Antenna Matrix

Purpose

The purpose of this Antenna Matrix is to assist you in deciding which antenna from Codan's range best suits your requirements for high frequency (HF) communication over the 2–30 MHz range.

The document is divided into four sections:

- Antenna Selection Proforma
- Fundamental Antenna Selection Criteria
- Practical Antenna Selection Criteria
- general information section outlining the aspects of each antenna

For higher power applications (>125 W PEP) please contact your Codan representative for specific antenna models and suitability.

Using the Antenna Selection Proforma

In order to determine which antenna best suits your needs, it is important that you consider a series of criteria. We have included an Antenna Selection Proforma in this document so you can record your considerations, and therefore reach an informed decision about which antenna best suits your particular requirements. We have divided these criteria into two categories:

- Fundamental Criteria (see page 3)
- Practical Criteria (see page 5)

Some additional information is given at the beginning of each of the Fundamental and Practical Criteria sections. This information explains how to use the Antenna Selection Proforma effectively.

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ANTENNA MATRIX

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Antenna Selection Proforma

Fundamental criteria

Maximum communication distance _____ km

Minimum communication distance _____ km

Maximum frequency _____ MHz

Minimum frequency _____ MHz

Distance from transceiver to antenna _____ metres

Antenna position: rooftop ☐ ground ☐ mobile ☐

Possible antenna choices

Practical criteria

Space requirements noted ☐

Grounding requirements noted ☐

Civil works requirements noted ☐

Budget constraints noted ☐

Benefits and limitations noted ☐

Final antenna choice _____

Notes: _____

_____

_____

Fundamental Criteria

The fundamental criteria for selecting an antenna cover the basic requirements of your system, e.g. communication distance, frequency range, etc.

Communication distance

Fill out the Antenna Selection Proforma with your expected maximum and minimum communication distances. This information is important as antennas have different capabilities over distance.

Frequency range

Fill out the Antenna Selection Proforma with your expected maximum and minimum frequencies. This information is important as antenna models have different capabilities over the range of HF.

Distance between transceiver and antenna

Fill out the Antenna Selection Proforma with the expected distance between the transceiver and the antenna. This distance will dictate the type of coaxial cable to be used in the installation, and may even eliminate some antennas from the selection process.

Type of installation

Fill out the Antenna Selection Proforma with the expected type of installation, i.e. rooftop, ground or mobile. Some antennas are very specific to the installation, e.g. a C411 antenna cannot be used in a mobile installation.

Antenna choices based on the fundamental criteria

Use the information provided in Table 1 to select those antennas that are most suitable for your requirements. Write your choices in the spaces provided on the Antenna Selection Proforma.

Table 1: Fundamental antenna selection criteria

Antenna Type	Product Code	Typical operating distance (km)	Frequency range (MHz)	Allowable distance between antenna and transceiver	Tuner required?	Antenna Location		
						Rooftop	Ground	Mobile
Horizontal								
Wire Dipole	400	0–1500	single frequency	≤30 m[a]	no	✓	✓	✗
Broadband	411B	0–1000	2.0–7.5	≤100 m[b]	no	✓	✓	✗
	411C	0–1500	2.5–9.0	as above	no	✓	✓	✗
	411D	0–1500	3.0–12.0	as above	no	✓	✓	✗
	411E	0–1500	4.0–15.0	as above	no	✓	✓	✗
	411F	0–1500	5.0–18.0	as above	no	✓	✓	✗
Broadband Dipole[c]	408	250–1500	2.0–15.0	as above	no	✓	✓	✗
	408L	250–1500	3.0–25.0	as above	no	✓	✓	✗
Inverted V								
Active Tuned Dipole	451	250–1500	2.0–30.0	≤30 m	yes[d]	✓	✓	✗
Broadband	411B	250–1500	2.0–7.5	≤30 m[a] ≤100 m[b]	no	✓	✓	✗
	411C	250–1500	2.5–9.0	as above	no	✓	✓	✗
	411D	250–1500	3.0–12.0	as above	no	✓	✓	✗
	411E	250–1500	4.0–15.0	as above	no	✓	✓	✗
	411F	250–1500	5.0–18.0	as above	no	✓	✓	✗
Delta[4]	D230	0–1000	2.0–30.0	as above	no	✗	✓	✗
	D330	0–1000	3.0–30.0	as above	no	✗	✓	✗
Vertical								
Tuned Whip	406	500–200	2.0–30.0	≤30 m	yes[c]	✓	✓	✗
Auto Tuning Whip	9350	200–1500	2.0–30.0	≤6 m	included	✗	✗	✓
Tapped Whip	300	200–1500	2.0–30.0	≤6 m	no	✗	✗	✓
Sloping								
Semi Delta[d]	SD214	0–1500	2.0–14.0	≤30 m[a] ≤100 m[b]	no	✓	✓	✗
Long Wire	403	250–1500	2.0–30.0	≤30 m	yes[c]	✓	✓	✗

a. Use RG58 coaxial cable
b. Use RG8 coaxial cable
c. Use 9103 Automatic Antenna Tuner
d. High power models available

Practical Criteria

The practical criteria for selecting an antenna covers the broader constraints that your particular circumstances may place on your choice of antenna. Refer to the information provided in Table 2 to consider your answers to the following questions:

- Do you have enough physical space at the intended antenna site?
- Does the antenna require grounding?
- Are there any civil works required?
- Have you considered how much can be spent on the antenna?
- Have the benefits and limitations of the antenna been carefully considered?

Please check the boxes provided on the Antenna Selection Proforma to indicate that you have considered the questions above.

Table 2: Practical antenna selection criteria

Antenna Type	Product code	Installation site requirements			Grounding requirements	Benefits	Limitations	Typical Applications
		No. of masts	Distance between masts (m)	Height (m)				
Horizontal								
Wire Dipole	400	2	142/f (MHz)	71.0/f (MHz)	None required	Highly efficient, requires no earth system, cost effective	Single frequency, not suitable for scanning networks	Base to base fixed frequency
Broadband	411B	2	58	13	None required	Good performance, lightweight, easy to install, cost effective	Narrow frequency range, requires large installation site	Base to base/mobile communications, suitable for data/voice/ scanning networks
	411C	2	47	10	None required	As above	As above	As above
	411D	2	38	8	None required	As above	As above	As above
	411E	2	31	6.5	None required	As above	As above	As above
	411F	2	26	5.5	None required	As above	As above	As above
Broadband Dipole	408	2	64	15	None required	Excellent performance, high quality components	Expensive, requires substantial support structures and large installation site	As above
	408L	2	46	15	None required	As above	As above	As above
Inverted V								
Active Tuned Dipole	451	1 centre mast 2 stub masts/anchor points	Centre to stub mast: 9	Centre: 6 Stub: 1	None required	Easy to install, requires no earth system, requires one main mast	Added cost of antenna tuner, inferior performance compared to full size broadband antennas	Rooftop installations for multifrequency data/ voice/scanning networks
Broadband	411B	1 centre mast 2 stub masts	Centre to stub mast: 27	Centre: 16 Stub: 6	None required	Good long distance, requires one main mast, smaller installation site than horizontal configuration, cost effective	Narrow frequency range, large installation site, performance may be inferior to 408 type antenna	Base to base/mobile multifrequency communications, suitable for data/voice/ scanning networks
	411C	1 centre mast 2 stub masts	Centre to stub mast: 22	Centre: 13 Stub: 4.2	None required	As above	As above	As above
	411D	1 centre mast 2 stub masts	Centre to stub mast: 18	Centre: 11 Stub: 4.8	None required	As above	As above	As above
	411E	1 centre mast 2 stub masts	Centre to stub mast: 14.5	Centre: 8 Stub: 3	None required	As above	As above	As above
	411F	1 centre mast 2 stub masts	Centre to stub mast: 12	Centre: 6.5 Stub: 2.4	None required	As above	As above	As above
Delta	D230	1 centre mast 2 ground anchor points	Centre to ground point: 29	Centre: 22	None required	High performance, two antennas may be mounted on same mast for transmitting	Expensive, requires large installation site	Communication stations requiring quality voice/ data/scanning network

Table 2: Practical antenna selection criteria (cont.)

Antenna Type	Product code	Installation site requirements			Grounding requirements	Benefits	Limitations	Typical Applications
		No. of masts	Distance between masts (m)	Height (m)				
	D330	1 centre mast 2 ground anchor points	Centre to ground point: 23	Centre: 16.5	None required	As above	As above	As above
Vertical								
Tuned Whip	406	Clear area of at least 8 m diameter			Ground—code 158 earth mat Roof—code 159 ground plane	Suits small sites, easy to install, good long distance performance	Poor short distance performance, requires antenna tuner, susceptible to local electrical noise	Networks requiring long distance multifrequency communications, but have limited antenna installation space
Auto Mobile Whip	9350	Heavy duty mounting bracket on vehicle			Good electrical connection to vehicle chassis and body	No manual changing of settings, durable construction, receiver scanning possible	Expensive, poor short distance performance unless NVIS[a] kit fitted	Mobile vehicles requiring flexible, high performance HF communications
Tapped Mobile Whip	300	Suitable mounting bracket on vehicle			Good electrical connection to vehicle chassis and body	Simple, reliable, cost effective	Average performance, maximum of 10 frequencies, manual retuning, no receiver scanning	Mobile vehicles requiring basic, medium performance HF communications
Sloping								
Semi Delta	SD214	2	20	Centre: 15 Stub: 2	Ground—well grounded stub mast Roof—5 copper radials under antenna	Suits small sites, excellent performance, cost effective	Difficult to install, requires quality earth system, limited frequency range	Base stations requiring quality broadband antenna for short to medium distances
Long Wire	403	High anchor point at least 15 m: low anchor point approximately 2 m and within 2 m of earth system connection			Ground—3 x 3 m copper earth stakes driven into moist soil Roof—5 copper radials under antenna	Adaptable installation configurations, minimal support structures, broadband operation	Inferior performance to full sized broadband antennas, requires earth system	Base stations requiring multifrequency operation, suitable for semi-permanent stations

a. Short vertical whip antennas, like the 9350 Automatic Tuning Whip Antenna provide poor performance over short distances. Performance over 20–500 km range may be improved by the addition of an NVIS (Near Vertical Incidence Skywave) antenna kit. Note: The frequency range of the NVIS kit is 1.6–12 MHz

Antenna data sheets

The application and technical details for each type of Codan antenna are available on specific data sheets. These describe the type of installation required and the characteristics for the antenna, including radiation patterns where applicable. These data sheets are available from your Codan representative.

Naming convention of Codan antennas

For ease of selection, antennas manufactured by Codan can be identified by their product code numbers e.g. Code 401.

Special application and high power antennas are coded differently, e.g. Semi Delta and Delta types SD214 and D230.

Masts and accessories

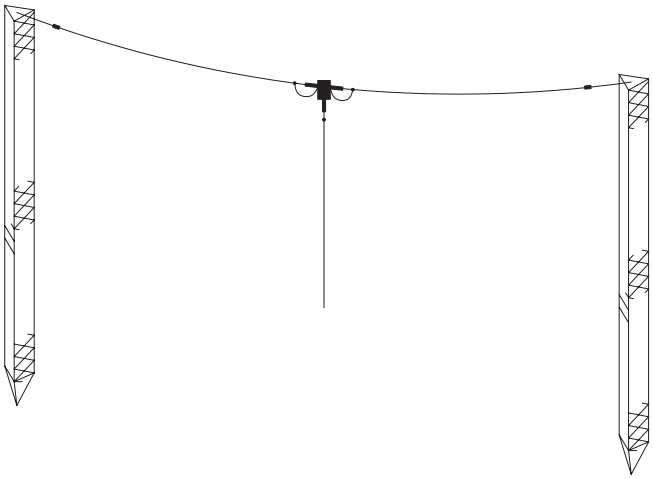
Codan is able to supply a range of installation hardware to suit your requirements. These include metal masts, halyards, low-loss coaxial cables and earthing hardware. For advice on these matters please contact your Codan representative.

Antennas for fixed installations

Wire Dipole Antenna (Code 400-1)

The wire dipole antenna is a highly efficient, half wavelength wire dipole. The dipole antenna is large in size, but easy to install. The antenna is raised horizontally above the ground, normally between two vertical masts or towers. The wire dipole antenna is fed by a direct 50 Ω coaxial cable connection from the transceiver, which must be properly earthed.

Figure 1: Wire dipole antenna



The Code 400-1 has some inherent rejection of broadband noise compared to broadband antenna. At lower operating frequencies where the wavelength is longer, the dipole can require considerable space e.g. at 2 MHz, the physical half wavelength is 75 metres.

The dipole does not require an artificial earth plane to radiate efficiently. For the best results make sure that the antenna is broadside to the destination of the frequency, as poor radiation is emitted off the ends of the antenna.

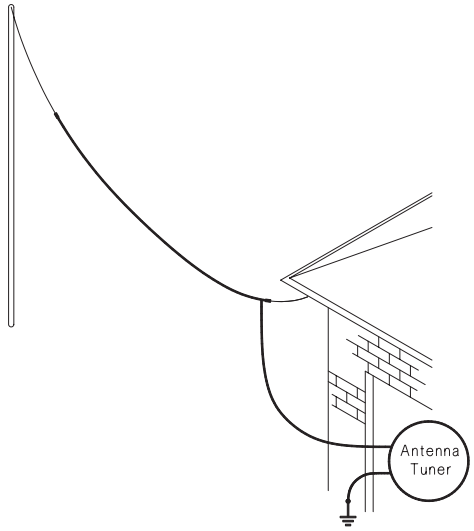
The Code 400-1 is manufactured to the user's specified frequency and is suitable only for single frequency operation.

Long Wire Antenna (Code 403)

The long wire antenna is an untuned length of wire, cut to 23 metres. It is designed to be used with the Codan Automatic Antenna Tuner 9103. It exhibits a good combination of efficiency and broadband capability.

This antenna is useful where space is limited. The tuner enables the wire to be resonated to frequencies within the HF band from 2 to 30 MHz. The long wire antenna is normally erected as shown in Figure 2, where the high end is supported on a suitable mast or tower, and the low end is connected to the insulated RF output of the tuner.

Figure 2: Long wire antenna

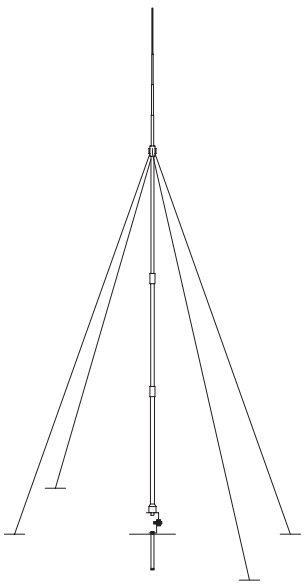


The tuner is fed by a 50 Ω coaxial cable from the transceiver. For reliable operation, the tuner requires a substantial earth system. Codan can supply the necessary earthing components if required.

Base Whip Antenna (Code 406 series)

The base whip antenna is 10 metres overall in height and will require Codan's Automatic Antenna Tuner 9103 to enable resonance within the HF band. The antenna is constructed of lightweight metal tubing (active element) and is mounted vertically on a suitable ground plane or metal roof.

Figure 3: Base whip antenna



The antenna is supplied with four guy wires, which may be anchored to suitable points at ground level to support the antenna in the vertical position. This antenna may be used where space is restricted and omnidirectional coverage is required. Do not choose the antenna on this point alone as it does not perform well for short distance communication. The antenna may be susceptible to local electrical noise due to its vertical orientation.

Broadband Dipole Antenna (Code 407/408)

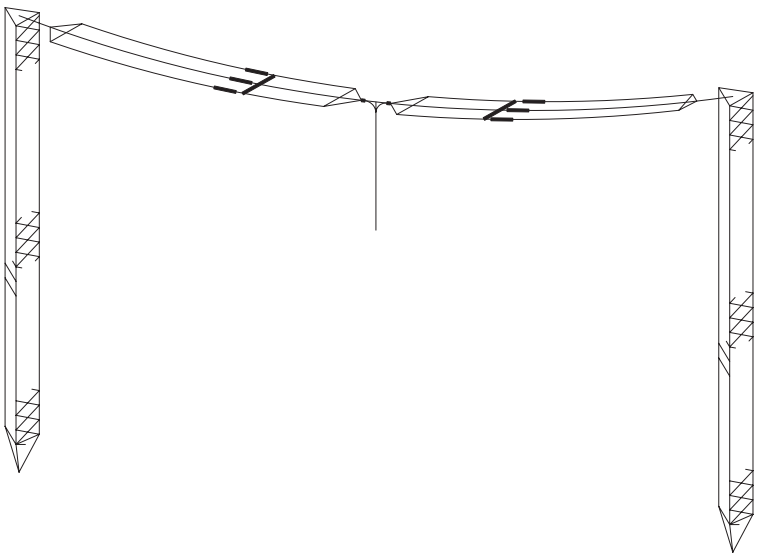
The broadband dipole antenna is a three element, centre-fed antenna. It is one of the original types adopted by Codan to fill the requirement for a wide or broadband antenna. In its original form, it was known as a travelling wave antenna.

The design has some of the advantages of the single frequency dipole, but is able to operate over a wide range of frequencies, therefore eliminating the need for multiple antennas or antenna tuners. The broadband dipole antenna is a durable antenna and while it requires a substantial amount of space for installation, it will offer superior on-air performance. It exhibits omnidirectional radiation capabilities, except for close range communications where the antenna should be orientated broadside to the preferred direction of transmission. As with all broadband, untuned antennas, it will be susceptible to local and atmospheric noise reception.

The current models cover a frequency range of 2.2 to 15 MHz (407, 408) or 3.0 to 20 MHz (407L, 408L). The antenna is mounted horizontally above the ground.

The Code 407 is a high power, 1 kilowatt, version of the Code 408.

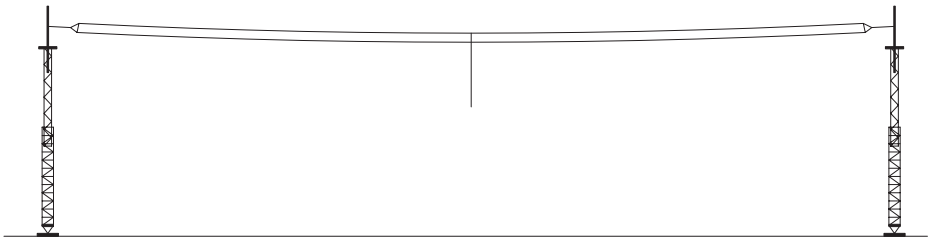
Figure 4: Broadband dipole antenna



Broadband Terminated Folded Dipole Antenna (Code 411)

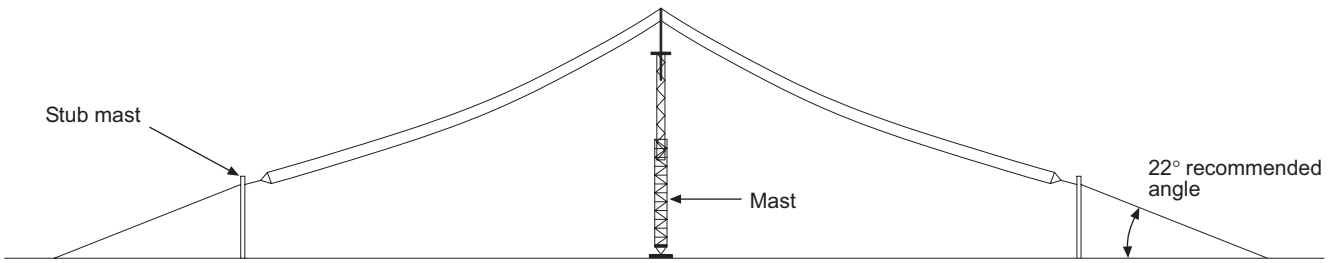
The broadband terminated folded dipole antenna is a two element, centre-fed antenna. The Code 411 provides good performance while being suitable for the budget conscious. It is available in a range of lengths depending on the operating bandwidth that the customer requires. There are 5 models (B, C, D, E, and F), which range in overall length from 27 to 56 metres and have extended frequency coverage between 2 to 30 MHz. As with all broadband, untuned antennas, it is susceptible to local and atmospheric noise reception.

Figure 5: Broadband terminated folded dipole antenna—horizontal configuration



The antennas are easy to install, but do require a substantial amount of space, especially for lower frequencies. The Code 411 antennas are relatively lightweight and can be raised on two masts as shown in Figure 5, or they may be supported at the centre by a single mast in what is known as an ‘inverted V’ configuration (Figure 6).

Figure 6: Broadband terminated folded dipole antenna—inverted V configuration



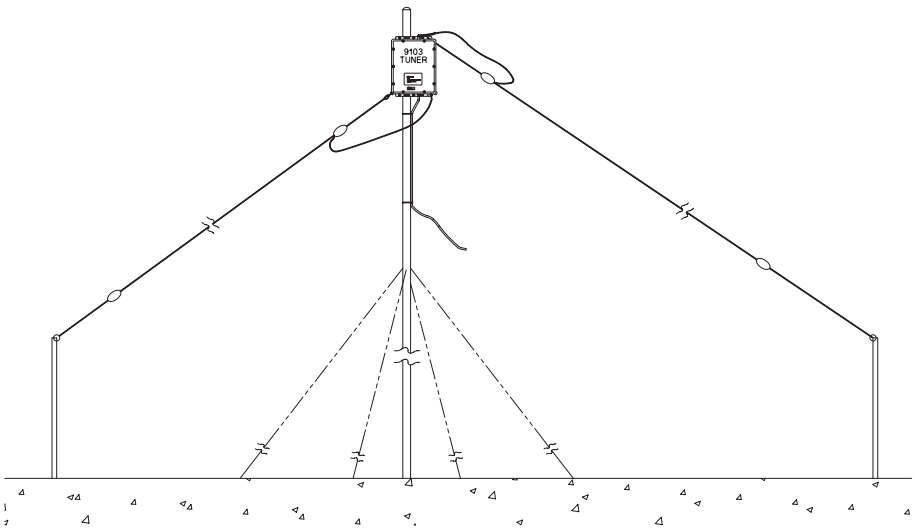
The inverted V type of installation will require two shorter stub masts or suitable tie off points to support the ground end of the antenna.

Active Tuned Dipole Antenna (Code 451)

The active tuned dipole antenna is made up of two radiating elements and a 9103 Automatic Antenna Tuner installed on a 6 m mast. One element is connected to the earth terminal of the tuner and the other to the antenna terminal of the tuner. The antenna configuration is adjustable, but is commonly installed on a single mast in an inverted V configuration. It is a dipole antenna that can be tuned over the full 2–30 MHz HF band.

The antenna is suited to sites where poor ground conditions exist and/or where an earth mat is impractical. The span of the antenna is 20 m, which is useful where space restrictions apply. The Code 451 can be installed in a variety of configurations and provides a suitable alternative for customers who want the convenience of a broadband antenna, but do not have the space or performance requirements for a full-sized antenna.

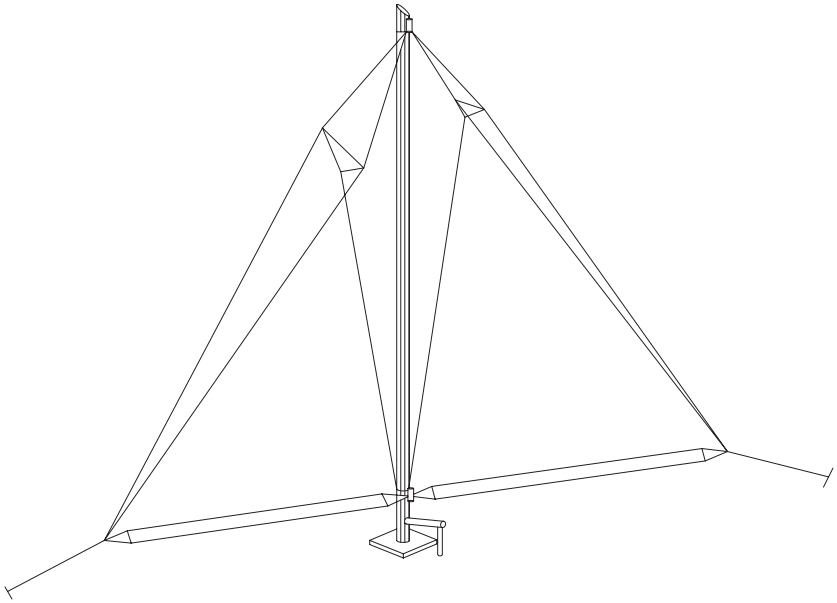
Figure 7: Active tuned dipole antenna



Delta Antenna (Codes D230, D330)

The delta antenna is a professional, high performance broadband antenna. It exhibits omnidirectional characteristics and performs well over very short to medium distances. The delta wire elements are supported by a single guyed metal mast (between 16–22 m in height) and will handle input powers between 200–1000 watt PEP, depending on the model. Two of these antennas may be mounted on the same mast and used for separate transmitter feeds if required. Up to 30 dB of isolation between antennas can be achieved. Generally these antennas require a large cleared area at ground level for installation and are more suitable for permanent higher powered installations.

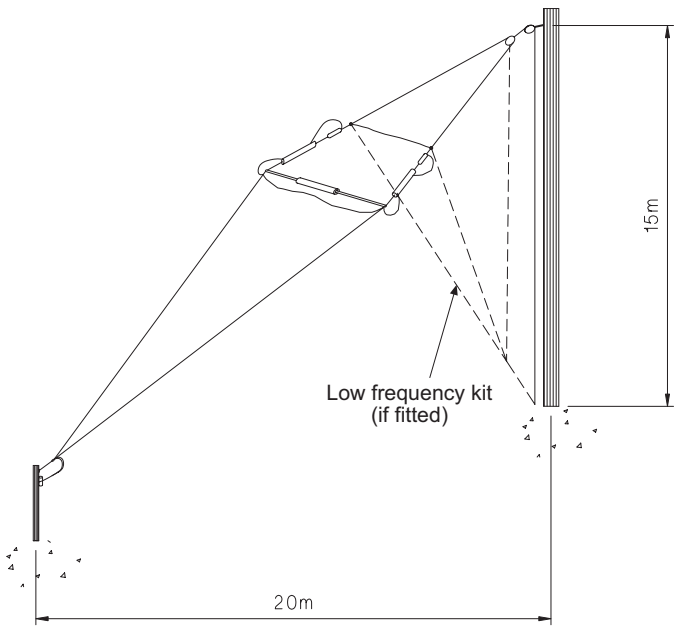
Figure 8: Delta antenna



Semi Delta Antenna (Code SD214)

The semi delta antenna is an excellent broadband antenna providing a good compromise between performance and price. It exhibits omnidirectional characteristics and performs well over short to medium distances. Generally these antennas require a large cleared area at ground level for installation and are more suitable for permanent low and high powered installations. During installation, consideration should be given to the antenna earthing, especially when mounted on rooftop locations, or at ground level where the soil conditions are poor.

Figure 9: Semi delta antenna



Antennas for mobile installations

Automatic Tuning Whip Antenna (Code 9350)

The automatic tuning whip antenna is a state-of-the-art antenna designed exclusively for mobile HF applications. The antenna eliminates the need for manual retuning of the antenna when changing frequencies. It is suitable for scanning networks. During installation, consideration must be given to antenna positioning, mounting and the provision of adequate earthing.

The antenna is of robust construction and, because of its composite protective casing and shock-mounted base, it is able to withstand the rigours of off-road travel. It features fully automated tuning over the HF range.

Figure 10: Automatic tuning whip antenna

Tapped Whip Antenna (Code 300)

The tapped whip antenna is a helically wound, pretapped, vertical-mounting antenna. Each whip can be tapped to a maximum of 10 discrete frequencies.

The antenna may be ordered with the customer's choice of frequencies. Manual retuning of the antenna is necessary whenever changing operating frequencies, therefore, the antenna is not suitable for scanning networks. A Code 301 spring mounting base and coaxial cable is required to complete the installation. Special consideration must be given to antenna positioning, mounting method and the provision of adequate earthing.

Figure 11: Tapped whip antenna