LMR400

OEM Board

User manual

Version 3.0

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www.javad.com

Table of Contents

Preface

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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. 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.

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

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

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

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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.

ABOUT THIS MANUAL

This Manual is designed to help you get familiar with the LMR400 uzer interface and introduce you to the JAVAD Mobile Tools main features.

Screen Captures

This Manual includes sample screen captures. Your actual screen can look slightly different from the sample screen due to the receiver you have connected, operating system used and settings you have specified. This is normal and not a cause for concern.

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.

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Description

INTRODUCTION

Product Features

LMR400 DSP based integrated UHF 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. LMR400 is a half duplex, UHF Radio Transceiver. It takes incoming data, modulates it with GMSK, FSK, PSK or most spectrum efficient QAM modulation and transmits it at RF power output levels from 15 dBm up to 30 dBm operating in UHF frequency band (406 to 470 MHz).
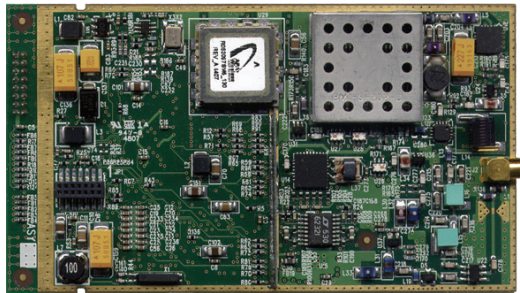
LMR400 OEM board

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

LMR400 delivers a reliable radio link at up to 38.4 kbps over the air for the 25 kHz channel spacing, 30 kpbs for 20 kHz, 19.2 kbps for 12.5 kHz, and 9.6 kbps for 6.25 kHz. The module requires a regulated DC voltage power supply 4.2 V ± 5%.

The delivered product is a wireless system, which includes:
- LMR400 – UHF 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 LMR400 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.

Operating at Ultra High Frequency Band

LMR400 operates in UHF frequency band covering both licensed and unlicensed frequencies. The following are its key benefits:

> Operating in UHF frequency band will provide a non-line of sight connection.
> User selectable operation mode (licensed or unlicensed mode) is a feature, which makes LMR400 system suitable for both licensed and unlicensed markets.
> Relatively low cost associated with installation equipment compared to the licensed wireless bands, since no capital is required to purchase spectrum rights.
> Single radio system covers the whole UHF frequency band from 406 to 470 MHz;
> User selectable channel spacing (25 kHz, 20 kHz, 12.5 kHz or 6.25 kHz);
> User selectable Output power level for Base (30mW/15dBm and 1W/30dBm);
> 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.

Modulation Technique

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

Modulation/ Channel Spacing	6.25 kHz	12.5 kHz	20 kHz	25 kHz
DBPSK – Differential Binary Phase Shift Keying	2.4 kbps	4.8 kbps	7.5 kbps	9.6 kbps
DQPSK – Differential Quadrature Phase Shift Keying	4.8 kbps	9.6 kbps	15 kbps	19.2 kbps
D8PSK – Eight Phase Shift Keying	7.2 kbps	14.4 kbps	22.5kbps	28.8 kbps
D16QAM – Sixteen Quadrature Amplitude Modulation	9.6 kbps	19.2 kbps	30 kbps	38.4 kbps
GMSK – Minimal Shift Keying with Gaussian Filtering	2.4 kbps	4.8 kbps	7.5 kbps	9.6 kbps
4FSK- Four Level Frequency Shift Keying	N/A	9.6 kbps	15.0 kbps	19.2 kbps

The following are its key benefits:

• Provides an excellent spectral efficiency (up to 2.3 bps/Hz for D16QAM), it is better than any product available on the market.

• FEC coding scheme used with GMSK and 4FSK modulations is based on Hamming Code known as Perfect Codes. Although Hamming Codes are not very powerful, they are easy to implement and do not require much DSP resources.

• More powerful Reed-Solomon FEC coding scheme used with ArWest 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).

Media Access Control (MAC)

The following Media Access protocols are available for LMR400 modem:

• Simplex protocols (Simplex Base, Simplex Remote, and Repeater) are developed primarily for GNSS applications.

• 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.

• 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 con-

troller through the data interface control lines (RTS or DTR), or by SLEEP input line (CMOS/TTL compatible input lines).

Operating Modes

The operating modes for LMR400 can be set through the CLI, and/or through AWLaunch. The following operating modes are available for LMR400 :

• 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.

• 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.

Management Tools

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

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

Security

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

• The Key Sequence generated by Pseudo-random generator scrambles the fully formatted frame (including Frame's CRC). This provides the wireless media access protection.
• 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.

Physical Interfaces

SPECIFICATIONS

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.

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 4.2V±5% DC. The standalone unit's RF interface is a 50-ohm impedance matched standard MMCX connector as required by regulation.

POWER CONSUMPTION

Power consumption of the UHF radio modem at continuous transmission mode with 1W output power level is less than 4500mW (refer to Table 2-1 for details).

Operating Mode / Description	Consumption
Maximum for continuous transmission with 1W output power level	< 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 mW

Note: The supply voltage (pins 15 and 16 in user interface connector,) must be 4.2 to 4.5VDC to provide RF output power >500mW (licensed operation mode).

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 LMR400 unit, an antenna mast should elevate the base antenna a minimum of 20 feet above the average level of the terrain.

GENERAL SPECIFICATION

- Input Voltage: 4.2 V ± 5 %
- Power Consumption (average):
  3 W – transmit with 50% duty cycle (1 W TPO)
  1 W – receive mode
- Temperature:
  Operation -40 °F ... 140 °F (-40 °C ... +60 °C)
  Storage -40 °F... 176 °F (-40 °C ... +80 °C)
- Dimensions:
  3.18 x 1.80 x 0.29/0.37 in (80.8 x 45.7 x 7.4/9.4 mm)
- Weight: 0.09 lbs (41 g)

FEATURES

- DSP-Modem
- Multi-Modulation Technologies
- Zero-IF Technologies
- Up to 115200 bps Data Rate
- Embedded Firmware Compensation for Operation and Extremely Low at High Temperatures
- Compact Design

RADIO TRANSMITTER SPECIFICATIONS

- Transmitter Output Power: +15... +30 dBm in 1 dB step / 50 Ω
- Carrier Power Stability: +1 dB / -2 dB

RADIO TRANSCEIVER SPECIFICATIONS

- Frequency Range:
  LMR 400: 406 - 470 MHz
  LMR400 EXT: 360 - 470 MHz

- Channel Spacing: 25/20/12.5/6.25 kHz
- Carrier Frequency Stability: ±1 ppm
- Modulation: GMSK/4FSK/DBPSK/DQPSK/D8PSK/D16QAM
- Communication Mode: Half duplex, simplex

RADIO RECEIVER SPECIFICATIONS

- Receiver Sensitivity for DBPSK (BER 1x 10^{-4}):
  -113 dBm for 25 kHz Channel Spacing
  -113 dBm for 20 kHz Channel Spacing
  -114 dBm for 12.5 kHz Channel Spacing
  -114 dBm for 6.25 kHz Channel Spacing
- Receiver Sensitivity for DQPSK (BER 1x 10^{-4}):
  -110 dBm for 25 kHz Channel Spacing
  -110 dBm for 20 kHz Channel Spacing
  -111 dBm for 12.5 kHz Channel Spacing
  -111 dBm for 6.25 kHz Channel Spacing
- Receiver Dynamic Range: -119 to -10 dBm

MODEM SPECIFICATION

- Interface DSP: UART (serial port)
- Interface Connector: 16-lead Connector
- Data Speed of Serial Interface:
  9600 - 115200 bps
- Data Rate of Radio Interface (25 kHz Channel Spacing)
  9600 bps – DBPSK/GMSK
  19200 bps – DQPSK
  28800 bps – D8PSK
  38400 bps – D16QAM
- Data Rate Radio Interface (20 kHz Channel Spacing)

7500 bps – DBPSK/GMSK
15000 bps – DQPSK
22500 bps – D8PSK
30000 bps – D16QAM
• Data Rate Radio Interface (12.5 kHz Channel Spacing)
4800 bps – DBPSK/GMSK
9600 bps – DQPSK
14400 bps – D8PSK
19200 bps – D16QAM
• Data Rate Radio Interface (6.25 kHz Channel Spacing)
2400 bps – DBPSK
4800 bps – DQPSK
7200 bps – D8PSK
9600 bps – D16QAM
• Forward Error Correction (FEC): Reed-Solomon Error Correction
• Data scrambling: Yes

EXTERNAL CONNECTORS

• RF Connector: J2 is Antenna Input / Output Connector: MMCX RIGHT ANGLE PCB JACK, AMPHENOL P/N 908-24100.
• Main Connector - 285209LF CONN, 16LEAD, HEADER, 5.84CONT COMM CON INC 3913-16G2

COMPLIANCE

• FCC Part 90
• Industry Canada RSS-210
• ETSI EN 300 113-2, ETSI EN 301 489-1, ETSI EN 301 489-5

The built-in user-friendly Command Line Interface (CLI) allows user to perform a full configuration of

Dimension in mm [inch].


16-Lead Header Connector
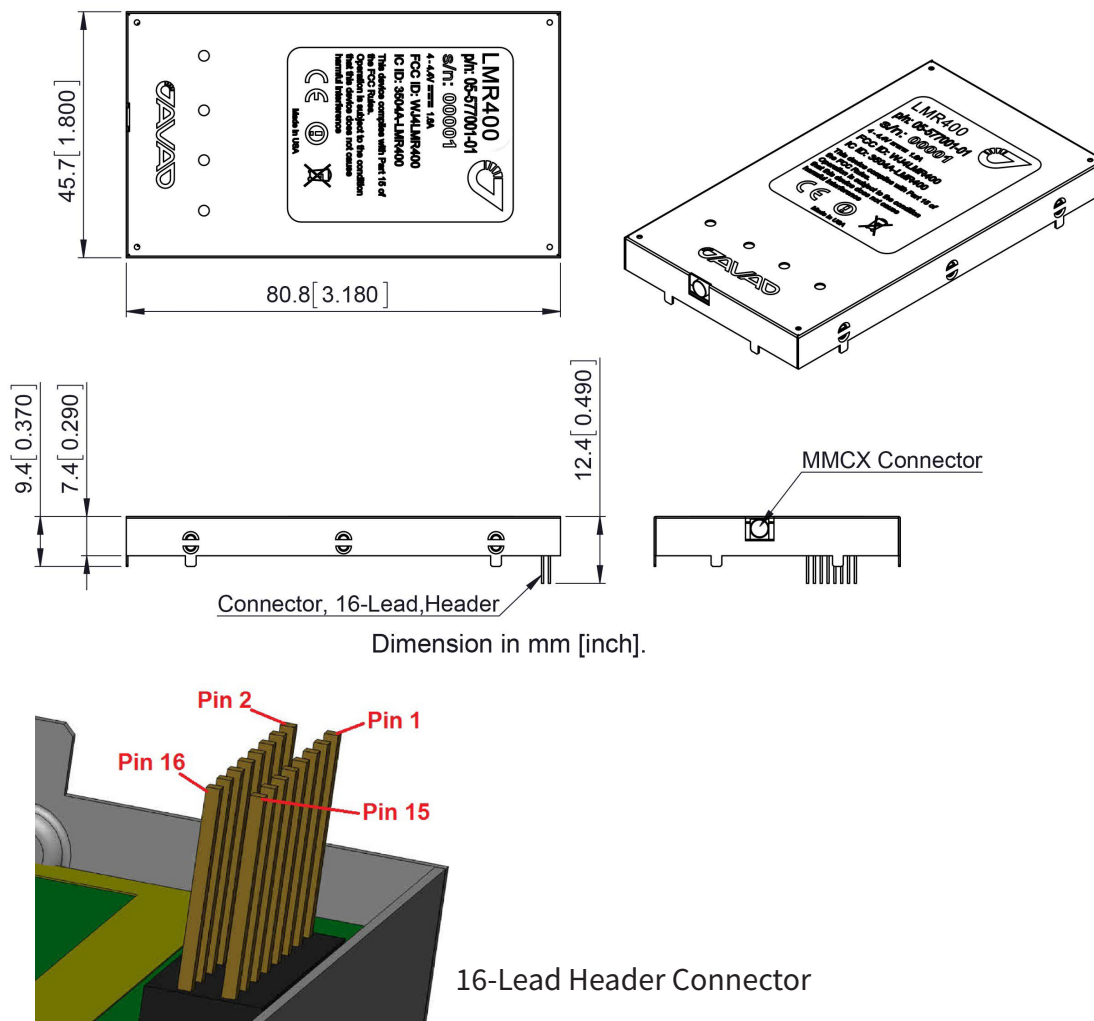
16-LEAD HEADER CONNECTOR PINOUT

PIN #	Signal Designator	Signal name	Description	I/O	Comments
1	GND	GND	Ground	-	Signal and Chassis Ground
2	DSP UART 1	TXD	Transmitted Data	TTL Input	Serial Data Input
3	DSP UART 2	RXD	Received Data	TTL Output	Output for received serial data
4	DPORT5	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)
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 the radio	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 4.2V DC from ext. Power Supply.
16	VCC36	PWR	Power Supply	External	Regulated positive 4.2V DC from ext. Power Supply.

CONNECTION

Connection to the Evaluation Kit

The LMR400 board can be connected directly to Evaluation Kit (p/n 99-571010-01) by its 16-Lead Header Connector, ECS Corp., as it shown on the figure below.
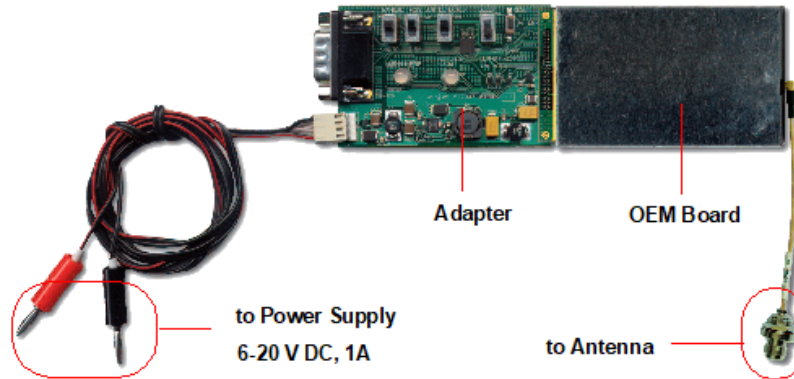
LMR400 board connected to Evaluation Kit

The LMR400 may be connected to external antenna using TNC to MMCX RA Antenna cable (included in the Kit).

Power connection

The LMR400 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 LMR400 power specifications.

Note: Evaluation Kit does not provide any over-voltage protection. Connecting Evaluation Kit to voltage exceeding particular LMR400 power voltage range may cause damage of LMR400 and Evaluation Kit board.

Note: Evaluation Kit provides reverse polarity protection only in voltages range, specified for particular LMR400.

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 below.
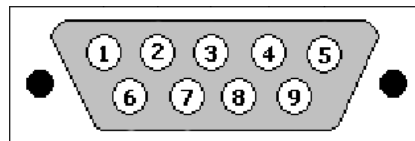
DB-9 Male connector

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

Pin	Signal Name	Dir	Description
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.

HOW TO INSTALL LMR400

Solder

Solder

Thermal Gap Filler required
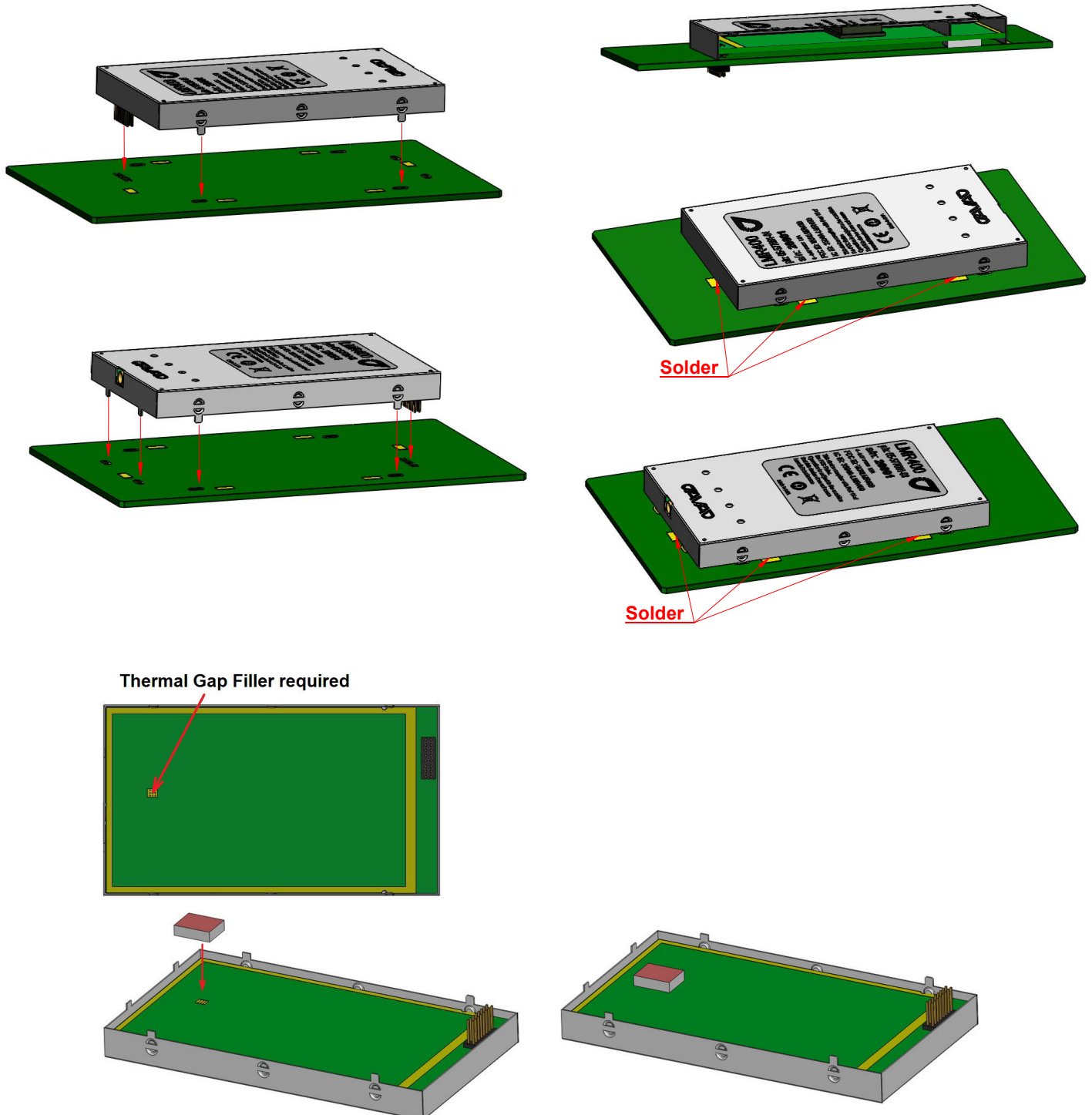
COMMAND LINE INTERFACE

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.

Command Line Interface Convention

The following convention is implemented in LMR400 Command Line Interface (CLI):

- The Carriage Return/Line Feed (CR/LF, 0x0D/0x0A) is a command delimiter.
- 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 3-1 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.

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.
0x05	Unspecified Error

Software Switching to Command Mode

On power-up the radio modem is in data-mode. To switch to command 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 Command mode and vice versa.

Happy Flow

- In data-mode the unit starts looking for the Escape-sequence if there is no data from DTE (Data Terminal Equipment) for more than 20 ms (Start Guard Time).
- 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.
- 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.
- The unit goes to command 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.)

Hardware Switching to Command Mode

As alternative to Software Switching, the switching through the MP/DP (Data Terminal Ready, DTR) control line can be used. To set Command Mode, the DTE must assert DTR signal active and then passive. By falling edge of DTR signal the unit goes to command mode and then sends Escape- Acknowledge to DTE ("@00<CR><LF>").

20 ms toggling on CTS control line needed to acknowledge switching from Data to Command mode and vice versa.

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

Switching to Data Mode

- DTE sends the CLI command "DATA-MODE<CR><LF>" to the unit.
- Unit answers with Escape-Acknowledge („@00<CR><LF>") and immediately goes to data-mode, 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.

CONNECT

To connect the radio unit through the local main-

Networking Commands

tenance 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 :

Unit	Serial Number	Connect
BS	003578659922	
1	003574459923	C

To disconnect from the remote unit and connect to

the local unit, the parameter (Unit_Numb) must be equal to 0x00.

LINK

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

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

Parameter Name	Parameter List
CHAN	1Selects 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
FEC	0 – Disable Forward Error Correction, a default setting (see note below) 1 – Enable Forward Error Correction (see note below)
FHOP	(1 – 32) – Frequency Hoping Pattern number LINK FHOP command can be processed only if the Channel Map (up to 32 channels) is defined by AWLaunch or by MAP command.
MOD	1 – DBPSK 2 – DQPSK, a default settings 3 – D8PSK 4 – D16QAM 5 – GMSK 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
PROT	1 – "Simplex Receiver" a default setting (see note below) 2 – "Simplex Transmitter" 3 – "Half Duplex" Base (reserved) 4 – "Half Duplex" Repeater (reserved) 5 – Not used 6 – Not used 7 – "TRMB Receiver" (used with GMSK modulation) 8 – "TRMB Transmitter" (used with GMSK modulation) 9 – "Transparent w/EOT" Repeater (used with GMSK and 4FSK) 10 – "Repeater" (ArWest Proprietary Simplex) 11 – "TRMB Repeater" (used with GMSK modulation) 12 – "Transparent w/EOT" Receiver (used with GMSK and 4FSK) 13 – "Transparent w/EOT" Transmitter (used with GMSK and 4FSK) 14 – "STL Receiver" (used with 4FSK modulation) 15 – "STL Transmitter" (used with 4FSK modulation) 16 - Not used 17 - "Fast Async" Receiver (used with GMSK and 4FSK) 18 - "Fast Async" 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)

Parameter Name	Parameter List
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) 1 – 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.
ADDR	Indicates the number of address bytes of "STL" protocol's data frame.
CLKCORR	0 – Disables Clock Correction algorithm of STL protocol 1- Enables Clock Correction algorithm of STL protocol.

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). The frequency defined by CHAN parameter is not valid if Frequency Hoping mode is selected. The radio link with GMSK and 4FSK modulations are used by Non-ArWest protocols only. Enabling FEC via LINK FEC command provides different options for different protocols:

- Enables Read-Solomon encoding for frame's header used by ArWest proprietary protocols
- Enables Hamming encoding for Trimble and Pacific Crest compatible protocols
- Enables Trellis encoding for Satel compatible protocol For JAVAD GNSSproprietary protocols, the Read-Solomon FEC encoding is always applied to data payload.
- "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.

Serial Interfacing Commands

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, a default setting 1 – Not used 2 – HW (RTS/CTS)

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 GNSSradio modem's does not support data flow and parity on the maintenance serial port.

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

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

Special Commands

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

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.

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
```

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.

SLEEP

The SLEEP command determines the sleep mode parameters. The sleeping LMR400 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

Diagnostics and Identification Commands

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 version in numeric "Major. Minor" format
SW	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	Ver. 1.0 Rev. A – displays BootLoader'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

The INFO command without Parameter Name indicates all values:

```
LMR400 UHF Radio Modem.
Product ID = 33
S/N = 000000 020303
Hardware = Ver. 1.0
Software = Ver. 1.8 Rev. 14
BootLoader = Ver. 2.0 Rev. 02
```

STATE

The STATE command is used to check the state of the wireless link, the unit in the link, and the alarm control lines.

```
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	406.000000 to 470.000000 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
SYNC	1 – Indicates the established link, 0 – if link is not established yet
MODE	AUTO – Indicates Automatic scanning mode FHOP – Indicates Frequency hopping mode FIXED – Indicates that the radio modem is working on fixed channel from channel map.

The STATE command without Parameter Name indicates all values:

```
TTL_IN1 = 0
TTL_IN2 = 1
RSSI = -110 dBm
BER = < 2.3E-5
FREQ = 140.000000 MHz
CHAN = 10
TEMP = 70C
SYNC = 1

MODE = FIXED
```

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

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.

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 AW400TX SHOULD NEVER BE USED IN DANGEROUS ENVIRONMENTS.

UHF RADIO USAGE

Many countries require a license for radio users (such as the United States). Be sure you comply with all local laws while operating a UHF radio.

The quality and strength of the UHF signals translates into range for UHF 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.

If needed, use a scanner to find clear channels for communication.

Warranty terms

JAVAD GNSS Inc. ("Company") warrants, to the end-user only, that the Narrow Band Radio Modems ("Radios") purchased (a) conforms to the Company's published specifications for the model purchased, and (b) is free from defects in material or workmanship.

The duration of this warranty is twelve (12) months from date of purchase and any claim for breach of warranty must be brought to the Company's attention within such twelve (12) month period and the Receiver must be returned for action on any such claim within twelve (12) months

from the date of purchase. Within a reasonable period of time after a claim, the Company will correct any failure of the Radio to conform to specifications or any defect in materials or workmanship, or replace the Radio, or, at its option, provide a full refund of the purchase price. A repaired or replaced product is warranted for 90 days from the date of return shipment to the buyer, or for the balance of the original warranty period, whichever is longer. These remedies are the buyer's exclusive remedies for breach of warranty.

To obtain warranty service, the buyer must return the Radio, postage-paid, with proof of the date of original purchase and the buyer's return address to the Company or an authorized service center. The Company will not be responsible for any loss or damage to the product incurred while it is in transit or is being shipped for repair. It is the buyer's responsibility to arrange for insurance, if the buyer so desires.

The Company does not warrant (a) any product, components or parts not manufactured by the Company, (b) defects caused by failure to provide a suitable installation environment for the Radio, (c) damage caused by disasters such as fire, flood, wind, and lightning, (e) damage caused by unauthorized attachments or modification, (f) damage during shipment, (g) any other abuse or misuse by the buyer, (h) that the Radio will be free from any claim for infringement of any patent, trademark, copyright or other proprietary right, including trade secrets.

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IN NO CASE SHALL THE COMPANY BE LIABLE FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES ARISING DIRECTLY OR INDIRECTLY OUT OF THE OWNERSHIP, USE OR OPERATION OF THE RADIO REGARDLESS OF WHETHER SUCH DAMAGES ARE PREDICATED OR BASED UPON BREACH OF WARRANTY, BREACH OF CONTRACT, NEGLIGENCE, STRICT TORT, OR ANY OTHER LEGAL THEORY. SUCH DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, LOSS OF PROFITS, LOSS OF SAVINGS OR REVENUE, LOSS OF USE OF THE RADIO OR ANY ASSOCIATED EQUIPMENT, COST OF CAPITAL, COST OF ANY SUBSTITUTE EQUIPMENT, FACILITIES OR SERVICES, THE CLAIMS OF THIRD PARTIES, INCLUDING CUSTOMERS AND INJURY TO PROPERTY. THIS LIMITATION DOES NOT APPLY TO CLAIMS FOR PERSONAL INJURY. SOME STATES DO NOT ALLOW LIMITS ON WARRANTIES, OR ON REMEDIES FOR BREACH IN CERTAIN TRANSACTIONS. IN SUCH STATES, THE LIMITS IN THIS PARAGRAPH AND THE PRECEDING PARAGRAPH MAY NOT APPLY.

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with a hardware device

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