RippleTech Electronics
www.rippletech.com.au
Sales@rippletech.com.au

TZ-SL-16 160m ¼ Sloper Installation Manual

The TZ-SL16 is a high performance antenna for both DXing and local rag-chewing in the 160m band. The antenna can be user tuned to for optimum VSWR in the 160m CW section, phone band or the DX phone window. With prudent tuning the antenna can be tuned to operate from 1800 kHz to 1875 kHz with a VSWR less than 2.0:1 an extremely useful feature which other antennas are not able to achieve. The antenna requires a minimum tower height of 14m, with the design being optimised about a 15m or 45 ft tower. Taller towers may be used by reducing the size of the base capacity hat and lengthening the radiating element length. A taller tower will have a slightly better radiation efficiency. The radiation pattern of the antenna includes both horizontal and vertical components as well as low and high angle radiation. The TZ-SL16-1 is designed to be used with an existing tower, nominally 13.7m (45 feet) tall and the ground space required is only 15-20m from the base of the tower, small enough to fit in an average suburban block.

Supplied Equipment

The following equipment and/or facilities are supplied with the TZ-SL-16 antenna:

Radiating element:	(1) One 21m (70 ft) grey PVC coated 2.5m^2 electrical wire complete with eyelet and Triple heatshrink mechanical strengthening.
Capacity Hat element:	(2) two 4m lengths of grey PVC coated 2.5m^2 electrical wire complete with eyelet and Triple heatshrink mechanical strengthening.
Balun:	1:1 linear ferrite core balun designed for operation 1.8 – 22 MHz
Mounting bracket:	Aluminium mounting bracket attached to balun
Mounting hardware:	(1) One 30mm stainless steel U bolt.
Thimble:	(2) Two nylon thimble to be used as an end termination
Cable Ties:	(4) Four 100mm cable ties, (wire termination).
Heat Shrink:	(2) Heat shrink sections for thimble termination.
Instruction Manual:	This document.

Required but not Supplied

To operate efficiently the TZ-SL-16 must be mounted on a tower or other support structure that is at least 10m tall. The support structure must be metal (conductive) or a separate down conductor must also be run to the ground. Note, as supplied the TZ-SL-16 is designed for tower mounting. The base of the tower must be grounded. For optimum low angle radiation at least 4 ground radials should be attached to the ground point. The longer and greater the number of radials the better will be the low angle performance of the antenna and the greater will be the radiating efficiency.

The following equipment and/or facilities are not supplied with the TZ-SL-16 antenna but must be provided by the operator for the antenna to operate correctly:

Ground Space	When mounted on a 14m tower the bottom mounting point for the radiating element is required to be approximately 14m away from the base of the tower, an additional 4m may be required for the capacity hat section depending on the configuration selected.
Ground Rod	2m or greater length copper clad steel earthing rod (available from electrical distributors)
Ground Radials	up to 64 insulated or bare copper conductors, preferably 20m long or greater.

Guidance for all installation types

To assist with corrosion protection for the RF connectors and radiating element connection, a layer of plastic insulation tape followed by a layer of self-amalgamating tape (bhutal rubber) tape may be used. The electrical tape assists in making removal of the self-amalgamating tape easier when maintenance is required. Use drip loops to form a single coil of cable that assists with corrosion protection and provides stress relief for the RF coaxial feeder. Do not over tighten the radiating element connection terminal nut. Use only enough torque to "flatten" the spring washer. Further torque may crack the internal lock tight adhesive making later removal of the balun difficult. Simply "nip up' the nuts just past finger tight.

Using the TZ-SL-16 on a 14m or greater height tower.

The TZ-SL-16 may be mounted on a 14m or taller tower. Installation on an Australian "nally" tower or American Rohn 50 is perfect. For other taller towers the feed point should be mounted as high as possible up to a maximum height of 28m or 100 ft. At this height the radiating element can be a full ¼ wavelength long (approx 40m) and no capacity hat section will be required. The longer the radiating element the smaller or higher the capacity hat section can be made/mounted.

As supplied, the radiating element has been trimmed to be slightly longer than that which would normally be required for resonance in the CW portion of the 80m band. The length of the element is 21m (69 ft). Thus, if required for operation on the 80 or 75m bands the capacity hat section may be removed from the antenna. When cut for operation at approximately 3.650 MHz the sloper will also perform well on 17m and on 30m when an ATU is employed

Determine the required frequency of operation of the antenna. For CW and rag-chewing select a resonance frequency of 1820 kHz. For SSB rag-chewing with the occasional foray into the DX window choose a resonance point of 1850 kHz.

Install the radiating element so that the angle of the wire from the balun is approximately 45º. That is, the base point should be the same distance from the base of the tower as the balun is from the ground. For guidance on mounting the balun on your tower refer to Figure 4 – Tower Mounting Details.

As a start point the radiating element should terminate approximately 1m (3ft) above the ground. At the eyelet, use the supplied M6 stainless steel bolt, flat and spring washer to connect the two 4m capacity hat sections and the bottom end of the radiating element. Use the chart below to determine the appropriate length of the radiating element if you wish to be able to operate on 80m by disconnecting the capacity hat section. DO NOT CUT the element to the exact length shown in Table 1 – Typical Radiating Element Lengths. The table is a guide only and each installation will be slightly different due to the various tower types, height and antennas in use. Once the resonant point for 80m has been established with a VSWR meter or antenna analyser, the radiating element may be cut and re-terminated with an automotive type eyelet for connection to the capacity hat section.

For the capacity hat ends use the thimble to form an end point, folding the wire back and twisting it back along the radiating element wire. Refer to Figure 1 – Capacity Hat Section Excess Cable Wrap Method, for guidance to the appropriate technique. You may trim the wire so that there is approximately 0.5m folded back without the need to cut the wire. This is preferred since a change to the tower mounted antennas may effect the resonant frequency of the sloper and it may need to be lengthened at a later date.

If the radiating element is cut too short, the wire may be stripped back, spliced, soldered and covered with heat shrink to extend the element length. Alternatively the wire ends may be soldered or crimped with an eyelet and a stainless steel or brass bolt used to join the wire together.

The end of the radiating element should terminate above the ground. This may be close to the ground, say 0.5 – 1.0m (1.5 – 3 ft) or alternatively the element may be terminated at the top of the property boundary fence, or suitable wooden pole 1.75 – 2.0m (5 – 6 ft) tall. Note the lower end of the radiating element is left unterminated, do not connect it to ground or any metallic object.

Typical Activity	Resonant Frequency (MHz)	Typical Upper Frequency (MHz)	Typical lower Frequency (MHz)	Length
CW Dxing & Rag-chewing	3.550 MHz	3.650 MHz	3.500 MHz	20.25 m, (66' 6" ft/in)
Phone Ragchewing	3.600 MHz	3.700 MHz	3.500 MHz	20.0 m, (65' 7" ft/in)
Phone DX/Chat Compromise	3.700 MHz	3.800 MHz	3.600 MHz	19.4 m, (64' 4" ft/in)
Phone DXing	3.800 MHz	3.650 MHz	3.850 MHz	19.1 m, (62' 6" ft/in)

Table 1 – Typical Radiating Element Lengths (80m – no capacity hat used)

Note for good performance, the VSWR of the 160m sloper does not need to be better than 3.0:1. A suitable ATU can be used to provide an acceptable match for your transceiver or amplifier and the radiation pattern and efficiency of the antenna will not be noticeably degraded. However, with time and persistence a good wide-band VSWR, less than 1.5:1 can be achieved.

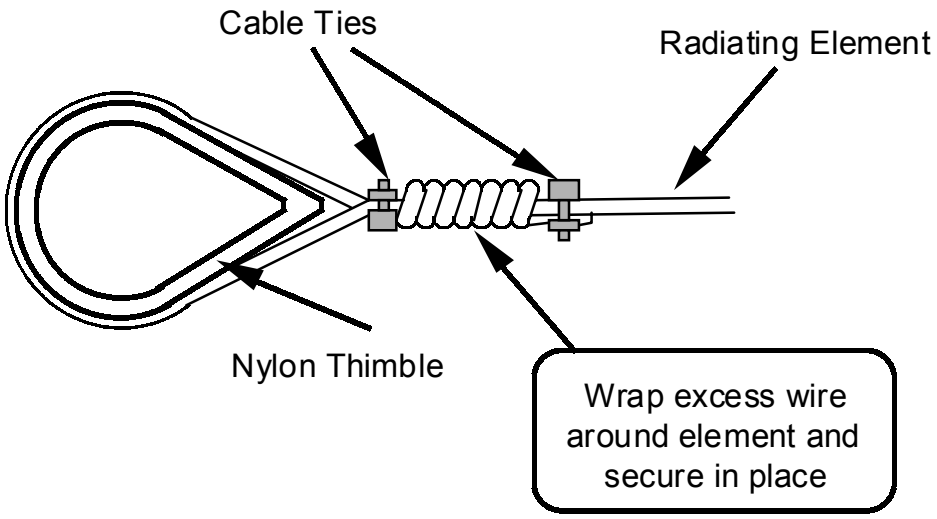

Figure 1 – Capacity Hat Section Excess Cable Wrap Method

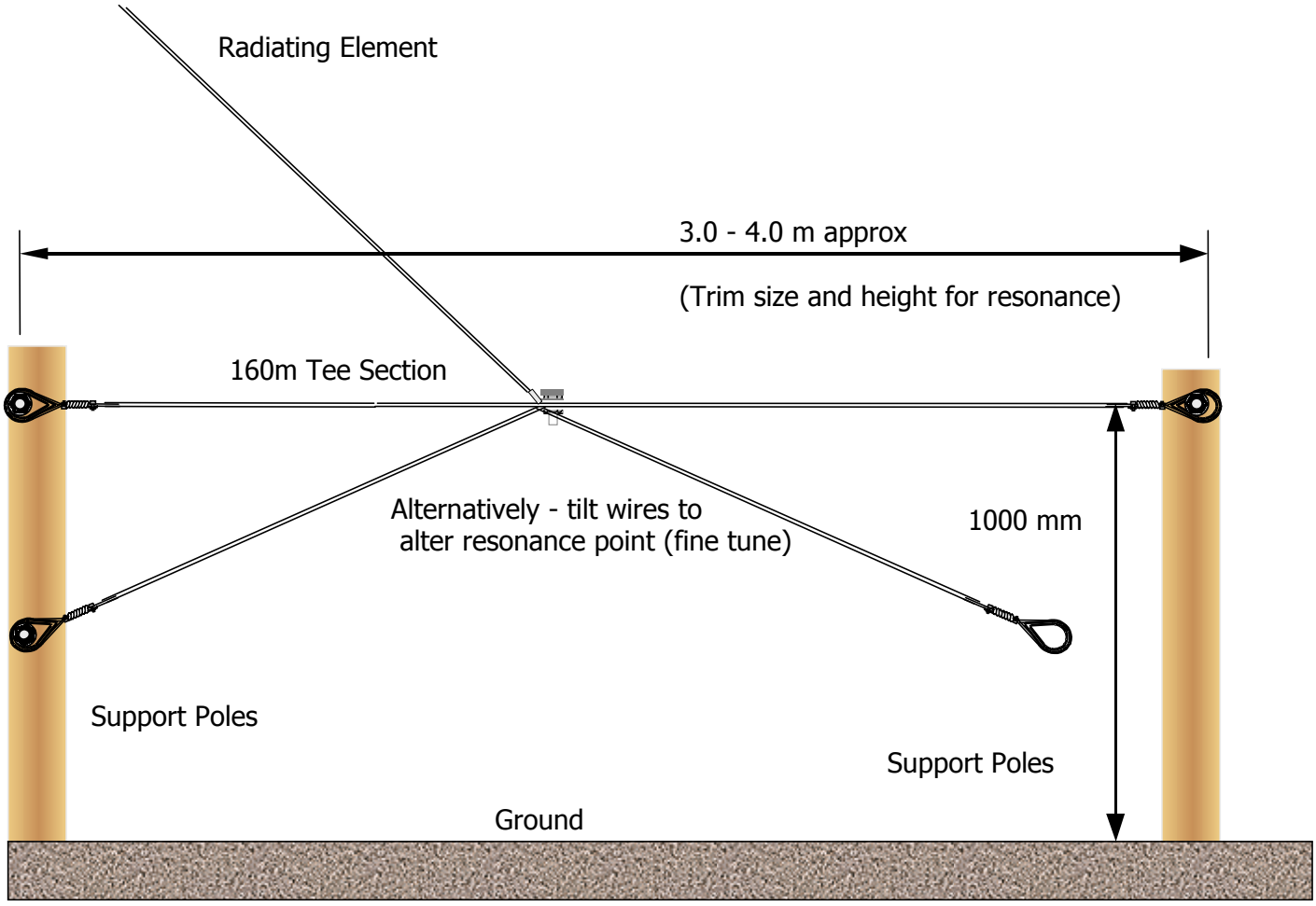

Figure 2 – Capacity Hat Section Installation

The base point for the radiating element should be approximately the same distance from the base of the tower as the height at the mounting point. Thus, the radiating element is mounted at 45° to the tower.

Alter the configuration of the radiating element to achieve the best VSWR. This may involve raising or lowering the feed point, the terminating height of the radiating element, the length of the radiating element or a combination of all three.

Normally, a good match can be achieved by altering the height or length of the capacity hat section. Since this can be achieved at ground level this task is relatively simple. Another alternative is to keep the junction of the wires at a constant height and move the ends of the capacity section up or down. Raising the ends, tends to lower the capacitance to ground and therefore raise the resonant frequency and vice versa. Simply put, raise the capacity section to raise the resonant frequency or lower the capacity section to lower the resonant frequency.

If difficulties are encountered use an antenna analyser to measure the input impedance of the antenna. This is best achieved using a ½ wavelength feeder cable or RG-58 or RG-8 (RG213). Refer to Table 3 - VSWR adjustment Options, which details the length of cable required for the intended use of your sloper. Using a ½ wavelength of cable ensures that the antenna analyser readout is correct for both magnitude and phase of the input impedance, i.e. the real and imaginary components are correct.

Frequency (kHz)	Cable Length (m)	Cable Length (ft & inches)	
1800	54.63	179	3
1820	54.03	177	3
1840	53.45	175	4
1860	52.87	173	5
1880	52.31	171	7
1900	51.76	169	10

Table 2 - 1/2 Wavelength Feeder Cable Lengths (Velocity Factor 0.66)

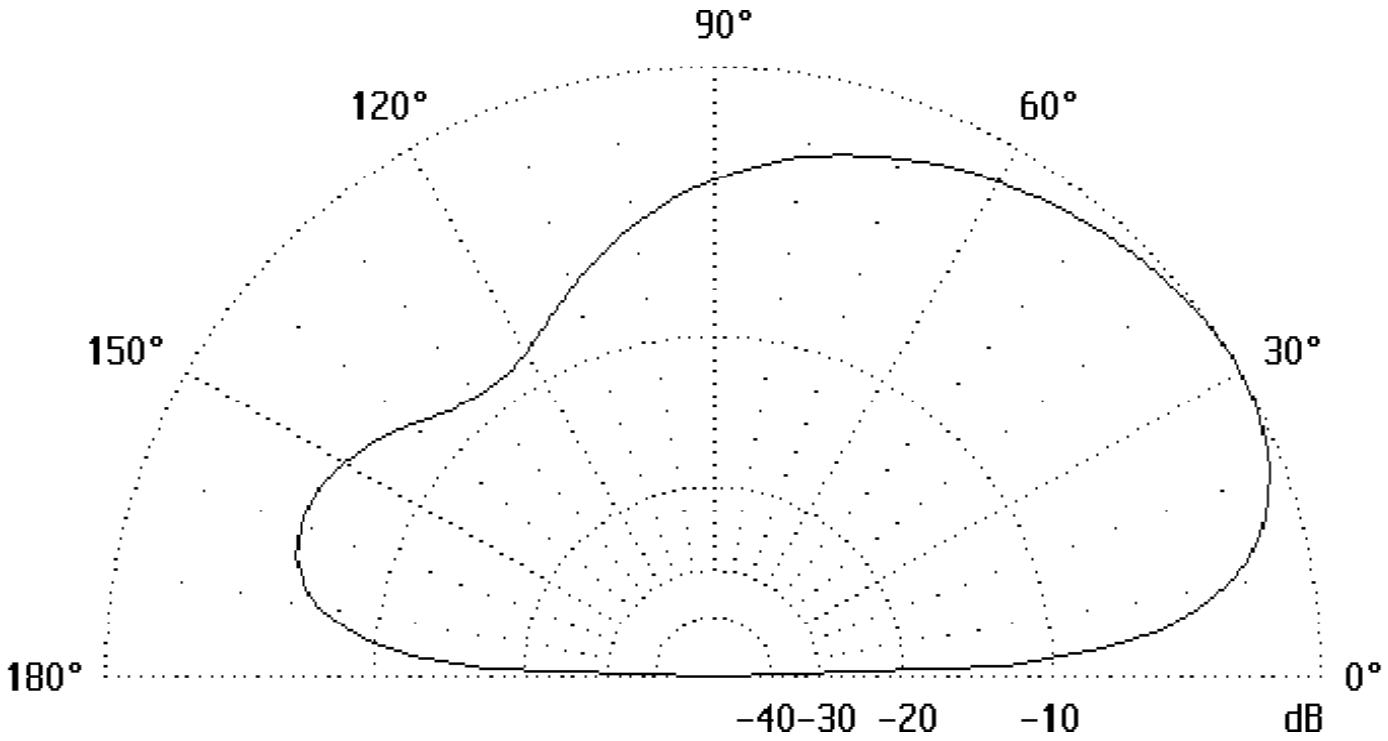

Figure 3 – Typical TZ-SL-16 SLOPER Radiation Pattern

By adding 32 1/4 wavelength radials to the base of the tower the low angle radiation performance of the antenna can be improved by about 1.0 dB. The front to back ratio of the antenna will also diminish. For DX contacts, it is still advisable to locate the radiating element towards the desired DX.

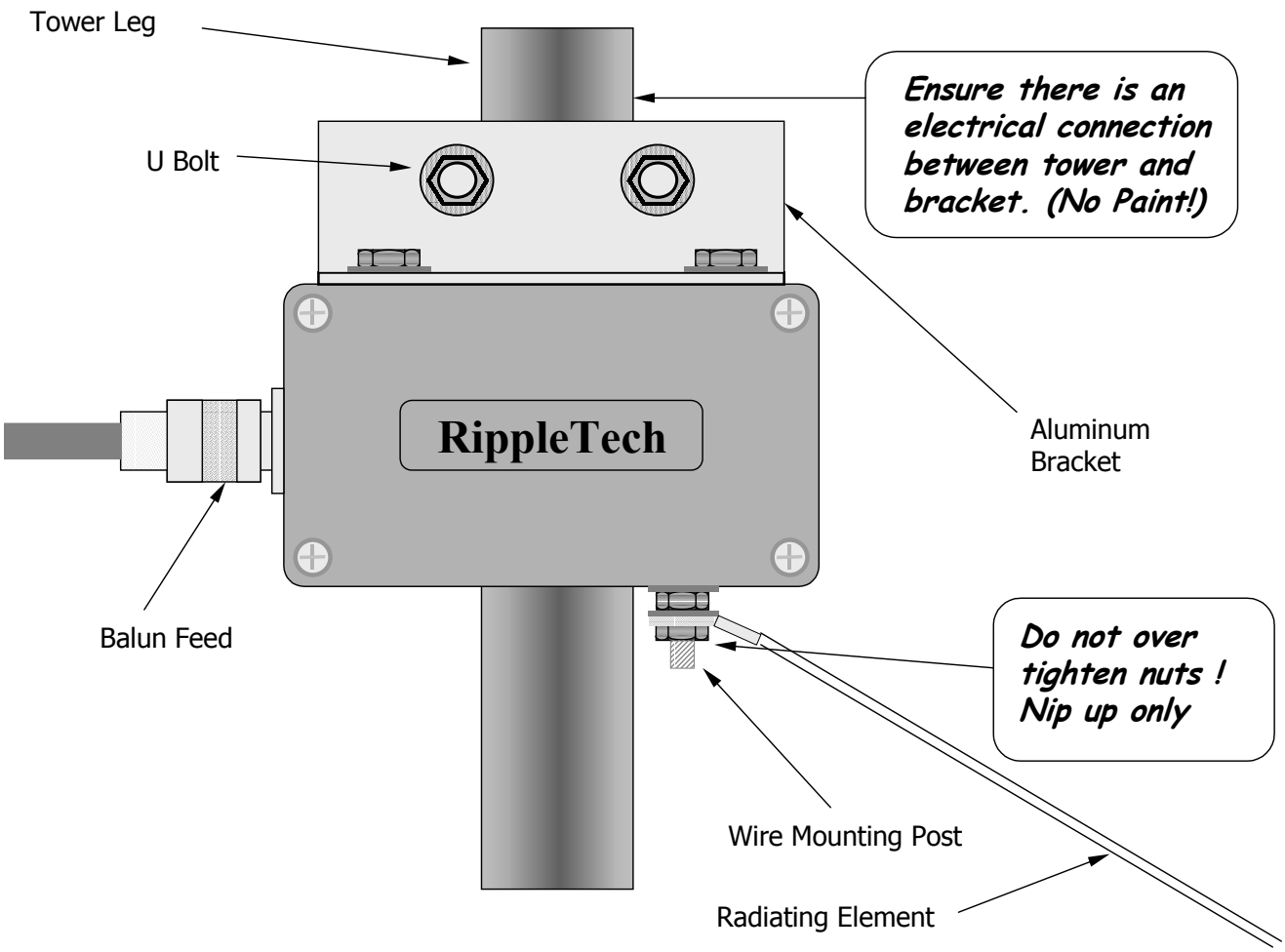

Figure 4 – Tower Mounting Details

Installation on a Short Tower

The TZ-SL-16 may be mounted on a shorter tower or support structure, however the performance of the antenna will be reduced with respect to acceptable VSWR, bandwidth and gain. The configuration of the antenna will need to be altered, refer to Figure 5 - Short Tower Installation Configurationfor details. To achieve resonance and an acceptable VSWR for this configuration, it is highly desirable to use an antenna analyser or other measurement equipment (such as a noise bridge) that can determine both the input reactance and resistance at the feed point. Adjustment can be made using a simple VSWR meter, however due to the variance of installation configurations & types this method may be extremely time consuming.

The base point for the radiating element should be approximately the same distance from the base of the tower as the height of the tower. Thus, the radiating element is mounted at 45º to the tower.

Raise or lower the loop or tee to achieve resonance at the desired frequency. Raising the loop decreases capacitance (raises the resonant frequency) whilst lowering the loop increases capacitance (lowers the resonant frequency). Alternatively, the size of the loop or length of the "tee" can be adjusted. Increasing the size of the loop or the length of the "Tee" will increase capacitance to ground and lower the resonant frequency of the antenna.

The shape of the wire loop is irrelevant. Any shape including, circular, square, triangular, diamond, etc will suffice. For a tower height of 9-10m a loop area of about $1m^2$ is the preferred starting point. Adjustment of the feed angle may be required to achieve a good VSWR, an antenna analyser will be most efficient to achieving a satisfactory match quickly. To assist with antenna analyser measurements a feed line length of exactly ½

wavelength will provide an accurate value of the impedance of the antenna, both reactive and resistive, at the feed point. For 80m operation using RG-58 or RG8, with a velocity factor of 0.66, the relevant feeder lengths are given in Table 3 - VSWR adjustment Options.

Change Required	Option One	Option Two
To increase impedance	Mount feed point higher on tower	Lower beam antenna mounting point
To decrease Real (R) component	Mount feed point higher on tower	Raise beam antenna mounting point
To Lower Resonance point	Lengthen radiating element.	Increase Loop size or lower loop
To Raise Resonance Part	Lengthen radiating element.	Decrease Loop size or raise loop.

Table 3 - VSWR adjustment Options

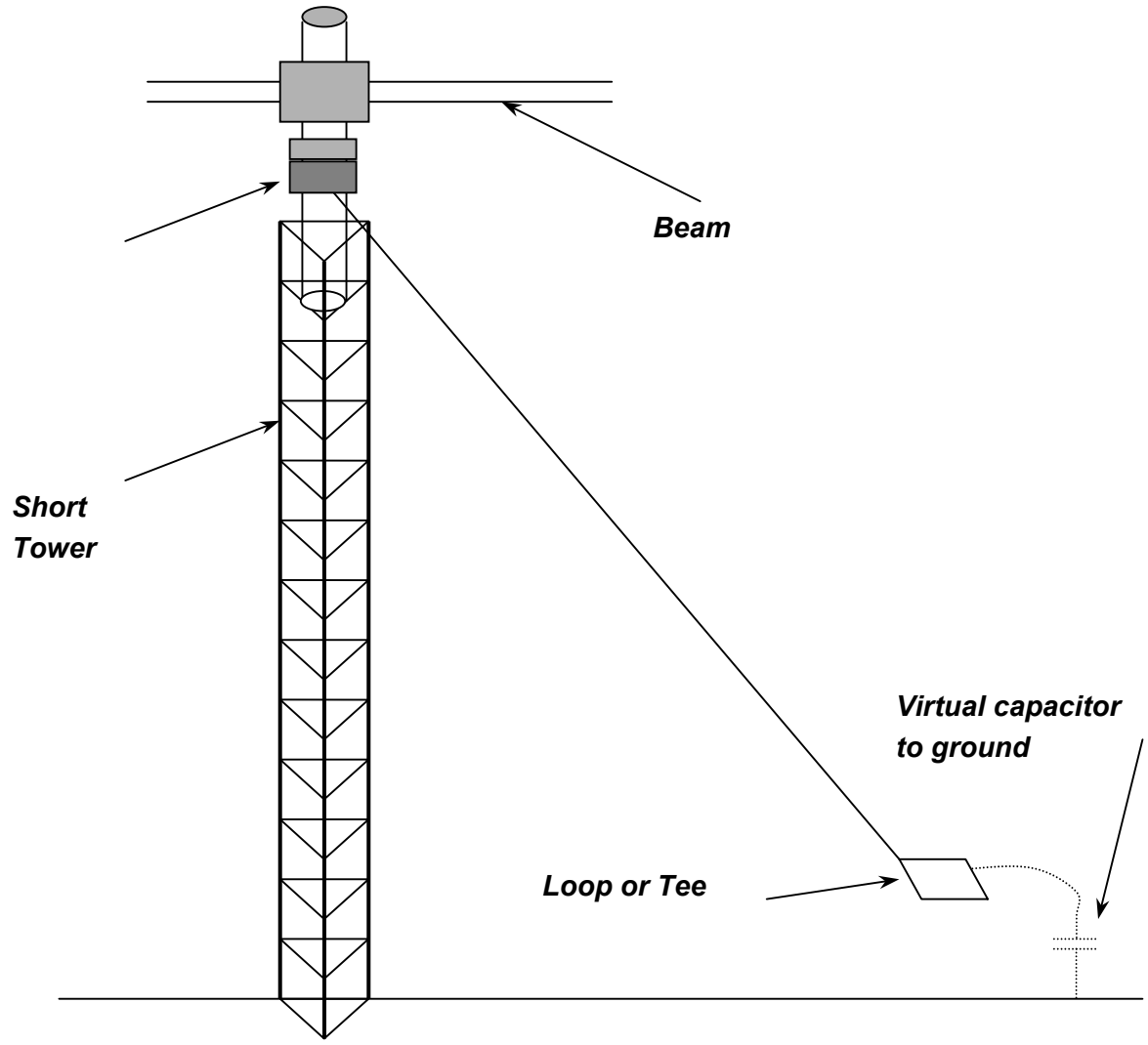

Figure 5 - Short Tower Installation Configuration

Shape of base Capacity Section

To operate correctly the 160m sloper must be "drawn" down to resonate at a frequency much lower than the actual resonant frequency of the radiating section. The capacity section performs this task, much in the same way that a capacity hat does with a shortened vertical antenna. The shape of the capacity hat is not critical. The critical factor is to achieve the required capacitance. Thus, if an inverted "tee" configuration is not suitable at your location other configurations may be used, such as a cross, square, triangle, diamond etc. The element may even be extended in a single direction as one long straight wire section 1 or 2 ft above the ground.

Using the Antenna on Other Bands

The antenna may be used on other bands, however the feed impedance is may not be ideal and high losses may be encountered in the feed line due to the high VSWR. The antenna may be used with an antenna tuner to provide a reasonable signal on most amateur bands.

By removing the capacity hat section the antenna will perform very well on 80m, with good performance on 17m. When used with an ATU the "no capacity hat" version will also perform well on the 30m band.

A trapped sloper for 40m, 80m and 160m is available from RippleTech Electronics for use on a 14m (45 ft) or greater tower. A mod kit to convert your 160m sloper to a dual band 160m/80m or tri-band 160m/80m/40m sloper will be available from RippleTech in the near future. Please contact your dealer or RippleTech Electronics directly for further information.

Specifications

Type	¼ wave half sloper antenna.
Frequency Range	Adjustable 1800 to 1900 kHz .
Bandwidth	100 kHz (2.0 : 1 VSWR limit).
Input Impedance	Nominally 50 ohm.
Radiation polarisation	Both Horizontal and Vertical components
Gain	2.0 dBi at 1845 kHz
Directivity	Up to 3 dB at low radiation angles omni-directional at high angles.
Front to Back	Up to 6 dB at low radiation angles.
Power Handling	1000 Watts PEP
Radiation Pattern	Near Omni-directional, See Figure 3.
Antenna Colour	Light Grey