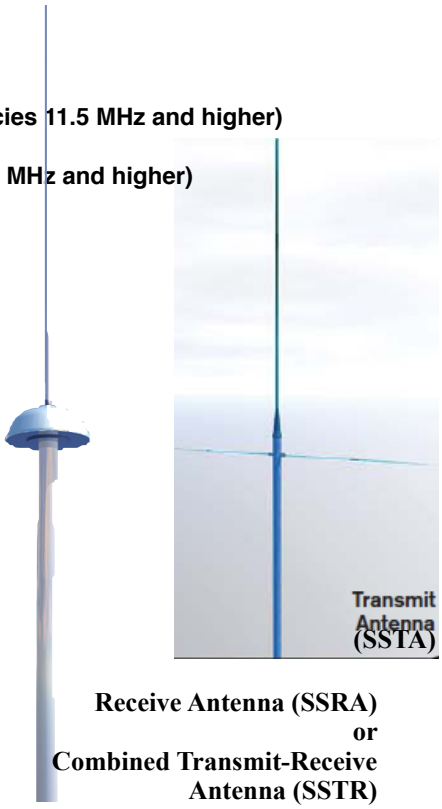
CODAR OCEAN SENSORS SeaSonde® Remote Unit System Specifications
Product Code: SSRS-100

SeaSonde Remote Unit Components†

- **1 Transmit Antenna Assembly (SSTA) & 1 Receiver Antenna Assembly (SSRA) OR,**
  1 Combined Transmit-Receive Antenna Assembly (SSTR) (avail. for frequencies 11.5 MHz and higher)
- **1 Transmit Cable & 1 Receive Antenna Cable Set OR,**
  1 Combined Transmit-Receive Antenna Cable Set (avail. for frequencies 11.5 MHz and higher)
- **1 SeaSonde Receiver Chassis (SSRX)**
- **1 SeaSonde Transmitter Chassis (SSTX)**
- **1 Radial Site Data Acquisition System (SSDA 100)**
- **1 Electronics Interconnector Cable Kit**
- **1 Set Operator Instruction Manuals, PDF format**
- **One Year Manufacturer's Warranty**

† Base components only: review *Remote Unit Configuration Options* inside this specification sheet.



Technical Specifications

RADIATED SIGNAL SPECIFICATIONS

Operators must adhere to local radiated signal regulations and receive proper authorizations prior to operation. Licenses should be obtained by system operator/owner prior to transmission. System can be manufactured to be tuned for operation at user-specified frequency, which can be one of the authorized oceanographic radar bands as defined by ITU, or any other band authorized by presiding local authority. Transmitted signals are within the latest ITU guidelines for oceanographic HF radar.

Output Radiated Power: 80 W peak, 40 W average

Operating Frequency Range:

Electronics: 4.4 – 50 MHz (select specific frequency for filter tuning)

Antennas: Select a frequency between 4.4-50 MHz

Modulation Format: Pulsed Swept Frequency CW (FMiCW)

Sweep Width: 12-300 kHz (typical)

Pulse Repetition Frequency: 514 - 8224 Hz

Sweep Repetition Frequency: 1-4 Hz

Total Radiated Signal Bandwidth: (at -20dB level) 65-200 kHz

Polarization: Vertical

System Power Requirement (transmitter, receiver & computer): 350 watts (24V DC ver.) or 500 watts (120-220 VAC)

TRANSMITTER

Transmitter Chassis: SSTX

Input RF Drive Level: 0 dBm

Output RF Power Level: 100 watts peak, 50 watts average

Power Requirements: 300 watts; 110 watts for 24VDC ver.
(select one when ordering):
120 V AC, 50-60 Hz, or 220 V AC, 50-60 Hz, or 24 V DC

Design: (gated FET) modular; solid state

Operation: Class AB

Dimensions: (single chassis) 19" rack mountable, 3U tall; 13H x 49W x 53D (cm)

Weight: 15 kg

Temperature Range (ambient): 0˚ F (-18˚ C) to 90˚F (32˚ C)

Internal Temperature Sensor

Maximum Humidity: 80% non-condensing

RECEIVER

Receiver Chassis: SSRX

Maximum In-band Input Level: 0 dBm

Receiver Channel Impedance: 50 ohm

Sensitivity (noise level): -166 dBm in 1 Hz BW

Power Requirements: 100 watts;
(select one when ordering):
120 V AC, 50-60 Hz, or 220 V AC, 50-60 Hz, or 24 V DC

Design: modular, solid state, three-channel

Operation: I/Q homodyne

Output: USB digital output; digital data at 4096 16-bit/second per channel

Dimensions: (single chassis) 19" rack mountable, 3U tall; 13H x 49W x 53D (cm)

Weight: 14 kg

[**Optional "SHARE" GPS-enabled modulation multiplexing synchronization feature:** GPS-assisted stability: 10 ns. PPS resolution: 0.1 ns]

Temperature Range (ambient): 0˚ F (-18˚ C) to 90˚F (32˚ C)

Maximum Humidity: 80% non-condensing

Internal Temperature Sensor

System Requirement: AC Power Conditioning via Uninterruptable Power Supply (UPS). Minimum recommended UPS capacity: 1500 VA (1050 Watt)

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ANTENNA CABLING

Requirement- Cabling Protection:
Ideally cables between antennas and electronics are fed through protective conduit (such as >6 cm diameter PVC pipe) and buried in trench. There are lower cost options available, but there will be greater risk to exposure and damage.

One cable set compatible with the antenna system is included. It will be one of the following:
Cable Set (compatible with the Combined Transmit-Receive Antenna):
Type: Single Strand RG-8 Low loss Coaxial + Double Strand RG-58 Low Loss Coaxial bundle, 75 m length

OR
Cable Set (compatible with the separate Transmit Antenna & Receive Antenna:
Type (Transmit Cable): Single Strand RG-8 Low loss Coaxial, 75 m length
Type (Receive Cable): 4- Strand RG-58 Low Loss Coaxial bundle, 100 m length

Upgraded cable types and lengths are available for purchase.

ANTENNA SYSTEM

Note: Antennas for operation at one frequency band and bandpass filters for operation at two frequency bands are included with SeaSonde remote unit purchase. Antennas and filters for operation at additional frequency bands can be purchased separately.

Requirement- Bases/Mountings for Antennas:
Antennas need be mounted vertically secured to concrete concrete pad or guyed with earth screws or lashed to fencing or other solid structure. Read SeaSonde Antenna Installation User's Guide for examples.
One antenna system is included that will operate at the user-specified frequency.

Combined Transmit-Receive Antenna
Shipped in 3 parts that are joined during installation:
•Transmit-Receive Antenna Assembly & •Transmit-Receive Antenna Dome & •Upper Whip
Total antenna height: will vary from 6.4 m - 7.6 m based on operating frequency.
E.g. 11 MHz antenna: ~7.6 m; 25 MHz antenna: ~ 6.4 m
Weight: ~90 lbs.
Durability: All-weather
Design (receive): vertical off-center-fed dipole
Functionality (receive): omnidirectional, adjustable (in software) from 1-360 degrees
Design (transmit): vertical off-center-fed dipole; Functionality (transmit): omnidirectional

Or **1 Transmit Antenna & 1 Receive Antenna (in lieu of combined transmit-receive antenna)**
Shipped in 4 parts (2 of which are joined during installation to form the receive antenna):
•Long-Range Antenna Assembly (Transmit) & •Receive Antenna Assembly & •Receive Antenna Dome & Upper Whip
Antenna height: Receive: ~6.4 m; Transmit: ~8.6 m
Antenna weight: Receive: ~76 lbs.; Transmit: ~96 lbs.
Durability: All-weather
Design (receive): vertical off-center-fed dipole
Functionality (receive): omnidirectional, adjustable (in software) from 1-360 degrees
Design (transmit): vertical monopole; Functionality (transmit): omnidirectional

Receive Antenna or Combined Transmit-Receive Antenna

Requirement – SeaSonde Antenna Placement
Shown below is a simplified description of requirement for antenna placement. For more detailed information on proper antenna placement, refer to SeaSonde Operators Manual.

Clear Space Around RX and TX Antennas
Objects that interact with or alter the response of the transmit or receive antenna can affect bearing accuracy or create bearing gaps in coverage. Position SeaSonde antenna one horizontal radar wavelength or greater away from tall (one quarter of the radar wavelength or taller) objects or obstructions (see chart). There should be no obstructions between the SeaSonde antenna and the seaward side that may block energy in direction of ocean. Ideally, position receive antenna one horizontal radar wavelength or greater away from a cliff or building edge (see chart). 5 MHz transmit and receive antenna should be spaced at least 50 m apart from each other.

SeaSonde Frequency Band (MHz)	RADAR TX wavelength (meters)-	Quarter wavelength (meters)-	Max. Distance to Water: 4xλ (meters)
5	60	15	240
12	25	6	100
25	12	3	48
40	8	2	30

Distance (on horizontal axis) from Water to Antenna
Antenna should be positioned close to the water to prevent propagation loss of energy traveling over ground. Maximum recommended distance from SeaSonde antenna to water is four radar wavelengths (see chart).

RADIAL SITE DATA ACQUISITION SYSTEM (SSDA 101)

SSDA 101 Consists of:

Mini Computer + **Monitor:** color TFT + **Keyboard & Mouse:** USB, extended
Radial Suite Software License (online version, single-use) & USB Software Key

Temperature Range: 0˚ F (-18˚ C) to 90˚F (32˚ C) for mini-style computer
Maximum Humidity: 80% non-condensing
Compatible Communications: 10/100/1000 Base-T Ethernet (RJ-45 connector) & Others (such as dial-up modem).
Communication Link Requirement

- A reliable data communications link is required for:
  - Real-time data transmission,
  - Real-time system monitoring,
  - Proper system maintenance and customer support,
  - Remote software updates.
- Minimum data bandwidth (upload and download each): 1 Mb/s for optimal remote interactions.

Radial Suite Software Data Products

Radial Surface Current Velocity Maps

Radial Map Display: archived ASCII vector files-- formatted to CODAR's LLUV columnar table format (MatLab® loadable).
Spatial Range (typical): 15-300 km offshore; 15-300 km alongshore. Observable range varies upon operating frequency, ocean conditions, external noise levels, antenna siting and a variety of other factors.
Range Resolution: user selectable from 200 m - 12 km. Resolution is based on transmit signal sweepwidth.
Angular Grid Spacing: 1-5 degree bins: user selectable.
Data Temporal Interval: User selectable in software. Typical averaging performed over one hour.
Current Accuracy: Varies with environment. Rms typical for the radial current speed: < 7 cm/s and 1-2 cm/sec for the tidal component.
Doppler Cross Spectra
Binary files of HF sea echo spectra for three receive channels (two cross-loops & vertical element). Raw and averaged are available for processing into radial vector maps.
Range Processed Spectra (Range Series)
Optional binary files of receiver range processing which can be processed into Doppler cross spectra.
Raw I & Q voltages (Time Series)
Optional binary files of receiver analog measurements which can be processed into range spectra and Doppler cross spectra.

Wave Field & Wind Outputs

Local on-shore wave conditions and wind direction averaged in range rings around each radar. Measurement range cell user-selectable. Wave field parameter measurements do not extend as far as radial surface current measurements. Ability to obtain any wave information with an HF radar is limited and will vary based on operating frequency, ocean conditions, external noise levels, antenna siting and a variety of other factors.
Significant Waveheight. typical accuracy: 7-15%
Dominant on-shore Direction. typical accuracy: 5-12 degrees, depends on waveheight.
Dominant Wave Period. typical accuracy: 0.6 s
Minimum Detectable Significant Waveheight: 0.2-1.5 m minimum, this will vary based on operating frequency and ocean conditions.
Data Temporal Interval: User selectable. Typical and recommended wave averaging performed over one hour.
Wave History Displays: Hourly waveheight vs. time. Hourly wave direction vs. time. Hourly wave period vs. time. Wind direction vs. time.
Diagnostics
ASCII or image of diagnostic time series data for system hardware, software and data performance parameters. ASCII files are formatted to CODAR's columnar table format (MatLab® loadable).

SeaSonde Radial Suite Software Properties & Functions:

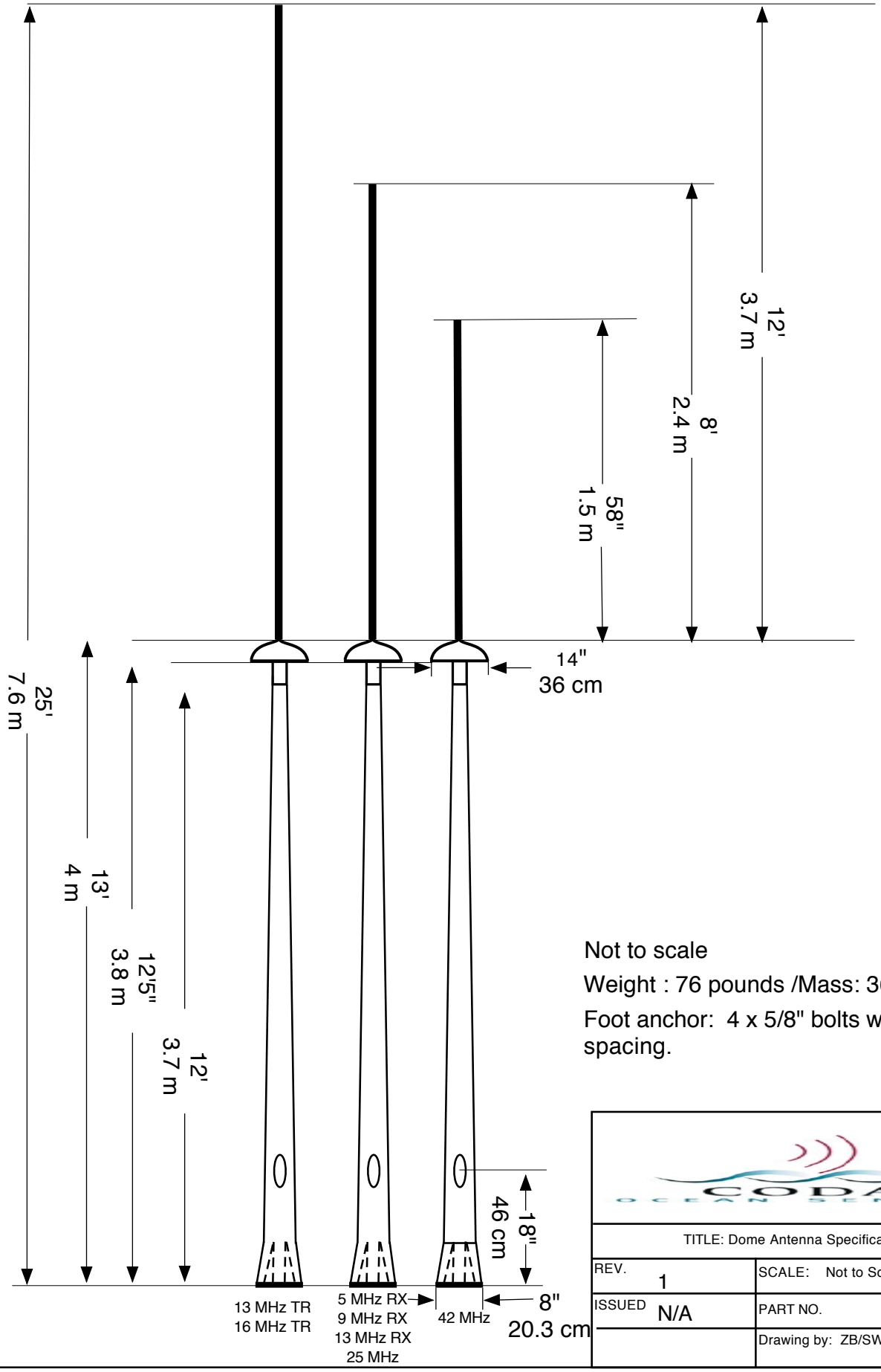
- Real-time autonomous operation & processing of current and waves
- Radio call sign capability for adherence to ITU guidelines
- Real-time system monitoring, diagnostics, logging & alerts (via email)
  - Hardware
    - Temperatures
    - Voltages
    - Data Acquisition
    - Miscellaneous Hardware
  - Software
    - Applications/Tools running (relaunch if not)
    - Data collection & processing operations
    - Acquisition and archiving
- Configuration done via Graphical User Interface
- Layered configurable properties for both basic and advanced functions including waveform settings
- Graphical or command line control and monitoring
- Visualization Software for all stages of data (raw binary I & Q to vector maps) and diagnostics
- JPEG or PNG plot images for sharing via email or web publishing
- Data archiving utility
- External Antenna Response Calibration & Implementation
- Multiple levels of configurable Quality Control:
  - Signal-To-Noise Computation & Thresholding
  - Peak Identification & Characterization
  - Ship Echo Removal
  - Burst Interference Removal (Lightning & Others)
  - Ionospheric Noise Removal
  - Outlier Detection & Removal

•Management for shared frequency, when using the SHARE technology
•Additional capabilities available with add-on software packages

SeaSonde Remote Unit Configuration Option Guide

Step 1: First choose a specific operating frequency between 4-50 MHz and find applicable column (at right) the selected frequency falls inside. Then select from the configurations options below.			**Frequency Band (MHz)** Select applicable column below		
"Std": option already included as part of standard configuration "N/C": option available at no extra charge "Opt. Add-On": option available for a fee in addition to the base price Grey boxes indicate option not available.			**>20-50**	**11-20**	**4 - <11**
⬇ Configuration Options ⬇					
Power Supply (select one)		110 V (AC)	Std	Std	Std
		220 V (AC)	N/C	N/C	N/C
		24 V (DC)	Opt. Add-On	Opt. Add-On	Opt. Add-On
		Low Power Transceiver (only available <14 MHz)		Opt. Add-On	Opt. Add-On
Frequency Modulation Multiplexing (SHARE) (single-use license)			Opt. Add-On	Std	Std
AutoAPM Kit (single-use license)			Opt. Add-On	Opt. Add-On	Opt. Add-On
Multi-Static Data Processing Software Package (single-use license)			Opt. Add-On	Opt. Add-On	Opt. Add-On
Tsunami Detection Software Package (single-use license)			Opt. Add-On	Opt. Add-On	Opt. Add-On
Vessel (Ship) Detection Software Package (single-use license)			Opt. Add-On	Opt. Add-On	Opt. Add-On
Chassis & Antenna Configuration (select one)	**Tx & Rx Antennas Separate**	Single Transmit Antenna	N/C	Std	Std
		Twin Transmit Antennas		Opt. Add-On	Opt. Add-On
		Dual-Transmitter w/ Twin Tx Antennas (not presently optional w/Low Power Transceiver)			Opt. Add-On
	Tx & Rx Antennas Combined		Std	Opt. Add-On	
Extended Lightning Protection Kit			Opt. Add-On	Add-On	Opt. Add-On
Antenna Base Hinge Assembly (compatible only with dome-style antennas & 5 MHz TX antennas)			Opt. Add-On	Opt. Add-On	Opt. Add-On
Dome Antenna Guy Rope Holder (rope included)			Opt. Add-On	Opt. Add-On	Opt. Add-On
Dome Antenna Guy Rope Holder (rope NOT included)			Opt. Add-On	Opt. Add-On	Opt. Add-On
Tx/Rx Cable Combine Tx/Rx AntennaOnly (select one)	**1 X RG-8 2 X RG-58**	75 meters	Std	N/C	
		price per meter (beyond 75m)	Opt. Add-On	Opt. Add-On	
Rx Cable Separate Antennas Only (select one)	**4 X RG-58**	100 meters	N/C	Std	Std
		custom length >100m	Opt. Add-On	Opt. Add-On	Opt. Add-On
	3 X RG-8	100 meters	Opt. Add-On	Opt. Add-On	Opt. Add-On
		custom length >100m	Opt. Add-On	Opt. Add-On	Opt. Add-On
Tx Cable Separate Antennas Only (select one)	**1 X RG-8**	75 meters	N/C	Std	Std
		custom length >75m	Opt. Add-On	Opt. Add-On	Opt. Add-On
Smart Uninterruptable Power Supply (UPS)			Opt. Add-On	Opt. Add-On	Opt. Add-On
External Hard Drive			Opt. Add-On	Opt. Add-On	Opt. Add-On
Electronics Enclsoure (ENC36)			Opt. Add-On	Opt. Add-On	Opt. Add-On
Electronics Rack			Opt. Add-On	Opt. Add-On	Opt. Add-On
BackUp Battery Bank			Opt. Add-On	Opt. Add-On	Opt. Add-On
UPS Power Conditioning Unit with Battery Array and Rack			Opt. Add-On	Opt. Add-On	Opt. Add-On
24 V(DC) to AC converter (choose one of either 110V or 220V)			Opt. Add-On	Opt. Add-On	Opt. Add-On
Mfr. Limited Warranty Extension (extending warranty beyond first year)			Opt. Add-On	Opt. Add-On	Opt. Add-On
Technical Support Service Contract (enquire on the variety available)			Opt. Add-On	Opt. Add-On	Opt. Add-On

ANTENNA DIMENSIONS (EXAMPLES OF MOST COMMON FREQUENCIES)



Not to scale

Weight : 76 pounds /Mass: 36 kg

Foot anchor: 4 x 5/8" bolts with 6" spacing.

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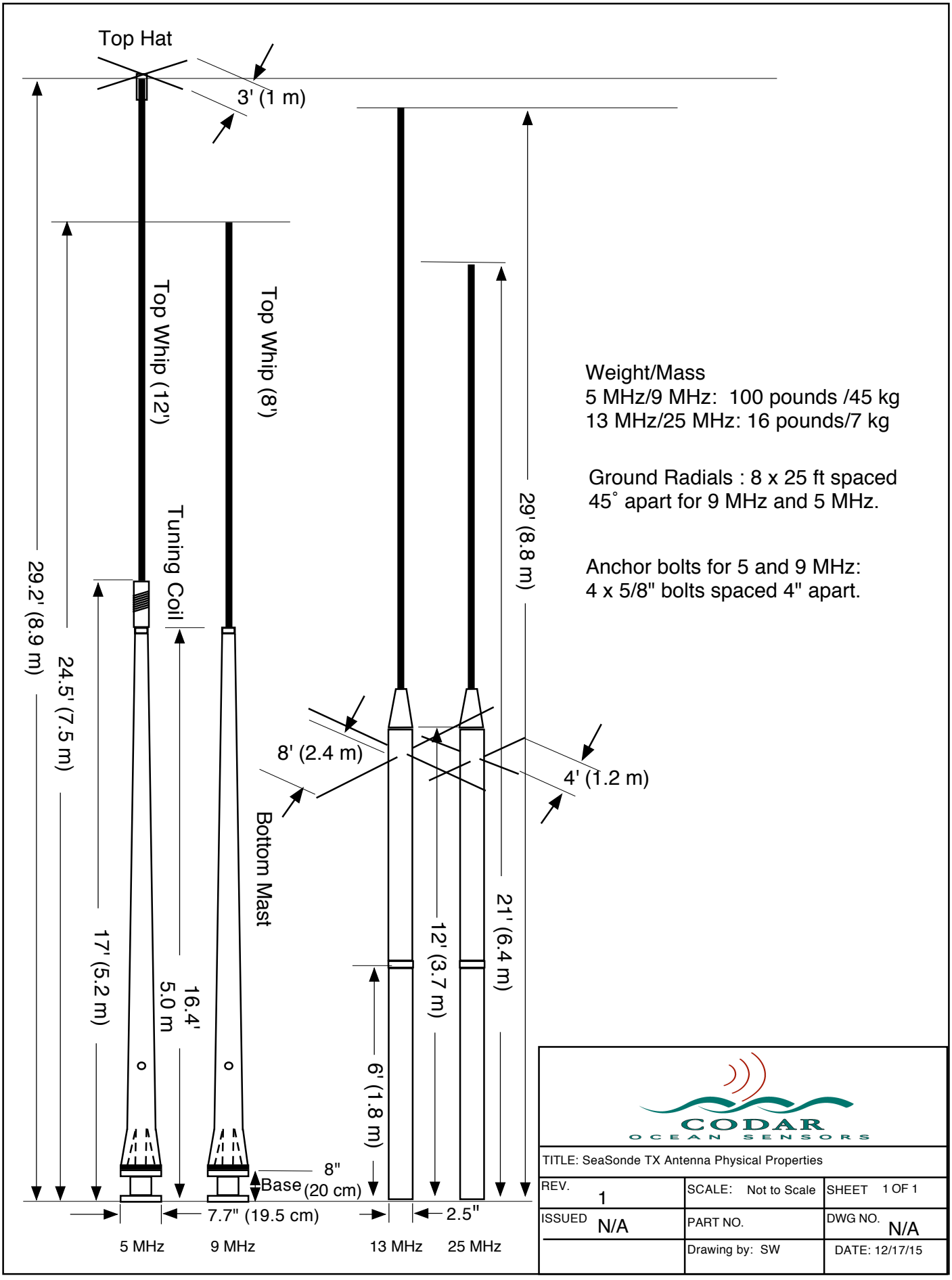
TITLE: Dome Antenna Specifications		
REV. 1	SCALE: Not to Scale	SHEET 1 OF 1
ISSUED N/A	PART NO.	DWG NO. N/A
	Drawing by: ZB/SW	DATE: 12/16/15

TRANSMIT-ONLY ANTENNA DIMENSIONS
(EXAMPLES OF MOST COMMON FREQUENCIES)



Weight/Mass
5 MHz/9 MHz: 100 pounds /45 kg
13 MHz/25 MHz: 16 pounds/7 kg

Ground Radials : 8 x 25 ft spaced 45˚ apart for 9 MHz and 5 MHz.

Anchor bolts for 5 and 9 MHz:
4 x 5/8" bolts spaced 4" apart.

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TITLE: SeaSonde TX Antenna Physical Properties		
REV. 1	SCALE: Not to Scale	SHEET 1 OF 1
ISSUED N/A	PART NO.	DWG NO. N/A
	Drawing by: SW	DATE: 12/17/15