

Sarsen

Sarsen is a compact HF antenna with co-sited monopole and crossed loop elements



Features and benefits

- Simultaneous vertical monopole and crossed loop outputs
- Ideal for use in multi-element arrays for beamforming or direction finding
- Robust and self supporting - no guying required
- DC grounded and protected against lightning induced transients
- Designed to withstand a wind speed of 165km/hr when loaded with 6mm of ice and 200mm of snow
- Extremely low field-maintenance requirement
- Total shipping weight < 200kg
- Operating temperature -40°C to +55°C

Description

Sarsen is a broadband, omnidirectional, High Frequency (HF), receive-only antenna. It comprises both a vertical monopole antenna and a co-sited 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 (i.e. no RF amplifiers) to permit the best possible dynamic range, and have built-in matching transformers to suit 50Ω systems.

Mechanical description

Sarsen consists of a 5.8m high central elevated feed monopole, combined with two tubular half-loops connected to a mesh ground mat. The square section lower column of the monopole is 2.0m high, and the upper section is 3.8m high. The upper monopole is made from powder-coated aluminium, and the rest of the antenna is galvanised steel.

Four curved arms extend from near the top of the 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 metal box housed inside the hollow column. An inspection hatch in the column provides for easy installation and maintenance access.

The 5m diameter ground mat is manufactured in four prefabricated sections to aid transportation. The ground mat requires a 6m diameter hard standing for support. Sarsen is also provided with a set of eight 5m long ground radials. Each radial connects to the ground mat at its inner end and to a ground stake at its far end. For closely spaced arrays, several antennas may share a larger common ground mat. The ground mat minimizes variations in antenna gain and phase due to local soil variations.

RF cables normally exit underneath the lower column and are routed via underground ducts or directly buried.

Electrical description

Vertical monopole antenna

The vertical monopole antenna is designed to respond to vertically polarized (VP) signals, primarily from 5° to 45° TOA, corresponding to long to medium range skywave propagation. Sarsen also responds to short range surface-wave signals arriving at low angles. For all TOAs, the antenna azimuth pattern is omnidirectional. The height and feed-point location are chosen such that the elevation pattern is consistent over the entire frequency range. Figure 1 shows the normalised space-wave elevation pattern at 10MHz over good ground as a function of TOA. Maximum gain occurs at a TOA of typically 25°.

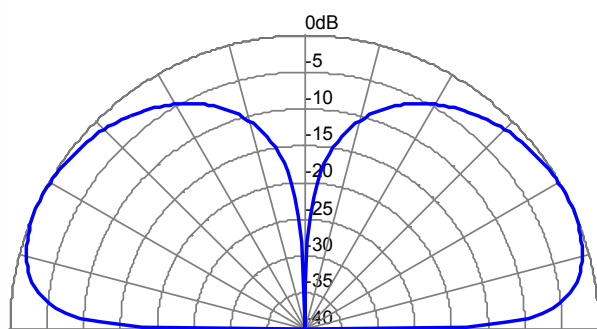


Figure 1 – Monopole normalised space-wave pattern versus TOA at 10MHz

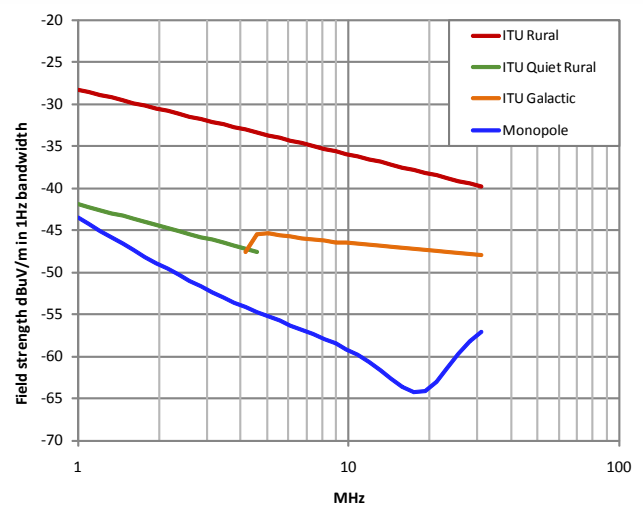


Figure 2 – Monopole ITU external noise and ENF

Figure 2 shows the equivalent noise field (ENF) of a receiving system comprising a Sarsen monopole and an HF receiver with a noise factor of 6dB. For comparison Figure 2 also shows the standard ITU-R man-made external noise models for rural and quiet rural locations, and galactic noise. 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.

Crossed loop antenna

The crossed loop antenna is optimised to respond to circularly polarized signals, primarily for TOAs from 25° to 90°, corresponding to medium range to short range and 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 10dB or more over this TOA range.

The crossed loop antenna also responds to both linear vertical and linear horizontal polarized signals in the 25° to 90° TOA range. Signals with slowly varying linear polarization will exhibit reduced fading with this type of antenna. Below 25° TOA signals are primarily VP, so the monopole would normally be used due to its enhanced sensitivity.

Figure 3 shows the normalised space-wave elevation pattern at 10MHz over good ground as a function of TOA. The azimuth pattern is omnidirectional at all TOAs. The loop size is chosen to allow consistent pattern shape over 3 to 30MHz.

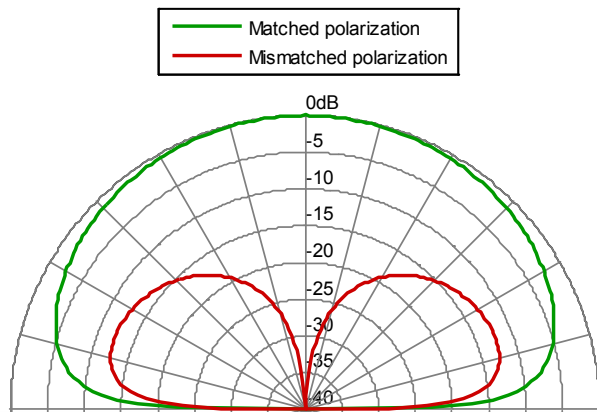


Figure 3 – Crossed loop normalised space-wave elevation pattern versus TOA at 10MHz

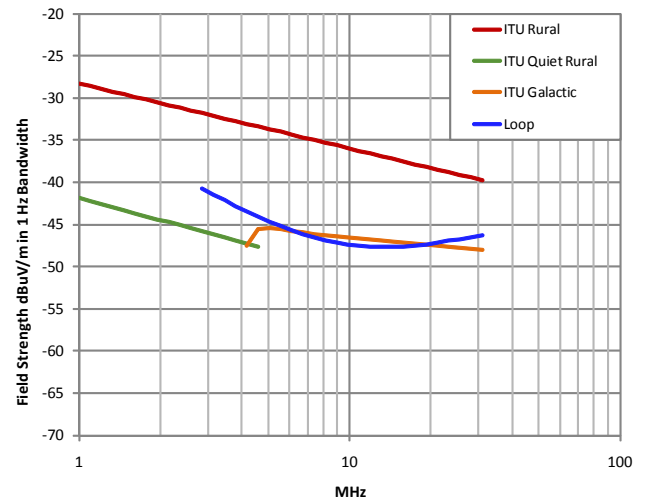


Figure 4 – Crossed loop ITU external noise and ENF for vertical polarization

Figure 4 shows the ENF of a receiving system comprising the Sarsen crossed loops and an HF receiver with a noise factor of 6dB. ENF is typically 10dB higher than the monopole, but at many receiving sites reception is still external noise limited.

Operating mode

In the standard Sarsen product there is a single N-type RF output connector designed for a 50Ω load. Selection of this RF output between crossed loop RHCP, crossed loop LHCP and VP monopole is performed by internal relays, according to a DC bias voltage conveyed via the RF feeder centre conductor.

Optionally, three N-type RF output connectors can be provided so that simultaneous output of RHCP, LHCP and VP is possible.

Specifications

Vertical monopole antenna

- Passive antenna with broadband internal matching
- Frequency range 1 to 30MHz
- Omnidirectional VP response for all TOAs below 30°

Frequency [MHz]	VP gain @ 25° TOA [dBi]	Antenna ENF* [dBuV/m (1 Hz)]
3	-28	-52
6	-18	-56
10	-6	-59
20	5	-63
30	2	-57

* Receiver noise factor = 6dB

Crossed loop antenna

- Passive antenna with broadband internal balanced matching
- Frequency range 3 to 30MHz
- Omnidirectional RHCP / LHCP response for all TOAs above 30°

Frequency [MHz]	RHCP/LHCP gain @ 45° TOA [dBiC]	Antenna ENF* [dBuV/m (1 Hz)]
3	-34	-41
6	-23	-46
10	-18	-47
20	-12	-47
30	-9	-46

* Receiver noise factor = 6dB

Operating mode

- Switched VP / RHCP / LHCP, activated by DC bias on RF centre conductor
- Switching time < 20ms

Bias voltage [V]	Operating mode
+8	RHCP crossed loop
-8	LHCP crossed loop
0	VP monopole

Options

- 3 RF outputs for simultaneous VP / RHCP / LHCP outputs without switching
- Monopole only without the crossed loop antenna (but with wire rope arms)



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Ordering Information
Sarsen, monopole with crossed loops, single RF output, part number:
X72/1/2254/001
Sarsen, monopole with crossed loops, three RF outputs, part number:
X72/1/2254/002
Sarsen, monopole only, part number:
X72/1/2254/004

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