper installation of CATV ground wire from the ground block to the best grounding electrode.
- Once the ground wire is installed, the wire should never be disconnected before installing a temporary connection between the outer shield of the drop wire and the grounding electrode.
- Active and disconnected drop service ground and bonding connections must be continuously maintained at the residence dwelling.
- Approved ground block and connectors must be used. Substitute material cannot be used until approval is obtained from the corporate engineering staff and a Connect/One part number has been assigned.
- When visiting the premises of a customer, the house drop bond or ground MUST be checked for proper grounding.
    - If it is not properly grounded, the house drop must be bonded or grounded according to Connect/One Drop Grounding Specification.

Service Problems

When installing or repairing cable, you may encounter some common service problems.

Tripped Circuit Breaker and/or Blown Fuse in Home when Ground Is Attached

A tripped breaker or blown fuse can occur when the cable ground is connected. The cause of this problem is most likely due to:

- A defective and/or tampered with electronic device attached to the cable wire (e.g. TV, VCR)
- The use of a polarized plug that has been tampered with.
- Improperly wired or defective electrical outlet. Use outlet tester to determine the circuit's polarity.

If this scenario occurs unplug the device. Then disconnect the cable from the device. Do not reinstall. Request the customer to have the device or house wiring repaired.

The service is not disconnected at this time to prevent damage to the equipment since the drop could be acting as the house neutral.

When Ground Is Attached, Hum Bars Appear in the TV Picture

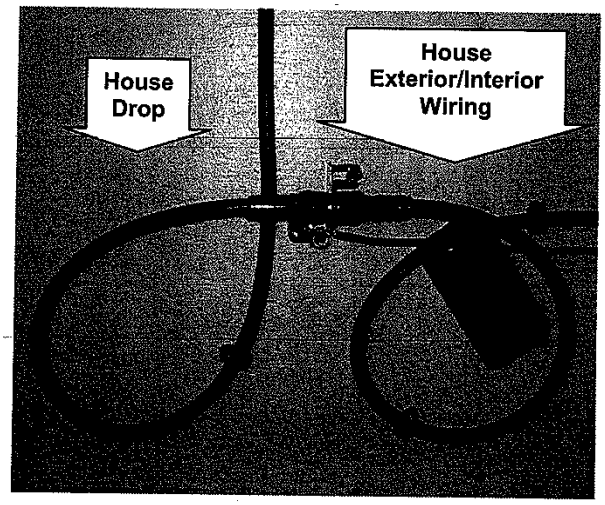
A device that is tampered with or an improperly installed polarized plug could be the problem if hum bars appear. Proceed with caution and use your hazardous voltage tester and gloves when working on this problem. Other possible causes include a poor neutral wire connection to the building or outlet and the CATV system on the street is inadequately bonded to the other utilities on the pole. Inform customer and Supervisor of the electrical problem. Inform the customer that you cannot troubleshoot further until the electrical problem is corrected.

Technical Specification:

Ground Block & Splitter use at the Drop Termination Point

This technical specification applies to all new customer installations as well as all future existing customer activities (install, repair and/or replacement of defective equipment). In these situations, where repair is required at the ground block, the new ground configuration will be brought up to this Connect/One technical specification.

Connect/One Technical Specification

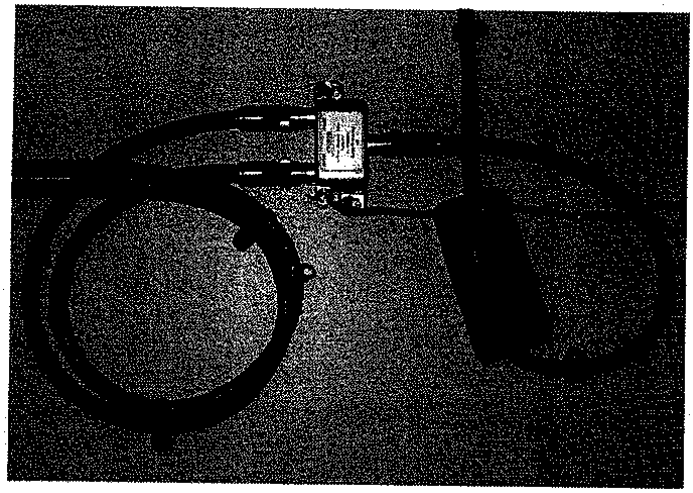


Single Ground Block Connection

All single house drops require the use of a ground block for connecting the house drop to the exterior/interior house wiring at the drop termination point.

Note: Ground wires should never be bent in 90 - 180 degree sharp turns but rather in gradual sweeping bends.

Note: In cases where centralized homerun wiring is terminated at a point that is hot co-located with the ground block, it is still correct procedure to run a single input line to the remote splitter array, grounding at the drop termination point

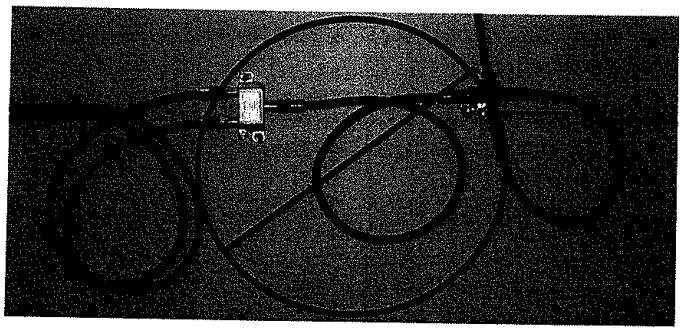


2 Outlets, 2-way Splitter

The proper splitter (2 outlets, use 2-way splitter, etc.) must be used when connecting several outlets at the drop termination point.

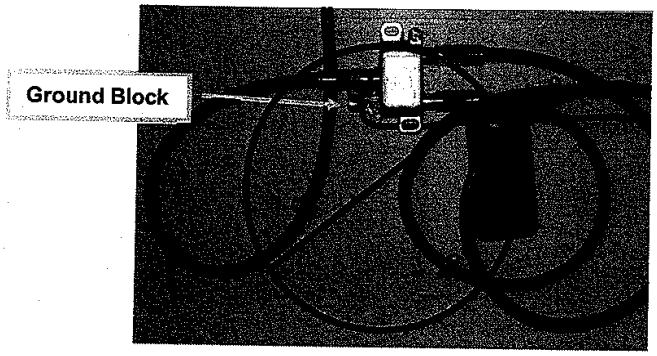
Connect the ground wire to the splitter housing, make sure it is properly tightened and connected.

Not Connect/One Technical Specification



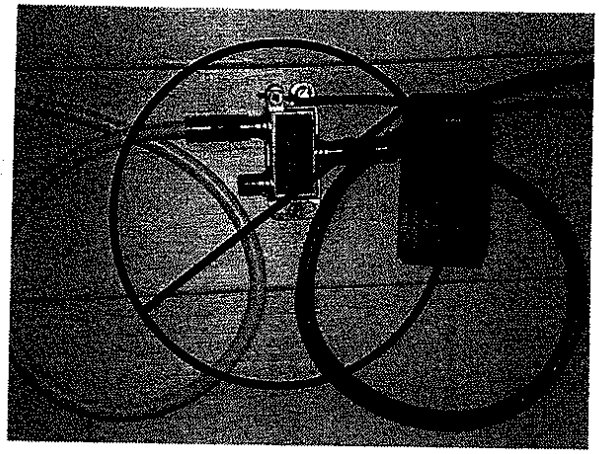
Splitter Connection via a Jumper Cable to the Ground Block

Do not use a short jumper wire between the ground block and splitter at the drop termination point.



Splitter Connected to Ground Block Frame

Do not connect a splitter to the ground block. Use a ground block or a splitter.



Splitter with Empty Ports

Do not use a 2-way splitter to connect 1 outlet at the drop termination point or use a 3-way splitter to connect 1 or 2 outlets at the drop termination point. Do not leave any empty port(s) on a splitter.