



415U-IAS Intelligent Antenna Switch User Manual

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Introduction

The ELPRO 415U-IAS provides a way to operate two radio telemetry systems side by side using existing infrastructure. The primary use-case is when an existing system is being incrementally upgraded to ELPRO 415U radio hardware. The 415U-IAS automatically switches the base station antenna between a legacy base station radio and the upgraded base station radio as needed to communicate with a mix of legacy and upgraded radios in the field.

The 415U-IAS switch module is used in conjunction with an ELPRO 415U-BSR (Base Station and Repeater) which monitors the polling requests sent to the remote field stations and instructs the switch module to connect the required base station radio (Legacy or 415U-BSR) to the antenna. Responses from field stations are monitored, and the switch will alternate between the two systems when it doesn't see a valid response from a field site. This allows incremental upgrades of field sites without a need to make configuration changes when field sites are switched from the legacy system to the new 415U system.

System Design

The 415U-IAS is designed to be installed with an existing legacy system. The 415U-BSR monitors MODBUS messages sent from a central SCADA computer and monitors MODBUS responses from field sites. The system can use either RS-232 serial communications or it can communicate over TCP-IP link.

The legacy system must use MODBUS protocol, and the radio network must be a polling-only system (No background communications between the legacy base station and legacy field sites).

The process for system upgrade is:

- 1) Install the 415U-IAS and 415U-BSR at the base station
- 2) Connect to the SCADA computer and the Legacy Base Radio
- 3) Ensure the Legacy system is operating correctly, with all existing sites remaining operational. The 415U-IAS will switch to the Alternate port each time a message is sent to a Legacy site.
- 4) Begin upgrading Legacy radios with new ELPRO 415U series radios. As each site is upgraded, the Base station should detect the change, and the 415U-IAS should switch to the Primary port when polling the ELPRO 415U series radios.

Redundancy

Some systems require a level of redundancy to support increased reliability. Once the system upgrade is complete, the ELPRO 415U system provides hot standby redundancy. During the system upgrade, the 415U-BSR is set up for cold standby. Only one of the two radios in the 415U-BSR is powered at any time. The two RF Switches on the 415U-IAS operate together. To switch to the standby 415U-BSR radio, switch the connections on the rear panel from the "Repeater 1" connections to the corresponding "Repeater 2" connections.

If a redundant system is being implemented, then connect both RF Switches on the 415U-IAS. If redundancy is not to be implemented, then only connect to RF Switch 1. Refer to the install guide for a detailed diagram for connecting redundant systems.

Connection to the SCADA computer

Most existing systems will be using an RS-232 serial connection between the SCADA computer and the Legacy base radio. The 415U-IAS allows either RS-232 communications or communication over a TCP-IP stream.

To connect to the SCADA computer using RS-232 serial, connect to the DB-25 female connector marked "SCADA Computer" on the front of the 415U-IAS unit. Data to and from the SCADA computer is transferred to the 415U-BSR RS-485 serial port. Ensure the data rate and character format on the 415U-BSR RS-485 serial port match the data rate of the SCADA computer (See "SCADA Computer RS-232 Serial connection" on page 4 below).

To connect to the SCADA computer using TCP-IP stream, connect the Ethernet cable to the ethernet port on the 415U-BSR (See "Multicast Pipe Manager Configuration" on page 4 below).

Connection to the Legacy Base Radio

Connect the Legacy Base Radio to the DB-25 Male plug on the front of the 415U-IAS marked "Legacy Radio". When the Legacy radio is a DB-25 Female (DCE), you can connect using a standard DB-25 extension cable. When the Legacy radio is turned on and the connection is made, the yellow LED marked "ACT" will come on and will flicker with traffic between the 415U-IAS and the Legacy Radio.

Messages to and from the legacy radio are sent and received on the 415U-2 BSR RS-232 serial port. Ensure the data rate on the 415U-BSR RS-232 serial port to match the data rate of the Legacy Base Radio (See "MODBUS Migration Router configuration" on page 3 below).

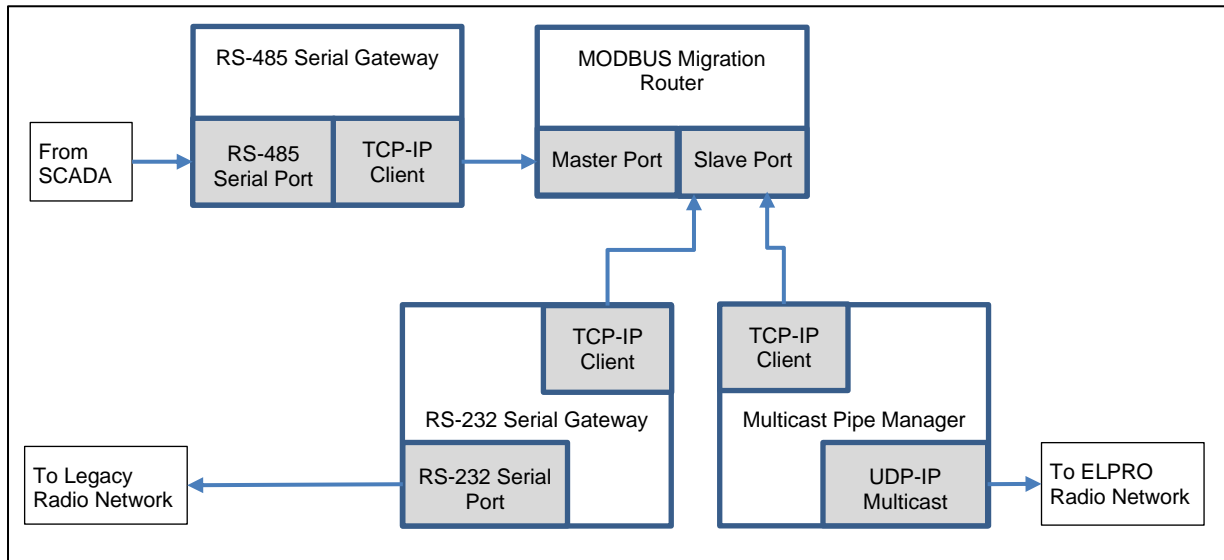
Configuration

This section covers the configuration required on the 415U-BSR and the Remote sites for a system update with the 415U-IAS.

415U-BSR (Base Station and Repeater) Configuration

The 415U-BSR controls the 415U-IAS switching between Primary and Alternate ports, and transfers data messages from the SCADA computer to the Legacy base radio and to the ELPRO 415U radio network. This section describes how to configure the 415U-BSR that relate to the 415U-IAS operation. Refer to the separate user manual for the 415U-BSR for other configuration items. Refer to *Figure 1-415U-BSR Functional Elements* below to see how the four configuration elements are related.

Figure 1- 415U-BSR Functional Elements



The configuration items for the operation of the 415U-IAS are on the Serial configuration page. Select “Full Configuration” under “Advanced” on the right-side menu, then select “Serial” under “Configuration”. To set up for 415U-IAS operation, configure the RS-232 serial port, the RS-485 serial port, the MODBUS Migration Router and the Multicast Pipe Manager.

MODBUS Migration Router configuration

The Modbus Migration Router receives Modbus polls from the SCADA computer, and forwards these messages to either the ELPRO 415U radio network (via the Multicast Pipe Manage) or the Legacy radio network (via the RS-232 Serial Gateway). First check “Enabled” to enable the configuration, then select the Master Port and Slave Port.

Master Port The port used for the connection to the SCADA computer

Slave Port The port used for the connection to the radio networks.

Max failed polls The number of times a remote site will fail to respond before the Migration router switches to the alternate port for that slave.

Main Port Dwell Time The minimum amount of time the switch will remain on the Primary position

Main Port Tail Time The amount of time the switch will remain on the Primary position after completing message transmission on that Port

Aux Port Tail Time The amount of time the switch will remain on the Alternate position after completing message transmission on that Port

Modbus Migration Router:

Enabled	<input checked="" type="checkbox"/>
Master Port	<input type="text" value="6001"/>
Slave Port	<input type="text" value="6002"/>
Max Failed Polls	<input type="text" value="2"/>
Main Port Dwell Time	<input type="text" value="500"/> milliseconds
Main Port Tail Time	<input type="text" value="750"/> milliseconds
Aux Port Tail Time	<input type="text" value="50"/> milliseconds

SCADA Computer RS-232 Serial connection

When the connection to the SCADA computer is via RS-232 serial, the SCADA computer connection is through the 415U-IAS and via the RS-485 connection on the 415U-BSR. Configure the 415U-BSR RS-485 serial port to match the SCADA computer serial connection. Configure RS-485 Port Type to "Serial Gateway". Set the data rate and data format to match the configuration for the SCADA computer. Set Serial Gateway Mode to "TCP Client". Set the Remote Device IP Address to 127.0.0.1 to address the local unit. Set the Remote Device Port match the Master port on the Modbus Migration Router.

Multicast Pipe Manager Configuration

The Multicast Pipe Manager provides the connection to the ELPRO 415U radio network. Set the network mode to Client. Set the Remote Device IP Address to 127.0.0.1 to address the local unit. Set the Remote Device Port to match the Slave Port on the Modbus Migration Router. Set the Multicast Group IP Address and Port to match the configuration for the ELPRO 415U Radio network. Multicast Group IP Addresses are in the range 224.0.1.1 through 239.255.255.255. Select "Disable AP Bridge" to reduce radio traffic.

Legacy Base Radio Connection

The Legacy Base Radio serial port connects to the RS-232 serial port on the 415U-BSR through the 415U-IAS. Configure the 415U-BSR RS-232 serial port to match the Legacy Base Radio serial port configuration. Configure RS-232 Port Type to "Serial Gateway". Set the data rate and data format to match the configuration for the Legacy Base Radio. Set Serial Gateway Mode to "TCP Client". Set the Remote Device IP Address to 127.0.0.1 to address the local unit. Set the Remote Device Port match the Slave port on the Modbus Migration Router.

SCADA Computer TCP-IP Ethernet connection

When the connection to the SCADA computer is via Ethernet connection (TCP-IP), configure the 415U-BSR Networking to allow the connection by disabling the RS-485 port.

Configure the SCADA computer connection to connect to the IP address of the 415U-BSR (Network Configuration Page) and to connect to the Master port on the Modbus Migration Router.

Network Configuration

IP Address	192.168.9.227
Subnet Mask	255.255.255.0

RS-485 Serial Port Configuration:

RS-485 Port Type	Serial Gateway
Data Rate	9600
Data Format	8N1

RS-485 Serial Gateway:

Serial Gateway Mode	TCP Client
Character Timeout (msec)	50
Packet Size (bytes)	500
Remote Device Port	6001
Remote Device IP Address	127.0.0.1

Multicast Pipe Manager:

Enabled	<input checked="" type="checkbox"/>
Network Mode	Client
Server IP Address	127.0.0.1
TCP Port	6002
Multicast Group IP Address	224.0.1.1
Multicast Group Port	5004
Disable AP Bridge	<input checked="" type="checkbox"/> ?

RS-232 Serial Port Configuration:

RS-232 Port Type	Serial Gateway
Data Rate	9600
Data Format	8N1
Flow Control	None

RS-232 Serial Gateway:

Serial Gateway Mode	TCP Client
Character Timeout (msec)	50
Packet Size (bytes)	500
Remote Device Port	6002
Remote Device IP Address	127.0.0.1

RS-485 Serial Port Configuration:

RS-485 Port Type	None
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Modbus Migration Router:

Enabled	<input checked="" type="checkbox"/>
Master Port	6001
Slave Port	6002

415U-E and 415U-C Field Station Configuration

The field station units must be configured to allow MODBUS communication from the connected device back to the Multicast Pipe Manager active in the 415U-BSR. Configure the RS-232 or RS-485 port as described below to communicate with the connected device on the corresponding port.

Field Station Serial Connection

This example shows configuration for RS-485 serial. The steps are identical for RS-232.

Configure Port Type to “Serial Gateway”. Set the data rate and data format to match the connected MODBUS device. Set Serial Gateway Mode to “UDP Multicast”. Set the Multicast Group IP address and Port to match the Multicast Group settings in the 415U-BSR (see Multicast Pipe Manager Configuration on page 4). Character timeout and Packets Size will normally operate correctly with the default values. See the 414U-2, 415U-E User manual for more detail on setting these items.

RS-485 Serial Port Configuration:

RS-485 Port Type	<input type="text" value="Serial Gateway"/>
Data Rate	<input type="text" value="9600"/>
Data Format	<input type="text" value="8N1"/>

RS-485 Serial Gateway:

Serial Gateway Mode	<input type="text" value="UDP Multicast"/>
Character Timeout (msec)	<input type="text" value="50"/>
Packet Size (bytes)	<input type="text" value="500"/>
Multicast Group Port	<input type="text" value="5004"/>
Multicast Group IP Address	<input type="text" value="224.0.1.1"/>

Diagnostics

LED indication on 415U-IAS

The 415U-IAS unit provides LEDs to indicate the status of the unit.

LED	Colour	Function
Power	Green	Indicates power connected to the 415U-IAS unit
Alternate	Green	Indicates the RF switch (Switch1 or Switch2) is connected between ANT and Alternate ports on the rear panel. This is the connection used for the Legacy radio network.
Primary	Green	Indicates the switch (Switch1 or Switch2) is connected between ANT and Primary ports on the rear panel. This is the connection used for the ELPRO 415U radio network.
Alarm	Red	Indicates the IAS attempted to switch RF ports while the connected radio (Legacy or ELPRO 415U) was sending data through the active port. This LED should not come on unless there is a problem with the system configuration resulting in the RF switching at the wrong time.
Legacy ACT	Yellow	Indicates the Legacy radio is connected and powered on. The LED will flicker with serial data from the Legacy radio through the IAS to the BSR.
RS232 DTE ACT	Yellow	Indicates the BSR RS-232 serial is connected and the BSR is powered on. This port is used to transfer the messages for the Legacy radio network. This LED will flicker when there is serial data from the 415U-BSR through the IAS to the Legacy radio.

415U-BSR Internal Diagnostics

The 415U-BSR provides internal webpages providing a wide range of diagnostic information. This section describes the diagnostic information relating to the operation of the 415U-IAS. Additional information on operation of the 415U-BSR is described in the separate user manual for that product.

Serial Connection Statistics

Access this page by selecting Statistics under Unit Diagnostics. Scroll down to the panel "Serial Connection Statistics".

This panel provides details on the status of the connection. You can view the active field devices under "Slave Port Connections". ELPRO 415U devices are listed under "Main Port" and legacy radio network devices under "Legacy Port".

Serial Connection Statistics:

```

Modbus Routing Server 1 Statistics:
=====
Master TCP Port = 6001; Slave TCP Port = 6002;
Active Connections = 3; Lifetime Connections = 3;
TxBcastFrames=440; RxInvalidFrames=1

Master Port Connections:
=====
Active Connections = 1
1: Main Port. Connected for: 0000:00:43:14 (dddd:hh:mm:ss)
LocalPort=6001 DestPort=51553 DestIP=192.168.9.232
TxBytes=87623 RxBytes=30792
TxFrames=3408 RxFrames=3848 RxInvalid=1

Slave Port Connections:
=====
Active Connections = 2

```

Capture IP Comms

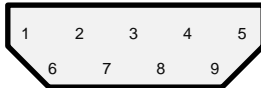
This feature is available by selecting "Capture IP Comms" under "Network Diagnostics" on the right-side menu. It provides a useful diagnostic tool to view messages between the Multicast Pipe Manager and the ELPRO radio network. These messages will have the Multicast IP address configured in "Multicast Pipe Manager Configuration" and in "Field Station Serial Connection". When the SCADA computer connection is via TCP-IP, this will also show the communication between the SCADA computer and the Modbus Migration Router (see SCADA Computer TCP-IP Ethernet connection on page 4 above).

Connection

Rear Panel Connections

This section provides a detailed reference on the 415U-IAS rear panel connections.

RS232 DTE – DB9 Male (DTE)



Pin#	Abbrev	Signal Name	Direction	Required	Notes
1	-				No Connection
2	RD	Received Data	To DTE	Yes	Receive to DTE
3	TD	Transmitted Data	From DTE	Yes	Transmit from DTE
4	DTR	Data Terminal Ready	From DTE		Loop from DSR pin 9
5	SG	Signal Ground	<->	Yes	Reference Ground for signals
6	-				No Connection
7	RTS	Request to Send	From DTE		Loop from CTS pin 8
8	CTS	Clear to Send	To DTE		Loop to RTS pin 7
9	DSR	Data Set Ready	To DTE		Control for RF Switch. Low: Primary High: Alternate Loop to DTR pin 4

RS-485 and Power – 4-way Connector 5.08mm

Pin#	Abbrev	Signal Name	Direction	Notes
1	B	RS485 "B"	Bidirectional	Negative Sense RS485 signal
2	A	RS485 "A"	Bidirectional	Positive Sense RS485 signal
3	"-"	Power Negative	Into Unit	Internal Connection to Earth
4	"+"	Power Positive	Into Unit	9 – 30VDC Power 100mA.

RF Switch 1 and RF Switch 2

Signal Name	Connection	Notes
Primary	To ELPRO 415U Base antenna connection	50Ω Maximum input 10W
Ant	To Shared System Antenna	50Ω impedance
Alternate	To Legacy Base Radio antenna connection	50Ω Maximum input 10W

Earth

This is the protection earth for the unit and should be connected to a reliable earth point, such as a building earth or external earth stake. Resistance to ground should be less than 2Ω, and must not be more than 5Ω.

Front Panel Connections

This section provides a detailed reference on the 415U-IAS front panel connections.

Scada Computer – DB25 Female - DCE



Pin#	Abbrev	Signal Name	Direction	Required	Notes
1	FG	Frame Ground	<->		Connected to Chassis Gnd
2	TD	Transmitted Data	To DCE	Yes	Transmit from DTE
3	RD	Received Data	From DCE	Yes	Receive to DTE
4	RTS	Request to Send	To DCE		Loop to CTS pin 5
5	CTS	Clear to Send	From DCE		Loop from RTS pin 4
6	DSR	Data Set Ready	From DCE		Loop from DTR pin 20
7	SG	Signal Ground	<->	Yes	Reference Ground for signals
8	DCD	Data Carrier Detect	From DCE		Loop from DTR, pin 20
9-19	-				No Connection
20	DTR	Data Terminal Ready	To DCE		Loop to DSR, DCD, Pins 6,8
21-25	-				No Connection

Legacy Radio – DB25 Male - DTE



Pin#	Abbrev	Signal Name	Direction	Required	Notes
1	FG	Frame Ground	<->		Connected to Chassis Gnd
2	TD	Transmitted Data	From DTE	Yes	Transmit from DTE
3	RD	Received Data	To DTE	Yes	Receive to DTE
4	RTS	Request to Send	From DTE		Loop from CTS pin 5
5	CTS	Clear to Send	To DTE		Loop to RTS pin 4
6	DSR	Data Set Ready	To DTE		Loop to DTR, pin 20
7	SG	Signal Ground	<->	Yes	Reference Ground for signals
8-19	-				No Connection
20	DTR	Data Terminal Ready	From DTE		Loop from DSR, pin 6
21-25	-				No Connection

Specifications – ELPRO 415U-IAS

ELPRO 415U-IAS-C1, -C4, -C9	
Power Supply	9-30VDC 100mA. Internal fuse protection.
Serial Connections	4 Serial Connections
RS232 DTE	DB9 DTE to 415U-BSR
Legacy Radio	DB-25 DTE to Legacy Base Radio
SCADA Computer	DB-25 DCE to SCADA computer
RS-485	RS-485 to 415U-BSR
RF Ports	2 Absorptive SPDT Switches.
Primary, Alternate	50 Ω Connection to radio
	10W maximum power
	50 Ω termination when disconnected from ANT
	Power detection and Protection from Switching while carrying power
	Internal Surge protection provides additional protection for surges coming from the Antenna port.
ANT	50 Ω connection to Antenna.
	Internal Surge protection. Additional Protection recommended when connected to exposed antenna.
LED Indication	Showing status for both switches including Alarm status.
RF Operating Band	
415U-IAS-C1	148-170MHz
415U-IAS-C4	400-540MHz
415U-IAS-C9	890-960MHz

References:

415U-IAS Installation Guide	inst_415U-IAS_V1.0
415U-BSR User Manual	EL-MN-415-BSR_V1.1
415U-BSR Installation Guide	EL-IL-415-BSR-R1.1
415U-2, 415U-E User Manual	415U_UserManual_v2-20