locate

Sarsen

Compact HF Crossed Loop Antenna

roke

Roke Manor Research Ltd
a Siemens company

Features and benefits

- Simultaneous vertical monopole and cross loop outputs
- Ideal for use in multi element arrays for beam forming or direction finding
- Robust and self supporting-no guying required
- Designed to withstand a wind of 165km/hr, when loaded with 6.5mm of ice and/or 20.3 cm of snow
- Total shipping weight <200kg
- Operating temperature -40°C to +55°C
- Extremely low field-maintenance requirement
- DC grounded and protected against lightning induced transients
- Highly cost effective DF antenna solution
- One year full warranty

General description

The Compact Crossed Loop Antenna is a broadband omnidirectional High Frequency (HF) receive-only antenna.

It comprises both a vertical monopole antenna and a cosited crossed loop antenna, and is suited to fixed land based installations. Together, the two antennas allow reception of HF signals over the entire range of take-off angles (TOAs) from the horizon to overhead. Both antennas are passive (no built-in amplifiers) to allow the best possible dynamic range, and have built-in matching transformers to suit 50- ohm systems.

Mechanical description

The antenna consists of a 6.1m high central elevated feed monopole, combined with two tubular half-loops connected to a lower mesh ground mat. The square section lower column of the monopole is 2m high, and the tubular upper section is 4.1m high. The upper section of the monopole is of fibreglass construction. The rest of the antenna is constructed of galvanised steel.

Four arms extend from near the top of the monopole lower column down to the ground mat, forming two loops each with an effective diameter of 3.6m. The RF connections and associated electronics are encased in a fully waterproof aluminium box housed inside the hollow column, with a cable exit hole near ground level.

The 5m diameter ground mat is manufactured in four prefabricated sections to aid transportation. The antenna is provided with a set of eight 5m long ground radials. Each radial connects to the ground mat at its inner end and to a 2m long ground stake at its far end.

Electrical description

Vertical Monopole Antenna

The vertical monopole antenna is designed to respond to vertically polarized signals, primarily from 5 degrees to 45 degrees TOA, corresponding to long to medium range skywave propagation. The antenna also responds to shortrange surface-wave signals arriving at low angles.

The azimuth pattern is circular at all TOAs. The height and feedpoint location are chosen such that the elevation pattern is consistent over the entire frequency range.

Figure 1 shows the space wave gain in dBi at 10 MHz over good ground, as a function of TOA. Maximum gain occurs at a TOA of 25 degrees.

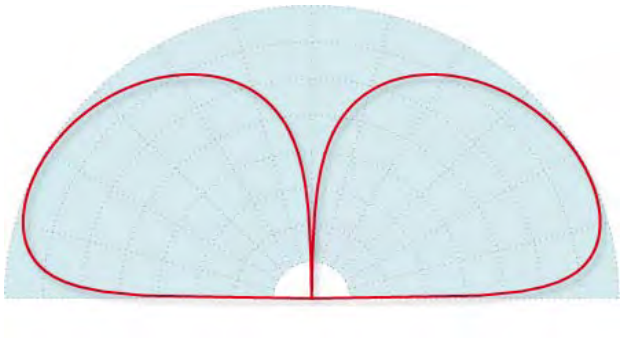

Figure 1 – Vertical Antenna Space-Wave Gain Versus TOA at 10MHz

Figure 2 shows the space-wave gain in dBi versus frequency, for TOAs of 5, 20 and 45 degrees when erected over good ground. The falling gain at low frequencies is typical of broadband matched HF antennas optimised for receive-only applications. The surface-

wave gain is also shown.

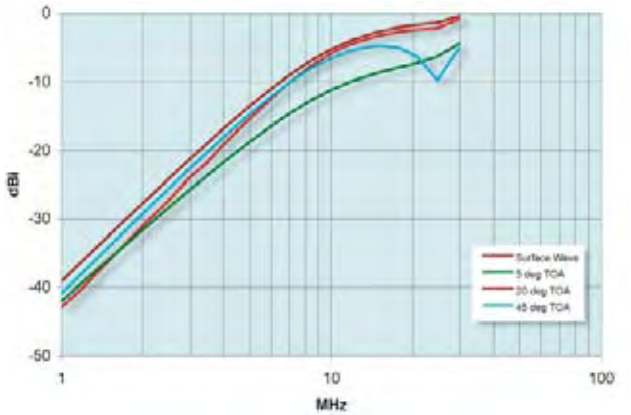

Figure 2 – Vertical Antenna – Surface-Wave Gain and Space-Wave Gain

Figure 3 shows the equivalent noise field (ENF). This is the external noise field strength, which would yield an antenna noise output equal to the receiver's internal noise. Figure 3 also shows the standard ITU-R external noise models for "Rural", and "Quiet Rural" locations. In nearly all cases the external noise dominates over the receiver's internal noise, i.e. reception is external noise limited even at the quietest sites.

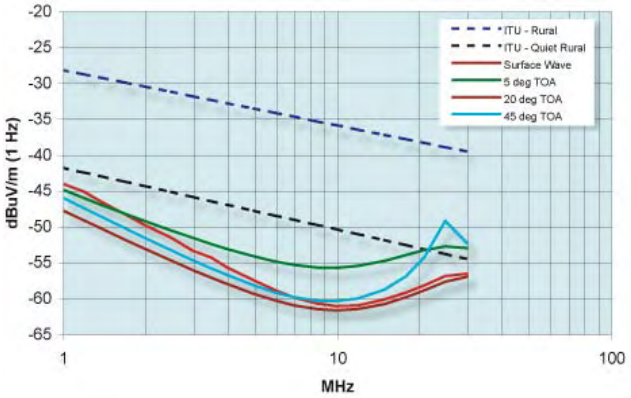

Figure 3 – Vertical Antenna ITU External Noise and ENF

Crossed Loop Antenna

The crossed loop antenna is optimised to respond to circularly polarized signals, primarily for TOAs from 25 degrees to 90 degrees (overhead), corresponding to medium range to short range / NVIS skywave propagation. The individual loop outputs are combined in a broadband quadrature hybrid network, to yield two possible RF outputs. These two outputs are matched to incoming Right and Left hand circularly polarized signals (RHCP / LHCP) respectively. For each output, the suppression of signals of mismatched (opposite handed) polarization is typically 10 dB or more over this TOA range. The antenna offers enhanced discrimination to circularly polarized signals, which are encountered under certain skywave propagation conditions.

The crossed loop antenna also responds well to both linear vertical and linear horizontal polarized signals in the 25 to 90 degree TOA range. Signals with slowly varying linear polarization will exhibit reduced fading with this type of antenna. Below 25 degrees TOA the response is primarily to vertically polarized signals, though the monopole would normally be used for these due to its enhanced sensitivity.

Figure 4 shows the space-wave gain in dBiC (dBi circular) at 10 MHz over good ground, as a function of TOA. The azimuth pattern is circular at all TOAs. The loop size is chosen to allow consistent pattern shape over the entire HF band.

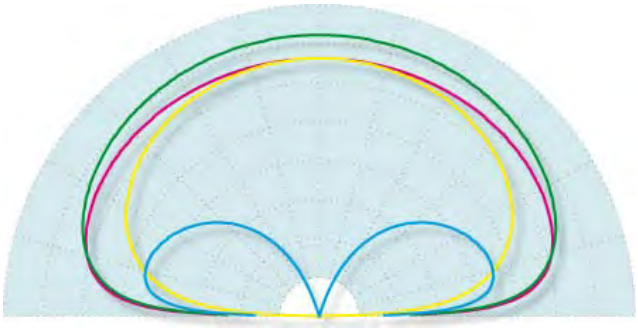

Figure 4 – Crossed Loop Antenna (RHCP output)

Space-Wave Gain Versus TOA at 10MHz

Green Trace - RHCP (matched polarization)
Blue Trace - LHCP (mismatched polarization)
Purple Trace - Vertical Polarization
Yellow Trace - Horizontal Polarization

Figure 5 shows the antenna space wave gain to matched circular polarization versus frequency, for TOAs of 20, 45 and 90 degrees when erected over good ground.

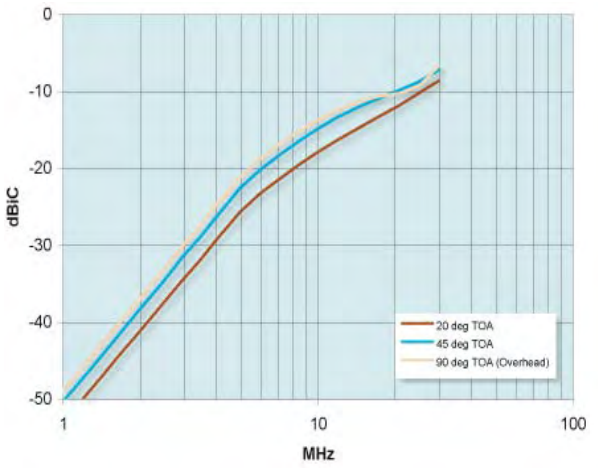

Figure 5 – Crossed Loop Antenna Space-Wave Gain

Sensitivity to vertical polarization is typically 9 dB less than the monopole, but this is still adequate to allow external noise limited reception at most sites. Figure 6 shows the ENF for vertical polarization.

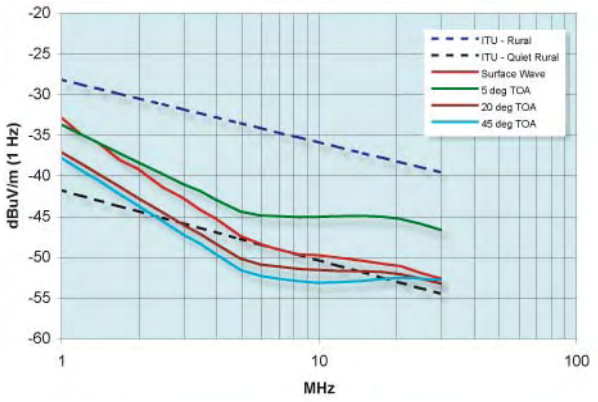

Figure 6 – Loop Antenna ITU External Noise and ENF

Operating mode

There is a single RF output connector designed for a 50-ohm load. Selection of this RF output between Crossed Loop RHCP, Crossed Loop LHCP and Vertical Monopole is performed by internal relays, according to the bias voltage conveyed via the RF feeder centre conductor:

Bias voltage	Operating mode
+8V	RHCP
-8V	LHCP
0V	Monopole

Electrical summary – Vertical Monopole

- Passive antenna with broadband internal matching
- Frequency range 1 to 30 MHz
- Omni-directional VP response for all takeoff angles below 30 degrees

Frequency	Vertically polarized gain	Antenna ENF (RX NF = 10db) @ 20deg TOA @20deg TOA
MHz	dbi	dBuV/m (1 Hz)
3	-22	-56
6	-11	-60
10	-6	-62
20	-2	-59
30	-1	-57

Field deployed Roke HF Crossed Loop Antenna (static location - Eurasia)

Electrical summary – Crossed Loops

- Passive antenna with broadband internal balanced matching
- Inbuilt quadrature hybrid combiner
- Frequency range 3 to 30 MHz
- Omni-directional CP response for all take-off angles above 30 degrees
- Response also to linear vertical and linear horizontal polarization
- Switched RHCP/LHCP, activated by ±8V DC bias on RF centre conductor
- Switching time <20ms
- Delay matched between RHCP/LHCP

Frequency	Circularly Polarized gain @ 45deg	Vertically Polarized gain @ 45deg TOA	Antenna ENF (RX NF = 10 dB) @ 45deg TOA
MHz	dBiC	dBi	dBuV/m (1 Hz)
3	-32	-30	-47
6	-20	-19	-52
10	-15	-14	-53
20	-10	-8	-53
30	-7	-5	-53

Options

- Monopole and dual RHCP/LHCP loop outputs – simultaneous, no switching
- Loops only – no Monopole
- Monopole only – no Loops

For further information please contact:

Roke Manor Research Limited
Roke Manor, Romsey, Hampshire SO51 0ZN UK
T +44 (0)1794 833000
F +44 (0)1794 833433
es@roke.co.uk
www.roke.co.uk