Light Beam Antenna Feed-line Options

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This paper discusses three options that you have to connect your transceiver to your Light Beam Plus Antenna or Light Beam Antenna. The pros and cons of each option are also discussed. Also included is an explanation why feeding the antenna properly is important. Step-by-step Installation Instructions are also provided.

The installation of any antenna and the performance of the antenna will vary from location to location. This variation is caused by differences in the ground conductivity, ground permitivity, the exact height of the antenna and the objects and topography near the antenna location. As a consequence, the Standing Wave Ratio (SWR) at the antenna feed-point will vary from one QTH to another. Also keep in mind that all Light Beam antennas are balanced antennas, similar to a ½ wave dipole. Most modern receivers, transmitters and transceivers are unbalanced. Therefore one must transition from balanced to unbalanced within the antenna system or the antenna performance will be adversely affected as well as radio frequency energy being carried into your shack on the outside of an unbalanced coaxial cable.

To minimize SWR and the RF power loss that results, one either must alter the design of the antenna or utilize one of the following options.

The Three Options Are:

- Balanced Feed-line Impedance Transformer: Using a ½ wavelength long Balanced Feed-line Transformer from the antenna, to a location below the antenna, to either a 1:1 Balun or a Coaxial Choke then using 50 Ohm Coaxial Cable to your transceiver.

- Balanced Feed-line Home-run: Using any length of Balanced Feed-line from the Antenna to a Balanced Antenna Tuner, then coaxial cable from the tuner to your transceiver.

- Coaxial Cable Home-run: Interfacing either a 1:1 Balun or a coaxial choke to the antenna feed-point, then running coaxial cable to an Unbalanced Antenna Tuner, then coaxial cable from the tuner to your transceiver.

Option 1: Balanced Feed-line Impedance Transformer

This is the preferred method of feeding a Light Beam Plus or Light Beam antenna.

Any type of balanced feed-line can be used. My personal preference is 450 ohm ladder line. Cutting the feed-line to the appropriate length can easily make a balanced feed-line transformer. To determine the physical length you first need to determine the feed-line manufacturer specification for the feed-line velocity factor (V_f). The physical length of the feed-line can be calculated by using the following formula:

$$\text{Length (in feet)} = V_f \text{ X } \{492 / \text{Frequency (MHz)}\}$$

EXAMPLE:

½ Wavelength of 450 ohm balanced feed-line having a Velocity Factor of .91 at 28.4 MHz
Physical Length = .91 X (492 / 28.4) = .91 X 17.3 = 15.7 feet

When the feed-line is cut properly, the impedance measured at the far end of the feed-line will be the same as the impedance measured on the end of the feed-line that is connected to the antenna.

The Light Beam Plus antenna series and the Light Beam antenna series are both balanced antennas and have the same RF characteristics. Depending on the design frequency of the antenna, the radiation resistance varies from 34 ohms to 52 ohms. In addition, the antenna is slightly reactive with a reactance between – j 90 ohms to –j 4 ohms. Both resistance and reactance will vary depending on the conditions at your QTH.

The reactive component of your antenna can be eliminated by adjusting the length of the of the ½ wavelength section of balanced feed-line. The optimal length of feed-line transforms the resulting impedance to pure radiation resistance, thus becoming a feed-line impedance transformer. This will result in a minimum SWR at the frequency that you wish to operate.

Continuing the example above, a Light Beam antenna is located at your QTH and you mount it at 10 feet above the ground. Ground conditions and the interaction of nearby objects is unknown. Minimum SWR is desired at about and near 28.4 MHz. To achieve the desired minimum SWR, do the following:

1. Attach a 17-foot length of 450-ohm ladder-line to the antenna. This length is slightly longer than the calculated length thereby enabling you to address the unknown conditions at your QTH.
2. Standoff the balanced feed-line and twist the balanced feed-line to minimize common mode coupling with nearby objects. Follow the best practices outlined in the ARRL Amateur Radio Handbook.
3. On the ground-level end of the balance feed-line attach either a coaxial choke or a 1:1 balun. Either of these will perform the Balanced to Unbalanced transition thereby enabling you to interface the antenna to unbalanced coaxial cable or your transceiver.

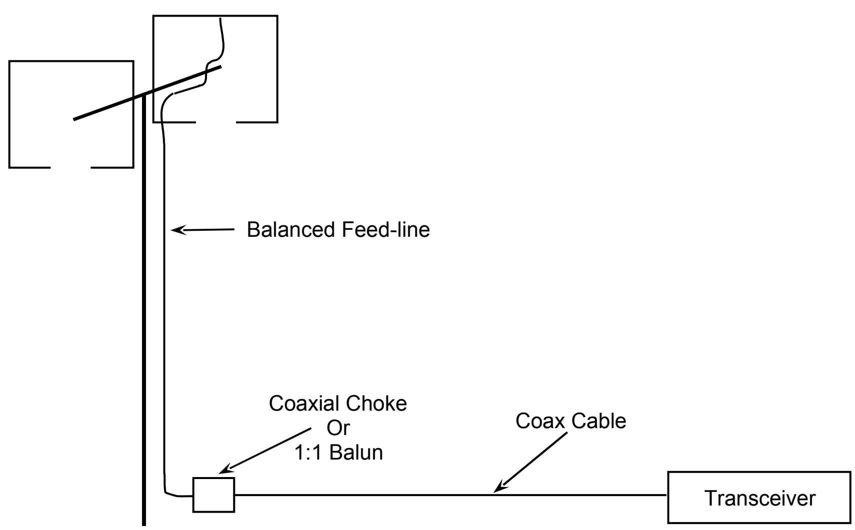
4. Determine the frequency where the minimum SWR is measured by using either an antenna analyzer or your transceiver (at low power) and a SWR Meter. Most likely, the SWR will be lower at frequencies below 28.4 MHz. because the balanced-line transformer is initially cut long. Remove several inches of balanced feed-line from the transformer and repeat the SWR measurement. The frequency that provides a minimum SWR will have moved up toward 28.4 MHz. Repeat this process till you achieve a minimum SWR at the frequency you desire, in this case 28.4 MHz.
5. If conditions at your QTH resulted in the initial minimum SWR to be at a frequency above 28.4 MHz., then lengthen the balanced feed-line transformer.
6. Minimum SWR of 1.6:1 is acceptable. An unbalanced antenna tuner can be then used between the transceiver and the coaxial cable to enable you to operate anywhere within the amateur band with a 1:1 SWR.

Benefits of this approach:

- Minimum power loss is achieved in the balanced feed-line and coaxial cable.
- Optimization of the antenna system is easily achieved to accommodate conditions unique to your QTH. Put the antenna up only once with no need to adjust the antenna element length for minimum SWR.
- All the work to optimize the system is performed at ground level. No need to raise and lower the antenna between adjustments.

Negatives of this approach:

- The use of two different types of feed-line, balanced feed-line and coaxial cable.



Option 1

Option 2: Balanced Feed-line Home-run

This approach will result in the greatest antenna system Efficiency and least effort to achieve a 1:1 SWR.

Any type of balanced feed-line can be used. My personal preference is 450-ohm ladder line. Any convenient length of feed-line can be used from the antenna to a Balanced Antenna Tuner located at your operating position.

EXAMPLE:

You purchased a Light Beam LBP-20M antenna and want to mount the antenna on your garage roof using a tripod mount, rotor and a mast 8 feet long. The garage is separate from your home and is located on the side of the house that is a considerable distance from the operating position in your radio shack. The final height of the antenna will be 30 feet above the ground. The antenna is also 150 feet from your transceiver.

Do the following:

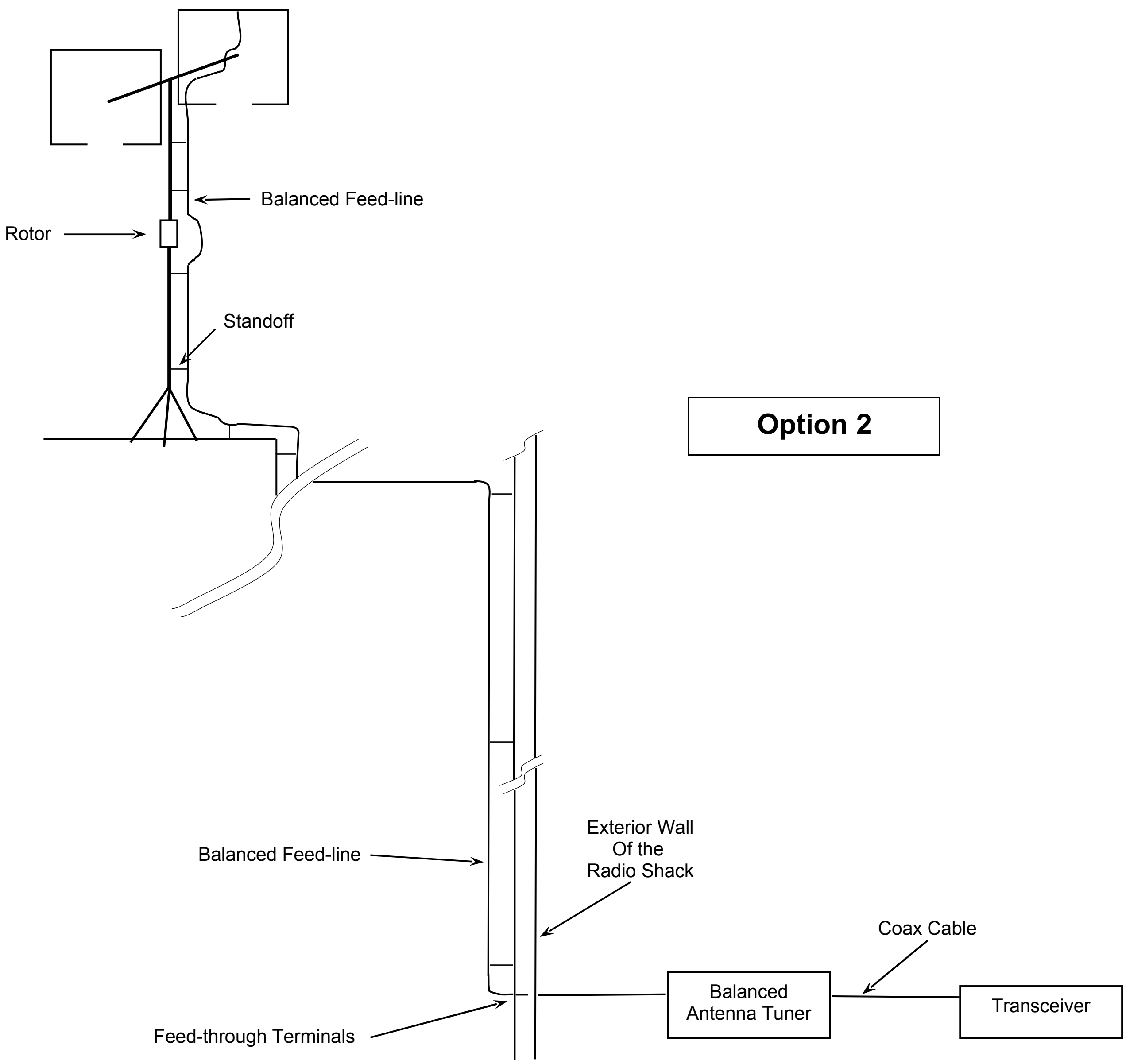
1. Ensure you follow the instructions provided by the tripod and rotor manufacturers and more importantly follow appropriate safety procedures.
2. Attach an end of the balanced feed-line to the antenna terminals using the ring terminals provided with your antenna.
3. Using non-conductive standoffs, which are at least 6 inches long, route the balance feed-line down the mast, past the rotor and by the tripod. Ensure a sufficient length of feed-line to accommodate full rotation of the rotor.
4. Standoff the balanced feed-line and twist the balanced feed-line to minimize common mode coupling with nearby objects. Follow the best practices outlined in the ARRL Amateur Radio Handbook.
5. Ensure that the balanced feed-line and the rotor control cable are kept separate. Do not bundle the two cables together.
6. Route the balanced feed-line to your operating position. Ensure you use appropriate feed-though terminals when passing the balanced feed-line through a structure wall.
7. Inside your radio shack, attach the balanced feed-line to the balanced antenna terminals of the Balanced Antenna Tuner.
8. Using a short coaxial cable, connect the UHF connector of your Balanced Antenna Tuner to your transceiver.
9. Follow the Balanced Antenna Tuner manufacturer’s instructions for tuning the antenna to a 1:1 SWR.

Benefits of this approach:

- Only balanced feed-line is used for the majority of the distance. A short coaxial jumper is only needed between the balanced tuner and the transceiver.
- Due to the low loss of the balanced feed-line, the overall efficiency is very high for the entire antenna system. Particularly with long feed-line lengths.
- Minimum power loss is achieved in the balanced feed-line and coaxial cable.
- Optimization of the antenna system is easily achieved to accommodate conditions unique to your QTH. Put the antenna up only once with no need to adjust the antenna element length for minimum SWR.
- The balanced antenna tuner enables you to maintain a 1:1 SWR anywhere on the band.

Negatives of this approach:

- A balanced antenna tuner is required. Only a limited choice of balanced tuners is commercially available.



Option 3: Coaxial Cable Home-run

This method is the easiest option when routing the coaxial feed-line from the antenna to the radio shack and operating position. Common mode coupling will be minimal. Unfortunately, power loss will be greatest with this option, particularly with long feed-line runs from a distant antenna to the transceiver.

EXAMPLE:

Using the same example as Option 2, You purchased a Light Beam LBP-20M antenna and want to mount the antenna on your garage roof using a tripod mount, rotor and a mast 8 feet long. The garage is separate from your home and is located on the side of the house that is a considerable distance from the operating position in your radio shack. The final height of the antenna will be 30 feet above the ground. The antenna is also 150 feet from your transceiver.

Do the following:

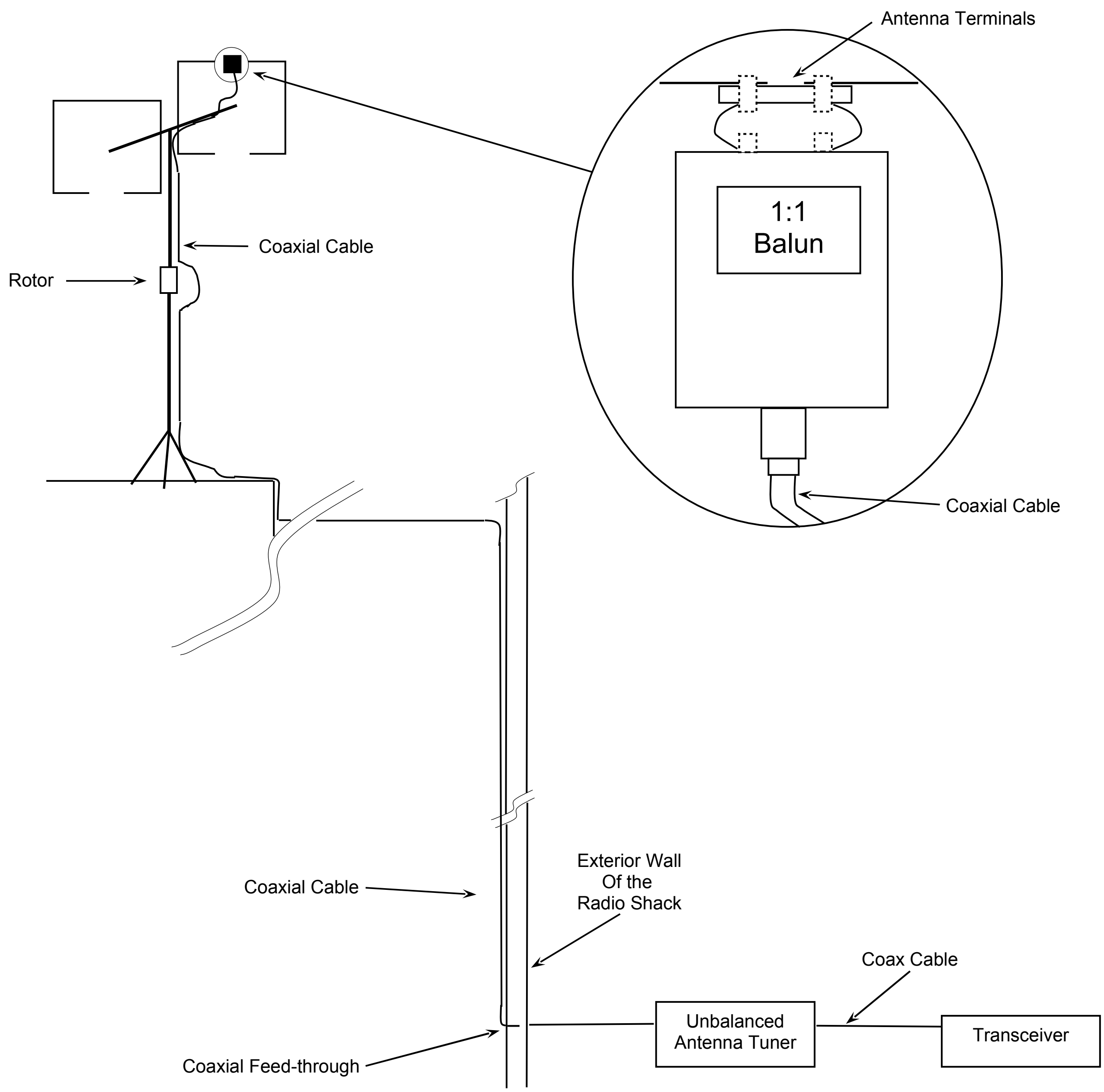
1. Ensure you follow the instructions provided by the tripod and rotor manufacturers and more importantly follow appropriate safety procedures.
2. Using a 1:1 Balun, connect the antenna feed-point terminals to the balanced terminals of the Balun. Then attach your coaxial cable to the UHF connector of the Balun.
3. Support the weight of the balun or if you use a coaxial choke, support the choke to eliminate the weight from the antenna terminals.
4. Route the coaxial cable to your radio shack. Follow the best practices outlined in the ARRL Amateur Radio Handbook.
5. Route the coaxial cable to your operating position. Ensure you use an appropriate coaxial feed-though when passing the coaxial cable through a structure wall.
6. Inside your radio shack, attach the coaxial cable to the antenna connector of the Unbalanced Antenna Tuner.
7. Using a short coaxial cable, connect the UHF input connector of your Unbalanced Antenna Tuner to your transceiver.
8. Follow the Unbalanced Antenna Tuner manufacturer's instructions for tuning the antenna to a 1:1 SWR.

Benefits of this approach:

- Only coaxial cable is used for the total distance between your antenna and transceiver.
- Cable routing is simplified with little concern about common mode coupling.
- Optimization of the antenna system is easily achieved to accommodate conditions unique to your QTH. Put the antenna up only once with no need to adjust the antenna element length for minimum SWR.
- The unbalanced antenna tuner enables you to maintain a 1:1 SWR anywhere on the band.
- There are many unbalanced antenna tuner choices available on in the commercial market.

Negatives of this approach:

- A good, low-loss coaxial cable is needed to minimize power loss.
- Low-loss coaxial cable is more expensive than balanced feed-line
- The best coaxial cables have a greater power loss per foot than balanced feed-line. This becomes important for long cable lengths.
- Due to the high loss of the coaxial cable, the overall efficiency of the antenna system is reduced by the cable loss. Particularly with long coaxial cable lengths.
- An unbalanced antenna tuner is required.



Option 3