ELPRO Technologies

Read and Retain for Future Reference

Cooper Bussmann

E2-450 Radio Module Instruction Manual

Version 1.1

COOPER Bussmann

ATTENTION!

Incorrect termination of the supply wires may cause internal damage. Before turning the power on double-check ALL connections by referring to this User Manual.

CAUTION

To comply with FCC RF Exposure requirements in section 1.1310 of the FCC Rules, antennas used with this device must be installed to provide a separation distance of at least 20 cm from all persons to satisfy RF exposure compliance.

DO NOT

- Operate the transmitter when anyone is within 20 cm of the antenna.
- Operate the transmitter unless all RF connectors are secure and any open connectors are properly terminated.
- Operate the equipment near electrical blasting caps or in an explosive atmosphere.

All equipment must be properly grounded for safe operations. All equipment should be serviced only by a qualified ELPRO staff only.

FCC Notice:

- Part 15 – This device has been tested and found to comply with the limits for a Class B digital device, pursuant to Part15 of the FCC rules (Code of Federal Regulations 47CFR Part 15). Operation is subject to the condition that this device does not cause harmful interference.
- Part 90 – This device has been type accepted for operation by the FCC in accordance with Part90 of the FCC rules (47CFR Part 90). See the label on the unit for the specific FCC ID and any other certification designations.

⚠ **Note: This device should only be connected to Devices that are covered by either a FCC DoC or are FCC certified.**

Antenna Models:

Manufacturer	Model Number	Coax Kit	Net
ELPRO	UDP400-3	Includes 3m Cellfoil	1dB Gain
ELPRO	UDP400-5	Includes 5m Cellfoil	Unity Gain
ELPRO	BU-3/400	CC10/450	2.5dB Gain
ELPRO	BU-6/400	CC10/450	5.5dB Gain
ELPRO	YU3/400	CC10/450	3.5dB Loss
ELPRO	YU6/400	CC10/450	6.5dB Gain
ELPRO	YU9/400	CC20/450	5dB Gain
ELPRO	YU16/400	CC20/450	10dB Gain

Safety Notices:

Exposure to RF energy is an important safety consideration. The FCC has adopted a safety standard for human exposure to radio frequency electromagnetic energy emitted by FCC regulated equipment as a result of its actions in Docket 93-62 and OET Bulletin 65 Edition 97-01.

Limitations and Condition of Use:

ELPRO E2-450 radio module is designed as a reusable module for use with future development of ELPRO products. The module is limited for use by ELPRO only. This module is not to be made available for third party use or in any OEM arrangements.

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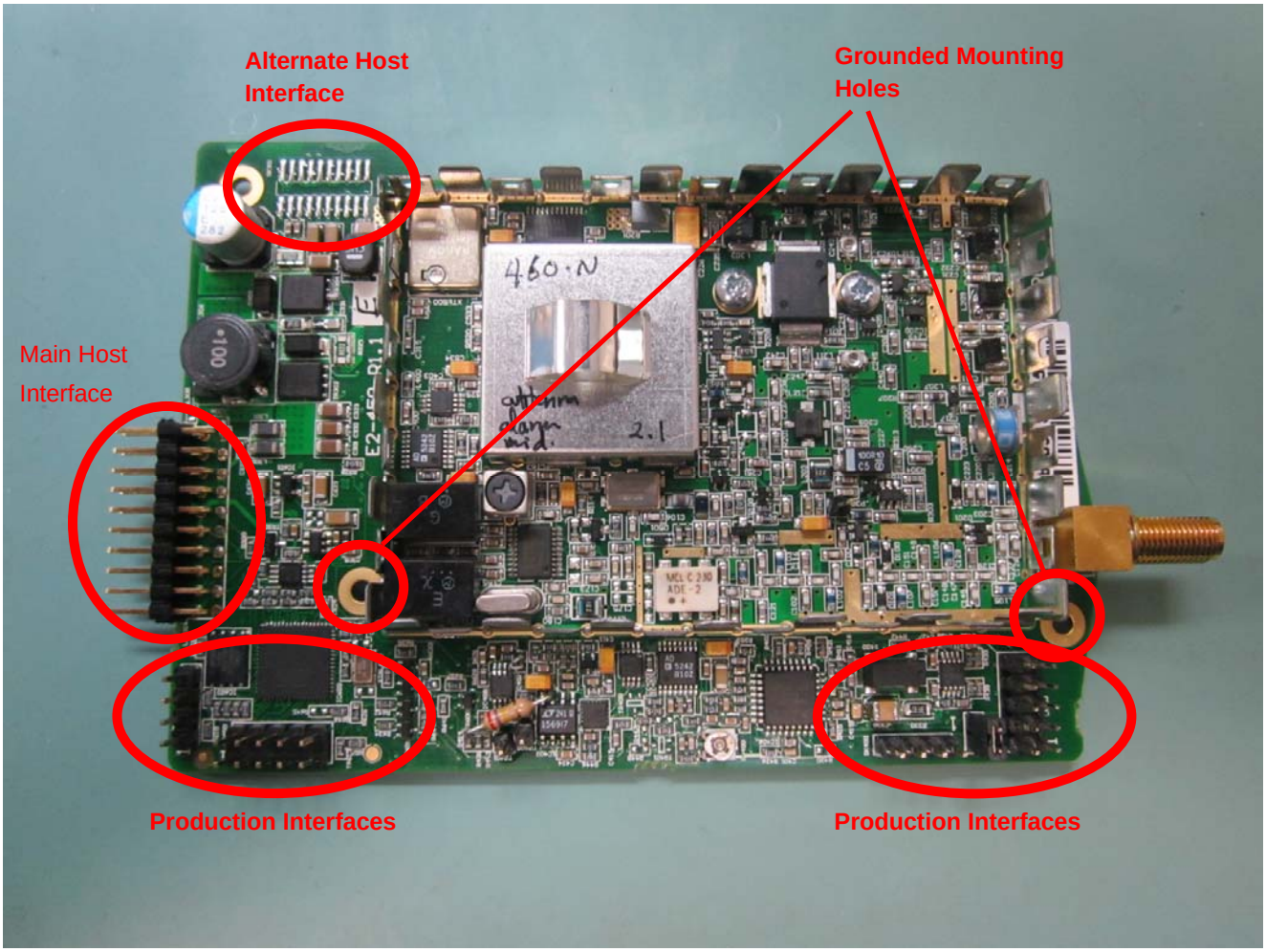
CHAPTER 1 - INTRODUCTION

The E2-450 is a radio modem module that will be used as a base radio for a number of Elpro wireless products in the future. It will be primarily used to act as a wireless network adapter for transfer of 802.11 data frames over lower speed wireless links. The E2-450 consists of a radio microcontroller and a host microcontroller, an RF transceiver section, and a power supply section.

CHAPTER 2 - Module Description



2.0 Main Host Interface

The main host interface is delivered through a 20 pin standard right angle pin header connector indicated in the picture above. The pin description will be described in chapter 4. This interface provides power supply to the module. This interface also provides a serial interface to the module where data can be supplied to be transmitted and received through.

2.1 Alternate Host Interface

The alternate host interface port provides similar signals to the main host interface. This port may be used for future development.

2.2 Production Interfaces

The production interfaces consists of JTAG ports and serial interfaces directly to microcontrollers. These interfaces are used in production and development only.

CHAPTER 3 - OPERATION

The host system communicates with the E2-450 module via the serial interface provided by the main host interface. The serial interface is a standard TTL UART interface in full duplex asynchronous connection. The baud rate is 1.0Mbps. RTS and CTS lines are used to provide flow control between the host and radio processors.

The serial protocol is a proprietary message structure.

Message Framing

Message framing is based on PPP Byte stuffing. The special characters 0x7F, 0x7D and 0xFF are the beginning of a frame, data link escape and end of frame characters respectively.

Each message begins with the transmission of the start of frame character. This is followed by the message data payload for the message end of the message is indicated by the end of frame character.

Occurrence of the characters for start of frame, end of frame, or the data link escape character within the data packet is indicated by stuffing an additional data link escape character into the data stream before the special character and then setting bit 5 of the control character to 0.

Whenever the start flag character is detected, the framer state is reset to receiving the first data payload byte. (Start flag should never occur in the data payload due to the escaping scheme above.)

The end of frame character ensures that the transmitter and receiver are synchronised at the beginning of the next data frame. If they are not correctly synchronised, the 0xFF will result in the additional “ones” being detected as a long stop condition at the receiver and subsequent characters being correctly synchronised.

Message Format

Endian

All multi-byte fields are transmitted in little endian format.

General Message Format

Table 1 describes the general format of the messages including the start and end flags.

START_FLAG	1 byte	Start of message identifier (0x7E)
Service_code	2 bytes	Service code to identify message type and message ID
Payload Data	0-n bytes	Message payload data. Interpreted according to Service code
END_FLAG	1 byte	End of message identifier (0xFF)

Table 1: General message format

Service code encoding

Table 2 describes the encoding of the Service code field from the Service Type and Service ID

b15 - b14	**Service Type** 00: request 01: indicate 10: confirm 11: unused
b13 - b0	**Service ID** 0x41: Transmit 0x42: Flush 0x43: Receive 0x44: Local_Management 0x45: Extended Transmit 0x46: Extended Flush 0x47: Extended Receive

Table 2: Service code encoding

Service types

Table 3 describes the service types and their interactions.

Request (0b00)	Request messages are used where a message acknowledgement is required. A confirm message is expected to be sent from the other party. Matching of request and confirm messages depends on the message ID. Messages may include a unique handle to that can used to match request to confirm, or the process transmitting the message can ensure that only one message of that type is outstanding at any time.
Indicate (0b01)	Used when acknowledgement of the message is not required. Indicate messages do not have any matching confirm message.
Confirm (0b10)	Confirm messages are returned to the process that initiated a Request message to acknowledge receipt of the request message (and possible acknowledge processing of the request message is complete). Generation of the Confirm message and the details of any payload data depend on the Service ID for the message. The Service ID for the confirm must match the service ID for the original request message.

Table 3: Service types

For more detailed information about the protocol, refer to ELPRO document; spec_E2-Radio-io-protocol_V2-5.doc.

CHAPTER 4 - Locale

The E2-450 radio is designed to operate in frequency bands as listed below.

Model (X is W for 25kHz bandwidth, N for 12.5kHz)	Supported Frequency Band
E2-450-WR-P5W-F370-X	360-390 MHz
E2-450-WR-P5W-F390-X	380-400 MHz
E2-450-WR-P5W-F410-X	400-420 MHz
E2-450-WR-P5W-F430-X	420-440 MHz
E2-450-WR-P5W-F440-X	430-450 MHz
E2-450-WR-P5W-F460-X	450-470 MHz
E2-450-WR-P5W-F480-X	470-490 MHz
E2-450-WR-P5W-F500-X	490-512 MHz

The host software shall implement Locale settings to restrict the range of frequencies and power relevant to the regulations of the specified locale. The user manual of the product shall state that the unit is to be installed by professional personnel.

4.0 United States

The following restrictions on each of the bands apply when US Locale is selected.

Model (X is W for 25kHz bandwidth, N for 12.5kHz)	Supported Frequency Band
E2-450-WR-P5W-F370-X	Not available
E2-450-WR-P5W-F390-X	Not available
E2-450-WR-P5W-F410-X	Not available
E2-450-WR-P5W-F430-N	421.00625-440Mhz
E2-450-WR-P5W-F430-W	412.0125-440MHz
E2-450-WR-P5W-F440-X	430-450 MHz
E2-450-WR-P5W-F460-X	450-470 MHz
E2-450-WR-P5W-F480-X	470-490 MHz
E2-450-WR-P5W-F500-X	490-512 MHz

CHAPTER 5 - Interface Pin Description

5.0 Main Host Interface Pin Description

Pin	Signal	Description	Direction
1	GND	Ground	
2	5V_RADIO	5V supply rail supplied by host	Input to module
3	GND	Ground	
4	5V_RADIO	5V supply rail supplied by host	Input to module
5	GND	Ground	
6	VSUP_CON	Main DC input power supply rail of the host (9-30V)	Input to module
7	GND	Ground	
8	VSUP_CON	Main DC input power supply rail of the host (9-30V)	Input to module
9	3.3V_RADIO	3.3V supply rail supplied by host	Input to module
10	CTS0_7	Clear to send (When toggled, it indicates that the host should wake up.)	Output from module
11	3.3V_RADIO	3.3V supply rail supplied by host	Input to module
12	RTS0_7	Ready to Send (When toggled, it indicates that the radio processor should wake up.)	Input to module
13	BRX	Not used	
14	TXD0_7	Data Transmit	Input to module
15	BTX	Not used	
16	RXD0_7	Data Receive	Output from module
17	_SHDN	Radio Shutdown	Input to module
18	AUX1	Not used	
19	nR_OC	Over Current	Output from module
20	GND	Ground	

5.1 Alternate Host Interface Pin Description

Pin	Signal	Description	Direction
1	VSupply	13.8V regulated supply from host	Input to module
2	GND	Ground	
3	VSupply	13.8V regulated supply from host	Input to module
4	GND	Ground	
5	5V_CON	5V regulated supply from host	Input to module
6	GND	Ground	
7	5V_CON	5V regulated supply from host	Input to module
8	GND	Ground	
9	5V_CON	5V regulated supply from host	Input to module
10	nR_OC	Over Current	Output from module
11	3.3V_CON	3.3V supply rail supplied by host	Input to module
12	nEN_RADIO_PWR	Radio Power Enable	Input to module
13	3.3V_CON	3.3V supply rail supplied by host	Input to module
14	TXD0_7	Data Transmit	Input to module
15	RXD0_7	Data Receive	Output from module
16	RTS0_7	Ready to Send (When toggled, it indicates that the radio processor should wake up.)	Input to module
17	CTS0_7	Clear to Send (When toggled, it indicates that the host should wake up.)	Output from module
18	N.C	Not connected	
19	N.C	Not connected	
20	Test Point	Not used	

5.2

5.3 Protective Earthing Point

There are four mounting screw points around the cage which are connected to the ground plane of the module. These should be screwed on with metallic screws to the metallic casing or ground points on the host system.

CHAPTER 6 - SPECIFICATIONS

	Transmitter/Receiver
Frequency	360-512MHz (8 x 20MHz bands)
Transmit Power	Licensed - 5 Watt (+37dBm), Unlicensed – 0.5Watt (+27dBm)
Data Encoding	2-FSK, 4-FSK
Receiver Sensitivity	25 KHz channel : -99dBm @19,200 bps (4FSK), -110dBm @ 9600 bps (2FSK) 12.5 KHz channel : -100dBm @9600 bps (4FSK), -111dBm @ 4800 bps (2FSK)
Channel Bandwidths	25 KHz channel 12.5 KHz channel
Data Rate	25 KHz channel : 4800 bps, 9600 bps 12.5 KHz channel : 9600 bps, 19,200 bps
Range, Line of Site (LoS)	50Km (31mi.) @ 5Watts 20Km (12mi.) @ 0.5Watts
Antenna Connector	Female SMA Standard Polarity
Supply Voltage	5V, 3V, 9-30V (VSUP_CON)
Operating Temperature	-30 to 60 C
Humidity	0-99% RH Non-Condensing