

HF Broadband Multi-Mode SPIRA-CONE® Antennas

- 2 to 30 MHz Frequency Range, Dependent Upon Type
- Up to 20 kW Average, 40 kW Peak Power Rating
- Horizontal-Elliptical Polarization to Reduce Fading
- Omnidirectional Log-Periodic
- 2.0:1 VSWR
- Multi-Mode Capability for Short-, Medium- and Long-Range Communications
- Single Tower for Simplicity of Installation
- Innovative Switching or Combining of Radiators to Provide Switchable or Simultaneous Short- or Long-Range Mode

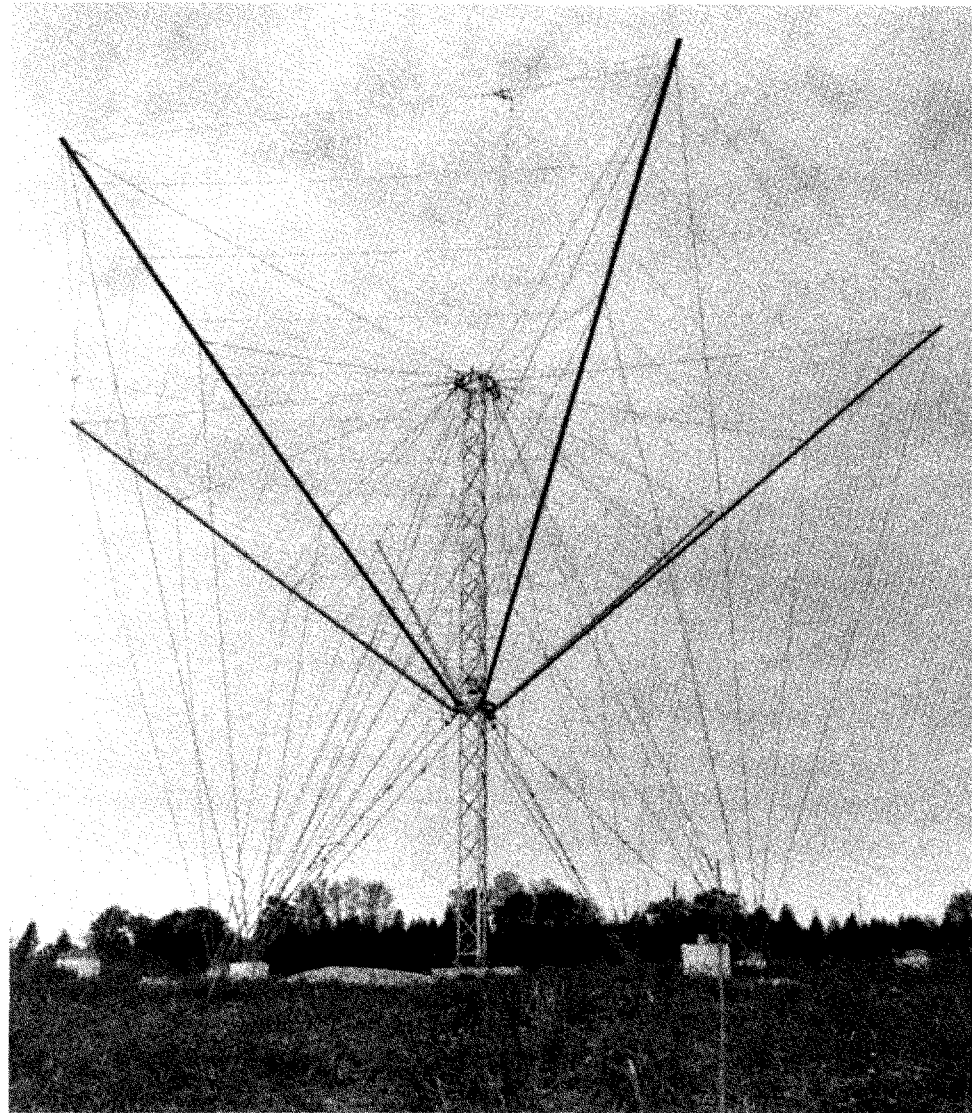
General Description

Many operational applications require short and medium-to long-range omnidirectional antennas; for example, shore-to-ship and ground-to-air services. Conventionally, this requirement has been fulfilled by means of conical or bi-conical monopole arrays used in conjunction with an extensive ground screen. This type of antenna produces useful beams at low take-off angles, but with comparatively little gain and no short range capability.

An alternative is to use a number of horizontally polarized, log-periodic arrays arranged in a triangle or a square with the feed point at the center. This solution produces an improvement in performance, but such antennas are expensive and require extensive land.

The patented* SPIRA-CONE uses a four-arm conical logarithmic spiral with interleaved wire elements and does not require a groundscreen.

- * United States Patent 4,656,485
- United States Patent 4,498,084
- United Kingdom Patent 2,133,219



The 3000 Series antennas employ horizontal-elliptical polarization, with it's well-known advantages of minimizing fades because of Faraday rotation effect. The antennas are log-periodic, spiral arrays, supported, with the exception of the low profile version, on a single, central, guyed tower for simplicity of installation. The apex of the hexagonal cone points towards the ground and it's height above ground determines the take-off angle of the main (lowest) lobe. Alternative configurations are offered to enable the best choice of take-off angle for a variety of applications. By pointing

the apex of the cone towards ground, problems associated with low efficiency at the low frequencies and pattern fragmentation, as a result of multi-lobing at the high frequencies, are avoided.

Clockwise or counterclockwise rotation of the electric field as required by the geographical location or application of the antenna can be chosen at the time of installation, as no components of the array are special to any particular direction of rotation. In the northern hemisphere, a transmitting antenna must be clockwise whereas the receiving antenna

must be counterclockwise. Conversely, in the southern hemisphere, the transmitting antenna must be counterclockwise, while the receiving antenna must be clockwise.

Reflection efficiency is improved by the proper interaction of the radiated electromagnetic wave, the electrons in the ionosphere, and the earth's geomagnetic field acting on the "ordinary wave" component of the circularly polarized wave.

Features

Choice of Operating Modes. Two families of elevation patterns (mode 1 and mode 2) can be generated by selective excitation of the four arms:

Mode 1 beam maximum is on-axis of the tower (high-angle mode) with overhead maximum.

Mode 2 beam maximum is off-axis of the tower (low-angle mode) with overhead null.

Single Mode Operation (SM). The SPIRA-CONE will be permanently connected in either of the required modes at installation.

Switched Selective Mode Operation (SW). Single input switched mode is available. Switching is carried out at the balanced inputs of the SPIRA-CONE by means of relay contacts controlled by cable from a unit located at the control center. Full remote control systems are available.

*United States Patent 4,635,070
 United Kingdom Patent 2,151,852

Dual-Mode Operation (DM). Each of the two separate modes of the SPIRA-CONE is activated simultaneously through a patented Broad Band Isolating Coupler (BBIC)**. The two port version of the BBIC permits simultaneous operation of two transmitters (or one transmitter and one receiver), limited in frequency only by the low frequency cut-off of each mode. The standard version activates one high angle and one low angle mode but an optional arrangement provides two simultaneous high modes.

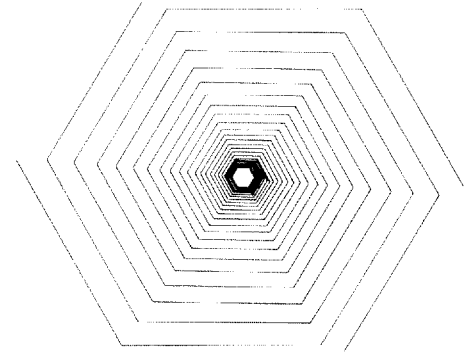
Switched 2 Port BBIC: This provides one high angle mode with a simultaneous selectable high or low angle mode.

Triple-Mode Operation (TM). With a 3-port BBIC, two high angle modes are generated simultaneously with a low angle mode resulting in ability to transmit three simultaneously independent signals. The result is a saving in land area for the DM and TM SPIRA-CONE antennas with respect to conventional antennas.

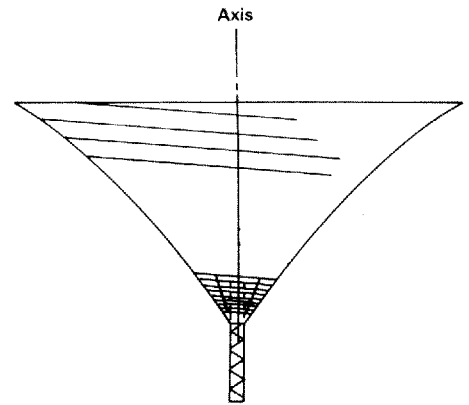
Outstanding performance is achieved when the antenna is used as a receiving antenna. The anti-fading benefits of elliptical polarization are immediately evident by the reduction in signal fading, which is equivalent to space or polarization diversity.

Use of a dual diversity receiver fed through a two port receiving BBIC adds an additional reliability enhancement angle of arrival diversity to the existing polarization diversity inherent in both the high and low modes.

SPIRA-CONE® Geometry

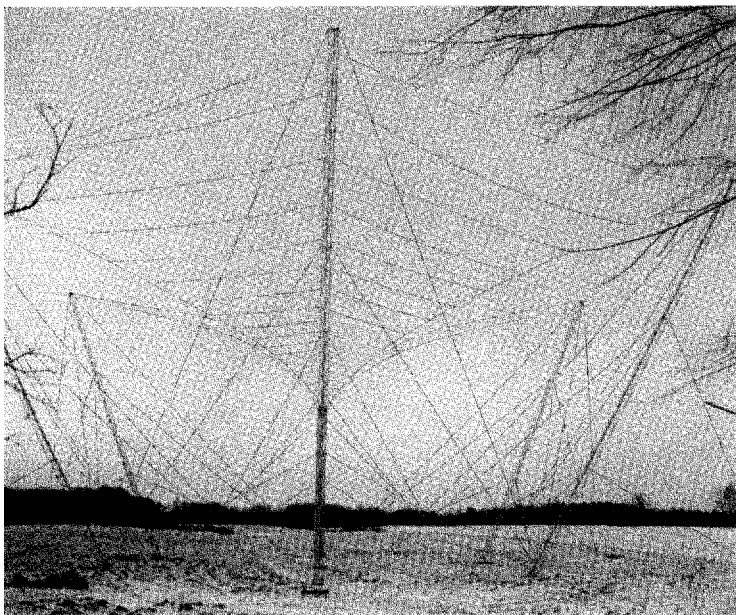
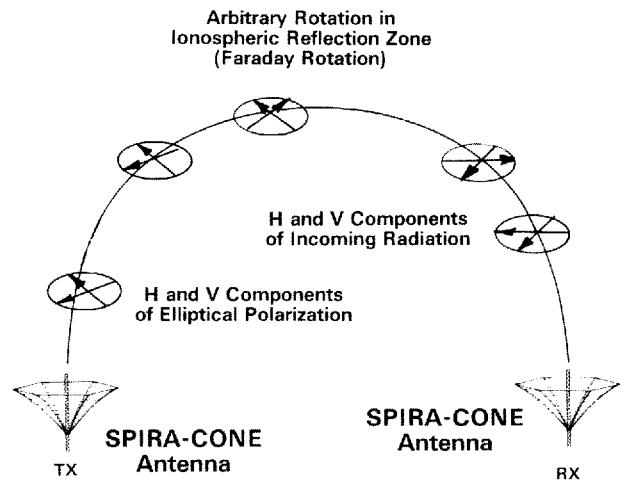


Top View

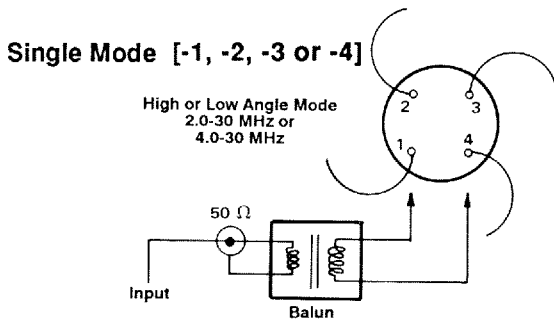


Front View

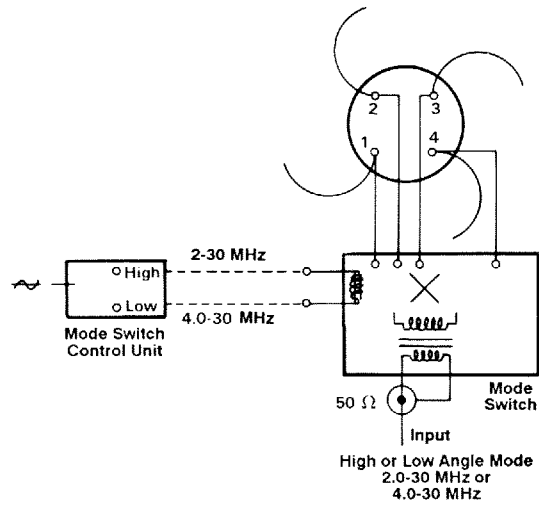
Faraday Rotation Effect



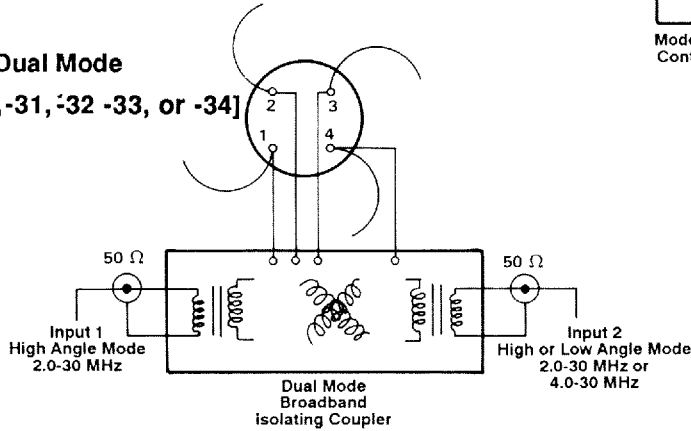
Methods of Transmitter/Receiver Interface [Power Level Function Number]



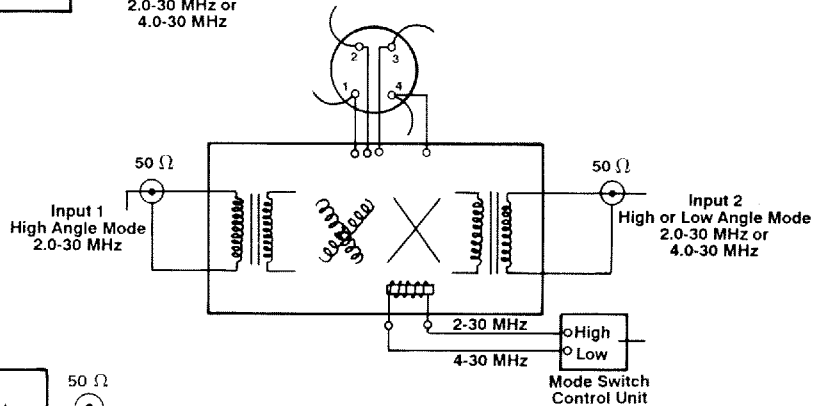
Switched Mode (Single) [-21, -22, -23 or -24]



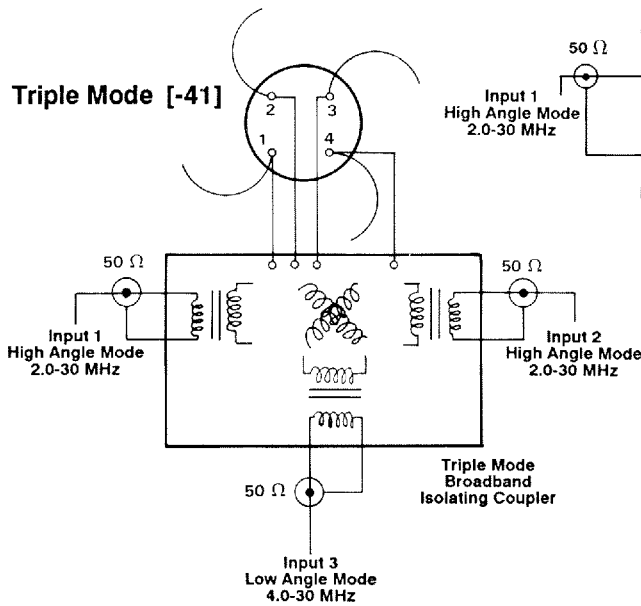
Dual Mode [-30, -31, -32 -33, or -34]



Switched Mode (Dual) [-53]



Triple Mode [-41]



Sizes Available

Full Sized. Designed for main communication centers, the 3001 Series Antennas offer the highest efficiency and power gain required for worldwide omnidirectional use such as shore-to-ship services. Since the 3001 Series Antennas require no ground screen, their performance exceeds that of vertically

polarized monopoles which suffer significant ground losses. Typically, over poor soil, a gain advantage of 6-7 dBi can be expected. Elliptical polarization can further add to system performance.

Compact. Compact models offer similar performance advantages in truncated array designs which are terminated to extend low frequency cut-off beyond the

natural unloaded frequency. Input power is limited by radiator size, insulators and terminations. These models will accept up to 5 kW average power per mode. The antennas differ in mounting arrangement and application. All are available with mode option kits.

Roof Mounted (Series 3002A). The 3002A series antennas were designed for applications in which only roof top space is available, such as diplomatic services, security services and operational headquarters. Elevation patterns are influenced by array height above the effective ground. The array is supported by six tubular poltruded fibreglass compression booms. It can also be ground mounted where space is at a premium.

Transportable (Type 3003MT). The Type 3003MT is particularly suited to applications such as emergency or transportable communications centers, in which it's omnidirectional high and medium low angle elevation patterns provide communication on short to medium paths by skywave reflection. The elliptical polarization is especially effective when the distant terminal is mobile. Supported by a 70 ft (21m) light weight, nested aluminum mast, the antenna can be deployed by a team in under two hours. An installation site of 75 ft (23m) radius is required.

Fixed (Types 3004-70 and 3004-90). Electrically similar to the 3003 transportable, this fixed station model offers two array heights supported by galvanized steel lattice masts of 70 or 90 ft (21 or 27m). This model provides a choice of elevation angles to match communication requirements; the 90 ft (27m) version offers lower angles necessary for longer distances.

Low Profile (Type 3005-2L). With the same electrical performance characteristics as it's single mast counterpart, this low profile, compact antenna is ideally suited for height restricted areas such as airports or in areas where minimal ground is available. The antenna uses a full-sized apex down four arm conical logarithmic spiral with interleaved wire element radiators suspended from six peripheral, RF transparent, support structures. As the array is suspended from six dielectric halyards, raising and lowering of the antenna can be accomplished from ground level once the radiators have been disconnected from the BBIC, which sits on top of the center stub tower.

Accessories

The following accessories are available for ease of installation and maintenance: tower lighting kit, erection kit, paint kit, lightning rod kit, anti-climbing kit, and spares kit.

Characteristics, Series 3001-Full Sized

Type	HF log-periodic, spiral, omnidirectional
Frequency Range, MHz	3 models: 2/3.6-30 3/5.2-30 4/7.2-30
Power Rating, kW	Up to 20 average, 40 peak
Polarization	Horizontal elliptical; can be installed for right or left rotation, as required
Input Impedance, ohms	50, coaxial input option
VSWR	2.0:1 maximum**
Directivity, dBi	7
Azimuth Plane Radiation Pattern	Omnidirectional
Elevation Plane Radiation Pattern	Variable with frequency and mode selection
Efficiency	Greater than 95%
Wind Survival Rating, mph (km/h)	
Without Ice	140 (225)
With 0.5 in (12 mm) Radial Ice	60 (100)

Characteristics, Series 3002, 3003 & 3004-Compact

Type	HF log-periodic, spiral, omnidirectional
Frequency Range, MHz	2.0-30 (high angle mode) 4.0-30 (low angle mode)
Power Rating, kW	Up to 5 average, 10 peak
Polarization	Horizontal elliptical, can be installed for right or left rotation as required
Input Impedance, ohms	50, coaxial
VSWR	2.0:1 maximum**
Directivity, dBi	7 nominal
Azimuth Plane Radiation Pattern	Omnidirectional
Elevation Plane Radiation Pattern	Variable with frequency and mode selection
Wind Survival Rating, mph (km/h)	3002A-36S 3002A-36HE 3003 3004
Without Ice	125 (200) 140 (225) 100 (160) 100 (160)
With 0.5 in (12mm) Radial Ice	50 (80) 70 (110) 50 (80)* 50 (80)

* With 0.25 in (6mm) Radial Ice
**VSWR depends upon the influence of unknown adverse factors in built up areas, such as roof tops where the array may be installed. In the case of triple mode, operation VSWR is 2.0:1 nominal, 2.5:1 maximum.

Characteristics, Series 3005-2L

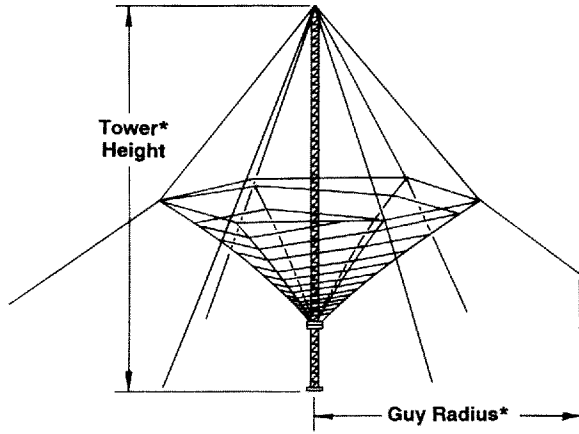
Type	HF log-periodic, spiral
Frequency Range, MHz	Mode 1 (High Angle) 2-30 Mode (Low Angle) 3.6-30
Power rating, kW	Up to 20 average, 40 peak per mode Horizontal elliptical; can be installed for right or left hand rotation, as required
Input Impedance, ohms	50, coaxial input option
VSWR	20:1 nominal
Directivity, dBi	7
Efficiency	Greater than 95%
Azimuth Plane Radiation Pattern	Omnidirectional
Elevation Plane Radiation Pattern	Mode 1 Beam Maxima 90° @ 2 MHz 50° @ 30 MHz Mode 2 Beam Maxima 45° @ 4 MHz 10° @ 30 MHz
Wind Survival Rating, mph (km/h)	
Without ice	150 (240)
With 0.5 in (12mm)	90 (145)
Tower Height, ft. (m)	87 (26.5)
Tower Base Diameter, ft (m)	110 (33.5)
Guy Diameter, ft (m)	208 (63.5)

Characteristics, Broad Band Isolating Couplers

Type	Switched, dual and triple mode
Frequency, MHz	2-30
Power Rating, kW	See ordering information
Input Impedance, ohms	50, coaxial
Isolation, dB	30 nominal*
Insertion Loss, dB	0.15

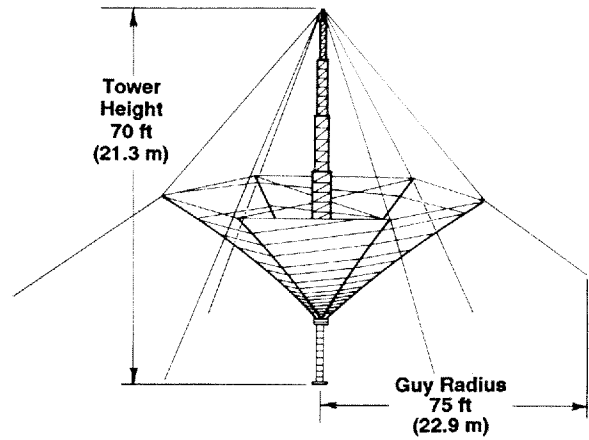
*Output ports terminated into matched loads.

Series 3001 Full Sized

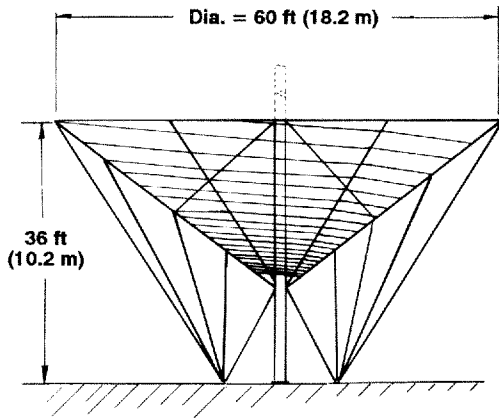


*See table, page 7.

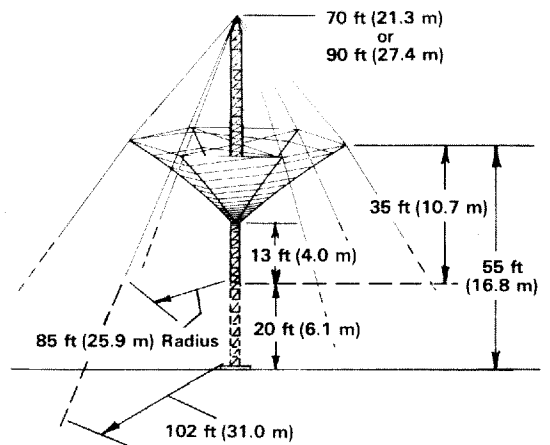
Series 3003MT Transportable



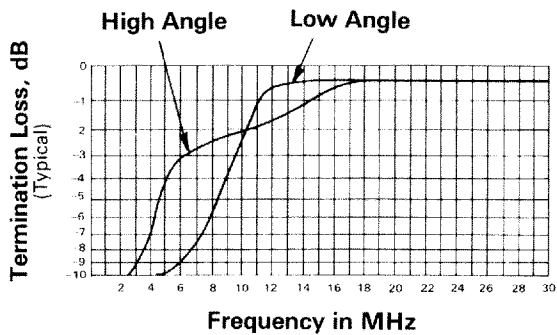
Series 3002A Roof Mount



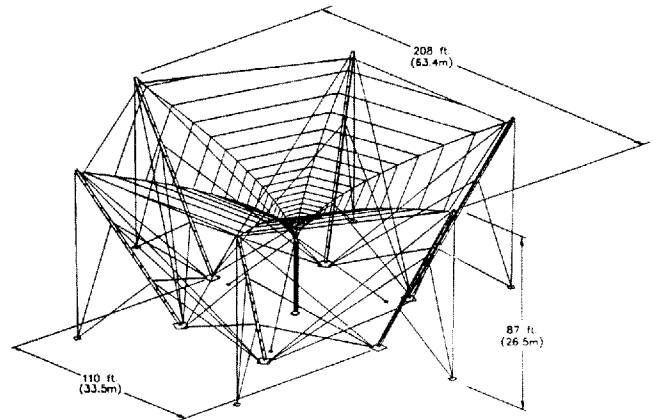
Series 3004 Fixed



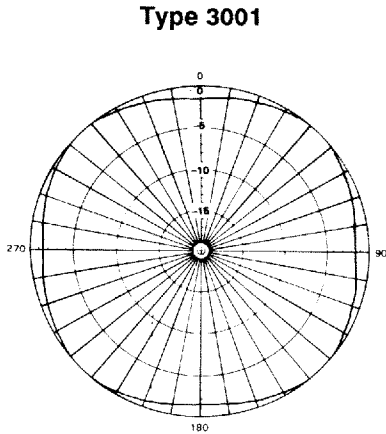
Antenna Efficiency Compact Models



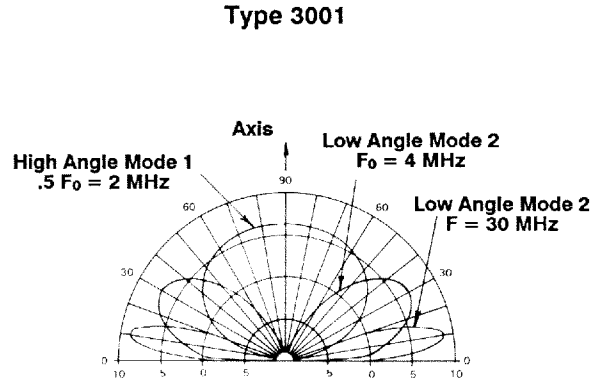
Series 3005 Low Profile



Typical Azimuth Radiation Pattern
Full-Sized Series (Directive gain in dB below beam peak)

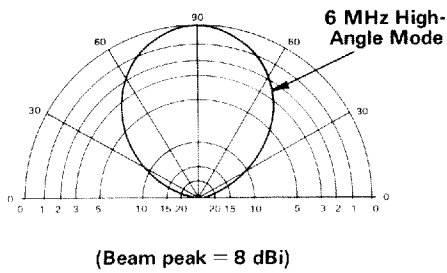


Typical Elevation Plane Radiation Pattern
Full-Sized Series

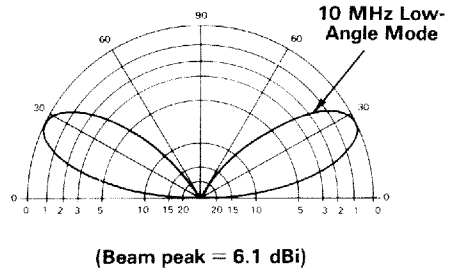
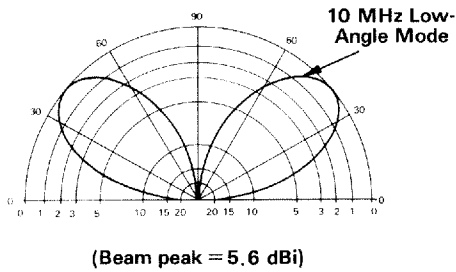
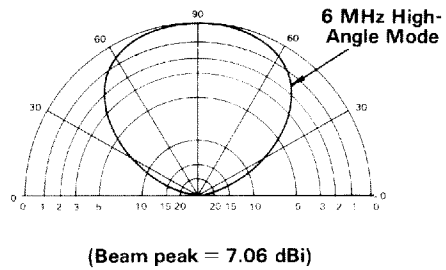


Elevation Plane Radiation Patterns
Compact Series (Directivity, in dB below beam peak)

Type
3003-70MT
3004-70F
3002-36M



Type
3002-36S (Mounted on 20 ft (6.1 m) High Roof)
3004-90F



Ordering Information, Series 3001

Type Number	3001-2VL-(*) Very Low Angle	3001-2L-(*) Low Angle	3001-2ML-(*) Medium Low Angle	3001-3L-(*) Low Angle	3001-3ML-(*) Medium Low Angle	3001-4L-(*) Low Angle
Tower Height, ft (m)	240 (73.2)	220 (67.1)	200 (60.9)	150 (45.7)	130 (39.6)	120 (36.6)
Guy Radius, ft (m)	267 (81.4)	265 (80.8)	238 (72.5)	166 (50.6)	157 (47.9)	135 (41.2)
Freq. Range High-Angle Mode, MHz	2-30	2-30	2-30	3-30	3-30	4-30
Freq. Range Low-Angle Mode, MHz	3.6-30	3.6-30	3.6-30	5.4-30	5.4-30	7.2-30
4 MHz Upper 1/2 Power Angle, deg.	57	66	70			
4 MHz Beam Peak Angle, deg.	33	38	42			
4 MHz Lower 1/2 Power Angle, deg.	16	17	19			
6 MHz Upper 1/2 Power Angle, deg.				57	68	
6 MHz Beam Peak Angle, deg.				33	40	
6 MHz Lower 1/2 Power Angle, deg.				16	18	
8 MHz Upper 1/2 Power Angle, deg.						52
8 MHz Beam Peak Angle, deg.						30
8 MHz Lower 1/2 Power Angle, deg.						14
30 MHz Upper 1/2 Power Angle, deg.	15	15	31	15	31	15
30 MHz Beam Peak Angle, deg.	10	10	20	10	20	10
30 MHz Lower 1/2 Power Angle, deg.	5	5	9	5	9	5

*Append with Power Level Function Number from Series 3001 Option Table below.

Series 3001 Option Number Table – Power Level Functions

Power Rating, kW		Single Mode (SM)	Switched Mode (SW)		Dual Mode (DM)	Triple Mode (TM)	Input Connector
Average	Peak		Single	Dual			
Receive Only		-1	-21	–	-30	–	Type N Jack
1	2	-1	-21	–	-31	-41	Type N Jack
5	10	-2	-22	–	-32	–	7/8" EIA
10	20	-3	-23	-53	-33	–	1-5/8" EIA
25	50	-4	-24	–	-	–	3-1/8" EIA

Ordering Information, Series 3002 A Compact Series – Tubular Boom Types

Type No.	Support Type	Mounting	Low Freq. Cut-off MHz		Power Rating kW	Height ft (m)
			High Angle	Low Angle	Average/Peak	
3002A-36S-(*)	Standard 125 mph, no ice	Roof or Ground	2.0	4.0	5/10	36 (11)
3002A-36HE-(*)	High Environment	Ground	2.0	4.0	5/10	36 (11)

*Append Power Level Function Number from 3002, 3003 and 3004 below.

Ordering Information, Series 3003 & 3004 Compact Series - Catenary Supported Types

Type No.	Support Type	Mounting	Low Freq. Cut-off MHz		Power Rating kW	Height ft (m)
			High Angle	Low Angle	Average/Peak	
3003-70MT-(*)	Transportable†	–	2.0	4.0	5/10	70 (21)
3004-70F-(*)	Fixed	Ground	2.0	4.0	5/10	70 (21)
3004-90F-(*)	Fixed	Ground	2.0	4.0	5/10	90 (27)

*Append Power Level Function Number from Table 3002, 3003 & 3004 below.

†Erection Kit included; other optional accessories available.

Series 3002A , 3003 & 3004 Option Number Table – Power Level Functions

Power Rating, kW		Single Mode (SM)	Switched Mode (SW)	Dual Mode (DM)	Triple Mode (TM)	Input Connector
Average	Peak					
Receive Only		-1	-21	-30	–	Type N Jack
1	2	-1	-21	-31	-41	Type N Jack
5	10	-2	-22	-32	–	7/8" EIA

Ordering Information Series 3005-2L-(*)-Power Level Functions

Power Rating, kW		Single Mode (SM)	Switched Mode (SW)		Dual Mode (DM)	Triple Mode (TM)	Input Connector
Average	Peak		Single	Dual			
1	2	-1	-21	-	-31	-41	Type N Jack
5	10	-2	-22	-	-32	-	7/8" E/A
10	20	-3	-23	-53	-33	-	1-5/8" E/A
25	50	-4	-24	-	-34	-	3-1/8" E/A

* Append Power Level Function Number from Series 3005 Option Table above.



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