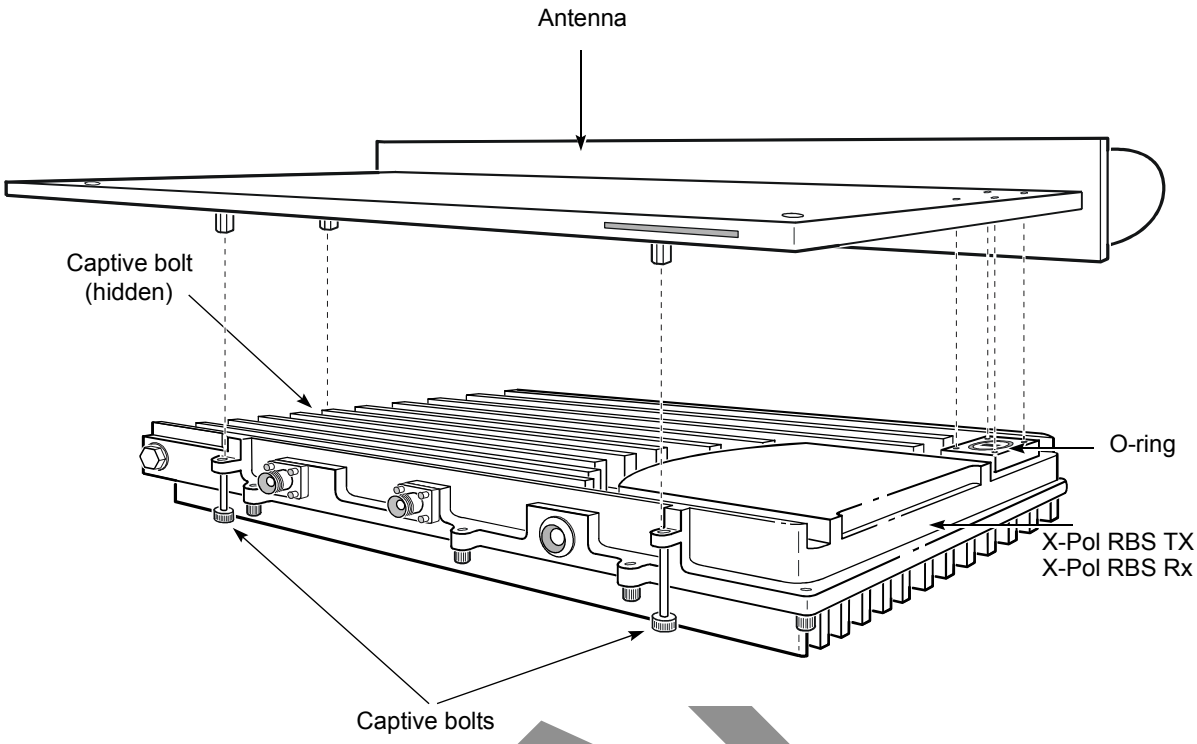


Figure 10 – Antenna, X-Pol RBS Tx/X-Pol RBS Rx and captive bolts

5. As shown in *Figure 11*, place a lock washer and a flat washer on each of the four RF wave guide screws, and insert and tighten each of the four screws to 0.56 Nm (5 in.-lb) torque.

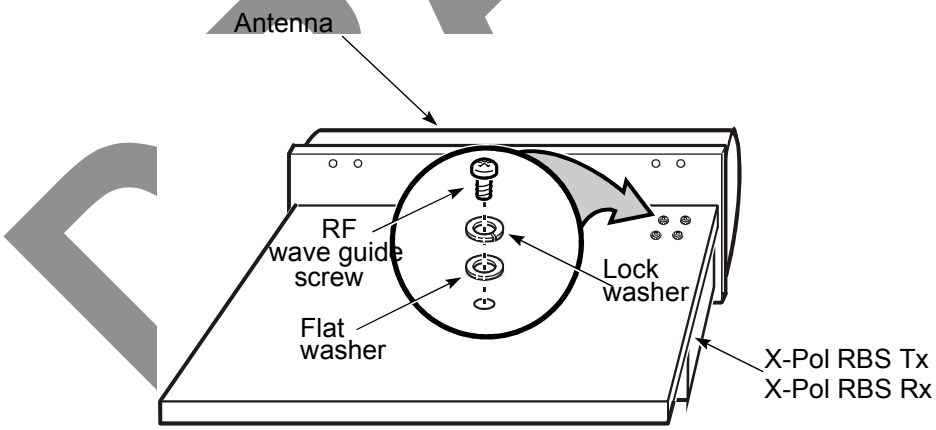


Figure 11 – Installing the RF wave guide screws

6. Ensure that each of the captive screws and RF wave guide screws are tightened to the correct torque, and that there is no gap between the radio and antenna.

2.5.3 – Attaching a mounting plate and antenna to a pole

The following parts are required:

- an antennna with an attached X-Pol RBS Tx or X-Pol RBS Rx,
- a single-antenna mounting plate and mounting hardware (provided with the antenna), or a dual-antenna mounting plate and mounting hardware (part number 90-7385-02).

The BS mounting hardware is composed of the following:

- downtilt adjustment screws,
- flat washers,
- lock washers,
- antenna bolts,
- U-bolts and U-bolt brackets,
- 17 mm nuts.

The dual antenna mounting plate can accommodate either one or two antennas. Single-antenna configurations are used for non-redundant X-Pol RBS Tx or X-Pol RBS Rx operation, and double-antenna configurations are used for redundant X-Pol RBS Tx or X-Pol RBS Rx operation.

Warning - If an antenna is attached to a mounting plate on a pole before an X-Pol RBS Tx or X-Pol RBS Rx is attached to the antenna, the RF wave guide and screws must be covered with weatherproof tape to protect the antenna from moisture.

Caution - Do not install an X-Pol RBS Tx and an X-Pol RBS Rx on the same mounting plate, otherwise the X-Pol RBS Tx transmit signal will interfere with the X-Pol RBS Rx receive signal.

Caution - Mounting poles should be grounded to a suitable lightning discharge ground.

To connect a mounting plate and antenna to a pole

1. Attach the mounting plate to the pole using the pole mounting hardware, as shown in *Figure 12*, where a single antenna mounting plate is shown.
    1. Thread the downtilt adjustment screw(s) into the mounting plate until the hole in the adjustment screw plate aligns with the antenna bolt channel at the top of the mounting plate.
    2. Connect the top of the mounting plate to the pole using a U-bolt, U-bolt bracket, washers and nuts.
    3. Tighten the two nuts until the top of the mounting plate is held securely to the pole, but is still shifts enough from side-to-side to allow the bottom U-bolt to be inserted.
    4. Connect the bottom of the mounting plate to the pole using a U-bolt, U-bolt bracket, washers and nuts.
    5. Tighten all four U-bolt nuts to 54.4 Nm, ± 2.7 Nm (40 ft-lb, ± 2 ft-lb) of torque.

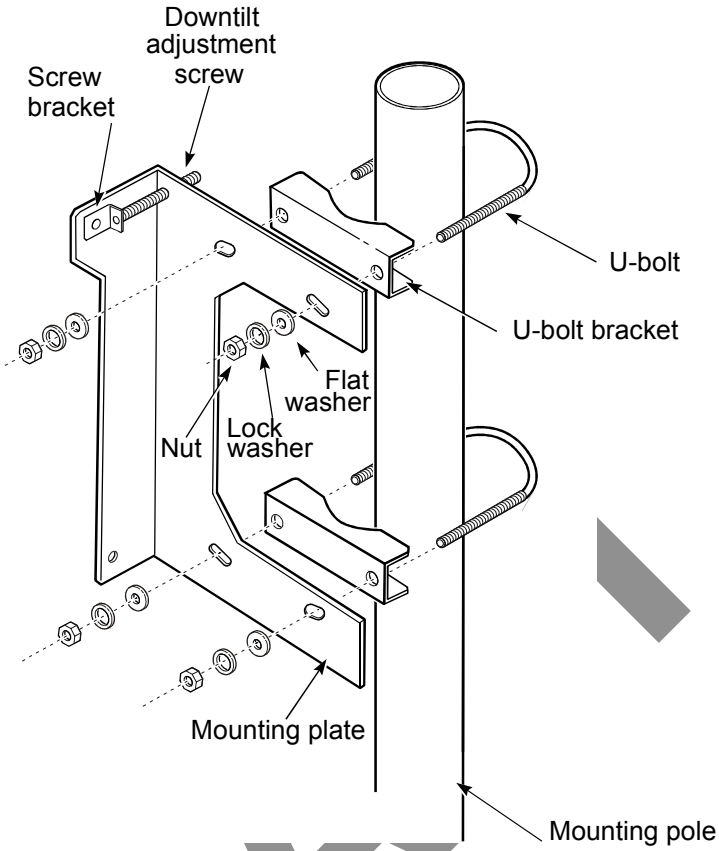


Figure 12 – Connecting the mounting plate to the pole

2. Connect the antenna to the mounting plate, as shown in *Figure 13*.

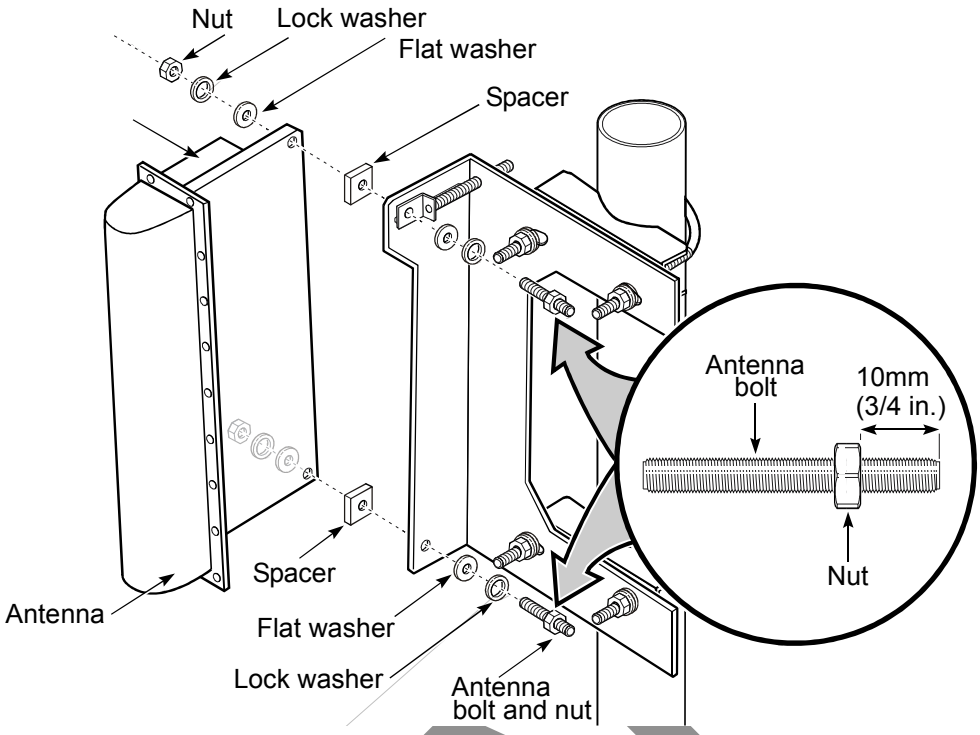


Figure 13 – Connecting the antenna to the mounting plate

1. Thread a nut roughly 10 mm (3/4 in.) onto each of the two antenna bolts.
2. Connect the top of the antenna to the top of the mounting plate by inserting one of the antenna bolts through a lock washer, a flat washer, the adjustment screw plate, antenna bolt channel on the mounting plate, a spacer and upper bolt hole on the antenna. Add a flat washer, a lock washer and a nut to the antenna side of the antenna bolt, and tighten both nuts to 54.4 Nm, ± 2.7 Nm (40 ft-lb, ± 2 ft-lb) of torque.
3. Connect the bottom of the antenna to the bottom of the mounting plate by inserting the remaining antenna bolt through a lock washer, a flat washer, the antenna bolt hole on the mounting plate, a spacer and the lower bolt hole on the antenna. Add a flat washer, a lock washer and a nut to the antenna side of the antenna bolt, and tighten both nuts to 54.4 Nm, ± 2.7 Nm (40 ft-lb, ± 2 ft-lb) of torque.

To mount a second antenna on a dual antenna mounting plate

A second antenna can be attached to a dual antenna mounting plate, as shown in *Figure 14.*

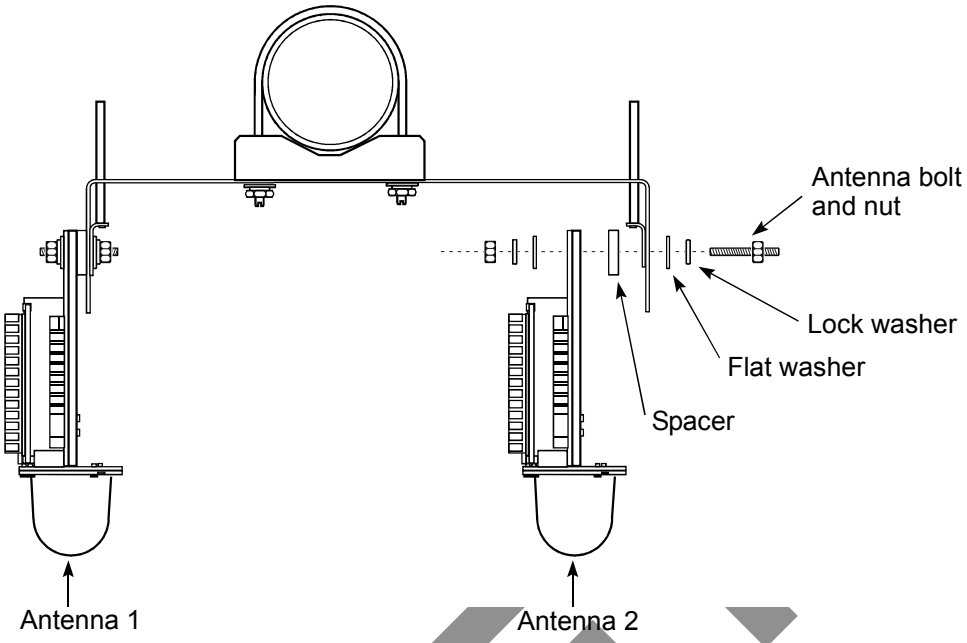


Figure 14 – Mounting a second antenna

1. Thread a nut roughly 10 mm (3/4 in.) onto each of the two antenna bolts.
2. Connect the top of the antenna to the top of the mounting plate by inserting one of the antenna bolts through a lock washer, a flat washer, mounting plate antenna bolt channel, the adjustment screw plate, a spacer and the upper antenna bolt hole. Add a flat washer, a lock washer and a nut to the antenna side of the antenna bolt, and tighten both bolts to 54.4 Nm, ± 2.7 Nm (40 ft-lb, ± 2 ft-lb) of torque.
3. Connect the bottom of the antenna to the bottom of the mounting plate by inserting the remaining antenna bolt through a lock washer, a flat washer, the lower mounting plate antenna bolt hole, a spacer and lower antenna bolt hole. Add a flat washer, a lock washer and a nut to the antenna side of the antenna bolt, and tighten both bolts to 54.4 Nm, ± 2.7 Nm (40 ft-lb, ± 2 ft-lb) of torque.

To ground the X-Pol RBS Tx or X-Pol RBS Rx

The following parts and supplies are required:

- an adequate length of ground conductor,
- an M8 ring lug,
- dielectric paste.

1. Measure a length of ground conductor sufficient to run from the X-Pol RBS Tx or X-Pol RBS Rx to the nearest suitable ground point. The required diameter, metal type and physical type of the ground conductor may vary according to local regulations. Consult local electrical authorities for information.
2. Connect an uninsulated M8 ring lug connector securely to one end of the ground conductor using a suitable mechanical connection method.
3. Apply an appropriately rated dielectric paste liberally to both sides of the ring lug.
4. Connect the ring lug to the X-Pol RBS Tx or X-Pol RBS Rx case ground connection point using the ground bolt, as shown in *Figure 15*. Tighten the bolt to 13.5 Nm (10 ft-lb) of torque.

5. Connect the remaining end of the ground conductor to a suitable lightning discharge ground, using a mechanical connection method that is approved by local electrical authorities.

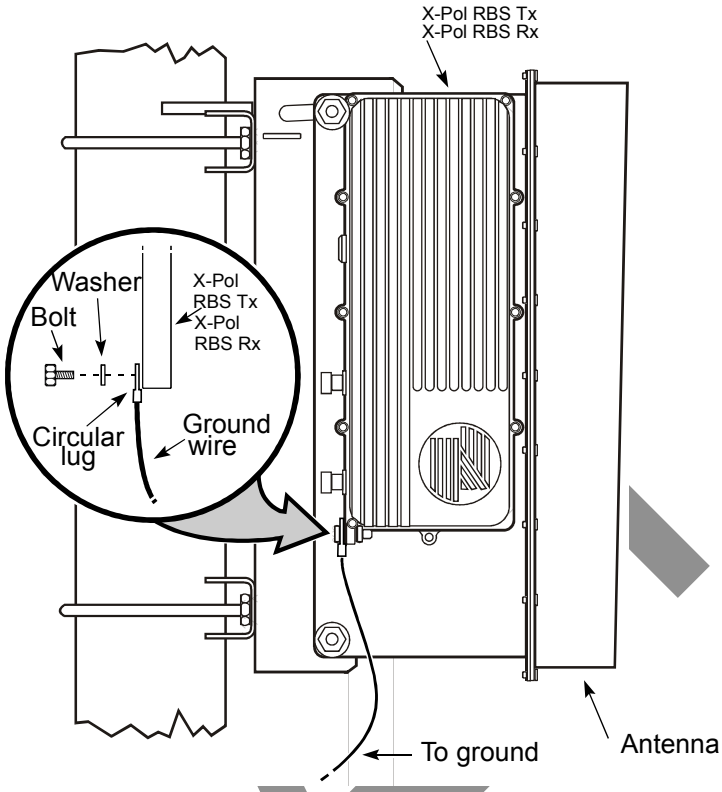


Figure 15 – X-Pol RBS Tx/X-Pol RBS Rx ground connection location

To adjust the antenna downtilt

The antenna downtilt is adjusted to optimize cell performance. By increasing the downward angle of the X-Pol RBS Tx and X-Pol RBS Rx antenna (see *Figure 17*), the area of sector coverage decreases. By decreasing the downward angle of the X-Pol RBS Tx and X-Pol RBS Rx antenna, the area of sector coverage is increased. The specific downtilt required for each X-Pol RBS Tx and X-Pol RBS Rx is calculated through detailed cell planning.

Figures 16 and 17 show the results of downtilt adjustment.

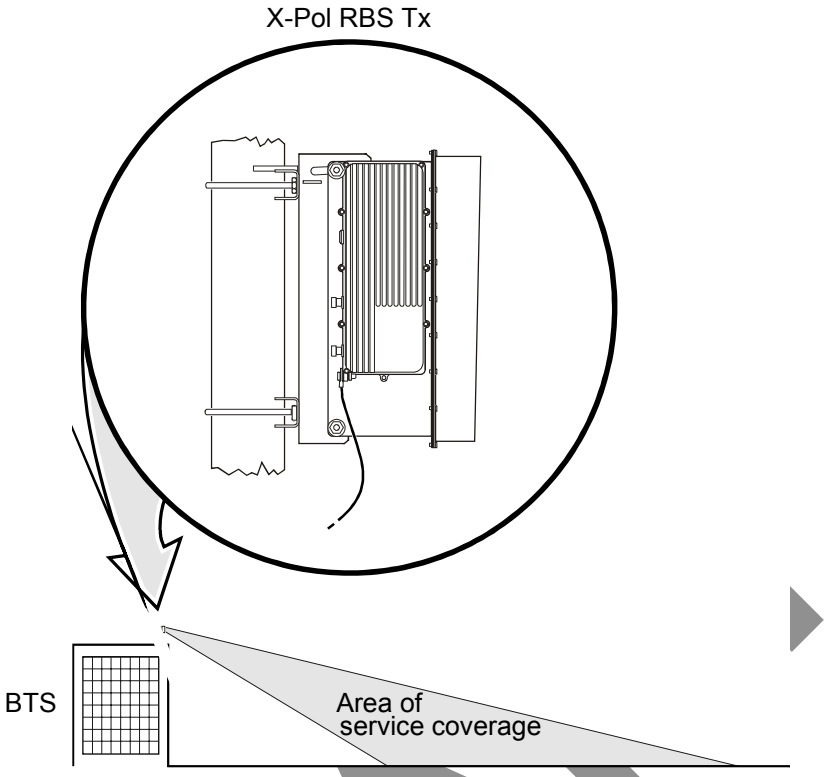


Figure 16 – Minimal downtilt

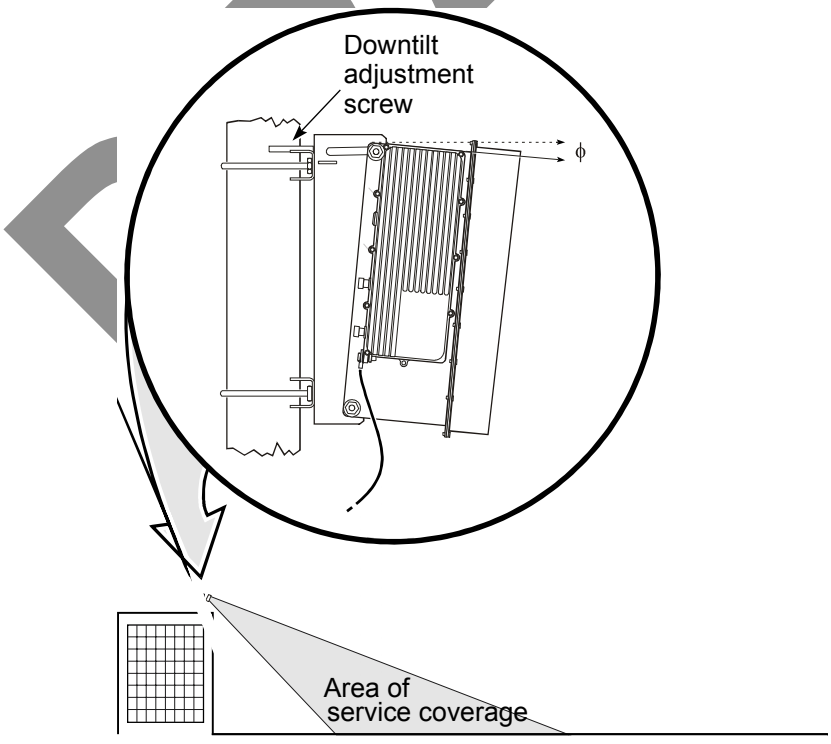


Figure 17 – Increased downtilt

1. Place a digital level on the top of the X-Pol RBS Tx or X-Pol RBS Rx antenna (see *Figure 18*).
2. Loosen the two antenna bolts to allow free movement of the antenna.
3. While observing the digital level, adjust the downtilt adjustment screw (see *Figure 18*) until the downtilt meets the angle required by cell planning analysis.

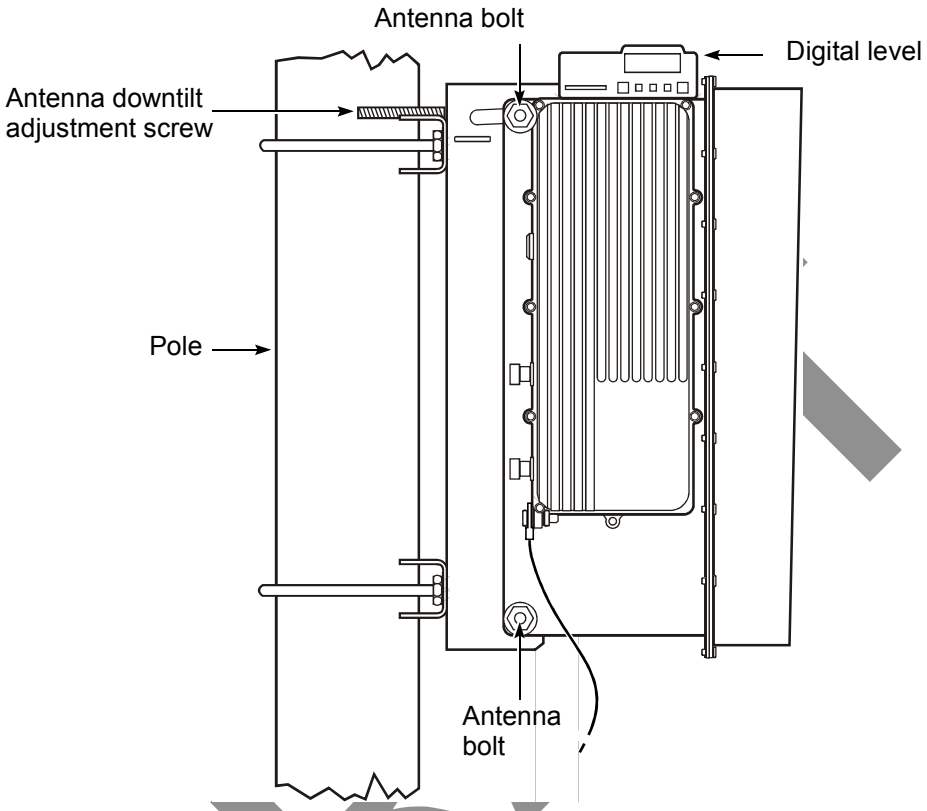


Figure 18 – Antenna downtilt adjustment screw

4. Tighten the two antenna bolts to 54.4 Nm, ± 2.7 Nm (40 ft-lb, ± 2 ft-lb) of torque.
5. Check the digital level to ensure that the antenna is adjusted to the correct downtilt angle. If the digital level indicates an incorrect downtilt angle, repeat the procedure.

2.5.4 – Replacing an X-Pol RBS Tx, X-Pol RBS Rx or antenna

When X-Pol RBS Txs, X-Pol RBS Rxs or antennas malfunction, they must be serviced by removing the malfunctioning unit (X-Pol RBS Tx/X-Pol RBS Rx or antenna), and then replacing it with a new unit. The malfunctioning unit should be packaged and sent to Alcatel for repair.

X-Pol RBS Txs and X-Pol RBS Rxs must not be replaced or serviced while still connected to antennas that are mounted on a pole. Disconnect power from the IF cables by switching off the appropriate breaker, and disconnect the IF and RS-422 cables from the X-Pol RBS Tx or X-Pol RBS Rx. Remove the antenna from the mounting plate before any replacement or servicing.

To replace an X-Pol RBS Tx, X-Pol RBS Rx or antenna

1. To remove –48 V dc power from the X-Pol RBS Tx or X-Pol RBS Rx IF cable, switch off the appropriate circuit breaker on the power distribution system.

2. Remove the antenna from the pole:
    1. If an X-Pol RBS Tx or X-Pol RBS Rx is attached to the antenna, disconnect all IF and RS-422 cable connectors from the X-Pol RBS Tx or X-Pol RBS Rx, and seal the cable connector ends using butyl tape.

       Label the IF and RS-422 cables so that they are easily identified when the X-Pol RBS Tx or X-Pol RBS Rx is reattached, and secure them to the mounting pole.

       Remove the ground bolt from the X-Pol RBS Tx or X-Pol RBS Rx, remove the ground strap, and replace the ground bolt to ensure that it is not lost during the procedure.
    2. Support the antenna and remove the upper and lower nuts and washers that secure the antenna to the mounting plate. Do not loosen or remove the other upper and lower nuts and washers that secure the antenna mounting bolts to the mounting plate.

Warning - Do not disturb the antenna downtilt hardware during this procedure.

    3. Remove the antenna from the mounting plate.
3. Disconnect the X-Pol RBS Tx or X-Pol RBS Rx from the antenna:
    1. Remove the RF wave guide screws and store them where they can be re-used when an X-Pol RBS Tx or X-Pol RBS Rx is reattached to the antenna.
    2. Unbolt the captive bolts that fasten the X-Pol RBS Tx/X-Pol RBS Rx to the antenna, and remove the X-Pol RBS Tx or X-Pol RBS Rx from the antenna.
    3. Remove the O-ring, and store it where it can be re-installed when the X-Pol RBS Tx or X-Pol RBS Rx is reattached to the antenna.
4. Replace the malfunctioning X-Pol RBS Tx, X-Pol RBS Rx or antenna with a new unit, and connect the X-Pol RBS Tx or X-Pol RBS Rx to the antenna again. See section *6.2* for information and procedures.
5. Attach the antenna to the mounting plate. See section *6.3* for information and procedures.
6. Reconnect the IF cables, RS-422 cables and ground connection.
7. Use a digital level to verify that the appropriate antenna downtilt is still set. See procedure *6-5*.
8. Reconnect the –48 V dc power to the IF cable at the power distribution system.

2.6 – Installing Bias-Ts and surge protectors

Bias-Ts are installed on 12:2 Combiner/Splitters, and require that a surge arrester is installed on each Bias-T DC IN connector. Each surge protector must be grounded to the system chassis ground.

Note 1 - BS components and cables must be installed and serviced by trained personnel who are experienced in the local, national and civil electrical and safety regulations of the area where the equipment is being installed.
Some areas require that only licensed individuals may install and service equipment. Consult appropriate local authorities prior to installation.

Note 2 - All IF cabling must meet local safety and building code requirements.

To install Bias-Ts and surge protectors

1. To correctly connect a surge protector to a Bias-T, connect the male BNC connector on the surge protector to the DC IN connector on the Bias-T, as shown in *Figure 19*.

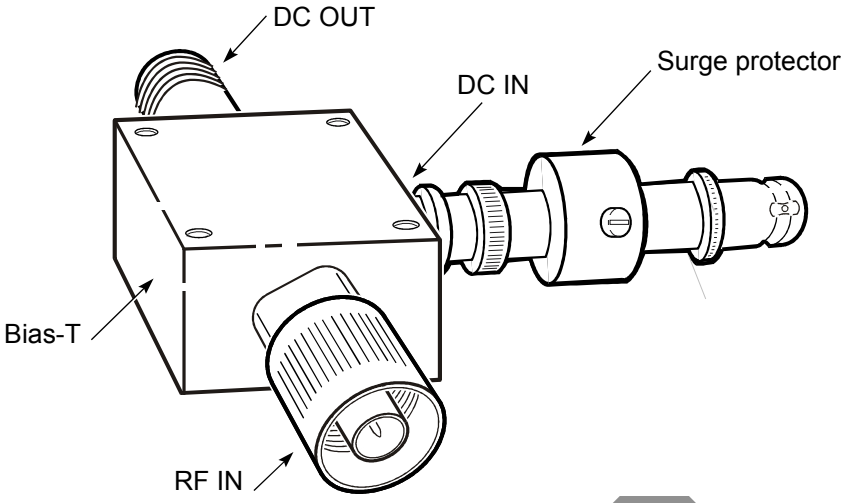


Figure 19 – Connecting the surge protector

2. Place the 12:2 Combiner/Splitter assembly in a permanent location near the MainStreetXpress 36170 shelf, within reach of the SMA cables that connect between the IBS card and the 12:2 Combiner/Splitter.
3. Position the Bias-T RF IN connector on one of the two Combiner/Splitter Primary/Redundant radio connectors, as shown in *Figure 20*.
4. Tighten the coupling on the RF IN connector until the Bias-T is firmly connected and does not rotate.
5. Install 50 Ω terminators on all unconnected 12:2 Combiner/Splitter connectors.

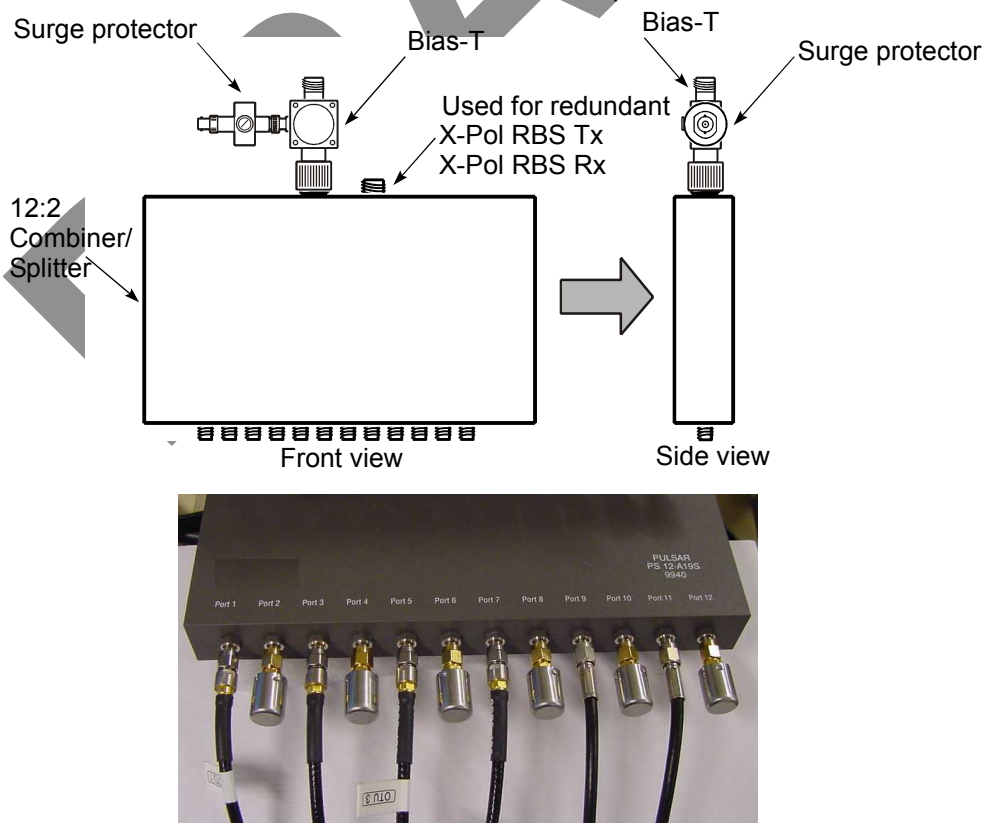


Figure 20 – Connecting the Bias-T to the Combiner/Splitter

To connect the surge protector ground wire

1. Measure a length of insulated copper wire that is long enough to run from the closest safety ground point to the surge protector.
2. Add a ring lug to one end of the ground wire, and connect it to the surge protector, as shown in *Figure 21.*

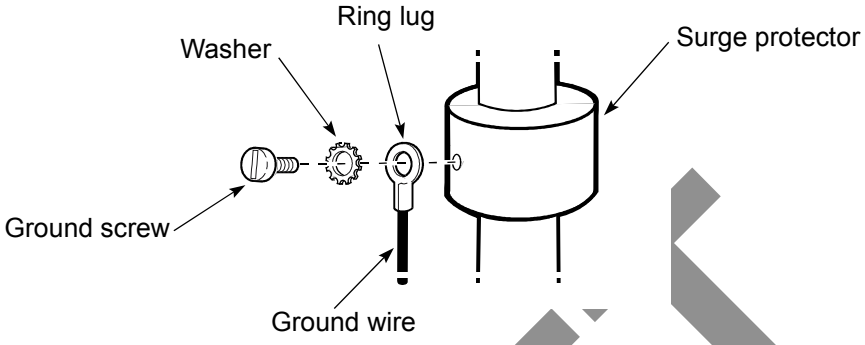


Figure 21 – Surge protector ground connection

3. Connect the unconnected end of the ground wire to the building ground.

2.6.1 – Replacing the gas discharge tube in a surge protector

The gas discharge tube should be replaced by qualified service personnel on a regular basis as recommended by the manufacturer, using an exact replacement from the original manufacturer. The surge protector carries –48 V dc that must be turned off before replacement.

Danger - Do not replace the gas discharge tube during storm activity.

To replace the gas discharge tube

1. Remove the dc power to the surge protector at the power source. Do not remove power by disconnecting the BNC connector on the Bias-T power cable because reconnecting live dc voltage can cause sparking and damage the connector.

Warning - If dc power is not disconnected at the dc power supply, sparking may occur when connecting any connector in the dc voltage path (surge protector, Bias-T, IF cable, X-Pol RBS Tx/X-Pol RBS Rx) when the connector has dc voltage on it. Sparking may damage the connector and affect service quality.

2. Disconnect the Bias-T power cable and remove the surge protector from the Bias-T.
3. Remove the screw cap (see *Figure 22*) and the gas discharge tube. Inspect the surge protector for damage. If there is damage, replace the surge protector and proceed to step 5; if not, proceed to

step 4.

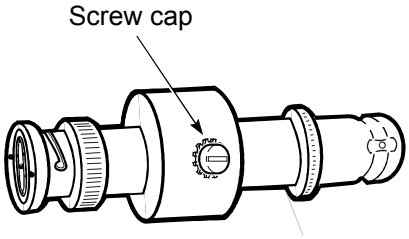


Figure 22 – Screw cap

4. Replace the gas discharge tube; see *Figure 23*.
    1. Hold the screw cap upside down.
    2. Place the discharge tube in the cap.
    3. Position the surge protector over the screw cap.
    4. Screw the cap into the surge protector as far as possible by hand, then tighten the cap with the screwdriver.

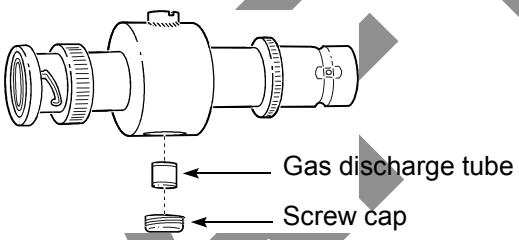


Figure 23 – Replacing a gas discharge tube in a surge protector

5. Connect the surge protector to the Bias-T.
6. Connect the Bias-T power cable to the surge protector.
7. Apply the dc power.

2.7 – Installing Type N lightning arresters

Type N lightning arresters must be secured to a copper grounding plate using mounting brackets, then connected to IF cables.

Note 1 - BS components and cables must be installed and serviced by trained personnel who are experienced in the local, national and civil electrical and safety regulations of the area where the equipment is being installed.
Some areas require that only licensed individuals may install and service equipment. Consult appropriate local authorities prior to installation.

Note 2 - All IF cabling must meet local safety and building code requirements.

To install a lightning arrester

1. Attach a mounting bracket to the copper grounding plate for each lightning arrester used in the system, as shown in *Figure 24*.

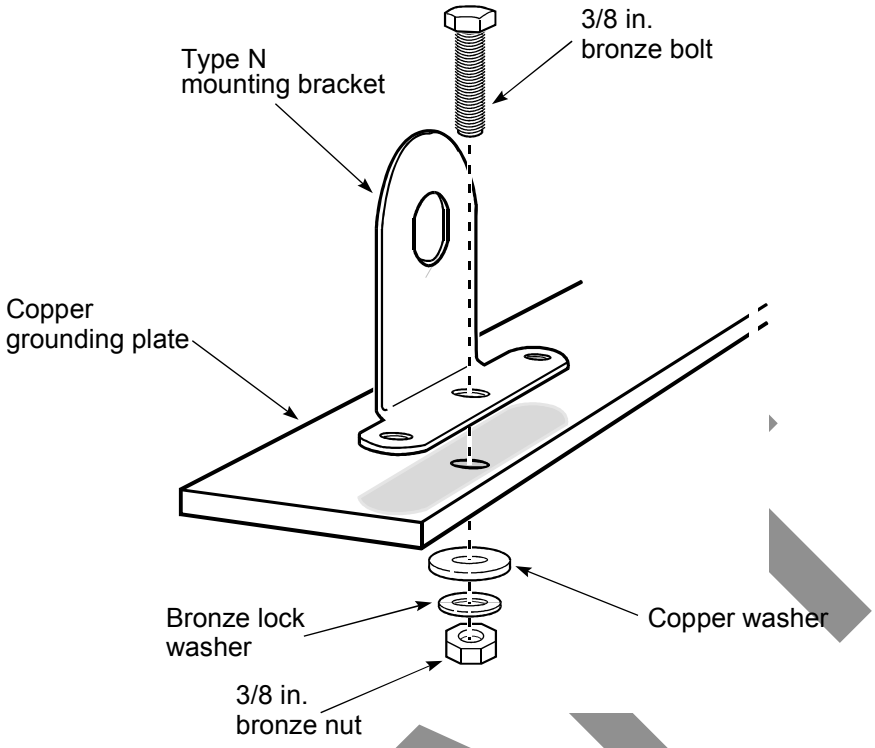


Figure 24 – Attach the mounting brackets to the copper grounding plate

2. Install each lightning arrester in a mounting bracket, as shown in *Figure 25*.

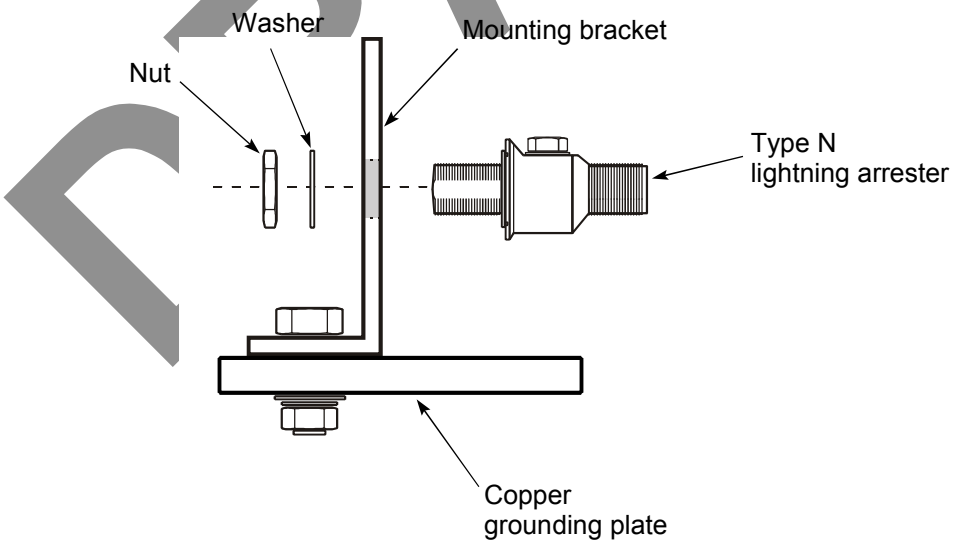


Figure 25 – Connecting the lightning arrester to the adapter bracket

3. Connect the IF cables to the lightning arrester, as shown in *Figure 26*.

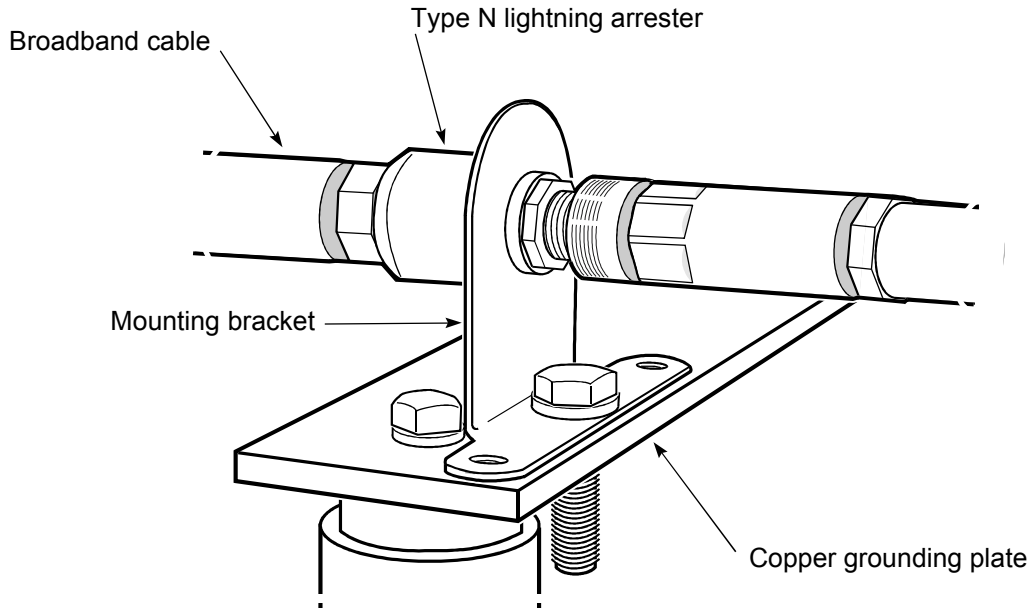


Figure 26 – Installed and connected lightning arrester

Replacing the gas discharge tube in a Type N lightning arrester

The gas discharge tube should be replaced by qualified service personnel on a regular basis as recommended by the manufacturer, using an exact replacement from the original manufacturer. The lightning arrester carries –48 V dc that must be turned off before replacement.

Danger - Do not replace the lightning arrester during storm activity.

To replace the gas discharge tube

1. Remove the dc power to the lightning arrester at the power source. Do not remove power by disconnecting one of the connectors in the dc voltage path, because reconnecting live dc voltage can cause sparking and damage the connector.

   Warning - If dc power is not disconnected at the dc power supply, sparking may occur when connecting any connector in the dc voltage path (surge protector, Bias-T, IF cable, X-Pol RBS Tx/X-Pol RBS Rx) when the connector has dc voltage on it. Sparking may damage the connector and affect service quality.

2. Remove the bolt cap from the lightning arrester; see *Figure 27*.

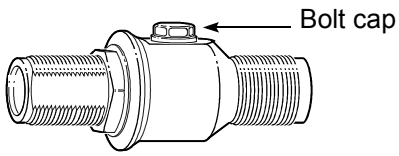


Figure 27 – Bolt cap

3. Inspect the lightning arrester for damage. If there is damage, replace the lightning arrester (see section *8.1*); if not, proceed to step 4.
4. Replace the gas discharge tube; see *Figure 28*.
    1. Use the pliers to pull the discharge tube out of the cap.
    2. Push the replacement discharge tube into the cap.
    3. Screw the cap into the lightning arrester by hand, then tighten the cap with the wrench.
5. Apply the dc power.

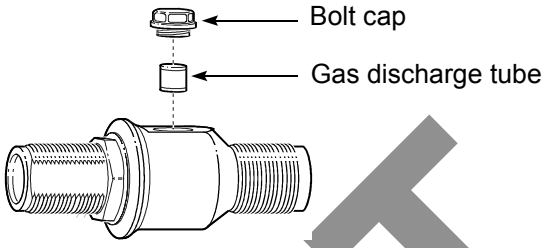


Figure 28 – Replacing a gas discharge tube in a Type N lightning arrester

2.8 – BS cables connections

Figure 29 shows a non-redundant X-Pol RBS Tx/X-Pol RBS Rx BS configuration (one X-Pol RBS Tx and one X-Pol RBS Rx). A fully installed BS uses the following five cable types:

- RS-422 data cables (indoor and outdoor runs),
- SMA jumper cables (indoor),
- IF cables (indoor, outdoor and outdoor jumper),
- synchronization cables (outdoor),
- Bias-T (–48 V dc) power supply cable.

Tables 14 through 9-5 list the cables and connectors identified in *Figure 29*.

Figure 30 shows a redundant X-Pol RBS Tx/X-Pol RBS Rx BS configuration. A redundant BS configuration has two X-Pol RBS Txs and one or two X-Pol RBS Rxs, with additional passive devices and cables. The redundant Tx (or Rx) RS-422 data cable attaches to the IBS. The redundant synchronization cables are connected by a 2:1 Combiner/Splitter.

Caution - Outdoor BS IF cables must be grounded via the outer conductor every 50 m (164 ft). Additionally, the section of cable that runs up the tower or pole must be grounded at the top and bottom of the tower or pole cable run. Use the cable grounding kits recommended by the cable manufacturer.

Note - All outdoor cable connections should be covered with cold shrink tubing or be wrapped in butyl electrical tape to protect against moisture.

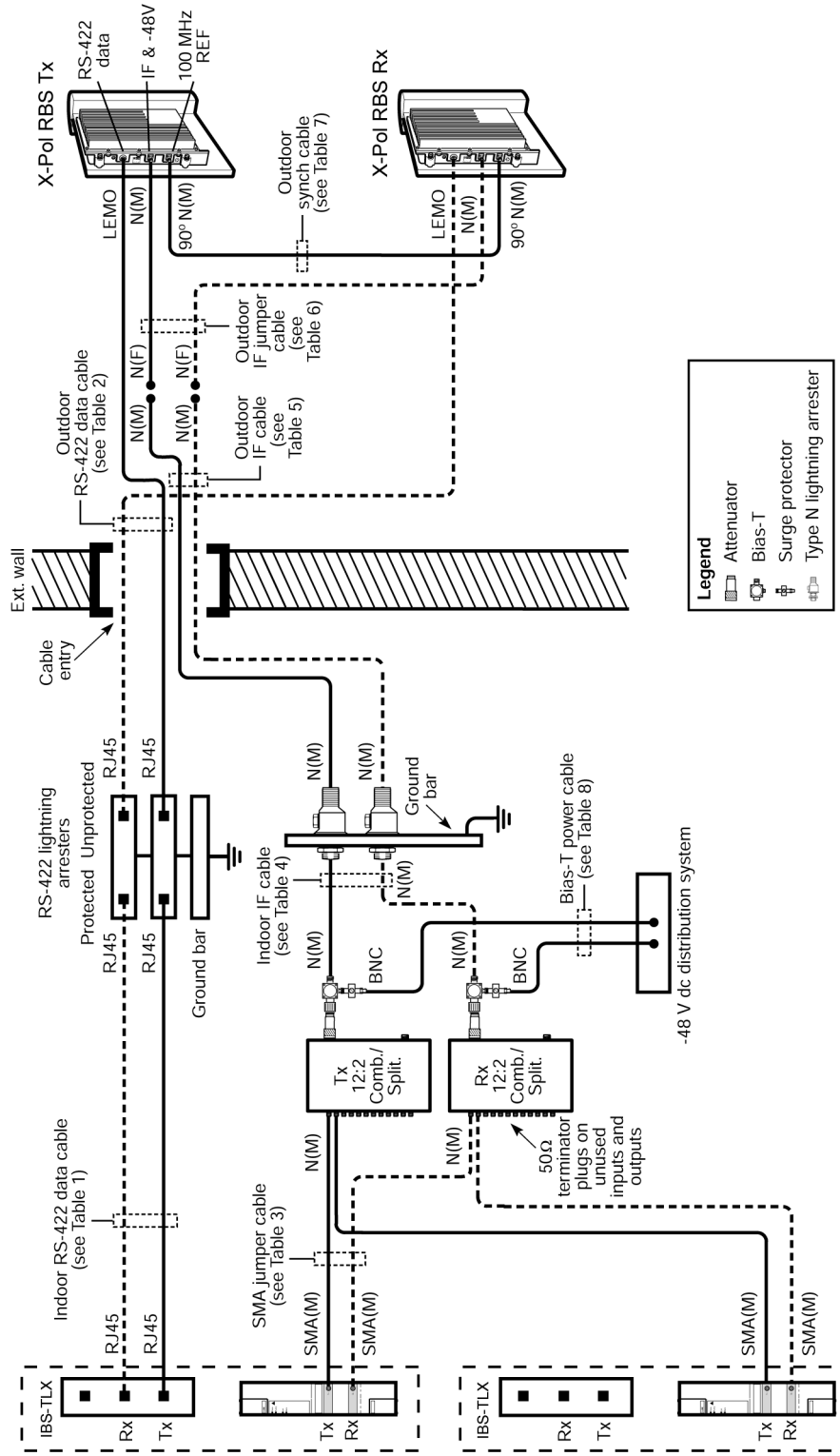


Figure 29 – Non-redundant X-Pol RBS Tx/X-Pol RBS Rx BS components and cables

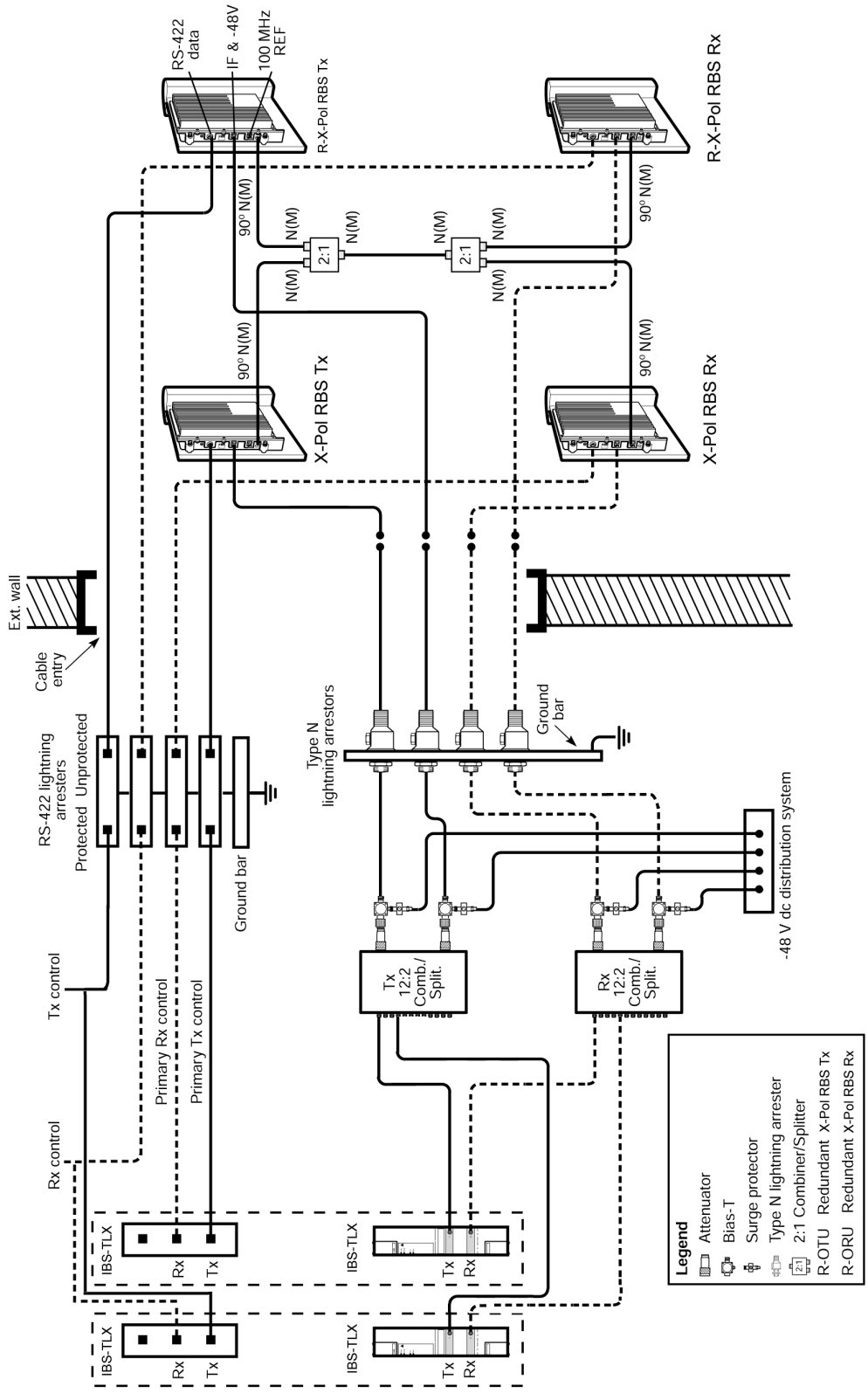


Figure 30 – Redundant X-Pol RBS Tx/X-Pol RBS Rx BS synchronization cables

Cable rating	Description	Connectors	Recommended cables
Indoor	IBS-TLX connector to RS-422 lightning arrester	RJ45(1) - RJ45(1)	Delco 398087P
Outdoor	RS-422 lightning arrester to X-Pol RBS Tx/X-Pol RBS Rx	RJ45(1) - LEMO(2)	Delco 398087

Table 14: RS-422 data cables and connectors

Note: *Alcatel part number 90-6815-01 (Stewart RJ45 connector)*
LEMO USA part number FGG.1K.304.CLCC.60Z (connector strain relief part number GMA.1B.065.DN)

Cable rating	Description	Connectors	Recommended cables
Indoor	IBS-TLX card to Tx 12:2 Combiner/Splitter IBS-TLX card to Rx 12:2 Combiner/Splitter	SMA(M) - SMA(M)	90-6656-01 (3 m [10 ft]) 90-6656-02 (6 m [20 ft])

Table 15: SMA jumper cable and connectors

Cable rating	Description	Connectors	Recommended cables
Indoor	Bias-T to Type N lightning arrester	N(M) - N(M)	See *Table 20*
Outdoor (main)	Type N lightning arrester to IF jumper cable	N(M) - N(M)	See *Table 20*
Outdoor (jumper)	IF jumper cable (1 m [3 ft]) to X-Pol RBS Tx/X-Pol RBS Rx	N(F) - N(M)	Times Microwave LMR-400 (part number FT-400DB/3/NM/NF)

Table 16: IF cables and connectors

Cable rating	Description	Connectors	Recommended cables
Outdoor	X-Pol RBS Tx to X-Pol RBS Rx 100 MHz REF connector	See *Table 23*	LDF2-50

Table 17: Synchronization cable and connectors

Cable rating	Description	Connectors	Recommended cables
Indoor	Surge protector to –48 V dc distribution system	BNC(F) - ring lugs	90-6518-01

Table 18: Bias-T power supply cable and connectors

2.8.1 – Selecting BS IF cables

When selecting BS IF cables, the main concern is the IF cable signal loss of the indoor and outdoor cable runs.

The system requires that all the components in the IF signal path between the IBS card and the X-Pol RBS Tx/X-Pol RBS Rx (cables, connectors and equipment) provide a fixed decibel loss in each of the downstream and upstream directions. System performance may be affected if the fixed loss is not met. The downstream losses must total 27 dB ±1 dB at the upper frequency of the IF band used for the downstream signal. The upstream losses must total 24 dB ±1 dB at the upper frequency of the IF band used for the upstream signal.

Note - The loss characteristics of all components used in the examples in this section are based on the worst-case frequencies of 2050 MHz downstream and 900 MHz upstream. Refer to the manufacturers' specifications when designing systems that use other frequencies.

Table 19 can be used to determine how much loss the IF cables must contribute in order to achieve the fixed loss requirement. The table lists each component and gives its loss value at 2050 MHz downstream and 900 MHz upstream. It is assumed that the installation uses a 3 m (10 ft) long SMA cable. The last row in the table shows that the IF cables, including connectors, must contribute the following losses to the system at the frequencies used in this example:

- 7.37 dB in the downstream path at 2050 MHz,
- 4.37 dB in the upstream path at 900 MHz.

Use the following formulas along with the cable and connector loss values given in *Table 20* to determine the types and lengths of cable that meet the fixed loss requirements and that are suitable for the installation. Formula 2 accounts for four connectors (two connectors for each of the indoor- and outdoor-rated cables).

Note 1 - Before the cable is installed, ensure that the correct cable types have been chosen for the required lengths and losses. Otherwise, new cables may need to be installed.

Note 2 - Non-plenum rated cables can be run through plenum space, if a suitable fireproof plenum conduit is used.

Formula 1: Calculation of dB loss for a cable segment

$Loss_{segment} = Length_{segment} X (dB\ loss/distance_{segment} \div 100)$

where

$Loss_{segment}$ is the loss of the indoor or outdoor segment (in dB)

$Length_{segment}$ is the length of the segment (in m [ft])

dB loss/distance is the loss characteristic of the segment (dB/100 m [dB/100 ft])

Formula 2: Calculation of total dB loss for the cable run

$Loss_{total} = Loss_i + Loss_o + (2 X\ Loss_i\ connector) + (2 x\ Loss_o\ connector)$

= 7.37 dB (at 2050 MHz downstream)

= 4.37 dB (at 900 MHz upstream)

where

$Loss_{total}$ is the loss of the IF cable run in dB/100 m (dB/100 ft)

$Loss_i$ is the loss of the indoor-rated cable (in dB)

$Loss_o$ is the loss of the outdoor-rated cable (in dB)

$Loss_{i\ connector}$ is the loss of the indoor cable connector (in dB)

$Loss_{o\ connector}$ is the loss of the outdoor cable connector (in dB)

After all components have been installed and connected, system loss measurements and calibration must be made to determine the actual losses. If the measured loss is greater than the required loss, different cable types may be necessary. If the measured loss is less than the required value, attenuators should be added between the 12:2 Combiner/Splitter and the Bias-T. See chapter 11 for measurement and calibration procedures.

BS component		Total downstream loss (1) (dB)	Total upstream loss (2) (dB)
Fixed loss requirement		27	24
Component	SMA jumper cable (3 m [10 ft])	1.0	1.0
	Tx 12:2 Combiner/Splitter	17.10	N/A
	Rx 12:2 Combiner/Splitter	N/A	17.10
	Bias-T	1.03	1.03
	Lightning arrester	0.20	0.20
	Outdoor IF jumper cable (including connectors)	0.3	0.3
Total loss due to all components except IF cables		19.63	19.63
Loss available for IF cable(3) (fixed loss requirement minus total component loss)		7.37	4.37

Table 19: BS passive device and IF cable losses

Note: *(1) Measured at 2050 MHz.*

(2) Measured at 900 MHz.

(3) The values given are for the sum of the indoor and outdoor cable runs, excluding the outdoor IF jumper cable. The values include four connectors, two for the indoor cable and two for the outdoor cable.

Cable type	Connector		Loss (dB/100 m [dB/100 ft])		Rating
	Type	Loss (dB)	Downstream (1)	Upstream (2)	
Indoor					
Heliax FSJ1-50A	F1PNM	0.05	29.03 (8.85)	18.59 (5.66)	Indoor
Heliax FSJ2-50	F2PNM	0.05	19.99 (6.09)	12.65 (3.86)	Indoor
Heliax FSJ4-50	BF4PNM	0.05	17.76 (5.39)	11.07 (3.38)	Indoor
Heliax HL4-RP-50	H4PNM	0.08	12.22 (3.91)	8.24 (2.51)	Indoor/plenum
Heliax HJ5-50	H5PNM	0.08	6.07 (1.88)	3.92 (1.19)	Indoor/plenum
Times Microwave LMR-400 Ultra Flex	TC-400-NMH	0.10	23.82 (7.26)	15.39 (4.69)	Indoor
Times Microwave LMR-600-LLPL	TC-600-NMH	0.10	13.09 (3.99)	8.45 (2.57)	Plenum/outdoor
Times Microwave LMR-900-FR	EZ-900-NMH	0.10	8.76 (2.67)	5.56 (1.69)	Indoor
Outdoor					
Heliax LDF2-50	L2PNM	0.05	16.98 (5.18)	10.88 (3.32)	Outdoor
Heliax LDF4-50A	L4PNM	0.05	11.48 (3.50)	7.23 (2.20)	Outdoor
Heliax LDF5-50A	L5PNM	0.05	6.56 (2.00)	4.04 (1.23)	Outdoor
Heliax LDF6-50	L6PNM	0.05	4.83 (1.47)	2.98 (0.91)	Outdoor
CommScope CR50-540-PE	CR540NM	0.10	10.4 (4.16)	6.59 (2.01)	Outdoor
CommScope CR50-1070-PE	CR1070NM	0.10	5.90 (1.80)	3.61 (1.10)	Outdoor
Times Microwave LMR-600-LLPL	TC-600-NMH	0.10	13.09 (3.99)	8.45 (2.57)	Plenum/outdoor

Table 20: IF cable loss characteristics, types and connectors

Note: *Measured at 2050 MHz.*
Measured at 900 MHz.

2.8.2 – Marking IF cables for identification

IF cables must be marked to indicate which X-Pol RBS Tx or X-Pol RBS Rx each cable connects to. It is recommended that you use bands of electrical tape to identify each cable:

- the tape color (blue, red, green or yellow) indicates the sector,
- the number of colored bands of tape indicates the X-Pol RBS Tx or X-Pol RBS Rx number in the sector,
- a white band on either side of the colored bands indicates that the IF cable connects to a redundant X-Pol RBS Tx or X-Pol RBS Rx.

Table 21 describes the electrical tape recommended for marking IF cables.

Electrical tape attribute	Description
Name	35 Scotch Brand vinyl electrical tape for color coding
Thickness	0.18 mm (7 mil)
Width	19 mm (31/44 in.)
Colors	Blue, green, red, white, yellow
Manufacturer	3M Electrical Products Division Telephone: 1-800-245-3573 http://www.3m.com/elpd/
Ordering code	35 Blue (UPC# 10836) 35 Red (UPC# 10810) 35 Green (UPC# 10851) 35 Yellow (UPC# 10844) 35 White (UPC# 10828)
Standards requirements	UL 510, CSA standard C22.2

Table 21: Electrical tape product information

Table 22 describes how colored bands are used to identify an IF cable.

Sector	X-Pol RBS Tx or X-Pol RBS Rx number	Number and color of bands (primary X-Pol RBS Tx or X-Pol RBS Rx)	Number and color of bands (Redundant X-Pol RBS Tx or X-Pol RBS Rx)
Sector A	X-Pol RBS Tx #1	1 blue band	1 blue band, 1 white band
	X-Pol RBS Rx #1	2 blue bands	2 blue bands, 1 white band
	X-Pol RBS Tx #2	3 blue bands	3 blue bands, 1 white band
	X-Pol RBS Rx #2	4 blue bands	4 blue bands, 1 white band
	X-Pol RBS Tx #n	2n-1 (1) blue bands	2n-1 (1) blue bands, 1 white band
	X-Pol RBS Rx #n	2n (2) blue bands	2n (2) blue bands, 1 white band
Sector B	X-Pol RBS Tx #1	1 red band	1 red band, 1 white band
	X-Pol RBS Rx #1	2 red bands	2 red bands, 1 white band
	X-Pol RBS Tx #2	3 red bands	3 red bands, 1 white band
	X-Pol RBS Rx #2	4 red bands	4 red bands, 1 white band
	X-Pol RBS Tx #n	2n-1 (1) red bands	2n-1 (1) red bands, 1 white band
	X-Pol RBS Rx #n	2n (2) red bands	2n (2) red bands, 1 white band

Sector	X-Pol RBS Tx or X-Pol RBS Rx number	Number and color of bands (primary X-Pol RBS Tx or X-Pol RBS Rx)	Number and color of bands (Redundant X-Pol RBS Tx or X-Pol RBS Rx)
Sector C	X-Pol RBS Tx #1	1 green band	1 green band, 1 white band
	X-Pol RBS Rx #1	2 green bands	2 green bands, 1 white band
	X-Pol RBS Tx #2	3 green bands	3 green bands, 1 white band
	X-Pol RBS Rx #2	4 green bands	4 green bands, 1 white band
	X-Pol RBS Tx #n	2n-1 (1) green bands	2n-1 (1) green bands, 1 white band
	X-Pol RBS Rx #n	2n (2) green bands	2n (2) green bands, 1 white band
Sector D	X-Pol RBS Tx #1	1 yellow band	1 yellow band, 1 white band
	X-Pol RBS Rx #1	2 yellow bands	2 yellow bands, 1 white band
	X-Pol RBS Tx #2	3 yellow bands	3 yellow bands, 1 white band
	X-Pol RBS Rx #2	4 yellow bands	4 yellow bands, 1 white band
	X-Pol RBS Tx #n	2n-1 (1) yellow bands	2n-1 (1) yellow bands, 1 white band
	X-Pol RBS Rx #n	2n (2) yellow bands	2n (2) yellow bands, 1 white band

Table 22: Color codes for IF cables

Note: *(1) For example, if n (X-Pol RBS Tx #) is 5, the number of bands is (2x5)-1, which equals 9 colored bands. A white band is added if the cable attaches to a redundant X-Pol RBS Tx.*

(2) For example, if n (X-Pol RBS Rx #) is 5, the number of bands is (2x5), which equals 10 colored bands. A white band is added if the cable attaches to a redundant X-Pol RBS Rx.

Figure 31 shows an example of a cable marked for identification. According to the bands on the cable (3 red bands and 1 white band), the cable connects to the second redundant X-Pol RBS Tx in sector B.

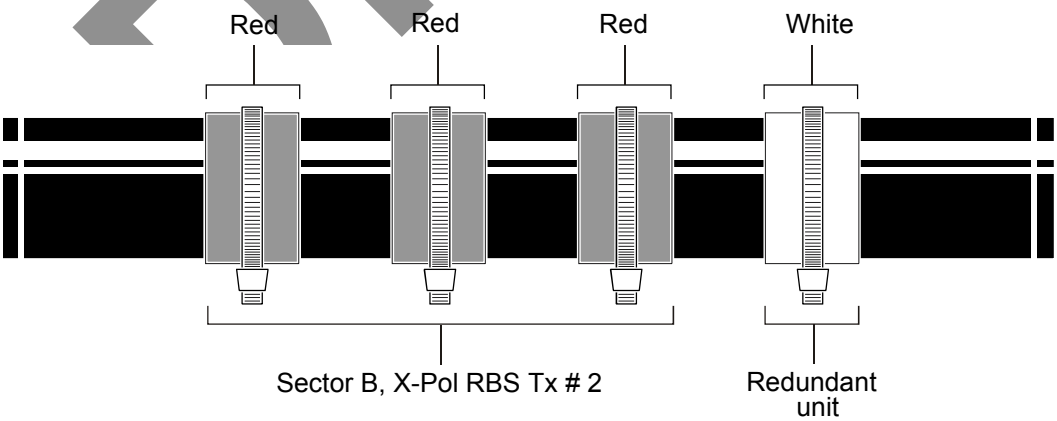


Figure 31 – IF cable marked for identification

All IF cables should be marked for identification close to where a cable connector is installed. To simplify the installation of IF cables, mark the cables as they are being installed at the following points:

– where a cable attaches to the 12:2 Combiner/Splitter,

– where a cable connects to the lightning arrester,

– where a cable connects to the X-Pol RBS Tx or X-Pol RBS Rx jumper cable.

Cables may be marked for identification at additional points along their lengths, however, always leave a space of at least 1 meter (3.28 ft) between groups of identification bands on the same cable.

To mark an IF cable for identification

1. Use *Table 22* to calculate the correct number and color of bands to be applied to the IF cable.
2. Apply the bands of electrical tape to the cable as follows:
    1. Cut the tape used for each band to a length that is sufficient to wrap around the cable at least three times.
    2. Create bands by wrapping strips of tape around the cable, leaving a space equal to the width of the tape between bands. See *Figure 32*.
    3. Apply a cable tie securely around the center of each band to prevent the band from falling off the cable. See *Figure 32*.
    4. If a white band (indicating redundancy) is required, add it on either side of the colored bands. The white band must be spaced and secured in the same way as the colored bands.

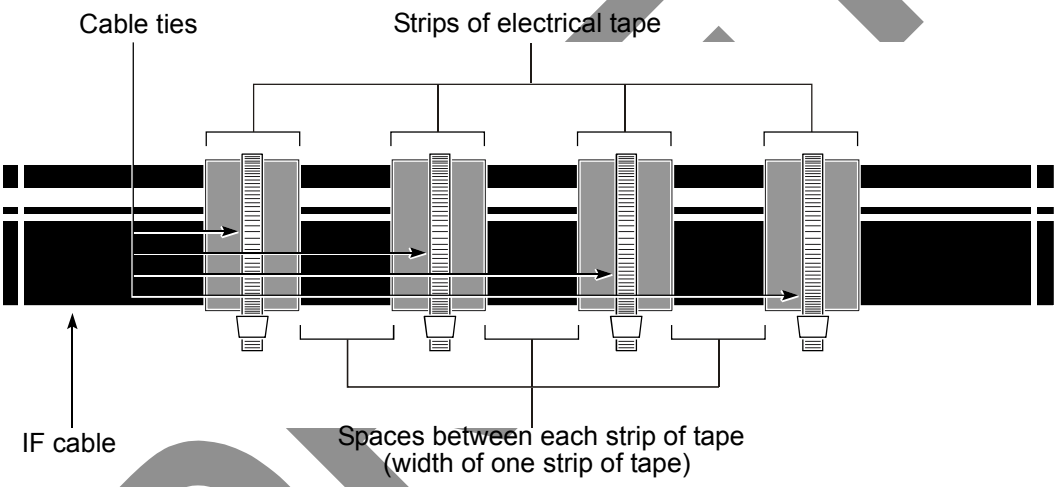


Figure 32 – Applying bands of tape

2.8.3 – Cable strain relief

Strain relief is required for every cable connected to an X-Pol RBS Tx, X-Pol RBS Rx or 2:1 Combiner/ Splitter. Strain relief protects the connectors on these devices from the potentially damaging stresses that occur when connected cables are subject to the forces of wind or accidental tugging. Strain relief can be provided by fastening the IF or RS-422 cables firmly to the mounting pole with plastic ties or cable hangers.

Caution - Plastic ties that are used as strain relief must be suitable for outdoor use in the year-round climate experienced at the installation site (UV exposure and temperature extremes). Select a plastic tie that is rated to survive until a scheduled maintenance time, and ensure that cable ties are replaced according to that schedule.
Alternately, strain relief can be provided by cable hangers available from the manufacturer of the IF cable used at the installation.

To provide cable strain relief

For each RS-422 or IF cable that connects to an X-Pol RBS Tx, X-Pol RBS Rx or 2:1 Combiner/Splitter:

1. Position the cable against the pole as close as possible to the X-Pol RBS Tx, X-Pol RBS Rx or 2:1 Combiner/Splitter connector. While positioning the cable:
   - ensure that the minimum possible stress is put on the connection at the X-Pol RBS Tx, X-Pol RBS Rx or 2:1 Combiner/Splitter by carefully bending the cable as required,
   - ensure that the minimum cable bend radius for the cable is not exceeded when positioning the cable.
2. Fasten the cable to the pole using a plastic cable tie or cable hanger.
3. Secure the cable to the pole every 1 m (3.28 ft) with plastic ties or cable hangers.

2.8.4 – Connecting BS IF cables

The BS IF cables run from the Bias-T mounted on the 12:2 Combiner/Splitter, through the Type N lightning arrester, and to the X-Pol RBS Tx/X-Pol RBS Rx. An outdoor IF jumper cable is used to connect the main outdoor IF cable to the X-Pol RBS Tx/X-Pol RBS Rx.

Warning - If an IF cable is carrying live dc voltage, do not connect or disconnect the cable. These actions can damage the connectors, which can affect service. To remove dc power, switch off the appropriate circuit breaker on the power distribution system to isolate the individual IF channel.

Note - Every Andrew L4PNM N(M) connector must be tightened to between 2.5 and 2.8 Nm (22 to 25 in.-lb) of torque, using the torque wrench available from Andrew Corporation (Andrew part number 244379).

To connect the outdoor IF cables

For each X-Pol RBS Tx and X-Pol RBS Rx:

1. At the rooftop, attach an N(M) connector to the end of the outdoor IF cable. See chapter 10 for details on attaching an N(M) connector.
2. Hoist the cable up the pole or tower and secure it at a point near the X-Pol RBS Tx/X-Pol RBS Rx.
3. At the X-Pol RBS Tx or X-Pol RBS Rx:
   1. Connect the outdoor IF jumper cable (N(F) connector) to the outdoor IF cable (N(M) connector).
   2. Secure the IF jumper cable.
   3. If the IF cable run is not being tested for signal losses immediately, wrap the IF jumper N(F) connector with butyl tape to protect it.
   4. Secure the IF cable to the pole or tower.
4. At the cable entry point:
   1. Cut the IF cable to a length sufficient to allow the end of the cable to reach and connect to the Type N lightning arrester.
   2. Feed the cable through the weatherproof access panel to the grounded entry point where the lightning arresters are installed. Secure the cable to the grounded entry point.
   3. Attach an N(M) connector to the end of the cable.
   4. Connect the cable to the unprotected side of the lightning arrester.
   5. Secure the cable.

5. After the cable run has been tested for signal losses, connect the IF jumper cable to the X-Pol RBS Tx or X-Pol RBS Rx.

To connect the indoor IF cables

For each X-Pol RBS Tx and X-Pol RBS Rx:

1. Cut a length of indoor IF cable long enough to reach and connect the protected side of the RS-422 lightning arrester to the Bias-T.
2. Attach an N(M) connector to each end of the cable.
3. Run the cable between the RS-422 lightning arrester and the Bias-T. Secure the cable.
4. Connect the cable to the protected side of the lightning arrester.
5. Connect the cable to the Bias-T.

Connecting synchronization reference cables

The synchronization reference cable carries the synchronization signal between the X-Pol RBS Tx and the X-Pol RBS Rx. In a redundant configuration, both X-Pol RBS Txs and both X-Pol RBS Rxs are connected by 2:1 Combiner/Splitters that connect the signal from the active X-Pol RBS Rx to the active X-Pol RBS Tx.

Note - If redundancy is planned in the future, use the redundant synchronization cable configuration and install 50 W weatherproof terminators on the unused 2:1 Combiner/Splitter connectors. This allows for future redundancy without disrupting service in order to reconfigure the cables for redundancy.

Figure 33 shows a redundant X-Pol RBS Tx/X-Pol RBS Rx synchronization reference cable configuration.

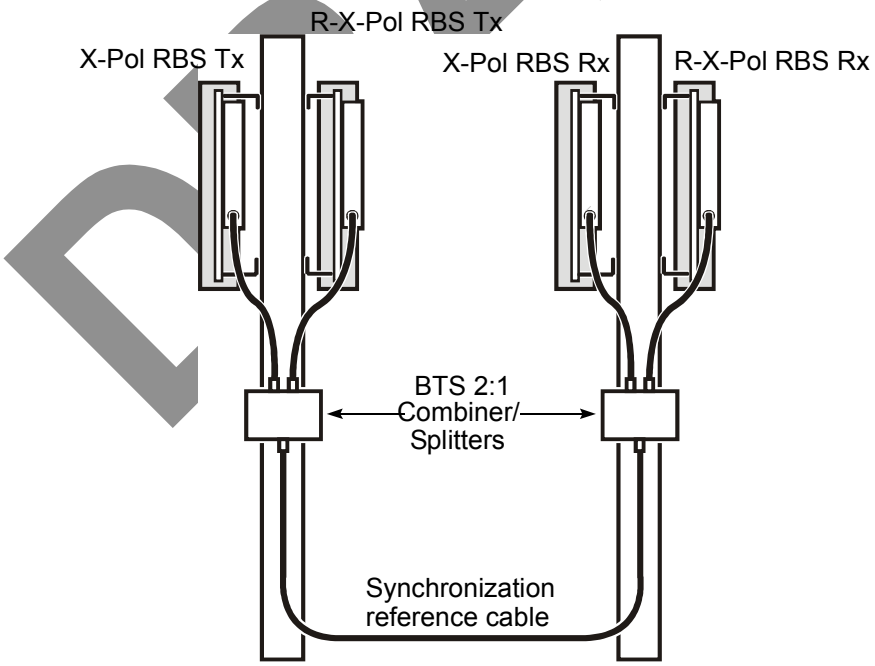


Figure 33 – Reference cables for redundant X-Pol RBS Tx/X-Pol RBS Rx configurations

Table 23 describes the requirements for both non-redundant and redundant X-Pol RBS Tx/X-Pol RBS Rx synchronization reference cable configurations.

Table 24 lists the cables and connectors recommended for use as synchronization reference cables. If the listed cable types are unavailable, the same cable type that is used to connect the X-Pol RBS Txs and X-Pol RBS Rxs to the lightning arresters may be used, with connectors appropriate for that cable type.

Configuration	Cable requirements	Connector
Non-redundant X-Pol RBS Rx and X-Pol RBS Tx	X-Pol RBS Rx to X-Pol RBS Tx	90° N(M)-90° N(M)
Redundant X-Pol RBS Rx and redundant X-Pol RBS Tx	X-Pol RBS Tx (primary) to 2:1 Combiner/Splitter 1 (1)	90° N(M)-N(M)
	R-X-Pol RBS Tx (redundant) to 2:1 Combiner/Splitter 1	90° N(M)-N(M)
	X-Pol RBS Rx (primary) to 2:1 Combiner/Splitter 2	90° N(M)-N(M)
	R-X-Pol RBS Rx (redundant) to 2:1 Combiner/Splitter 2	90° N(M)-N(M)
	One cable from 2:1 Combiner/Splitter 1 to 2:1 Combiner/Splitter 2	N(M)-N(M)
Redundant X-Pol RBS Tx, single X-Pol RBS Rx	X-Pol RBS Tx (primary) to 2:1 Combiner/Splitter 1	90° N(M)-N(M)
	R-X-Pol RBS Tx (redundant) to 2:1 Combiner/Splitter 1	90° N(M)-N(M)
	X-Pol RBS Rx (primary) to 2:1 Combiner/Splitter 2	90° N(M)-N(M)
	Unconnected 2:1 Combiner/Splitter 2 connector	50 Ω terminator, weatherproof
	One cable from 2:1 Combiner/Splitter 1 to 2:1 Combiner/Splitter 2	N(M)-N(M)

Table 23: Synchronization reference cable configuration requirements

Note: *(1) 2:1 Combiner/Splitter 1 is for the X-Pol RBS Tx/R-X-Pol RBS Tx pair. 2:1 Combiner/Splitter 2 is for the X-Pol RBS Rx/R-X-Pol RBS Rx pair.*

Cable type	Connectors	Connector part number
Heliax LDF2-50	N(M) 90° N(M)	L2PNM L2PNR-HC

Table 24: Recommended synchronization reference cables and connectors

To connect synchronization reference cables (non-redundant X-Pol RBS Tx/X-Pol RBS Rx configuration)

1. Measure and cut a length of cable long enough to run between the X-Pol RBS Tx and X-Pol RBS Rx, including the distance required to run up each pole to the X-Pol RBS Tx and X-Pol RBS Rx connectors.
2. Install an N(M) connector on each end of the cable.
3. Run the cable between the X-Pol RBS Tx and X-Pol RBS Rx.
4. Connect the cable to the X-Pol RBS Tx and X-Pol RBS Rx (100 MHz reference connectors).
5. Secure the cable according to the manufacturer's recommendations.

To connect synchronization reference cables (redundant X-Pol RBS Tx/X-Pol RBS Rx)

Using a metal hose clamp, attach a 2:1 Combiner/Splitter to the X-Pol RBS Tx pole under the X-Pol RBS Tx/R-X-Pol RBS Tx pair; see *Figure 33*.

1. Using a metal hose clamp, attach a 2:1 Combiner/Splitter to the X-Pol RBS Rx pole under the X-Pol RBS Rx/R-X-Pol RBS Rx pair.
2. Measure and cut four lengths of cable such that each length is long enough to run from the 2:1 Combiner/Splitter to the X-Pol RBS Tx or X-Pol RBS Rx mounted above it.
3. Install an N(M) connector on each end of the each cable.
4. Connect the four cables to the X-Pol RBS Txs and X-Pol RBS Rxs, as shown in *Figure 33*.
5. Measure and cut a length of cable long enough to run between the X-Pol RBS Tx/R-X-Pol RBS Tx
6. 2:1 Combiner/Splitter and the X-Pol RBS Rx/R-X-Pol RBS Rx 2:1 Combiner/Splitter, including the distance required to run up each pole to the 2:1 Combiner/Splitter connectors.
7. Install an N(M) connector on each end of the cable.
8. Run the cable between the 2:1 Combiner/Splitters.
9. Connect the cable to the 2:1 Combiner/Splitters, as shown in *Figure 33*.
10. Ensure all connections meet the requirements of outdoor use.
11. Secure the cable according to the manufacturer's recommendations.

2.8.5 – Connecting the RS-422 data cables

Each RS-422 data cable run is composed of two intermediate cables: one indoor-rated and one outdoor-rated cable. The cables are connected by an RS-422 lightning arrester. *Table 14* lists the cables and the connectors required.

In a non-redundant X-Pol RBS Tx/X-Pol RBS Rx system, RS-422 data cables connect the IBS associated with the first IBS-TLX card in a IBS group to the X-Pol RBS Tx and X-Pol RBS Rx. In a redundant X-Pol RBS Tx/X-Pol RBS Rx system, additional RS-422 data cables connect:

- the IBS card configured for Tx control to the redundant X-Pol RBS Tx,
- the IBS card configured for Rx control to the redundant X-Pol RBS Rx.

To connect outdoor BS RS-422 data cable

For each X-Pol RBS Tx and X-Pol RBS Rx:

1. Cut a length of outdoor-rated cable long enough to connect the X-Pol RBS Tx/X-Pol RBS Rx to the RS-422 lightning arrester.
2. At an indoor location, attach a LEMO connector to the X-Pol RBS Tx/X-Pol RBS Rx end of the cable. *Figure 34* shows the pin and signal assignment and the wire color coding. See section 9.11 for instructions on installing a LEMO connector.

Note 1 - Attaching a LEMO connector to the outdoor IF cable is an intricate procedure that should not be done outdoors.

Note 2 - There are two pairs of conductors in the RS-422 data cable: one pair has a blue wire and a white wire; the other pair has an orange wire and a white wire. To distinguish the white wires from each other, use a permanent marker to mark the white wire of the blue-white pair.

3. At the outside of the weatherproof access panel, feed the end of the cable without the connector through the access panel, then to the grounded entry point where the RS-422 lightning arrester is installed.
4. Attach an RJ45 connector to the RJ45 lightning arrester end of the cable. *Figure 34* shows the pin and signal assignment and the wire color coding. See section 9.10 for instructions on installing an RJ45 connector.
5. Test the cable for pin-to-pin conductivity.
6. Connect the LEMO connector to the RS-422 data connector on the X-Pol RBS Tx/X-Pol RBS Rx, and connect the RJ45 connector to the unprotected side of the RS-422 lightning arrester.
7. Secure the cable according to the manufacturer's recommendations.

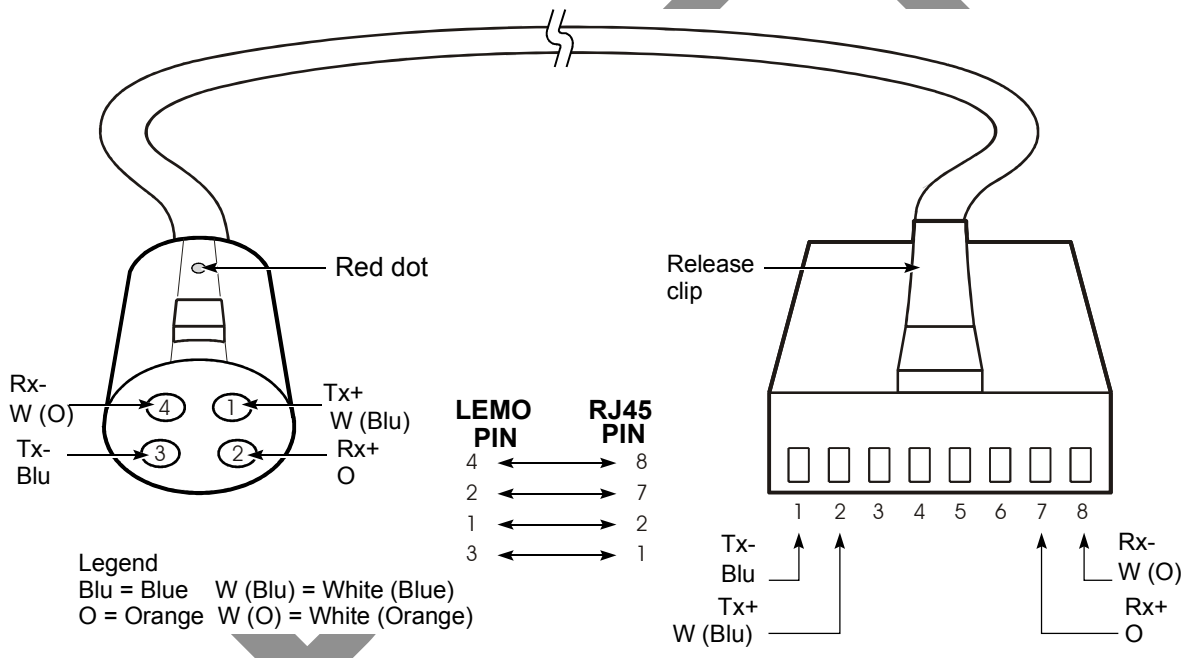


Figure 34 – LEMO and RJ45 connector pin and signal assignment

To connect indoor BS RS-422 cable

For each X-Pol RBS Tx and X-Pol RBS Rx:

1. Cut a length of indoor-rated cable long enough to connect the IBS-TLX to the RS-422 lightning arrester.
2. Attach an RJ45 connector to each end of the cable. *Figure 35* shows the pin and signal assignments and the wire color coding. See section 9.10 for instructions on installing an RJ45 connector.

Note - There are two pairs of conductors in the RS-422 data cable: one pair has a blue wire and a white wire; the other pair has an orange wire and a white wire. To distinguish the white wires from each other, use a permanent marker to mark the white wire of the blue-white pair.

3. Test the cable for pin-to-pin continuity.
4. Connect one end of the cable to the IBS (X-Pol RBS Tx or X-Pol RBS Rx connector, as appropriate), and the other end of the cable to the protected side of the RS-422 lightning arrester.
5. Secure the cable according to the manufacturer's recommendations.

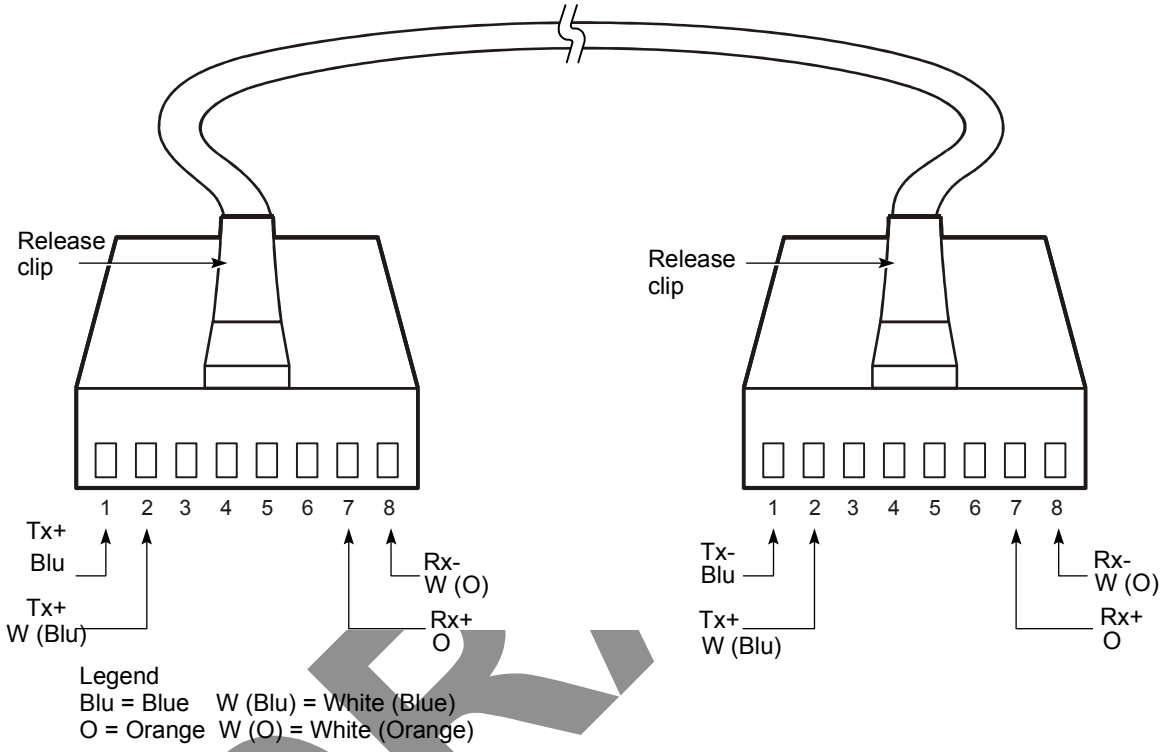


Figure 35 – RJ45 connector pin and signal assignment

2.8.6 – Connecting SMA cables

IBS cards are connected to 12:2 Combiner/Splitters by pairs of SMA cables. If multiple IBS cards are used, multiple pairs of SMA cables are used.

Note - The number of IBS cards connected to the 12:2 Combiner/Splitters may be limited by the X-Pol RBS Rx/X-Pol RBS Tx hardware. Consult Alcatel for the maximum number of IBS cards that can be connected to an X-Pol RBS Tx/X-Pol RBS Rx through a 12:2 Combiner/Splitter.

To connect an SMA cable

Note - All SMA cable connectors must be tightened to 1 Nm (9 in.-lb) of torque, using an SMA cable torque wrench equivalent to the Suhner SMA torque wrench (Suhner part number 74 z-0-0-21), or the Maury Microwave SMA torque wrench (Maury Microwave part number 879981).

1. Connect one end of an SMA cable to the Tx connector on the IBS card faceplate.
2. Connect the other end of the same SMA cable to connector 1 on the Tx 12:2 Combiner/Splitter.
3. Connect one end of another SMA cable to the Rx connector on the IBS card faceplate.
4. Connect the other end of the same SMA cable to connector 1 on the Rx 12:2 Combiner/Splitter.
5. Connect the Tx and Rx connectors from the other IBS cards (cards 2 through 12) to Tx and Rx 12:2 Combiner/Splitter connectors 2 to 12, as indicated in *Figure 36*.
6. Install 50 Ω terminators on all unused 12:2 Combiner/Splitter connectors.

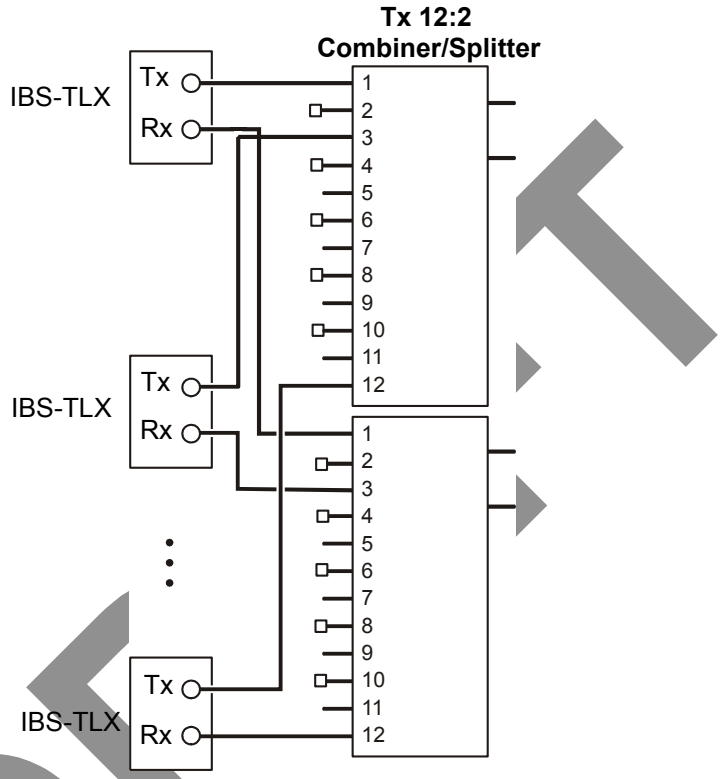


Figure 36 – SMA cable connections

2.8.7 – Connecting the Bias-T power cable

The Bias-T power cable connects between the Bias-T surge protector and the –48 V dc power distribution system.

Warning - Do not connect any connector (BS or Type N) in the IF cable run while the cables carry dc voltage. This can damage the connector, which can affect service. To remove dc power, switch off the appropriate circuit breaker on the power distribution system to isolate the individual IF channel.

To connect the Bias-T power cable

1. Use an ohmmeter to determine which wire on the Bias-T power cable connects to the center pin of the BNC connector. The center pin carries the –48 V dc voltage. Verify that the other wire connects to the outer shell of the BNC connector (ground).
2. Connect the wire connected to the BNC center pin to the –48 V dc distribution system.

3. Connect the ground wire to the ground terminal of the distribution system.
4. Ensure that the dc power supply is turned off and connect the Bias-T power cable BNC connector to the surge protector.

2.8.8 – Installing an RJ45 connector on an RS-422 cable

This section describes how to install a Stewart RJ45 connector on a Delco cable, using Stewart tools. It can also be used as a guideline for installing other manufacturers' connectors and cables.

Improper crimping or damaged connectors may result if tools other than the specified Stewart tools are used.

Tools and hardware

The following connector tools and hardware are required:

- Stewart RJ45 hand tool (Stewart part number 2940231-01) with Stewart RJ45 die set (Stewart part number 2906253-01).
- Stewart ferrule crimp tool (Stewart part number 29125212-01).
- Stewart shielded RJ45 connector(s) (Alcatel part number 90-6815-01 or Stewart part number 943-SP-370808SM2); each connector has:
  - RJ45 plug,
  - housing,
  - ferrule,
  - management bar.
- Delco cable.

To install an RJ45 connector

1. Cut one end of the cable with the wire cutters and slide the connector housing onto the cable, with the housing notch pointing toward the trimmed end of the cable; see *Figure 37*.

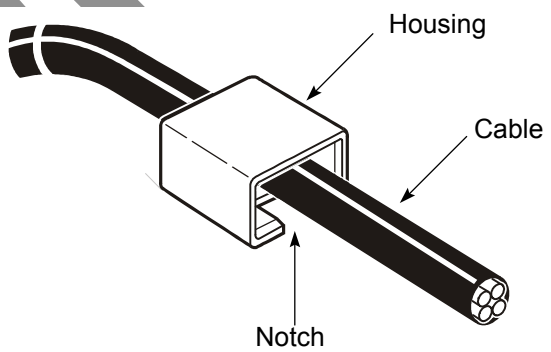


Figure 37 – Placing the connector housing on the cable

2. Strip off enough cable jacket with the wire strippers to expose approximately 25 mm (1 in.) of the braided shielding, being careful not to nick the braided shield.
3. Roll back the braided shielding and the drain wire over the cable jacket, exposing the aluminum-mylar shielding that covers the four conductors. Unwrap the mylar shielding and fold it back over the cable jacket. Ensure that the aluminum (silver) side of the mylar shielding is facing up so that it will

make contact with the ferrule when the ferrule is slipped over the cable; see *Figure 38*.

4. Slip the ferrule over the braided shielding, ensuring that the rounded edge of the ferrule points toward the trimmed end of the cable; see *Figure 38a*. Leave 1 mm (1/32 in.) of shielding showing; see *Figure 38b*. Ensure that there is good contact between the ferrule, the shielding and the drain wire.

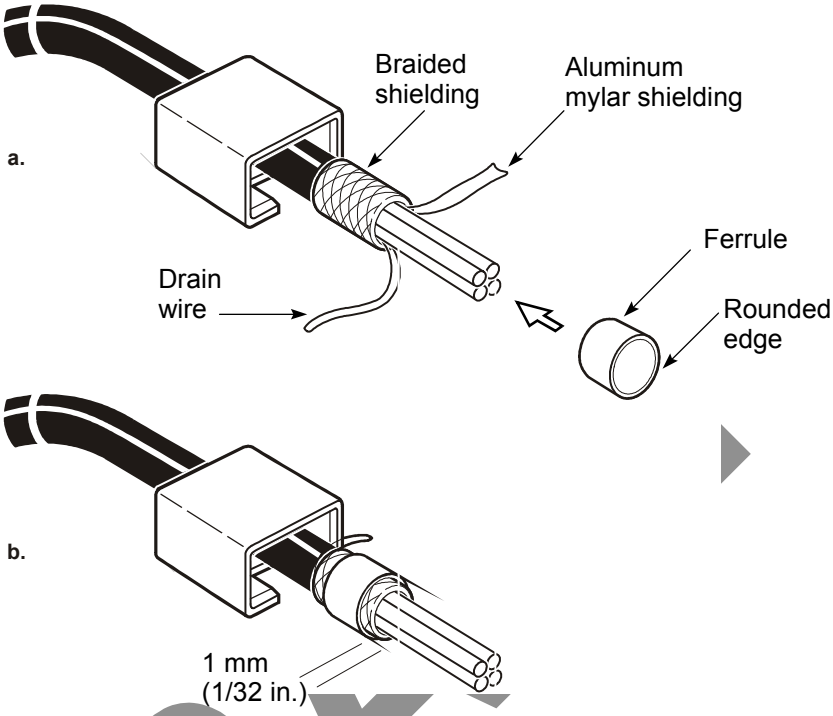


Figure 38 – Placing the ferrule on the cable

5. Prepare the ferrule and conductors for crimping.

Caution - Each pair of conductors has a white conductor. It is possible to get the white conductors mixed up at either end if they are not properly marked and identified.

1. Separate and untwist one of the pairs of conductors. Use a marker to place an identifying mark on the white conductor. Make a note of which pair has been marked, so that the conductors at the other end of the cable can be attached to the correct pins.
2. Separate and untwist the other pair of conductors.
3. Arrange the conductors so they are parallel when they come out of the cable jacket; see *Figure 39*.

To prevent damage to the conductors during crimping, ensure that the conductors do not overlap.

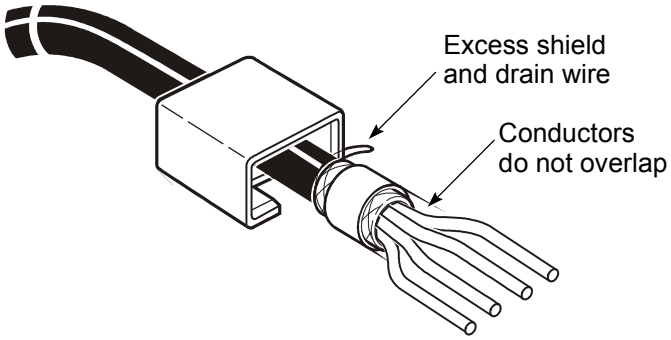


Figure 39 – Preparing the conductors for crimping

6. Insert the ferrule into the ferrule crimping tool, using the proper crimp insert in the crimping tool.
7. Crimp the ferrule such that the crimp wings are parallel to the row of conductors; see *Figure 40*.

Caution - Failure to crimp the ferrule prevents the RJ45 connector from assembling properly. Consequently, the connector may not fit properly into the lightning arrester or IBS.

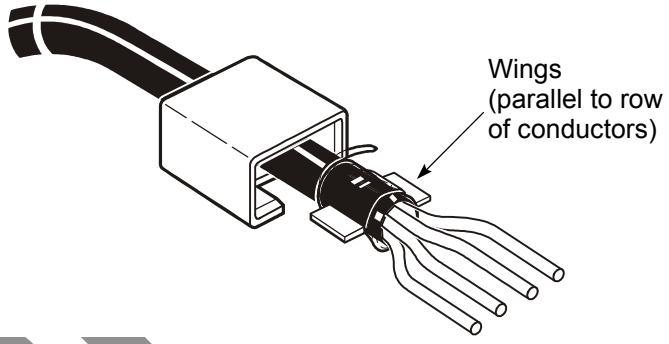


Figure 40 – Crimping the ferrule

8. Trim the excess shielding and drain wire.
9. Insert the conductors into the management bar, as shown in *Figure 41*. *Table 25* identifies the pin and signal assignments. The LEMO connector is installed as part of Procedure 9-7.

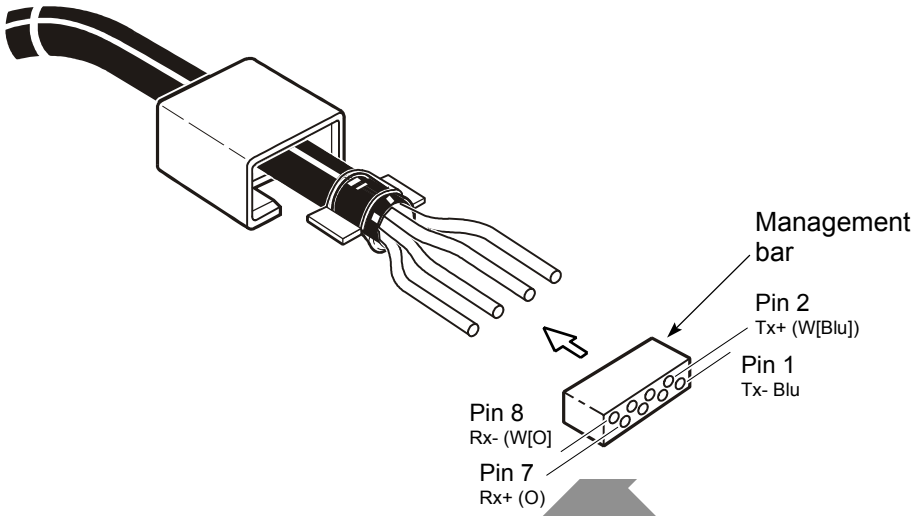


Figure 41 – Inserting the conductors into the management bar

Pin		Signal
RJ45 connector	LEMO connector	
1	3	Tx-
2	1	Tx+
7	2	Rx+
8	4	Rx-

Table 25 RS-422 cable pin and signal assignments

10. Slide the management bar towards the cable jacket until there is no more than 4 mm (0.15 in.) between the bar and the jacket; see *Figure 42*.

Note - The cable may not work properly if the distance between the management bar and the cable jacket is greater than 4 mm (0.15 in.).

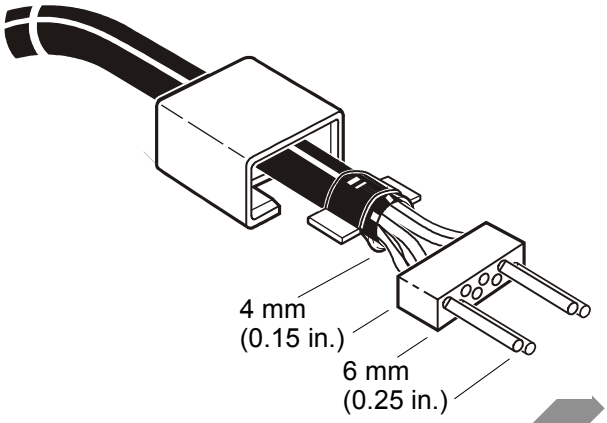


Figure 42 – Positioning the management bar

11. Prepare the conductors for insertion into the RJ45 plug.
    1. Trim all the conductors so that they extend from the management bar by 6 mm (0.25 in.); see *Figure 42*.
    2. Pull the management bar to the ends of the conductors, as shown in *Figure 43*.

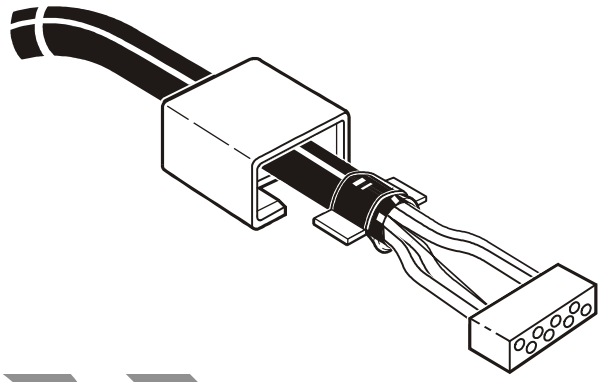


Figure 43 – Preparing the conductors for insertion into the RJ45 connector

12. Insert the management bar (with conductors and ferrule) into the RJ45 plug; see *Figure 44*. When the management bar stops, continue to push the conductors until they can be seen under the plug contacts. Inspect the conductors by looking through the transparent plug to ensure that all conductors are pushed completely under the contacts, and are ready for termination.

Warning - The cable may not function properly if all conductors are not positioned correctly.

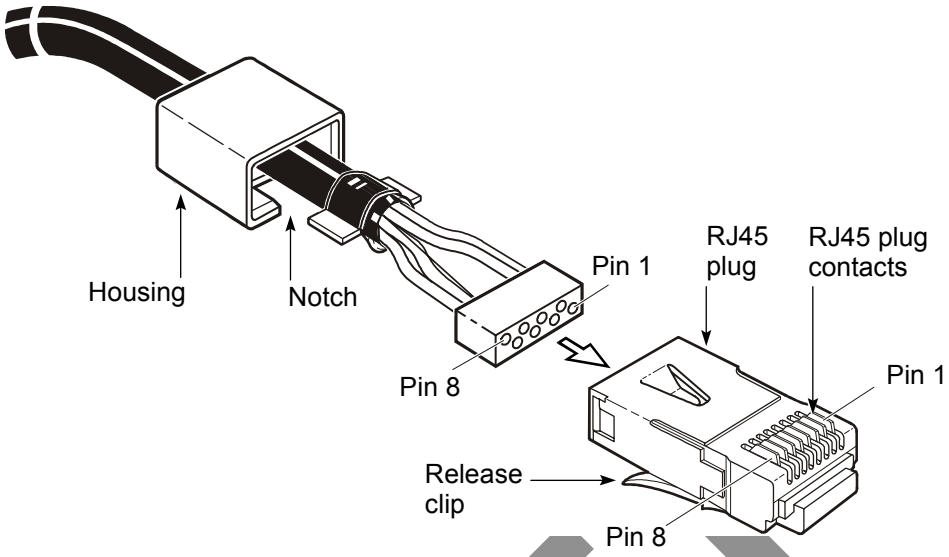


Figure 44 – Inserting the management bar into the RJ45 connector

13. Insert the RJ45 connector assembly into the RJ45 crimping tool with the appropriate termination die set. Crimp the connector in order to terminate the conductors; when the conductors are terminated, they make contact with the appropriate pins.

Warning - Improper crimping or damaged connectors may result from using tools other than the specified Stewart tools. For example, the AMP crimping tool may not allow the Stewart connector to be completely inserted. The Wearns-Hollingworth crimping tool requires that the Stewart connector be aligned by hand, because the connector does not have a stop that prevents the body of the connector from passing completely through the tool.

14. Slide the RJ45 housing over the plug, and snap the housing into position. When positioned correctly, the notch in the housing clears the RJ45 release clip on the bottom of the plug; see *Figure 44*.

2.8.9 – Installing a LEMO connector on an RS-422 cable

This section describes how to install a LEMO Series K connector on a Delco cable. It can also be used as a guideline for installing a LEMO Series K connector on other manufacturers' cables.

Note - Attaching a LEMO connector to the outdoor IF cable is an intricate procedure that should not be done outdoor.

Tools and hardware

The following tools and hardware are required:

- LEMO Series K connector (Alcatel part number 90-6816-01, LEMO USA part number FGG.1K.304.CLCC.60Z) with extra contact pins,
- DMC crimping tool (LEMO part number MH860) with positioner tool (LEMO part number DCE.91.091.BVC),
- LEMO contact pin extraction tool (LEMO part number DCC.91.090.5LA),
- Delco cable,

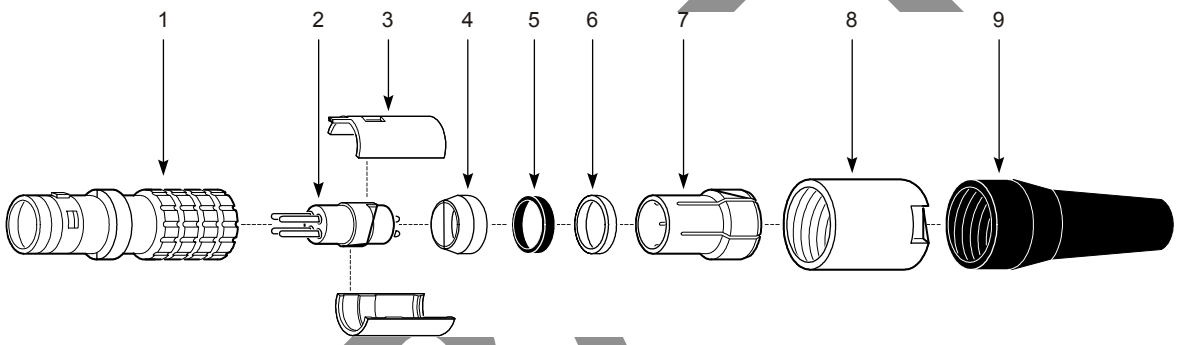
– wire cutter,
– wire stripper,
– permanent marker,
– ruler (metric and imperial distances).

Improper crimping or damaged connectors may result if tools other than the specified tools are used.

To install a LEMO connector

Caution - The Delco cable has two pairs of conductors and each pair has a white conductor. It is possible to get the white conductors mixed up if one of the conductors is not properly marked and identified.

1. Identify all parts of the LEMO connector; see *Figure 45*.



1. Connector body
2. Insert
3. Insert carrier
4. Cone washer
5. Sealing gland
6. Metal washer
7. Collet
8. Collet nut
9. Bend relief

Figure 45 – LEMO Series K connector

2. Remove approximately 50 mm (2 in.) of cable jacket, being careful not to nick the braided shield underneath the jacket.
3. Slide the bend relief, collet nut, collet, metal washer and sealing gland on to the cable jacket; see *Figure 46*. Ensure that:
   - the slots in the collet face towards the collet nut,
   - the sealing gland fits snugly over the cable jacket,
   - the bevel in the metal washer faces towards the collet.

Caution - Water may enter the LEMO connector if the sealing gland does not fit snugly over the cable jacket. If the fit is not snug, do not continue the installation until the correct cable and connector is confirmed.

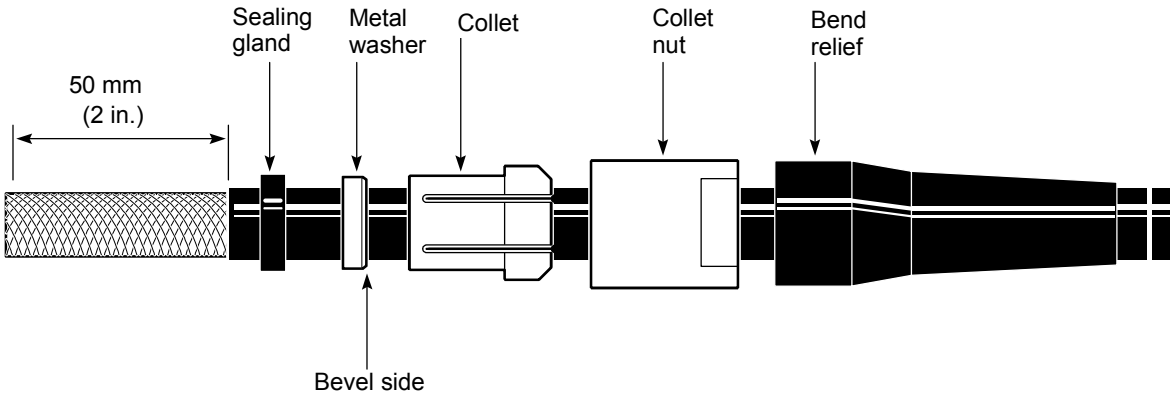


Figure 46 – LEMO connector installation

4. Strip off the braided shielding to expose the aluminum-mylar shielding. Leave 4 mm (0.16 in.) of braided shielding; see *Figure 47*.

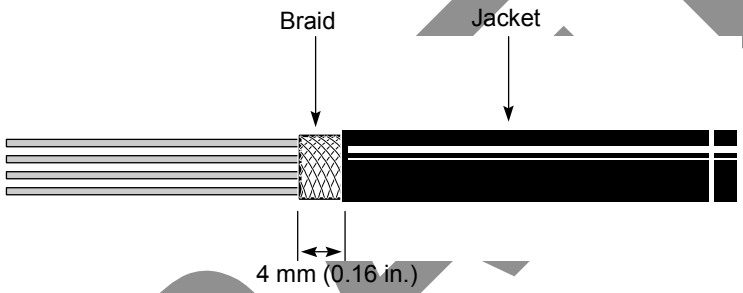


Figure 47 – Exposing the shielding

5. Fit the cone washer over the braided shielding until it reaches the cable jacket. The bevelled edge on the cone should face toward the exposed wires; see *Figure 48*.
   1. Fold the shielding back over the cone.
   2. Remove the drain wire, aluminum-mylar shielding and fiberglass reinforcing material at the base of the cone.
   3. Identify the white-blue twisted-pair and mark the white wire with the marker to distinguish it from the white wire of the white-orange pair. Make the mark at the base of the cone so that it does not get removed when the insulation is stripped from the wire.

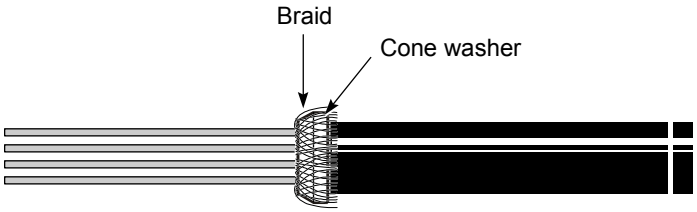


Figure 48 – Fitting the cone washer and trimming excess material

6. Trim the braided shielding at the point where the bevel in the cone becomes a cylinder; see *Figure 49*. Excess braid prevents the insertion of the cone into the connector body

.

Note - The shielding provides strain relief when it is pressed between the cone washer and the insert.

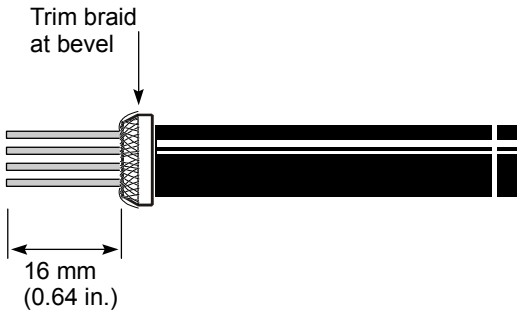


Figure 49 – Trimming the braided shielding

7. Cut all the wires to a length of 16 mm (0.64 in.); see *Figure 49*.
8. Strip 8 mm (0.32 in.) of insulator from each wire (see *Figure 50a*), being careful not to damage any strands, and ensuring that the white wire of the white-blue pair will still be marked after stripping it. Tin each conductor with high-quality solder.

   Fold each conductor back on itself to make a 4 mm (0.16 in.) lead that doubles the lead diameter (approximately 24 AWG); see *Figure 50b*.

Caution - A proper crimp connection cannot be made unless the lead is folded back.

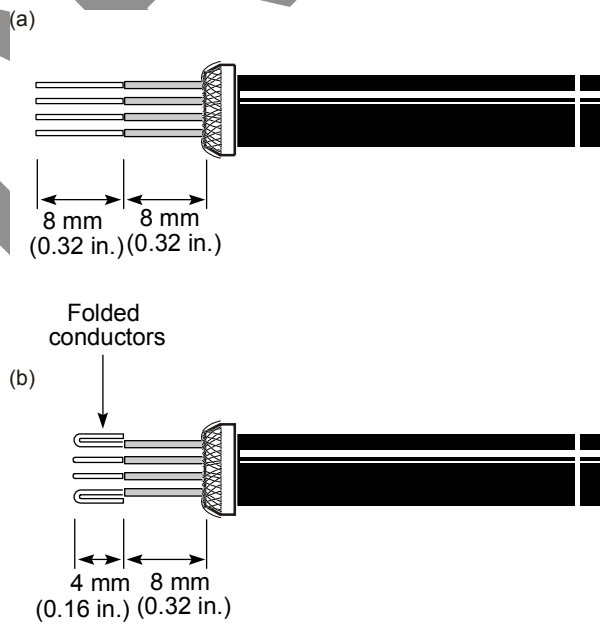


Figure 50 – Stripping and preparing the wires