JAVAD

FH915

Operator's Manual

Version 2.1

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PREFACE

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Regulatory Information

The following sections provide information on this product's compliance with goverment regulations

FCC Class B Compliance

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in residential installations. This equipment generates, uses, and can radiate

radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause interference to radio or television equipment reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by on or more of the following measures:

- Reorient or relocate the receiving antenna.
- Move the equipment away from the receiver.
- Plug the equipment into an outlet on a circuit different from that to which the receiver is powered.
- Consult the dealer or an experienced radio/television technician for additional suggestions.

CAUTION: *Any changes or modifications to the equipment not expressly approved by the party responsible for compliance could void your authority to operate such equipment.*

Canadian Emissions Labeling Requirements

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe B respecte toutes les exigences du Réglement sur le matériel brouilleur du Canada.

WEEE Directive

The following information is for EU-member states only:

The use of the symbol indicates that this product may not be treated as household waste. By ensuring this product is disposed of correctly, you will help prevent potential negative consequences for the environment and human health, which could otherwise be caused by inappropriate waste handling of this product. For more detailed information about the take-back and recycling of this product, please contact your supplier where you purchased the product or consult.

Technical Assistance

If you have a problem and cannot find the information you need in the product documentation, contact your local dealer. Alternatively, request technical support using the JAVAD GNSS World Wide Web site at: www.javad.com.

GENERAL DESCRIPTION

1.1. Physical Interfaces

1.1.1. Serial Data Interface

The serial asynchronous interface allows connection to external serial devices. It is shared between user data and unit's command/status information. All commonly supported baud rates, parity and bit configurations are available up to 115.2 kbps.

1.1.2. Power Interface

The power interface allows connection to an unregulated DC power source. The DC power source (third-party or user supplied) must provide DC power of 4.0V±5% DC.

The standalone unit's RF interface is a 50-ohm impedance matched standard MMCX connector as required by regulation.

1.1.3. Power Consumption

Power consumption of the Spread Spectrum radio modem at continuous transmission mode with 1W output power level is less than 4500mW (refer to Table 1-1 for details).

Table 1-1. Power Consumption

Operating Mode / Description	Consumption
Maximum for continuous transmission with 1W output power level[1]	< 4500 mW
Maximum for Rx Full Operation Mode	< 2000 mW
Average for Operation Mode with 30% Transmission duty cycle	< 2000 mW
Average for Operation Mode with 50% Transmission duty cycle	< 3000 mW
Sleep Mode	300 mW
Standby Mode, ordered by SLEEP input pin	500 μW

1. The supply voltage (pins 15 and 16 in user interface connector,) must be 3.6 to 4.2VDC to provide RF output power >500mW (licensed operation mode).

1.1.4. Antennas

Antenna type depends on the site requirements, and may be directional or omni-directional. Note that to support 8 miles distance range between Base station and FH915 unit, an antenna mast should elevate the base antenna a minimum of 20 feet above the average level of the terrain.

PRODUCT FEATURES

2.1. Introduction

FH915 radio transceiver is designed as universal license-free modem. It uses 902-928 MHz ISM (industrial, scientific and medical) license free USA/Australia band frequency hopping transmission techniques for excellent reliability in noisy plant environments and European CEPT license free 868-870 MHz band, allocated for narrow band telemetry, alarms and data transfer applications.

Thanks to its small size, and multiple functions, the FH915 is specifically well suited for amount of applications within industrial complexes, for various indoor as well as medium-range applications.

The unmatched features of FH915 include data scrambling, frequency hopping, user selectable transmit output power level, low power consumption sleep modes, repeater mode, autoscanning for base and plug-and-play installation for remote terminals.

Figure 2-1. FH915

FH915 supports two separate Application Data and Maintenance modes of single UART serial port. The built-in software tools provide the wireless link testing, unit's status and error statistics monitoring as well as unit's settings change over the air. The firmware of the FH915 radio transceiver resides in a flash memory. The updating of the radio transceiver programs is entirely software-based. The flash memory is re-programmable through an UART interface or over the air.

The FH915 is developed for exacting customer needs and to have pin-to-pin compatibility with OEM radios of JAVAD GNSS.

The Spread Spectrum transceiver is also capable of receiving RF signals through a 50 Ohm impedance external antenna port.

The delivered product is a wireless system, which includes:

- FH915 – Spread Spectrum Radio Transceiver;
- AWLaunch – Windows based Unit Configuration and Maintenance Software Application running on a IBM PC compatible computer and connecting to the device over RS-232 interface or USB-to-Serial adapter.

The setting can be done through the built-in Command Line interface (CLI), or through the configuration and maintenance application software running either on PC – AWLaunch.

The diagnostic feature of the FH915 system provides the information to monitor and maintain user's communications link. The output transmit power, receive signal strength (RSSI), antenna/feedline condition, and data decode performance are transmitted online without application interruption.

The product is designed for maximum performance and reliability even in the harshest environments. Plug and play at its best, robust, withstanding the most adverse of conditions.

2.2. Operating at Spread Spectrum Band

The Spread Spectrum (SSR) technique in which a signal is transmitted on a bandwidth considerably larger than the frequency content of the original information.

Spread-spectrum telecommunications is a signal structuring technique that employs direct sequence, frequency hopping or a hybrid of these, which can be used for multiple access and/or multiple functions. This technique decreases the potential interference to other receivers while achieving privacy. Spread spectrum generally makes use of a sequential noise-like signal structure to spread the normally narrowband information signal over a relatively wideband (radio) band of frequencies. The receiver correlates the received signals to retrieve the original information signal.

2.3. Modulation Technique

FH915 radio transceiver uses two bands: 902-928 MHz ISM license free USA band and European CEPT license free 868-870 MHz band. In 902-928 MHz band FH915 radio uses frequency hopping transmission techniques.

The design is based on high-level modulation techniques which include:

Modulation/ Channel Spacing	902.0-928.0
GMSK – Minimal Shift Keying with Gaussian Filtering	64.0 kbps, 128 *200.0 kHz
4FSK- Four Level Frequency Shift Keying (planned)	128.0 kbps, 128 *200.0 kHz

The following are its key benefits:

- Ten optimized Frequency Hopping Patterns provides simultaneous operating of several units with minimum of mutual interference.
- FEC coding scheme used with GMSK and 4FSK modulations is based on Convolutional code
- and the Viterbi decoding algorithm which is the most resource-consuming, but it does Maximum likelihood decoding.

In 868-870 MHz band the design is based on high-level modulation techniques which include

Modulation/ Channel Spacing	12.5 kHz	20 kHz	25 kHz
GMSK – Minimal Shift Keying with Gaussian Filtering	4.8 kbps	7.5 kbps	9.6 kbps
4FSK- Four Level Frequency Shift Keying (planned)	9.6 kbps	15 kbps	19.2 kbps

The following are its key benefits:

- FEC coding scheme used with GMSK and 4FSK modulations is based on Convolutional code and the Viterbi decoding algorithm.
- Powerful FEC scheme used with JAVAD GNSS proprietary frame format improves the tolerance to interference and ensures the highest link quality at distances range higher than 8 miles (13 km) and roaming speeds of up to 60 mph (96 km/h).

2.3.1. Media Access Control (MAC)

The following Media Access protocols are available for FH915 modem:

1. Simplex protocols (Simplex Base, Simplex Remote, and Repeater) are developed primarily for GNSS applications.
2. Half Duplex protocols (Half Duplex Base, Half Duplex Remote and Repeater) are the alternative to Simplex protocols that provide bidirectional link with the dynamic bandwidth allocation.

Note: Repeater decreases the user data rate. The user data rate in the link with the repeaters is equal to C / [(n+1]), where C is a link throughput determined by the modulation technique and n is a number of repeaters in the chain. Half duplex Base, Half duplex Remote and repeater are not supported in current release.

3. Sleep mode is an investment provided by MAC sub-layer that provides additional power saving. The wakeup from Sleep mode is user selectable either by an internal real-time clock, or by an external controller through the data interface control lines (RTS or DTR), or by SLEEP input line (CMOS/TTL compatible input lines).

2.3.2. Operating Modes

The operating modes for FH915 can be set through the CLI, and/or through AWLaunch. The following operating modes are available for FH915:

1. The sleep mode has automatic transmitter activation by an internal real-time clock, or by an external controller through the data interface control lines (RTS and DTR), or by the triggering of the external Sense Inputs.
2. Adaptive RF Power control used by Remotes minimizes the transmit power levels and interference to co-channel and adjacent channel users. It also reduces the Remote's power consumption.

2.3.3. Management Tools

The built-in management tools along with AWLaunch (configuration and monitoring software application) will provide the following benefits:

1. Easy user's interface for system configuration and monitoring using well developed CLI or intuitive GUI.
2. An ability to monitor status, alarms and radio performance through the intuitive GUI.
3. Software upgrades and improvements can be downloaded from AWLaunch to the units connected with PC/PDA.

2.3.4. Security

The system provides wireless media access protection as well as data scrambling. The following are its key features and benefits:

1. The Key Sequence generated by Pseudo-random generator scrambles the fully formatted frame (including Frame's CRC). This provides the wireless media access protection.
2. User selectable Frequency Hopping Pattern provides another level of the wireless media access protection. At the same time it allows operators to increase the number of links deployed in the same location.

CONNECTION

3.1. FH915 connection

The FH915 connected directly to Evaluation Kit (p/n 99-571010-01) by its 16-Lead Header Connector, ECS Corp., as it shown on the Figure 2-1.

Adapter   **OEM Board**

to Power Supply

6-20 V DC, 1A   **to Antenna**
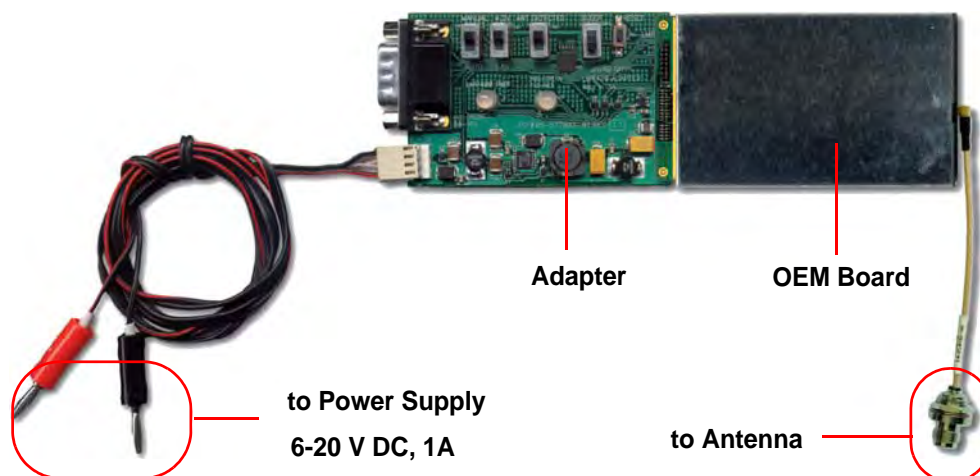
Figure 3-1. FH915 connected to Evaluation Kit

3.2. Antenna connection

The FH915 may be connected to external antenna using TNC to MMCX RA Antenna cable (included in the Kit).

3.3. Power connection

The FH915 powered through Evaluation Kit and Power Cable (included in Kit). The Banana plugs of power cable may be connected to any available laboratory power supply, battery or other power source with power parameters, suitable for particular FH915 power specifications.

CAUTION: Evaluation Kit does not provide any over-voltage protection. Connecting Evaluation Kit to voltage exceeding particular FH915 power voltage range may cause damage of FH915 and Evaluation Kit board.

CAUTION: *Evaluation Kit provides reverse polarity protection only in voltages range, specified for particular FH915.*

3.4. Serial RS-232 connection

A standard Null-Modem cable (included in Kit) with DB-9 Female connectors on both ends may be used to connect PC COM_X port with Serial port on adapter.

Adapter's DB-9 male connector external view and pinout is shown on the Figure 3-2.
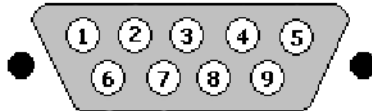
Figure 3-2. DB-9 Male connector

Table 3-1. DB-9 Male Connector Specification

Pin	Signal Name	Dir	Description
1	-	-	Not used
2	RXD	I	Receive Data
3	TXD	O	Transmit Data
4	DTR	O	Data Terminal Ready
5	GND	-	Signal Ground
6	DSR	I	Data Set Ready
7	RTS	O	Request To Send
8	CTS	I	Clear To Send
9	-	-	Not used

Please, refer to particular external device Serial port specification to select and use right Serial cable for proper connection.

COMMAND LINE INTERFACE

The built-in user-friendly Command Line Interface (CLI) allows user to perform a full configuration of the unit and read the statistics and alarm status. It is the most powerful tool to configure the unit. It makes changes to all possible settings that system will not be able to determine automatically.

The CLI commands allow user to configure and reconfigure the unit's settings. The user configuration parameters that could be changed through the CLI are:

- Data Port Settings
  - Baud Rate
  - Data Bits (8, 7)
  - Parity (Odd, Even, None)
  - Flow control (None or RTS/CTS)
- Alarm Settings
- Radio Operation Modes
- Sleep modes
  - On/Off
  - Activate by internal real-time clock
  - Activate through RTS/CTS lines
  - Activate by external sense lines
  - Activate by any combination of the parameters mentioned before

Note: The unit's configuration that is set or modified through the CLI will be lost after unit's reboot, unless the saving operation is used to store a new setting in the unit's configuration file.

The CLI commands also provide filing operations, which include:

- Downloading
  - Unit's Configuration files
  - Software Images
- Uploading Unit's Configuration files
- Saving into the configuration files the configuration parameters modified through the CLI.

4.1. Command Line Interface Convention

The following convention is implemented in FH915 Command Line Interface (CLI):

- The Carriage Return/Line Feed (CR/LF, 0x0D/0x0A) is a command delimiter. Command delimiters CR or LF or CR+LF are valid.

- The Carriage Return/Line Feed (CR/LF, 0x0D/0x0A) is a reply delimiter followed by the "CLI>" prompt if Echo option is On.

- The Carriage Return/Line Feed (CR/LF, 0x0D/0x0A) is a reply delimiter if Echo option is Off (default option).

- The 2-digit number followed by "@" in the unit's reply indicates the error code (refer to Table 4-1 for description), if Echo Off is selected, otherwise the error message is displayed.

- A successfully performed command is replied by @00 code, if Echo Off is selected, otherwise the set value is replied.

- A command with the certain [*Parameter Name*] and blank [*Parameter List*] displays the current settings for a given parameter.

- To set the mode ordered by CLI commands as permanent User Setting (the setting automatically selected for the boot-up unit) the SAVE command must be asserted.

- [/?] orders to show the help information for the given command.

- Commands are not key sensitive; small, none capital characters can be used to enter CLI commands.

Table 4-1. Command Line Interface Error Codes

Error Code	Short Description
0x01	Command Syntax Error. A command followed by "/?" displays a command usage.
0x02	The parameter has a format error. A command with the certain [Parameter Name] followed by "/?" displays the format and range of the variable.
0x03	The parameter is out of allowed range. A command with the certain [Parameter Name] followed by "/?" displays the format and range of the variable.
0x04	The command is not valid for specific radio model. To display the list of available commands, the HELP command must be used (see "Software Switching to Maintenance Mode").
0x05	Unspecified Error

4.1.1. Software Switching to Maintenance Mode

Software Switching to Maintenance Mode can be utilized if Data/Maintenance Port (DP/MP) control line is set to High Z (or 3.3v) level. To switch to Maintenance mode the special byte-sequences with special meanings are used:

- Escape-Sequence: "+++" with 20 ms guard time before and after the command characters

- Escape-Acknowledge: "@00<CR><LF>" 20 ms toggling on CTS control line needed to acknowledge switching from Data to Maintenance mode and vice versa. In Maintenance mode, the unit's serial port must keep CTS line always active.

Happy Flow

1. In data-mode the unit starts looking for the Escape-sequence if there is no data from DTE for more than 20 ms (Start Guard Time).

2. If the unit detects the Escape-Sequence:
   - The transmitter continues sending over the air the data received from DTE before Escape-Sequence and buffers the data from DTE;
   - The Receiver immediately stops forwarding to DTE the data received over the air and buffers it instead.

3. The radio unit waits for 20 ms and then sends Escape-Acknowledge to DTE if there is no data from DTE during 20 ms of Stop Guard Time.

4. The unit goes to Maintenance mode and discards Escape-Sequence from input buffer. The modem is immediately ready to receive commands. At the same time it continues buffering the data received over the air since step 2.

Escape-Sequence in Data

During its waiting in step 3, the unit receives data from DTE:

- The unit sends buffered Escape-Sequence from DTE to the air;
- The unit sends all buffered data received from the air since step 2 to DTE and stays in data-mode (i.e. transmits data received from DTE over the air – including the just received, unexpected, data and forwards data received over the air to DTE.)

4.1.2. Hardware Switching to Maintenance Mode

As alternative to Software Switching, the switching through the MP/DP control line can be used (this control line can be also used as Data Terminal Ready, DTR). To set Maintenance mode, the DTE must assert DTR signal active (0v level). By falling edge of DTR signal the unit goes to Maintenance mode and then sends Escape-Acknowledge to DTE („@00<CR><LF>“).

20 ms toggling on CTS control line followed by Escape-Acknowledge response is needed to acknowledge switching from Data to Maintenance mode and vice versa. In Maintenance Mode, the unit's serial port must keep Clear to Send (CTS) line always active (see also "MPORT" on page 22).

Note: The powered up radio modem by default goes to Data Mode regardless of DTR control line polarity.

4.1.3. Switching to Data Mode

- DTE sends the CLI command "DATAMODE<CR>" or „DATAMODE<LF>" to the unit.

Note: Command "DATAMODE<CR><LF>"will be accepted as command "DATAMODE<CR>" and Data Byte=0x0A.

- Unit answers with Escape-Acknowledge („@00<CR><LF>") and immediately goes to datamode, so that the DTE can start sending data as soon as the Escape-Acknowledge has been received.
- If no valid CLI commands received from DTE within 1 minute, the unit will automatically switch back to data-mode.

Note: The data received over the air could be lost due to Rx buffer overflow if the unit stays in Maintenance mode longer then 15 second.

4.2. Networking Commands

4.2.1. CONNECT

To connect the radio unit through the local maintenance serial port or to establish the link with the remote unit in the Point-to-Multipoint network, the CONNECT command must be used.

CONNECT *[Unit_Numb] [/?]*

Where the Unit_Numb is an assigned decimal number for the unit to be connected. To get the complete unit list, the CONNECT command must be used with no parameter. The list of units in the Point-to-Point link with the connection established with remote unit is shown in Figure 4-1:

Unit	Serial Number	Connect
BS	003578659922	
1	003574459923	C

Figure 4-1. Connection List

To disconnect from the remote unit and connect to the local unit, the parameter (Unit_Numb) must be equal to 0x00.

4.2.2. LINK

The LINK command is responsible for configuring radio's operation mode. It has six parameters listed below.

LINK [*Parameter Name*] [*Parameters List*] [*/?*]

LINK commands are as common so specific for two bands: 902-928 MHz band and 868-870 MHz band.

Commands common for two bands:

Parameter Name	Parameter List
FEC	0 – Disable Forward Error Correction, a default setting (see note below) 1 – Enable Forward Error Correction (see note below)
FHOP	(0-9) - Frequency Hoping Pattern numbers for USA; (10-19) - Frequency Hoping Pattern numbers for Australia;

Parameter Name	Parameter List
MOD	5 - GMSK, a default settings 6 - 4FSK;
PWRB / PWRW	0 – Automatic Transmit Power control, a default setting for Remote units (15 – 30) / (30 – 1000) – RF output Power in dBm / mW
PWRB / PWRW	(15 – 30) / (30 – 1000) – RF output Power in dBm / mW
RTR	0 – No Retransmission in the wireless cluster 1 – There is Repeater in the wireless cluster, valid for Base only
SCRAM	0 – No Scrambling (a default setting) (1 – 255) – Seed for Pseudo-Random Sequence Generator
FEC	0 – Disable Forward Error Correction (FEC), a default setting 1 – Enable Reed-Solomon encoding
CHAR	(0 – 255) – defines the ASCI code of the symbol indicating the end of a data chunk of "Transparent w/EOT Character" protocol.

Note: LINK FHOP and LINK CHAN commands can be processed only if Frequency Map is defined.

Auto-scanning may not start automatically, only when scanning requested via CLI command (see LINK CHAN 0 and STATE commands).

"Half Duplex" Base and "Half Duplex" Remote protocols are not supported in current release. LINK ADDR and LINK CLKCORR commands are not recommended for using on site of End Users.

Commands specific for 902-928 MHz band:

Parameter Name	Parameter List
PWRB / PWRW	0 – Automatic Transmit Power control, a default setting for Remote units (15 – 30) / (30 – 1000) – RF output Power in dBm / mW
PTRN	0…9 - Frequency hopping in ISM license free USA 902-928 MHz band; 10…19 - Frequency hopping in ISM license free 902-928 MHz band specified for Australia;

Commands specific for 868-870 MHz band:

Parameter Name	Parameter List
CHAN	Selects the Channel Number: CN = 1 to 32. Each Channel is defined by three parameters: Carrier Frequency, Channel Spacing and Allowed Output Power level. CN = 0 is reserved to set up the Frequency Automatic scanning mode. The LINK CHAN 0 command also forces the radio modem to continue scanning starting from the channel currently selected by automatic scanning algorithm. In Automatic scanning mode, to check the channel currently used or scanned, the STATE command must be used
PROT	1 - "Simplex Receiver" a default setting (see note below) 2 - "Simplex Transmitter" 3 - "Half Duplex" Base (reserved) 4 - "Half Duplex" Repeater (reserved) 9 - "Transparent w/EOT" Repeater (used with GMSK and 4FSK) 10 - "Repeater" (JAVAD GNSS Proprietary Simplex) 12 - "Transparent w/EOT" Receiver (used with GMSK and 4FSK) 13 - "Transparent w/EOT" Transmitter (used with GMSK and 4FSK) 17 - "Fast Sync" Receiver (used with GMSK and 4FSK) 18 - "Fast Sync" Transmitter (used with GMSK and 4FSK) 19 - "Transparent w/EOT Character" Receiver (used with GMSK and 4FSK) 20 - "Transparent w/EOT Character" Transmitter (used with GMSK and 4FSK)

Note: The frequency defined by CHAN parameter is not valid if Frequency Hoping mode is selected. "Half Duplex" Base and "Half Duplex" Remote protocols are not supported in current release.

4.3. Serial Interfacing Commands

4.3.1. DPORT

The DPORT is an object that responsible for data port interface configurations like Bit Rate, Flow Control, etc.

DPORT [*Parameter Name*] [*Parameters List*] [*/?*]

Parameter Name	Parameter List
RATE	0 – Maintenance Port baud rate, a default setting 1 – 1200 baud 2 – 2400 baud 3 – 4800 baud 4 – 9600 baud 5 – 14400 baud 6 – 19200 baud 7 – 38400 baud 8 – 57600 baud 9 – 115200 baud, a default setting
BITS	Set number of bits in one byte (8 or 7) 8 is a default setting
PARITY	0 – None, a default setting 1 – Odd 2 – Even
FLOW	0 – None 1 – Not used 2 - HW (RTS/CTS), a default setting

4.3.2. MPORT

The MPORT is an object that responsible for maintenance serial port interface configurations such as data rate and number of bits in a byte.

MPORT [*Parameter Name*] [*Parameters List*] [*/?*]

Parameter Name	Parameter List
RATE	0 – Auto. 1 – 1200 baud 2 – 2400 baud 3 – 4800 baud 4 – 9600 baud 5 – 14400 baud 6 – 19200 baud 7 – 38400 baud 8 – 57600 baud 9 – 115200 baud, a default setting

Note: JAVAD GNSS radio modem's does not support data flow and parity on the maintenance serial port.

MPORT operates using 8 bits in one byte fixed (not configurable).

The radio modem with none-dedicated maintenance serial port must keep CTS line always active in MPORT mode (DP/MP is low).

4.4. Special Commands

4.4.1. ALARM

The ALARM command is intended to set up the alarm indication mode and alarm control lines' behavior.

ALARM [*Parameter Name*] [*Parameters List*] [*/?*]

Parameter Name	Parameter List
TTL1	0 – TTL_OUT1 = logic "1" 1 – TTL_OUT1 = TTL_IN, received from remote unit (default settings)
TTL2	0 – TTL_OUT2 = logic "1" 1 – TTL_OUT2 = TTL_IN2, received from remote unit (default settings) 2 – TTL_OUT2 = SYNC Loss 3 – TTL_OUT2 = BER > BERTH or SYNC Loss
BERTH	1– BER Threshold $>10^{-3}$ (default threshold level for BER) 2 – BER Threshold BER $>10^{-2}$

The Alarm LED must indicate the SYNC Loss and BER exceeding the defined threshold.

Note: The BERTH 1 / 2 is optional for TTL2 = 3 condition, otherwise the BERT alarm is off

4.4.2. BOOT

The BOOT command is intended to reboot the unit using selected user settings. Two options are available, to use the default user settings defined by dealer or to use the settings defined by end-user

BOOT [*Parameter Name*] [*Parameters List*] [*/?*]

Parameter Name	Parameter List
CFG	0 – selects the default user settings 1 – selects user modified settings

The BOOT command with no parameters selects the user settings defined by the prior "parameterized" BOOT commands.

4.4.3. HELP

The HELP command types the list of all available commands:

```
HELP    - Display this usage
```

```
BOOT     - Reboot the unit
LINK     - RF Link Operation Mode
DPORT    - Data Port Configuration
MPORT    - Maintenance Port Configuration
ALARM    - Alarm Indication and Alarm Control Configuration
SLEEP    - Sleep Mode Configuration
CONNECT - Connect to Specified Unit
STATE    - Display Status and Statistics
SAVE     - Save Current Configuration into Configuration File
INFO     - Display Product ID along with Hardware/Software Versions
DATAMODE - Exit Maintenance Mode
[COMMAND] /? - Display Command Usage
```

4.4.4. SAVE

The SAVE command is intended to store the unit's currently used configuration into the User Configuration file. The configuration stored in the User Configuration file is activated by automatically after unit's reboot.

4.4.5. SLEEP

The SLEEP command determines the sleep mode parameters. The sleeping FH915 can be activated by real-time CLK, DTR/RTS lines, and command received through TTL inputs. The user can select one, two, or all three conditions.

SLEEP [*Parameter Name*] [*Parameters List*] [*/?*]

Parameter Name	Parameter List
CLK	0 – Do not activate by internal real-time clock (1 – 255) – Activate by internal real-time clock after 100 to 25500 msec of sleeping
HW	0 – Do not activate through DTR/RTS lines 1 – Activate through DTR/RTS lines
TTL	0 – Do not activate by external sense lines 1 – Activate by external sense lines
GTS	0 – Disable Sleep mode (default) (1 – 255) – Go to sleep mode if there is no activity in 10 to 2550 msec

4.5. Diagnostics and Identification Commands

4.5.1. INFO

The INFO command is used to retrieve the Radio ID along with its Hardware version, the loaded real-time software version/revision and BootLoader's version/revision.

INFO [*Parameter Name*] [*Parameters List*] [*/?*]

Parameter Name	Parameter List
ID	Product ID
SN	Six bytes Serial Number (SN)
HW	1.0 – hardware revision
FW	Ver. 1.0 Rev. A – displays software's version in numeric "Major.Minor" format and revision in numeric format (range from 01 to 99) for engineering releases and alphabetic format (A to Z) for manufacturing releases
BL	BootLoader Version

The INFO command without Parameter Name indicates all values:

```
FH915 Spread Spectrum Radio Modem.
Product ID =41
S/N = 11327
Hardware =2.0
Firmware =2.1.9
BootLoader =4.03
```

4.5.2. STATE

The STATE command is used to check the state of the wireless link, the unit in the link, and the alarm control lines. To specify a radio unit (local or remote), the CONNECT command must be used in prior of STATE command using.

STATE [*Parameter Name*] [*Parameters List*] [*/?*]

Parameter Name	Parameter List
TTL1	0/1 – State of TTL_IN1 line
TTL2	0/1 – State of TTL_IN2 line
RSSI	-52 to -116 dBm – Indicates the Receive Signal Strength in dBm
BER	1.0E-6 to 9.9E-3 – Indicates the BER level
FREQ	902.000000 to 928.000000 MHz – Displays the central frequency of the operating channel
CHAN	1 to 9601 – Displays the selected or currently scanned frequency channel
TEMP	-30°C to 100°C – Displays the temperature inside of enclosure

The STATE command without Parameter Name indicates all values:

```
TTL_IN1 = 0
TTL_IN2 = 1
RSSI = -110 dBm
BER = < 2.3E-5
FREQ = 910.000000 MHz
CHAN = 10
TEMP = 70C
```

Note: The indicated receive signal strength (RSSI) is equal to -147 dBm if there is no signal received from transmitter.

TECHNICAL SPECIFICATIONS

FH915 DSP based integrated Spread Spectrum Modem is the single board OEM wireless transceiver intended for SCADA, outdoor telemetry applications and transmission /receiving of differential corrections and additional information by terrestrial radio channels between two GNSS receivers.

The Spread Spectrum module provides half-duplex communication with transmitter output power of 1 W (+30 dBm) in the frequency band 902-928 MHz z. In 868-870 MHz band module provides half-duplex communication with transmitter output power up to 1W (+30 dBm) with channel spacing 25.0/ 20.0/12,5/ 6.25 kHz. It supports the following modulation methods: GMSK, 4FSK.

A.1. Technical Specifications

A.1.1. Radio Transceiver

Table A-1. Radio Transceiver Specifications

Component	Details
Frequency Range	902-928 MHz (USA) 915-928 MHz (Australia) 868-870 MHz (EU) with 25/20/12.5 kHz CS
Link Rate, symbols/second	9600, 19200, 38400, 64000 (USA/Australia) 4800, 9600 (EU)
Carrier Frequency Stability	±1 ppm
Modulation	GMSK/4FSK
Communication Mode	Half duplex, simplex, repeater

A.1.2. Radio Transmitter

Table A-2. Radio Transmitter Specifications

Component	Details
Transmitter Output Power	+10... +30 dBm in 1 dB step / 50 Ω (USA/Australia) +10...+27 dBm in 1dB step/50 Ω (EU)

A.1.3. Radio Receiver

Figure A-1. Radio Receiver Specifications

Component	Details
Receiver Sensitivity for GMSK (BER $1x\ 10^{-4}$)	-110 dBm for 25 kHz CS -110 dBm for 20 kHz CS -112 dBm for 12.5 kHz CS
Receiver Dynamic Range	-119 to -10 dBm

A.1.4. Modem

Figure A-2. Modem Specifications

Component	Details
Interface	DSP UART (serial port)
Interface Connector	16-lead Connector
Data Speed of Serial Interface	9600 - 115200 bps
Data Rate of Radio Interface (USA/Australia)	64000 bps - GMSK 32000 bps - GMSK 19200 bps - GMSK 16000 bps - GMSK 128000 bps - 4FSK 64000 bps - 4FSK 32000 bps - 4FSK 19200 bps - 4FSK 16000 bps - 4FSK
Data Rate Radio Interface (25 kHz CS)	9600 bps – GMSK 19200 bps – 4FSK
Data Rate Radio Interface (20 kHz Channel Spacing)	7500 bps – GMSK 15000 bps – 4FSK
Data Rate Radio Interface (12.5 kHz Channel Spacing)	4800 bps – GMSK 9600 bps – 4FSK
Forward Error Correction (FEC)	Convolutional code
Data scrambling	Yes

A.1.5. Compliance

Component	Details
FCC	FCC Part 15.247
ETSI	EN 300 220-1, EN 301 489-1

A.1.6. General

Component	Details
Input Voltage	4.0 V ± 5%
Power Consumption (average)	3 W – transmit with 50% duty cycle (1 W TPO) 1 W – receive mode
Operation Temperature	-40°C - +60°C
Storage Temperature	-40°C - +80°C
Dimensions	L: 80 mm x W: 46.5 mm x H: 7.6 / 9.5 mm
Weight	43 g

Features

- DSP-Modem
- Multi-Modulation Technologies
- Zero-IF Technologies
- 902-928 MHz (USA), 915-928 MHz (Australia), 868-870 MHz (EU) Frequency Ranges
- Up to 115200 bps Serial Interface Data Rate
- Embedded Firmware Compensation for Operation at Extremely Low and High Temperatures
- Compact Design
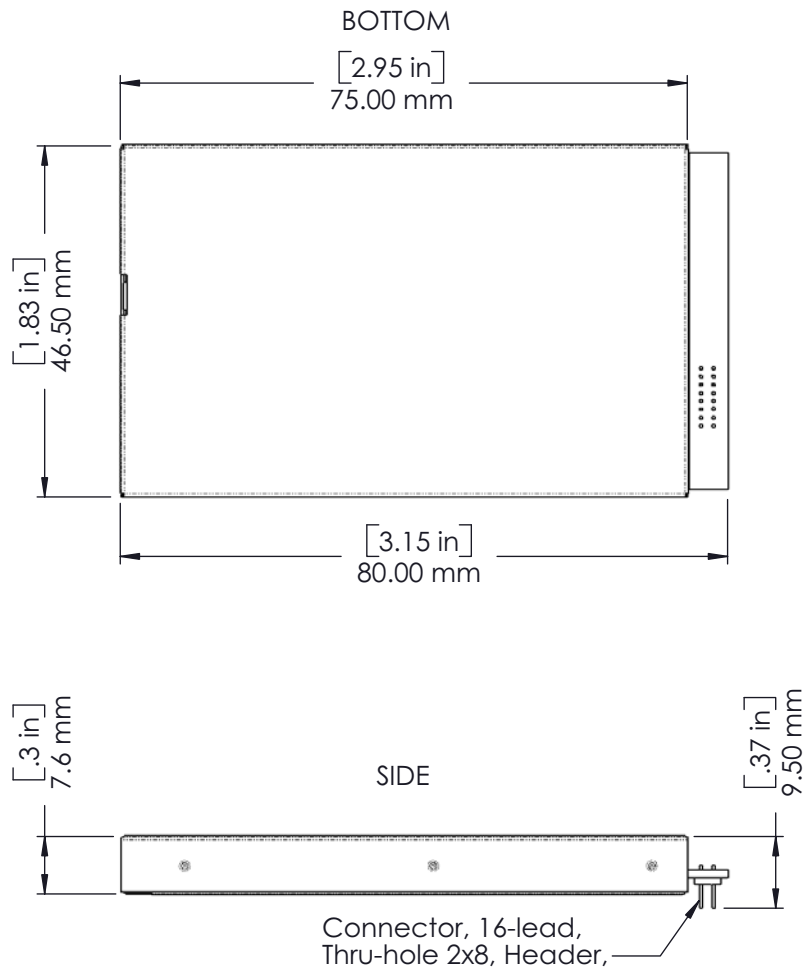
A.1.7. Mechanical Properties For End-product

Dimensions for PCB Mounted Enclosure:

80 mm x W: 46.5 mm x H: 7.6/9.5 mm (3.15" x 1.83" x 0.3")

BOTTOM

2.95 in
75.00 mm

1.83 in
46.50 mm

3.15 in
80.00 mm

.3 in
7.6 mm

SIDE

.37 in
9.50 mm

Connector, 16-lead,
Thru-hole 2x8, Header,

A.2. External Connectors

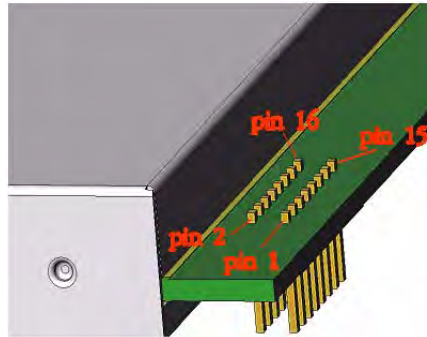## A.2.1. Antenna Connector

J2 is Antenna Input / Output Connector: MMCX RIGHT ANGLE PCB JACK, AMPHENOL P/N 908-24100

A.2.2. Main Connector

The user ports connector is used to provide connection with an external DTE or with the PC running AWLaunch management software applications.

Note: The RS232-to-TTL adapter must be used to provide physical level compatibility between COM port of PC running AWLaunch and FH915 user interface port.

16-Lead Header Connector, ECS Corp. P/N 9616-D1-01-03.

PIN #	Signal Designator	Signal name	Description	I/O	Comments
1	GND	GND	Ground	-	Signal and Chassis Ground
2	DSP UART 1	TXD	Transmit Data	TTL Input	Serial Data Input
3	DSP UART 2	RXD	Receive Data	TTL Output	Output for received serial data
4	DPORT-5	DTR or DP/MP	Data Terminal Ready	TTL Input	Control line can be used as a backup method for entering Command mode: (0V) – Maintenance Mode; (3.3V) – Data Mode An internal 100K pull-up enables Data Mode if this signal is left unconnected. Maintenance Mode is also accessible by transmitting an escape sequence.
5	DPORT1	CTS	Clear to Send	TTL Output	Used to control transmit flow from the user to the radio: (0V) – Transmit buffer not full, continue transmitting (3.3V) – Transmit buffer full, stop transmitting
6	TTLI1	SLEEP	Sleeps/wakes radio Receive only	TTL Input	In sleep mode, all radio functions are disabled consuming less than 50µA. An internal 10K pull-down wakes up the radio if this signal is left unconnected. At wake up, any user programmed configuration settings are refreshed from flash memory, clearing any temporary settings that may have been set: (3.3V) – Sleep Radio; (0V) – Wake Radio As an option could be used as TTL Input Line 1.
7	DPORT3	MDM_GRN	Data Carrier Detect	TTL Output	Used by remotes to indicate that the remote has successfully acquired the signal from base station: (0V) 1 – Carrier detected (synchronized) (3.3V) 0 – No carrier detected (not synchronized)

PIN #	Signal Designator	Signal name	Description	I/O	Comments
8	DPORT4	RTS	Request to Send	TTL Input	Gates the flow of receive data from the radio to the user on or off. An internal 10K pull-down enables data receive if this signal is left unconnected. In normal operation, this signal should be asserted: (0V) – Receive data (RxD) enabled (3.3V) – Receive data (RxD) disabled
9	DPORT2	DSR	Data Set Ready	TTL Output	Used to control transmit flow from the user to the radio: (0V) 1 – Receive buffer has data to transfer; (3.3V) 0 – Receive buffer is empty
10	RES CONT	RESCONT	Reset Control	TTL Input	Reset the radio by shortening this pin to the ground.
11	TTLO1	TTLOUT1	TTL Output Line 1	TTL Output	Reserve line
12	TTLO2	TTLOUT2	TTL Output Line 2	TTL Output	Reserve line
13	GND	GND	Ground	-	Signal and Chassis Ground
14	TTLI2	TTLIN	TTL Input line	TTL Input	An internal 100K pull-up resistor is applied.
15	VCC36	PWR	Power Supply	External	Regulated positive 4.0V DC from ext. Power Supply.
16	VCC36	PWR	Power Supply	External	Regulated positive 4.0V DC from ext. Power Supply.

SPREAD SPECTRUM RADIO USAGE

Many countries require a license for radio users. Be sure you comply with all local laws while operating a Spread Spectrum radio.

The quality and strength of the Spread Spectrum signals translates into range for Spread Spectrum communications.

The system's range will greatly depend on the local conditions. Topography, local communications and even meteorological conditions play a major role in the possible range of communications.

SAFETY WARNINGS

Read these instructions.

- Keep these instructions.
- Heed all warnings.
- Follow all instructions.
- Clean only with a damp cloth.
- Do not block any of the ventilation openings. Install in accordance with the manufacturer's instructions.
- Do not install near any heat sources such as radiators, heat registers, stoves, or other apparatus (including amplifiers) that produce heat.
- Protect the power cord from being walked on or pinched particularly at plugs, convenience receptacles, and the point where they exit from the apparatus.
- Only use attachments/accessories specified by the manufacturer.
- Refer all servicing to qualified service personnel. Servicing is required when the apparatus has been damaged in any way, such as power-supply cord or plug is damaged, liquid has been spilled or objects have fallen into the apparatus, or has been dropped.
- Apparatus shall not be exposed to dripping or splashing and no objects filled with liquids, shall be placed on the apparatus.

C.1. General Warnings

This product should never be used:

- Without the user thoroughly understanding operator's manual.
- After disabling safety systems or altering the product.
- With unauthorized accessories.
- Contrary to applicable laws, rules, and regulations.

DANGER: THE FH915 SHOULD NEVER BE USED IN DANGEROUS ENVIRONMENTS.

WARRANTY TERMS

JAVAD GNSS electronic equipment are guaranteed against defective material and workmanship under normal use and application consistent with this Manual. The equipment is guaranteed for the period indicated, on the warranty card accompanying the product, starting from the date that the product is sold to the original purchaser by JAVAD GNSS' Authorized Dealers[1].

During the warranty period, JAVAD GNSS will, at its option, repair or replace this product at no additional charge. Repair parts and replacement products will be furnished on an exchange basis and will be either reconditioned or new. This limited warranty does not include service to repair damage to the product resulting from an accident, disaster, misuses, abuse or modification of the product.

Warranty service may be obtained from an authorized JAVAD GNSS warranty service dealer. If this product is delivered by mail, purchaser agrees to insure the product or assume the risk of loss or damage in transit, to prepay shipping charges to the warranty service location and to use the original shipping container or equivalent. A letter should accompany the package furnishing a description of the problem and/or defect.

The purchaser's sole remedy shall be replacement as provided above. In no event shall JAVAD GNSS be liable for any damages or other claim including any claim for lost profits, lost savings or other incidental or consequential damages arising out of the use of, or inability to use, the product.

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1. The warranty against defects in JAVAD GNSS battery, charger, or cable is 90 days.

JAVAD