

## Always a Wavelength Ahead

- One of WERA's unique features is the flexibility to be set-up in **Compact** or **Array Type configuration**. In the table below the parameter for these configurations are listed. This enables you to find the **best radar configuration** for **your specific application** !
- The **compact WERA** site configuration uses Direction Finding methods to provide ocean current data to monitor **mesoscale current** features. With an **array type antenna** system the high resolution software Beam Forming allows to monitor **sub-mesoscale current** features and in addition **wave data maps** are provided.
- The WERA system core can operate over a broad frequency range from **4.5 to 70 MHz** to provide **longest ranges** of more than **300 km** or **highest resolution** for **short ranges**. To change the operating frequency band just some filter modules and the antenna tuning need to be changed.
- A **multi-frequency band** operation with automatic switching is available as option.
- **Very low RF-power** typically <30 Watts to prevent interference with other radio services.
- The **FM-cw principle** provides **the best signal to noise ratio** and makes WERA the most effective ocean radar with the **best frequency to range** performance.
- The **robust and small antenna** system are easy to install and can be integrated smoothly to the natural environment or into existing structures.
- WERA always provides the best ocean radar configuration for your specific application.

Pos	Parameter	Description	Value		
01	<b>Working range</b> <i>Can be reduced due to environmental effects</i>	Depends on frequency	<b>all values are valid for 24.5 to 26.5 MHz</b>		
		for currents:	50 km		
		wind direction:	35 km		
		for wave height:	20 km		
		for wave spectra:	15 km		
02	<b>Range resolution</b> <i>Integration in range</i>	Depends on allocated bandwidth	<b>150 kHz</b>	<b>300 kHz</b>	<b>500 kHz</b>
		The used grid size should be 20 % wider than this value:	1000 m	500 m	300 m
03	<b>Angular field of view</b>	<b>± 50° with 8 antennas (35 m long array)</b> ± 60° for 12 or 16 antennas in a linear array (55 or 80 m long array) > ± 70° for 12 or 16 antennas in a curved array > ± 90° for 4 antennas in a square (4.5 x 4.5 m square as Compact Array)			

Pos	Parameter	Description	Value		
04	<b>Angular Accuracy</b>	with 8 antennas	<b>± 2° stable under all conditions*</b>		
		with 12 or 16 antennas	± 1° stable under all conditions*		
		with compact 4 antenna array	* due to automatic calibration, but it can be critical with moving metal nearby (e.g. cranes, ships, cars)		
			± 5° (antenna calibration recommended)		
05	<b>Beam width</b> <i>Integration in azimuth</i>	depends on beam steering angle	<b>at centre</b>	<b>Typical</b>	<b>at edge</b>
		for 16 antennas	± 3°	± 4°	±6°
		for 12 antennas	± 4°	± 6°	±8°
		for 8 antennas	± 7°	± 10°	±16°
		for compact array	No beam, using Direction Finding methods		
		Angular resolution	always finer than 1°		
06	<b>Temporal resolution</b> <i>Integration time</i>	recommended integration time to get independent data sets:	For current measurements:	3 ... 5 min	
			For wave parameters:	10 ... 20 min	
			Minimal time step:	30 sec	
07	<b>Data up-date rate</b> <i>to optimise data transfer rate</i>	recommended up-date rate:	For current measurements:	15 ... 30 min	
			For wave parameters:	20 ... 60 min	
			for disaster warning:	30 sec	
08	<b>Data output</b> <i>all data (current, wind and wave) are provided on a user defined grid</i>	<i>for each individual WERA station</i>	<b>Compact</b>	<b>8 Antennas</b>	<b>12 to 16 Ant.</b>
		radial current velocity	Yes	<b>Yes</b>	Yes
		significant wave height	No	<b>Yes</b>	Yes
		Tsunami Detection	Limited	<b>Yes</b>	Yes
		Tsunami Warning	No	<b>Yes</b>	Yes
		<i>Within the overlapping area of two or more WERA stations</i>			
		current velocity vectors	Yes	<b>Yes</b>	Yes
		wave height & direction (spectra)	No	<b>In Center ± 30°</b>	Yes
		Wind direction	Yes	<b>Yes</b>	Yes
		Wind Speed	No	<b>In Center ± 30°</b>	Yes

Pos	Parameter	Description	Value
09	<b>Accuracy</b> <i>These parameters are typical values, affected by site configuration, geometry and environmental conditions</i>	for 25 MHz, radial current velocity:	3 cm/s @ 5 min integration time
		significant wave height:	< 10 % @ 20 min integration time
		mean wave direction:	< 5° @ 20 min integration time
		mean wave period:	< ± 0.6 sec
		directional wave spectra:	0.01 Hz
		wind direction:	10° ... 40° depends on wind speed
10	<b>Limits for wave detection</b>	min. significant wave height	0.4 m
		min. for wave directions (spectra)	0.8 m
		max. significant wave height	4.0 m
11	<b>Limits for wind direction</b>	at very low wind speed the measurement of the direction becomes uncertain	
12	<b>Antenna construction</b> <i>Transmit and receive antennas are designed identical</i>	Simple vertical monopoles, individually match to site specific ground conditions	Pole length: 1.5 m Overall height: 2.5 m
13	<b>Antenna array</b>	Rectangular configuration for Tx	2 x 6 m
		<b>Linear receive array, 8 antennas</b>	<b>35 m</b>
		Linear receive array, 12 antennas	55 m
		Linear receive array, 16 antennas	80 m
14	<b>Transmit power</b>	Low, non harmful rf power, typically 7.5 W per antenna pole, 30 Watts total	
15	<b>Synchronise WERA systems</b>	Multiple stations can use the same frequency band with WERA-multi method	
16	<b>Analog data acquisition system</b>	Non multiplexed quadrature detector with amplitude and phase conserving analogue to digital conversion	
17	<b>Digital data acquisition</b>	WERA software beam forming in near real time Unique WERA noise reduction in connection with beam forming Optional direction finding software for compact antenna type systems	
18	<b>System control</b>	Access to all radar parameters via web based user interface, listen before talk mode with frequency adaptation, rf interference reduction, system self-check and automatic calibration	
19	<b>System Hardware</b>	Desktop case (19" rack) to be installed indoors width: 560 mm    depth: 630 mm    height: 780 mm (for 8 channels) Weight 56 kg (without UPS and PC) Supply 115 – 230 V / 50 - 60 Hz / 400 to 600 Watts-peak with intelligent UPS Environment: 0 ... 30°C, 5 ... 80% rel. humidity (no condensation)	

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20	<b>WERA Container</b>	The WERA system should be installed indoors in an air conditioned room. If such a room is not available a WERA container can be provided:  Vandalism protected, thermal insulated cabin, electricity installation, 19" cabinet for WERA rack, desk, shelves, lightning protection, fire proof, water tight, integrated high efficient air-conditioning. dimensions: 3000 x 2200 x 2300 mm (L x W x H) (other dimensions available) weight app.: 900 kg	
21	<b>Software packages</b>  <i>All packages are included in the standard WERA tool box.</i>	<b>WERA-RT:</b>	real-time processing
		<b>WERA-CTL:</b>	remote system control via web interface
		<b>WERA-RFI:</b>	unique noise reduction for array type WERA systems
		<b>WERA-FA:</b>	frequency adaptation (listen-before-talk mode)
		<b>WERA-Share:</b>	Use of allocated radio band for multiple WERA stations
		<b>WERA-DF:</b>	direction finding
		<b>WERA-BF:</b>	beam forming with automatic self calibration feature
		<b>WERA-crad:</b>	radial current velocity
		<b>WERA-wrad:</b>	significant wave height for about 40 % of the current range
		<b>WERA-Wind:</b>	wind direction for about 70 % of the current range
		<b>WERA-2D:</b>	combines radial data of wind, waves and currents of multiple WERA stations
		<b>WERA-QC:</b>	Quality control
<b>WERA-HK:</b>	House keeping tool to optimise the available disk space		
22	<b>Software packages</b>  <i>Optional (extra charge)</i>	<b>WERA-Data-Manager</b>	Provides vector maps for ocean currents, wind and waves. Comfortable user interface for data viewer and data archive. Display of time series of individual grid points.
		<b>WERA-Clean-Map</b>	Provides artefact removing tools as add on for Data Manager.
		<b>WERA-Synthetic-Wave-Buoy</b>	Provides directional wave spectra for selected user-defined grid cells within the overlapping radar ranges and time-series of derived parameters such as significant wave height, peak period, peak direction as well as wind direction.
		<b>WERA-Wave-Grid</b>	Provides directional wave spectra for all grid cells with sufficient signal quality within the overlapping radar ranges. Various options for real-time or off-line processing are available.

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22	<b>Software packages</b>  <i>Optional (extra charge)</i>	<b>WERA-Parallel</b> (Variable integration time)  Recommended to get optimised wave data and sub-mesoscale current structures in parallel.  Required for time sensitive applications like disaster warning.
		<b>WERA-TEWS</b>  Extracts current signature generated by an approaching tsunami at the shelf edge. Providing automatic alerts according to user settings.
		<b>WERA-CurDrift</b>  Surface current drift prediction for search and rescue or environmental protection applications.
		<b>WERA-SDT</b>  Ship detection and tracking software in non real-time mode for scientific applications.
23	<b>Software services</b>	<p><b>All output data can be formatted in user specific formats.</b></p> <p><b>Special services for data assimilation into oceanographic models are available.</b></p> <p><b>Bathymetry data can be used to correct the measured data.</b></p> <p><b>External sensors can be connected to the WERA data processing computer to use the same data transfer channel as WERA.</b></p> <p><b>External sensor data can be integrated into WERA data maps.</b></p> <p><b>The integration of WERA output data in GRIB format into meteorological data networks can be provided.</b></p>
24	<b>Additional Services</b>	Site Planning
		Site preparation
		Installation of WERA systems
		User training at Helzel factory and at customers site
		WERA system configuration
		WERA data management service
		Extended warranty
		Software hotline
		Maintenance contracts
		Financing support ( leasing)