Quick Installation Guide

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1.1 Intended Use and Safety Instructions

- The WERA system is a short wave radar device for oceanographic applications. **To run the system the user has to get an official permission from the local authorities to operate radio wave transmitting systems.**
- This system complies with part 15 of the FCC rules. Operation is subject to the condition that this system does not cause harmful interference.
- The WERA system is designed for radar measurements at the ocean coast line. The transmitter antennae array will transmit a continuous RF signal with a power less than 10 Watts per antenna. Even if this low power won't generate any harmful voltage or radiation, it is required to take care that the installation of the transmit antenna system complies with the FCC requirements.

  Depending on the radar operation frequency, the antenna gain and the cable loss between power amplifier and Tx antenna system the minimum distance "D" can be calculated:

$$D = \sqrt{\frac{P}{4 * \pi * PD}}$$

$$P = P_{out} + G_{ant} - Att_{cable}$$

$$PD = 900 / f^2$$

where

D:	minimum distance in cm between human and antenna
P:	radiated power in mW,
P_{out} :	Output power of Power amplifier in dBm
G_{ant} :	Antenna gain of transmit antenna system in dB
Att_{cable} :	Cable attenuation in dB for cable from power amplifier output to transmit antenna
PD:	Power Density in mW/cm^2
f:	Radar operating frequency in MHz

The formulary to calculate the value of the power density is given in the FCC document "Radiofrequency radiation exposure limit" 47CFR § 1.1310

<u>Caution</u>: It is required to apply adequate precautions, e.g. fences with warnings signs, to prevent that humans enter the area around the transmit antenna system which is closer than the minimum distance as calculated above.

- The system must be installed by skilled personnel using calibrated HF test instruments. The radiated HF power must be kept below the defined maximum radiation power for Ocean Radar of 50 W_{ERIP} (47 dBm). Please note that the WERA power amplifier is capable to provide up to 49 dBm to compensate for cable losses for cases with the Tx antenna system installed in a distance of several 100 Meters.

  PA output level = max radiation – antenna gain + cable loss

  If the radiation can't be measured in the field, the antenna gain should be assumed as best case which is 6 dB. The output power can be set in steps of 2 dB and must always be adjusted to be below the permitted radiation level.

- The WERA system may only be operated in rooms with an electrical installation complying with the regulations for the use of outdoor equipment.
- The WERA system is only to be maintained or repaired by appropriately qualified personnel. **Any modification** of the system which is not explicitly defined in the user manual **will void the authorisation to operate the system**.
- This equipment has been tested and found to comply with the limits as defined for a Class "A" device in part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. **Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense**.

Caution: Never use the WERA system without training or reading these instructions.

2. Introduction

For information about the radar principle and the technical specifications, please refer to the WERA user manual chapter 2.

3. Site Survey

For information about site survey, please refer to the Manual chapter 3 or the template "WERA site planning form and instructions".

Please note this document is an extract of the complete user manual. The chapter and figure numbers are used from this manual, for this reason some chapter and figure numbers are missing is this quick guide. The WERA manual and other related documents can be found on the WERA PC at: /home/wera/Documents/

4. WERA Hardware

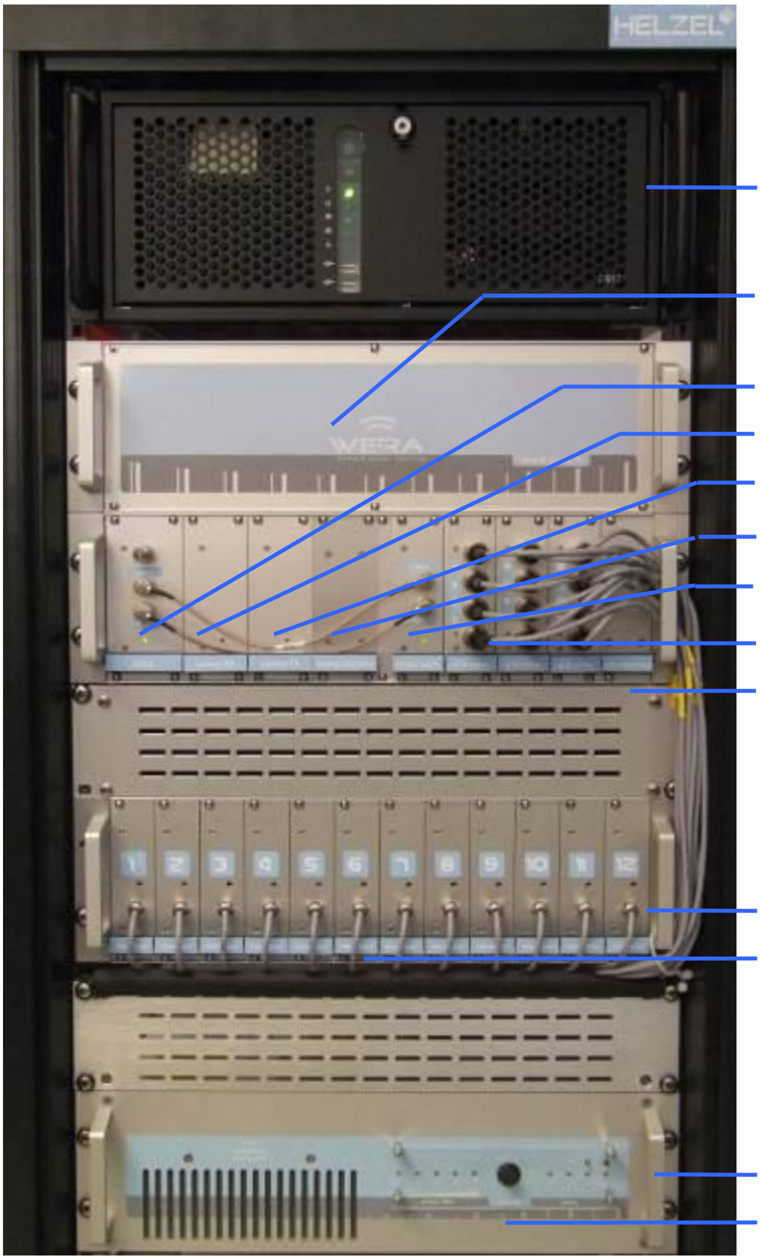


Figure 1: Front view, WERA 12-Channel System

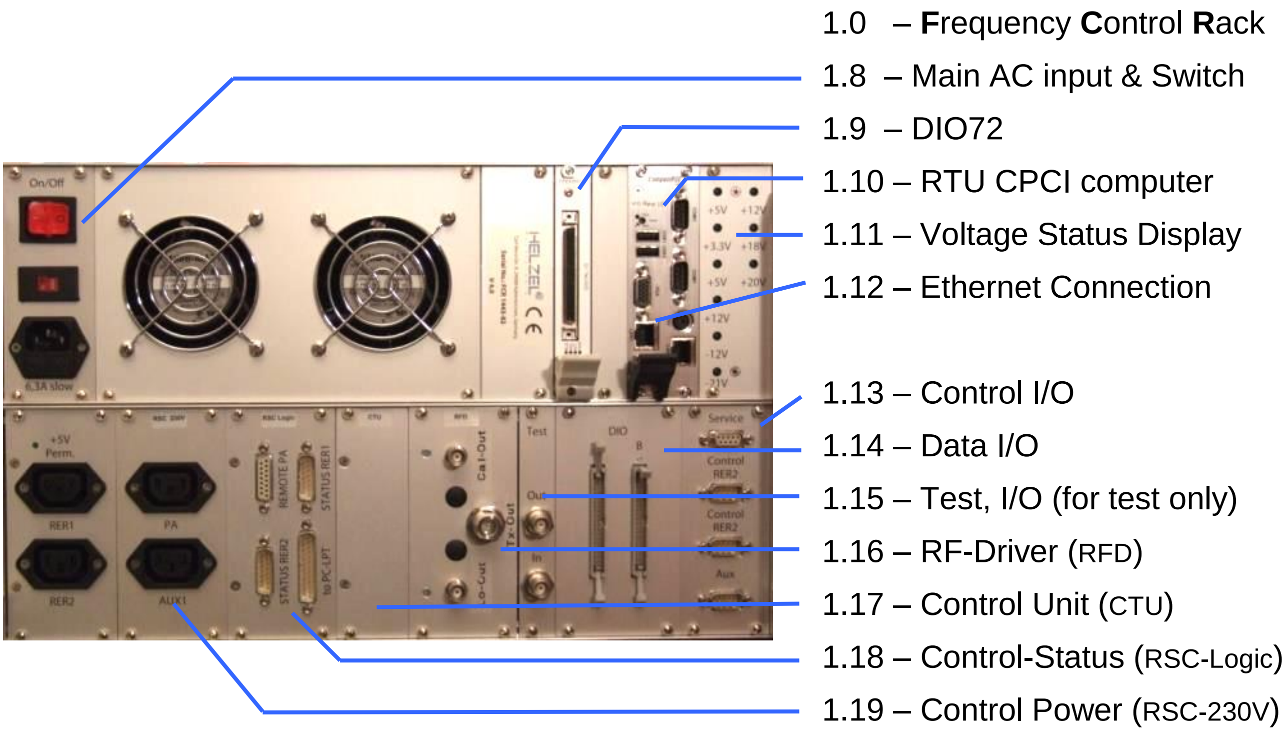


Figure 2: Back view, WERA FCR

Figure 3.1: Back view, WERA RER internal Filters (8 channels)

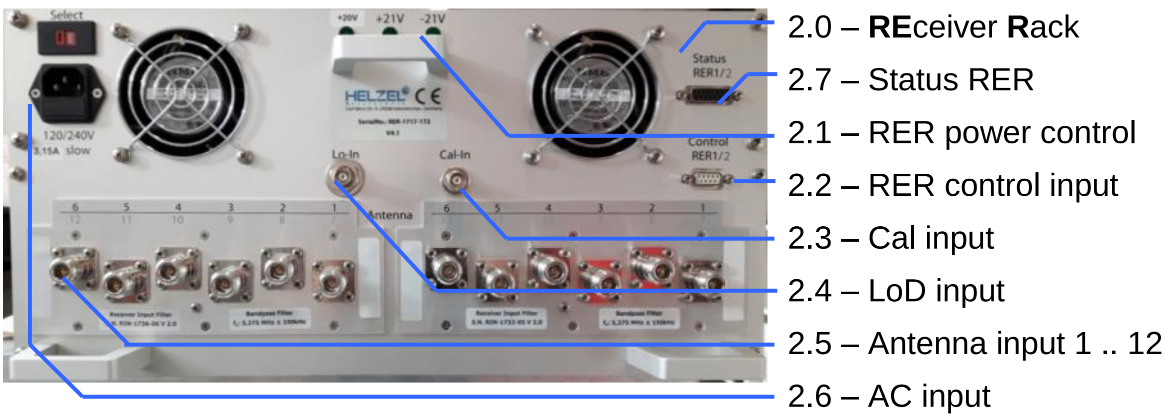


Figure 3.2: Back view, WERA RER (12 channels) – Version with internal Filters (RIN6)

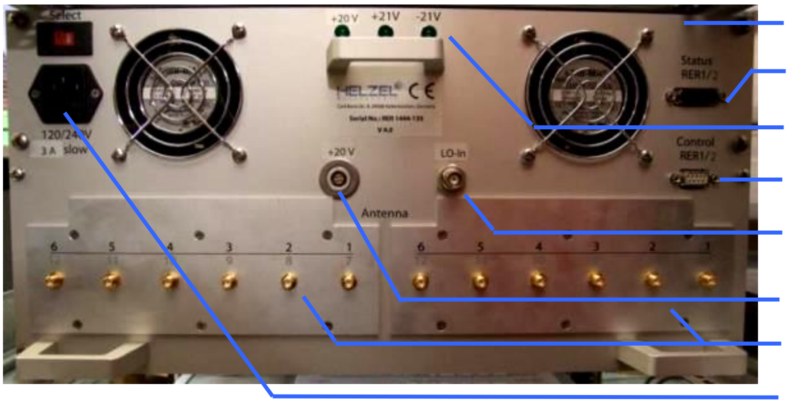


Figure 3.3: Back view, WERA RER (12 channels) – Version with external Filters (on AIP)

4.1 WERA-FCR FrequencyControlRack

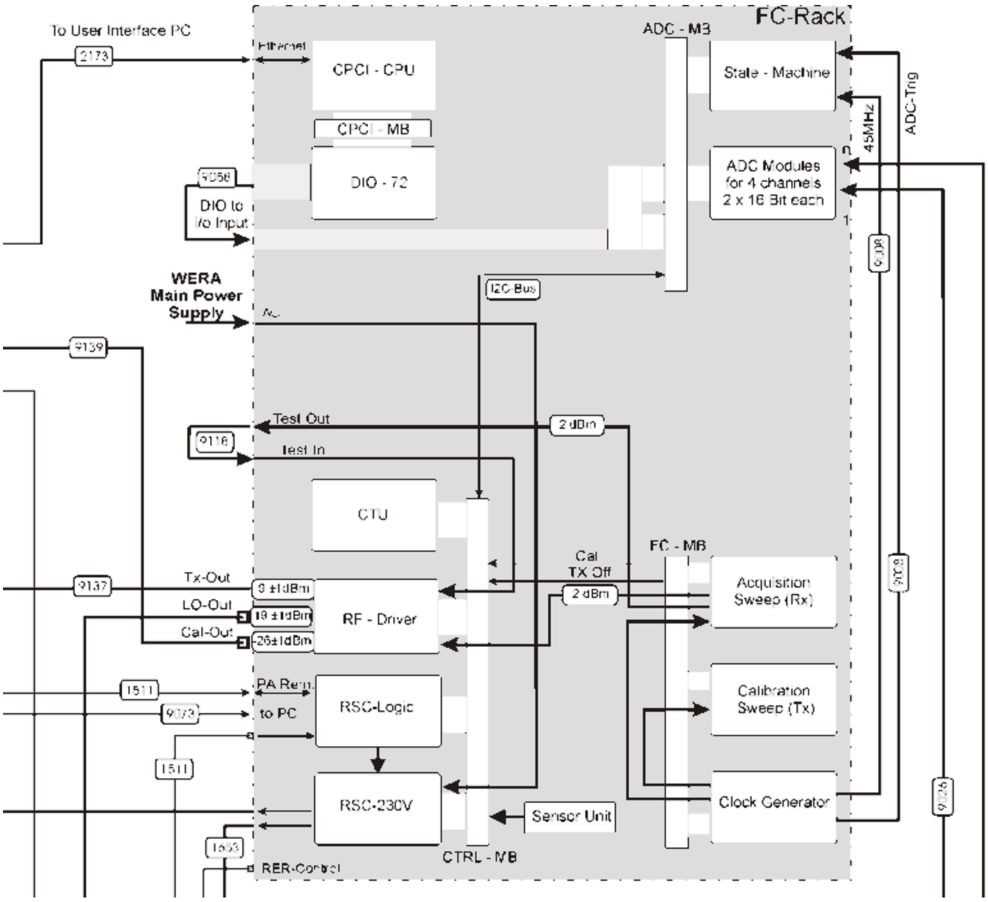
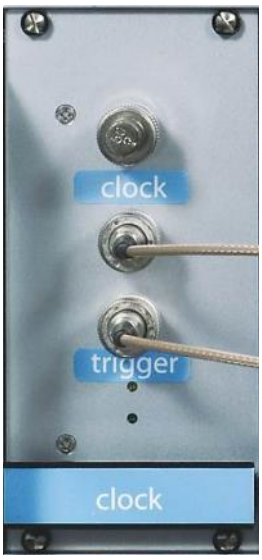


Figure 4: FCR Block Diagram

The frequency control rack generates all required rf signals (clock and sweep) and provide the Tx and Lo signals. In addition to that it contains the state machine (process control unit - STM) and the ADCs. The ADC output is clocked via a digital i/o-card into the memory of a CPCI module (RTU). It holds the following main modules:
CLK, STX, SRX, SDU, STM, ADC, RTU, CTU.
For more information about these modules read the following pages.

4.2 Clock - CLK



1.1.0 – SYNC antenna,
for clock only. CLK

1.1.1 – Clock signal out,
to be connected to STM

1.1.2 – Trigger signal out,
to be connected to STM

Figure 5: Clock Module

Master clock for the whole WERA system

The standard module has got one clock and trigger output only. The third connector is for the SYNC antenna only (option).

4.3 Sweep-RX - SRX / 4.4 Sweep-TX - STX

1.2.1 – LEDs
-> indicates
signal generation

Figure 6: Sweep Module

The sweep modules generate the transmit (TX) and receive (RX) signals for the measurement. Normally their output is a linearly swept frequency sweep.

In the newer WERA versions (since 2009) just the Rx sweep is active during acquisition. The Tx is used for calibration only and can be used as a “spare part” in case of a failure of the Rx sweep.

The sweep dummy is an empty housing in an unused sweep module slot of the FCR. Its purpose is to keep the correct airflow and thus the proper cooling of the other modules
.

4.4 State-Machine - STM

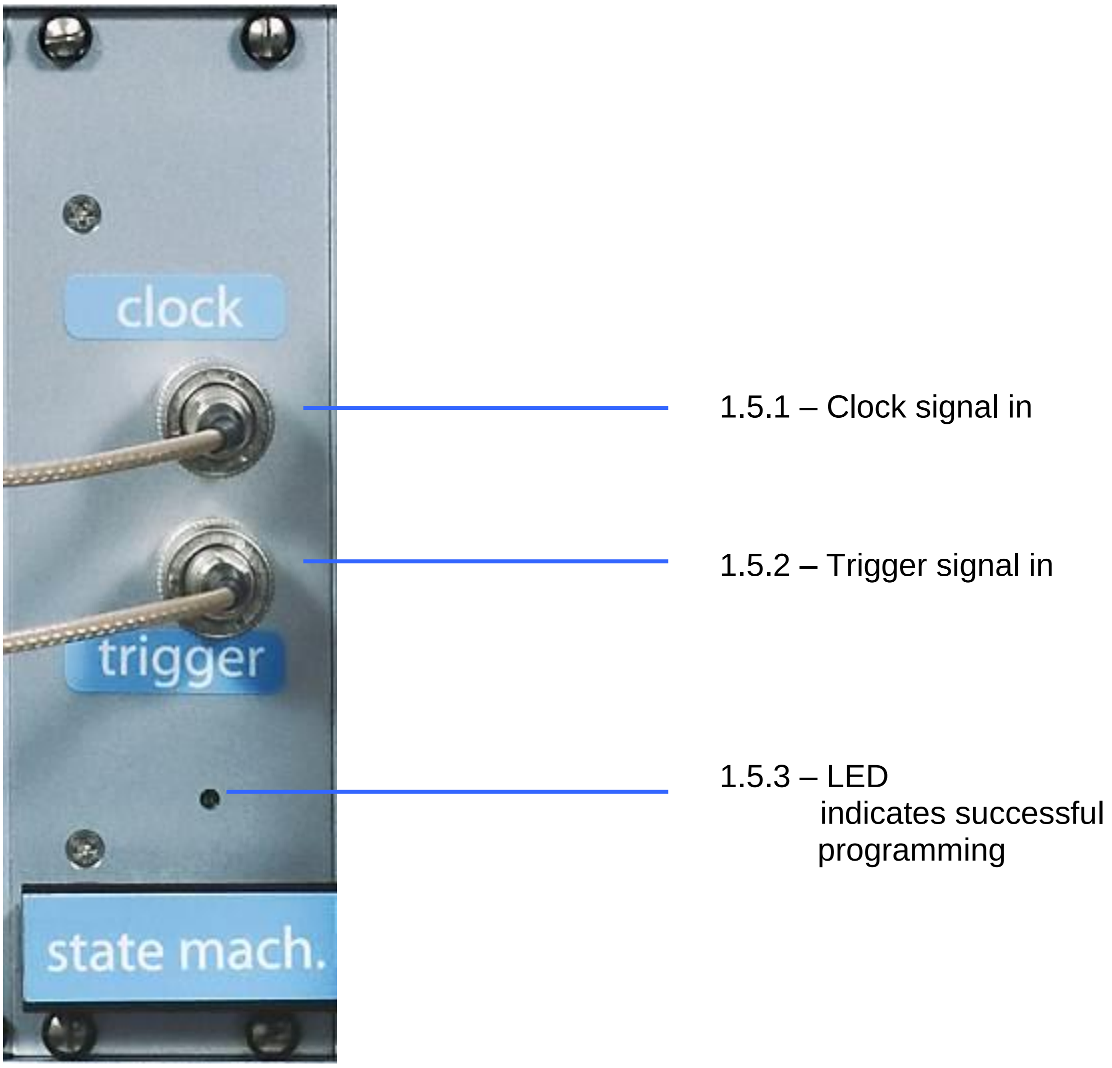


Figure 7: State Machine Module

The state machine synchronises data acquisition.
After a restart of the system the illuminated LED indicates that the system is operational. To turn on the LED the RTU needs to mount directories on the user pc.

4.5 A/D converter - ADC

Figure 8: ADC Module

Each ADC module samples I and Q information of four receive channels.

4.6 WERA-RTU - WERA Real-Time-Unit

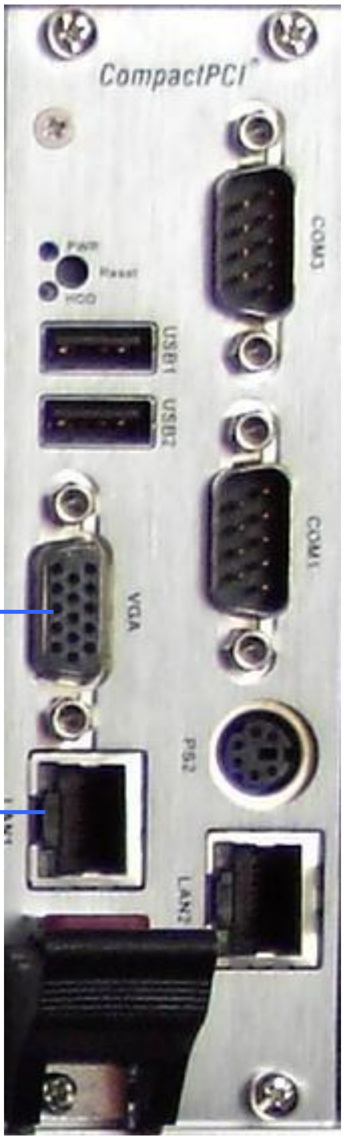


Figure 9: RTU Module

The real time unit controls data acquisition and stores measurement data on the user interface pc. It communicates with the user interface pc and forwards all needed parameters to the control unit.

4.7 WERA-CTU - WERA Control-Unit

The WERA control unit is programmed via an I^2C Bus driven from the DIO 72. This unit programs the sweep modules with the parameters received from the real time unit and controls the receive and transmit signals. There are no front panel connections for this unit.

4.8 WERA-RSC - WERA Remote & Status Control

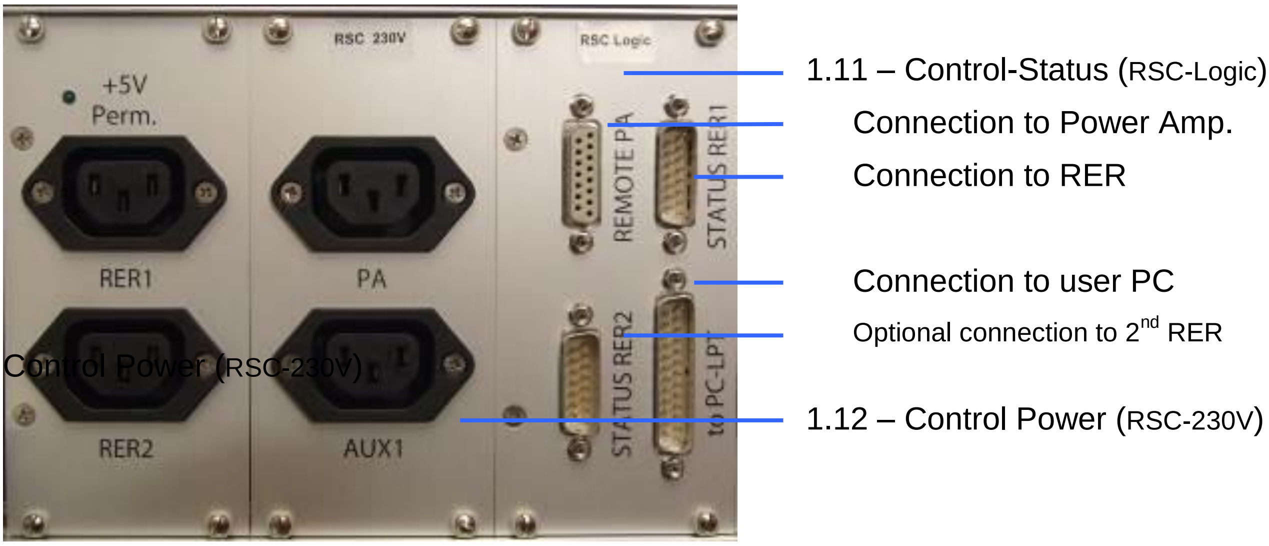


Figure 10: Remote & Status Control Modules (RSC 230 & RSC Logic)

The RSC Logic module is connected to the WERA Interface PC via the LPT port. Through this connection system settings are programmed and system status can be monitored.

The RSC 230 module is used to remotely switch on and off individual parts of the WERA system, e.g. to save power at sites that produce their own energy.

4.9 WERA-RFD - WERA RF-Driver

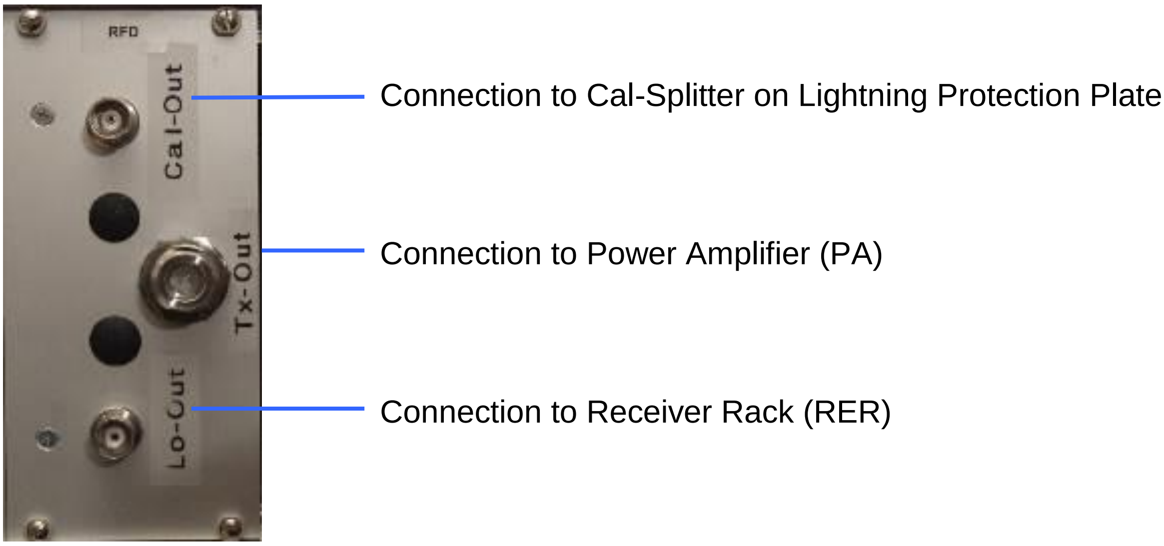


Figure 11: **RF-Driver Module - RFD** (figure shows version to drive one Receiver Rack)

The RFD module provides the RF signals for acquisition and calibration modes.

For 16 Channel operation (2xRER), secondary CAL and LO outputs can be mounted.

4.10.1 WERA-RER - Receiver Rack (12 channels) – external filter

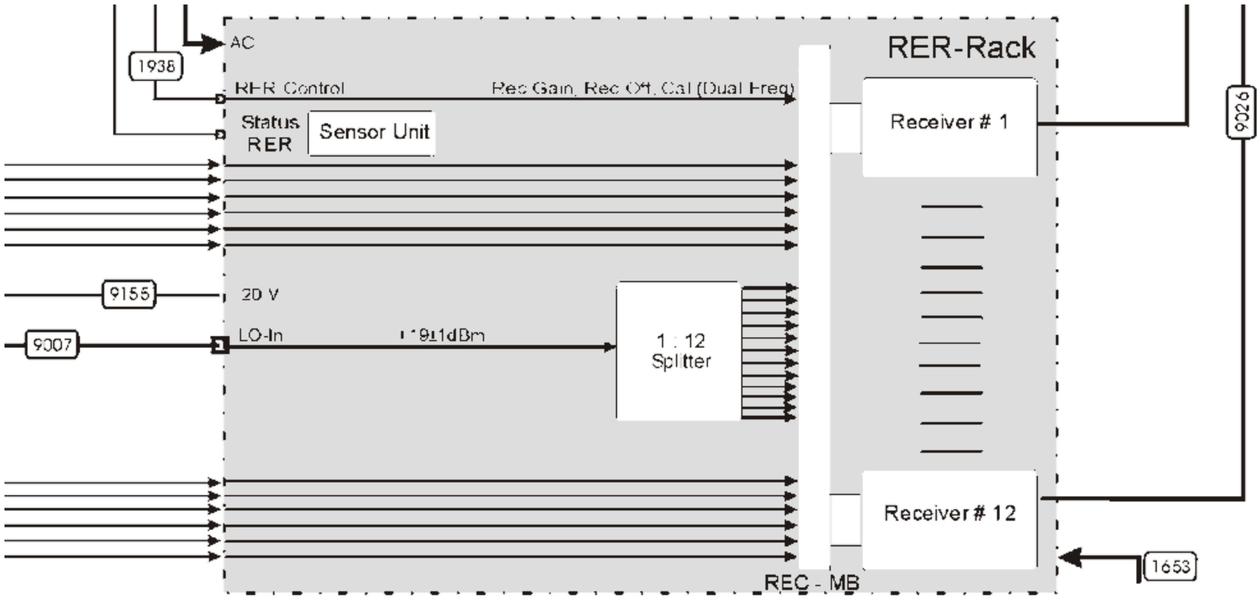


Figure 12: RER Block Diagram for 12 channels (external filter)

The receiver rack holds the input filters and receiver modules of up to 12 channels.

For this version the Receiver Input Filters (RIN filters, chapter 4.11) and the Calibration Splitter Unit (Cal-Splitter, chapter 4.12) are mounted on the Antenna Interface Plate (AIP).

4.10.2 WERA-RER - Receiver Rack (12 channels) – internal filter

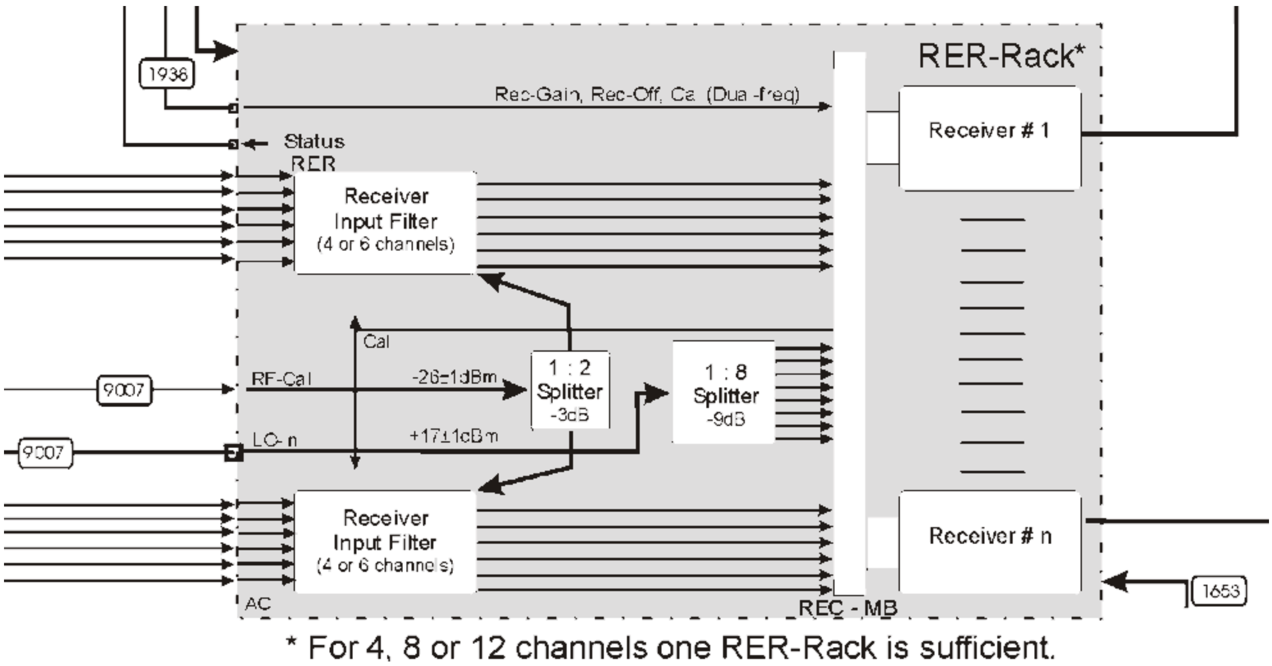


Figure 13: RER Block Diagram for 12 channels (external filter)

4.10.3 WERA-RER - Receiver Rack (8 channels)

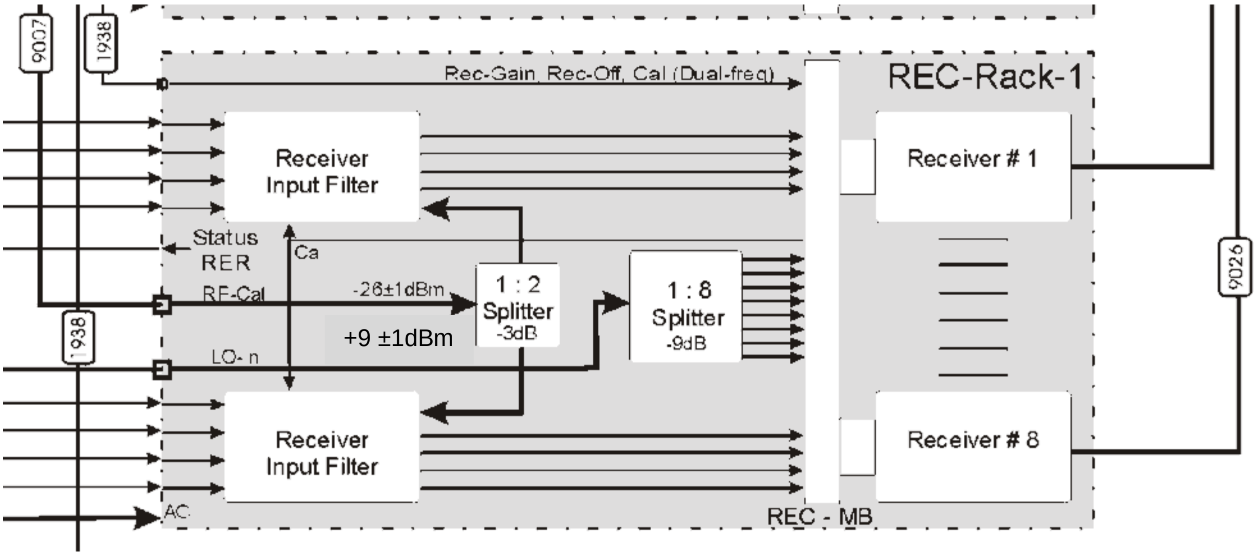


Figure 14: RER Block Diagram for 8 channels

The receiver rack holds the input filters and receiver modules of up to 8 channels.
For a system with 16 receive channel you always need two receiver racks, each containing 8 receiver.

4.11.1 Receive-Input-Filter - RIN (for 12 channels) – external Filter Version

Figure 15: RIN Module

Each RIN module contains a band-pass input filter as well as the relays for the internal calibration. The filter is designed for a specific frequency and bandwidth to provide optimum noise reduction.

In addition to that these modules contain two lightning protection stages. The first stage is a 350 V surge protector and the second stage consists of 4 switching diodes which get conducive in case of an overload at the filter output. The system will operate even with burned fuses but with reduced signal levels at these channels.

If a different operating frequency is needed, the RIN modules have to be exchanged.

4.11.2 Receive-Input-Filter - RIN6 (for 12 channels) – internal Filter Version

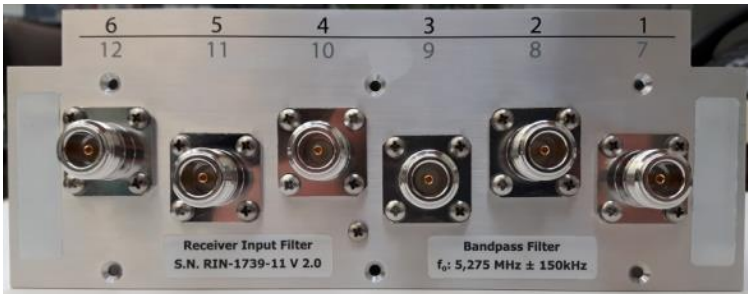


Figure 16: RIN Module

Each RIN module contains band-pass input filters for six receive channels as well as the relays for the internal calibration. The filter is designed for a specific frequency and bandwidth to provide optimum noise reduction.

In addition to that these modules contain the last lightning protection fuses. These fuses consist of 4 switching diodes which get conducive in case of an overload at the filter output. The system will operate even with burned fuses but with reduced signal levels at these channels.

If a different operating frequency is needed, the RIN modules have to be exchanged. In older WERA versions the lid of the RER unit need to be removed to get access to the SMA connectors.

4.11.3 Receive-Input-Filter - RIN (for 8 channels)

Figure 17: RIN Module

Each RIN module contains band-pass input filters for four receive channels as well as the relays for the internal calibration. The filter is designed for a specific frequency and bandwidth to provide optimum noise reduction.
In addition to that these modules contain the last lightning protection fuses. These fuses consist of 4 switching diodes which get conducive in case of an overload at the filter output. The system will operate even with burned fuses but with reduced signal levels at these channels.

If a different operating frequency is needed, the RIN modules have to be exchanged. In older WERA versions the lid of the RER unit need to be removed to get access to the SMA connectors.

4.11.4 Dual-Receive-Input-Filter - DRIN (for 8 channels)

Each RIN module contains band-pass input filters for four receive channels as well as the relays for the internal calibration and switching filters. Each of the two filters per channel is designed for a specific frequency and bandwidth to provide optimum noise reduction. From the outside, the DRIN is mechanically and optically identical to a normal RIN module and is also connected in the same way. If a DRIN Filter is used in a non-dual frequency environment (no Software updates, no modified PA) then it can be used as a normal RIN (default Filter path is active).

4.11.5 Supply for Active Rx Antennas

All Receiver-Input Filters can supply the dc-voltage which is required to use active Rx antennas. This dc-supply needs to be activated by means of an internal jumper for each antenna. The RIN module needs to be un-plugged and opened to access these jumpers.

4.12 Calibration – Splitter (for 12 channel versions only, refer to 4.11.1)

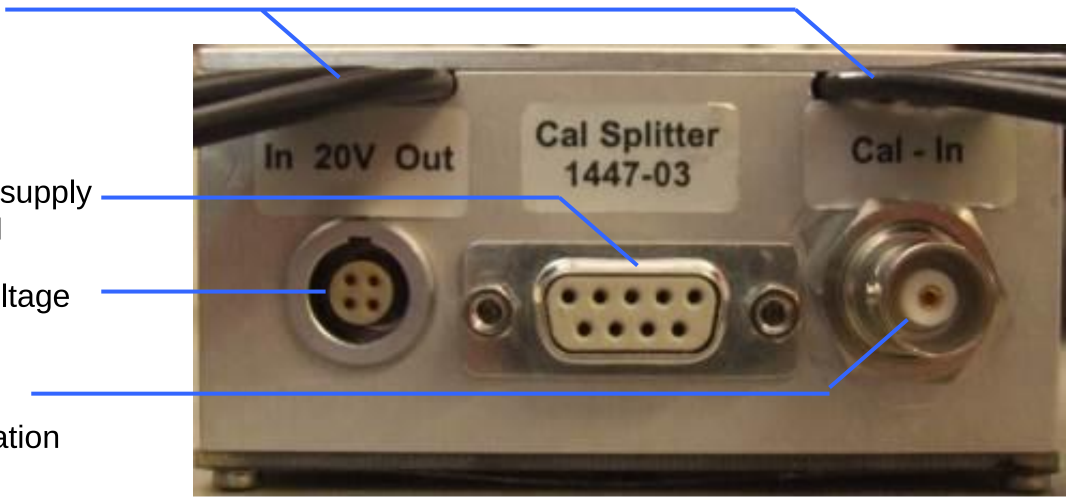


Figure 18: Cal-Splitter Module

This module distributes the 20 V supply voltage and the calibration signals to the 12 Receiver-Input-Filters modules (RIN)

4.13 Receiver - REC

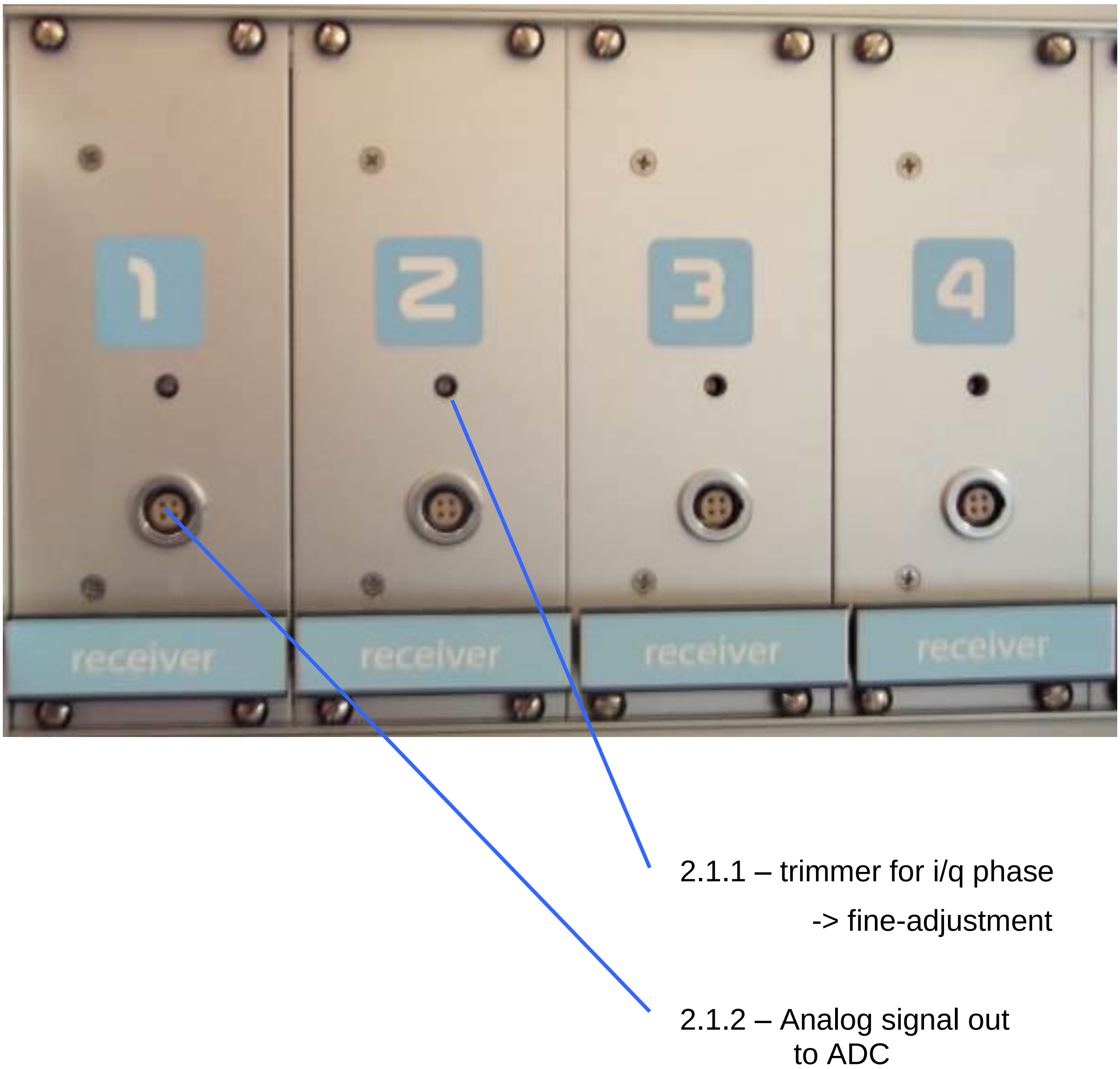


Figure 19: Receiver Module

The receiver modules receive the antenna signal over the receiver input filters, mix it down in frequency and amplify it for the ADC modules.

Note:
The thinner 12 Channel REC have a pre-mounted ADC-cable instead of a detachable one.

4.14 WERA-PA - Power Amplifier (Rack Version)

The standard version of the power amplifier is housed in 19” rack, 3 HU, see figure 21. This version can provide up to 80 Watts output power to compensate cable loss. The antennas should be connected via an external 1:4 power splitter with two pairs of “phase cables”, the longer cables are always used to connect those antennas which are located closer to the water front.

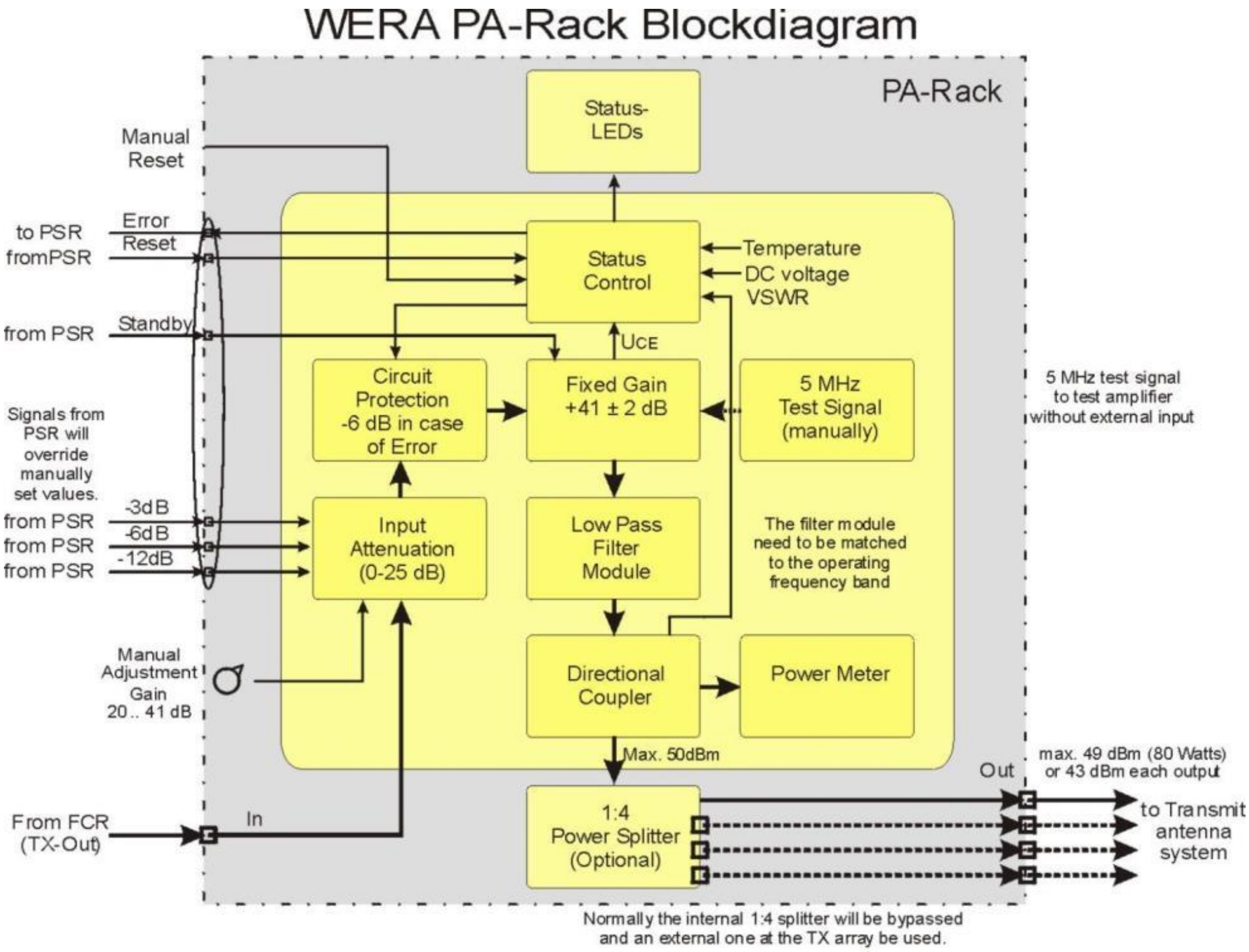


Figure 20: Power Amplifier – Rack Version Block Diagram

Figure 21: Power Amplifier – Rack Version

4.1 – PA-Rack rear

4.3 – Transmit signal TX in

4.4– Voltage selector

For new versions this function is disabled

4.5 – AC in

4.6 – Transmit signal out
(4 identical signals) newer WERA versions will only have 1 transmit signal out as the signal will be splitted at the power splitter at the TX area

4.7 – Dual Frequency Feature
Not shown in picture or functional diagram:
- A dual frequency PA provides one TX input and two separate TX-Outputs (one for each frequency). Internally they are connected to two separate low pass filters.
- Via an additional Dsub connector the switch frequency signal is carried from the FCR (Control I/O -> aux connector) to the PA.

Figure 22: Power Amplifier – Rack Version – rear view with 4 outputs

4.15 WERA-IPC - User-Interface-PC

The User Interface PC is used to control the WERA system. Measured data are stored on (removable) hard disks and can also be send to a central processing station over a data link. There are tools to process and visualize the data.

Figure 23: Typical User Interface PC (in this case with 3 height units, newer ones with 2 HU)

4.16 Block Diagrams and Table of Interconnecting Cable

Cable Id	Quant.	Connect to	Connect to	Description
1511	1	1.21	3.2	**PA Control (15 poles male-female)**
310	1	Line	UPS	**AC Power of the whole WERA System**
1511	1 (2)	2.7	3.7/8	Status control RER
1653	1	UPS	3.4	AC power cable 1 m for FCR
1653	1 (2)	2.6	3.4	AC power cable 1 m for RER
1938	1 (2)	1.20	2.2	**RER Control (9 poles male-female)**
1965	1	1.17	keyboard	**Y-cable for keyboard and mouse**
2173	1	1.25	Interface PC	**Ethernet, cross-over**
2528	3	AC input	3.4	AC power cable 1,8 m, FCR, PA, Monitor
2528	1	PC	UPS	AC power cable 1.8 m, monitor & PC
2870	1	SYNC	SYNC-Ant	PS2/RS232 special cable
9100	4 to 12	RF	RIN	RF cables to lightning protection, 3 m
3325	1	UPS	Interface PC	RS232 special cable
9007	1 (2)	1.23	2.4	Local oscillator signal to RER With one RER only, 50 Ohms at 1.23
9139	1	2.3	4.12	Internal Cal. signal to Cal-Splitter
9155	1	2.4	4.12	20 V to Cal-Splitter
9008	1	1.1.1	1.5.1	Clock signal
9008	1	1.1.2	1.5.2	Trigger signal
9014	*1*	*4.3*	*4.6.8*	*PA RF in to board (in-side PA)*
9025	1	Line	4.4	AC Power PA (out-door version only)
	4 to 12	*2.1.2*	*1.6.1 to 1.6.4*	*Analog data signal, REC to ADC 1 pig-tail cable at each receiver*
9034	*1*	*2.1.2*	*Scope*	*Test cable Receiver to Oscilloscope*
9058	1	1.16	1.19	Digital i/o port (DIO)
9073	1	PC-LPT	3.9	LPT cable, 1.8 m
9117	*1*	*Test - Out*	*Cal-Box*	*Option: for dynamic test purpose only*
9118	1	Test – In	Test – Out	Normal connection for operation
9137	1	Tx-out	PA Input	H155 coax, 1.5 m

Table 1: Cable Connections

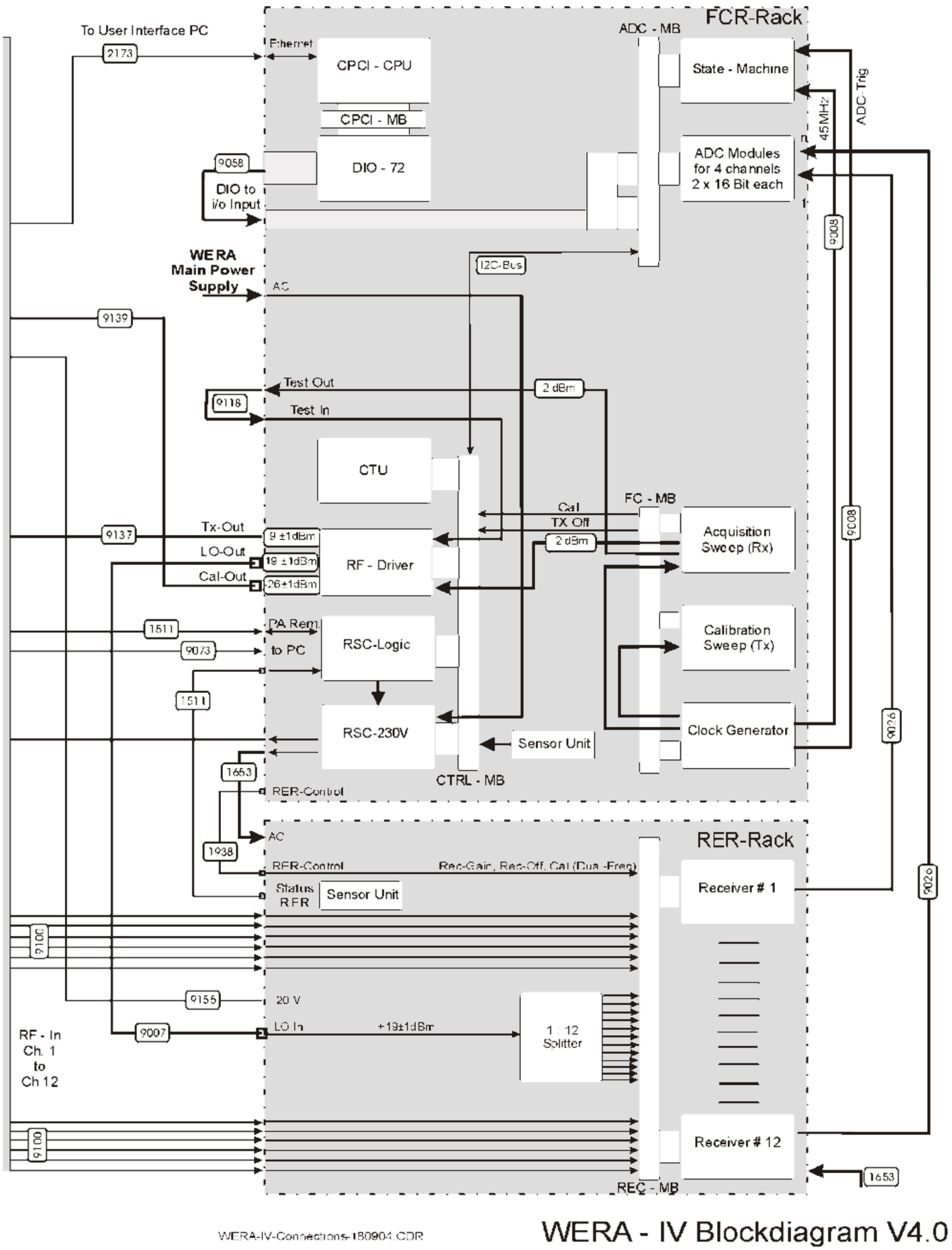


Figure 24: Block Diagram WERA IV 12 Channel with AIP (external Filters) Part 1 of 2

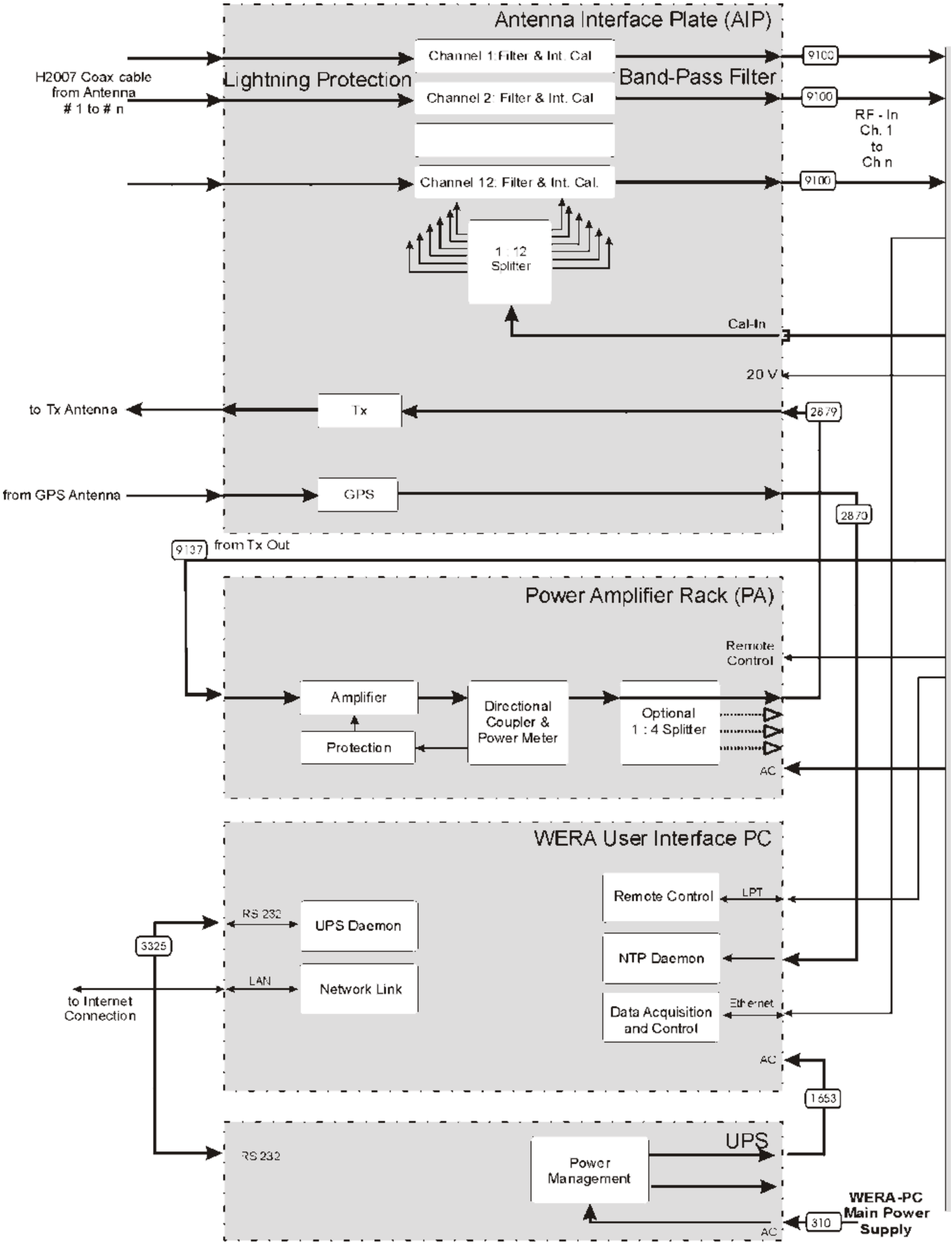


Figure 25: Block Diagram WERA IV 12 Channel with AIP (external Filters) Part 2 of 2

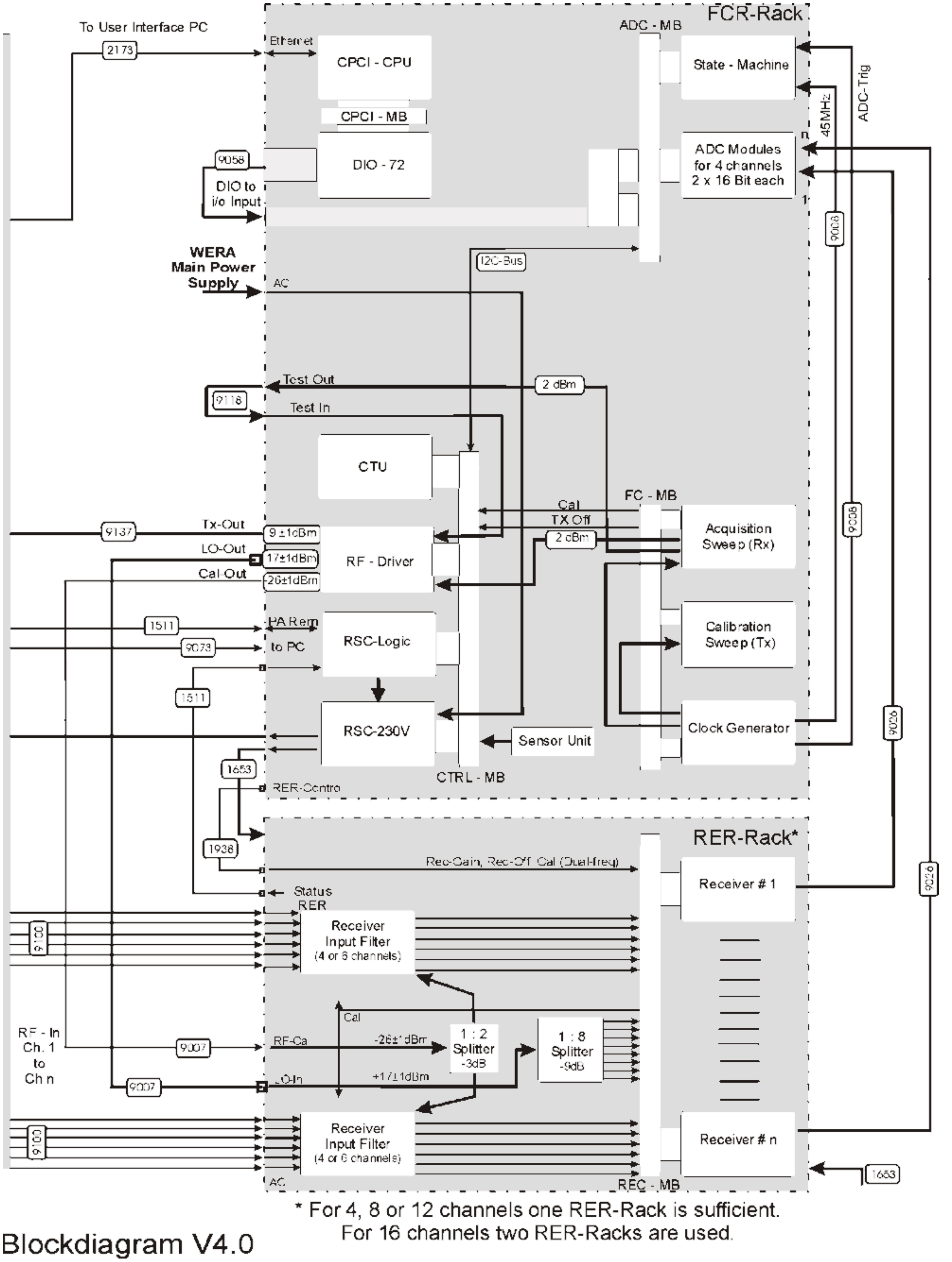


Figure 26: Block Diagram WERA IV 8 or 12 Channel with RIN or RIN6 (internal Filters) Part 1 of 2

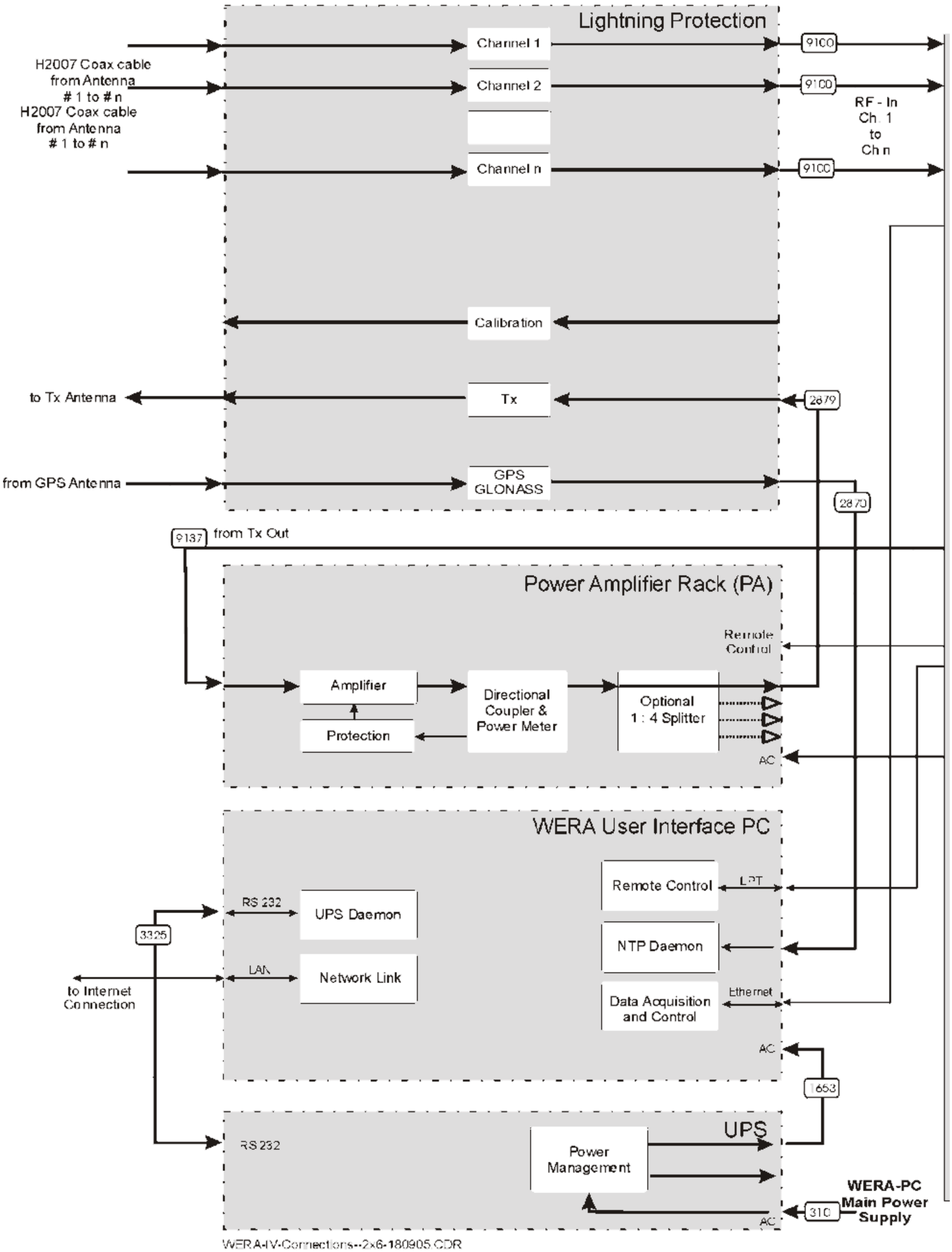


Figure 27: Block Diagram WERA IV 8 or12 Channel with RIN or RIN6 (internal Filters) Part 2 of 2

Note:

- All the delivered cables have identification numbers.
- Plug in all the cable (given in table 1) fig. 9 and refer to fig. 1 to 8
- Take care for the correct order of connection of cable 9026 for REC and ADC. The REC`s are numbered from left to right, the ADC inputs are numbered from bottom to top and left to right, for example:

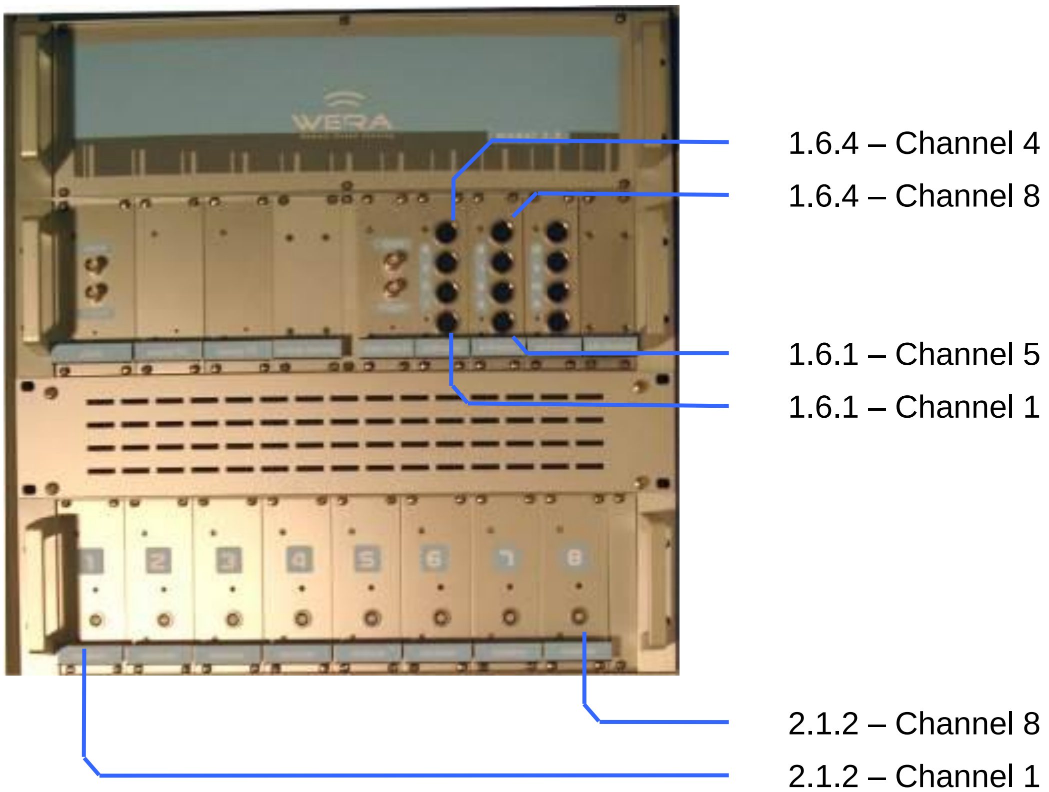


Figure 28: FCR and RER, front view, numbers of RECs and ADCs

- Take care for the correct connection of cable 9028 for DIO72 and control port. The DIO72, #1 is the left one. The two flat cables are marked with A and B.
- A crossed LAN cable 2173 is needed to connect the RTU with the external PC.
- It's optional to plug the Y-cable 1965 in the PS2 socket of the RTU to connect keyboard and mouse. Newer ones support USB mouse/keyboard.
- A standard extension flex cable is used to connect the control ports in between the racks.
- If the system is used with only one RER, terminate the second LoD out with 50 Ohms / 0,5 W

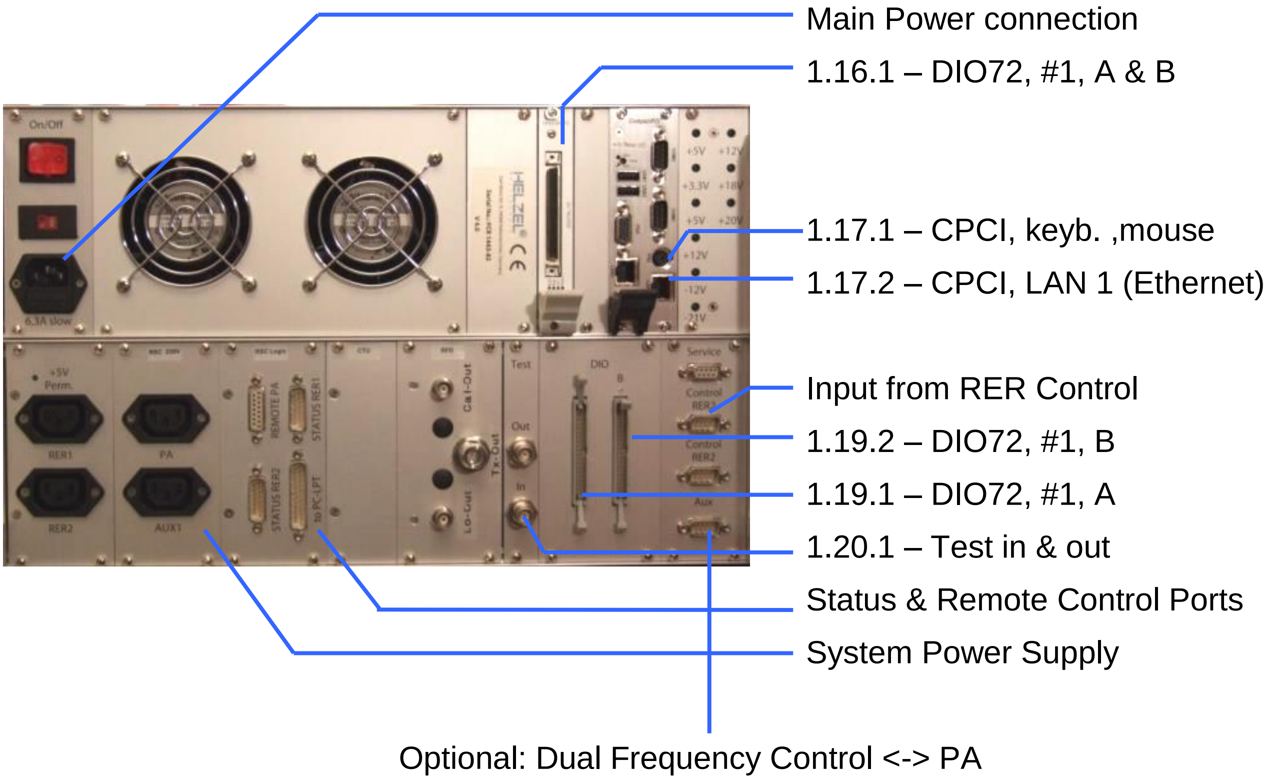


Figure 29: FCR back view, connection of digital data links

Please note: ***Never cover any air slots.***

Since there are slots in the bottom lid of the FCR and the RER also, do not operate parts of the system on a desktop without putting some "foots" underneath the lowest rack.

For this reason please use only the recommended order for setting up the rack:

- PC — WERA Interface PC
- FCR — Frequency Control Rack
- RER — Receiver Rack
- PAR — Power Amplifier Rack

Figure 30: WERA front view

Please note: ***Exact rack mounting order is required for optimal cooling***

4.17 Uninterrupted Power Supply (UPS)

It is strongly recommended to operate the WERA from an UPS unit. At least the WERA User Interface PC should be connected to such a unit to guarantee a controlled and safe ramping down of the PC in case of a power failure. The hard- and software of the ups needs to be configured to safely shut down the PC in case of a longer power loss.
So a data link and software between the PC and ups is required.

In case of a very insecure power line, it might be better to operate the WERA system from a UPS that continuously is generating the AC. Please contact factory to get more information about these options.

4.18 Lightning Protection (-Plate) for WERA 8- channels

All WERA installations needs to be equipped with professional lightning protection units. If the WERA electronics not housed in the original WERA container it is very important to feed-in all cables via lightning protection filters. These filters are provided by Helzel, 8 surge protectors mounted on one plate. This plate needs to be connected to “Earth” potential by means of a suited cable (a 10 mm^2 cable is enclosed). Please carefully check these connections and if there are any doubts, please contact Helzel factory or a local service company for help.

For the **WERA 12-channel systems with AIP**, the lightning protection is integrated in the RIN filters.

Some models have a separate lightning protection plate, depending on the system configuration.

5. Installation and Tune Up Information

This table shows all installation steps in an order as they should be carried out. On the following pages some more details can be found.

Pos	Task	Required Tools, Material, Personnel
01	Mark position for both containers	Tape measure (5 m)
02	Build simple fundament for containers	Brig stones or equivalent to keep the container 30 cm above ground
03	Download containers and place it on the fundament	Forklift to handle 3000 kg
04	Mark all receive and 4 transmit antenna positions	poles for bearing, sticks to mark positions, hammer, tape measure 3 men
05	Define route of cable channel if required	more sticks to mark channel
06	Install antenna poles with guide ropes	2 to 3 men
07	Install antenna coil with radials and check tuning	1 man
08	Cable laying (if required in tubes or foil)	3 men
09	Connect line power and phone connection	
10	Unpack system components and install rack	2 men
11	Power up system and configure WERA Control	1 men
12	Run internal calibration (256 samples, 80 Hz offset)	1 men
13	Connect Calibration Box outdoors at end of Rx cables and run calibration. Activate calibration.	1 men
14	Connect all Rx antennas	1 man
15	Connect Tx array and feed-in just one signal from Tx output (no power amplifier connected yet) Run calibration and check direct path signals	2 men
16	Connect Power Amplifier, switch all attenuators “on” and start test calibration. Adjust PA power to “green”	1 men
17	Stop test calibration and run calibration to check direct path signal. Reduce power if required.	1 men
18	Fill out check list	1 men
19	Seal all outdoors coaxial connectors	1 man
20	Run single acquisition to check SORT spectra	1 man
21	Edit params.config to match with site geometry and WERA Control parameters	1 man
22	Run “Plott_WERA_Sort_RCs_Beam”	1 man
23	Check .crad and .wrad outputs	1 man
24	Configure script files and set system to cont. Acq.	1 man

The required time for the installation of one site is about one week with a man-power of 3 or 4 people.

5.1 Position of Container

If possible find a place for the container in-line or behind the antenna arrays. It is possible to use the roof of the container to place the TX array. In this case the container should be placed in line or in front of the Rx array.

The container needs to be placed at least 20 cm above ground due to the opening for the cables is in the floor. The fundament can be made with brig stones or wooden beams.

5.2 Transportation and Handling of Container

The container can be lifted with a forklift or a crane that can handle 3000 kg of load. For transportation all electronic units need to be packed carefully and the empty 19' rack should be stabilised. All boxes inside the container need to be protected to prevent movements.

	
Forklift for normal road	Off road option

Please note, if the computer is placed inside the container for transportation it is strongly recommended to install an extra protection for the CPU heat sink.

5.3 Antenna Positions

Rx Antennas

The Rx antenna array should be installed about parallel (+/-15°) to the shore line or the edge of a cliff. The centre of the Tx array should be located in line with the Rx array or in-front of the Rx array. If the Rx array may be installed on a cliff, the Tx can be installed down hills, directly in front.

It is possible to place the array as a curved array or even as random spaced antenna array. In all cases the distance between the Rx antenna poles should be about:

Rx pole to pole distance = 0.45 • Lambda.

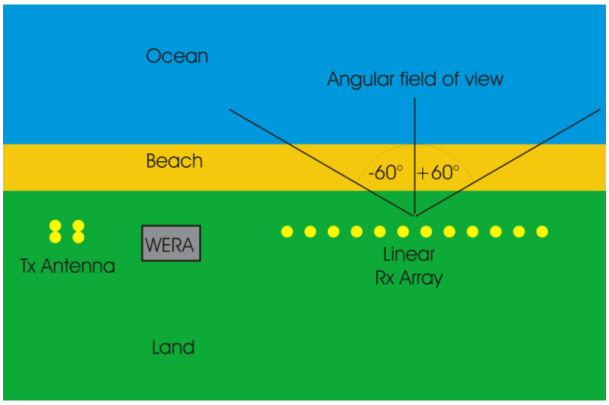
In case of the standard linear configuration the accuracy of this distance should be ±10cm.

In any other case the individual antenna positions need to be measured by means of a differential GPS that can provide the ±10cm accuracy.

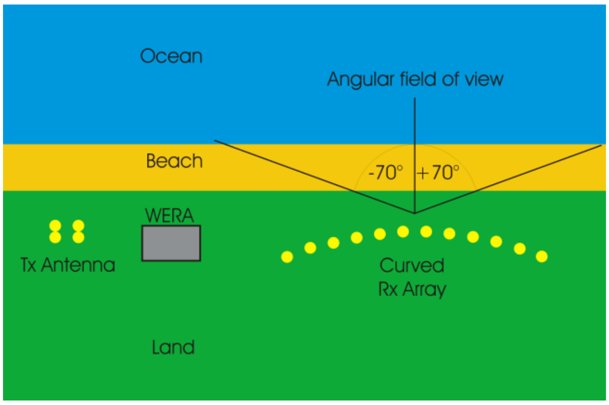
The variation in height is less critical for the Rx array. A slope of half the pole length can be accepted.

Tx Antennas

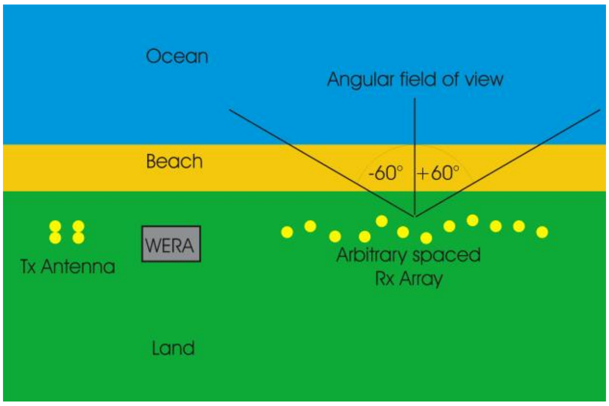
The optimum position of the Tx antenna array is in a distance of 5 to 10 Lambda from the Rx array orientated in-line with the Rx array. But there are other options as well, see below:



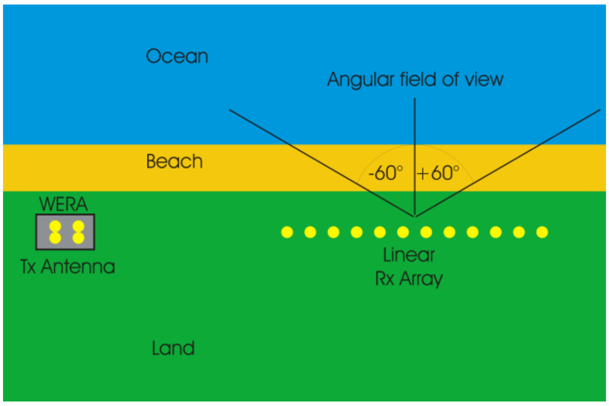
Optimum with Rx and Tx in-line



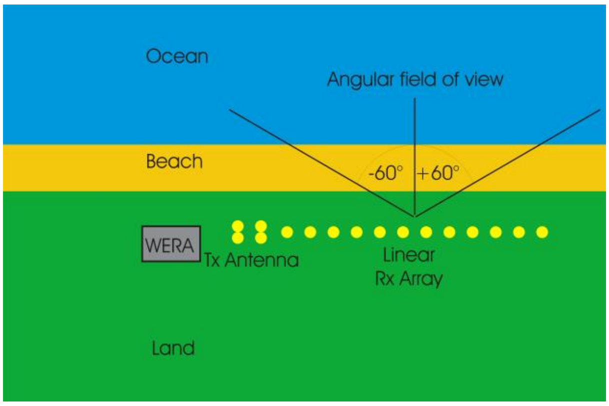
Curved array to provide more angular field of view



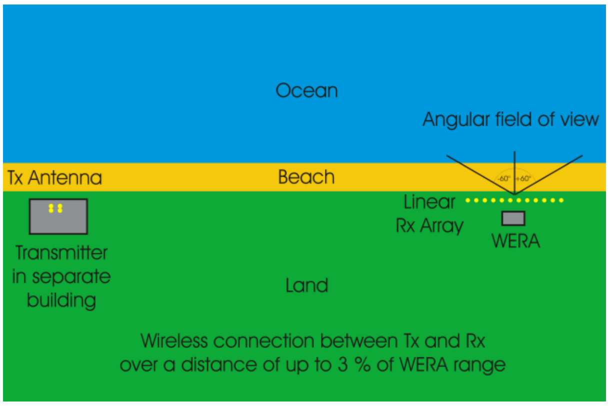
Arbitrary spaced, **attention**: all inter antenna distances must be smaller than ½ Lambda



The Tx can be located on the roof of a container, the Tx pattern need to be carefully checked before



The compact configuration can be used if a 30 % reduction of the radar range is acceptable



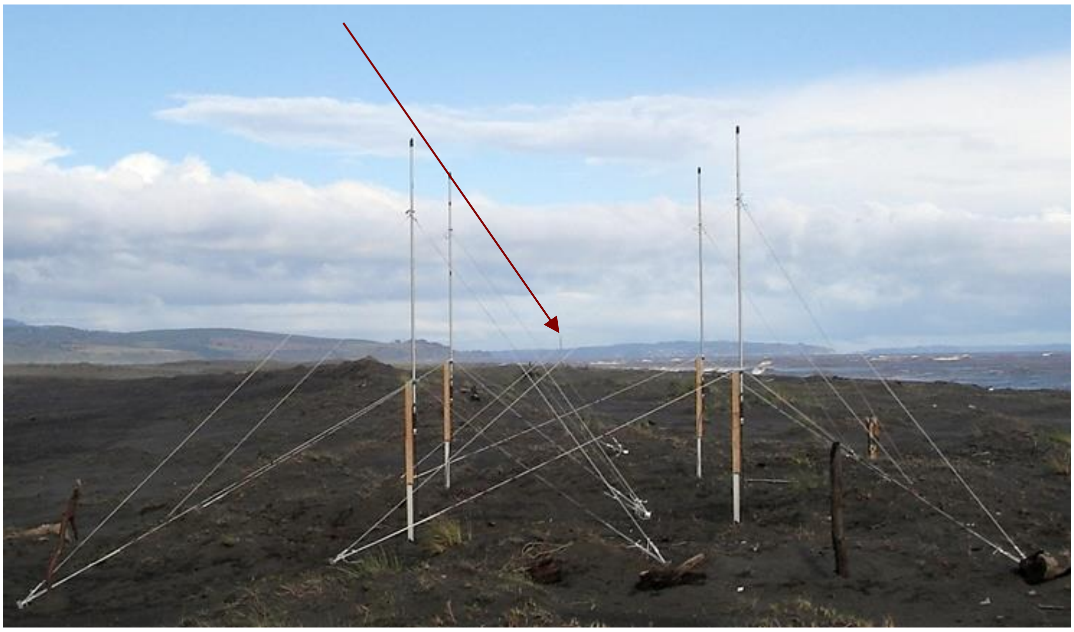
The Tx-SAT option allows to place the Tx array in a distance of some km from the Rx array

Please note, in any case the Tx the height of the 4 antenna poles should be almost equal with a tolerance of about ±20 cm.

The Tx array geometry defines the Tx beam pattern. The rectangular configuration with 0.5 Lambda along the water front and 0.15 Lambda perpendicular provides a theoretical null towards the Rx array and a quite narrow beam towards the bore sight of the radar. At the outer edges (± 60°) the Tx signal is already attenuated by more than 10 dB.

For this reason the **optimum Tx geometry** is 0.35 to 0.45 Lambda x 0.15 Lambda. This provides a wider beam width -6 dB at the edges and a soft minimum towards the Rx array.

Tx array exact in-line with Rx array



5.5 Cable Protection

The Rx cables need to be protected against direct sunlight because this will lead to inhomogeneous heating resulting in different phase shifts. This can reduce the angular accuracy of the beam forming process. If for a non permanent installation the cables are buried in the ground it should be taken into account that removing the cables can cause strong mechanical stress that may damage the cables.

Please note, that the preferred low loss cables are sensitive to mechanical stress and do not allow narrow bending.

Use a flexible tube to protect cables

or dig a cable channel

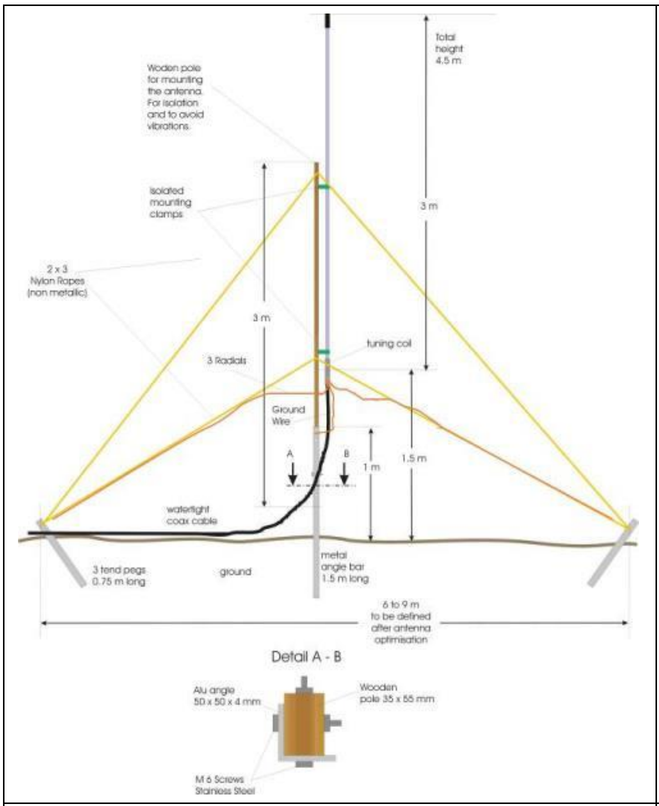
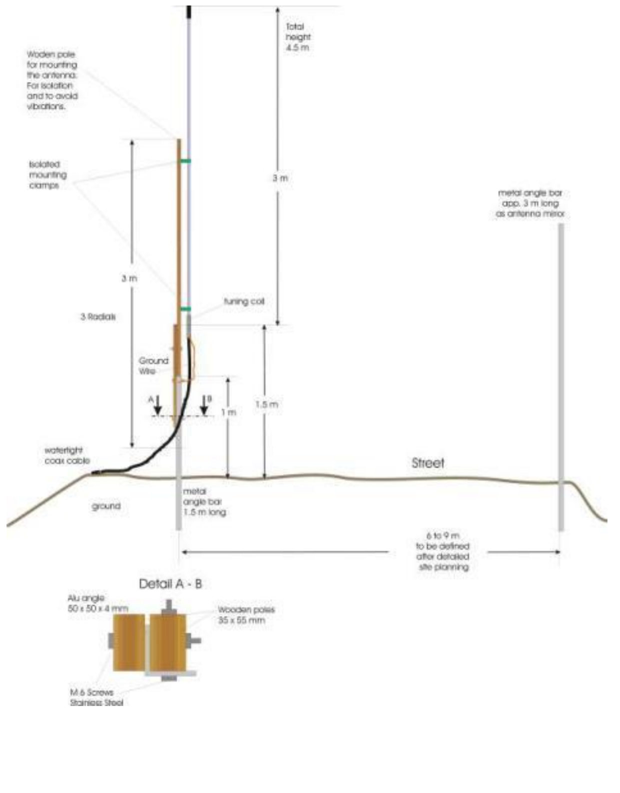
The kind of connection of the Tx array depends on the distance between the Tx array position and the container. If this distance is very long, the RF power loss on the coax cable can be quite high. The cable loss depends on the distance, frequency and cable type. Please refer to the “WERA Tables” to check if for your installation this cable loss can be accepted.

To achieve the full performance of the system, at least 20 Watts (43 dBm) of RF power should reach the centre of the Tx array. The outdoor version of the PA can generate up to 50 Watts (47 dBm), the standard indoor, rack mount version can generate up to 80 Watts (49 dBm).

If the required cable length results in a much smaller value, the power amplifier should be placed outdoors next to the Tx array. In this case a line power connection to this position is required. Please check the kind of protection that is required for save operation in this environment.

5.6 Install Antennas

The antenna poles need to be installed isolated from the ground. The recommend construction is to use a metallic ground anchor, attach a wooden beam to that (at least 1.5m) and mount the antenna pole to that wooden beam. To stabilise that construction guide ropes (**no metal**) should be used. For antennas not higher than 4 m overall one set of guide ropes may be sufficient. For higher antennas we recommend to use two sets of guide ropes.

	
Typical antenna construction for antenna poles of up to 4 m length.	Antenna without radials and guy ropes and with a “mirror” pole.

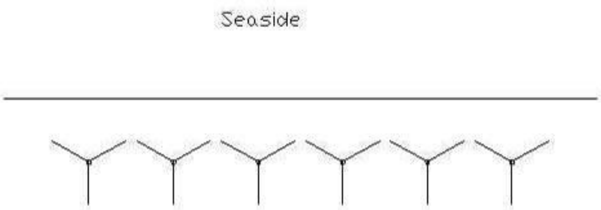
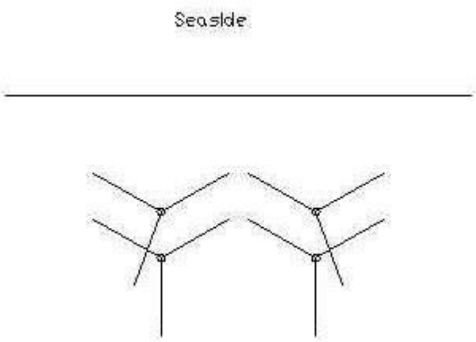
The typical antenna construction is sketched on the left, the right schematic shows an antenna geometry, suited for the installation on a mole. The “mirror” pole would suppress the signal from the other side of the array.

A lot of other antenna construction versions are available, please contact the Wera team.

 	
Wooden beam mounted to metal anchor	Antenna coil mounted above metal anchor

The guide ropes should be fixed with ground nails or tent pegs, - their positions depend on the length of the used radials. The distance between the antenna pole and the tent pegs should be about 30 to 50 cm longer than the radials.

The orientation of the radials and the guy ropes is sketched below.

	
Typical Rx antenna radial orientation	Typical Tx antenna radial orientation

5.7 Antenna Tuning

5.6.1 Rx-Antenna Tuning

The antenna tuning coils should be installed with contact grease and secured by means of the hose clamps. Please attach just loose for the first step, since the depth of shifting in the tuning coil into the pole will be used for fine tuning later on. Ensure that the ends of antenna poles (tubes) are clean inside and free of an oxide layer. If required clean with a metal brush.

The radials should be connected with a little bit of contact grease as well. Attach the radials without mechanical stress to the guide ropes (using a cable clamp or tape) and wind it around the guide rope (5 to 10 turns). Attach the end of the radial to the peg by means of a guide rope. Use at least 50 cm guide rope to keep the end of the radial isolated from the ground.

	
Attaching radial to guide rope	Radials twisted around guide rope

Now check the antenna tuning (resonant frequency) and matching (VSWR). We recommend using a battery driven antenna meter.

	
Antenna meter with broad resonance	Sharp resonance peak

The antennas should be tuned to the intended working frequency and it needs to be matched to 50 Ω, low VSWR over a wide bandwidth > 500 kHz.

Please note, always use a cable of at least ¼ wave length to connect the antenna meter. Layout this test cable almost identical to the proposed layout for the final connection, otherwise the readings will be incorrect.

As test cable the longer one of the phase cables for the Tx array can be used. Nobody should be standing next to the antenna and metal material (ladder, tool box) should be removed from the antenna.

If the antenna's bandwidth is wide like it is shown in the graph on the left picture, then tune the antennas centre frequency to working frequency.

If the antenna's bandwidth is more narrow like on the right picture, then tune the antenna a little bit to the left or to the right of the working frequency. Choose that side, where the graph has a smooth shoulder and use **this side for all antennas**.

Please note, metal fences, power cables or other electrically conductive material should be avoided within 1 electromagnetic wavelengths distance around the antennas. Particularly the Tx array is sensitive to metal constructions close to it.

The resonance can be tuned by changing the length of the antenna pole. A variation of about 20 cm can be achieved by changing the antenna tuning coil connection to the pole.

If this fine tuning (+/-150 kHz) is not sufficient, there are additional options for tuning:

- If the antenna tuning coils are new, they may not be sealed. In this case the frequency can be shifted lower by pressing the winding of the coil closer to each other and vice versa.
- The mounting height above ground level will influence the position of the resonance frequency. A higher elevation will typically increase the frequency.
- The radial length will have a strong effect on the frequency. Shorter radials will increase the resonance frequency.
- The layout of the radials will have an influence as well. Keeping the radials higher above ground will increase the frequency and laying it on the ground or even connecting the end to the ground will decrease the resonance.

Regarding the matching (VSWR) the last three modifications will strongly chance this parameter as well. The VSWR is more critical for the Tx array. It should be better than 1:2 at centre frequency with a tolerance of +/- 0.3 for all antennas.

For the Rx array the VSWR should be better than 1:2.5 at centre frequency with a variation of +/- 0.4 for the whole array.

Please note, that the VSWR values given above, are the values at the centre frequency, not at the resonance. The values at the resonance are typically much lower.

It is recommended to note the antenna parameters of each antenna in the log book:
- Resonance, VSWR at resonance, Band width for VSWR 1:2, VSWR at centre frequency

5.6.2 Tx-Antenna Tuning

The Tx antenna tuning is slightly different from the Rx tuning because due to the fact that 4 antennas are located very close to each other, these antennas will affect each other. For this reason it is recommended to install just one Tx antenna first and tune it without having another Tx antenna mounted. This Tx antenna should be tunes very similar to the Rx antennas.

Now leave the Tx array with just this one Tx antenna mounted and tuned.

5.8 Cable laying

The cables are sensitive to mechanical stress like strong pulling or bending with a small radius. The connectors should be protected against any kind of pollution. There are plastic caps in the antenna package that can be placed on the connectors. If it is raining or very windy with flying sand, we recommend to seal the gap between cap and cable with tape.

Don’t forget to mark each end of the cable with a label.

It is recommended to put the cable spool on an axis. Then two people should carry that spool along the cable path spooling down the cable.

If the cable needs to be fed through a pipe or a closed cable channel, the spool should be placed on that axis at one end. The cable can be pulled through the pipe slowly if the following conditions are taken into account:

- no pulling for more than 50 m
- no pulling around a corner
- attach the rope for pulling at several positions and prevent any stress on the connector

5.9 Connect line power and phone connection

Connect the line power according to the instructions that are written on the transformer and the red mains connector. The system can operate from 115 or 230 Volts and the transformer can be configured for both input voltages. Furthermore the transformer can be used to compensate a small voltage drop of the input line.

After this the phone line, micro wave link or any other data line can be installed.

5.10 Install WERA rack

Unpack the system carefully, keeping the boxes undamaged. These may be used again if the installation should be moved in the future.

Please ensure that the WERA racks are mounted in the right order.

Connect all cables at the front and rear of the system.

5.11 Power up system

Please ensure that the UPS is installed correctly – there is a protection plug for transportation. If it is planned to move the system in the future, **place a note on the UPS** to unplug this protection for transportation.

The user interface PC will be delivered with an additional transportation protection inside. **This protection needs to be removed before switching on**. Keep this protection material for future transportation.

If the system is connected correctly, the user interface PC is directly connected to the UPS and can be started without switching on the WERA system.

Turn on the PC and wait until Linux has booted. Please check if there is access to WERA Desk.

Turn on the WERA system with the main switch at the front of the lower rack.

The green LED of the Clock Generator (top left) should be on immediately.

After about 30 seconds the green LED of the State Machine (STM) should turn on. This indicates that the internal PC has booted. If this LED does not illuminate, please check the connections at the front and rear. The internal PC can't boot before the user interface PC has booted. If the user interface PC needs to be restarted the systems CL7 needs to be restarted as well or measurement data may not be saved.

5.12 Calibrations

5.11.1. Full Calibration

Please do not use this calibration, it takes 3 hours to run and was already carried out at the factory. It may be required in case of a major system fault and the replacement of the receivers only.

5.11.2. Internal Calibration

Even if this internal calibration was carried out at the factory as well, it should be checked to verify if everything is ok after transport.

Start an **Internal Calibration** under the WERA Control Centre. Use settings for a short run:

256 samples, 0.260 sec sweep time, 80 Hz offset

Check the results using "Plott_WERA_Cal_lsq" according to the description in pos. 11.7.

In the resulting table all RMS-Voltage should be almost identical and the "**Cal values"** should be between 1.0 and 1.1.

In the second part of the table are the phase values listed. At the **"Peak"** the phase should be between +6 to -6 degrees.

Finally the "**I/Q-Balance**" should be between 84 and 96 degrees.

If the results are ok, the name of this calibration file and its results should be changed to **calibration.wera_internal** and should be noted in the log book. It may be helpful for future trouble shooting.

5.11.3 Cable Calibration

This calibration is essential for the operation of the WERA system. Normally this calibration was already carried out at the factory.

In that case the calibration is already activated and should not be run again!

If the cable calibration needs to be carried out in the field there are several options.

5.11.3.1 Calibration with Calibration Box (1:16 Splitter)

All cable ends should be labelled with the correct receive channel number.

In any case the “Receiver Input” of all channels needs to be connected to the lightning arrestor plate or for WERA IV to the Receiver Input filters.

All Rx coax cables need to be connected to the input of the lightning arrestor plate.

The cables can be calibrated before they are rolled out. In that case all Rx cables spools need to be placed next to the lightning arrestor plate to be connected.

All other ends of the Rx cables should be connected to the Calibration Box.

One extra coax cable need to be connected from the Tx driver output (chapter 4 page 2). (**Attention**, never use the output from the Power Amplifier for the calibration). This cable need to be connected to the centre connection of the “Calibration Box”.

Start a **Calibration** under the WERA Control Centre. Use settings for a short run:

256 samples, 0.260 sec sweep time, 80 Hz offset

Check the results using “Plott_WERA_Cal_lsq” according to the description in pos. 11.7.

In the resulting table all RMS-Voltage should be almost identical and the “**Cal values”** should be between 1.0 and 1.1.

If this is not the case the according cable or connector has a problem.

In the second part of the table are the phase values listed. At the **“Peak”** the phase should be between +30 to -30 degrees.

If this is not the case one of the cables has a different length (outside of normal tolerance). Phase differences of up to 180° can be compensated by the WERA software. Nevertheless such a cable is suspicious and should be double checked.

If the results are ok, the calibration file (.amphase) should be copied into the directory /home/wera/etc/ and renamed to **calibration.wera.** Additionally this should be noted in the log book.

Now this calibration is activated and will be used for all measurements.

Note that some programs may need to be restarted to use the modified calibration constants.

This calibration procedure can also be carried out **with the cables already laid out**. In that case the cable ends need to be collected in the field and connected to the Calibration Box. The input of the Calibration Box needs to be connected with a long cable to the “TX-Out” output of the Frequency Control Rack (FCR).

Normally no power amplifier should be used for this type of calibration to avoid damaging the 1:16 calibration splitter box or the receiver input filters.

5.11.3.2 Calibration with special Spectrum analyser

Some portable spectrum analysers like the Rohde & Schwarz FSH3 with build-in tracking generator got the option to measure phases relative to a calibrated reference cable after performing an open/short/load calibration at the end of the reference cable.

There is a separate document describing in detail how to perform such a calibration measurement with this analyser model. See the document “WERA-Cable-calibration_using FSH3-150907.pdf” for details.

Other analyzers might be used in a similar way.

The resulting phase values are not as stable as when using the 1:16 calibration splitter box. Additionally it must be kept in mind, that the displayed phase values are results from a reflection measurement and thus the values need to be divided by 2 to retrieve the correct values for the calibration table.

5.11.3.3 Calibration with precise TDR

If all receive cables are from the same manufacturing batch and thus got exactly the same velocity factor, then an alternative method is to use a very precise Time-Domain-Analyser TDR and measure the differences in cable length. With these values known, and the correct velocity factor for the cables, the according phase difference to cable 1 can be calculated. That means a cable that is longer than cable #1 will have a positive phase value. These calculated phase values need to be **subtracted** from the phases values of the internal calibration. For this the file **calibration.wera_internal** need to be edited and the modified file should be stored as **calibration.wera** in the .etc folder.

But beware ! - If it is not known, if all cables are from the same batch, the velocity factors may be different and then the calculated phase differences would be wrong.

So the other mentioned calibration methods are preferred.

5.13 Connect all RX antennas

Now all Rx antennas can be connected, but do not seal them now. The coax cables should be placed in their final position.

5.14 Connect Tx array

Now connect the one already tuned Tx antenna direct to the Tx cable (a female-female N connector is required).

The Tx cable can be connected to power amplifier (PA) output, but ensure to switch the PA to lowest gain (**turn knob to left most position or use “PA” setup section of “WERA Remote control” software if remote controlled PA**).

Start a **Calibration** under the WERA Control Centre. Use settings for a short run:

256 samples, 0.260 sec sweep time, 80 Hz offset

Check the results using “Plott_WERA_Cal_lsq” according to the description in pos. 11.7.

In the resulting table no RMS-Voltage should be higher than 7 Volts. No voltage should be >7 Volts but it should be >1 Volt.

If one voltage is higher, check if the PA is really operating with lowest gain. If the power need to be further reduced, connect a 20 dB N-attenuator (enclosed in the tool box) at the ***input of the PA*** *and run the test again.*

Now the voltage must be smaller than 7 volts but maybe now it is lower than 1 volts. In that case you may need to increase the gain of the PA (1 step of the knob to the right is +3 dB).

The voltage level for the Rx antenna that is closest to the Tx should have the highest signal. The level should decrease with increasing distance to Tx. If there is a strong “jump” in the signals level behaviour, something with the Rx array is not normal (cable, VSWR, resonance, strong reflections, dunes). If the reason might be environmental conditions, this effect can be accepted. Mismatching or wrong tuning needs to be corrected.

If the voltage is correct, keep this setting and write down the **rms voltage** of that antenna closed to the Tx array in the “Installation Check List”.

Now Start a **Single Acquisition**, don’t forget to set the frequency offset to 0Hz

512 samples, 0.260 sec sweep, no frequency offset

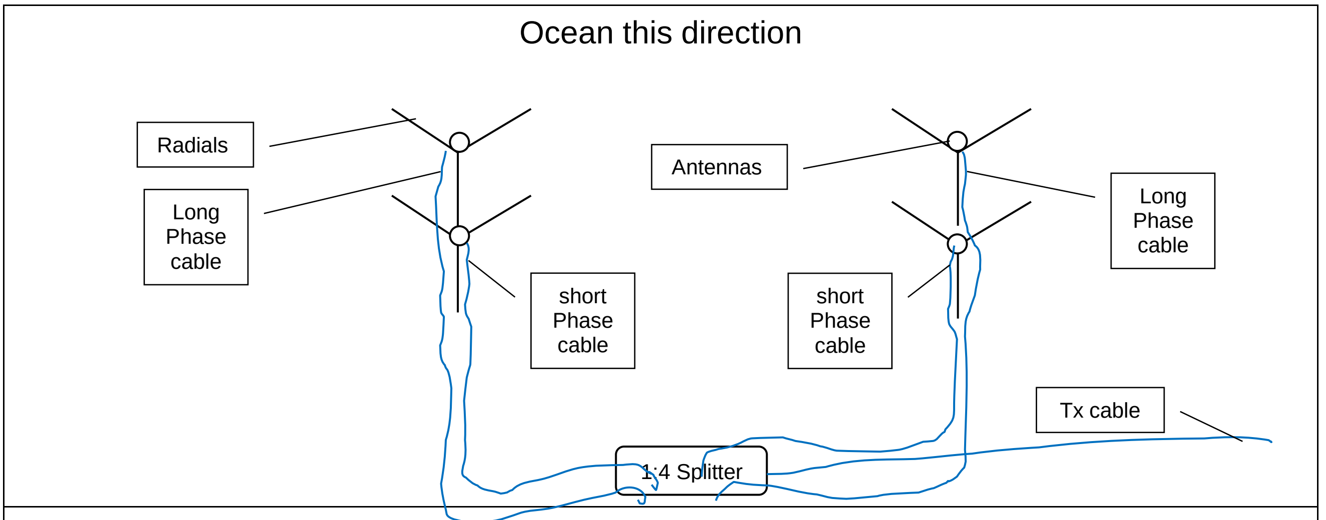
Check the results using “Plott_WERA_Sort_RCs_Beam_rfi〃 according to the description in pos. 11.5.

From the Range Doppler plot the range can be estimated. Please write down this estimated range at 0° in the “Installation Check List”.

After these first tests with a single Tx antenna (with an omni-directional beam pattern) the remaining Tx antennas need to be installed and tuned, see chapter 5.6

Important: Because the 4 Tx antennas are located quite close to each other, the individual characteristic is affected by their neighbours. For that reason please carefully follow these instructions:

Mount all antennas and connect all cables. Layout all cables in their final position. The cables should not be moved again. The cable layout should be similar to the sketch below.



The cables should be laid out as sketched. The coax cables should run in parallel with the radials and the left over coax cable should be placed as coil next to the 1:4 splitter which is placed behind the array. The splitter can be buried in the ground.

When all cables are in their final position and connected to the Splitter the final tuning starts:

1. Connect the already tuned antenna to the antenna meter and check the tuning. Most likely it has changed and a re-tuning is required.
2. Reconnect the first antenna to the Splitter to ensure a correct load and proceed to the next antenna for tuning.
3. Reconnect the second antenna to the Splitter and proceed with the next antenna.
4. Reconnect the third antenna to the Splitter and proceed with the last antenna.
5. Now reconnect the last antenna to the Splitter and check the first one again. Most likely it has changed and a re-tuning is required.
6. Repeat the entire cycle until the result is ok.

The VSWR of the Tx antennas is critical and should be almost identical for all 4 Tx antennas. The resonance dip (if it is sharp) should be outside the sweep bandwidth. The VSWR value should be lower than 1:1.6 (in worst case 1:2).

Finally when all 4 Tx are well tuned and connected to the 1:4 Splitter the performance should be checked:

Use the identical WERA settings as before at the beginning of this chapter.

Start a **Calibration** under the WERA Control Centre. Use settings for a short run:

256 samples, 0.260 sec sweep time, 80 Hz offset

Check the results using “Plott_WERA_Cal_lsq″ according to the description in pos. 11.7.

*Write down the **rms voltage** of the antenna closest to the Tx array in the “Installation Check List” in the line below the value measured with one Tx antenna only. This new value must be lower than the value measured before.*

The ratio between the first measured voltage and this new one should be better than 3 the best case is about 10.

If not the Tx array is radiating in a wrong direction or rf power is directed through a metal fence towards the Rx array or it is reflected from a metal construction nearby.

Now Start a **Single Acquisition**, don’t forget to set the frequency offset to 0Hz

512 samples, 0.260 sec sweep, no frequency offset

Check the results using “Plott_WERA_Sort_RCs_Beam_rfi″ according to the description in pos. 11.5.

From the Range Doppler plot the range can be estimated. Please write down this estimated range at 0° in the “Installation Check List” below the before measured value.

The range should be longer now.

If not the Tx array is radiating backwards or the environmental conditions have strongly changed since the first acquisition.

Now the Tx array should be ok.

5.15 Adjust Power Amplifier (PA) level (Tune Up Info Part I)

There are two power amplifier versions available. The outdoor version in a water proof box and a rack mount version. The rack mount version is easy to handle because all displays and knobs are at the front panel. To access the knobs, the transparent lid can be removed (this is to prevent any accidentally “adjustments”). The adjustment is easy, turn the knob to the left most position to start with lowest power (continue with chapter 5.14).

The **outdoor version** needs to be opened to access the adjustment switches.

- Open the PA box carefully and leave it open.
- **Check that the line power voltage switch is in the correct position**
- Switch all four attenuators inside the PA to “on”-position (minimum output power).
- Connect all four Tx antenna cables to the PA’s outputs. The order does not matter but it is recommended to use an order that should be marked on the antennas and may be noted in the log book.

If an outdoor 1 to 4 power splitter is used, the internal splitter of the PA needs to be bridged. A coax cable is enclosed to provide a direct connection from the SMA connector to the N-output connector, please refer to chapter 4.14.

- Leave the input of the PA open, do not connect the input cable to the PA.
- Connect the line power. The green LED should be on.
- Start a test calibration.
- Now connect the PA’s input with the Tx cable from the system output and check the status of the LED power meter. If the power level is above the green level, the attenuator switches might be in the wrong position or the PA is connected with a very short cable. In that case, connect the 20 dB attenuator at the PA input.
- Normally one of the yellow LEDs of the PA’s power meter should be on. In this case carefully increase the power level by means of the attenuator switches until the green LED is on.
- If the PA gets into failure mode (red LED on), please make sure that the reason for this failure is eliminated and than push the reset knob. In error mode the PA will continue operation but with reduced gain (- 4 dB).
- Stop test calibration.

5.16 Direct path check and optimise power (Tune Up Info Part II)

Run a short calibration measurement (80 Hz frequency offset) with the PA connected and set to minimal gain.

Check the results using “Plott_WERA_Cal_lsq” according to the description in pos. 11.7.

- Normally no rms voltage should be above 7 Volts
  - If some voltages are higher check if the PA is really set to minimum gain
  - Connect a 20 dB N-Attenuator at the input of the PA.

- Increase the gain by one step and run a calibration again. Please check the power level LED at the PA, **do not increase the power** further when **the second green LED** is on.

Attention: Always check that at the PA no red LED is on. In that case reset the PA before the next calibration cycle is started.

  - If no antenna has reached the 7 volts limit the gain (=power) can be increased again. Always check the power LED when running a new calibration after increasing the gain.

- The **optimum is reached** when one Rx antenna **comes close to the 7 Volts (4 .. 7 V) and one green power LED on** the PA is on.

  If this optimum is not reached, please proceed with the next steps, but double check that all connections and settings are correct (-80 Hz offset).

If the Rx levels are already at 7 Volts even if the Tx level is still quite low (no green power LED on, just the yellow one left of the green) please proceed with:

- Switch the Receiver Attenuation on WERA Desk (chapter 7.1.5) to 4 dB and increase the PA gain by 3 dB

Attention: Always check that at the PA no red LED is on. In that case reset the PA before the next calibration cycle is started.

- Now the voltages should be slightly lower but the PA power level higher.
  - If now one green power LED is on, keep this setting.
  - If still the lower yellow power LED is on switch to 8 dB receiver attenuation and increase the PA gain by another 3 dB.
- Now the voltages should be again slightly lower but the PA power level higher.
  - If now one green power LED is on, keep this setting.
  - If still the lower yellow power LED is on switch to 12 dB receiver attenuation and increase the PA gain by another 3 dB.
- Now the voltages should be again slightly lower but the PA power level higher.
  - If now one green power LED is on, keep this setting.
  - If still the lower yellow power LED is on increase the PA gain by another 3 dB.
- Now the voltages should be again higher but the PA power level as before.
  - If the voltages are now too high switch back to the gain as before and keep that setting
  - If the voltages are still ok, keep these settings.

5.17 Fill-in check list

With the finally optimised PA settings one more short calibration with 80 Hz offset should be run. Use the checklist (see attachments) to fill in the measured values. We recommend to use this check list for regular system checks.

5.18 Seal connectors

Now all outdoor connectors should be sealed. Also all antenna coils if not yet done.

5.19 Run single acquisition

The system performance can be checked now by running a single acquisition. It is recommended to use even for these first tests at least 512 samples.

Don’t forget to **switch off the 80 Hz offset**.

On all channels the 1st order Bragg lines should be clearly visible. The range for all channels should be similar.

Please refer to the following chapters to get instructions about how to run these tests.

6. Final configuration

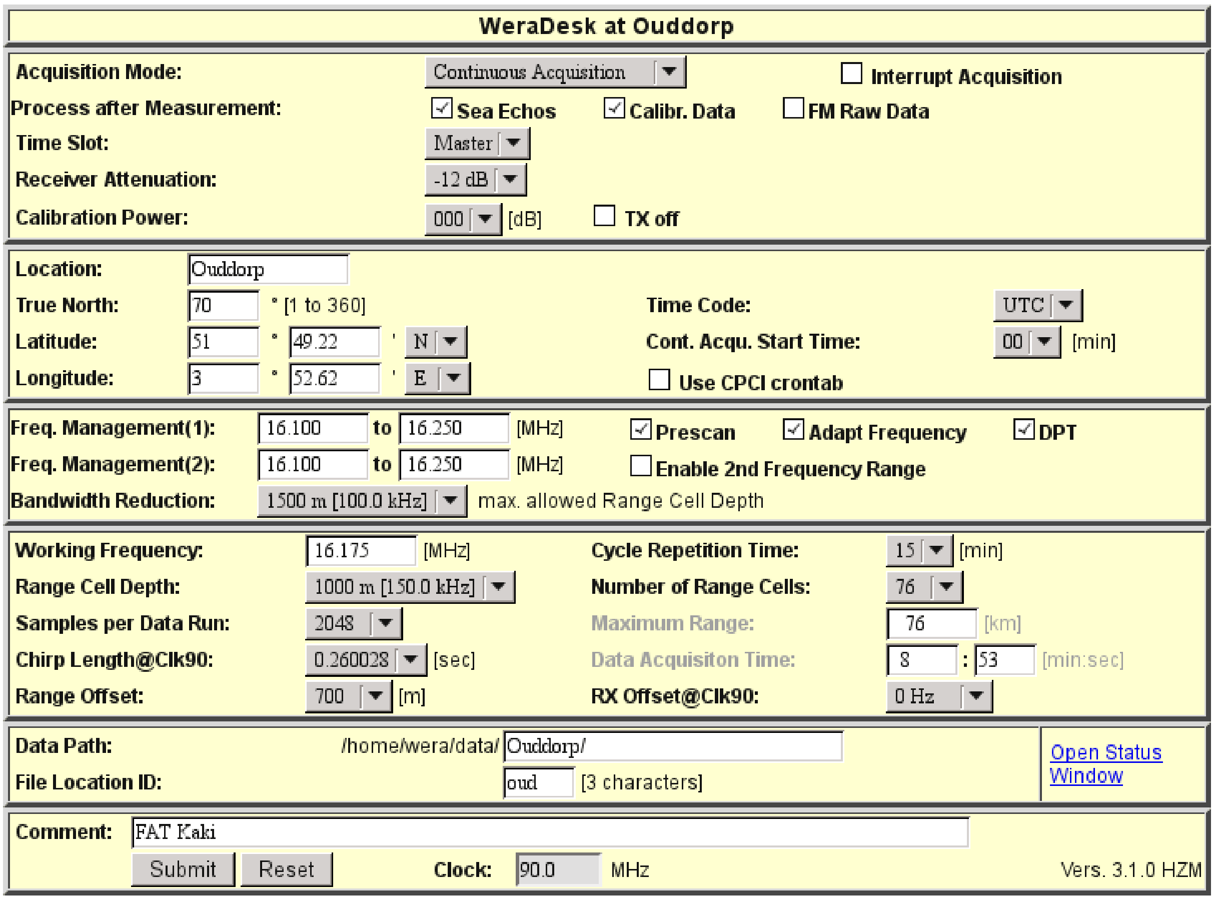
The system configuration file should be pre-configured prior to the installation. If modifications are required, please refer to the WERA user manual, chapter 6: “Final Configurations”.

7. Software Technical User Guides

7.1 WERA-Desk Control Center

To start WeraDesk from a browser, enter the following URL:
http://localhost/~wera/WeraDesk.html

This page is password protected, please ask for username and password and note this combination at the station and in a safe place in your office.



The WeraDesk web page can be used to control the system, perform measurements or configure repetitive automatic measurement cycles.

Note that the real status of the system can only be observed from the WERA-Desk Status window. The status window can be opened over the link “Open Status Window”.

The “Submit” button can be used to submit new settings, while the “Reset” button can be used to reset all input fields to the last submitted state. Make sure you know what you are doing, or who gets access to this web page, or the system might not operate correctly anymore.

Note that this window is not automatically updated. So if another user opens this web page in parallel you will not see his changes until you manually reload the web page.

Note that the version number is followed by by the string “HZM” which indicates that this is a WeraDesk version with special functionality, which may only be obtained from Helzel Messtechnik.

Note that some of the features might be deactivated, but will be available on request.

7.1.1 Acquisition Modes

STOP	Stop any running cycles after they finish; deactivate automatic cycle control; Interrupt/Stop full calibration cycles (if it takes too long); stop test modes; required before other modes can be selected
Continuous Acquisition	Start continuous acquisition cycles as defined in WeraDesk
Permanent Acquisition	Start permanent acquisition cycles as defined in WeraDesk
Infinite Acquisition	Start infinite acquisition cycles as defined in WeraDesk
Single Acquisition	Start one acquisition cycle immediately
Calibration	Start one calibration cycle immediately
Cont. Calibration	Start continuous calibration cycles as defined in WeraDesk
Internal Calibration	Start an internal calibration cycle
Full Calibration	Start a full calibration cycles - caution that takes ~ 5 hours
Internal Full Calibration	Start internal full calibration cycles - caution that takes ~ 5 hours
FM RAW Acquisition	Run single measurement in chirp mode without internal range resolution. RAW data will be saved.
Cont. FM RAW Acquisition	Start continuous FM raw acquisition cycles
Test Acquisition	Switch WERA to chirped mode without storing data; can immediately be stopped
Test Calibration	Switch WERA to non-chirped (single tone) mode without storing data; can immediately be stopped
Test internal Calibration	Switch WERA to internal calibration mode without storing data; can immediately be stopped
Scan Frequencies	Activate a single frequency scan as defined in the frequency management fields

Remarks:

- To dynamically update the 'Maximum Range' and 'Data Acquisition Time' fields, Javascript needs to be enabled for the browser. Do not enter values into these two fields.
- If you allow JavaScript to open unrequested windows, a window showing the current WERA status will automatically pop up. (Allow pop-ups for your browser)
- Clicking 'Open Status Window' opens the status window manually. For updating the frequency scan image of the status page the cache of some browsers (e.g. Mozilla and Firefox) must be disabled by setting the cache size to zero. If the frequency scan image is not updated by the browser, manually update the web page e.g. by pressing the F5 key under Firefox or Internet Explorer.

7.1.2 Interrupt Acquisition

By selecting this check-box and submitting a “stop” as acquisition mode, any type of acquisition will immediately interrupted. Automatic cycles will be deactivated.

Note that any full calibration measurement is a series of 256 single calibration measurements. By using the interrupt Acquisition check box only the currently running calibration measurement will be stopped.

7.1.3 Process after Measurement

WERA Desk provides three options of automatic post processing new WERA data.

If the sea echoes check box is marked, the script located at /home/wera/etc/process_SORT.sh is executed at the end of an acquisition measurement cycle. This script can e.g. process radial current velocities from the measured data and transfer the results to a central server.

If the calibr. data check box is marked, the script located at /home/wera/etc/process_CAL.sh is executed at the end of a calibration measurement cycle. This script can e.g. be used to process automatic directpath test (DPT) measurements.

If the FM raw data check box is marked, the script located at /home/wera/etc/process_RAW.sh is executed at the end of an FM raw acquisition measurement cycle.

7.1.4 Time slot

Master	Run WERA in time slot 0 - default
Slave 1	Run WERA in time slot 1
Slave 2	Run WERA in time slot 2
Triangle	Run WERA in triangular sweep mode

Remarks

Time slots are currently ignored. Use different time offsets in "Cont. Acqu. Start Time" or different "Working Frequency" entries to avoid multiple WERAs to interfere with each other.

WeraDesk V2.4 and higher activates in Master mode to chirp up in frequency and in Slave modes to chirp down in frequency. This avoids two WERAs operating at the same frequency to interfere with each other, when run simultaneously (or at least reduces the interference to a minimum).

Note that calibration should only be performed in Master mode.

7.1.5 Receiver Attenuation

Note that older WERA systems do not support this feature.

If available, the input signals of each channel can be attenuated by a fixed value in dB.

Some WERA systems got 0 dB and –6 dB receiver input attenuation available, while the latest systems got steps of 0 dB, -4 dB, -8 dB and –12 dB receiver input attenuation.

This feature should only be activated, if the direct path signal between TX and RX antenna arrays is too large to further increase TX power. E.g. by activating –8 dB receiver input attenuation, TX power could be increased by +8dB, if possible.

By increasing TX power, the signal to (external) noise ratio can be increased. This will result in larger ranges and better coverage of the measurement area.

7.1.6 Calibration Power & TX off

Calibration Power field can be used to reduce the direct path TX signal during 'Calibration' mode. When switching to Calibration (80 Hz offset), the receivers might be overdriven by the direct path signal, if the normal transmit power is kept. This mode enables to add attenuation to the transmitted signal during calibration cycles; it does not have any effect on normal cycles without frequency offset (RX Offset).

Note that this option is intended for test measurements only and should not be used for normal operation, because it may add noise.

The Calibration Power field has got the following options:

000 Set full calibration power

-01 Reduce calibration power by 1 dB

-02 Reduce calibration power by 2 dB

-nn Reduce calibration power by nn dB

If the TX off box is checked, the local transmitter is disabled by programming the TX DDS frequency to Zero (DC). This mode is especially useful for cross calibrations (one WERA transmitting, the other WERA receiving), or during ship calibration.

Note that for newer WERA systems only one sweep module (RX) is used to generate LO- and TX-signals, if the RX-Offset value is set to zero. Only for calibration measurements with a frequency offset between LO- and TX-signal, both sweep modules are programmed. The TX off checkbox will only effect the second (TX) sweep module. So to perform a cross calibration with a newer system, the TX signal can only be set to zero with the checkbox, if an RX Offset value (e.g. 80 Hz) different than zero is selected.

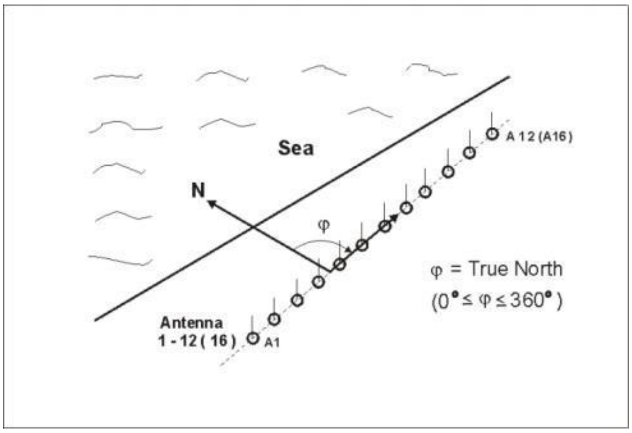
7.1.7 Location

Please enter the name of the site [up to 12 characters] into this field. This information will be stored in the header of the data files. It will also be displayed when plotting maps later.

7.1.8 True North

Please enter the direction of the receive antenna array referred to North into this field.

See the following explanations for the correct definition of true north.



The beam-forming software assumes, that the receive antennas are numbered from 1 to 16 as displayed. So a person standing in front of the receive antenna array with the seaside to the left, will be closest to receive antenna 1.

The angle of true north is the angle covered by rotating clockwise from geographical north to the line of the receive antenna array. The angle must be measured up to the left hand side of the antenna line when counting from the first to the last receive antenna, see sketch above.

7.1.9 Latitude & Longitude

Please enter the Latitude in degrees [0...90°] and minutes into corresponding fields and select "N" for the northern, or "S" for the southern hemisphere.

Please enter the Longitude in degrees [0...180°] and minutes into the corresponding fields and select "E" for the eastern, or "W" for the western half of the earth, regarding Greenwich in England.

These coordinates should reflect the position of receive antenna 1, as the software normally uses this position as starting point for the beam-forming.

These coordinates will be saved in the header of all data files and will be used to identify the station. So these coordinates need to match the settings in the configuration file /home/wera/etc/params.cfg to enable post-processing.

7.1.10 Time code + Cont. Acq. Start Time

The Time Code field has got the following options:

- UTC Refer WERA cycles and data file names to UTC (strongly recommended)
- LOC Refer WERA cycles and data file names to Local Time

This information is stored in the header of all data files for evaluation.

If the wrong time code is stored, then all post-processing steps will assume a wrong measurement time.

By default the operating system of the UPC is configured to use UTC. So this should be selected here. If the system time of the UPC is changed to local time, then this WeraDesk parameter should also be changed to local time (LOC).

The Cont. Acqu. Start Time field has got the following options:

- 00 Start continuous measurement cycles with an offset of 00 minutes to a full hour
- nn Start continuous measurement cycles with an offset of nn minutes to a full hour
- 59 Start continuous measurement cycles with an offset of 59 minutes to a full hour

Remarks

By setting multiple WERAs to a different Cont. Acqu. Start Time, they can be operate in different time slots to avoid one WERA to interfere with another WERA. To set up a timing scheme, also take a look at Cycle Repetition Time and Data Acquisition Time.

If the Cont. Acqu. Start Time is set to 59 and the cycle repetition time is set to 10 minutes, then measurements are started at these minutes: 9, 19, 29, 39, 49, 59.

The first measurement will start to the next minute defined by this timing. It will not wait until minute 59.

In CPCI crontab mode the measurement will be prepared at the defined time, but acquisition/transmission will start the next minute. The resulting data file will have a time encoding of the real acquisition start, so one minute later than defined in this field.

7.1.12 Use CPCI crontab

By selecting this check box, the measurements will be started directly by the crontab of the CPCI computer in the WERA system and not by the crontab of the user interface pc.

It can be used to synchronize the start of several WERA systems or remote stand-alone transmitters (SAT) very accurately.

This option needs modified hardware compared to the standard WERA system.

Only use this option, if your system is capable to do so.

7.1.12 Freq. Management + Prescan + Adapt Frequency

Automatic frequency management is available for continuous measurements only, not for single measurements. It requires that an allowed (licensed) frequency range is defined. Please enter the lowest working Frequency into the first field and the highest working frequency in the second field. The format is [nn.nnn] MHz. In continuous mode the system will never operate outside of this frequency band.

If two separate frequency bands are available, then enter the start and stop frequency of the first frequency band in the Freq. Management(1) fields and the start and stop frequency of the second frequency band in the Freq. Management(2) fields. Additionally select the check box labelled Enable 2nd Frequency Range.

Enabling the Prescan box will start a 1-minute frequency scan of the defined frequency bands 100 seconds before each automatic measurement cycle. Scan data will be stored at the same location as the measurements. If the scan data should be processed and used for automatic adaptation of the working frequency, please also check the box "Adapt Frequency". This will process the scan data and automatically adapt the working frequency. If the box "Prescan" is not checked, while “ Adapt Frequency ” is, the "Prescan" box will be checked automatically, as no frequency adaptation can be done without prescans.

7.1.13 DPT

This parameter is used in continuous mode only. By selecting this check box, a short (16 seconds) direct path test (DPT) measurement will be performed 2 minutes before the real measurement starts. It can be combined with a frequency pre-scan.

The resulting .CAL file may automatically be processed by the process_CAL.sh script, by selecting the appropriate “process after Measurement” check box is activated.

Note that in the wera crontab the DPT and a frequency scan are initiated within the same minute, but the start of the scan is delayed by approx. 30 seconds, while the DPT starts immediately.

7.1.14 Bandwidth Reduction

This parameter is used in continuous mode only, when pre-scan and frequency adapt is activated.

This value needs to be smaller or equal to the bandwidth determined by the range cell depth parameter.

If the frequency pre-scan post-processing software cannot find a free gap for the desired sweep bandwidth, then the sweep bandwidth will automatically be reduced step by step, until a useful free gap in the frequency band is found, or until the defined value for this parameter is reached. The next measurement will use the determined sweep bandwidth.

As such a change will alter the range cell depth, the amount of range cells will automatically be readjusted at the same time to maintain the same maximum range.

Note that the given steps are fixed in the post-processing software. If different values are desired, contact the manufacturer, because modifying the WeraDesk web page only will not work. You might end up with a few very large range cells only.

7.1.15 Working Frequency

Please enter the Center Working Frequency into this field. The format is [nn.nnn] MHz.

This value is used for single measurements and for continuous measurements if the "Adapt Frequency" option of the frequency pre-scan is disabled.

7.1.16 Range Cell Depth

Ensure that the required bandwidth is available at the selected "Working Frequency" (which is the center frequency).

7.1.17 Samples per Data Run

The actual length of the time series is calculated from the Samples per Data Run and Chirp Length fields.

The value 13312 is intended for permanent mode. In permanent mode the amount of possible samples per data run will be re-calculated by taking the cycle repetition time and time for the optional frequency pre-scan and DPT into account. If there is not enough time for the selected amount of samples, the samples will be reduced to a value that fits and can be divided by 128. In this case a warning will be displayed to notify the user.

7.1.18 Chirp Length

The chirp length value defines the duration in seconds of each linear frequency sweep. The Chirp Length field has got the choice as listed in the pull-down menu. We recommend to use one of the chirp rates listed below:

Chirp length	Doppler spectra width	Optimum operating frequency	Comment
0.216667	±2.308 Hz	43.2 MHz	Best for 60 Hz line freq
0.260000	±1.923 Hz	30.0 MHz	Best for 50 Hz line freq
0.433333	±1.154 Hz	10.8 MHz	Best for 60 Hz line freq
0.520000	±0.962 Hz	7.5 MHz	Best for 50 Hz line freq

1.876875	This is the duration of the chirp during frequency scans

Remarks

There are some restrictions regarding the choice of the chirp length:

1.) The chirp length must be kept synchronous with the sample rate to maintain phase continuity. So only certain chirp length values are allowed for the fixed sample rate.

2.) It is recommended to keep the chirp length synchronous with the period of the line frequency (0.02 sec for 50Hz or 0.0167 sec. for 60 Hz). If this is not the case, the net frequency and its harmonics can produce artifacts that might disturb the Bragg lines.

Chirp length values of 0.2600 and 0.5200 are synchronized to 50 Hz net frequency, values of 0.2167 and 0.4333 to 60 Hz net frequency.

Different unsynchronized values should be tested for each system and the resulting Bragg spectra examined, before activating automatic cycles.

Note that an unstable line frequency will smear out the line artifacts into the Bragg spectrum. So a minimum offset to the Bragg lines should be kept.

If a chirp length is selected, which is not synchronized to line frequency, then select a shorter chirp length for your operating frequency regarding the row „Optimum operating frequency“.

7.1.19 Range Offset

This parameter is used to correct the absolute range measured by the WERA by the offset introduced by cable delays. Both Rx and Tx cable lengths must be taken into account.

This value is not directly the cable length. It needs to be calculated for free space, so the velocity factors of the cables need to be taken into account. A radio wave travelling in a coaxial cable will have a shorter wavelength than a radio wave of the same frequency travelling in free space. The signal is slower inside the cable. The velocity factor, which can be different for different types of cable, is a factor expressing this difference relative to the radio wave in free space.

The chosen range cell depth value is the value in meters for one complete range cell.

Note that in the header of the resulting data files this value will be saved as multiple of one range cell.

7.1.20 Cycle Repetition Time

The Cycle Repetition Time field is used for continuous measurements.

It is a repetition time in minutes. Examples:

- 01 - Repeat a measurement cycle every 1 minutes
- nn - Repeat a measurement cycle every nn minutes
- 60 - Repeat a measurement cycle every 60 minutes

Remarks

The Cycle Repetition Time must be larger than the Data Acquisition Time.

Only for permanent mode a shorter time may be entered. In that case the software will automatically adapt the amount of samples to fit into the cycle repetition time.

If the frequency pre-scan or DPT option is used, then the Cycle Repetition Time must be larger than the Data Acquisition Time plus 2 minutes.

The measurement cycles will be reset at the end of each hour. So if equidistant measurement times are desired, then 60 minutes should be dividable by the cycle repetition time.

7.1.21 Number of Range Cells

A value between 32 and 256 needs to be selected.

By multiplying the number of range cells with the range cell depth in meters, the maximum processed range in meters can be obtained.

This value depends on the range cell depth, and on the real range of first order Bragg lines of the station.

If this value is configured too small, then the Bragg lines will be cut and data is lost for far ranges.

If this value is configured too large, then the data files will grow in size without getting more information. This can rapidly fill up your data disk.

Remarks

- The Number of Range Cells should not be set to values larger than the working range physically possible by WERA due to the attenuation of the ground wave.
- This value should be monitored and readjusted after having installed the system.
- If the option “bandwidth reduction” is used, then the amount of range cells may vary from measurement to measurement.

7.1.22 Maximum Range

The value of this field is calculated by multiplying the Range Cell Depth with the Number of Range Cells.

Can’t be modified.

7.1.23 Data Acquisition Time

The value of this field is calculated by multiplying the Samples per Data Run with the Chirp Length.

Can't be modified.

7.1.24 RX Offset

This is an optional frequency offset between TX- and LO-signal. It is normally only used for calibration measurements to enable the test signal to pass the receivers high pass filters.

By default an offset of 80 Hz should be used for all calibration measurements.

For normal acquisition measurements this value should be set to 0Hz.

While in the original WeraDesk software only one table with values was available, newer WeraDesk versions will use different DDS step values to program the RX Offset value, depending on the frequency of the master clock.

Remark

When a chirp length of 0.26 s is selected, 80 Hz RX Offset refers to a signal at about 0.5 Hz Doppler shift at range cell 20.

7.1.25 Data Path

Please enter the path to directory where to store the measured data [up to 30 characters] into this field.

In permanent or infinite mode "_" characters should not be used to avoid problems when post-processing.

7.1.26 File Location ID

Please enter a 3-character code to identify the radar site into this field.

This code is included into the measurement data file names to distinguish between the sites, e.g. yyyydddhhmm_cod.SORT

7.1.27 Comment

You may enter comments for the site or measurement campaign [up to 80 characters] into this field. This comment is included into the header of each data set.

7.1.28 Clock

In this field the software displays the currently configured master clock frequency.

For systems with an older clock module the value should be set to 90.7 MHz. All new systems operate at 90.0 MHz.

This parameter is defined by the file /home/wera/etc/WERA_Clock.asc.

If a newer 90 MHz master clock is used, this file must be existent and contain the string 180.000000 in the first line.

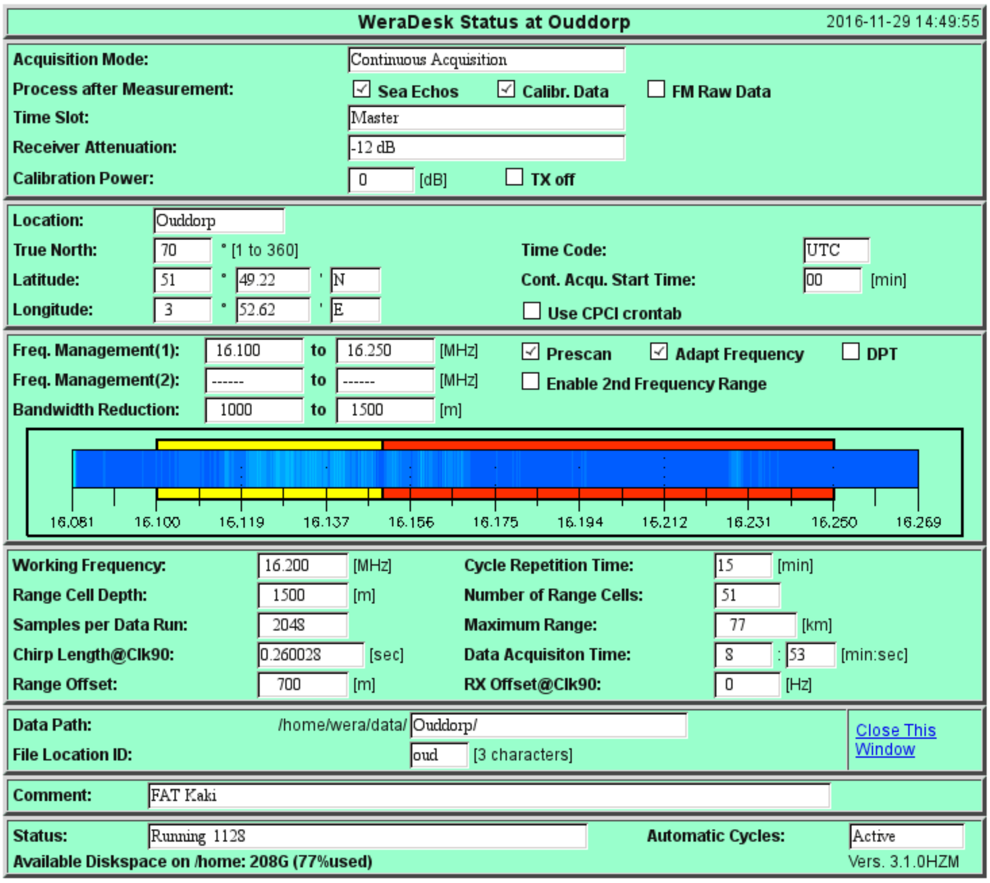
If a newer 90.7 MHz master clock is used, the file should be renamed, removed or contain a different string.

After any changes regarding this file at least one “stop” command needs to be submitted under WeraDesk to update the web page and display the correct values for the used clock frequency.

If the wrong master clock frequency is defined, the wrong sample rate will be used and the measurement will be invalid. In this case the Bragg lines in the range Doppler maps will not be vertically anymore.

7.2 WERA-Desk Status window

The Status Page reflects the actual status of the WERA system and is automatically updated every 5 seconds (You need JavaScript for the update to work).



For a description of most of the parameters see the description of WeraDesk in the previous chapter.

The plot in the frequency management section displays an average of the external noise measured during the last frequency pre-scan.

The last line shows the status of the measurement cycle on the left side and the status of automatic cycles (by crontab) on the right side.

"Close This Window" closes the status page, which can be re-opened from the WeraDesk main page.

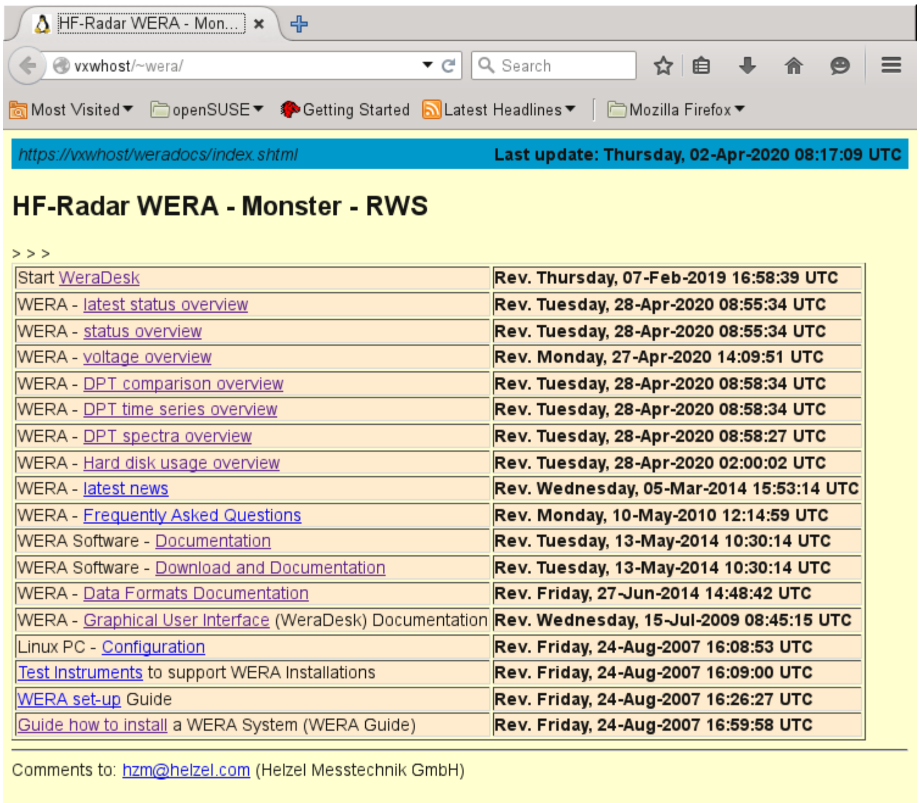
If the web browser caches the graphics, the web page might need to be updated manually to reload the frequency pre-scan graphics. For the Firefox and Internet Explorer web browsers this can be done by pressing the “F5” key.

7.3 WERA Status overview

On each WERA UPC the results of regularly processed measurement can be viewed via web. These pages can be accessed via the start page of WERA Control Center.

To display the start page on the UPC, enter the URL http://localhost/~wera/ .

To access this page over the internet, replace “localhost” with the ip adress of the UPC.



An overview of the last processed measurement results can be obtained, if you click on “Latest WERA results”.

An overview of all processed results can be reached with a click on “WERA status overview”, this will open a list of directories, coded by the day.

In these directories are sub-directories for the time, coded in hour and minutes of acquisition time.

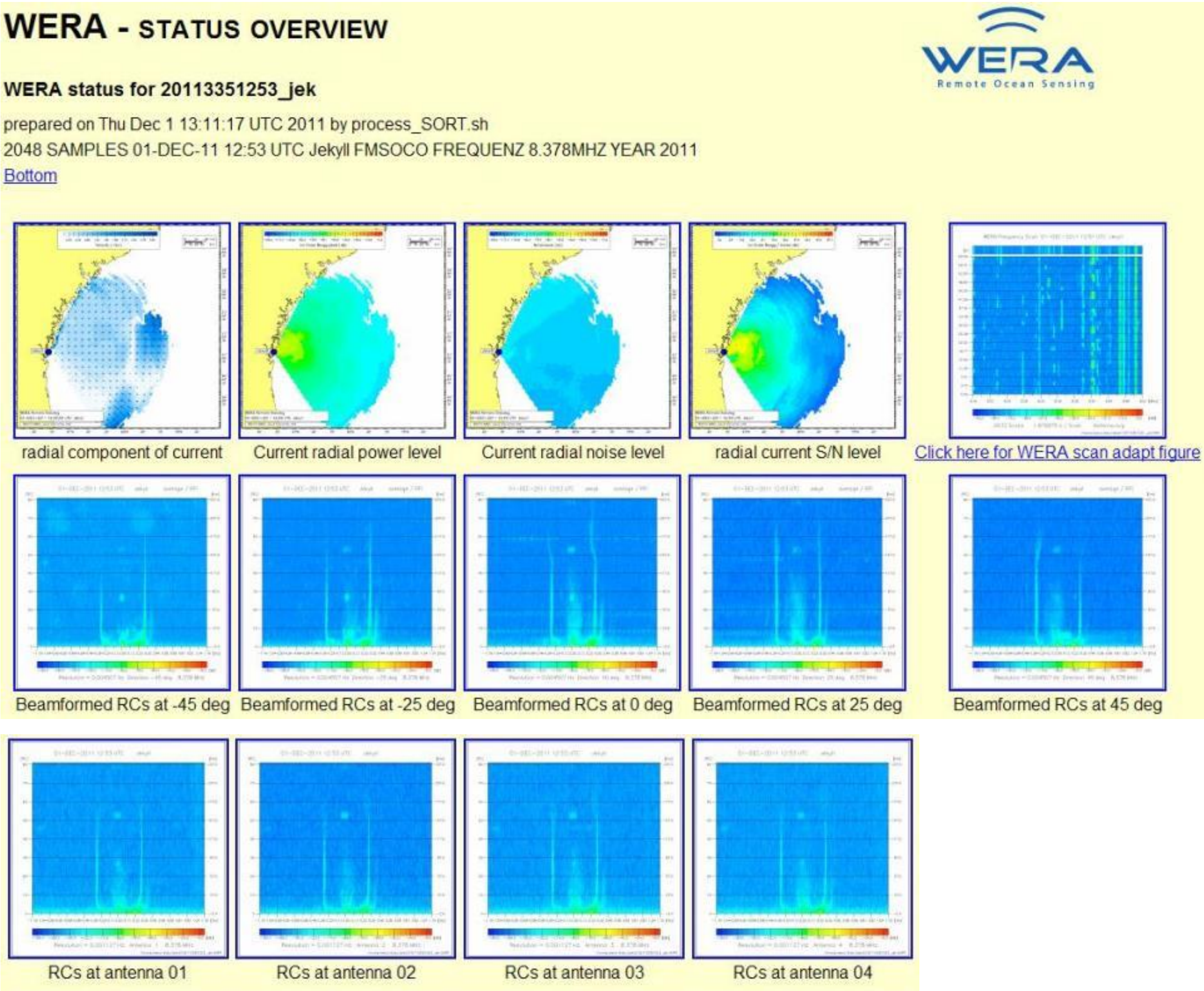
With a click on the desired directory the contained status overview web page will be opened.

Each status overview displays some information about the last measurement, followed by plots of radial sea surface current, radial sea surface current power level, radial current noise level, radial current signal to noise level and a plot of external frequency usage over time from the last frequency scan.

Below that are some beam-formed Bragg spectra, followed by a Bragg spectrum for each receive antenna.

By visually checking and comparing the results, defective receive channels/antennas or other problems may be spotted.

The example plots show part of the gulf stream on the east coast of the USA with a distance of more than 140 km from the coast.



By clicking on any of the small graphics a larger version with more detail may be opened.

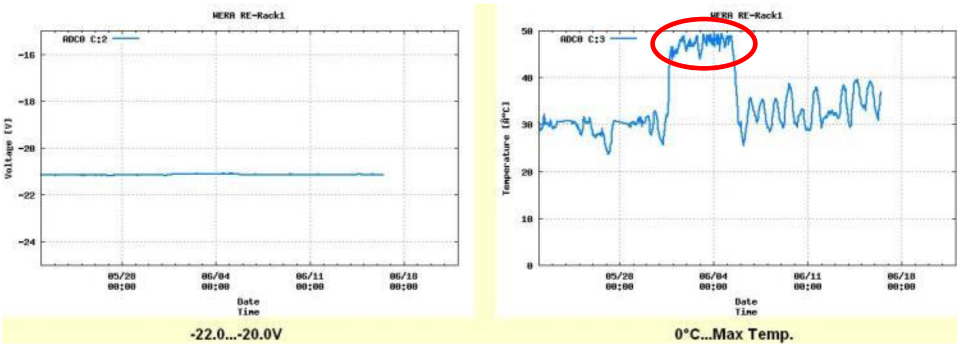
These status overviews are generated by the script /home/wera/etc/process_SORT.sh if automatic post-processing of sea-echos is selected under WeraDesk.

In the script status overview creation times (hour and minute) should be configured.

Normally a status overview every few hours is sufficient.

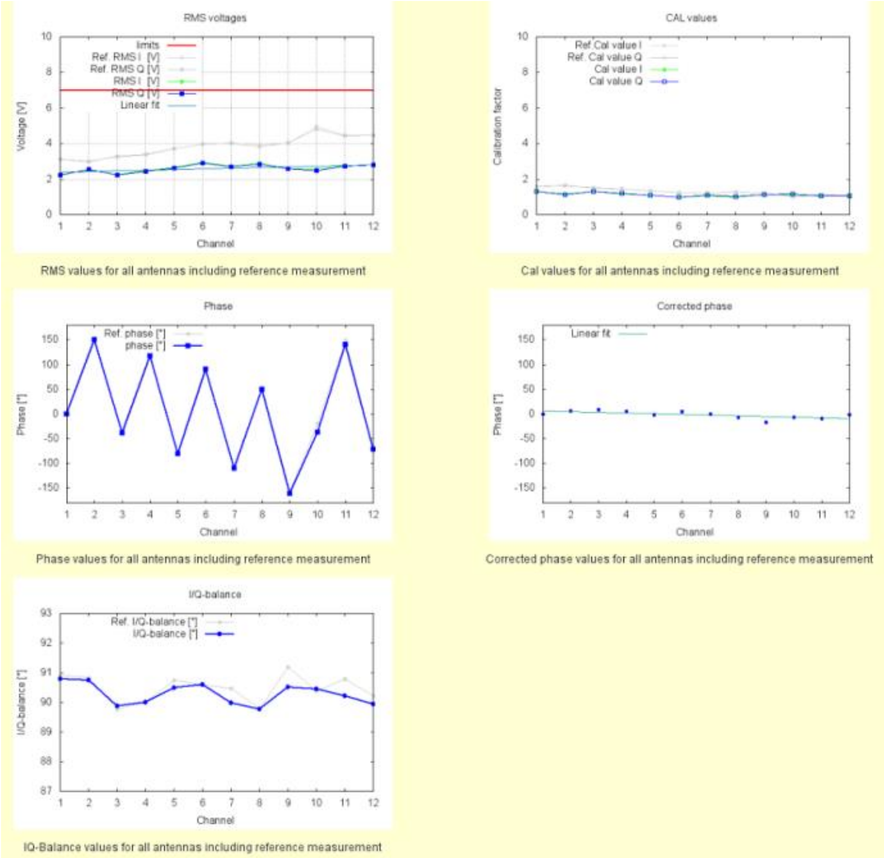
7.4 WERA voltage overview (optional)

If the latest WERA remote control software is running and configured to regularly measure the voltages and temperatures of the WERA racks, then it will generate a web page with plots of these parameters over time. This information can be useful to monitor the status of the electronics power supplies, fans and the air conditioning in the building.



7.5 WERA DPT (Direct Path Test) comparison overview plots (optional)

If a time window of 2 minutes before the next measurement is available, it can be useful to activate a Direct Path Test measurement by selecting the check boxes “DPT” and “Process after Measurement: Calibr. Data” under WeraDesk.
The DPT comparison plots are displaying the main test signal information of the last DPT for all receive channels in one plot.
Additionally reference data will be shown (derived from a real measurement or theory) to see, if something has changed since the reference was saved, or to see how well the phase values fit the theory.
Note that depending on the site (layout, landscape, surrounding infrastructure) the DPT test signal might not travel the standard path and thus the derived values might be completely different than the theoretical values.
With these plots problematic receive channels can easily be detected. See the example plots below.



RMS values for all antennas including reference measurement

Cal values for all antennas including reference measurement

Phase values for all antennas including reference measurement

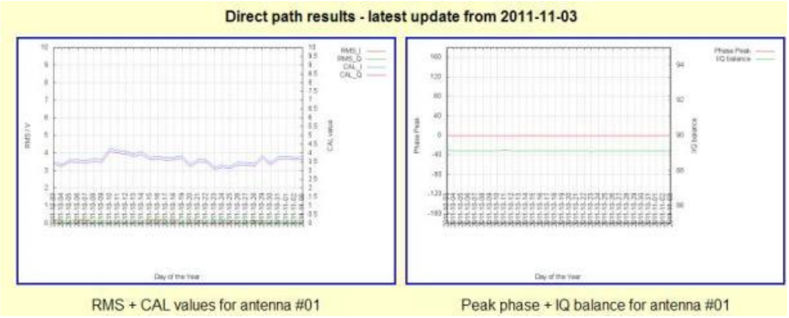
Corrected phase values for all antennas including reference measurement

IQ-Balance values for all antennas including reference measurement

The light grey lines in the background show the reference DPT data.
In this example it can be seen that the RMS voltages have all dropped compared to the reference (from a real measurement after initial installation), but they are linearly increasing, which looks good.
The phases look very good, too.
Note that only phase values between +/-180 degrees are measured.
That is why the phases of channel 11 and 12 in the following plot seem to be shifted. (See channel 11 in the plot: +140 degrees=+140-360= -220 degrees)
For a standard antenna distance of 0.45 lambda the phases between the receive channels should be around 162 degrees for the DPT signal. But note that due to the landscape the DPT signal might not be able to travel the shortest route to all antennas and this will change the phases.

7.6 WERA DPT (Direct Path Test) time series overview (optional)

With the DPT time series of measurements it is possible to retrieve information about antenna behaviour. Often it is possible to detect a degrading receive antenna before it fails completely.
Additionally the time series will show, if some of the receive channels are sometimes overdriven by the TX signal. The RMS voltages of each receive antenna should always be below 7 V.
For each receive channel plots like these will be available:



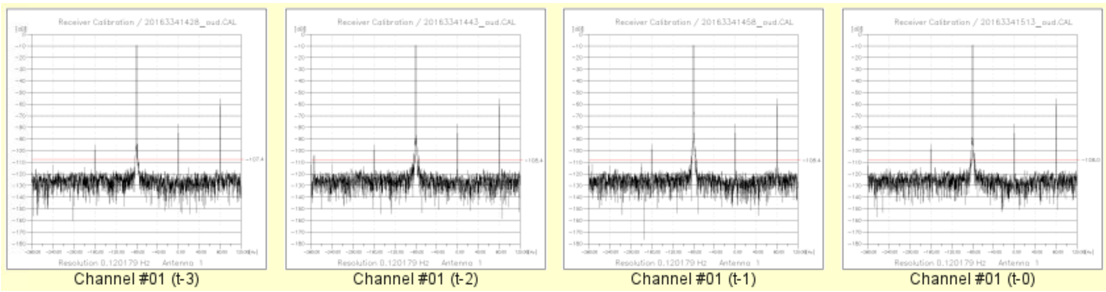
By default a link to this web page is available on the start web page:

Since WeraDesk 3.0.6HZM a DPT measurement can be configured by just selecting the “DPT” check box when submitting settings for continuous cycles.

For manual installation instructions see chapters 6.7 Create direct path test setup and 6.8 Set up your individual wera crontab.

7.7 WERA DPT (Direct Path Test) spectra overview (optional)

If the automatic DPT test measurement has been activated, then additionally to the comparison plots and time series from chapter 7.5 and 7.6 plots of the last spectra for each receive channel are being generated. The plots from time step (t-0) are from the last automatic DPT measurement, (t-1) from the previous one and so on.



In case there is noise on one channel, which is weaker than the test signal, it can be seen in these plots, as well as in the status overview plots of chapter 7.3. If the noise is aused by a loose contact, some plots will show the noise and some not.

The test signal displayed at -80 Hz in the spectrum also gives an information about the decoupling between TX and RX antennas. As long as the test signals of all receive antennas are below 0 dB, they are not yet overdriven. In that case the difference between the strongest test signal and the 0 dB line is the maximum that the TX power might be increased without overdriving the receivers. But there may be limitations by the possible PA gain and the allowed transmit power. So this plot may also be used to adjust the gain of the PA.

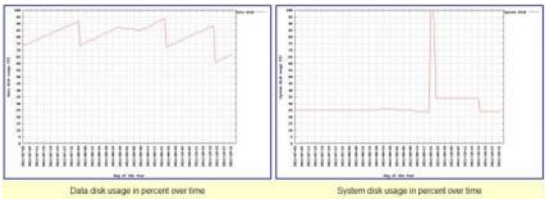
7.8 WERA Hard disk Usage overview (optional)

It can be useful and informative to monitor the usage of the partitions of the hard disks of the control pc over time.

It is possible to graphically predict the best time to replace a data disk or just to monitor if data files are generated continuously.

For this purpose the script /home/wera/etc/Harddisk_Usage.sh has been programmed.

This script will determine the hard disk usage of all defined hard disks or partitions and store the values in a file, including a time stamp. Then a plot over the last months is generated for each device, and a web page created.



It might be needed to modify the device names of the hard disks in the script.

By copying some lines of code, the script can easily be extended to display even more hard disks or partitions, e.g. external backup disks.

7.9 WERA UPS overview (optional)

If the manufacturer of the used UPS supports a web based interface, this can optionally be linked here.

7.10 WERA Remote Control

The software tool “WERA Remote-Control” is intended to read the actual voltages and temperatures out of one WERA system equipped with a power supply rack with hardware version 4.0 or later. Furthermore you are able to get access to the power supply of the system in case of shutdown/restart and maintenance. This can be done via internet remote access or sitting in front of the WERA system on-site. It’s used as an graphical user interface giving the operator a fast overview of system performance and service/maintenance information.

Depending on the hardware of the power supply rack (PSR), different software versions are needed. Since hardware version 4.0 of the power supply rack, the software “WERA Remote-Control V3.0x” is needed. For older PSR hardware versions “WERA Remote-Control V2.6x” should be used.

7.10.1 WERA Remote-Control 3. xx

The software tool “WERA Remote-Control V3.xx” is intended to read and display the internal supply voltages and temperatures and optionally forward and reflected power of one WERA system.

Furthermore it enables the user to remotely control the system in different ways. This is useful in case it is needed to shut down or restart part of the system or for maintenance/adjustments.

This software tool got a graphical user interface, giving the operator a fast and easy overview of hardware status, system performance and service/maintenance information.

The software can either be operated sitting in front of the WERA system on-site, or remotely by logging in to the graphical user interface via internet remote access. Software like NX NoMachine, TeamViewer, OpenVPN or similar may be used for this purpose.

This document contains an overview of the configuration possibilities of this software tool.

WERA Remote-Control V3.xx may only be used in combination with a WERA system equipped with a power supply rack with hardware version 4.0 or later. If you got an earlier hardware version of the power supply rack, you may use V2.6 of the software.

7.10.1.1 WERA Remote-Control-Window

The “WERA Remote-Control-Window” is the main window of the whole program. For the operator the actual system voltages, WERA power status, clock and additional options are displayed here. Please have a look at following list to get further details.

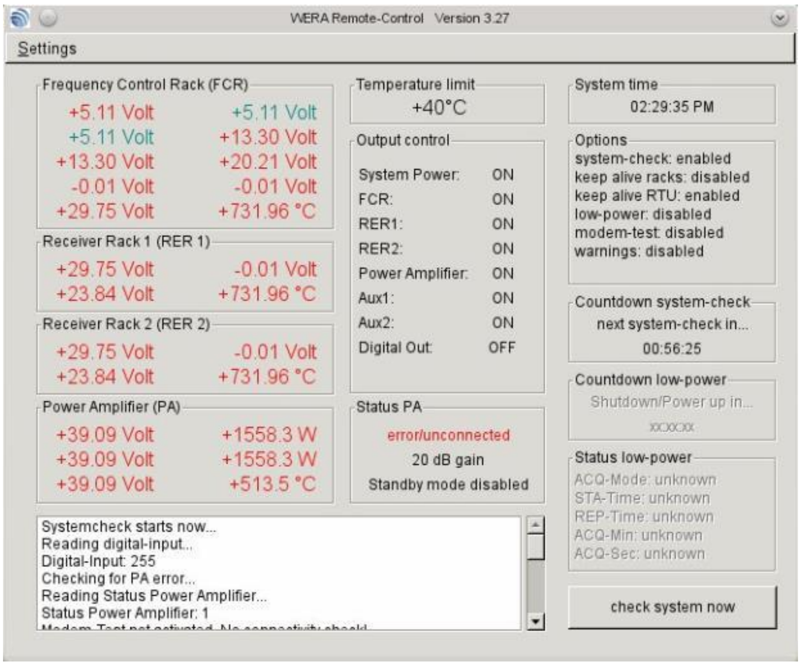


Figure: 1 main window

You can see the actual measured supply-voltages of each used rack (FCR - frequency control rack, RER1 - receiver rack 1, RER2 – receiver rack 2) and the temperature in degrees inside each rack. If a newer version of the power amplifier (PA) is connected, the voltages, temperature and forward and reverse power at the output can also be displayed, as well as the set overall gain of the power amplifier (PA), or if the power amplifier (PA) has ben set to standby mode or if the automatic self-protection circuit got triggered.

If the values are within the valid range, the colour of the displayed values turns green. If not , the colour is changed to red. The temperatures might also be displayed in yellow colour, if the temperature is just below the limit or if the racks are still switched off to cool down.

In addition you can see the maximum temperature, that is allowed inside the racks (FCR and RER). If one temperature is going above this limit, the WERA-system will automatically be switched off and will not automatically be switched back on again, before the temperature in all these racks has fallen at least 5 °C below the limit.

At the bottom of the window there is an information field, which informs you about the actual software progressing steps. If a problem is detected, the software will also display help information here like possible error sources that should be checked.

There is a status overview in the group-box “Power”. You can see here if the AC voltages distributed by the Power Supply Rack (PSR) to the individual racks are switched “ON” or “OFF”. Additionally you can see the status of the optional digital output of the PSR, which may be used to control external hardware.

When you click on the button “check system now”, new values will be read in and the display will be updated.

Over the “Settings” menu or with the help of some shortcuts, you can open the configuration-windows:

“Ctrl-W” ➔ opens the window “WERA-Setup”

“Ctrl-Q” ➔ quits the program

7.10.1.2 WERA Setup-Window – System Power, hardware and system check timing configuration tab

This section of the setup window helps you to control the AC power distribution to the individual WERA racks and other external equipment connected to the spare (Aux 1 / Aux 2 (optional)) outputs.

The optional „Digital Out“ relay can be used to switch an externally supplied DC voltage. Its main function is to reset a modems/routers supply voltage, if the internet connection is lost. See section **4 WERA Setup-Window** – Modem tab for details.

The standard power configuration is:

System Power	ON	Power Amplifier	ON
FCR	ON	Aux 1	OFF
RER 1	ON	Aux 2	OFF
RER 2	ON	Digital Out	OFF

The new setting will immediately be used after clicking the button „set relays now“.

Additionally this window is used to activate the automatic system check and configure the interval. By default this should be activated and set to once per hour, but sometimes a shorter repetition time might be useful.

During the system check, the voltages, temperatures and forward/reverse power of the FCR, RER, RER 2 and PA are read in and displayed in the main window. If the temperature in one of the racks exceeds the user defined limit, the system will automatically be switched off as a self protection mechanism against overheating. The system will be switched back on the next system check cycle, if the temperature has dropped at least 5°C below the limit again.

So please choose your temperature limit depending on the external conditions. You can choose between 40 and 50 degrees celsius in five degree steps. In a well temperatured air conditioned room a setting of 40 to 45 degrees should be OK.

Note that the temperature sensors off these racks are supplied with +5V from the PSR, so temperatures can even be read out while the racks are switched off.

Optionally the “keep alive racks” and “keep alive RTU” may be selected and executed together with the automatic system check.

If “keep alive racks” is selected, the software may automatically switch off and back on a rack, if the measured supply voltages for this rack all seem to be wrong, and if the software thinks this rack should be switched on now. This option should only be used, if a rack seems to have been switched off for an unknown reason. Normally it is not needed. It may even cause problems if somebody is troubleshooting the hardware, or if the software got false readings.

If “keep alive RTU” is selected, the software will try to ping the RTU if the FCR should be switched on. If the ping fails three times, the software will automatically switch off and back on the FCR to reset the RTU. Normally this should not be needed due to the hardware watchdog of the RTU, but it should be safe to keep this option selected, and may help to loose data files.

Since version 3.27 the available hardware versions of the FCR and RER need to be defined.

The different hardware versions got different internal supply voltages.

If the wrong hardware is selected, wrong warnings will be generated.

Note that WERA II RER contain up to 8 receiver modules, while WERA IV RER contain up to 12 receive channels. The software is currently configured to support up to 16 receive channels. So if a WERA IV RER is available, it is assumed that there is only one RER.

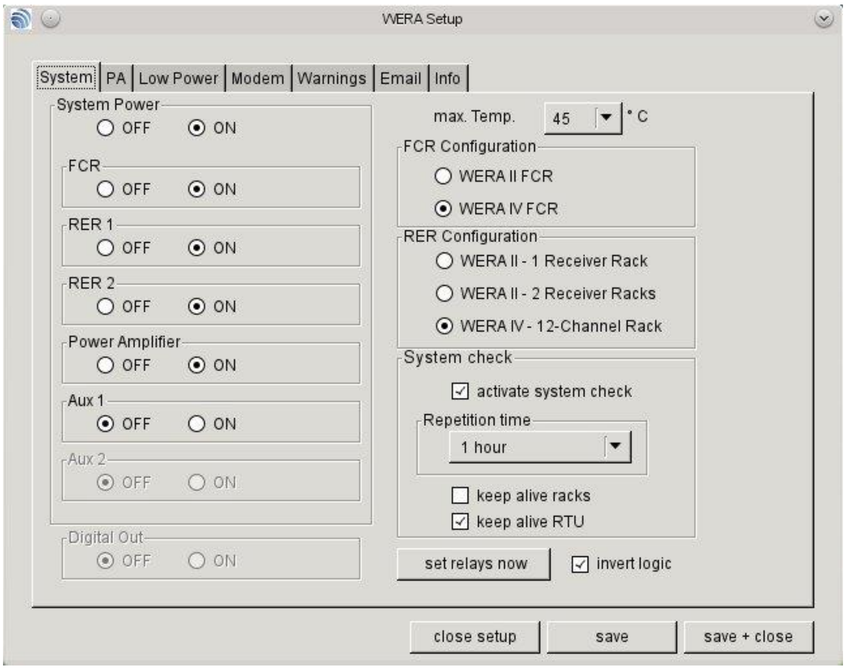


Figure: 2 setup window – System tab

If you finished configuring the software, click on “save” to save your settings or on “save and close” to close the setup window. If you want to discard your changes, then click on “close setup”.

7.10.1.3 WERA Setup-Window – PA (Power Amplifier) tab

This section of the setup window can optionally be used to control a newer version rack mounted power amplifier and check its status.

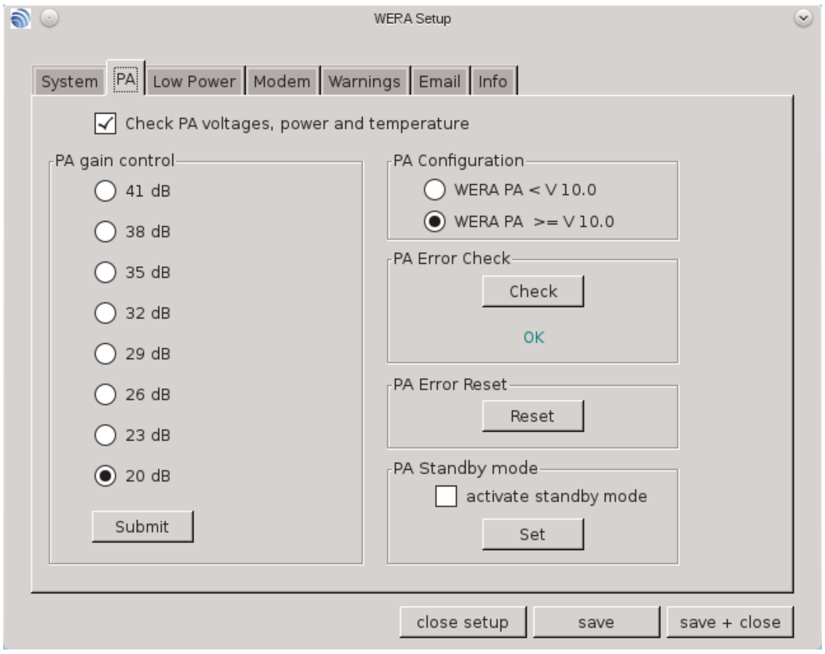


Figure: 3 setup window – PA tab

If the “Check PA voltages, power and temperature” check box is selected, these parameters will automatically be read out together with the automatic system check.

The “PA gain control” can be used to manually change the overall gain of the power amplifier by selecting the desired radio button and then pushing the “Submit” button.

This option may only be used while the system is stopped, or the PA is set into standby mode.

With the PA Configuration radio button the correct PA version needs to be selected. The displayed PA versions got different internal supply voltages. If this selection is wrong, the system will send out wrong error messages claiming that one of the internal voltages is wrong.

With the “PA Error Check” button it may be manually read out, if the PA is in self-protection mode. If everything is OK the status message will display the text “OK”. If the PA is in self-protection mode or if there is no control cable to the PA connected, the status message will display “error/unconnected”.

Note that if the supply voltages and temperature of the PA displayed in the main window do all make sense, and the status displays “error/unconnected”, then the PA should be in self-protection mode. If all these parameters seem to be wrong, the control cable is not connected, or the PA is not switched on.

With the “PA Error Reset” button the self-protection circuit of the PA may be manually reset.

This option may only be used while the system is stopped, or the PA is set into standby mode.

By selecting the “activate standby mode” check box and then pushing the “Set” button, the PA will be set into standby mode. To wake up the PA again, de-select the check box and push “Set” again.

Note that it is possible to change the gain of the PA or reset the self-protection circuit while the PA is set to standby mode.

Further note that the settings for PA gain and standby mode will be saved if the “save” or “save + close” buttons are pressed. The next time the software is started, or the FCR reboots, the PA will automatically set to these values. This setting might need some seconds.

If you finished configuring the software, click on “save” to save your settings or on “save and close” to close the setup window. If you want to discard your changes, then click on “close setup”.

7.10.1.4 WERA Setup-Window – Low Power tab

In the Low Power section of the setup window it is possible to activate the Low Power Options by selecting the corresponding check box.

When this option is activated, the software will automatically switch off the selected WERA racks in between the measurements in continuous acquisition measurement mode.

This may be useful for installation in remote places, which are running from off-grid by renewable energy or generators.

With the check boxes the user may select which AC outputs of the PSR should be switched off. Over a drop-down box it may be selected how many minutes before the next measurement the racks should be switched back on again.

Note that depending on the temperatures the electronics might need some time to reach nominal temperature for optimum performance.

Note that this mode may only be activated after continuous acquisition mode has been started over WeraDesk.

The information text field on the right will display parameters from the active acquisition mode and the scheduled timing to switch on and off the AC voltages.

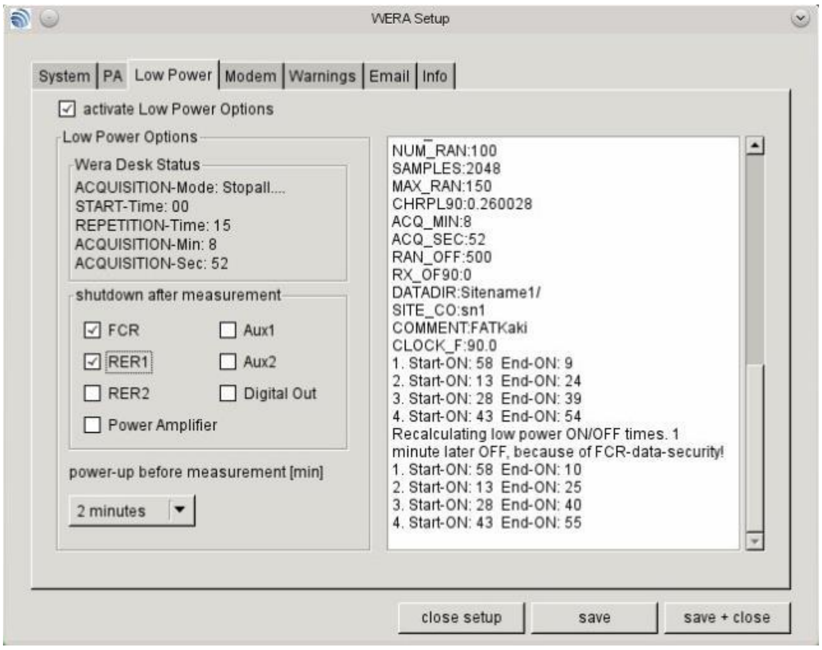


Figure: 4 setup window – Low Power tab

If you finished configuring the software, click on “save” to save your settings or on “save and close” to close the setup window. If you want to discard your changes, then click on “close setup”.

7.10.1.5 WERA Setup-Window – Modem tab

In the Modem section of the setup window the self-acting modem test can be controlled. The test is verifying a valid internet-connection by pinging up to two ip addresses like “www.yahoo.com” and “www.google.com”. If from both addresses no response is received after several tries, the selected relays are switched to the opposite setting from the WERA System power tab for a short time, then switched back.

This option may be useful if you got an unstable router or modem for the network connection, which needs to be reset automatically to dial into the internet again.

Please activate the checkbox at the top, if you want to use this option, and make sure the correct port is defined.

This modem test will be executed together with the automatic system test.

To manually test the internet connection, please click on the corresponding "TEST" button.

Make sure that no hardware is connected to the selected ports, which should not be switched off.

Further note that the PSR in the WERA IV FCR or later do not have got the optional "Digital Out" and "Aux2" outputs.

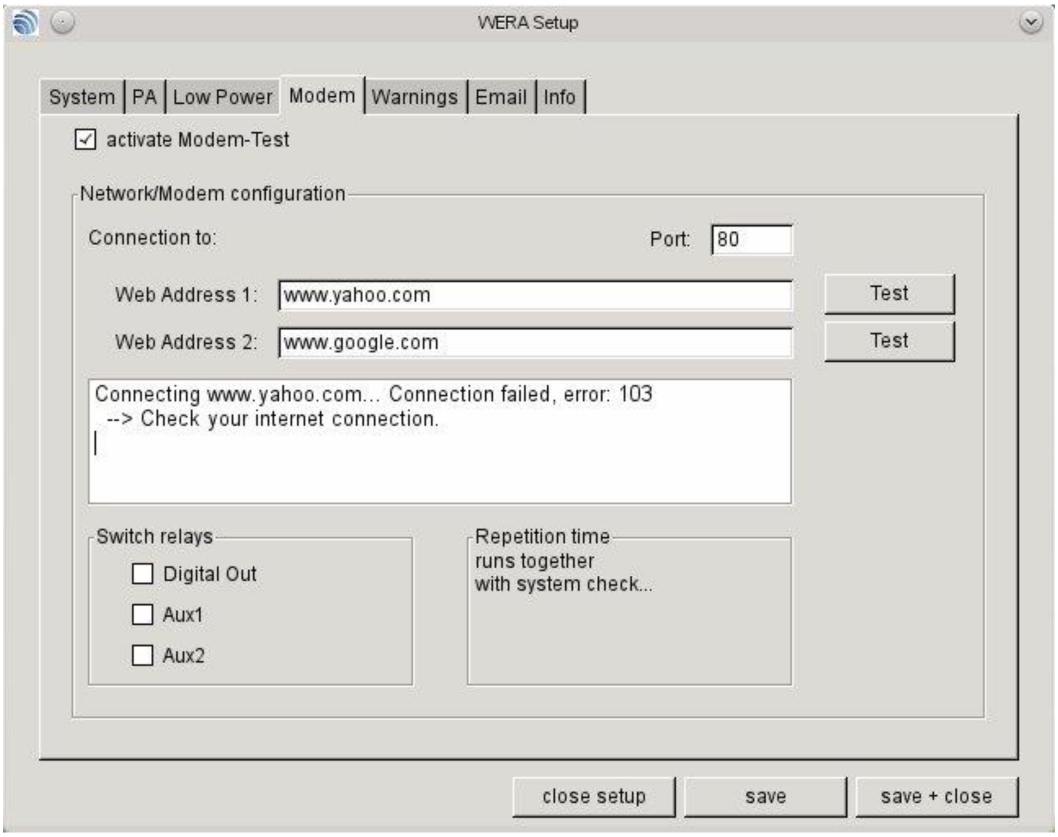


Figure: 5 setup window – Modem tab

If you finished configuring the software, click on "save" to save your settings or on "save and close" to close the setup window. If you want to discard your changes, then click on "close setup".

7.10.1.6 WERA Setup-Window – Warnings tab

In the Warnings section of the setup window the automatic generation of warning and status messages for the WERA warning system can be configured.

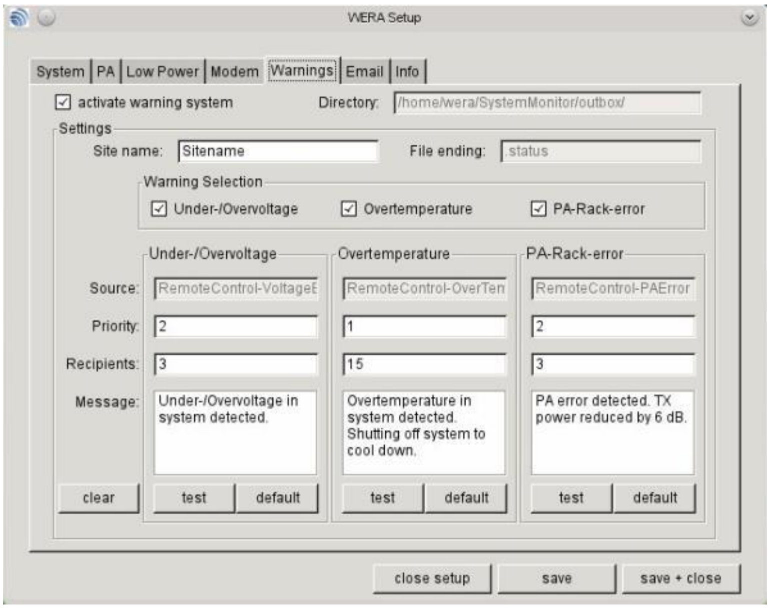


Figure: 6 setup window – Warnings tab

If the “activate warning system” check box is selected, the software will generate warnings and status messages. These messages will be saved in the displayed directory with the shown file ending. By default this is /home/wera/SystemMonitor/outbox/. If you want to use a different directory or file ending, you may manually edit the configuration file setup.txt. But this is not recommended, because the standard WERA warning system will handle messages in the default directory only.

For each site a unique site name should be used to be able to identify, which WERA station send out the message. It is recommended to use the same site name for all parts of the warning system.

With the check boxes in the “warning Selection” group box the user can select what kind of warnings should be generated.

The “Priority”, “Recipients” and “Message” list boxes may be filled with customized values, but should normally kept at default values.

The “Source” parameter should normally not be modified, but this would also manually be possible in the configuration file setup.txt.

For more information about the meaning of these parameters read the document “Manual-SystemMonitor-131017.pdf” or a later version, which describes the warning system on server side.

Note that there are buttons to reset the parameters to default or generate a test message.

If you finished configuring the software, click on “save” to save your settings or on “save and close” to close the setup window. If you want to discard your changes, then click on “close setup”.

7.10.1.7 WERA Setup-Window – Email tab

The Email section of the setup window is not activated.

In the future this section could be used to configure warning emails, which may automatically be send out if an error has been detected.

If you need this feature, please contact the Helzel team

Note that this feature is now being replaced by the warning system.

If you finished configuring the software, click on “save” to save your settings or on “save and close” to close the setup window. If you want to discard your changes, then click on “close setup”.

7.10.1.8 WERA Setup-Window – Info tab

The Info section of the setup window contains the information about the valid voltage ranges of each supply-voltage in each rack.

Note that some supply voltages depend on the hardware version being installed.

Figure: 8 setup window – Info tab

If you finished configuring the software, click on “save” to save your settings or on “save and close” to close the setup window. If you want to discard your changes, then click on “close setup”.

Since version 3.0.2 of the software, the manual can directly be opened over a link in the main menu.

7.11 WERA Advanced Settings

WERA Advanced settings is an web-based editor for settings of the WERA system which are hidden in /home/wera/etc and changed seldom. It has two layers of access control: First the standard mode for more often accessed settings and a special user who also can change settings, not used so often with the help of the Advanced settings mode. For details see the corresponding section in the complete WERA manual.

7.12 WERA UPS overview (optional)

It is strongly recommended to use a UPS unit to buffer at least the WERA User Interface PC. Please refer to the operators manual of the used device.

7.13 WERA Remote Control

The software tool “WERA Remote-Control” is intended to read the actual voltages and temperatures.

For further details plese refer to the WERA manual chapter 7.8

There you will find all required settings to generate automatic warnings etc.

8. Data processing scripts

These scripts are used to carry out specific software tasks after each measurement.

Please refer to the WERA user manual chapter 8 if some settings might need to be modified.

9. Data formats

There are various data formats used after each processing step. Please refer to the WERA user manual to get details about the formats.

9.1 RAW
9.2 SORT - WERA range resolved data
9.3 SPEC - WERA Spectra on UV-Grid (.spec)
9.4 crad and wrad – Current and wave radial data
9.5 cur_asc, wav_asc and win_asc
9.6 CAL - WERA Calibration data
9.7 USORT - unsorted RAW data

10. Data processing tools

All WERA data processing programs are command – line tools. So a base knowledge of UNIX/Linux shell use is very advantageously. Please refer to the WERA user manual for details.

11. Visualization

In a standard application the visualization takes place on the WERA Server. For this reason **please refer to the WERA Server Manual** for all visualization and data management options.

All WERA data processing programs are command – line tools. So a base knowledge of UNIX/Linux shell use is very advantageously. Please refer to the WERA user manual for details.

12. Installation Checklist

Pos	Name of Site				
11	Co-ordinates of Rx 1	LON:		LAT:	
	of last Rx	LON:		LAT:	
	Distance between poles			Type of array:	
	Tx centre position	LON:		LAT:	
	Container position	LON:		LAT:	
13	Height of antenna foot	Rx_{min}	Rx_{max}	Tx_{min}	Tx_{max}
	Radial type				
14	(a) Calibration, Internal	/home/wera/etc/calibration.wera_internal__________			
	(b) Cable calibration	/home/wera/etc/calibration.wera_cable____________			
	(c) Optional Ant. Cal.	/home/wera/etc/calibration.wera_ant______________			
	(d) other methods	/home/wera/etc/calibration.wera_xxx______________			
15	Calibration activated:	file name: (a) (b) (c) (d) calibration.wera		Sign:	
17	Antenna Test Tx #1	f_0:	VSWR:	BW_{SWR2}:	
	Antenna Test Tx #2	f_0:	VSWR:	BW_{SWR2}:	
	Antenna Test Tx #3	f_0:	VSWR:	BW_{SWR2}:	
	Antenna Test Tx #4	f_0:	VSWR:	BW_{SWR2}:	
18	Direct Path Test (DPT)	Rx # 1 in Volts	Rx # last in Volts	Range in km	
	with one Tx antenna:				
	with Tx array:				
		Directivity	$D = V_{oneTx} / V_{Tx\text{-}array}$ $D = dB_{oneTx} - dB_{Tx\text{-}array}$	D = D =	
	Optimise Tx power:	Rx # 1 in Volts	Rx # last in Volts	Range in km	
	Tx-Power / Rec-Atten				
	/				
	/				
	/				
	/				
19	Perform DPT, file at:	/home/wera/etc/calibration.wera_DPT______________			
21	All Antennas checked and sealed	Date:		Sign:	