



Wideband Radio Head

Installation and Service Manual

044-05251 Rev A

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This Powerwave product is designed to operate within the Normal Operating (typical operating) ranges or conditions specified in this document. Operation of this equipment beyond the specified ranges in this document may cause (1) spurious emissions that violate regulatory requirements; (2) the equipment to be automatically removed from service when maximum thresholds are exceeded; or (3) the equipment to not perform in accordance with its specifications. It is the Operator's responsibility to ensure this equipment is properly installed and operated within Powerwave operating specifications to obtain proper performance from the equipment and to comply with regulatory requirements.

The rated output power of this equipment is for single carrier operation. For situations when multiple carrier signals are present, the rating would have to be reduced by 3.5 dB, especially where the output signal is re-radiated and can cause interference to adjacent band users. This power reduction is to be by means of input power or gain reduction and not by an attenuator at the output of the device. Input power is rated at 115/230VAC, 50/60Hz, and should be protected with a 20 A breaker. Power strips should, at a minimum, conform to this requirement to prevent equipment damage and possible overload.

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This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. Changes or modifications not expressly approved by Powerwave Technologies, Inc. for compliance could void the user's authority to operate this equipment. 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.

Industry Canadian Requirement

All Powerwave apparatus introduced on the Canadian market meet all requirements of the Canadian Interference-Causing Equipment Regulations. The -20dB bandwidth is 80MHz.

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Abbreviations

The following list of abbreviations are used throughout this manual, the software, and the repeater:

AGC	Automatic Gain Control
ALI	Alarm Interface
AMPS	Advanced Mobile Phone Service
BA	Booster Amplifier
BeO	Beryllium Oxide
BMU	Base Station Master Unit
BS	Base Station, BS antenna = towards the base station
BSA	Band Selective Amplifier
BSel	Band Selective
BTS	Base Transceiver Station
CDMA	Code Division Multiple Access
CHE	Channel Amplifier for GSM and EDGE
CMB	Combiner
CSA	Channel Selective Amplifier
CSel	Channel Selective
CU	Control Unit
CW	Continuous Wave
DAMPS	Digital Advanced Mobile Phone Service
DC	Directional Coupler
DCS	Digital Communication System (same as PCN)
DIA	Distribution Interface
DL	Downlink signal direction (from base station via repeater to mobile station)
DPX	Duplex filter
EDGE	Enhanced Data rates for GSM Evolution
EEPROM	Electrical Erasable Programmable Read Only Memory
EGSM	Extended Global System for Mobile communication
ESD	Electrostatic Discharge
ETACS	Extended Total Access Communication System
ETSI	European Telecommunications Standard Institute
FLI	Fiber Link Interface
FON	Fiber Optic Node
FOR	Fiber Optic Repeater
FOU	Fiber Optic Unit
GSM	Global System for Mobile communication
HW	Hardware
ICNIRP	International Commission on Non-Ionizing Radiation Protection
LED	Light Emitting Diode
LNA	Low Noise Amplifier
MS	Mobile Station, MS antenna = towards the mobile station
MSC	Mobile Switching Center
NEMA	National Electrical Manufacturers Association

NiCd	Nickel Cadmium
NMT	Nordic Mobile Telephone system
NOC	Network Operations Center
OCM	Optical Converter Module
OMS	Operation and Maintenance System
PCN	Personal Communication Network (same as DCS)
PCS	Personal Communication System
POI	Point of Interconnect
PSM	Power Supply Module
PTFE	Polytetrafluoro Ethylene (Teflon)
R2R	Repeater-to-Repeater
RCI	Remote Control Interface
RCU	Remote Control Unit
RCM	RF Converter Module
RF	Radio Frequency
RIA	Repeater-to-Repeater Adapter
RMU	Remote Master Unit
RSSI	Received Signal Strength Indication
RTC	Real Time Clock
SW	Software
TACS	Total Access Communication System
TDMA	Time Division Multiple Access
UL	Uplink signal direction (from mobile station via repeater to base station)
UPS	Uninterruptible Power Supply
WHO	World Health Organization
WLI	Wire Link Interface
WRH	Wideband Radio Head

Chapter 1

Product Description

Introduction

This manual contains information and procedures for installation, operation, and maintenance of the Wideband Radio Head (WRH). The manual is organized into chapters as follows.

- Chapter 1 - Product Description
- Chapter 2 - Controls and Indicators
- Chapter 3 - Installation
- Chapter 4 - Maintenance
- Chapter 5 - Specifications

Scope of Manual

This manual is intended for use by service technicians familiar with similar types of equipment. It contains service information required for the equipment described and is current as of the printing date. Changes which occur after the printing date may be incorporated by a complete manual revision or alternatively as additions.

Safety

It is necessary that any personnel involved in installation, operation or service of units included in a Powerwave Distributed Antenna System (DAS) understand and follow the below points.



- Powerwave WRHs are designed to receive and amplify signals from one or more base stations and retransmit the signals to one or more mobile stations. And, also to act the other way round, that is to receive signals from one or more mobile stations, amplify and retransmit the signals to the base stations. Powerwave WRH systems must be used exclusively for this purpose and nothing else.
- Units supplied from the mains must be connected to grounded outlets and in conformity with the local prescriptions.
- Power supply units supplied from the mains contain dangerous voltage that can cause electric shock. Disconnect the mains prior to any work in such a unit. Local regulations are to be followed when servicing such units. Authorized service personnel only are allowed to service units while the mains is connected.
- The WRH cover must be secured in opened position, for instance by tying it up. Otherwise, the cover can be closed by the wind and cause your fingers getting pinched or your head being hit.
- When working on a WRH on high ground, for instance on a mast or pole, be careful not to drop parts or the entire WRH. Falling parts can cause serious personal injury.
- All RF transmitting units, including WRHs, will generate radio signals and thereby give rise to electromagnetic fields that may be hazardous to the health of any person who is extensively exposed close to an antenna.
- Beryllium oxide (BeO) may be contained in power devices, for instance in dummy loads in directional couplers (DCC), in combiner units (CMB), and in attenuators on the FON board. Beryllium oxide is poisonous if present as dust or smoke that can be inhaled. Do not file, grind, machine, or treat these parts with acid.
- Coaxial cables used in many Powerwave systems have the insulation made of PTFE, polytetrafluoro ethylene, that gives off small amounts of hydrogen fluoride when heated. Hydrogen fluoride is poisonous. Do not use heating tools when stripping off

coaxial cable insulation. No particular measures are to be taken in case of fire because the emitted concentration of hydrogen fluoride is very low.



- A lithium battery is permanently mounted on CU units, and in FON and OCM units. Due to the risk of explosion, this battery must only be removed from the board by an Powerwave authorized service technician.



- NiCd batteries are mounted on the FON unit. These batteries contain environmental poisonous substances. If replaced, the old batteries should be taken care of as stated in the local prescriptions.

- The FON unit contains a class IIIb laser transmitter that emits 2 – 4mW invisible laser radiation during operation. Avoid direct exposure from unconnected laser transmitter or fiber cord as follows:

- Do not power up the FON unit if a fiber cable is not attached to the fiber output UL port, neither if a fiber cable is attached to the port but unattached in the other end.

- **Never look in the end of a fiber cable.** The 1310nm and 1550nm laser light is not visible, so no signal identification can be made anyway. Use always an instrument, such as a power meter to detect signaling.

- **Never use any kind of magnifying devices that can focus the laser light to an unaided eye.**

Warning Signs

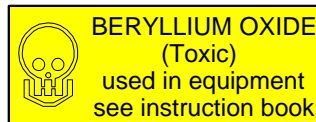


The following warning signs must be observed and be kept clean and readable.

Beryllium oxide

This warning sign is applied on boards and units which contain beryllium oxide parts.

This warning sign is applied at the bottom, inside the cabinet, below the power supply unit.



Human Exposure of RF Radiation

Safe distances must be kept when working around antennas. The following paragraphs describe the cautions to be aware of during the installation and maintenance of antenna systems and how to calculate safety distances needed for RF radiation at different antenna power and frequencies.

Antennas

To be able to receive and transmit signals, a WRH is connected to a donor antenna directed towards the base station and a service antenna directed towards the coverage area. A fiber optic cable from the base station might, however, be substituted for the donor antenna.

Installation and Maintenance of Antenna Systems

Installation and maintenance of all antenna systems must be performed with respect to the radiation exposure limits for public areas. The antenna radiation level is affected by WRH output power, antenna gain, and transmission devices such as cables, connectors, splitters and feeders. Also have in mind the system minimum coupling loss, typically between 25dB and 35dB, is determined by a standard with the purpose to protect base stations from noise and other performance dropping effects.

Radiation Exposure

The World Health Organization (WHO) and International Commission on Non-Ionising Radiation Protection (ICNIRP) have determined recommendations for radiation exposure. ICNIRP recommends not to exceed the following radiation power for public exposure:

Frequency Radiation power900MHz 4.5W/m²1800MHz 9.0W/m²2100MHz 10.0W/m²

For antennas larger than 20cm the maximum radiation power can be calculated by using the following formula:

$$S = \frac{P}{4 \times \pi \times r^2}$$

where S = Radiation power in W/m²

P = Output power in W

r = Distance between antenna and human in meter

To tackle the worst case successfully, the calculation does not consider system power reducing actions, such as power control and DTX. Figure 1-1 shows the safety distance to an antenna due to the RF radiation. The distance depends on antenna output power and frequency, which is illustrated with the two graphs. One graph applies to 4.5W/m² (900MHz) and the other to 9.0W/m² (1800MHz) or 10.0W/m² (2100MHz). The safety distance range is 0 to 1.4 meters which covers an antenna power range of 10dBm to 50dBm (0.01W to 100W).

Radiation Safety Distances

This section illustrates the safety distances to the antennas for some typical WRH configurations.

Outdoor GSM 900MHz

WRH output power	+33dBm
Feeder loss	-5dB
Antenna gain	+17dBi
Equivalent Isotropic Radiated Power (EIRP)	+45dBm

The safety distance can be read to 0.75 meter in Figure 1-1 as the maximum radiation power is 4.5W/m² for 900MHz.

Indoor GSM 900MHz

WRH output power	+22dBm
Feeder loss	-5dB
Antenna gain	+1dBi
EIRP	+18dBm

The safety distance can be read to 0.035 meter for 4.5W/m² (900MHz).

Outdoor UMTS Standard High Power

WRH output power	+38dBm
Feeder loss	-5dB
Antenna gain	+17dBi
EIRP	+50dBm

The safety distance can be read to 0.9 meter for 10W/m² (2100MHz).

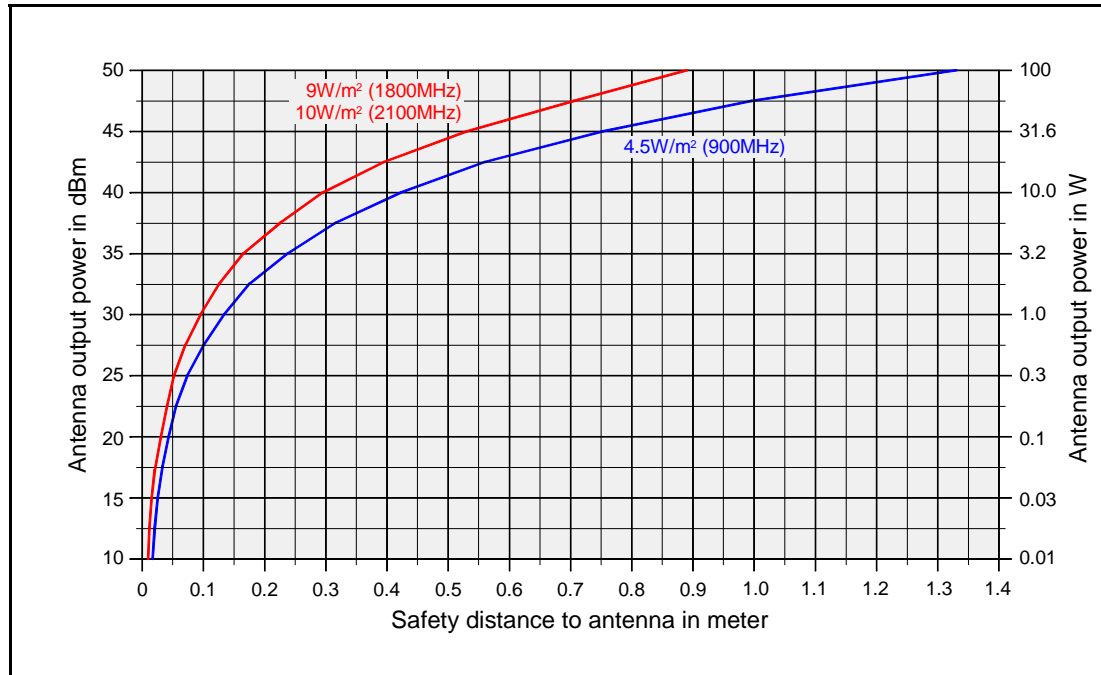


Figure 1-1 Safety distance to active antenna.

Indoor UMTS

WRH output power	+24dBm
Feeder loss	-5dB
Antenna gain	+3dBi
<u>EIRP</u>	<u>+22dBm</u>

The safety distance can be read to 0.035 meter for 10W/m² (2100MHz).

Electrostatic Discharge (ESD)

ESD can severely damage essential parts of the equipment if not handled carefully. Parts on printed circuit board assemblies (PCBA) as well as other parts in the equipment are sensitive to ESD. Never touch the PCBA or uninsulated conductor surfaces unless absolutely necessary.

If you must handle the PCBAs or uninsulated conductor surfaces, use ESD protective equipment or first touch the chassis with your hand. Never let your clothes touch PCBAs or uninsulated conductor surfaces and always store PCBAs in ESD-safe bags.

Overview



Figure 1-2 Powerwave Wideband Radio Head (WRH)

Powerwave WRHs work as bi-directional on-frequency amplifiers used to fill out uncovered areas in wireless mobile systems such as base station fringe areas, tunnels, convention centers, airports and business buildings. It receives, amplifies and transmits signals to/from a base transceiver station (BTS) to/from mobile stations (MS) with both directions being served simultaneously. Connections to the WRH are made with N-type or 7/16" male connectors.

WRHs are microprocessor controlled with alarm and operational status LEDs visible on the front cover. Cooling is provided through convection heat dissipation.

Operational parameters, such as gain, channel number and power levels are set using a PC running Powerwave OM-Online software which can communicate with the WRHs either locally or remotely via modem. Remote operation can be performed via PSTN or a GSM net. The Operation and Maintenance System (OMS) provides for Network Operations Center (NOC) configuration and alarm monitoring.

WRHs can be configured in many combinations depending on the wireless system, single or double system operation, and output power. The following paragraphs provide a description of the different models of WRH's available.

WRH

The Standard WRH is used for analog or digital systems such as GSM, TACS, ETACS, AMPS, DAMPS, CDMA and WCDMA. It can be equipped with two bands in the cabinet and two bands in a high cover. It has a fiber optic donor port and an RF port for a service antenna (or RF cable) and is designed to be connected to a BTS via a BMU or OCM.

A booster option is available for the standard WRH to provide greater output power. This unit is equipped with a 6dB Booster Amplifier (BA) in the downlink path. The BA reduces the number of bands with one band per BA used in the cabinet and an additional one band if a high cover is used. The BA is located in the cabinet and is supplied from the existing PSU. For two bands, a high cover is used.

WRH-V

The WRH-V is designed to provide a higher output power level and comes equipped with a MCPA in the downlink path. The MCPA reduces the number of bands to one band per MCPA used in the cabinet and an additional one band if a high cover is used. The MCPA is located in the cabinet and is supplied from the existing PSU. For two bands, a high cover is used.

Chassis Design

The WRH is housed in a cast aluminium waterproof chassis, class NEMA4 / IP65 approved for outdoor use but is also suited for indoor installations. The chassis consists of a cabinet and a cover attached with hinges. The cabinet contains the WRH circuitry. The cover comes as either a low or high version. The high cover can be used as an empty cover or be equipped as a part of the WRH or an independent WRH unit. A WRH with a high cover that is equipped as two independent units can, for example, be equipped for channel selective operation in the cabinet and band selective operation in the cover.

Inside the WRH, a number of amplifier PCBAs are individually shielded and located under a metal cover that can be opened outward. These PCBAs are of different types depending on the supported system. Functionally, all WRHs are built up with a number of sub units. These are listed and described in the following sections.

Sub Unit Overview

A number of amplifier PCBAs are individually shielded and located under a metal cover inside the WRH. This cover can be opened outward for access. These amplifier PCBAs are of different types depending on the supported system. All of the WRHs are built up with a number of sub units which are described in the following sections.

Wideband Amplifier PCBA (WBA)

WRHs can handle multiple carriers over a wide band. Each band requires one WBA for the uplink and downlink, and one PA for the downlink. The cabinet can be equipped with up to two WBAs and two PAs supporting two bands. Positions 1 and 3 are assigned for a WBA.

Power Amplifier PCBA (PA)

The PA is used to amplify the output signal from the WBA in the downlink direction and reside in positions 2 and 4.

Multi-Carrier Power Amplifier PCBA (MCPA)

Installed in the WRH-V only, the MCPA is used to amplify the output signal from the WBA. Each MCPA can handle one band in the downlink direction. It requires an extra heat sink element on the outside of the cabinet or high cover to dissipate the heat generated. The MCPA occupies positions 3 and 4 in the cabinet and 7 and 8 in a high cover.

Booster Amplifier PCBA (BA)

A WRH can be modified with a BA on the DL path to increase the output power by 6dB (typically) depending on system configuration. This BA can operate with a maximum of 2 channels and occupies position 3 in the cabinet and position 7 in a high cover. It also requires an extra heat sink element on the outside of the cabinet or high cover. Some configurations use the existing PSU while others require a second PSU.

Distribution PCBA (DIA)

The DIA is the core distribution PCBA on which all other PCBAs and units connect to in the cabinet with the exception of the PA. A shielded metal frame on the DIA provides the mounting location for the CU, ALI and RCIs, if used.

Signals from the DPX output are fed to the LNA input connector IN. OUT1 and OUT2 outputs feed the WBAs of the same signal direction. The signal level in these connectors are +20dB referenced to the antenna input. Another output, OUT LOW, is an expansion output for an additional LNA if the WRH is equipped in the cover part of the chassis. The gain to this connector is +2dB. The +7V input is used for +7V supply from the DIA PCBA and ATT is a control signal for a controllable attenuator in the LNA.

Duplex Filter (DPX)

DPXs are located on the metal cover sheet in the upper part of the cabinet. Service and donor DPXs are identical.

Fiber Optic Unit (FOU)

The FOU is a metal plate mounted on top of the cover plate in the upper part of the WRH. The FON and fiber optic connectors are mounted on the FOU. It can also be configured with combiners, splitters, and WDMs to obtain a desired combination of several branches with double or single fiber.

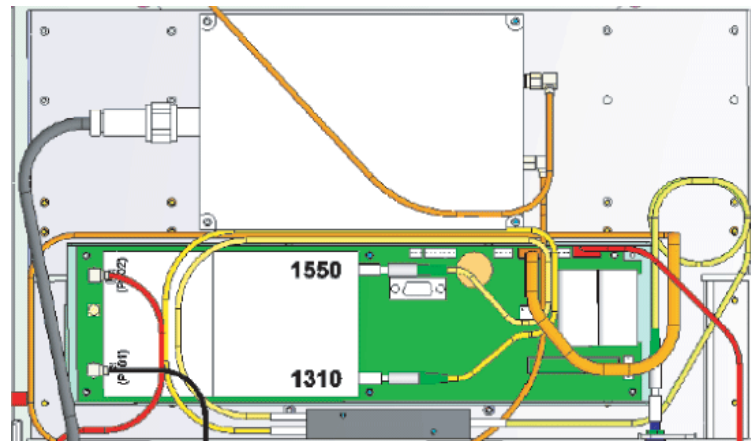


Figure 1-6 Fiber Optic Unit (FOU)

Fiber Optic Node (FON)

The FON is the main part of the FOU. It is a bi-directional electrical/optical signal converter and a node in a fiber network. In addition, the FON has all the functionality included in the CU PCBA and contains battery backup. It has also functionality for:

- Electrical and optical signal supervision
- Internal and external alarm handling
- RS232 interface for local PC control via an O&M software (OM-Online)
- Remote control via an O&M software (OM-Online or OMS)
- Interfaces for RCU, WLI, and FLI
- Battery backup with charger

There are two versions of the FON; a 3-port and 4-port version. The FON has coaxial ports and two optical ports for the downlink and uplink RF signal. The 4-port version has an additional coaxial port on the left side.

Power Supply Unit (PSU)

A PSU is located in the lower center of the cabinet and, if configured, in the lower center of the high cover.

Remote Control Unit (RCU)

The RCU is an optional communication unit for remote control of WRHs via PSTN or RF modems. RCU types and details are described in Chapter 4.

Alarm Interface PCBA (ALI) and Remote Control Interface PCBA (RCI)

The ALI handles alarms and alarm communication. It is replaced with an RCI if an RCU is used and provides an interface between the CU and an RCU for remote communication via modem. The RCI also handles alarms and alarm communication. Either unit is located in the lower left part of the shielded DIA frame.

Sub Unit Locations

WRH

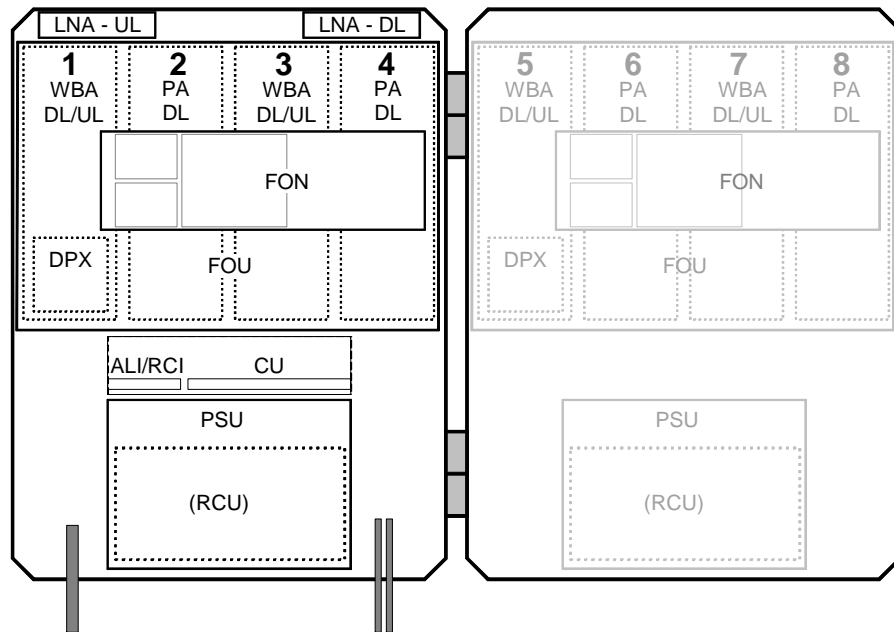


Figure 1-7 Standard WRH Sub Unit Locations

For single wideband operation the cabinet is equipped with a WBA in position 1 for both DL and UL paths and an associated PA in position 2 for DL signal amplification. For dual band operation another set of PCBAs can be used in positions 3 and 4. The WRH has a FON for uplink transmission via fiber optics. A high cover can be equipped as well providing up to four bands. PCBA positions are illustrated in the Figure 1-3 and a block diagram is located in Appendix A.

The booster option boosts the output DL signal from the PA. The BA is located at position 3 in the cabinet. A booster can only be equipped for one band in the cabinet and an additional band in a high cover. PCBA positions are illustrated in the Figure 1-4 and a block diagram is located in Appendix A.

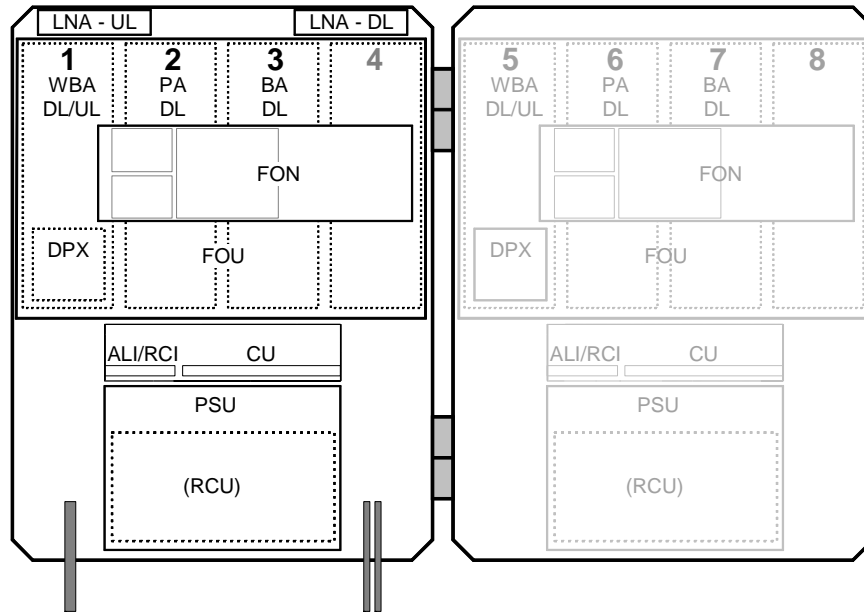


Figure 1-8 Standard WRH with Booster Option Sub Unit Locations

WRH-V

The WRH-V has a configuration similar to the standard WRH with the exception of a the MCPA that boosts the output DL signal from the PA. The MCPA is located at positions 3 and 4 in the cabinet. The MCPA requires an additional heat sink and is attached to the MCPA PCBA. A WRH-V can only be equipped for one band in the cabinet and an additional band in a high cover. PCBA positions are illustrated in the Figure 1-5 and a block diagram is located in Appendix A.

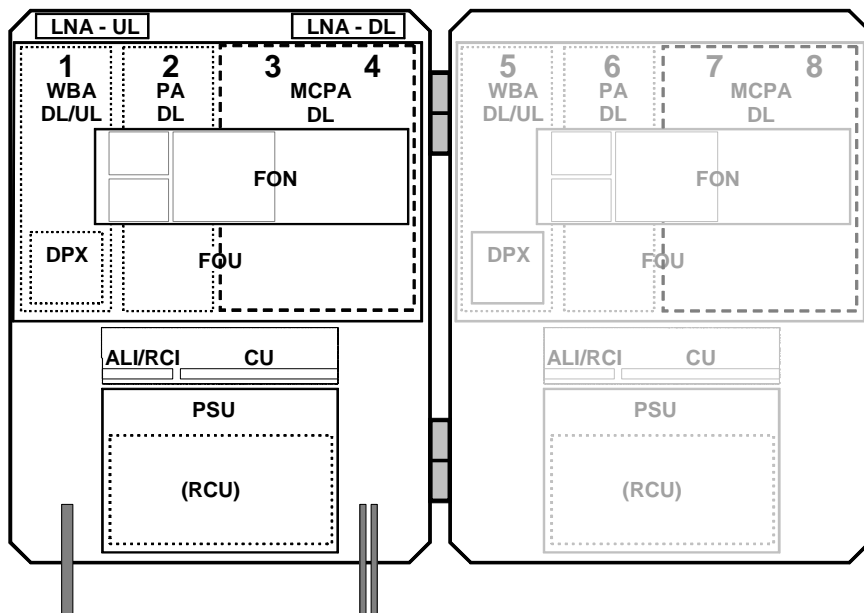


Figure 1-9 WRH-V Sub Unit Locations

Fiber Optic Distribution Networks

Fiber optic networks are setup identically to data networks. WRHs are connected in a star configuration as illustrated in Figure 1-6. In this example, a Base Station Master Unit (BMU) is fed by a BTS via an RF cable. An Optical Converter Module (OCM) could also be used depending on the system configuration. The BMU or OCM contain three FONs and provide continuity to the FONs in the four WRHs. By using Wave Division Multiplexers (WDMs) and Optical Splitters (OSPs) in the WRHs, the distribution net can be built up with a combination of star and daisy-chain connections using double or single fiber.

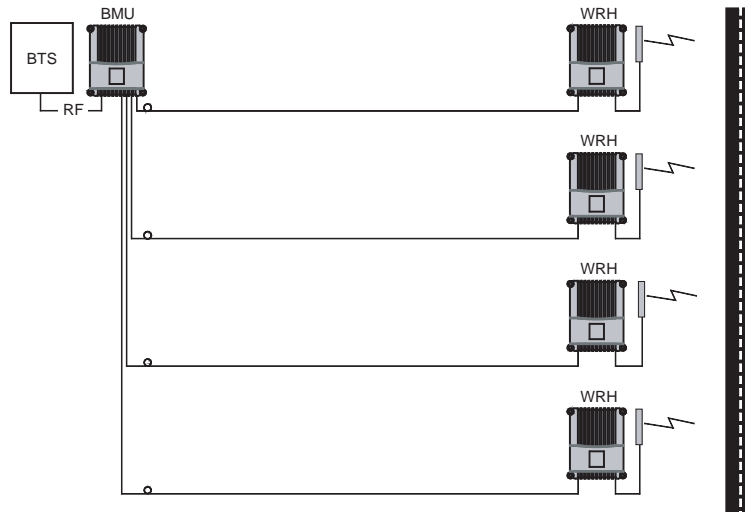


Figure 1-10 Fiber Optic Star Configuration

Multi-Operator Configurations

Multi-operator systems require the use of Point of Interconnects (POIs), RF Combining Modules (RCMs) and OCMs as illustrated in Figure 1-7. In this simple example, two operators have two sectors each. Each sector is connected to a POI and then to a RCM. The RCM is interconnected with an OCM via coaxial cables. The combined DL and UL signals are converted to optical signals in the OCM and then distributed to the ARs. Additional information is provided in the Fiber Optic Equipment Operation and Maintenance Manual.

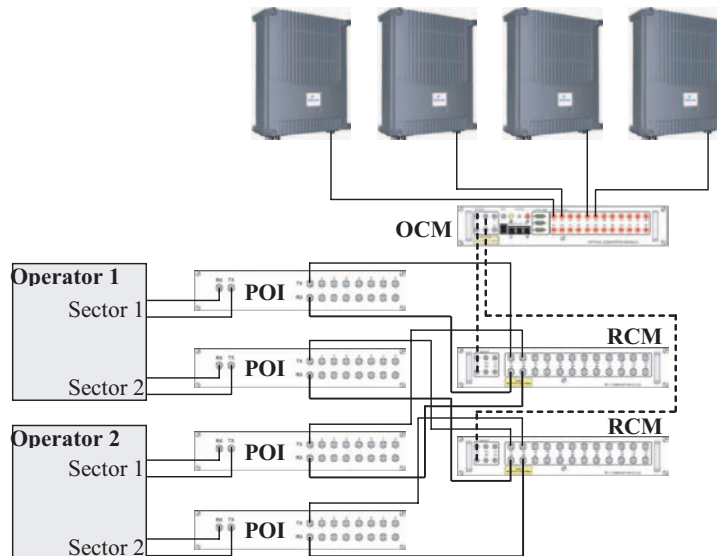


Figure 1-11 Multi-operator System

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Chapter 2

Controls, Indicators and Connectors

Introduction

This chapter contains descriptions of the WRH controls, indicators and connectors.

Front Cover Indicators



Figure 2-1 External Indicators

Two LEDs are located on the front cover to provide easy identification of a fault in the system. The amber operation LED lights up approximately 15 seconds after the main power is switched on. When the LED is steady, the WRH is ready for operation. The red alarm LED indicates a system error alarms when flashing and a critical alarm when steady.

Cabinet Indicators

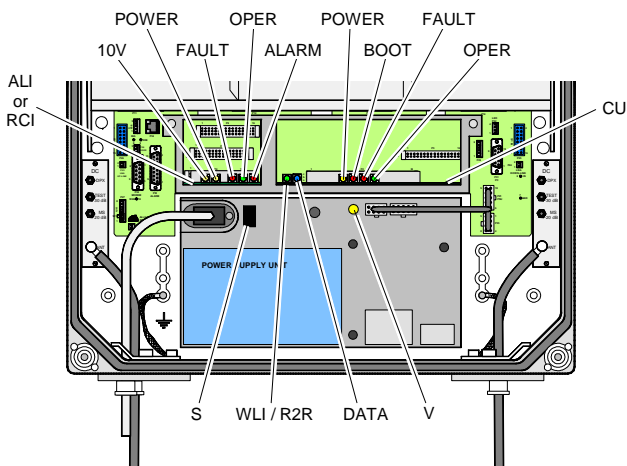


Figure 2-2 Cabinet Internal Indicators

Figure 2-2 illustrates the LED indicators located on the ALI, or RCI, and CU PCBAs as well as the 115/220V main power switch ('S') in the cabinet. These indicators are described in further detail in the following sections.

PCBA Indicators

This following paragraphs describe the LED indicators on the main PCBAs inside the WRH.

CU PCBA

Figure 2-3 illustrates the ocaion of the LEDs on the CU and Table 2-1 describes their indications.

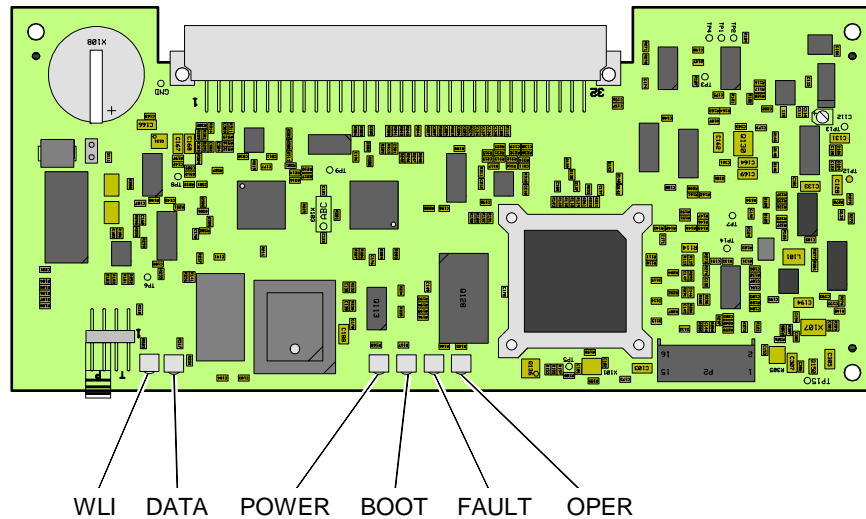


Figure 2-3 CU PCBA Indicators

Table 2-1 CU PCBA LED Indicators

LED	Description
WLI	Wire Line Interface. A flashing green LED indicates the unit is receiving data over the subcarrier. A steady green LED indicates: the unit is currently not receiving any data, is currently not a control station or there is no other node in the network.
DATA	Blue LED indicating data transmission in the W-net.
POWER	Yellow LED indicating present power and remains steady after power is switched on.
BOOT	Steady red LED when the CU boots (10 – 15 seconds after main power is switched on), then flashing red (5 – 10 seconds), then off if no error is detected. If an error is detected LED will stay on.
FAULT	Flashing red LED for 15 – 20 seconds after main power is switched on. Flashes for less serious alarms (Error) and is on solid for fatal alarms (Critical).
OPER	Steady green LED indicates WRH is ready for operation.



WARNING: A lithium battery is permanently mounted on the CU PCBA. Due to risk of explosion, this battery must not be removed. In case of battery malfunction, replace the CU PCB.

FON PCBA

The FON is illustrated in Figure 2-4 and the LED indicators are described in Table 2-2.

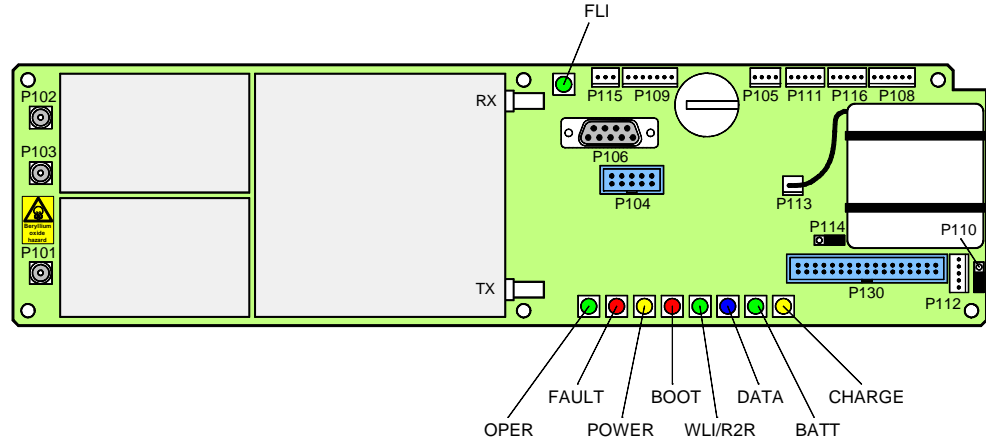


Figure 2-4 FON LED Indicators

Table 2-2 FON LED Indications

LED	Description
FLI or F2F	Green LED. Fiber Line Interface (FLI). Flashing LED indicates the unit is receiving data over the sub carrier. A steady LED indicates the unit has detected an FLI sub-carrier, but is not carrying any data.
OPER	Green LED. Lights up for approximately 15 seconds after the mains is switched on. When steady, it indicates the unit is ready for operation.
FAULT	Red LED. Flashes for 15 – 20 seconds after the mains is switched on. Will flash for less serious alarms and be steady for fatal alarms.
POWER	Yellow LED. Indicates power is present
BOOT	Red LED. Steady LED when the control unit boots up (10 – 15 seconds after the mains is switched on). Next enters a flashing state for 5 – 10 seconds. If no error is detected, the LED is off. If an error occurs, the LED remains on.
WLI	Green LED. Wire Line Interface. Flashing LED indicates unit is receiving data over the subcarrier. A steady LED indicates one of the following: The unit is not currently receiving any data, the unit is not currently a control station or there is no other node in the network.
DATA	Blue LED. Indicates data transmission in the W-net
BATT	Green LED. Steady LED indicates battery pack is currently used as power source
CHARGE	Yellow LED. Steady LED indicates battery charging

PCBA Connectors

The following Tables list the connections on the main PCBAs inside the WRH. Table 2-3 describes the connections for the WRH-V configured for PCS with diversity and non-diversity and Table 2-4 for Cellular with diversity and non-diversity.

Table 2-3 WRH-V PCS Connections

From	To	Cable Type	Non-Diversity 800-15790-001	Diversity 800-15790-002
ANT M	Duplexer M	1/4 super flex	Used	Used
ANT D	Duplexer D	RG223	Not Used	Used
DuplexerM	MCPA Out	.141 conform	Used	Used
DuplexerM	LNA In	RG223	Used	Used
DuplexerD	LNA In	RG223	Not Used	Used
M LNA Out	WBA P2101	RG316	Used	Used
D LNA Out	WBA P3101	RG316	Not Used	Used
MCPA IN	WBA P1401	.086 conform	Used	Used
WBA P2401	M FON P101	RG316	Used	Used
WBA P3401	D FON P101	RG316	Not Used	Used
WBA P1101	M FON P102	RG316	Used	Used

Table 2-4 WRH-V Cellular Connections

From	To	Cable Type	Non-Diversity 800-16568-001	Diversity 800-16568-002
ANT M	Duplexer M	1/4 super flex	Used	Used
ANT D	Duplexer D	RG223	Not Used	Used
DuplexerM	MCPA Out	.141 conform	Used	Used
DuplexerM	LNA In	RG223	Used	Used
DuplexerD	LNA In	RG223	Not Used	Used
M LNA Out	WBA P2101	RG316	Used	Used
D LNA Out	WBA P3101	RG316	Not Used	Used
MCPA IN	WBA P1401	.086 conform	Used	Used
WBA P2401	M FON P101	RG316	Not Used	Not Used
WBA P3401	D FON P101	RG316	Not Used	Not Used
WBA P1101	M FON P102	RG316	Not Used	Not Used
DX DL LO (M)	WBA P1101	RG316	Used	Used
DX UL1 LO (M)	WBA P2401	RG316	Used	Used
DX UL2 LO (D)	WBA P3401	RG316	Not Used	Used
DX DL HI (M)	Cable 327	RG316	Used	Used
DX UL1 HI (M)	Cable 325	RG316	Used	Used
DX UL2 HI (D)	Cable 326	RG316	Not Used	Used
DX DL C	M FON P102	RG223	Used	Used
DX UL1 C (M)	M FON P101	RG223	Used	Used

DX UL2 C (D)	M FON P101	RG223	Not Used	Used
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BA PCBA

Table 2-5 lists the connections for the BA PCBA.

Table 2-5 BA PCBA Connections

Port	Connected to
P3	P5 on the PA/DL PCBA
P4	HI on the service DPX

DIA PCBA

Figure 2-5 illustrates and Table 2-6 lists the connections on the DIA PCBA.

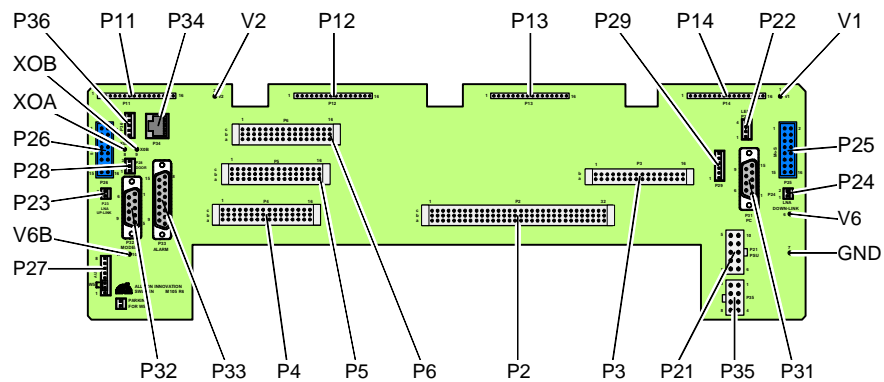


Figure 2-5 DIA PCBA Connectors and Testpoints

Table 2-6 DIA PCBA Connections

Port	Connected to
P2	CU PCBA
P3, 5, 6	Not Used
P4	ALI or RCI PCBA
P11 - 14	Channel PCBA positions 1 through 4
P21	PSU, connector 1
P22	LED PCBA in cover
P23	LNA/UL
P24	LNA/DL
P25	Expansion output port to cover circuitry. Only in cabinets.
P26	Expansion input port to cover circuitry. Used in equipped high covers.
P27	AUX1
P28	Door switch
P29	Power to FON
P31	PC RS-232
P32	Modem RS-232
P33	External Alarm

P34	WLI for IP or R2R network
P35	PSU, connector 2
P36	WLI for IP or R2R network

DPX

DPXs are located on the metal cover sheet in the upper part of the cabinet. Service and donor filters are identical.

Table 2-7 DPX Connections

Service DPX Port	Connected to
ANT	Service antenna (or DPX on the service (MS) DC
HI	P5 on the PA/DL
LO	IN on the LNA/UL. P2101 on the WBA PCBA
Donor DPX Port	Connected to
ANT	ANT on the FOU/DPX filter.
HI	IN on the LNA/DL
LO	P5 on the PA/UL

LNA

LNAs are located at the top of the cabinet and the high cover, if equipped. LNA/UL is located to the left and LNA/DL to the right. All coaxial connectors are SMA-type.

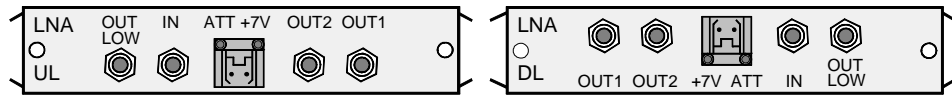


Figure 2-6 Low Noise Amplifiers

Signals from the DPX output are fed to the LNA input connector IN. OUT1 and OUT2 outputs feed the CHE, CSA, BSA, or WBAs of the same signal direction. The signal level in these connectors are +20dB referenced to the antenna input. Another output, OUT LOW, is an expansion output for an additional LNA if the WRH is equipped in the cover part of the chassis. The gain to this connector is +2dB. The +7V input is used for +7V supply from the DIA PCBA and ATT is a control signal for a controllable attenuator in the LNA.

Table 2-8 LNA Connections

LNA/UL Port	Connected to
OUT LOW	IN on the LNA/UL in the cover, if equipped
IN	LO on the service DPX duplex filter.
ATT +7V	P23 on the DIA PCBA.
OUT1	P101 on the CHE3/UL, CSA/UL, or BSA/UL PCBA. P2101 on the WBA PCBA.
OUT2	P101 on the CHE4/UL channel PCBA.
LNA/DL Port	Connected to
OUT LOW	IN on the LNA/DL in the cover, if equipped
IN	HI on the donor DPX duplex filter.
ATT +7V	P24 on the DIA PCBA.

OUT1	P101 on the CHE2/DL, CSA/DL, or BSA/DL PCBA. P2102 on the WBA PCBA.
OUT2	P101 on the CHE1/DL channel PCBA.

Not used outputs do not need to be terminated.



WARNING: Some LNA power transistors may contain beryllium oxide (BeO) that is poisonous. Refer to the Safety section in Chapter 1

FOU – Fiber Optic Unit

The FOU is a metal plate on which a FON PCBA, a DPX and fiber optic connectors are assembled. It is mounted on top of the cover plate in the upper part of the WRH. The RF connections for the FOU are defined in the Table 2-7.

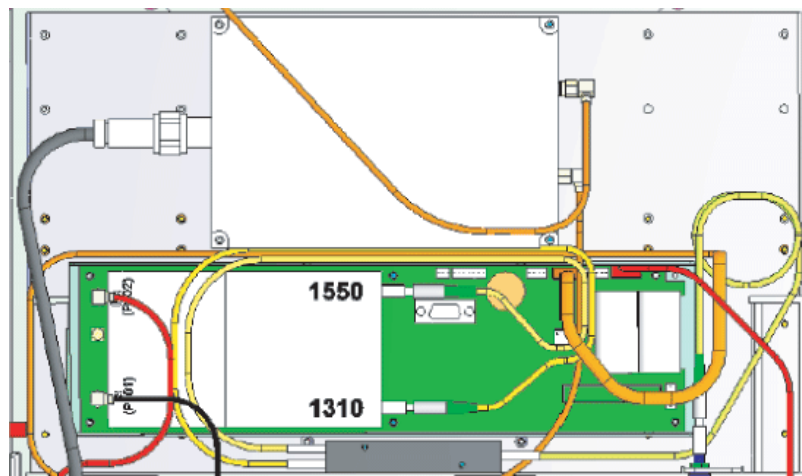


Figure 2-7 Fiber Optic Unit (FOU)

Table 2-9 Fiber Optic Unit (FOU) Connections

on the donor side	
Port	Connected to
ANT	BS -20dB on the donor (BS) DC
HI	P101 on the FON
LO	P102 on the FON
on the service side	
Port	Connected to
ANT	Service antenna
HI	P5 on the PA/DL or P4 on the BA
LO	IN on the LNA/UL or P2101 on the WBA

FON

Table 2-9 defines the FON port numbers, connector types, and port usage.

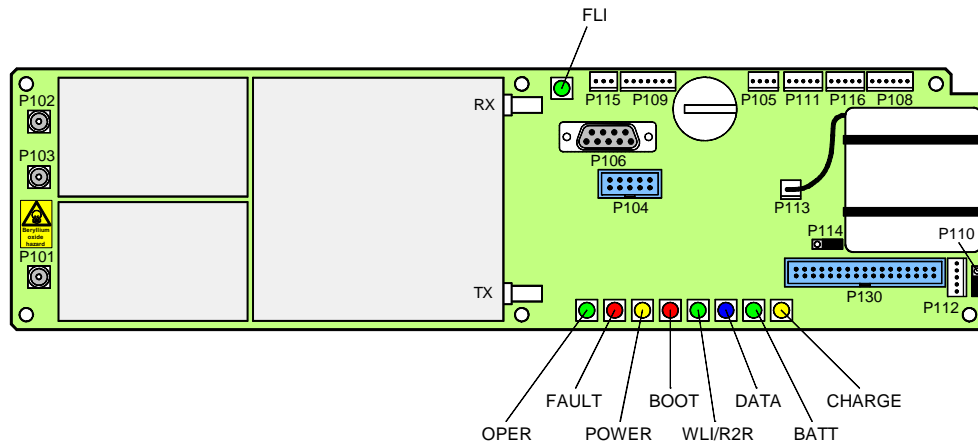


Figure 2-8 FON Connector Locations

Table 2-10 FON Connectors

Port	Description
P101	SMA, electrical RF input port (to the optical TX port)
P107	SMA, electrical RF input port (15dB below the P101 port)
P102	SMA, electrical RF output port (from the optical RX port)
P103	SMA, electrical RF output port (15dB below the P102 port)
RX	DIN/APC, optical input port (to the P102 and P103 RF ports)
TX	DIN/APC, optical output port (from the P101 RF port)
P104	Used only for development and debugging
P105	4-pin male, door LED indicators. Used for the yellow and red LED indicators located on the front cabinet door
P106	9-pin D-sub female, RS-232 used for local PC communication
P108/116	6-pin male, parallel connected power ports for the FON
P109	7-pin male, used for external alarm sensors
P110	W-link jumper, used to terminate units in a W-link. It has to be set in the parking state for all units except for the first and last units in a W-link. The Parking state (P) has the jumper between the center and bottom pins. The opposite state (T) terminates the W-link.
P111/112	5-pin male, WLI ports used for interconnecting nodes in WLI-nets (IP or R2R networks). They are identical and connected in parallel. One of the connectors are intended to be used from the previous node and the other connector to the next node in the network. Either can be used for the first and the last unit in the net chain.
P113	2-pin male, used for the on-PCBA backup batteries.
P114	Backup power output jumper, sets the backup power output state. The OFF state has jumper between the center and left pins. This jumper has to be in the OFF state when used in an OCM. Otherwise, it shall be in the ON state.
P115	3-pin male, future port - intended for future use

P130	34-pin, 2-line male, RCU port used for connecting an RCU. The connector contains both the modem connection and RCU power supply.
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PSU

The PSU is located in the bottom middle of the cabinet or in an equipped high cover. The PSU has all the voltages required for the WRH. It has capacity for the radio circuitry, fiber optics, modem, etc., and also supplies the BA if used. Multi-band WRH-Vs always require a second PSU. There are two PSU types with different input voltages:

1. 115/230V 50/60Hz, 300W input max.
2. 21- 60V DC, 300W input max.

The DIA provides most of the internal connection between the sub units and external ports. Connectors involved in the installation are also located on the DIA. Table 2-13 describes these connections.

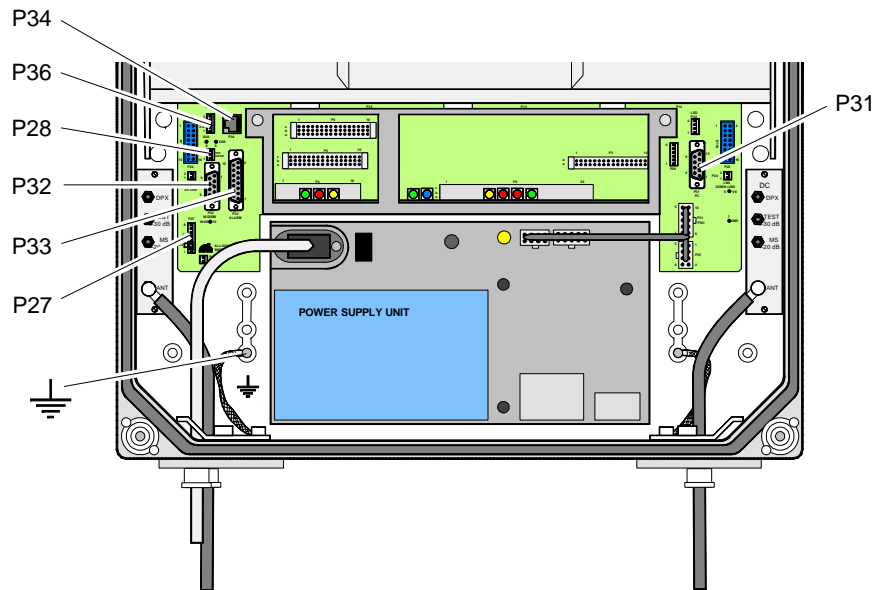


Figure 2-9 PSU Location

Table 2-11 PSU Connectors

Port	Description
P27	Auxiliary Port (8-pin male) - Used to power the old RCU. It is located on the DIA to the left in the cabinet. Pins 2 and 3 must always be interconnected to provide the CU and ALI/RCI PCBs with voltage supply. If there is no cable connected, pins 2 and 3 must be interconnected with a jumper.
P31	RS-232 PC Port (9-pin D-sub female) - Used for local PC communication. It is located on the DIA to the right in the cabinet.
P32	RS-232 Modem port (9-pin D-sub male) - V.24 interface used for the old RCU. It is located on the DIA to the left in the cabinet.

P33	<p>Alarm Port (15-pin D-sub female) - Used for external alarm sensors and alarm equipment. It is located on the DIA to the left in the cabinet. The port has four alarm inputs, EAL1 – EAL4, and two alarm outputs.</p> <p>The four alarm inputs are low-level inputs with common ground (AIC). Use insulated switch or relay to initiate alarms (open switches in normal operating mode, closed switches cause alarm). The alarm switch connection can be toggled between active open and active closed. This is further described in the OM-Online User Manual and the Advanced WRH OMS User Manual.</p> <p>The alarm input voltage ratings, related to ground (AIC), are: Vinmax= 5.5V, Vinmin= -0.5V</p> <p>The four alarm inputs are connected to the following pins: Pin 14 AI1 External alarm input 1 - EAL1 Pin 15 AI2 External alarm input 2 - EAL2 Pin 7 AI3 External alarm input 3 - EAL3 Pin 8 AI4 External alarm input 4 - EAL4 Pin 6 AIC Ground. See also the P28 door switch port below.</p> <p>Two alarm outputs are 1 pole closing and 1 pole opening relay outputs insulated from each other. Maximum ratings, related to ground or any other alarm terminal, are 50V AC / 60V DC. The alarm outputs are defined as follows: Pin 9 and 1 AO1 and AO8 Closed when operating, otherwise open. Pin 10 and 2 AO6 and AO7 Open when operating, otherwise closed. Pin 11 and 3 AO2 and AO5 Closed at alarm state, otherwise open. Pin 12 and 4 AO3 and AO4 Open at alarm state, otherwise closed.</p>
P28	<p>Door switch port - Normally, alarm input AI4 is used for WRH door opening alarm EAL4 which is arranged using an optional door switch. Signal AI4 and AIC are thus available also in the P28 connector, to which the door switch is connected. It is located on the DIA to the left in the cabinet. The EAL4 door switch alarm is activated 10 – 30 seconds after the cover has been opened.</p>
P34	<p>WLI Port (8-pin RJ45 female) - Used for the WLI network (R2R). It is located on the DIA to the left in the cabinet.</p>
P36	<p>WLI Port (5-pin male) - Used for the WLI network (IP or R2R). It is located on the DIA to the left in the cabinet. Connecting P111 or P112 on a FON to this port, an FLI network is interconnected to a WLI network (IP or R2R) making all the included WRHs in both the networks accessible.</p>

Software and Hardware Compatibility

There are different versions of CU PCBA software which can be combined with PCBAs of various revisions. These have unique part numbers and revision information. Below, you will find a table of software currently available in combination with CU PCBA revisions.

Table 2-12 Hardware / Software Compatibility

CU PCBA part #	CU Software part #	Comments
K103/3 (500-13817-001)	SA102 06/x SA102 07/x SA102 08/x	More memory. MAC ID is added on the PCBA. R2R functionality integrated.

This information is accurate as of 01/31/2007. As new versions of hardware and software are released without prior notice. Contact your Powerwave sales representative if in doubt about the latest revision status.

For detailed information, refer to the release notes for the CU software to be downloaded (normally found in the readme.txt file provided with the program files).

Chapter 3

Installation

Introduction

This chapter contains unpacking, inspection and installation instructions for installing and powering up the WRH.

Site Survey

Powerwave recommends that a site survey be performed prior to equipment ordering or installation. Performing a detailed site survey reduces or eliminates installation and turn-up delays. Pay particular attention to power plant capacity, cooling needs, floor space, and RF/DC cabling/breaker requirements. Cabinet dimensions, clearance dimensions, and weights are listed in Chapter 5.

Unpacking and Inspection

This equipment has been operated, tested, and calibrated at the factory. Carefully open containers to remove equipment. Retain all packing material that can be reassembled in the event unit must be returned to the factory. Perform the following steps:

- Visually inspect equipment for damage that may have occurred during shipment. If possible, in the presence of the delivery person.
- Check for evidence of water damage, bent or warped chassis, loose screws or nuts, or extraneous packing material in connectors.

If equipment is damaged, file a claim with the carrier once the extent of any damage is assessed.

If equipment must be returned to factory, please contact factory for a Return Material Authorization (RMA). See Chapter 4.

WRH Location

The WRH is designed with a weather proof outdoor cabinet that can be mounted without any kind of shelter from rain, snow or hail. The same unit can be installed indoors. A preferable site for the WRH is a location free of obstructions, easily accessible and allows for proper air-flow and ventilation.

If a WRH is installed outdoor and can be exposed to direct sunshine, it is essential that air can circulate around the WRH with no obstacle. The operating temperature must not exceed 131°F (55°C). A shelter can be used to shade the WRH from direct sunshine.

Never open a WRH when rain, snow, hail, high humidity or high winds are present unless some kind of temporary shelter can be erected. Limitations for very bad weather are found in the next section.

Mounting

The WRH is easy to mount using the provided mounting bracket, which has 9/16" (14mm) holes for 3/8" (10mm) or 1/2" (12mm) fixing screws. Clamps with C-C measures of 3.5" (90mm), 5.3" (135mm), 5.7" (144mm), 8.1" (205mm), 9.8" (250mm), and 11.8" (300mm) can be used as well. The vertical C-C measure for these are 16.2" (411mm). There is a 9/16" (14mm) single hole in the middle of the mounting bracket, marked 'A' in the figure, which is intended for a locking screw to lock the bracket into place.

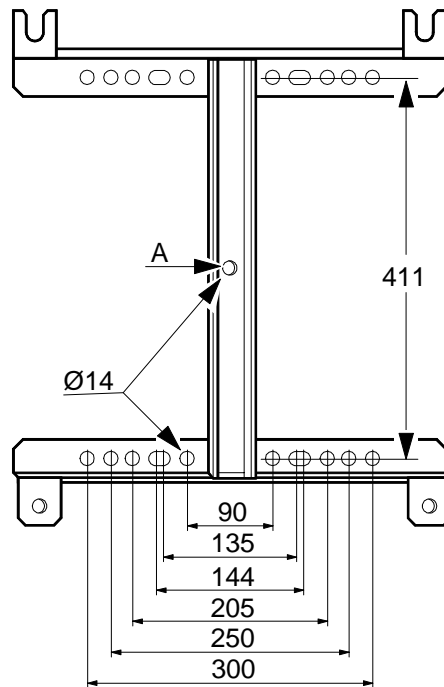


Figure 3-1 Mounting bracket

Normally, the WRH is mounted on a wall, pole, or mast. Figure 3-2 illustrates the installation of the mounting bracket on a wall using four fixing screws and a locking screw.

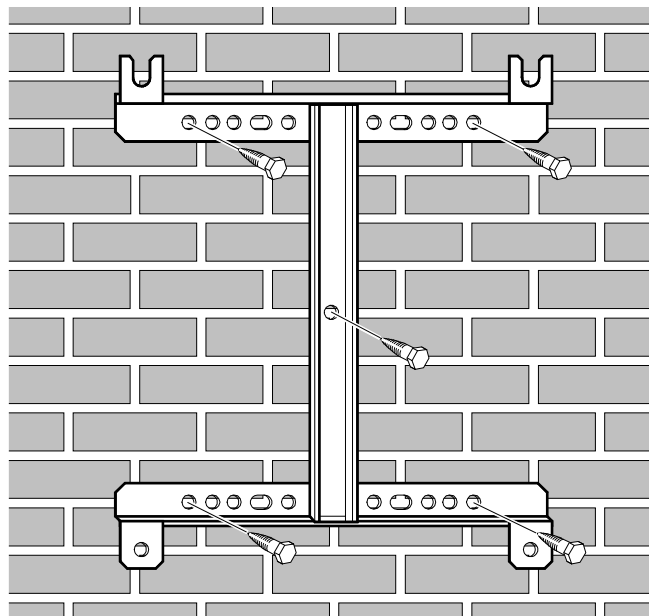


Figure 3-2 Mounting bracket installation on wall

Figure 3-3 illustrates the installation of the mounting bracket on a pole using two 5.7" (144mm) U-shaped clamps and a locking screw.

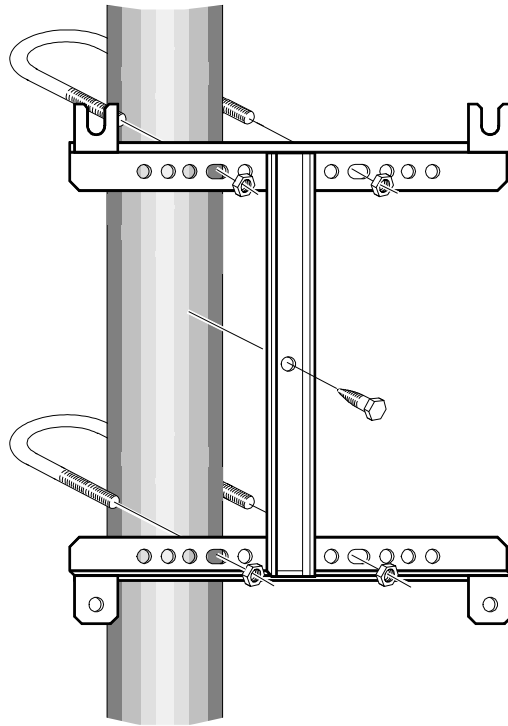


Figure 3-3 Attaching the bracket to a pole

Figure 3-4 illustrates a mast installation using two 11.8" (300mm) bar-shaped clamps and no locking screw.

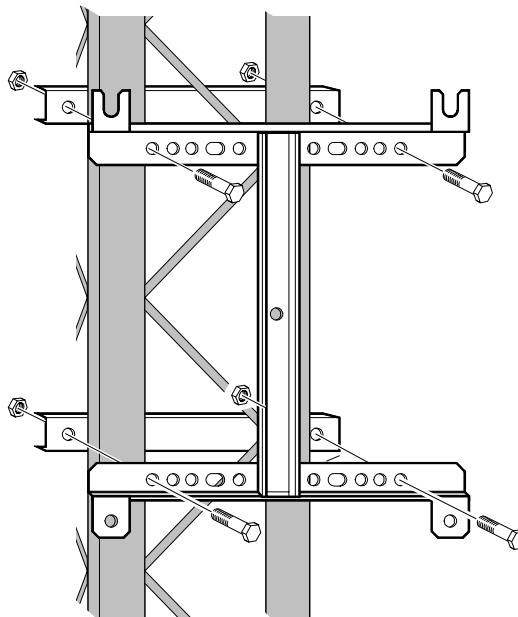


Figure 3-4 Attaching the bracket to a mast

After installing the mounting bracket, hang the WRH on the upper supports, as illustrated in Figure 3-5. Tighten the upper and lower mounting screws to secure it into place. Locking cylinders, used to prevent unauthorized removal of the repeater, can be inserted and locked with a key after the lower screws have been tightened. Make sure the donor antenna, directed towards the BTS antenna, and the service antenna, directed towards the area to be covered by the WRH, are mounted and installed properly.

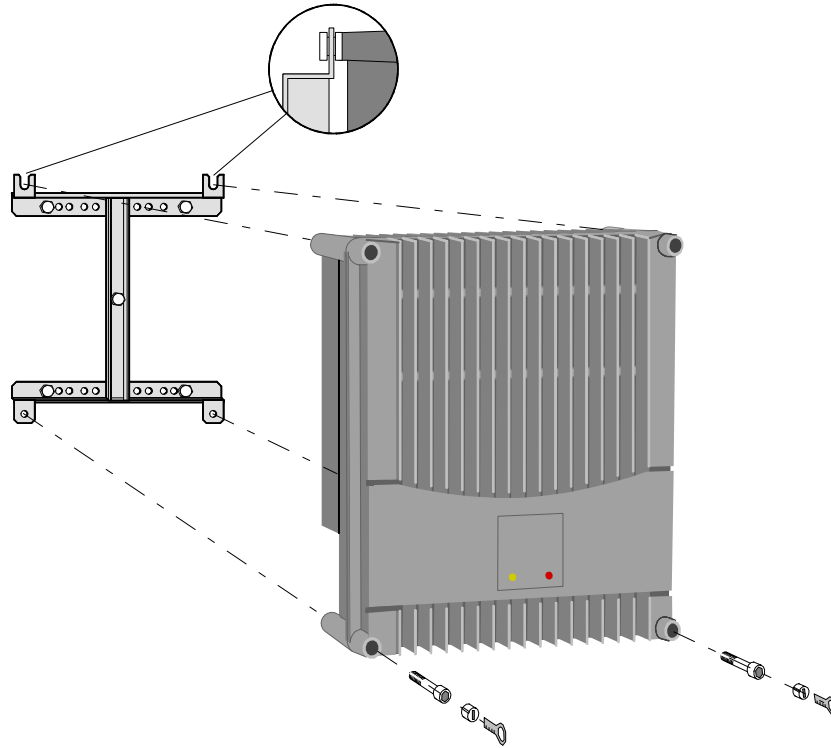


Figure 3-5 Attaching the WRH to the bracket

Connections

This section describes general examples of how to connect the input and output ports on the WRH.

Main Power and Grounding

Local regulations need to be followed for the main power connection. WRHs are approved in accordance with EN and UL/cUL regulations. This is, however, only valid if a classified power cord is used. For the WRH to meet these regulations you must select one of the following classified and approved cord types:

- EN – H 05 W5 - F HMR
- UL – AWM Style 2587
- CSA– AWM 1 A/B 11 A/B

For outdoor use, the power cord should meet at least IP65 encapsulation requirements. Do not turn the main power on until you are ready to commission the WRH



WARNING: For WRHs supplied from the main power source, the main outlet must be grounded.

Fiber Optic and RF Connections

Fiber optic and RF cable connections should be verified both internally and externally before powering up the equipment. This section illustrates the general internal connections of the WRH and WRH-V. Verify these connections with the as-built drawings and documents for your specific system configuration. Table 3-1 lists the steps for external connections to the WRH.

Table 3-1 Cable Connection Procedure

Step	Action
1	Connect the service antenna coaxial cable to the left in the cabinet using an N-type male connector
2	Connect the fiber optic cable from the BMU to the fiber optic cable demark on the FOU
3	Connect station ground
4	Mount the main power plug to the main power cord and connect it to the PSU

WRH

Figure 3-6 illustrates the WRH cables and connections.

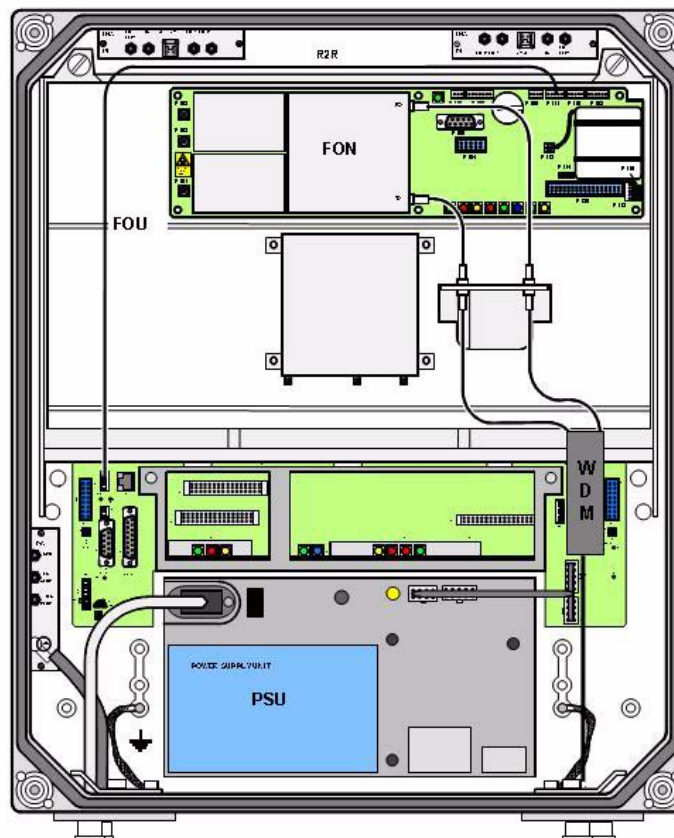


Figure 3-6 WRH Cable Connections

WRH-V

Figure 3-7 illustrates the WRH-V cables and connections.

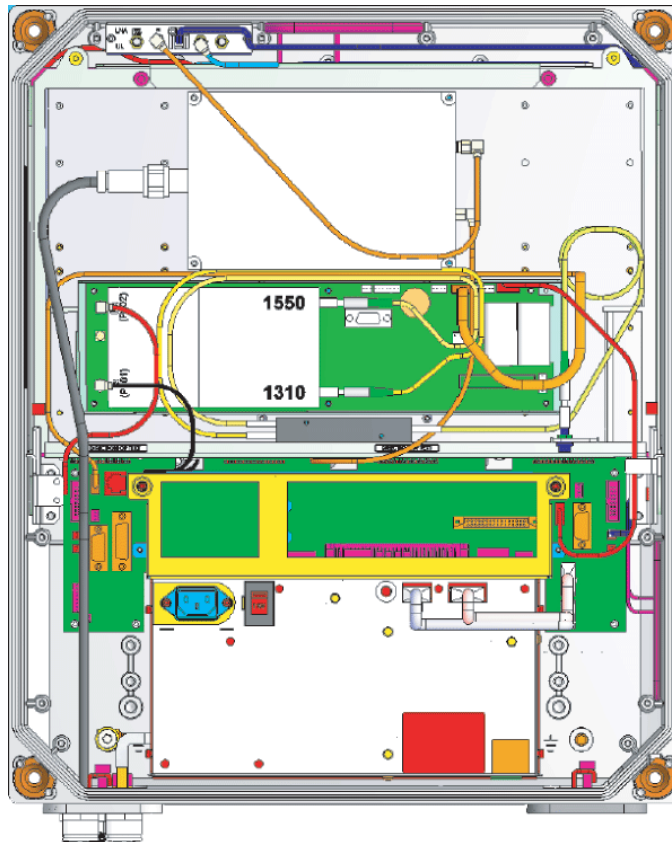


Figure 3-7 WRH-V Cable Connections

Optional Connections**Alarms**

Alarm signals from external sensors are received by an ALI or RCI which forwards them to the CU. The RCI is used if the WRH has an RCU, otherwise the ALI is used. The software on the CU can activate acoustic or visual alarms or direct the alarm to the P33 alarm port for forwarding via an RCU to an OM-Online or OMS workstation. Alarms can also be handled by the FON. Alarms can be configured from an OM-Online or OMS workstation.

External Alarm

Burglary, fire or other external alarms can be handled by the WRH. External alarm sensors and alarm signals are connected to the P33 alarm port located to the left in the cabinet, as illustrated in Figure 3-8. The P33 alarm port is described in Chapter 2. The cable for this installation is taken through a strain relief bushing at the bottom of the WRH cabinet.

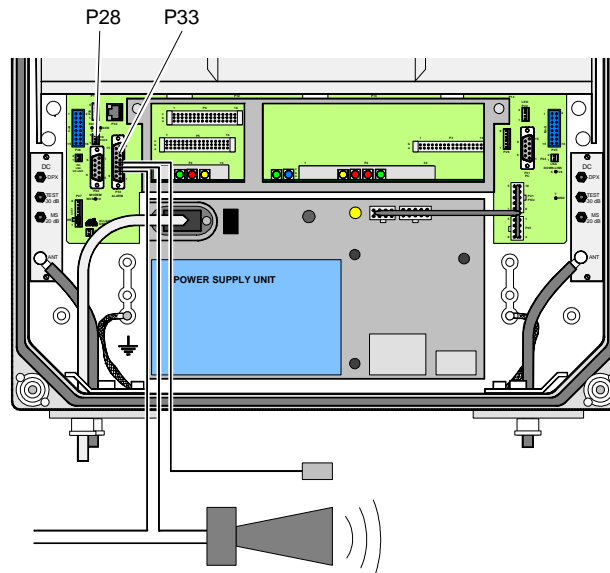


Figure 3-8 External alarm connection

Door Open Alarm

A door open alarm can be configured and installed in the WRH. This is arranged with a door switch connected to P28, as illustrated in Figure 3-8.

Fiber Link Interface (FLI)

The FLI feature makes it possible to interconnect WRHs. By using an RF distribution fiber network, no wire or other communication device is required.

Wire Link Interface (WLI) Network (IP to R2R)

Two types of WLI networks are available for the WRH: Internet Protocol (IP) and a Repeater-to-Repeater Link (R2R).

The network cables are connected to the P34 or P36 WLI ports on the DIA PCBA as illustrated in Figure 3-9. The cables can either be interconnected at the P1 terminal on the connector PCBA located to the right in the cabinet or to both P34 and P36.

Any cable type can be used for indoor installations. For outdoor installations, the Li 2YC11Y, 2x2xAWG24/222, non-halogen, Metrofunkkabel-Union cable type is recommended. Use strain relief bushings or connectors at the bottom of the WRH. If the link cable between two WRHs is longer than 25 meters, an RS-485 WRH is required as illustrated Figure 3-10.

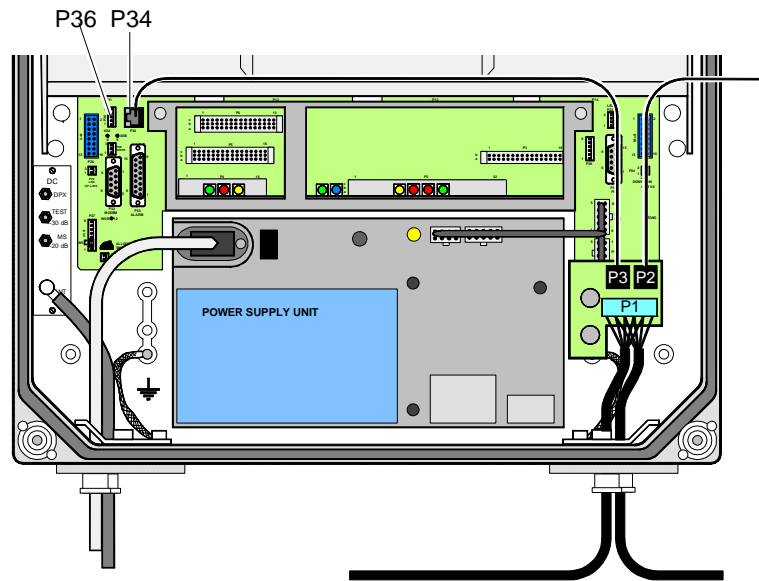


Figure 3-9 IP and R2R network connection

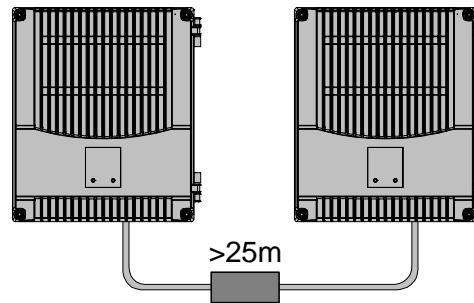


Figure 3-10 RS485 Cable Repeater

Main Power Breakdown Relay

To be able to distinguish PSU faults from power failure, a main power breakdown relay can be used. This relay is not included in the WRH. It has to be mounted outside the WRH cabinet. The relay intended for this purpose must fulfil the following specifications:

Closing time: Max. 30 milliseconds

Insulation coil/contact: Min. 4KV

A main power connected relay must also be in compliance with valid local regulations.

Table 3-2 Main Power Breakdown Relay Connection

Step	Action
1	Connect a currentless closed relay contact to pin A11 and A1C on the P33 alarm connector, see Figure 3-11. Alarm is initiated by short circuiting pin A11 and A1C in the P33 port.
2	Connect the relay coil. It must be supplied from the same fuse as the WRH
3	After commissioning, select Mains Breakdown in the alarm configuration window in OM-Online or OMS. Refer to the OM-Online User Manual

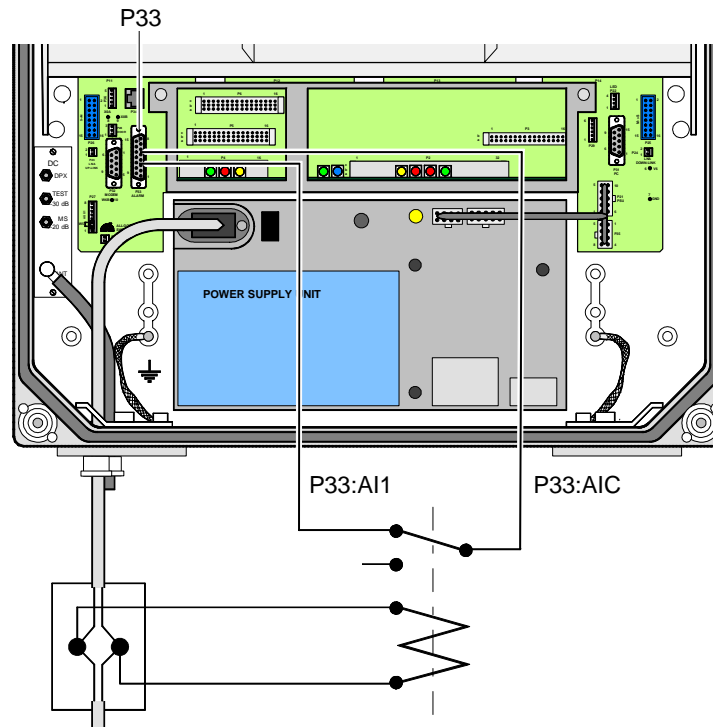


Figure 3-11 Main power breakdown relay connection

21-60 Volt DC PSU Installation

The 115/220 VAC PSU can be replaced with a 21 to 60 VDC DC PSU as described below.

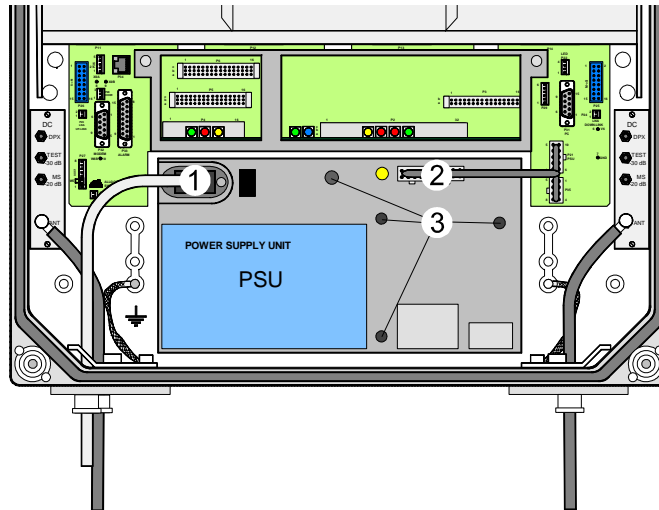


Figure 3-12 PSU Connections

Table 3-3 PSU Replacement Procedure

Step	Action
1	Disconnect main power
2	Remove the main power plug from the PSU ('1' in Figure 3-12)
3	Disconnect the power cable bundle connectors (2) on the PSU
4	Loosen the four fixing screws (3) using a 5mm Allen key and remove the PSU
6	Examine the removed PSU and identify the supply voltage for the WRH (13.5V or 27V)
7	Set the new PSU to the correct supply voltage by moving the jumper as illustrated on the PSU. This must be done before the PSU is mounted in the WRH
8	Mount the PSU with the four fixing screws (3)
9	Connect the PSU to the DIA PCBA (2) with a cable marked VE007 98/1. This cable must be used even if one connector will be left over at the DIA PCBA (previous versions of the DIA had only one connector)
10	Connect the DC power cable. The supplied cable should have a radiation limiter. The + pole should be connected to one of the left terminals in the PSU connector with the brown part of the DC cable. The – pole should be connected to one of the right terminals in the PSU connector with the blue part of the DC cable
11	Apply power and verify the yellow LED on the PSU lights

Commissioning

Before proceeding, carefully read the Safety section and check all connections made during the installation. To fulfill the IP65 weather protective requirements, ensure cable strain relief bushings are properly tightened. Also, ensure gaskets at cable inlets and on the cabinet are properly fitted and not damaged.

A WRH can be configured locally with OM-Online by connecting a standard serial cable from the COM port on the PC to the P31 PC port (RS-232) located to the right in the cabinet (see Figure 3-14). The P31 PC port is described in Chapter 2. OM-Online is described in the OM-Online User Manual.

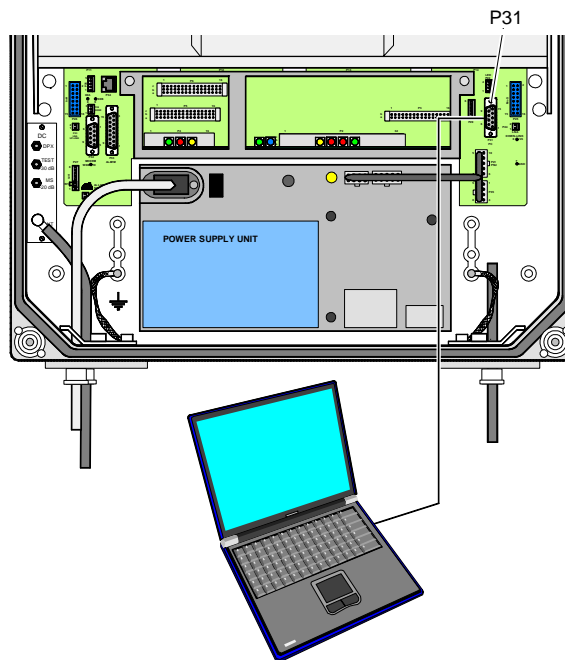


Figure 3-13 Connecting a PC for Local Access

Initial Startup

Table 3-4 Initial Startup Procedure

Step	Action
1	Turn the main power on
2	Check the Yellow LED on the power supply unit. It must be a steady on
3	Check the four CU PCBA LEDs. Refer to the CU PCBA section in Chapter 2 for the correct power up indications
4	Check the three ALI PCBA LEDs or the corresponding LEDs on the RCI PCBA. Refer to the ALI or RCI PCBA section in Chapter 2 for the correct power up indications. The LEDs follow the alarm relays.

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Chapter 4 Maintenance

Introduction

This chapter contains periodic maintenance and performance test procedures for the WRH.

Periodic Maintenance

Periodic maintenance requirements are listed in Table 4-1, as well as the intervals at which the tasks should be performed.

Table 4-1 Recommended Periodic Maintenance

Task	Interval	Action
Inspection of cables and connectors	12 months	Inspect power, RF and Fiber cables for signs of damage or wear (frayed insulation, cracks, punctures, etc.) Check connections to be sure they are tight.
	Optional	Perform cable sweeps.
Clean equipment	Clean as required depending on operating environment.	

Troubleshooting

The sections that follow contain a list of problems that could occur and a few suggested actions that can correct the problem. If the suggested corrective action does not eliminate the problem, please contact your Powerwave field representative or help line for further instruction.

Clearing Alarm Faults

Table 4-2 contains a list of those alarms which can be generated in the WRH. Critical, Error and Warning alarms can be sent automatically from a WRH to OM-Online and/or OMS, stored and then viewed. These can be viewed in the Alarm window.

Table 4-2 Alarm Troubleshooting

ID	Alarm Text	Alarm Unit	Alarm	Description
1	Power	PSU	Critical	PSU1 in the cabinet does not work properly. A sum signal from the PSU1 indicates that at least one voltage output has dropped. If no mains breakdown relay is used, then the alarm will also be sent at mains breakdown.
			Ceasing	PSU1 in the cabinet works properly again. Ceasing is sent if the PSU1 works at start-up, and there is a corresponding critical PSU1 alarm logged in the Events log. The WRH will restart when the power is back and this alarm will be sent.

		PSU	Critical	PSU2 in the cover does not work properly. A sum signal from the PSU2 indicates that at least one voltage output has dropped. If no mains breakdown relay is used, then the alarm will also be sent at mains breakdown.
			Ceasing	PSU2 in the cover works properly again. Ceasing is sent if the PSU2 works at start-up, and there is a corresponding critical PSU2 alarm logged in the Events Log. The WRH will restart when the power is back and this alarm will be sent.
		FON	Error	The FON 10 Volt charger voltage is below limit. Suggested remedy: Replace the FON
			Ceasing	The cause of the alarm has ceased.
2	WRH restart	CU	None	Power on start, or user ordered reboot. Logged to indicate a normal power up, or a restart ordered by the operator.
			Warning	Software error restart, 1st – 7th time. Restart 1st to 7th time during a 14 day period. The counter is reset every 14th day, counted from power up.
			Error	Software error restart 8th – 10th time. Restart 8th to 10th time during the 14 day period. At the 11th time, the SW bank will be blocked and not used anymore until a user ordered reset is performed, or power is switched off/on.
3	Mains breakdown	External	Critical	The mains power is gone. Used with an external relay indicating mains breakdown. The external relay should be connected to External Alarm 1 and the WRH configured to indicate this alarm. If no relay is used, a mains breakdown will be reported as a PSU fault.
			Ceasing	The mains power is back. Sent if there is a corresponding critical mains breakdown alarm logged in the Events Log. The WRH will restart when the power is back.
4	Alarm reset	CU	None	Alarm reset by the user. All alarms are reset. The cause of the alarm will be re-evaluated and reported, if still active.
5	Local bus error	WBA #, PA#, MCPA#	Error	Error when communicating on the bus. The CU has no contact with the WBA, PA or MCPA PCBA, which is taken out of service.
6	Main bkd w backup	External	Error	Used to indicate that the mains is no longer available. WRH is powered by external battery backup unit. Suggested remedy: Check the mains power.
			Ceasing	The cause of the alarm has ceased.
7	Err in AD-converter		Warning	The analog-to-digital converter on the CU PCBA does not give reliable values.
8	New unit detected		None	Compared to the last power on, the CU has recognized at least one additional hardware unit.

9	Inst. unit lost		Error	Compared to the last power on, the CU lacks at least one hardware unit.
10	EEPROM error	CU	Error	EEP read or write fail. Data cannot be written or read from the EEPROM on the CU PCBA. User parameters are stored in the EEPROM.
11	Log memory fault		Error	Log memory fault. Indicates that the log memory on the CU PCBA is faulty. The WRH will not work. Not available in all CU software versions.
12	High temp	CU	Warning	The CU PCBA temperature is higher than 90°C.
			Ceasing	The CU PCBA temperature has fallen below 90°C.
13	REFO error		Error	Significant REFO drift or error detected by CU.
14	Ext refo error		Warning	Suggested remedy: Check the reference source and the cables.
15	CU battery fault	CU	Warning	CU RAM battery fault. The battery for the RAM on the CU PCBA has a voltage outside the normal 2.7 to 3.5 Volt. An alarm may be initiated at start-up if the WRH has been stored out of power for a long time. Suggested remedy: Ensure jumper P3 on the CU PCBA is mounted to charge the battery.
			Ceasing	The cause of the alarm has ceased.
16	SW load error	CU	Error	Software load error. An error has occurred during a software load process. The flash memory does not contain a proper software. Suggested remedy: Check the CU software using the OM-Online SW Manager. Do NOT restart the WRH.
17	Log cleared	CU	None	Log memory has been cleared. The check sum in the Events Log memory is faulty. The log is cleared. Can be caused of a bad RAM battery backup or low voltage to the RAM.
18	RTC restarted	CU	None	The time is changed by the operator (logged to keep track of changes made to the RTC).
			Warning	Time reset to 1994-01-01. The RTC was unable to keep track of the time and did a reset. Suggested remedy: Ensure jumper P3 on the CU PCBA is mounted to charge the battery.
19	RTC error		Error	RTC does not operate. The CU has detected an error in the RTC operation which makes the time unreliable. Suggested remedy: Replace the CU PCBA.
20	Door open alarm	External	Config	The door has been open 30 seconds without disabling the alarm.
			Ceasing	The door has been closed 30 seconds, or the alarm is disabled.
21	External alarm 1	External	Config	External alarm input EA1 active more than 1 second.
			Ceasing	External alarm input EA1 no longer active.

22	External alarm 2	External	Config	External alarm input EA2 active more than 1 second.
			Ceasing	External alarm input EA2 no longer active.
23	External alarm 3	External	Config	External alarm input EA3 active more than 1 second.
			Ceasing	External alarm input EA3 no longer active.
24	External alarm 4	External	Config	External alarm input EA4 active more than 1 second.
			Ceasing	External alarm input EA4 no longer active.
30	No modem found	Remote ctrl	None	No modem found, that is no answer is returned on a poll string to the modem.
33	No connection	Remote ctrl	None	No connection at callback. The WRH has tried to call as many times as stated in the alarm call settings. No connection was established.
			Warning	No connection at alarm call. The WRH has tried to call as many times as stated in the alarm call settings. No connection was established. This alarm does not generate a new attempt to report alarm by alarm call.
34	Login failed		None	Invalid WRH password.
35	Remote connection	Remote ctrl	None	Modem connection to OM-Online opened. Not logged on CU2. Login Registry gives the same function and more information about CU2.
36	Modem init failed	Remote ctrl	None	Initiation string to modem not OK. The initiation string sent to the modem is not OK. The string may contain commands not recognized by the modem. An alarm might be sent anyway. Suggested remedy: Check the modem using the OM-Online or OMS modem debugger.
37	Remote timeout	Remote ctrl	Warning	The time limit of 20 minutes is exceeded without extending the timer. The modem connection is terminated by the WRH.
38	PIN code failed	Remote ctrl	Warning	The PIN code sent to MS is incorrect. To unlock the MS/SIM card, the PUK code will probably be needed.
			Ceasing	The cause of the alarm has ceased.
39	No phone detected	Remote ctrl	Warning	When using a PC-card together with the MS, the alarm indicates contact with the PC-card, but MS is not present or turned off. Note: A Nokia MS does not power-up after power failure. Suggested remedy: Ensure the cellular phone is connected.
			Ceasing	The cause of the alarm has ceased.
40	Battery fault	RCU, FON charger	Error	The backup battery on the RCU or the FON PCBA does not work properly. Suggested remedy: Check cables or replace battery.

			Ceasing	The cause of the alarm has ceased.
41	RF blocking	Channel #, UL/DL	Error	Constant carrier, PA off. Uplink carrier has been constantly above 27dBm more than 10 seconds.
			Ceasing	The cause of the alarm has not been detected for 10 seconds.
42	Antenna isolation	WBA #, Channel #, UL/DL	Warning	Low antenna isolation. The antenna isolation is lower than the gain set. Gain is reduced by 10dB – 13dB below the oscillation point. Suggested remedy: Decrease gain or increase antenna isolation.
			Error	Low antenna isolation at lowest gain. The gain has been reduced as much as possible but the oscillation still remains. The amplifier is turned off. Suggested remedy: Decrease gain or increase antenna isolation.
			Ceasing	Normal operation again, that is no oscillation can be detected 13dB above the gain set.
44	Low stability margin	Channel #, UL/DL	Warning	MRX has detected that antenna isolation is below the gain set. The gain is reduced 10– 13dB below oscillation point. Suggested remedy: Decrease the gain or increase the antenna isolation.
			Ceasing	The cause of the alarm has ceased.
48	Battery backup fault	External	Error	If a battery backup unit alarm is connected to external alarm 2, then the operator can configure the WRH to display this alarm when the battery backup unit indicates alarm.
			Ceasing	The cause of the alarm has ceased.
50	Fiberoptical error	FOT fiber optics	Configurable	If a fiber unit alarm is connected to external alarm 3, then the operator can configure the WRH to display this alarm when the fiber optical unit indicates alarm.
			Ceasing	The cause of the alarm has ceased.
55	R2R Queue full	CU	None	R2R transmit queue is full, messages are lost. Suggested remedy: Check configuration and cables.
56	R2R Node lost	CU	None	An R2R node is lost. Suggested remedy: Check if node is still connected and operating.
			Warning	An R2R node is lost. Suggested remedy: Check if node is still connected and operating.
57	R2R HW Error	RIA	Error	R2R HW failure because the CU cannot read the MAC-ID of the RIA PCBA or any other HW error in the R2R logic. Suggested remedy: Replace the RIA PCBA.
		BSC R2R	Error	R2R HW failure because the CU cannot read the MAC-ID or any other HW error in the R2R logic. Suggested remedy: Replace the WRH.
		FON R2R FO	Error	R2R HW failure because the CU cannot read the MAC-ID or any other HW error in the R2R logic. Suggested remedy: Replace the FON PCBA.

60	Low traffic activity	RSSI Statistics	Warning	No signal strength on the channel was above the limit set longer than the time set in the configuration, indicating possible problems with service antenna. The area that the WRH is servicing may be covered by another stronger WRH or BTS. Suggested remedy: Ensure that the antennas and the cellular phone work in the area to be covered, and that WRH supported channels are used.
			Ceasing	The cause of the alarm has ceased.
61	No BCCH detected	RSSI Statistics	Warning	Signal strength on the BCCH channel was below the limit set longer than the time set in the configuration, indicating possible malfunction in the BTS or donor antennas. Suggested remedy: Ensure that the WRH is configured to the BCCH channel and that the signal from the BTS has enough strength.
			Ceasing	The cause of the alarm has ceased.
65	Gain reduction	Channel #, UL/DL	Warning	The gain is reduced below the limit. The gain is reduced because the output power has been above the MPC limit more than the preset limit allows.
			Ceasing	The cause of the alarm has ceased.
66	Over-power alarm	Channel #, UL/DL	Warning	Input power too high, output power above maximum limit.
			Ceasing	The cause of the alarm has ceased.
70	Bad table alarm	CU	Error	Requested table contains incorrect information (SW error).
71	Table not found	CU	Error	Requested table not found in the database (SW or calibration error).
72	Table database error	CU	Error	Table database not found (calibration error).
80	Antenna SWR alarm	Donor antenna service antenna	Error	Too low antenna return loss, caused either by cables, connectors, or antenna problems. Suggested remedy: Check antenna and cables.
			Ceasing	The cause of the alarm has ceased.
90	FON power alarm	FON RF	Error	A DC voltage on a FON PCBA is out of range. Suggested remedy: Replace the FON PCBA.
			Ceasing	The cause of the alarm has ceased.
91	FON TxStable alarm	FON RF	Error	Laser transmitter control loop voltage out of range. Suggested remedy: Replace the FON PCBA.
			Ceasing	The cause of the alarm has ceased.

92	FON RxLevel alarm	FON	Warning	Received optical level is below any of the two limits (one for Warning and one for Error). Suggested remedy: Check optical cables.
			Error	Received optical level is below any of the two limits (one for Warning and one for Error). Suggested remedy: Check optical cables.
			Ceasing	The cause of the alarm has ceased.
93	FON SPI alarm	FON F2F	Error	The SPI bus connection to the RF modem does not work properly. Suggested remedy: Replace the FON PCBA.
97	No GPS signal	GPS	Warning	The GPS device cannot find any satellites. If active antenna is used, then the power supply for it can be faulty or wrongly configured. Suggested remedy: Check the GPS antenna and cables. If an active antenna is used, then the jumper switch should be set accordingly.
			Ceasing	The cause of the alarm has ceased.
98	No GPS device	GPS	Error	The GPS device cannot be detected although an adapter PCBA is mounted. Suggested remedy: Check the GPS PCBA.
			Ceasing	The cause of the alarm has ceased.
99	GPS Antenna power	GPS	Error	The power supply to the GPS antenna is faulty or there is a power supply to a passive antenna. Suggested remedy: Check the GPS antenna and cables. If an active antenna is used, then the jumper switch should be set accordingly.
			Ceasing	The cause of the alarm has ceased.
100	Startup error	CHA #	Error	A hardware error is detected on the PCBA at powering up.
101	Synthesizer fault	CHA #	Error	Unlocked synthesizer. The frequency synthesizer is unlocked and the transmission can take place on an unknown frequency.
102	Volt Reg. fault	CHA #	Error	DC voltage missing. A DC voltage to an analog part of the PCBA is missing.
103	PA fault	CHA #	Error	Low power amplifier gain. The PA PCBA has too low output power for the RSSI and gain set. Not available in all CU software versions.
104	Param R/W error	CHA #	Error	EEPROM read or write failure on the PCBA.
105	High temperature	CHA #	Warning	The CHA PCBA temperature is higher than 85°C.
			Error	The CHA PCBA temperature is higher than 95°C.
			Ceasing	The CHA PCBA temperature has fallen below 70°C.

110	SW incompatibility	MRX	Error	The MRX and CU software is not compatible. Suggested remedy: Check the software versions and replace the incompatible one.
120	Startup error	BSA #	Error	A hardware error is detected on the BSA PCBA at powering up.
121	Synthesizer fault	BSA #	Error	Unlocked synthesizer. The frequency synthesizer is unlocked and the transmission can take place on an unknown frequency.
122	Volt Reg fault	BSA #	Error	A DC voltage to an analog part of the PCBA is missing.
123	PA fault	BSA #	Error	Low power amplifier gain. The PA PCBA has too low output power for the RSSI and gain set. Not available in all CU software versions.
124	Param R/W fault	BSA #	Error	EEPROM read or write failure on the BSA PCBA.
125	High temperature	BSA #	Warning	The BSA PCBA temperature is higher than 85°C.
			Error	The BSA PCBA temperature is higher than 95°C and the power is turned off.
			Ceasing	The temperature has fallen to below 70°C and the power is turned on again.
126	High PSU voltage	BSA #	Critical	The PA supply voltage is too high. Suggested remedy: Ensure that correct PSU is used.
127	Unsupported PA-type	BSA #	Error	The ID of the mounted PA PCBA is not expected by the BSA PCBA. Suggested remedy: Ensure that correct PA PCBA is used.
128	BA HW alarm	BA #	Error	A HW error on the BA PCBA has been detected.
			Ceasing	The BA PCBA is working properly after failure.
129	PA Under-voltage alarm	PA/BA #	Error	PA voltage level below alarm limit. Suggested remedy: Check the PSU.
			Ceasing	The cause of the alarm has ceased.
		BSC, UL/DL	Error	PA voltage level below alarm limit. Suggested remedy: Check the PSU.
			Ceasing	The cause of the alarm has ceased.
245	Not In Allowed Area	CU	None	WRH is moved from the operating area and the RF HW is switched on or off.

Remarks:

The Door open alarm requires an optional door switch described in the P33 Alarm Port section in Chapter 5.

The Main power breakdown alarm requires a relay not included in the WRH (see Main Power Breakdown Relay in Chapter 3).

Field Replaceable Units

The following units can be replaced in the field on-site by a qualified technician with experience maintaining RF equipment:

- FON
- PSU
- WRH

FON

To replace a FON PCBA, proceed as described in the Table 4-3.

Table 4-3 FON Replacement Procedure

Step	Action
1	Open WRH door and secure
2	Locate power connector on FON and remove connector from PCBA
3	Verify all cables on FON are labeled before disconnecting, then disconnect all cables
4	Remove screws securing FON PCBA to FOU and remove PCBA
5	Replace FON PCBA in reverse order and apply power
6	Connect PC to OM Online port, login to FON and verify configuration and IP address. NOTE: Make sure 'Fiberoptical' classmark in the FON Status window is checked, otherwise FON will not be operational.
7	Close WRH door and secure

PSU

To replace a PSU, proceed as described in the Table 4-4.

Table 4-4 PSU Replacement Procedure

Step	Action
1	Open WRH door and secure
2	Disconnect main power plug from PSU
3	Disconnect power cable bundle from PSU
4	Loosen screws securing PSU using a 5mm Allen key and remove. NOTE: screws are designed to not be removed completely from PSU.
5	Replace PSU in reverse order and apply power
6	Close WRH door and secure

WRH

To replace a WRH, proceed as described in the Table 4-5.

Table 4-5 WRH Replacement Procedure

Step	Action
1	Open WRH door and secure
2	Disconnect main power plug from PSU
3	Verify all cables connected to WRH are labeled before disconnecting, then disconnect all cables
4	Remove mounting screws from bottom legs of WRH and loosen mounting screws in top legs
5	Close and secure door
	WARNING: A fully loaded WRH can weigh 96lbs. Lifting of the WRH should be done by two people. Do not attempt to carry the WRH up a ladder.
6	Lift the WRH off the mount hinges
7	Replace WRH in reverse order
8	Connect PC to OM Online port and verify configuration. For Fiber Optic installations, verify IP address.
9	Close WRH door and secure

Return For Service Procedures

When returning products to Powerwave, the following procedures will ensure optimum response.

Obtaining an RMA

A Return Material Authorization (RMA) number must be obtained prior to returning equipment to the factory for service. Please contact our Repair Department at 1-714-466-1000 to obtain this number, or FAX your request to 1-714-466-5800. Failure to obtain this RMA number may result in delays in receiving repair service.

Repackaging for Shipment

To ensure safe shipment of the unit, it is recommended that the original package designed for shipping the unit be reused. If it is not available, contact Powerwave's Customer Service Department for packing materials.

Remote Control Unit (RCU)

The RCU provides remote control of Powerwave WRHs. It contains an integrated mobile phone, modem and power supply backup. The RCU is installed in the bottom front of the cabinet, on top of the PSU as illustrated in Figure 4-1.

The RCU is connected to P130 on either an RCI or FON. A jumper is required between pins 1 and 2 on the RCI if the P130 cable connector is disconnected. If a main power failure occurs, the unit has a battery with enough capacity for sending a number of alarms.

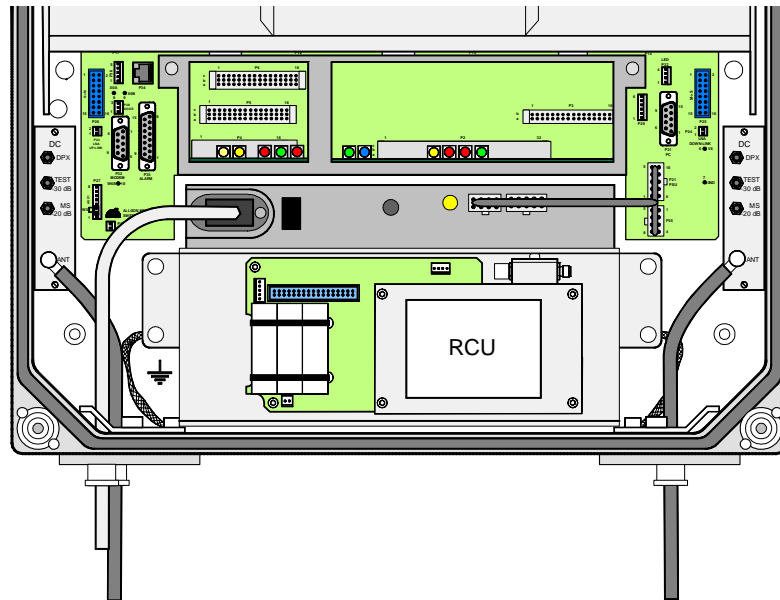


Figure 4-1 RCU in the WRH cabinet

RCU for Radio Communication

The RCU antenna for a radio modem is connected to the BS antenna via the uplink DC, provided the RCU and the WRH operate in the same cell system. Otherwise, the modem must have a separate antenna. Data is transferred between the WRH and the RCU via the P130 modem port on the RCI or FON. The RCU is also powered via the same port and has a battery with enough capacity to send a number of alarms if a main power failure occurs.

RCU for Telephone Line Communication

The land line version uses a telephone line connected to a terminal block on the RCU. A free strain relief bushing at the bottom of the WRH is used for the external telephone line cable.

Repeater-to-Repeater Link (R2R)

This section briefly describes the R2R network. Node configuration for the R2R network is described in the OM-Online User's Manual. The R2R network is a Powerwave specific network that can handle up to 13 nodes, one or several of which being a gateway for communication with OM-Online or OMS via modem.

Sliding Window (SLW) is a Powerwave specific protocol developed for the R2R network. The SLW protocol and the IP protocol do not support each other and they cannot be mixed in any node.

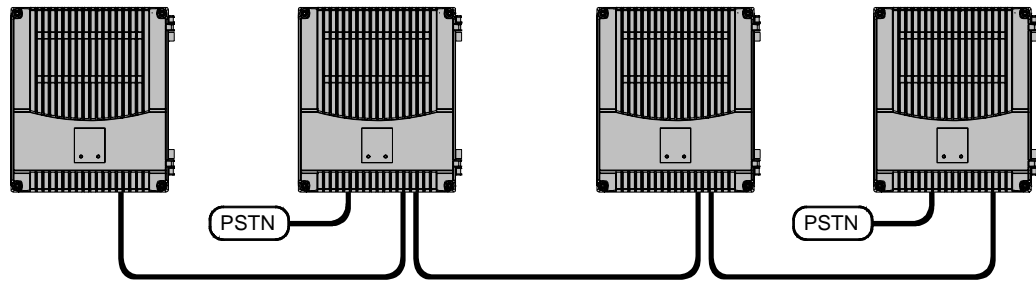


Figure 4-2 R2R network

Chapter 5 Specifications

Introduction

This chapter provides specifications for the different WRH product line.

Table 5-1 WRH Specifications

Generic	
Dimensions (W x H x D in inches)	17.5 x 21 x 7 (low cover) 17.5 x 21 x 11 (high cover)
Weight Empty low cover Cabinet with a low cover Cabinet with a high cover Equipped cabinet or high cover w/extra heat sink element	13 lbs (6.0 kg) 50 lbs (22.5 kg) 96lbs (44.0 kg) 41 lbs (18.5 kg)
Temperature range	-13 to +131°F (-25 to + 55°C)
Casing class	NEMA4/IP65
Fiber-Optic Link Budget	10dBo
Amplifiers in 1 cabinet	Standard = 2 (WBA / PA combination) High Power = 1(WBA / MCPA combination)
Receiver input port return loss	14dB
Power supply voltage (default)	115 VAC
Power consumption	160 W (standard WRH) 210 W typical, 250 W max (WRH-V)
Fiber Optics	
Bandwidth @ 3dB	800 – 2200 Mz
Power Consumption, total	<5 W
Wavelength	TX: DFB 1310 or 1550 nm RX: 1250 – 1600 nm
Transmitter Max continuous RF input Optical output power, two levels RF attenuation settable by SW in 1dB steps	+36dBm +3 or 0dBm 0-20dB
Receiver Max optic power input RF attenuation settable by SW in 1dB steps Alarm threshold level, settable warning Alarm threshold level, settable error	+5dBm 0-20dB 0-40dBm 0-40dBm

Standard WRH (SMR / iDEN 800 / 900 MHz)	
Frequency band UL	806-824 MHz; 896-901 MHz
Frequency band DL	851-869 MHz; 935-940 MHz
Max absolute delay	<300 ns
Filter bandwidth (remotely adjustable)	0.5-16.9 MHz, remote adjustable
Gain adjustment range (in 1 dB steps)	30dB
Gain (max variation -25 to +55 °C)	<2dB
Maximum input power (non-destructive)	+13dBm
Return Loss	14dB
AGC for UL and DL	≥30dB
Input IP3 UL (max gain)	-25dBm
Output power @ -13dBm IMD RMS	for 8 ch +27dBm/ch for 16 ch +25dBm/ch
Noise figure including fiber optic node	4dB
Standard WRH (900 / 1800 / 2100 MHz)	
Frequency band UL	890-915 MHz; 1710-1785 Mhz; 1920-1980 MHz
Frequency band DL	935-960 MHz; 1805-1880 MHz; 2110-2170 MHz
Absolute group delay	5 μs
Gain adjustment range (in 1 dB steps)	30dB
Gain (max variation -25 to +55 °C)	<2dB
Output Power per carrier	Carriers / dBm
GSM900	8 / 18dBm 16 / 16dBm
DCS1800	8 / 21dBm 16 / 19dBm
WCDMA	4 / 30dBm 8 / 27dBm 16 / 25dBm
Noise figure UL at max gain	4dB

WRH-V	
Frequency band UL	1850-1910 MHz
Frequency band DL	1930-1990 MHz
Max absolute delay	<300 ns
Filter bandwidth (remotely adjustable)	0.5-16.9 MHz, remote adjustable
Gain adjustment range (in 1 dB steps)	30dB
Gain	
Uplink	35 to 60dB typical
Downlink	45 to 70dB typical
Variation	3dB versus temperature and frequency including fiber link

Instantaneous bandwidth	60 MHz
Maximum input power (non-destructive)	+13dBm
Return Loss	14dB
TX band IMD	< -60dBc (1930-1990 MHz) Full power 8 EDGE carriers
TX spurious in RX band	< -111dBm / 200kHz Full power 8 EDGE carriers
Output power	+43dBm
Noise figure excluding fiber optic link	4dB

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Appendix A Block Diagrams

Introduction

This appendix describes the main signals paths for the WRH.

Standard WRH

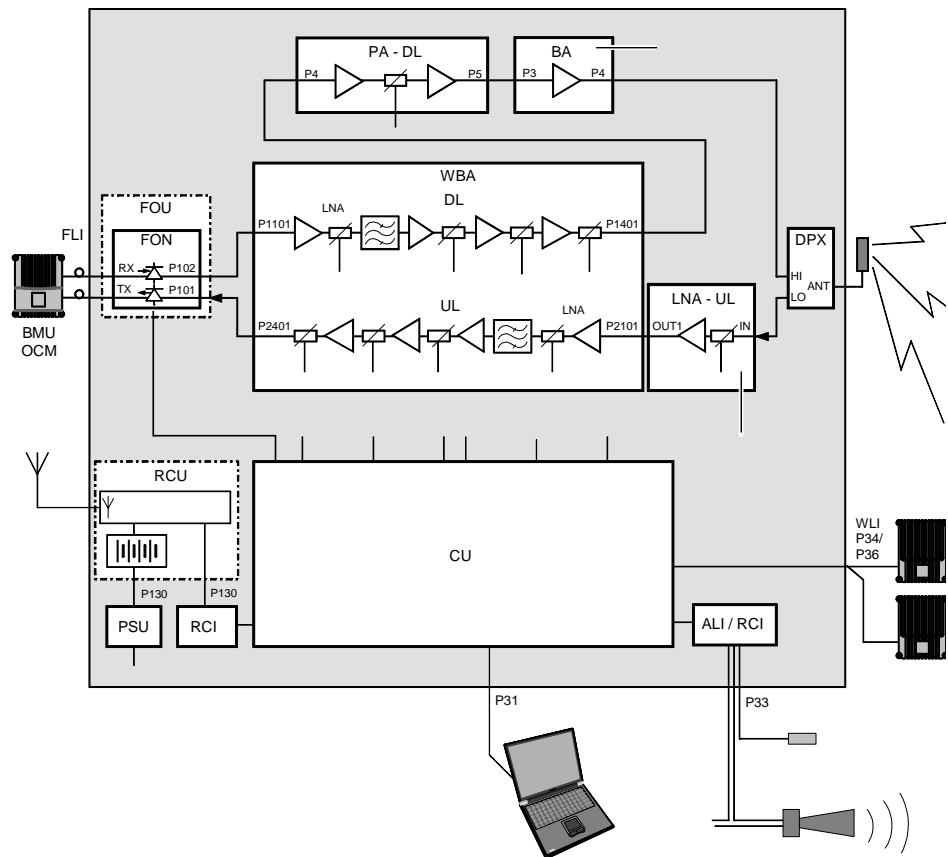


Figure A-1 Standard WRH Block Diagram

Figure A-1 illustrates a single band WRH block diagram. The TX signal from the BTS is converted to an optical signal at a FON within a BMU or OCM and fed to the WRH via a fiber optic cable. The FON in the WRH converts the fiber optic signal back to RF. It also supervises the signaling and reports errors via the RCU connected to the CU. The RF signal enters the WBA at P1101. Amplification occurs in the LNA and the additional amplifier stages followed by controllable attenuators. The signal exits the WBA on P1401 and enters the PA at P4 where it is amplified and fed to the DPX.

If a BA is installed, the signal goes through it before being fed to the DPX, boosting the output DL signal from the PA by typically 6dB. The amplified output signal passes the DPX before it is fed to the service antenna.

The uplink signal path is located on the same WBA but has no PA or BA stage. An optional LNA can be used.

WRH-V

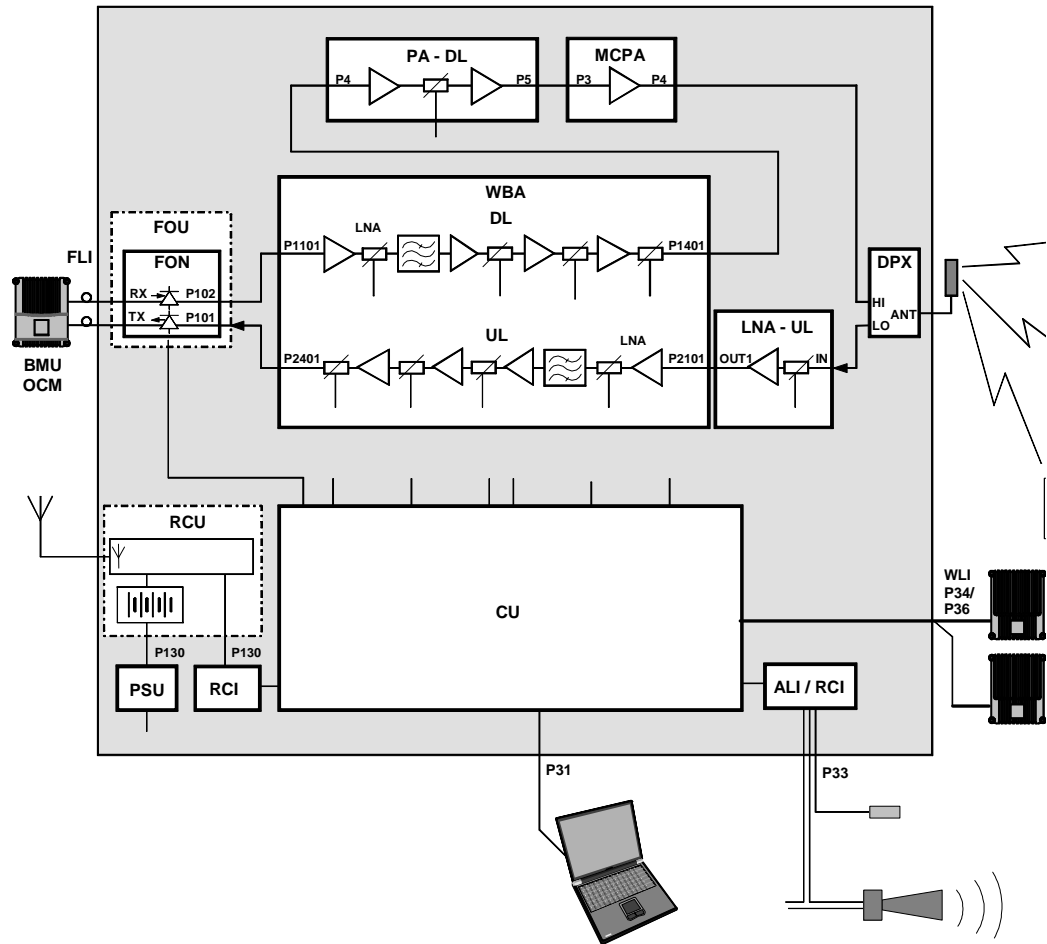


Figure A-2 WRH-V Block Diagram

Figure A-2 illustrates a block diagram the WRH-V. The WRH-V is always fed by a BTS via either a BMU or an OCM. The TX signal from the BTS is converted to an optical signal in a BMU or OCM and fed to the WRH-V via a fiber optic cable. The optical signal is received by the FON and converted to an RF signal. The FON supervises the signaling and reports errors via the RCU connected to the CU.

The RF signal enters the WBA at P1101, is amplified in a LNA and is then further amplified in amplifier stages followed by controllible attenuators. The signal exits the WBA on P1401 and enters the PA at P4 where it is amplified and fed to the DPX. The signal then goes through an MCPA before being fed to the DPX. The amplified output signal passes the DPX before it is fed to the service antenna.

The uplink signal path is located on the same WBA but has no PA or MCPA stage. An optional LNA can be used.



Powerwave Installation and Service Manual

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