4RF

Aprisa SR

User Manual

October 2013

Version 1.6.2

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RoHS and WEEE Compliance

The Aprisa SR is fully compliant with the European Commission's RoHS (Restriction of Certain Hazardous Substances in Electrical and Electronic Equipment) and WEEE (Waste Electrical and Electronic Equipment) environmental directives.

Restriction of hazardous substances (RoHS)

The RoHS Directive prohibits the sale in the European Union of electronic equipment containing these hazardous substances: lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyls (PBBs), and polybrominated diphenyl ethers (PBDEs).

4RF has worked with its component suppliers to ensure compliance with the RoHS Directive which came into effect on the 1st July 2006.

End-of-life recycling programme (WEEE)

The WEEE Directive concerns the recovery, reuse, and recycling of electronic and electrical equipment. Under the Directive, used equipment must be marked, collected separately, and disposed of properly.

4RF has instigated a programme to manage the reuse, recycling, and recovery of waste in an environmentally safe manner using processes that comply with the WEEE Directive (EU Waste Electrical and Electronic Equipment 2002/96/EC).

4RF invites questions from customers and partners on its environmental programmes and compliance with the European Commission's Directives (sales@4RF.com).

Compliance General

The Aprisa SR digital radio predominantly operates within frequency bands that require a site license be issued by the radio regulatory authority with jurisdiction over the territory in which the equipment is being operated.

It is the responsibility of the user, before operating the equipment, to ensure that where required the appropriate license has been granted and all conditions attendant to that license have been met.

Changes or modifications not approved by the party responsible for compliance could void the user's authority to operate the equipment.

Equipment authorizations sought by 4RF are based on the Aprisa SR radio equipment being installed at a fixed restricted access location and operated in point-to-multipoint or point-to-point mode within the environmental profile defined by EN 300 019, Class 3.4. Operation outside these criteria may invalidate the authorizations and / or license conditions.

The term 'Radio' with reference to the Aprisa SR User Manual, is a generic term for one end station of a point-to-multipoint Aprisa SR network and does not confer any rights to connect to any public network or to operate the equipment within any territory.

Compliance European Telecommunications Standards Institute

The Aprisa SR radio is designed to comply with the European Telecommunications Standards Institute (ETSI) specifications as follows:

	12.5 kHz Channel	25 kHz Channel
Radio performance	EN 300 113-2	EN 302 561
EMC	EN 301 489 Parts 1 & 5	
Environmental	EN 300 019, Class 3.4	
Safety	EN 60950-1:2006	

Frequency band	**Channel size**	**Power input**	**Notified body**
136-174 MHz	12.5 kHz, 25 kHz	12 VDC	
400-470 MHz	12.5 kHz, 25 kHz	12 VDC	

Compliance Federal Communications Commission

The Aprisa SR radio is designed to comply with the Federal Communications Commission (FCC) specifications as follows:

Radio performance / EMC	47CFR part 90 Private Land Mobile Radio Services 47CFR part 15 Radio Frequency Devices
Safety	EN 60950-1:2006

Frequency band limits	Channel size	Power input	Authorization	FCC ID
406.1 to 454.0 MHz 456.0 to 470.0 MHz	12.5 kHz	12 VDC	Part 90 Certification	UIPSRN0400012A

NOTE: 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.

Compliance Industry Canada

The Aprisa SR radio is designed to comply with Industry Canada (IC) specifications as follows:

Radio performance	RSS-GEN RSS-119
EMC	This Class A digital apparatus complies with Canadian standard ICES-003. Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.
Safety	EN 60950-1:2006

Frequency band limits	Channel size	Power input	Authorization	IC ID
406.1 to 430.0 MHz 450.0 to 470.0 MHz	12.5 kHz, 25 kHz	12 VDC	RSS-119	6772A-SRN400

Compliance Hazardous Locations Notice

This product is suitable for use in Class 1, Division 2, Groups A - D hazardous locations or non-hazardous locations.

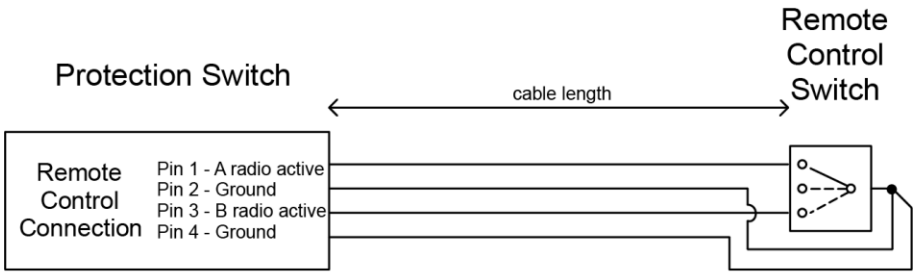
WARNING - EXPLOSION HAZARD - DO NOT REPLACE FUSE UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.

AVERTISSEMENT - RISQUE D'EXPLOSION - COUPER LE COURANT OU S'ASSURER QUE L'EMPLACEMENT EST DESIGNE NON DANGEREUX AVANT DE REPLACER LE FUSIBLE.

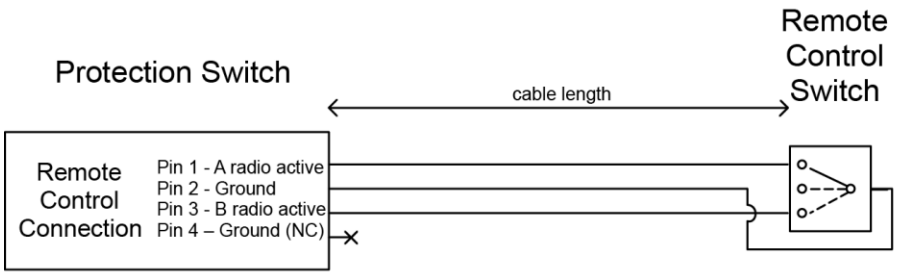
WARNING - EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.

AVERTISSEMENT - RISQUE D'EXPLOSION - AVANT DE DECONNECTER L'EQUIPEMENT, COUPER LE COURANT OU S'ASSURER QUE L'EMPLACEMENT EST DESIGNE NON DANGEREUX.

Protection switch remote control connection diagram for hazardous locations.



Vmax = 3.3 V d.c.; Imax = 1.4 A; Ca = 270 uF; La = 18 uH
Maximum cable length = 30 ft (9.1 m)



Vmax = 3.3 V d.c.; Imax = 1.4 A; Ca = 270 uF; La = 18 uH
Maximum cable length = 40 ft (12.2 m)

Title: Control Drawing
Revision: 1.0
Date: 21 May 2013

RF Exposure Warning

WARNING:

The installer and / or user of Aprisa SR radios shall ensure that a separation distance as given in the following table is maintained between the main axis of the terminal's antenna and the body of the user or nearby persons.

Minimum separation distances given are based on the maximum values of the following methodologies:

1. Maximum Permissible Exposure non-occupational limit (B or general public) of 47 CFR 1.1310 and the methodology of FCC's OST/OET Bulletin number 65.
2. Reference levels as given in Annex III, European Directive on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz) (1999/519/EC). These distances will ensure indirect compliance with the requirements of EN 50385:2002.

Frequency (MHz)	Maximum Power (dBm)	Maximum Antenna Gain (dBi)	Minimum Separation Distance (m)
136	+ 37	15	2.5
174	+ 37	15	2.5
330	+ 37	15	2.5
400	+ 37	15	2.5
470	+ 37	15	2.3

Contents

1. Getting Started

This section is an overview of the steps required to commission an Aprisa SR radio network in the field:

Phase 1:	**Pre-installation**	
1.	Confirm path planning.	Page 50
2.	Ensure that the site preparation is complete: • Power requirements • Tower requirements • Environmental considerations, for example, temperature control • Mounting space	Page 53

Phase 2:	**Installing the radios**	
1.	Mount the radio.	Page 56
2.	Connect earthing to the radio.	Page 55
3.	Confirm that the: • Antenna is mounted and visually aligned • Feeder cable is connected to the antenna • Feeder connections are tightened to recommended level • Tower earthing is complete	
4.	Install lightning protection.	Page 55
5.	Connect the coaxial jumper cable between the lightning protection and the radio antenna port.	Page 59
6.	Connect the power to the radio.	Page 60

Phase 3:	Establishing the link	
1.	If radio's IP address is not the default IP address (169.254.50.10 with a subnet mask of 255.255.0.0) and you don't know the radio's IP address see 'Command Line Interface' on page 213.	Page 213
2.	Connect the Ethernet cable between the radio's Ethernet port and the PC.	
3.	Confirm that the PC IP settings are correct for the Ethernet connection: • IP address • Subnet mask • Gateway IP address	Page 65
4.	Open a web browser and login to the radio.	Page 69
5.	Set or confirm the RF characteristics: • TX and RX frequencies • TX output power	Page 92
6.	Compare the actual RSSI to the expected RSSI value (from your path planning).	
7.	Align the antennas.	Page 219
8.	Confirm that the radio is operating correctly; the OK, DATA, CPU and RF LEDs are light green (the AUX LED will be off).	

2. Introduction

About This Manual

What It Covers

This user manual describes how to install and configure an Aprisa SR point-to-multipoint digital radio network.

It specifically documents an Aprisa SR radio running system software version 1.6.2.

It is recommended that you read the relevant sections of this manual before installing or operating the radios.

Who Should Read It

This manual has been written for professional field technicians and engineers who have an appropriate level of education and experience.

Contact Us

If you experience any difficulty installing or using Aprisa SR after reading this manual, please contact Customer Support or your local 4RF representative.

Our area representative contact details are available from our website:

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Attention	Customer Services

What's in the Box

Inside the box you will find:

- One Aprisa SR radio fitted with a power connector.
- One Aprisa SR Accessory kit containing the following:

  Aprisa SR CD
  Aprisa SR Quick Start Guide
  Management Cable

Aprisa SR Accessory Kit

The accessory kit contains the following items:

Aprisa SR Quick Start Guide	
Aprisa SR CD	
Management Cable USB Cable USB A to USB micro B, 1m	

Aprisa SR CD Contents

The Aprisa SR CD contains the following:

Software

- The latest version of the radio software (see ‘Radio Software Upgrade’ on page 222)
- USB Serial Driver
- Web browsers - Mozilla Firefox and Internet Explorer are included for your convenience
- Adobe™ Acrobat® Reader® which you need to view the PDF files on the Aprisa SR CD

Documentation

- User manual - an electronic (PDF) version for you to view online or print
- Product collateral - application overviews, product description, quick start guide, case studies, software release notes and white papers

3. About the Radio

The 4RF Aprisa SR Radio

The 4RF Aprisa SR is a point-to-multipoint digital radio providing secure narrowband wireless data connectivity for SCADA, infrastructure and telemetry applications.

The radios carry a combination of serial data and Ethernet data between the base station, repeater stations and remote stations.

A single Aprisa SR is configurable as a point-to-multipoint base station, a remote station or a repeater station.

Product Overview

Network Coverage and Capacity

In a simple point-to-multipoint network, an Aprisa SR, configured as a base station, will communicate with multiple remote units in a given coverage area. With a link range of up to 60 km, a typical deployment will have 30 – 150 remote stations operating to the base station. However, geographic features, such as hills, mountains, trees and foliage, or other path obstructions, such as buildings, tend to limit radio coverage. Additionally, geography may reduce network capacity at the edge of the network where errors may occur and require retransmission. However, the Aprisa SR uses Forward Error Correction (FEC) which greatly improves the sensitivity performance of the radio resulting in less retries and minimal reduction in capacity.

Ultimately, the overall performance of any specific network will be defined by a range of factors including the geographic location, the number of remote stations in the base station coverage area and the traffic profile across the network. Effective network design will distribute the total number of remote stations across the available base stations to ensure optimal geographic coverage and network capacity.

The following are the maximum number of remotes that can operate to a base station for the product configuration:

Configuration	Maximum Number Of Remotes
Non Protected Base Station	500
Protected Base Station	150

Remote Messaging

On start-up, the remote station transmits a registration message to the base stations which responds with a registration response. This allows the base station to record the details of all the remote stations active in the network.

If a remote station cannot register with the base station after multiple attempts (RF LED flashing red) within 10 minutes, it will automatically reboot. If a remote station has registered with the base station but then loses communication, it will automatically reboot within 6 minutes.

There are two message types in the Aprisa SR network, broadcast messages and unicast messages. Broadcast messages are transmitted by the base station to the remote stations and unicast messages are transmitted by the remote station to the base station.

All remotes within the coverage area will receive broadcast messages and pass them on to either the Ethernet or serial interface. The RTU determines if the message is intended for it and will accept it or discard it.

Only the base station can receive the unicast messages transmitted from the remote station. Unicast messages are ignored by other remote stations which may be able to receive them.

Repeater Messaging

The Aprisa SR uses a routed protocol throughout the network whereby messages contain source and destination addresses. Upon registration, the radios populate an internal neighbor table to identify the radios in the network. The remote stations will register with a base station, or a repeater, and the repeater registers with a base station. In networks with a repeater, the repeater must register with the base station before the remotes can register with the repeater.

Additionally, all messages contain a 'message type' field in the header and messages are designated as either a 'broadcast' message, originating from a base station, or a 'unicast' message, originating from a remote station.

In a network with a repeater, or multiple repeaters, the base station broadcasts a message which contains a message type, a source address and a destination address. The repeater receives the message and recognizes it is a broadcast message, from the message type and source address and re-broadcasts the message across the network. All remote stations in the coverage area will receive the message but only the radio with the destination address will act upon the message.

Similarly, the remote station will send a unicast message which contains a message type (unicast) a source address and a destination address (the base station). The repeater will receive this message; recognize the message type and source address and forward it to the destination address.

It is this methodology which prevents repeater-repeater loops. If there is repeater (A) which, in some circumstances, is able to pick up the RF signal from another repeater (B), it will not forward the message as it will only forward broadcast messages from the base station (recognized by the source address). For unicast messages the repeater (A) will recognize that the message (from repeater (B)) is not from a remote with which it has an association and similarly ignore the message.

Product Features

Functions

- Point-to-Point (PTP) or Point-to-Multipoint (PMP) operation half duplex
- Licensed frequency bands:
  VHF 136-174 MHz
  UHF 400-470 MHz
- Channel sizes:
  12.5 kHz
  25 kHz
- Typical deployment of 30 remote stations from one base station with a practical limit of a few hundred remote stations
- Transparent to all common SCADA protocols; e.g. Modbus, IEC 60870-5-101/104, DNP3 or similar
- Dual antenna port option for external duplexers or filters (half duplex operation)
- Two Ethernet data interfaces *plus* two RS-232 asynchronous data interfaces
- Terminal server operation for transporting RS-232 traffic over IP
- Data encryption and authentication
- Layer 2 Ethernet and layer 3 IP filtering
- SNMPv2 and SNMPv3 support
- Radio and user interface redundancy (provided with Aprisa SR Protected Station)
- Complies with international standards, including ETSI RF, EMC, safety and environmental standards

Performance

- Long distance operation
- High transmit power
- Low noise receiver
- Forward Error Correction
- Electronic tuning over the frequency band
- Thermal management for high power over a wide temperature range

Usability

- Configuration / diagnostics via front panel Management Port USB interface, Ethernet interface
- Built-in webserver with full configuration, diagnostics and monitoring functionality, including remote station configuration / diagnostics over the radio link
- LED display for on-site diagnostics
- Software upgrade and diagnostic reporting via the Host Port USB flash drive
- Over-the-air software distribution and upgrades
- Simple installation with integrated mounting holes for wall, DIN rail and rack shelf mounting

Architecture

Product Operation

There are three components to the wireless interface: the Physical Layer (PHY), the Data Link Layer (DLL) and the Network Layer. These three layers are required to transport data across the wireless channel in the Point-to-Multipoint (PMP) configuration. The Aprisa SR DLL is largely based on the 802.15.4 MAC layer using a proprietary implementation.

Physical Layer

The Aprisa SR PHY uses a one or two frequency ½ duplex transmission mode which eliminates the need for a duplexer. However, a Dual Antenna port option is available for separate transmit and receive antenna connection to support external duplexers or filters (half duplex operation).

Remote nodes are predominantly in receive mode with only sporadic bursts of transmit data. This reduces power consumption.

The Aprisa SR is a packet based radio. Data is sent over the wireless channel in discrete packets / frames, separated in time. The PHY demodulates data within these packets with coherent detection.

The Aprisa SR PHY provides carrier, symbol and frame synchronization predominantly through the use of preambles. This preamble prefixes all packets sent over the wireless channel which enables fast Synchronization.

Data Link Layer / MAC layer

The Aprisa SR PHY enables multiple users to be able to share a single wireless channel; however a DLL is required to manage data transport. The two key components to the DLL are channel access and hop by hop transmission.

Channel Access

The Aprisa SR radio has two modes of channel access, Access Request and Listen Before Send.

Option	Function
Access Request	Channel access scheme where the base stations controls the communication on the channel. Remotes ask for access to the channel, and the base station grants access if the channel is not occupied.
Listen Before Send	Channel access scheme where network elements listen to ensure the channel is clear, before trying to access the channel.

Access Request

This scheme is particularly suited to digital SCADA systems where all data flows through the base station. In this case it is important that the base station has contention-free access as it is involved in every transaction. The channel access scheme assigns the base station as the channel access arbitrator and therefore inherently it has contention-free access to the channel. This means that there is no possibility of contention on data originating from the base station. As all data flows to or from the base station, this significantly improves the robustness of the system.

All data messages are controlled via the AG (access grant) control message and therefore there is no possibility of contention on the actual end user data. If a remote station accesses the channel, the only contention risk is on the AR (access request) control message. These control messages are designed to be as short as possible and therefore the risk of collision of these control messages is significantly reduced. Should collisions occur these are resolved using a random back off and retry mechanism.

As the base station controls all data transactions multiple applications can be effectively handled, including a mixture of polling and report by exception.

Listen Before Send

The Listen Before Send channel access scheme is realized using Carrier Sense Multiple Access (CSMA). In this mode, a pending transmission requires the channel to be clear. This is determined by monitoring the channel for other signals for a set time prior to transmission. This results in reduced collisions and improved channel capacity.

There are still possibilities for collisions with this technique e.g. if two radios simultaneously determine the channel is clear and transmit at the same time. In this case an acknowledged transaction may be used. The transmitter requests an ACK to ensure that the transmission has been successful. If the transmitter does not receive an ACK, then random backoffs are used to reschedule the next transmission.

Hop by Hop Transmission

Hop by Hop Transmission is realized in the Aprisa SR by adding a MAC address header to the packet. For 802.15.4, there are 2 addresses, the source and destination addresses.

Network Layer

Packet Routing

Packet routing is realized in the Aprisa SR by adding a network address header to the packet. This contains source and destination addresses. For the Network Layer, there are 2 addresses, the address of the originating radio and the address of the terminating radio (i.e. end to end network). This is required for routing packets across multiple hops e.g. PMP with repeaters.

The Aprisa SR uses an automated method for performing address assignment and routing information.

There are two types of packets: unicast and broadcast. Only the base station sends broadcasts which are received by all remote stations. User packets are not interpreted as the radio link is transparent.

Traffic

- Data originating on the base station is broadcast to all repeater stations and remote stations
- Data originating on a remote station is unicast to the base station only

  This can be via multiple repeater stations.
- Data originating on a repeater station is unicast to the base station only
- Data originating on a base station serial port is terminated on remote station serial ports only
- Data originating on a base station Ethernet port is terminated on remote station Ethernet ports or serial ports (Terminal Server mode)

User Traffic

User traffic is prioritized depending on the Serial and Ethernet Data Priority options (see Traffic Settings on ‘Radio > Channel Setup’ on page 97).

If the Serial and Ethernet Data Priority options are equal, then first come first served is invoked.

Repeater stations repeat traffic also on a first come first served basis.

Management Traffic

Management Traffic is prioritized relative to user traffic priority (see Traffic Settings on ‘Radio > Channel Setup’ on page 97).

Security

The Aprisa SR provides security features to implement the key recommendations for industrial control systems. The security provided builds upon the best in class from multiple standards bodies, including:

- IEC/TR 62443 (TC65) 'Industrial Communications Networks – Network and System Security'
- IEC/TS 62351 (TC57) 'Power System Control and Associated Communications – Data and Communication Security'

The security features implemented are:

- Data encryption

  Counter Mode Encryption (CTR) using Advanced Encryption Standard (AES)

- Data authentication

  Cipher Block Chaining Message Authentication Code (CBC-MAC) using Advanced Encryption Standard (AES)

- Data payload security

  CCM Counter with CBC-MAC integrity (NIST special publication 800-38C)

- Secured management interface protects configuration
- Address filtering enables traffic source authorization
- Proprietary physical layer protocol and modified MAC layer protocol based on standardized IEEE 802.15.4
- Licensed radio spectrum protects against interference

Interfaces

Antenna Interface

Single Antenna Option

- 1 x TNC, 50 ohm, female connector

Dual Antenna Port Option

- 2 x TNC, 50 ohm, female connectors

Ethernet Interface

- 2 x ports 10/100 base-T Ethernet layer 2 switch using RJ45

  Used for Ethernet user traffic and product management.

RS-232 Interface

- 1x RS-232 asynchronous port using RJ45 connector
- 1x RS-232 asynchronous port using USB host port with USB to RS-232 converter

  Used for RS-232 asynchronous user traffic only.

USB Interfaces

- 1 x Management Port using USB micro type B connector

  Used for product configuration with the Command Line Interface (CLI).
- 1 x Host Port using USB standard type A connector

  Used for software upgrade and diagnostic reporting.

Alarms

- 2 x hardware alarm inputs on the power and alarm connector

  The alarm states can be transported over the radio link and used to generate SNMP traps.

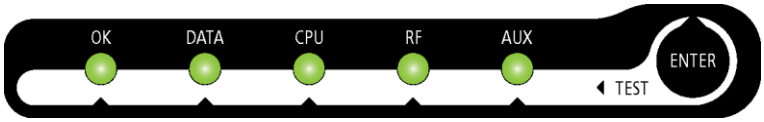
Front Panel Connections

All connections to the radio are made on the front panel. The functions of the connectors are (from left to right):

Designator	Description
A1 / A2	The A1, A2 are alarm connections are used in the Protected Station.
10 - 30 VDC; 3A	+10 to +30 VDC (negative ground) DC power input using Phoenix Contact 4 pin male screw fitting connector. AC/DC and DC/DC power supplies are available as accessories. See ‘External Power Supplies’ on page 60.
ETHERNET 1	Integrated 10Base-T/100Base-TX layer-2 Ethernet switch using RJ45 connector. Used for Ethernet user traffic and product management. See ‘Ethernet > Port Setup’ on page 108.
ETHERNET 2	Integrated 10Base-T/100Base-TX layer-2 Ethernet switch using RJ45 connector. Used for Ethernet user traffic and product management. See ‘Ethernet > Port Setup’ on page 108.
MGMT	Management Port using USB micro type B connector. Used for product configuration with the Command Line Interface. See ‘Connecting to the Management Port’ on page 213.
	Host Port using USB standard type A connector. Used for software upgrade and diagnostic reporting. See ‘Radio Software Upgrade’ on page 222 and ‘Maintenance > General’ on page 134.
SERIAL	RS-232 traffic interface using a RJ45 connector. Used for RS-232 asynchronous user traffic only. See ‘Serial’ on page 102.
ANT *(Antenna connector)*	TNC, 50 ohm, female connector for connection of antenna feeder cable. See ‘Coaxial Feeder Cables’ on page 53.

LED Display Panel

The Aprisa SR has an LED Display panel which provides on-site alarms / diagnostics without the need for PC.



Normal Operation

In normal radio operation, the LEDs indicate the following conditions:

	OK	DATA	CPU	RF	AUX
Solid Red	Alarm present with severity Critical, Major and Minor			*RF path fail*	
Flashing Red				*Radio not connected to a base station*	
Solid Orange	Alarm present with Warning Severity		Standby *radio in Protected Station*		
Flashing Orange		*Tx Data or Rx Data on the USB management or data port*	*Device detect on the USB host port*	*RF path TX is active*	*Diagnostics Function Active*
Flashing Green		*Tx Data or Rx Data on the serial port*		*RF path RX is active*	
Solid Green	*Power on and functions OK and no alarms*	*All interface ports are OK*	*Processor Block is OK and Active radio in Protected Station*	*RF path is OK*	

LED Colour	Severity
Green	No alarm – information only
Orange	Warning alarm
Red	Critical, major or minor alarm

Single Radio Software Upgrade

During a radio software upgrade, the LEDs indicate the following conditions:

- Software upgrade started - the OK LED flashes orange
- Software upgrade progress indicated by running AUX to DATA LEDs
- Software upgrade completed successfully - the OK LED solid orange
- Software upgrade failed - any LED flashing red during the upgrade

Network Software Upgrade

During a network software upgrade, the AUX LED flashes orange on the base station and all remote stations.

Test Mode

Remote station and repeater station radios have a Test Mode which presents a real time visual display of the RSSI on the LED Display panel. This can be used to adjust the antenna for optimum signal strength (see 'Maintenance > Test Mode' on page 137 for Test Mode options).

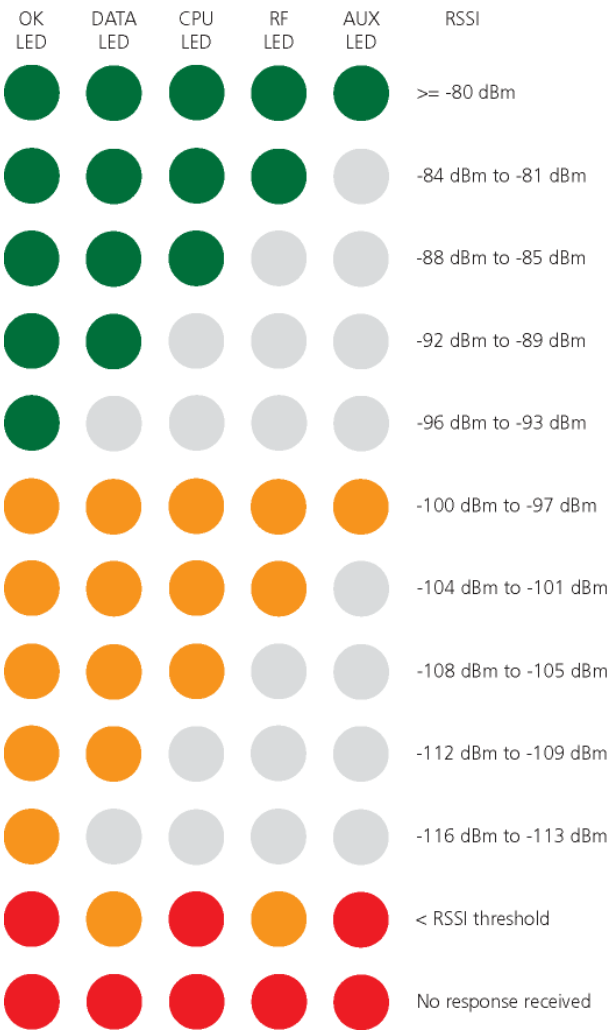
To enter Test Mode, press and hold the ENTER button on the radio LED panel until all the LEDs flash green (about 3 - 5 seconds). The response time is variable and can be up to 5 seconds.

To exit Test Mode, press and hold the ENTER button until all the LEDs flash red (about 3 – 5 seconds).

The RF LED will be green if the network is operating correctly.

Note: Test Mode traffic has a low priority but could affect customer traffic depending on the relative priorities setup.

The RSSI result is displayed on the LED Display panel as a combination of LED states:



4. Product Options

Dual Antenna Port

The standard Aprisa SR uses a one or two frequency ½ duplex transmission mode which eliminates the need for a duplexer. However, a dual antenna port option is available for separate transmit and receive antenna connection to support external duplexers or filters. The transmission remains half duplex.

Example Part:

Part Number	Part Description
APSR-N400-012-DO-12-ETAA	4RF SR, BR, 400-470 MHz, 12.5 kHz, DO, 12 VDC, ET, AA

Protected Station

The Aprisa SR Protected Station provides radio and user interface protection for Aprisa SR radios. The RF ports and interface ports from two standard Aprisa SR Radios are switched to the standby radio if there is a failure in the active radio.

Example Part:

Part Number	Part Description
APSR-R400-012-SO-12-ETAA	4RF SR, PS, 400-470 MHz, 12.5 kHz, SO, 12 VDC, ET, AA

The Aprisa SR Protected Station is comprised of an Aprisa SR Protection Switch and two standard Aprisa SR radios. This configuration provides the ability to 'hot-swap' a failed radio without interrupting user traffic on the active radio. Additionally, retains the full temperature range specification of a single radio.

The Aprisa SR radios can be any of the currently available Aprisa SR radio frequency bands, channel sizes or single / dual antenna port options.

The Aprisa SR Protected Station can operate as a base station, repeater station or remote station. The protection behavior and switching criteria between the active and standby radios is identical for the three configurations.

By default, the Aprisa SR Protected Station is configured with the left hand radio (A) designated as the primary radio and the right hand radio (B) designated as the secondary radio. Each radio is configured with its own unique IP and MAC address and the address of the partner radio.

On power-up, the primary radio will assume the active role and the secondary radio will assume the standby role. If, for some reason, only one radio is powered on it will automatically assume the active role.

Protected Ports

The protected ports are located on the protected station front panel. Switching occurs between the active radio ports and the standby radio ports based on the switching criteria described below.

The protected ports include:

- Antenna ports ANT/TX and RX (if dual antenna ports used)
- Ethernet ports 1 and 2
- Serial port

Operation

In normal operation, the active radio carries all RS-232 serial and Ethernet traffic over the radio link and the standby radio is unused with its transmitter turned off. Both radios are continually monitored for correct operation and alarms are raised if an event occurs.

Both the active and standby radios send regular ‘keep alive’ messages to each other to indicate if they are operating correctly. In the event of a failure on the active radio, the RF link and user interface traffic is automatically switched to the standby radio.

The failed radio can then be replaced in the field without interrupting user traffic (see ‘Replacing a Protected Station Faulty Radio’ on page 36).

Configuration Management

The Primary and Secondary radios are managed with the embedded web-based management tool, SuperVisor (see ‘Managing the Radio’ on page 63) by using either the Primary or Secondary IP address. Configuration changes in one of the radios will automatically be reflected in the partner radio.

To ensure all remote stations are registered to the correct (active) base station, changes to the Network Table are automatically synchronized from the active radio to the standby radio. The Network Table is only visible on the active radio. This synchronization does not occur if the Hardware Manual Lock is active.

Switch Over

The switch over to the standby radio can be initiated automatically, on fault detection, or manually via the Hardware Manual Lock switch on the Protection Switch or the Software Manual Lock from SuperVisor. Additionally, it is possible to switch over the radios remotely without visiting the station site, via the remote control connector on the front of the Protection Switch.

On detection of an alarm fault the switch over time is less than 0.5 seconds. Some alarms may take up to 5 seconds to be detected.

The Protection Switch has a switch guard mechanism to prevent protection switch oscillation. If a switch-over has occurred, subsequent switch-over triggers will be blocked if the guard time has not elapsed.

The guard time starts at 20 seconds and doubles each switch-over to a maximum of 320 seconds and halves after a period of two times the last guard time with no protection switch-overs.

Switching Criteria

The Protected Station will switch over operation from the active to the standby radio if any of the configurable alarm events occur, or if there is a loss of the 'keep alive' signal from the active radio.

It is possible to configure the alarm events which will trigger the switch over. It is also possible to prevent an alarm event triggering a switch over through the configuration of blocking criteria.

Any of the following alarm events can be set to trigger or prevent switching from the active radio to the standby radio (see 'Events > Events Setup' on page 146).

- PA current
- Tx reverse power
- Temperature threshold
- RSSI Threshold
- Rx CRC errors
- Port1 Eth no receive data
- Port1 Eth data receive errors
- Port1 Eth data transmit errors
- Port1 Serial Data No RX Data
- USB Port Serial Data No RX Data
- Component failure
- Configuration not supported
- Alarm Input 1
- Tx AGC
- Thermal shutdown
- Thermal shutdown
- RX Synthesizer Not Locked
- RF no receive data
- Port2 Eth no receive data
- Port2 Eth data receive errors
- Port2 Eth data transmit errors
- Port1 Serial Data RX Errors
- USB Port Serial Data RX Errors
- Calibration failure
- Protection Hardware Failure
- Alarm Input 2

It will not attempt to switch over to a standby radio which has power failure.

It will also not switch over to a standby radio with an active alarm event which has been configured as a 'blocking criteria'.

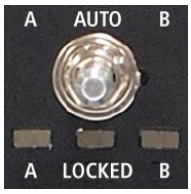
Switch over will be initiated once either of these conditions is rectified, i.e. power is restored or the alarm is cleared.

Hardware Manual Lock

The Hardware Manual Lock switch on the Protection Switch provides a manual override of the active / standby radio.

When this lock is activated, the selected radio (A or B) becomes the active radio regardless of the Software Manual Lock and the current switching or block criteria.

When the lock is deactivated (set to the Auto position), the protection will become automatic and switching will be governed by normal switching and blocking criteria.



The state of the switch is indicated by the three LEDs on the Protection Switch:

A LED	B LED	Locked LED	State
Green	Off	Off	Auto - Radio A is active
Off	Green	Off	Auto - Radio B is active
Green	Off	Orange	Manual Lock to radio A
Off	Green	Orange	Manual Lock to radio B

The Protection Switch also has a Software Manual Lock (see ‘Protected Station: Maintenance > Protection’ on page 190). The Hardware Manual Lock takes precedence over Software Manual Lock if both diagnostic functions are activated i.e. if the Software Manual Lock is set to ‘Primary’ and the Hardware Manual Lock set to ‘Secondary’, the system will set the Secondary radio to Active.

When a Hardware Manual Lock is deactivated (set to the Auto position), the Software Manual Lock is re-evaluated and locks set appropriately.

Remote Control

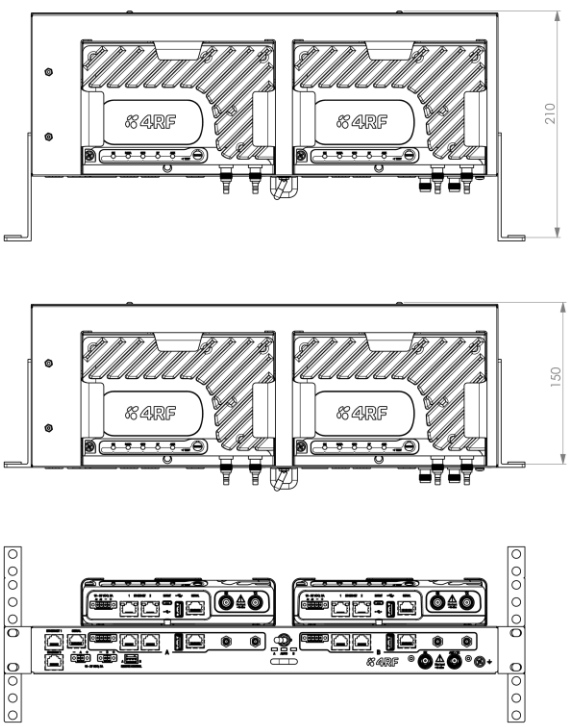
The switch over to the standby radio can be initiated via the Remote Control connector on the front of the Protection Switch. This control will only operate if the Hardware Manual Lock switch is set to the Auto position.

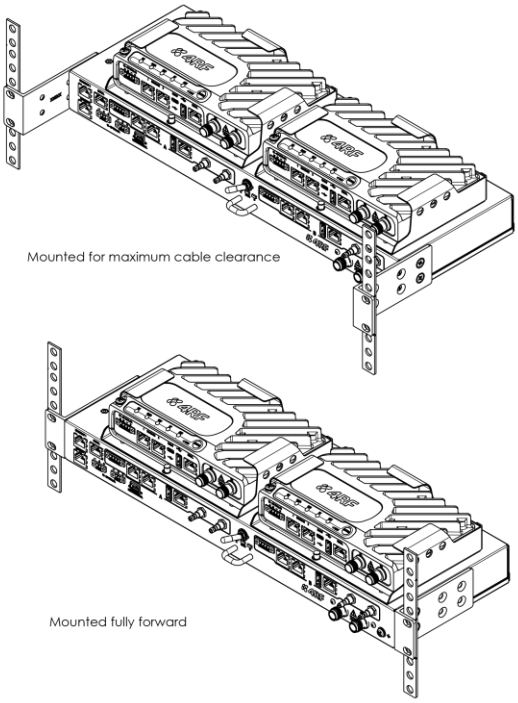
The inputs are logic inputs with 4700 Ω pullup to +3.3 VDC. They require a pull down to ground to activate the control. The ground potential is available on the connector (see ‘Protection Switch Remote Control Connections’ on page 227).

Installation

Mounting

The Aprisa SR Protected Station is designed to mount in a standard 19 inch rack.





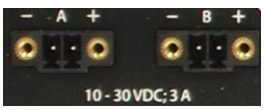
Cabling

The Aprisa SR Protected Station is delivered pre-cabled with power, interface, management and RF cables.

The set of interconnect cables is available as a spare part (see ‘Spares’ on page 37).

Power

A +10.5 to +30 V DC external power source must be connected to both the A and B Phoenix Contact 2 pin male power connectors located on the protected station front panel. The A power input powers the A radio and the B power input powers the B radio. The protection switch is powered from the A power input or the B power input (which ever is available). The maximum combined power consumption is 35 Watts.



Maintenance

Changing the Protected Station IP Addresses

To change the IP address of a Protected Station radio:

1. Change the IP address of either or both the Primary Radio and Secondary radio (see ‘Protected Station: ’ on page 186). Changes in these parameters are automatically changed in the partner radio.

Protected Station Software Upgrade

The Protected Station software upgrade can be achieved without disruption to traffic.

Network Software Upgrade

This process allows customers to upgrade their Aprisa SR network from the central base station location without need for visiting remote sites.

The Software Pack is loaded into the base station with the file transfer process (see ‘Software > File Transfer’ on page 156) and distributed via the radio link to all remote stations.

When all remote stations receive the Software Pack version, the software can be remotely activated on all remote stations.

Single Radio Software Upgrade

USB Boot Upgrade Method

Assuming the Primary radio is active and the Secondary radio is standby

1. Using the Hardware Manual Lock switch, force the primary radio to active.
2. Insert the USB flash drive with the new software release into the secondary radio Host Port .
3. Power cycle the secondary radio. The radio will be upgraded with the new software.
4. When the secondary radio upgrade is completed, remove the USB flash drive, power cycle the secondary radio and wait for it to become standby.
5. Using the Hardware Manual Lock switch, force the secondary radio to active.
6. Insert the USB flash drive with the new software release into the primary radio Host Port .
7. Power cycle the primary radio. The radio will be upgraded with the new software.
8. When the primary radio upgrade is completed, remove the USB flash drive, power cycle the primary radio and wait for it to become standby.
9. Set the Hardware Manual Lock switch to the Auto position. The secondary radio will remain active and the primary radio will remain standby. To set the primary radio to active, use the hardware lock switch to select the primary radio and wait for it to become active, then set the hardware manual lock switch to the Auto position.

Replacing a Protected Station Faulty Radio

Replacing a faulty radio in a Protected Station can be achieved without disruption to traffic.

Assuming that the primary radio is active and the secondary radio is faulty and needs replacement:

1. Ensure the replacement radio has the same version of software installed as the primary radio. If necessary, upgrade the software in the replacement radio.
2. Set the RF Interface MAC Address (see ‘Maintenance > Advanced’ on page 141). This MAC address is present on chassis label.
3. Using SuperVisor > Maintenance > Advanced ‘Save Configuration to USB’ and ‘Restore Configuration from USB’ operation, clone the primary radio’s configuration to the replacement radio.
4. Configure the replacement radio as the secondary radio and setup the IP address and other protection parameters (see ‘Terminal > Operating Mode’ on page 85).
5. Set the Hardware Manual Lock switch to make the primary radio active.
6. Carefully remove the faulty radio from the protection switch and install the replacement radio.
7. Power on the replacement radio and wait for it to become standby.
8. Set the Hardware Manual Lock switch to the Auto position.

Spares

The Aprisa SR Protection Switch is available as a spare part. This spare includes the protection switch and two sets of Protection Switch interconnect cables (one set is 6 cables).

Part Number	Part Description
APSP-SRPSW	4RF Spare, Aprisa SR, Protection Switch

The set of interconnect cables is available as a spare part (set of 6 cables).

Part Number	Part Description
APSP-SRPSC-ST6	4RF Spare, Aprisa SR, Protection Switch Cables, Set Of 6

Replacing a Faulty Protection Switch

Note: Replacing a faulty Protection Switch will disrupt traffic.

Move the radios, the interconnect cables, the interface cables and the power cables to the replacement Protection Switch.

On both Protected Station radios:

1. Power on the radio and wait for it to become ready.
2. Using SuperVisor > Maintenance > Advanced, enter the RF Interface MAC address shown on the Protection Switch label (see ‘RF Interface MAC address’ on page 142).
3. Using SuperVisor > Maintenance > Advanced, Decommission the node (see ‘Decommission Node’ on page 142) and then Discover the Nodes (see ‘Discover Nodes’ on page 142).

Ensure that the Hardware Manual Lock switch is set to the Auto position.

The Aprisa SR Protected Station is now ready to operate.

Data Driven Protected Station

The Aprisa SR Data Driven Protected Station provides radio and RS-232 serial port user interface protection for Aprisa SR radios.

Example Part:

Part Number	Part Description
APSR-D400-012-DO-12-ETAA	4RF SR, PD, 400-470 MHz, 12.5 kHz, DO, 12 VDC, ET, AA

The Aprisa SR Data Driven Protected Station shown is comprised of two standard Aprisa SR dual antenna port option radios and two external duplexers mounted on 19" rack mounting shelves.

The Aprisa SR radios can be any of the currently available Aprisa SR radio frequency bands, channel sizes or single / dual antenna port options.

By default, the Aprisa SR Data Driven Protected Station is configured with the left hand radio (A) designated as the primary radio and the right hand radio (B) designated as the secondary radio.

Each radio is configured with its own unique IP and MAC address and the address of the partner radio.

On power-up, the primary radio will assume the active role and the secondary radio will assume the standby role. If, for some reason, only one radio is powered on it will automatically assume the active role.

Operation

The active radio is determined explicitly by which radio receives data on its RS-232 serial port input from the interface.

The active radio carries all RS-232 serial traffic over its radio link and the standby radio is unused with its transmitter turned off.

If data is received on the RS-232 serial port interface input of the standby radio, it will immediately become the active radio and the radio which was active will become the standby radio.

Switch Over

The active radio is determined explicitly by which radio receives data on its RS-232 serial port.

The switching and blocking criteria used for the standard Protected Station do not apply. This means that events and alarms on the unit are not used as switching criteria.

Configuration Management

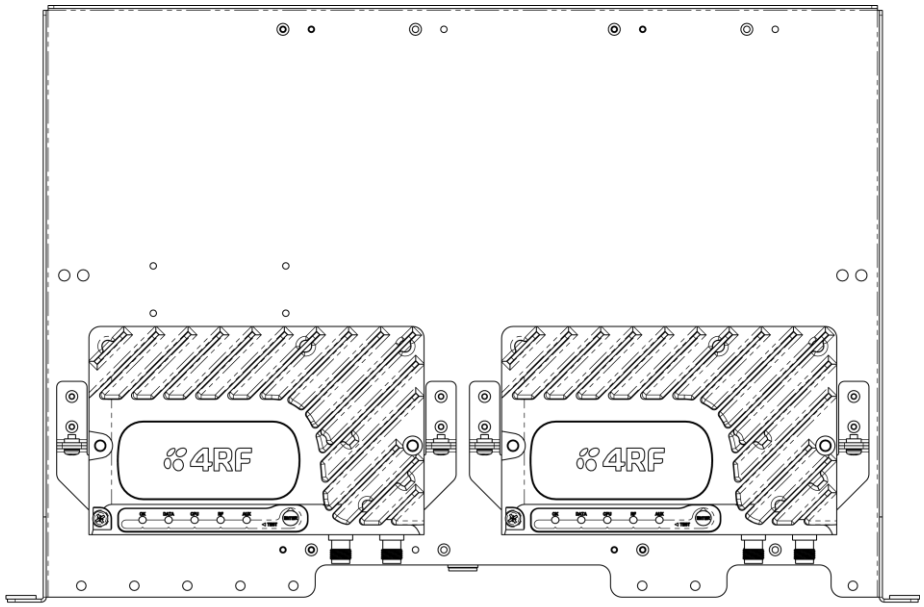
The Primary and Secondary radios are managed with the embedded web-based management tool, SuperVisor (see ‘Managing the Radio’ on page 63) by using either the Primary or Secondary IP address. Configuration changes in one of the radios will automatically be reflected in the partner radio.

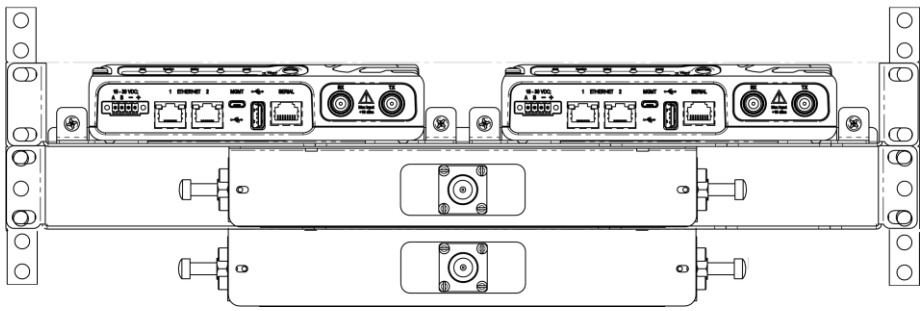
Changes to the Network Table are automatically synchronized from the active radio to the standby radio but the Network Table is only visible on the active radio.

Installation

Mounting

The Aprisa SR Data Driven Protected Station is designed to mount in a standard 19” rack on two 1U rack mounting shelves.





Cabling

The Aprisa SR Data Driven Protected Station is delivered with the radios, duplexers, rack mounting shelves and RF cables.

The picture demonstrates the RF cabling but the product is delivered with the cables separately packaged.

The set of interconnect cables is available as a spare part.

Power

A +10.5 to +30 V DC external power source must be connected to both the A and B Phoenix Contact 4 pin male power connectors. The maximum combined power consumption is 35 Watts.

Duplexer Kits

The Aprisa SR product range contains Duplexer Kit accessories for use with the Dual Antenna port Aprisa SR radios.

UHF Duplexer Kits

The Aprisa SR UHF Duplexer Kit contains:

- 1x 1U 19" rack mount shelf with duplexer mounting brackets and screws
- 1x Duplexer
- 2x TNC to SMA right angle 590mm cables

Part Number	Part Number
APSA-KDUP-400-B1	4RF SR Acc, Kit, Duplexer, 400-470 MHz, s 5 MHz, p 0.5 MHz, ext

VHF Duplexer Kits

The Aprisa SR VHF Duplexer Kit contains:

- 1x 1U 19" rack mount shelf with duplexer mounting brackets and screws
- 1xVHF Procom Duplexer
- 1x VHF Filter, Procom BPF 2/3 HX-150, 145 to 174 MHz
- 1x N type male to N type male 325mm
- 2x TNC to N type male right angle 590mm cable

Part Number	Part Number
APSA-KDUP-VHF-R2	4RF SR Acc, Kit, Duplexer, 152-175 MHz, s4-6 MHz, p100 kHz, High
APSA-KDUP-VHF-R3	4RF SR Acc, Kit, Duplexer, 152-175 MHz, s6-8 MHz, p100 kHz, High
APSA-KDUP-VHF-R4	4RF SR Acc, Kit, Duplexer, 152-175 MHz, s8-10 MHz, p100 kHz, High
APSA-KDUP-VHF-R5	4RF SR Acc, Kit, Duplexer, 138-156 MHz, s4-6 MHz, p100 kHz, Low
APSA-KDUP-VHF-R6	4RF SR Acc, Kit, Duplexer, 138-156 MHz, s6-8 MHz, p100 kHz, Low
APSA-KDUP-VHF-R7	4RF SR Acc, Kit, Duplexer, 138-156 MHz, s8-10 MHz, p100 kHz, Low

USB RS-232 Serial Port

The Aprisa SR USB host port is predominantly used for software upgrade and diagnostic reporting. However, it can also be used to provide an additional RS-232 DCE serial port for customer traffic.

This is accomplished with a USB to RS-232 serial converter cable. This plugs into the USB host port connector and can be terminated with the required customer connector.

This additional RS-232 serial port is enabled with the SuperVisor mode setting in Serial Port Settings (see ‘Serial > Port Setup’ on page 103).

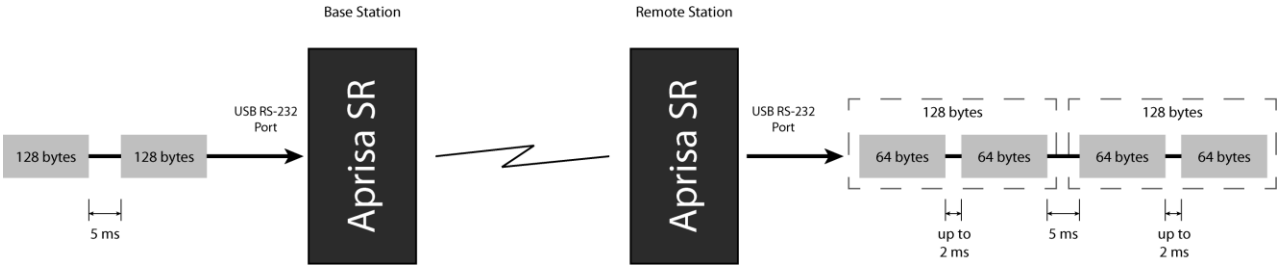
The Aprisa SR USB port has driver support for these USB serial converters. Other USB serial converters may not operate correctly.

USB RS-232 operation

The USB serial converter buffers the received data frames into 64 byte blocks separated by a small inter-frame gap.

For the majority of applications, this fragmentation of egress frames is not an issue. However, there are some applications that may be sensitive to the inter-frame gap, therefore, these applications need consideration.

A 5 ms inter-frame is recommended for the applications that are sensitive to inter-frame gap timings.



On a USB RS-232 port, Modbus RTU can operate up to 9600 baud with all packet sizes and up to 115200 if the packet size is less than 64 bytes. The standard RS-232 port is fully compatible with Modbus RTU at all baud rates.

Cabling Options

The following converter cables are available as Aprisa SR accessories to provide the customer interface. The kit contains a USB connector retention clip (see USB Retention Clip below):

1. USB Converter to 1.8 metre multi-strand cable 6 wire for termination of customer connector

Part Number	Part Number
APSA-IFCA-USB-MS-18	4RF SR Acc, Cable, Interface, USB Converter, Multi-strand, 1.8m

2. USB converter to RJ45 female kit for USB to RS-232 DCE conversion.

Part Number	Part Number
APSA-KFCA-USB-45-MF-18	4RF SR Acc, Kit, Interface, USB Converter, RJ45, Female, 1.8m

3. USB converter to DB9 female kit for USB to RS-232 DCE conversion.

Part Number	Part Number
APSA-KFCA-USB-D9-MF-18	4RF SR Acc, Kit, Interface, USB Converter, DB9, Female, 1.8m

USB Retention Clip

The USB Retention Clip attaches to the underside of the Aprisa SR enclosure adjacent to the USB connector.

To attach the USB Retention Clip:

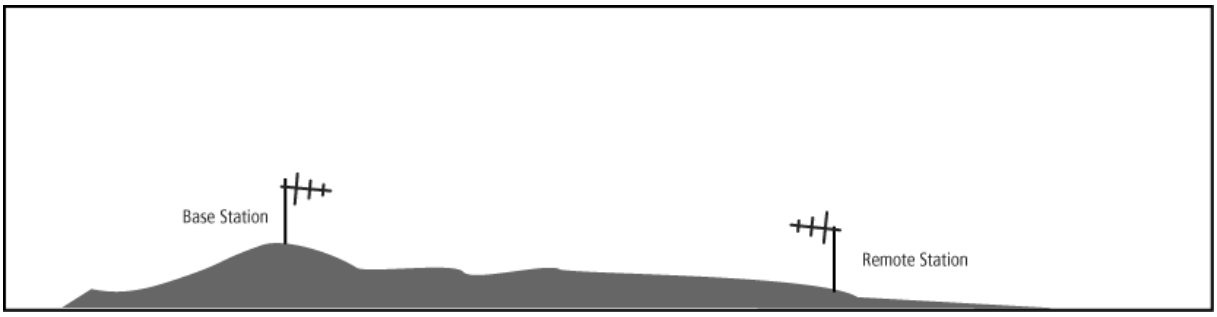
1. Clean the enclosure surface where the retention clip will attach with an alcohol based cleaner e.g. Isopropanol.
2. Peel off the retention clip protective backing.
3. Stick the clip onto the SR enclosure ensuring that it aligns to the middle of the radio USB connector.

5. Implementing the Network

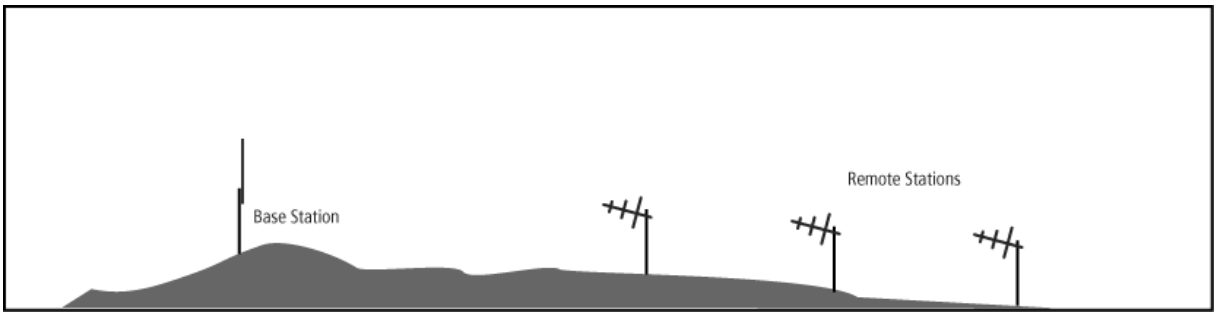
Network Topologies

The following are examples of typical network topologies:

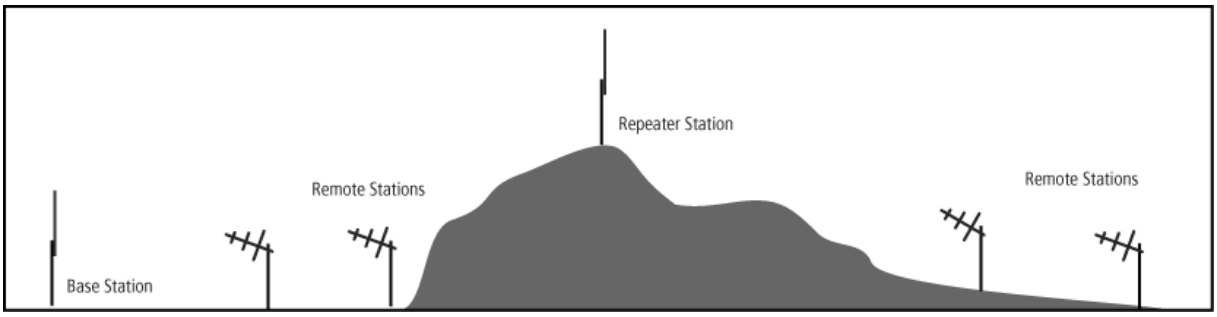
Point-To-Point Network



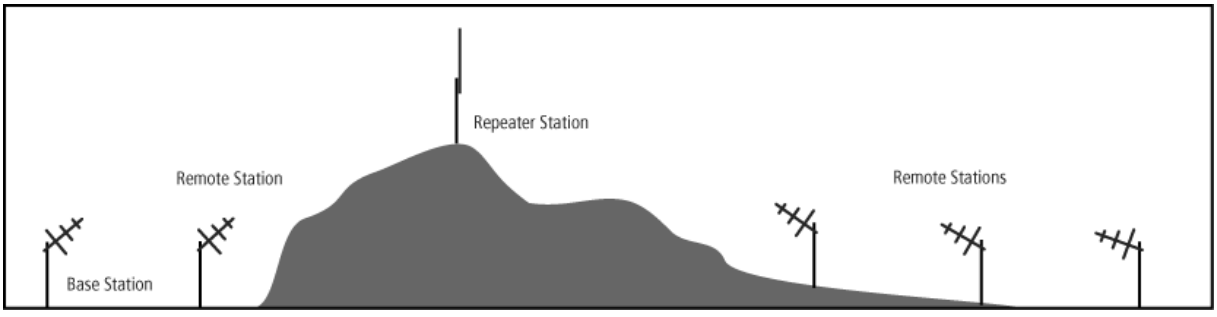
Point-to-Multipoint Network



Point-to-Multipoint with Repeater 1



Point-to-Multipoint with Repeater 2



Initial Network Deployment

Install the Base Station

To install the base station in your network:

1. Install the base station radio (see ‘Installing the Radio’ on page 56).
2. Set the radio Network ID (network) to a unique ID in your entire network (see ‘Terminal > Device’ on page 82).
3. Set the radio IP address (see ‘Terminal > Device’ on page 82).
4. Set the radio frequencies to the frequencies you wish to operate from (see ‘Radio > Radio Setup’ on page 92).
5. Set the radio operating mode to ‘base station’ (see ‘Terminal > Operating Mode’ on page 85).
6. Set the radio security settings (see ‘Security > Setup’ on page 117).

Installing the Remote Stations

To install the remote stations in your network:

1. Install the remote station radio (see ‘Installing the Radio’ on page 56).
2. Set the radio Network ID (network) to the same ID as the other stations in the network (see ‘Terminal > Device’ on page 82).
3. Set the radio IP address (see ‘Terminal > Device’ on page 82).
4. Set the radio frequencies to the base station / repeater station frequencies you wish to operate from (see ‘Radio > Radio Setup’ on page 92).
5. Set the radio operating mode to ‘remote station’ (see ‘Terminal > Operating Mode’ on page 85).
6. Set the radio security settings to the same as the base station (see ‘Security > Setup’ on page 117).

The base station will automatically allocate a node address to the new remote station.

Install a Repeater Station

To install a repeater station in your network:

1. Install the repeater station radio (see ‘Installing the Radio’ on page 56).
2. Set the radio Network ID (network) to the same ID as the other stations in the network (see ‘Terminal > Device’ on page 82).
3. Set the radio IP address (see ‘Terminal > Device’ on page 82).
4. Set the radio frequencies to base station frequencies you wish to operate from (see ‘Radio > Radio Setup’ on page 92).
5. Set the radio operating mode to ‘repeater station’ (see ‘Terminal > Operating Mode’ on page 85).
6. Set the radio security settings to the same as the base station (see ‘Security > Setup’ on page 117).
7. Increase the radio network radius by one on all stations in the network (see ‘Terminal > Device’ on page 82).

The base station will automatically allocate a node address to the new repeater station.

Network Changes

Adding a Repeater Station

To add a repeater station to your network:

1. Install the repeater station radio (see 'Installing the Radio' on page 56).
2. Set the radio Network ID (network) to the same ID as the other stations in the network (see 'Terminal > Device' on page 82).
3. Set the radio IP address (see 'Terminal > Device' on page 82).
4. Set the radio frequencies to the base station frequencies you wish to operate from (see 'Radio > Radio Setup' on page 92).
5. Set the radio operating mode to 'repeater station' (see 'Terminal > Operating Mode' on page 85).
6. Increase the radio network radius by one on all stations in the network (see 'Terminal > Device' on page 82).

The base station will automatically allocate a node address to the new repeater station.

To remove a repeater station from your network:

1. Turn the power off on the remote station radios operating from the repeater station radio you wish to remove.
2. Turn the power off on the repeater station radio you wish to remove.
3. Decrease the network radius by one on all stations in the network (see 'Terminal > Device' on page 82).

Adding a Remote Station

To add a remote station to your network:

1. Install the remote station radio (see 'Installing the Radio' on page 56).
2. Set the radio Network ID (network) to the same ID as the other stations in the network (see 'Terminal > Device' on page 82).
3. Set the radio IP address (see 'Terminal > Device' on page 82).
4. Set the radio frequencies to the base station / repeater station frequencies you wish to operate from (see 'Radio > Radio Setup' on page 92).
5. Set the radio operating mode to 'remote station' (see 'Terminal > Operating Mode' on page 85).

The base station will automatically allocate a node address to the new remote station.

To remove a remote station from your network:

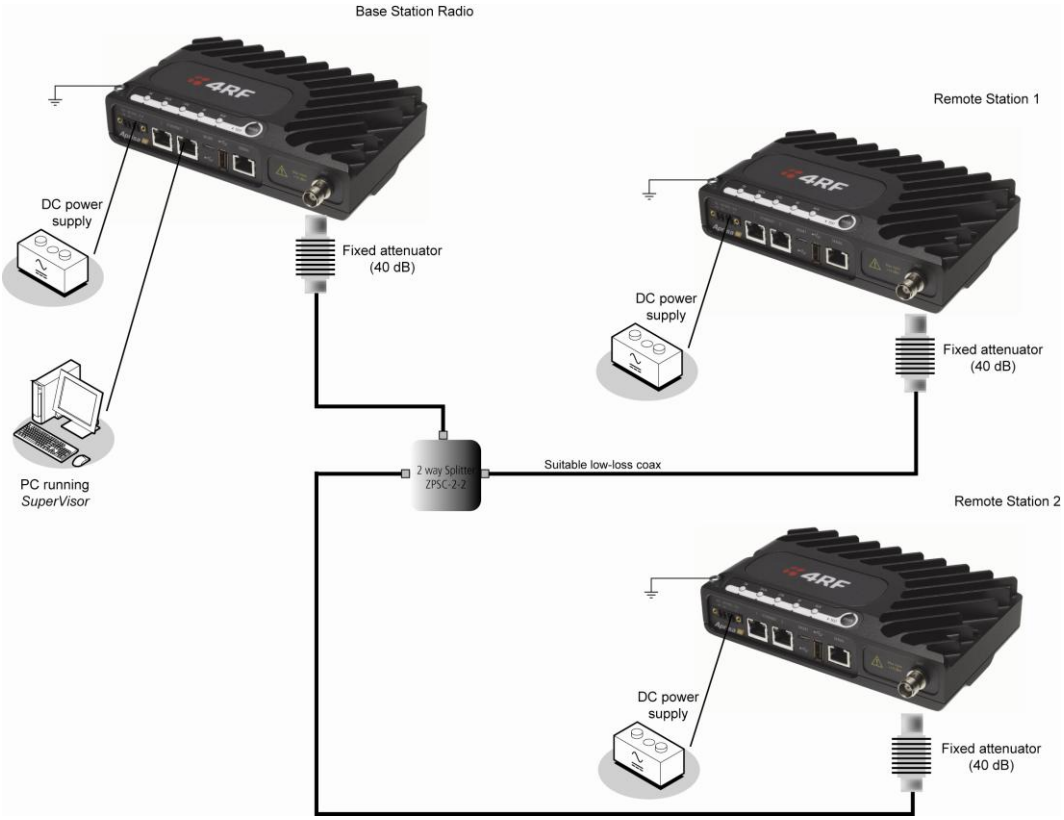
1. Turn the power off on the remote station radio you wish to remove. This is the only action that is required.

Note: The remote station will continue to show in the Network Table list.

6. Preparation

Bench Setup

Before installing the links in the field, it is recommended that you bench-test the links. A suggested setup for basic bench testing is shown below:



When setting up the equipment for bench testing, note the following:

Earthing

Each radio should be earthed at all times. The radio earth point should be connected to a protection earth.

Attenuators

In a bench setup, there should be 60 - 80 dB at up to 1 GHz of 50 ohm coaxial attenuation, capable of handling the transmit power of +37 dBm (5 W) between the radios' antenna connectors.

Splitter

If more than two radios are required in your bench setup, a multi-way splitter is required. The diagram shows a two way splitter. This splitter should be 50 ohm coaxial up to 1 GHz and capable of handling the transmit power of +37 dBm (5 W).

Cables

Use double-screened coaxial cable that is suitable for use up to 1 GHz at ≈ 1 metre.

CAUTION: Do not apply signals greater than +10 dBm to the antenna connection as they can damage the receiver.

Path Planning

The following factors should be considered to achieve optimum path planning:

- Antenna Selection and Siting
- Coaxial Cable Selection
- Linking System Plan

Antenna Selection and Siting

Selecting and siting antennas are important considerations in your system design. The antenna choice for the site is determined primarily by the frequency of operation and the gain required to establish reliable links.

Base or Repeater Station

The predominant antenna for a base station or a repeater station is an omni-directional collinear gain antenna.

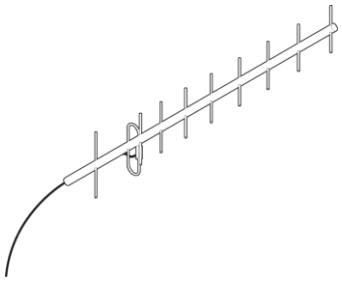
Omni Directional Collinear Antennas

Factor	Explanation
Frequency	Often used in 380-530 MHz bands
Gain	Varies with size (5 dBi to 8 dBi typical)
Wind loading	Minimal
Tower aperture required	Minimal
Size	Range from 2 m to 3 m length
Polarization	Vertical

Remote station

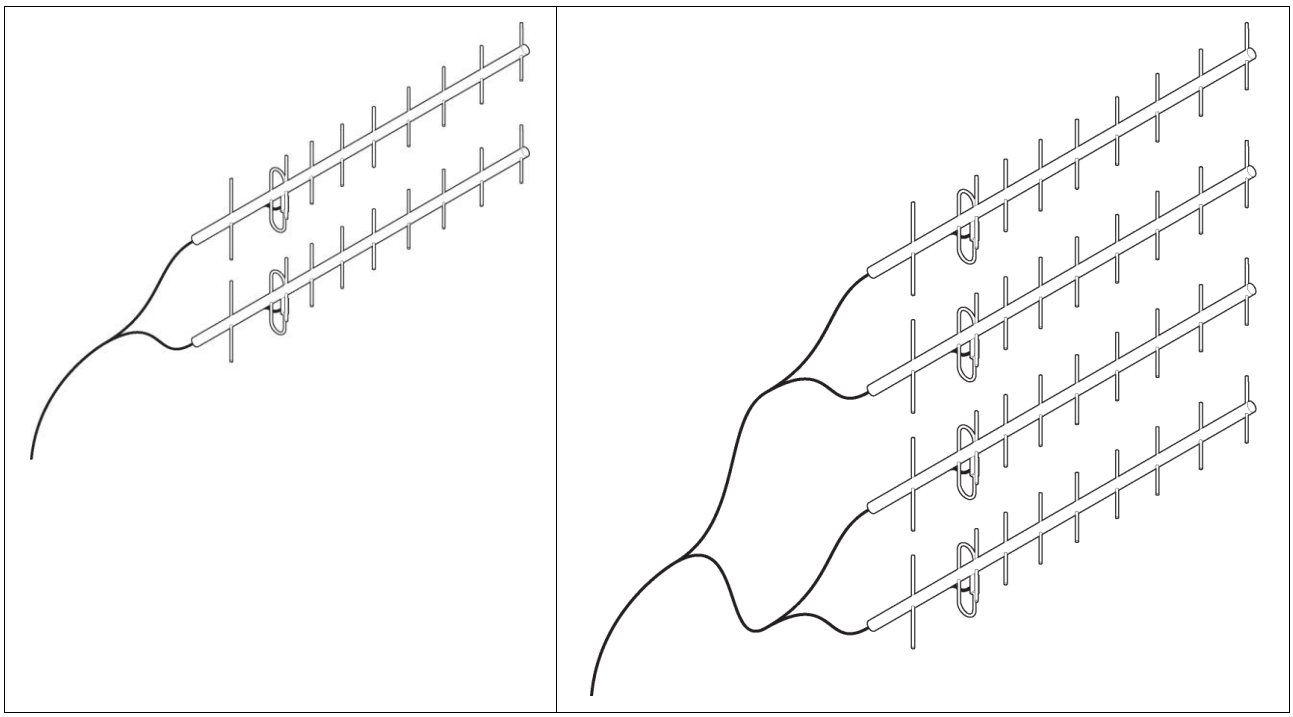
There are two main types of directional antenna that are commonly used for remote stations, Yagi and corner reflector antennas.

Yagi Antennas



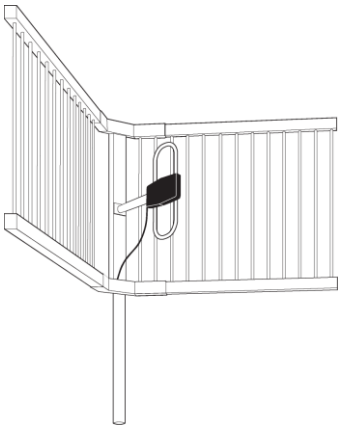
Factor	Explanation
Frequency	Often used in 350-600 MHz bands
Gain	Varies with size (typically 11 dBi to 16 dBi)
Stackable gain increase	2 Yagi antennas (+ 2.8 dB) 4 Yagi antennas (+ 5.6 dB)
Size	Range from 0.6 m to 3 m in length
Front to back ratio	Low (typically 18 to 20 dB)

It is possible to increase the gain of a Yagi antenna installation by placing two or more of them in a stack. The relative position of the antennas is critical.



Example of stacked antennas

Corner Reflector Antennas

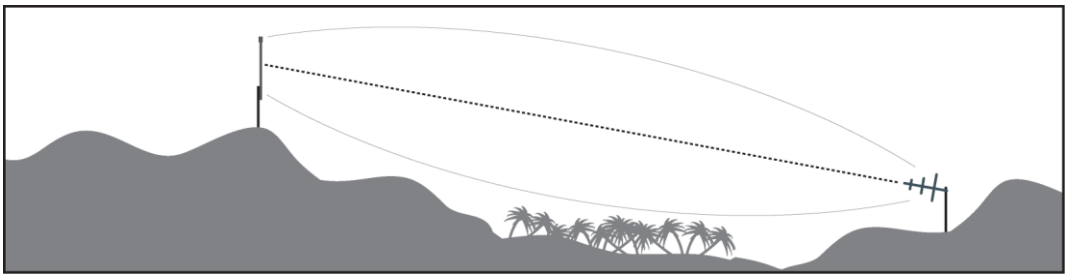


Factor	Explanation
Frequency	Often used in 330-960 MHz bands
Gain	Typically 12 dBi
Size	Range from 0.36 m to 0.75 m in length
Front to back ratio	High (typically 30 dB)
Beamwidth	Broad (up to 60°)

Antenna Siting

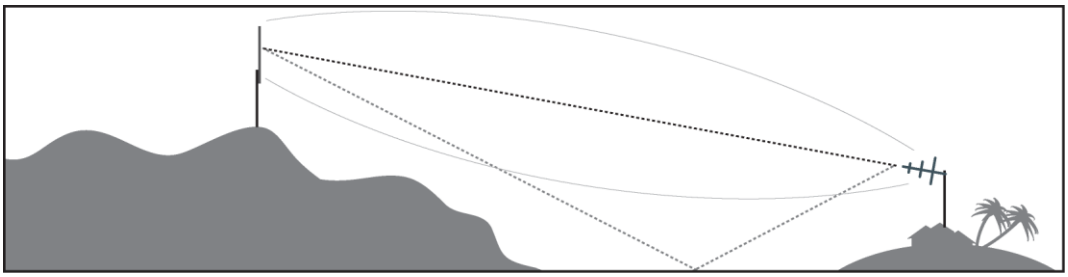
When siting antennas, consider the following points:

A site with a clear line of sight to the remote radio is recommended. Pay particular attention to trees, buildings, and other obstructions close to the antenna site.



Example of a clear line-of-sight path

Any large flat areas that reflect RF energy along the link path, for instance, water, could cause multipath fading. If the link path crosses a feature that is likely to cause RF reflections, shield the antenna from the reflected signals by positioning it on the far side of the roof of the equipment shelter or other structure.



Example of a mid-path reflection path

The antenna site should be as far as possible from other potential sources of RF interference such as electrical equipment, power lines and roads. The antenna site should be as close as possible to the equipment shelter.

Wide angle and zoom photographs taken at the proposed antenna location (looking down the proposed path), can be useful when considering the best mounting positions.

Coaxial Feeder Cables

To ensure maximum performance, it is recommended that you use good quality low-loss coaxial cable for all feeder runs. When selecting a coaxial cable consider the following:

Factor	Effect
Attenuation	Short cables and larger diameter cables have less attenuation
Cost	Smaller diameter cables are cheaper
Ease of installation	Easier with smaller diameter cables or short cables

For installations requiring long feeder cable runs, use the LCF78, LCF12 or CNT-400 feeder cable or equivalent:

Part Number	Part Description	Specification
RFS LCF78 50JA	Feeder Cable, 7/8', CELLFLEX, Low Loss, Std, /m, MOQ 50	Low loss 7/8' (22.2 mm) feeder cable Bending radius of 125 mm min Attenuation of 2.5 dB / 100m @ 450 MHz
RFS LCF12 50J	Feeder Cable, 1/2', CELLFLEX, Low Loss, Std, /m, MOQ 50	Low loss 0.5' (12.7 mm) feeder cable Bending radius of 125 mm min Attenuation of 4.7 dB / 100m @ 450 MHz
RFI CNT 400	Feeder, CNT-400, 10.8mm, Double Shielded Solid Polyethylene	Low loss 0.4' (10.8 mm) feeder cable UV protected black Polyethylene, bonded AL tape outer conductor Bending radius of 30 mm min Attenuation of 8.8 dB / 100m @ 450 MHz

For installations requiring short feeder cable runs, use the RFI 8223 feeder cable or equivalent:

Part Number	Part Description	Specification
RFI 8223	Feeder, RG 223 5.4mm d, Double Shielded Solid Polyethylene	Bending radius of 20 mm min Attenuation of 30.5 dB / 100m @ 450 MHz

When running cables:

Run coaxial feeder cable from the installation to the antenna, ensuring you leave enough extra cable at each end to allow drip loops to be formed.

Terminate and ground the feeder cables in accordance with the manufacturers' instructions. Bond the outer conductor of the coaxial feeder cables to the base of the tower mast.

Linking System Plan

All of the above factors combine in any proposed installation to create a Linking System Plan. The Linking System Plan predicts how well the radios will perform after it is installed.

Use the outputs of the Linking System Plan during commissioning to confirm the radios have been installed correctly and that it will provide reliable service.

Site Requirements

Power Supply

Ensure a suitable power supply is available for powering the radio.

The nominal input voltage for a radio is +13.8 VDC (negative earth) with an input voltage range of +10 to +30 VDC. The maximum power input is 30 W.

WARNING:

Before connecting power to the radio, ensure that the radio is grounded via the negative terminal of the DC power connection.

Equipment Cooling

If the Aprisa SR is operated in an environment where the ambient temperature exceeds 50°C, the Aprisa SR convection air flow over the heat sinks must be considered.

The environmental operating conditions are as follows:

Operating temperature	-40 to +70° C
Storage temperature	-40 to +80° C
Humidity	Maximum 95% non-condensing

WARNING:

If the Aprisa SR is operated in an environment where the ambient temperature exceeds 50°C, the Aprisa SR must be installed within a restricted access location to prevent human contact with the enclosure heatsink.

Earthing and Lightning Protection

WARNING:

Lightning can easily damage electronic equipment.

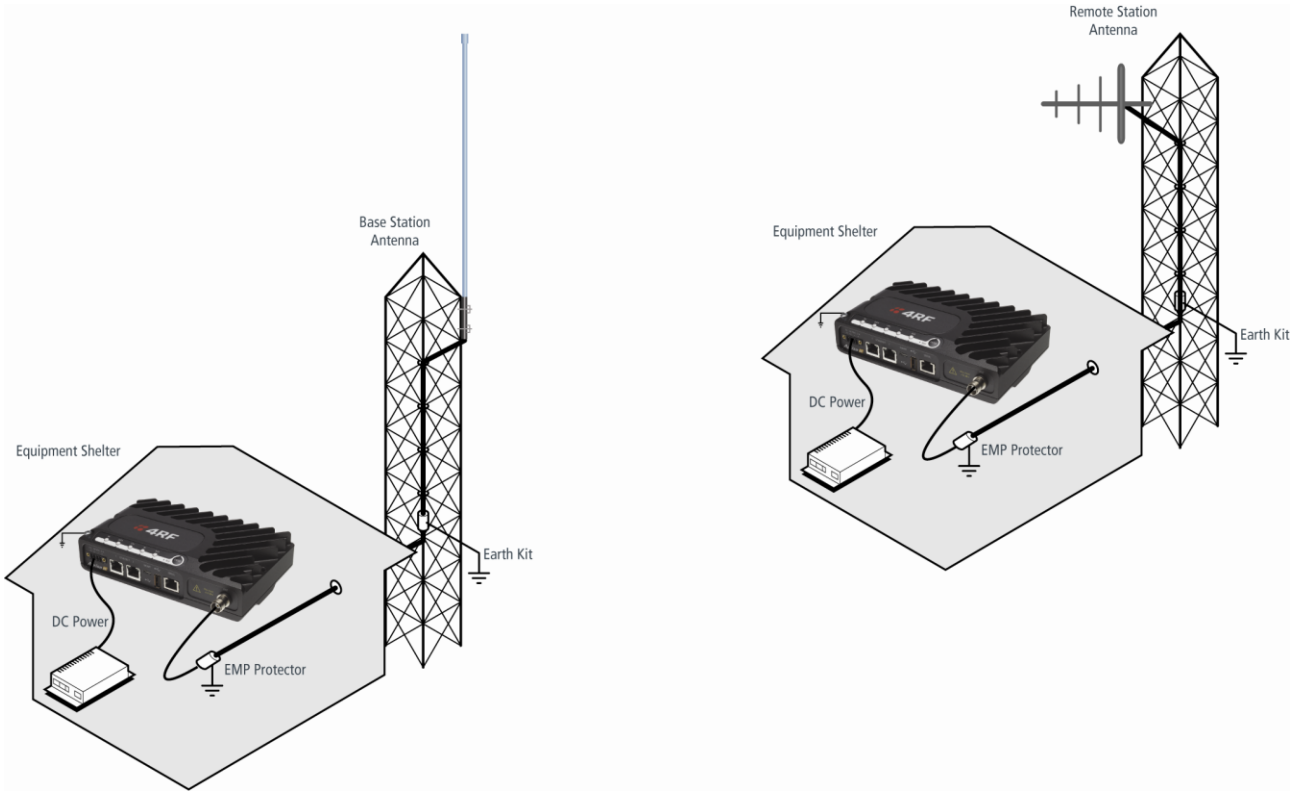
To avoid this risk, install primary lightning protection devices on any interfaces that are reticulated in the local cable network.

You should also install a coaxial surge suppressor on the radio antenna port.

Feeder Earthing

Earth the antenna tower, feeders and lightning protection devices in accordance with the appropriate local and national standards. The diagram below shows the minimum requirements.

Use grounding kits as specified or supplied by the coaxial cable manufacturer to properly ground or bond the cable outer.



Radio Earthing

The Aprisa SR has an earth connection point on the top left of the enclosure. A M4 8mm pan pozi machine screw and a M4 lock washer is supplied fitted to the radio. This can be used to earth the enclosure to a protection earth.

7. Installing the Radio

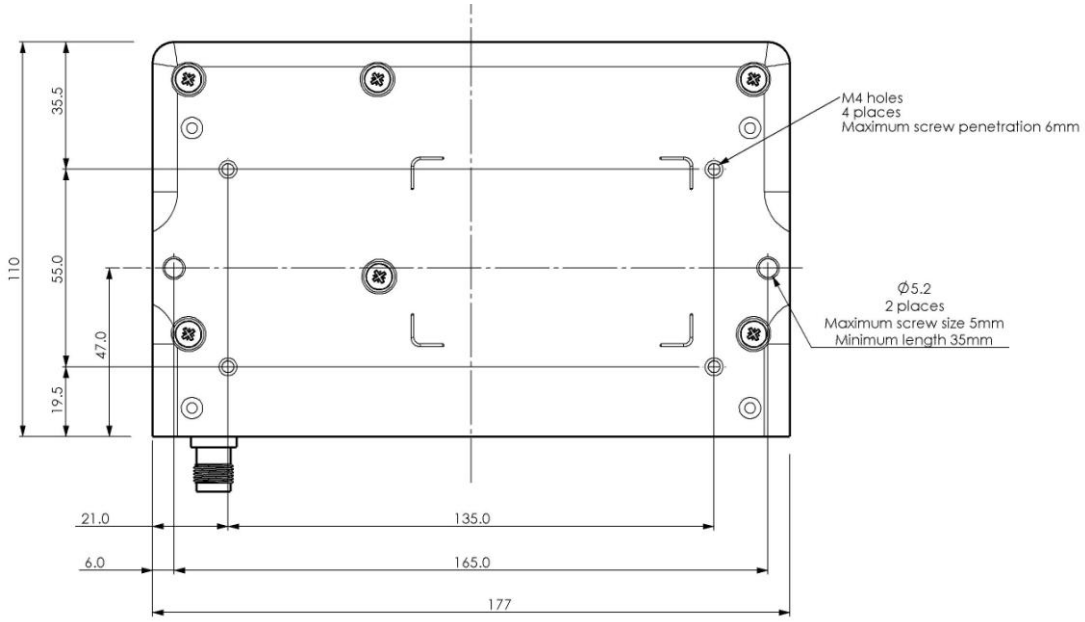
CAUTION:

You must comply with the safety precautions in this manual or on the product itself.

4RF does not assume any liability for failure to comply with these precautions.

Mounting

The Aprisa SR has four threaded holes (M4) in the enclosure base and two holes (5.2 mm) through the enclosure for mounting.



Mounting options include:

- DIN rail mounting with the Aprisa SR DIN Rail Mounting Bracket
- Rack shelf mounting
- Wall mounting
- Outdoor enclosure mounting

WARNING:

If the Aprisa SR is operated in an environment where the ambient temperature exceeds 50°C, the Aprisa SR must be installed within a restricted access location to prevent human contact with the enclosure heatsink.

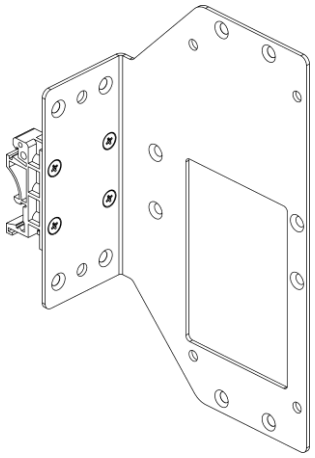
Required Tools

No special tools are needed to install the radio.

DIN Rail Mounting

The Aprisa SR has an optional accessory part to enable the mounting on a standard DIN rail:

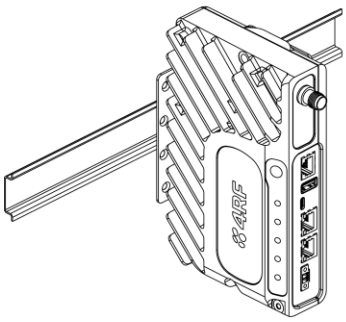
Part Number	Part Description
APSA-MBRK-DIN	4RF Aprisa SR Acc, Mounting, Bracket, DIN Rail



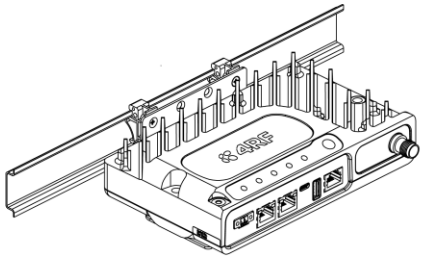
The Aprisa SR is mounted into the DIN rail mounting bracket using the four M4 threaded holes in the Aprisa SR enclosure base. Four 8 mm M4 pan pozi machine screws are supplied with the bracket.

The Aprisa SR DIN rail mounting bracket can be mounted in four positions on a horizontal DIN rail:

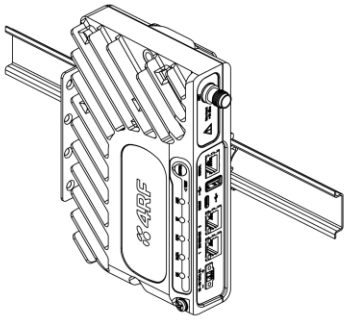
- Vertical Mount (vertical enclosure perpendicular to the mount)
- Horizontal Mount (horizontal enclosure perpendicular to the mount)
- Flat Vertical Mount (vertical enclosure parallel to the mount)
- Flat Horizontal Mount (horizontal enclosure parallel to the mount)



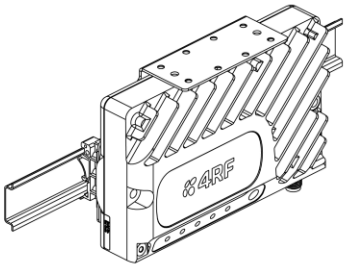
Vertical Mount



Horizontal Mount



Flat Vertical Mount

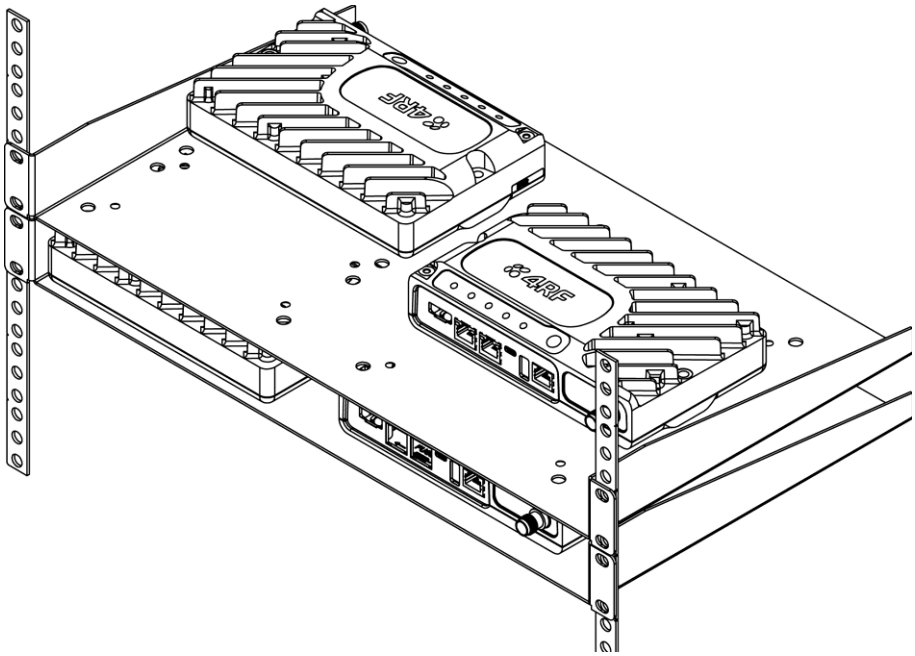


Flat Horizontal Mount

The DIN rail mounting bracket has two clips which are positioned to allow for the four mounting positions.

Rack Shelf Mounting

The Aprisa SR can be mounted on a rack mount shelf using the four M4 threaded holes in the Aprisa SR enclosure base. The following picture shows Aprisa SR mounted on 1 RU rack mounted shelves.

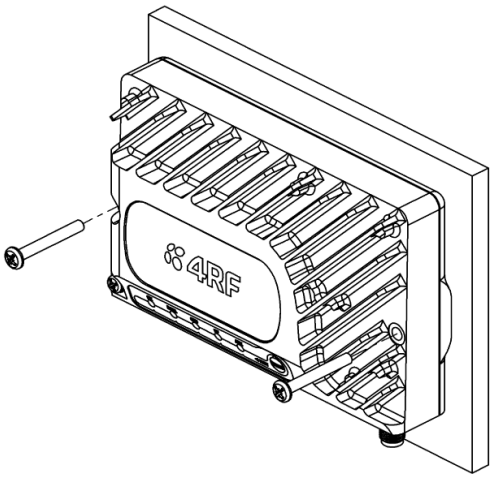


WARNING:

If the Aprisa SR is operated in an environment where the ambient temperature exceeds 50°C, the Aprisa SR convection air flow over the heat sinks must be considered.

Wall Mounting

The Aprisa SR can be mounted on a wall using the two holes through the enclosure (5.2 mm diameter). Typically, M5 screws longer than 35 mm would be used.



Installing the Antenna and Feeder Cable

Carefully mount the antenna following the antenna manufacturers' instructions. Run feeder cable from the antenna to the radio location.

Lightning protection must be incorporated into the antenna system (see 'Earthing and Lightning Protection' on page 55).

WARNING:

When the link is operating, there is RF energy radiated from the antenna. Do not stand in front of the antenna while the radio is operating (see the 'RF Exposure Warning' on page 3).

Fit the appropriate male or female connector (usually N-type) to the antenna feeder at the antenna end. Carefully follow the connector manufacturers' instructions.

Securely attach the feeder cable to the mast and cable trays using cable ties or cable hangers. Follow the cable manufacturer's recommendations about the use of feeder clips, and their recommended spacing.

Connect the antenna and feeder cable. Weatherproof the connection with a boot, tape or other approved method.

The Aprisa SR antenna connection is a TNC female connector so the feeder / jumper must be fitted with a TNC male connector.

If a jumper is used between the feeder and the radio, connect a coaxial surge suppressor or similar lightning protector between the feeder and jumper cables (or at the point where the cable enters the equipment shelter). Connect the feeder cable to the antenna port on the radio.

Earth the case of the lightning protector to the site Lightning Protection Earth.

The Aprisa SR has an earth connection point on the top left of the enclosure. A M4 8mm pan pozi machine screw and a M4 lock washer is supplied fitted to the radio. This can be used to earth the enclosure to a protection earth.

Connecting the Power Supply

The nominal input voltage for a radio is +13.8 VDC (negative earth) with an input voltage range of +10 to +30 VDC. The maximum power input is 30 W.

The power connector required is a Phoenix Contact 4 pin female screw fitting part MC 1.5/ 4-STF-3.5. This connector is supplied fitted to the radio.

The negative supply of the Aprisa SR power connection is internally connected to the Aprisa SR enclosure. Power must be supplied from a Negative Earthed power supply.

Wire your power source to power connector and plug the connector into the radio. The connector screws can be fastened to secure the connector.

Additional Phoenix Contact 4 pin female power connectors can be ordered from 4RF:

Part Number	Part Description
APSA-CPH4-FEM-01	4RF Aprisa SR Acc, Connector, Phoenix 4 pin, Female, 1 item

Turn your power source on:

- All the radio LEDs will flash orange for one second and then the OK, DATA and CPU LEDs will light green, the RF LED will light orange and the AUX LED will be off
- The Aprisa SR radio is ready to operate
- The RF LED will light green when the radio is registered with the network

If the LEDs fail to light, carefully check the supply polarity. If the power supply connections have been accidentally reversed, internal fuses will have blown to protect the unit.

Spare fuses are contained within the radio, see ‘Spare Fuses’ on page 61 for instructions on how to locate and replace the fuses.

External Power Supplies

The following external power supplies are available from 4RF as accessories:

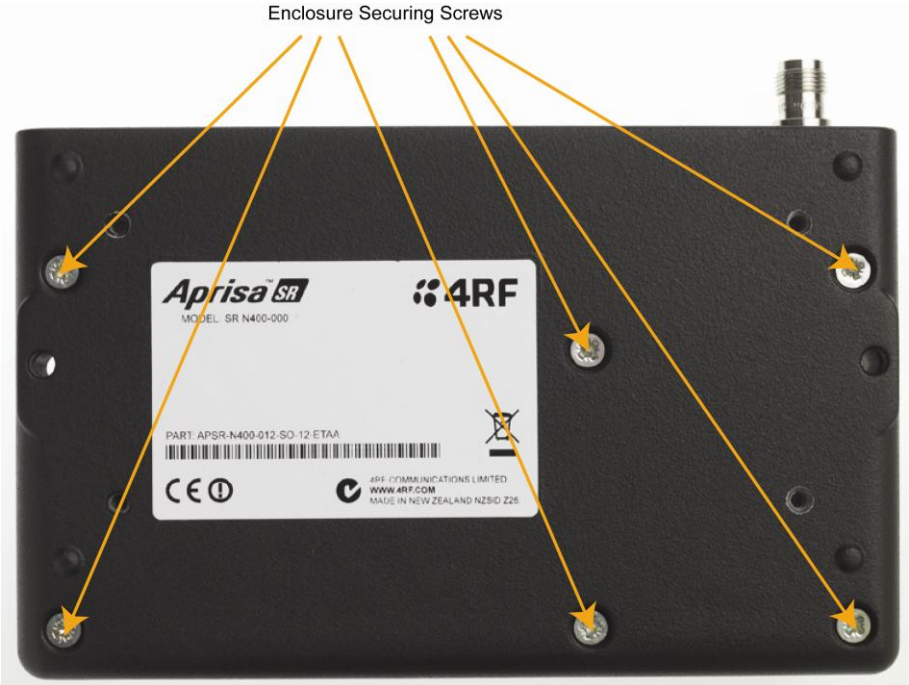
Part Number	Part Description
APSA-P230-030-24-TS	4RF Aprisa SR Acc, PSU, 230 VAC, 30W, 24 VDC, -10 to +60C
APSA-P230-048-24-TE	4RF Aprisa SR Acc, PSU, 230 VAC, 48W, 24 VDC, -20 to +75C
APSA-P230-060-24-TS	4RF Aprisa SR Acc, PSU, 230 VAC, 60W, 24 VDC, -10 to +60C
APSA-P48D-050-24-TA	4RF Aprisa SR Acc, PSU, 48 VDC, 50W, 24 VDC, 0 to +50C

Spare Fuses

The Aprisa SR PBA contains two fuses in the power input with designators F2 and F3. Both the positive and negative power connections are fused. The fuse type is a Littelfuse 0453005 with a rating of 5 A, 125 V, very fast acting.

To replace the fuses:

1. Remove the input power and antenna cable.
2. Unscrew the enclosure securing screws (posi 2).



2. Separate the enclosure halves.

CAUTION: Antistatic precautions must be taken as the internal components are static sensitive.

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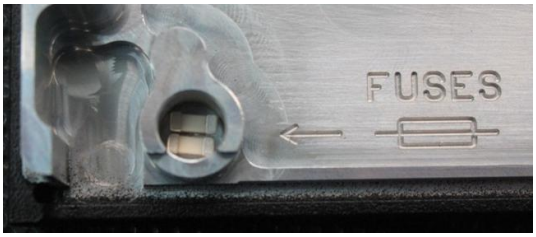
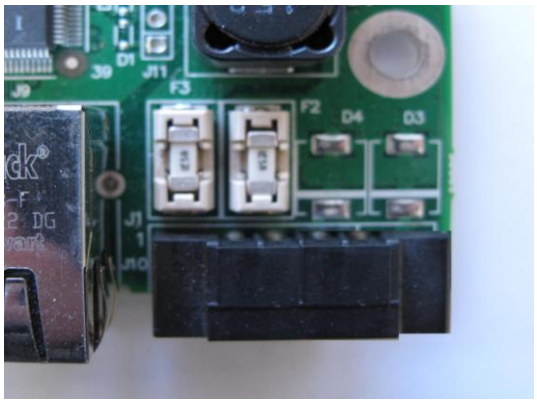
3. Access the enclosure spare fuses under the plastic cap.



4. Replace the two fuses.



5. Close the enclosure and tighten the screws.

Note: Is it critical that the screws are re-tightened to 1.2 Nm. The transmitter adjacent channel performance can be degraded if the screws are not tightened correctly.

Additional Spare Fuses

Additional spare fuses can be ordered from 4RF:

Part Number	Part Description
APSA-FNAN-453-05-02	4RF Aprisa SR Acc, Fuse, Nano SMF, 453 Series, 5A, 2 items

8. Managing the Radio

SuperVisor

The Aprisa SR contains an embedded web server application (SuperVisor) to enable element management with any major web browser (such as Mozilla Firefox or Microsoft® Internet Explorer).

SuperVisor enables operators to configure and manage the Aprisa SR base station radio and repeater / remote station radios over the radio link.

The key features of SuperVisor are:

- Full element management, configuration and diagnostics
- Manage the entire network from the Base Station (remote management of elements)
- Managed network software distribution and upgrades
- Performance and alarm monitoring of the entire network, including RSSI, alarm states, time-stamped events, etc.
- View and set standard radio configuration parameters including frequencies, transmit power, channel access, serial, Ethernet port settings
- Set and view security parameters
- User management

Connecting to SuperVisor

The predominant management connection to the Aprisa SR radio is with an Ethernet interface using standard IP networking. There should be only one Ethernet connection from any radio in the network to the management network.

The Aprisa SR has a factory default IP address of 169.254.50.10 with a subnet mask of 255.255.0.0. This is an IPv4 Link Local (RFC3927) address which simplifies the connection to a PC.

Each radio in the network must be set up with a unique IP address on the same subnet.

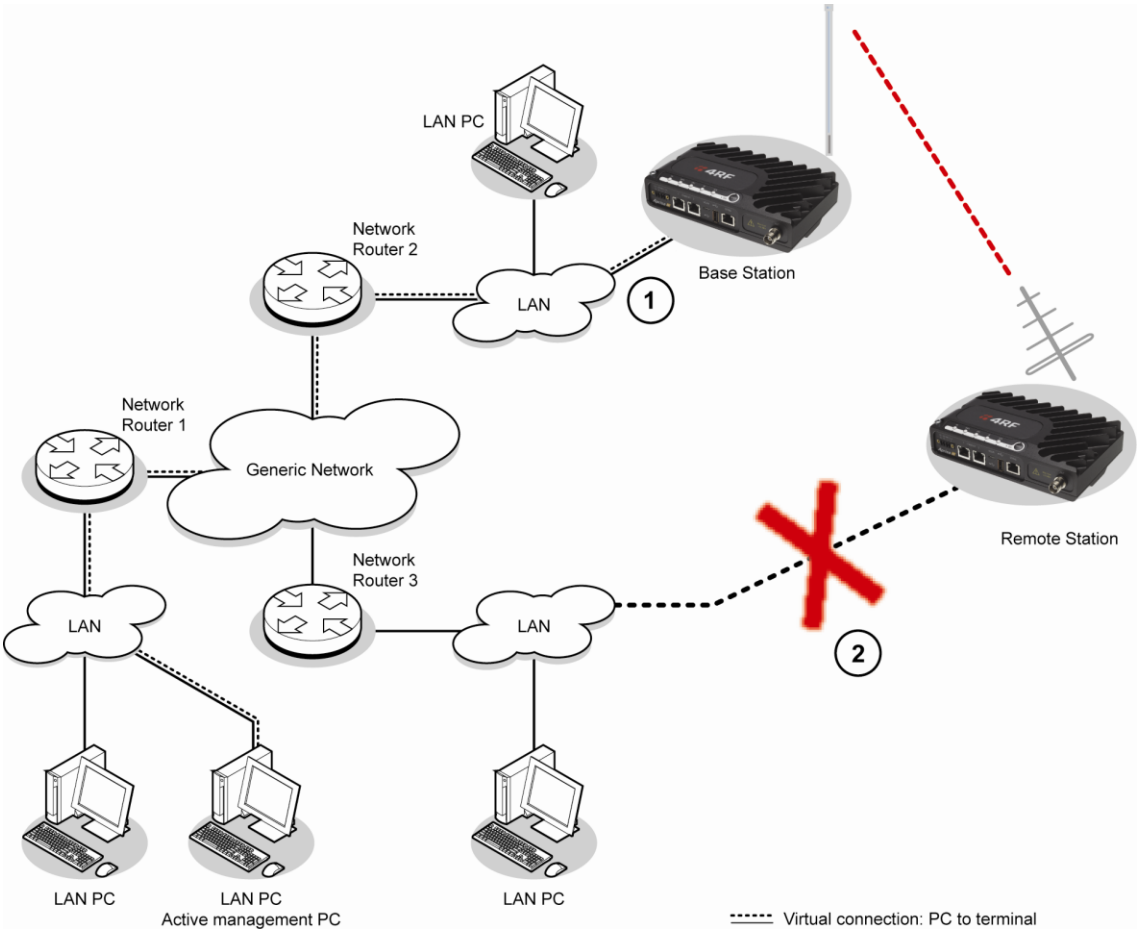
The Aprisa SR Protected Station radio A (left radio) has a factory default IP address of 169.254.50.10 and radio B (right radio) has a factory default IP address of 169.254.50.20, both with a subnet mask of 255.255.0.0.

To change the Aprisa SR IP address:

1. Set up your PC for a compatible IP address e.g. 169.254.50.1 with a subnet mask of 255.255.0.0.
2. Connect your PC network port to one of the Aprisa SR Ethernet ports.
3. Open a browser and enter http://169.254.50.10.
4. Login to the radio with the default Username ‘admin’ and Password ‘admin’.
5. Change the IP address to conform to the network plan in use.

Management PC Connection

The active management PC must only have one connection to the network as shown by path ①. There should not be any alternate path that the active management PC can use via an alternate router or alternate LAN that would allow the management traffic to be looped as shown by path ②.



When logging into a network, it is important to understand the relationship between the Local Radio and the Remote Radios.

The Local Radio is the radio that your IP network is physically connected to.

If the Local Radio is a base station, SuperVisor manages the base station and all the repeater stations and remote stations in the network.

If the Local Radio is a remote station or repeater station, SuperVisor only manages the remote / repeater station radio logged into.

If the user is at the remote station and connects SuperVisor directly to the remote radio via their computer, all relevant features are still available. This includes the ability to monitor the 'Last received packet RSSI. If ICMP is enabled on the base station, the user will also be able to ping the base station to confirm the connectivity.

PC Settings for SuperVisor

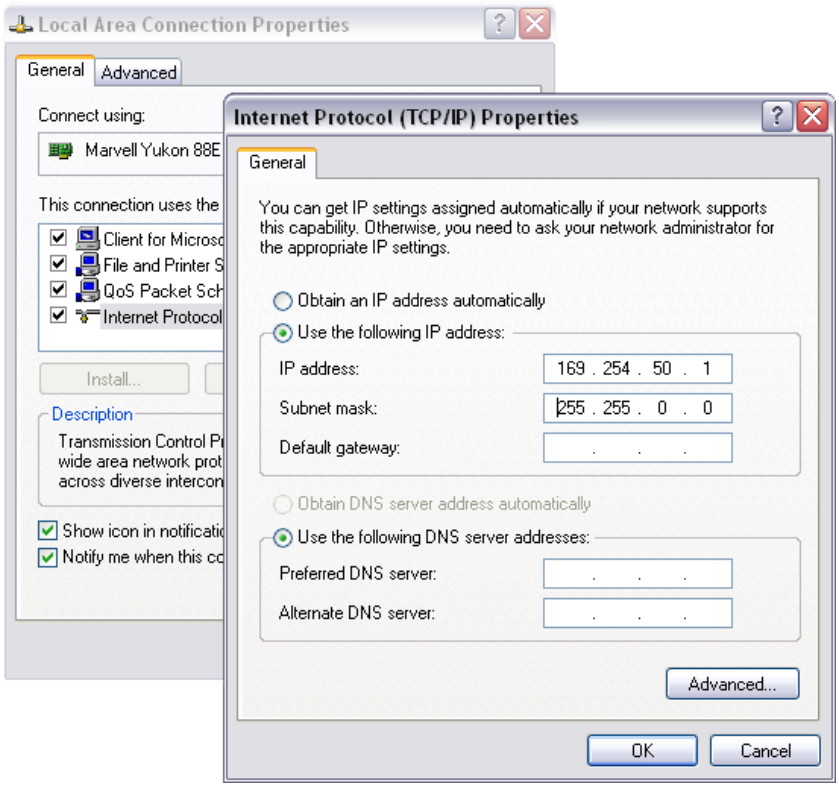
To change the PC IP address:

If your PC has previously been used for other applications, you may need to change the IP address and the subnet mask settings. You will require Administrator rights on your PC to change these.

Windows XP example:

1. Open the ‘Control Panel’.
2. Open ‘Network Connections’ and right click on the ‘Local Area Connection’ and select ‘Properties’.
3. Click on the ‘General’ tab.
4. Click on ‘Internet Protocol (TCP/IP)’ and click on properties.
5. Enter the IP address and the subnet mask (example as shown).
6. Click ‘OK’ then close the Control Panel.

If the radio is on a different subnet from the network the PC is on, set the PC default gateway address to the network gateway address which is the address of the router used to connect the subnets (for details, consult your network administrator).

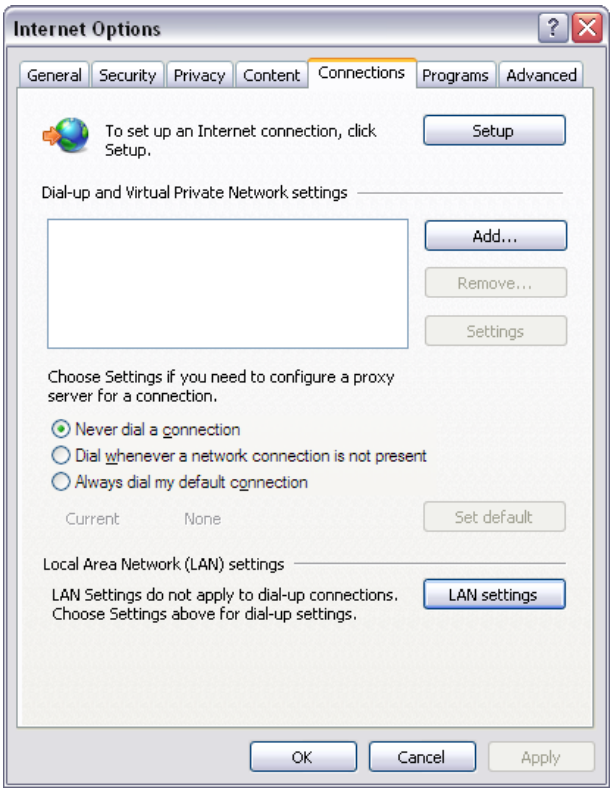


To change the PC connection type:

If your PC has previously been used with Dial-up connections, you may need to change your PC Internet Connection setting to 'Never dial a connection'.

Windows Internet Explorer 8 example:

1. Open Internet Explorer.
2. Open the menu item Tools > Internet Options and click on the 'Connections' tab.
3. Click the 'Never dial a connection' option.

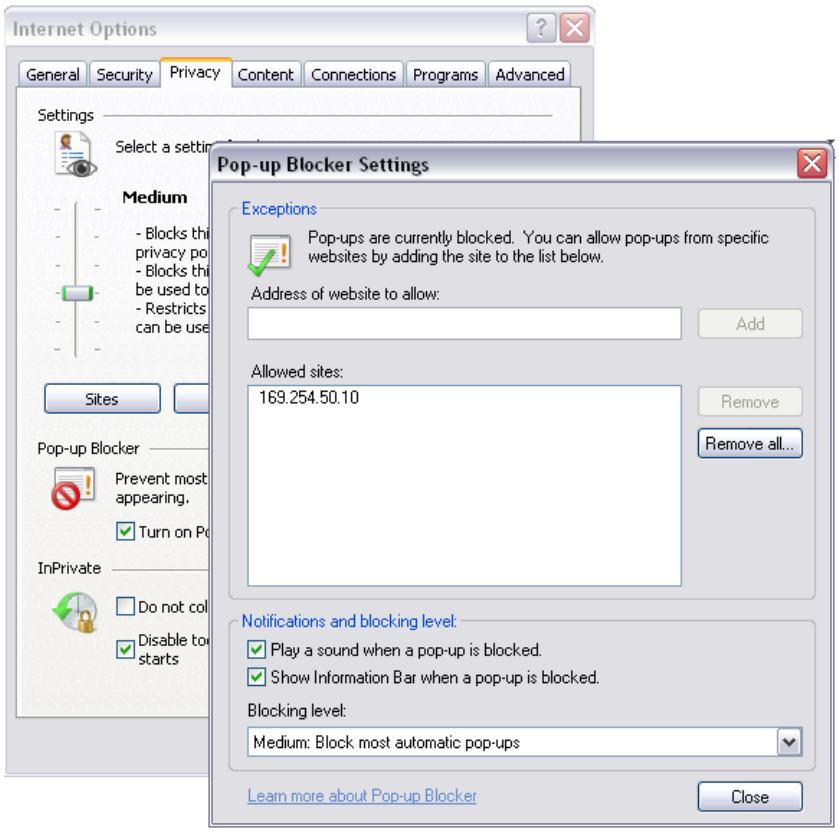


To change the PC pop-up status:

Some functions within SuperVisor require Pop-ups enabled e.g. saving a MIB

Windows Internet Explorer 8 example:

1. Open Internet Explorer.
2. Open the menu item Tools > Internet Options and click on the 'Privacy' tab.
3. Click on 'Pop-up Blocker Settings'.
4. Set the 'Address of Web site to allow' to the radio address or set the 'Blocking Level' to 'Low: Allow Pop-ups from secure sites' and close the window.

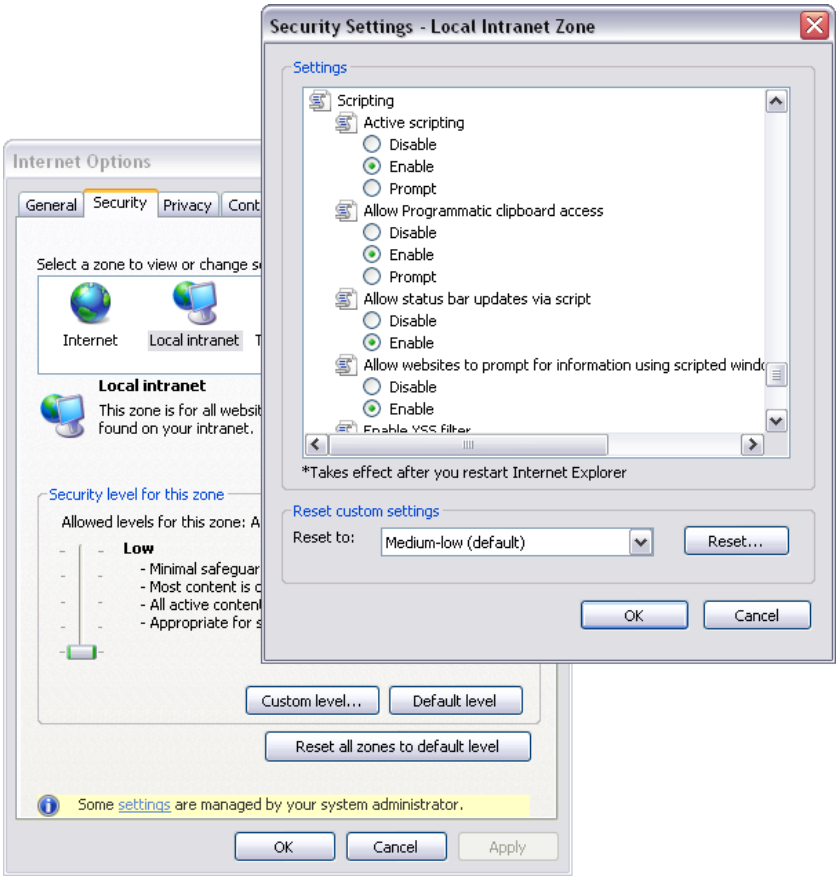


To enable JavaScript in the web browser:

Some functions within SuperVisor require JavaScript in the web browser to be enabled.

Windows Internet Explorer 8 example:

1. Open Internet Explorer.
2. Open the menu item Tools > Internet Options and click on the 'Security' tab.
3. Click on 'Local Intranet'.
4. Click on 'Custom Level'.
5. Scroll down until you see section labeled 'Scripting'.
6. Under 'Active Scripting', select 'Enable'.



Login to SuperVisor

The maximum number of concurrent users that can be logged into a radio is 6.

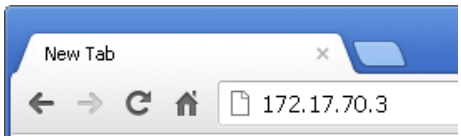
If SuperVisor is inactive for a period defined by the Inactivity Timeout option (see 'Maintenance > General' on page 134), the radio will automatically logout the user.

To login to SuperVisor:

1. Open your web browser and enter the IP address of the radio.

If you haven't assigned an IP address to the radio, use the factory default IP address of 169.254.50.10 with a subnet mask of 255.255.0.0.

If you don't know the IP address of the radio, you can determine it using the Command Line Interface (see 'Command Line Interface' on page 213).



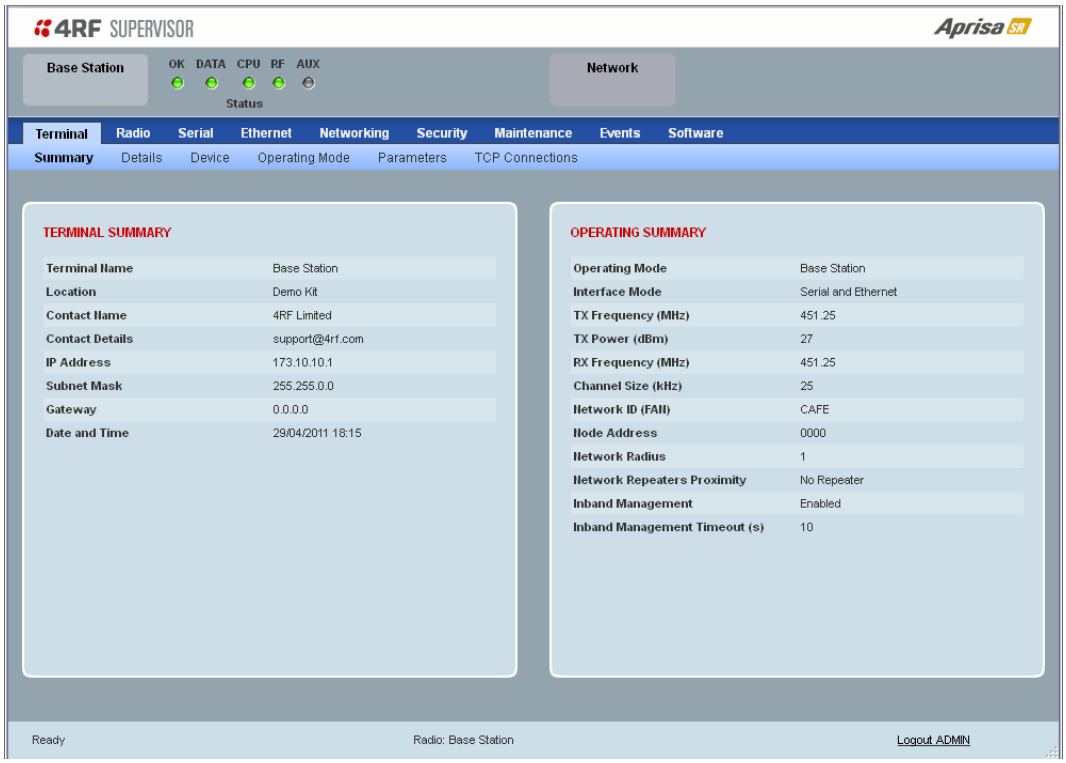
Note: The Aprisa SR has a Self Signed security certificate which may cause the browser to prompt a certificate warning. It is safe to ignore the warning and continue. The valid certificate is 'Issued By: 4RF-APRISA' which can be viewed in the browser.

2. Login with the Username and Password assigned to you.

If unique usernames and passwords have not yet been configured, use the default username 'admin' and password 'admin'.

Important: After you login for the very first time, it is recommended that you change the default admin password for security reasons (see 'Changing Passwords' on page 123).

If the login is successful, the opening page will be displayed.



Logout of SuperVisor

As the maximum number of concurrent users that can be logged into a radio is 6, not logging out correctly can restrict access to the radio until after the timeout period (30 minutes).

Logging out from a radio will logout all users logged in with the same username.

If the SuperVisor window is closed without logging out, the radio will automatically log the user out after a timeout period of 3 minutes.

To logout of SuperVisor:

Click on the ‘Logout’ button on the Summary Bar.

SuperVisor Page Layout

Standard Radio

The following shows the components of the SuperVisor page layout for a standard radio:

SuperVisor Branding Bar

The branding bar at the top of the SuperVisor frame shows the branding of SuperVisor on the left and the product branding on the right.

SuperVisor Alarm Bar

The alarm bar shows the name of the radio terminal that SuperVisor is logged into (the local radio) on the left.

If the local radio is a base station, the page shows the name of the current remote / repeater station (the remote radio) on the right. SuperVisor will manage all the repeater stations and remote stations in the network.

If the local radio is a remote station or repeater station, the page shows the name of the remote / repeater station on the left. The right side of the Alarm Bar will be blank. SuperVisor manages only the remote / repeater station logged into.

The LED alarm indicators reflect the status of the front panel LEDs on the radio.

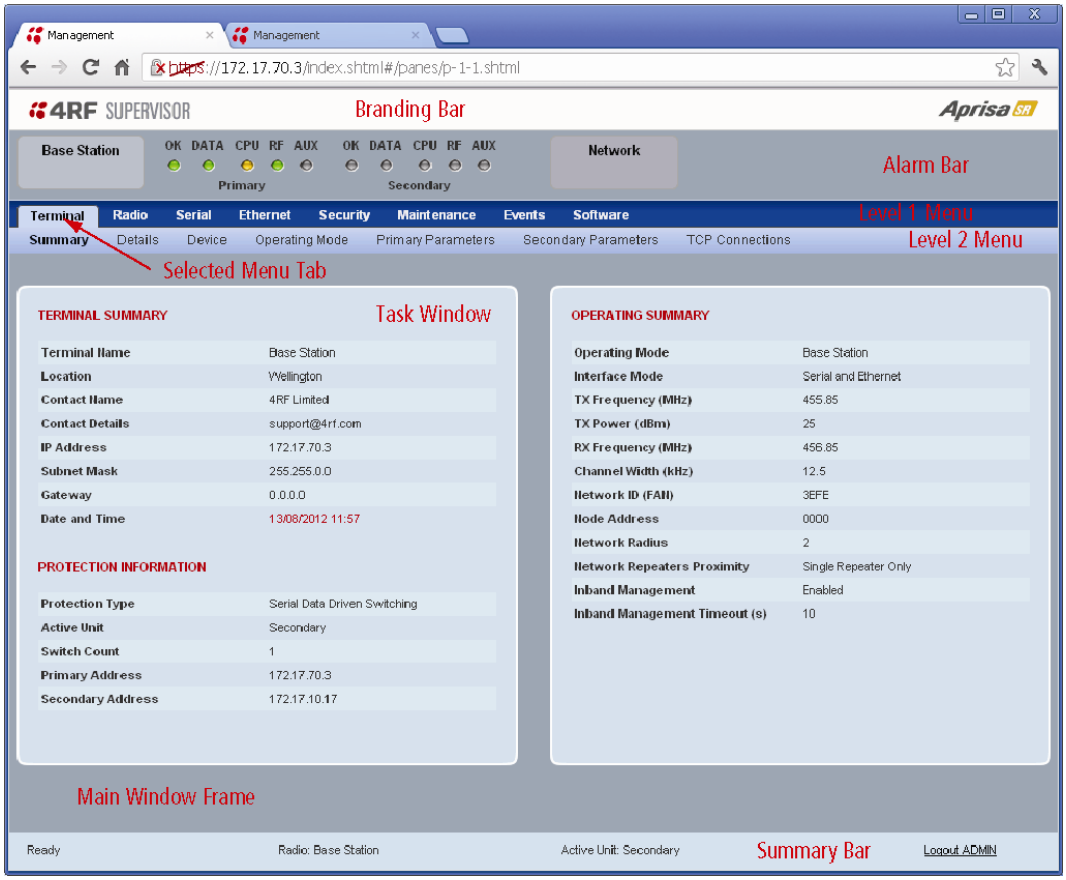
SuperVisor Summary Bar

The summary bar at the bottom of the page shows:

Position	Function
Left	Busy - SuperVisor is busy retrieving data from the radio that SuperVisor is logged into. Ready - SuperVisor is ready to manage the radio.
Middle	Displays the name of the radio terminal that SuperVisor is currently managing.
Right	The access level logged into SuperVisor. This label also doubles as the SuperVisor logout button.

Protected Station

The following shows the components of the SuperVisor page layout for a protected station:



SuperVisor Branding Bar

The branding bar at the top of the SuperVisor frame shows the branding of SuperVisor on the left and the product branding on the right.

SuperVisor Alarm Bar

The alarm bar shows the name of the radio terminal that SuperVisor is logged into (the local radio) on the left.

If the local radio is a base station, the page shows the name of the current remote / repeater station (the remote radio) on the right. SuperVisor will manage all the repeater stations and remote stations in the network.

If the local radio is a remote station or repeater station, the page shows the name of the remote / repeater station on the left. The right side of the Alarm Bar will be blank. SuperVisor manages only the remote / repeater station logged into.

The LED alarm indicators reflect the status of the front panel LEDs on the primary and secondary radios.

SuperVisor Summary Bar

The summary bar at the bottom of the page shows:

Position	Function
Left	Busy - SuperVisor is busy retrieving data from the radio that SuperVisor is logged into. Ready - SuperVisor is ready to manage the radio.
Middle	Displays the name of the radio terminal that SuperVisor is currently managing and the active radio.
Right	The access level logged into SuperVisor. This label also doubles as the SuperVisor logout button.

SuperVisor Menu

The following is a list of SuperVisor top level menu items:

Local Terminal	Network
	Network Table
Terminal	Summary
Radio	Exceptions
Serial	View
Ethernet	
Networking	
Security	
Maintenance	
Events	
Software	

SuperVisor Parameter Settings

Changes to parameters settings have no effect until the ‘Save’ button is clicked.

Click the ‘Save’ button to apply the changes or ‘Cancel’ button to restore the current value.

SuperVisor Menu Access

The SuperVisor menu has varying access levels dependant on the login User Privileges.

The following is a list of all possible SuperVisor menu items versus user privileges:

Terminal Settings Menu Items

Menu Item	View	Technician	Engineer	Admin
Terminal > Summary	Read-Only	Read-Only	Read-Only	Read-Only
Terminal > Details	Read-Only	Read-Only	Read-Only	Read-Only
Terminal > Device	No Access	Read-Write	Read-Write	Read-Write
Terminal > Operating Mode	No Access	Read-Write	Read-Write	Read-Write
Terminal > Parameters	Read-Only	Read-Only	Read-Only	Read-Only
Terminal > Primary Parameters	Read-Only	Read-Only	Read-Only	Read-Only
Terminal > Secondary Parameters	Read-Only	Read-Only	Read-Only	Read-Only
Terminal > TCP Connections	Read-Only	Read-Only	Read-Only	Read-Only
Radio > Radio Summary	Read-Only	Read-Only	Read-Only	Read-Only
Radio > Channel Summary	Read-Only	Read-Only	Read-Only	Read-Only
Radio > Radio Setup	No Access	Read-Write	Read-Write	Read-Write
Radio > Channel Setup	No Access	Read-Write	Read-Write	Read-Write
Serial > Summary	Read-Only	Read-Only	Read-Only	Read-Only
Serial > Port Setup	No Access	Read-Write	Read-Write	Read-Write
Ethernet > Summary	Read-Only	Read-Only	Read-Only	Read-Only
Ethernet > Port Setup	No Access	Read-Write	Read-Write	Read-Write
Ethernet > L2 Filtering	No Access	No Access	Read-Write	Read-Write
Networking > IP Summary	Read-Only	Read-Only	Read-Only	Read-Only
Networking > IP Setup	No Access	Read-Write	Read-Write	Read-Write
Networking > L3 Filtering	No Access	No Access	Read-Write	Read-Write
Security > Summary	Read-Only	Read-Only	Read-Only	Read-Only
Security > Users	No Access	No Access	No Access	Read-Write
Security > Settings	No Access	No Access	Read-Write	Read-Write
Security > SNMP	No Access	No Access	No Access	Read-Write
Security > Manager	No Access	No Access	Read-Write	Read-Write
Security > Distribution	No Access	No Access	Read-Write	Read-Write
Maintenance > Summary	Read-Only	Read-Only	Read-Only	Read-Only
Maintenance > General	No Access	Read-Write	Read-Write	Read-Write
Maintenance > Test Mode	No Access	Read-Write	Read-Write	Read-Write
Maintenance > Defaults	No Access	No Access	No Access	Read-Write
Maintenance > Protection	No Access	Read-Write	Read-Write	Read-Write
Maintenance > Licence	No Access	No Access	Read-Write	Read-Write
Maintenance > Advanced	No Access	No Access	Read-Write	Read-Write

Events > Alarm Summary	Read-Only	Read-Only	Read-Only	Read-Only
Events > Event History	Read-Only	Read-Only	Read-Only	Read-Only
Events > Event Primary History	Read-Only	Read-Only	Read-Only	Read-Only
Events > Event Secondary History	Read-Only	Read-Only	Read-Only	Read-Only
Events > Events Setup	No Access	No Access	Read-Write	Read-Write
Events > Traps Setup	No Access	No Access	Read-Write	Read-Write
Events > Alarm I/O Setup	Read-Only	Read-Only	Read-Write	Read-Write
Events > Defaults	No Access	No Access	Read-Write	Read-Write
Software > Summary	Read-Only	Read-Only	Read-Only	Read-Only
Software > File Transfer	No Access	No Access	Read-Write	Read-Write
Software > File Primary Transfer	No Access	No Access	Read-Write	Read-Write
Software > File Secondary Transfer	No Access	No Access	Read-Write	Read-Write
Software > Manager	No Access	No Access	Read-Write	Read-Write
Software > Setup	No Access	No Access	Read-Write	Read-Write
Software > Remote Distribution	No Access	No Access	Read-Write	Read-Write
Software > Remote Activation	No Access	No Access	Read-Write	Read-Write

Network Settings Menu Items

Menu Item	View	Technician	Engineer	Admin
Network Table	Read-Only	Read-Only	Read-Only	Read-Only
Summary	Read-Only	Read-Only	Read-Only	Read-Only
Exceptions	Read-Only	Read-Only	Read-Only	Read-Only
View	Read-Only	Read-Only	Read-Only	Read-Only

SuperVisor Menu Items

As SuperVisor screens are dependent on the Aprisa SR configuration deployed, the following section is split into two sections:

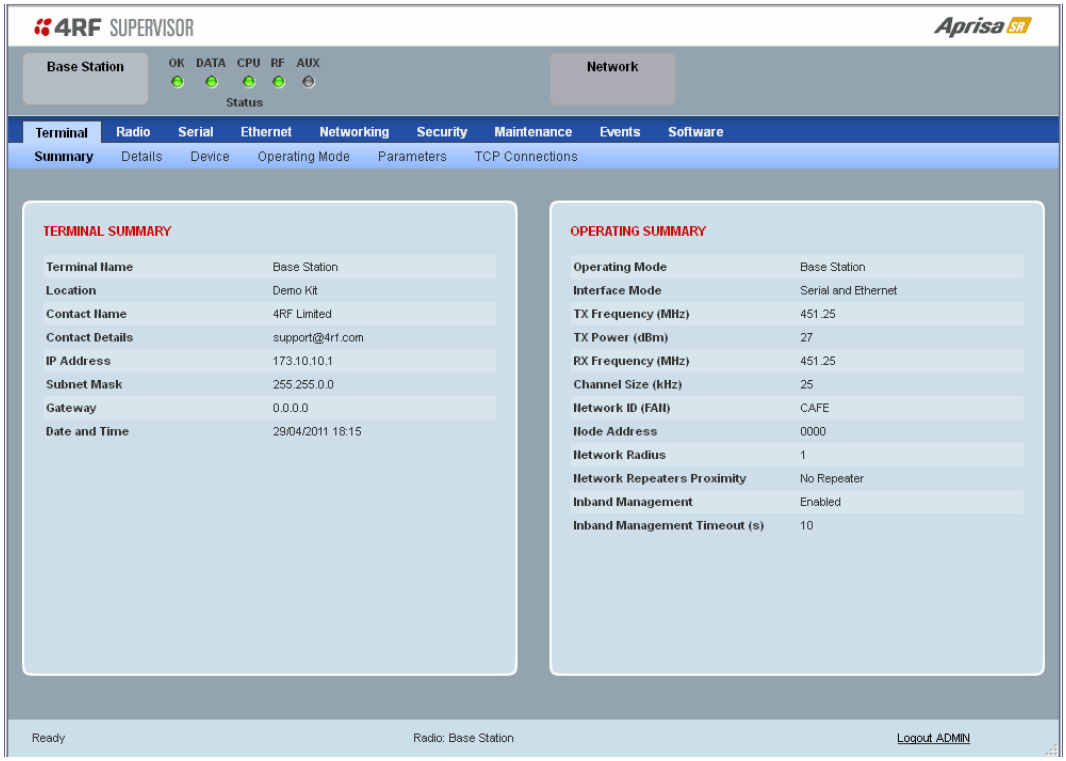
- Standard Radio
- Protected Station

All SuperVisor menu item descriptions assume full access ‘Admin’ user privileges:

Standard Radio

Terminal

Terminal > Summary



TERMINAL SUMMARY

This page displays the current settings for the Terminal parameters.

OPERATING SUMMARY

Operating Mode

This parameter displays the current Operating Mode i.e. if the radio is operating as a base station, repeater station or remote station.

Interface Mode

This parameter displays the Interfaces available for traffic on the radio (see ‘Maintenance > Licence’ on page 140).

TX Frequency (MHz)

This parameter displays the current Transmit Frequency in MHz.

TX Power (dBm)

This parameter displays the current Transmit Power in dBm.

RX Frequency (MHz)

This parameter displays the current Receive Frequency in MHz.

Channel Width (kHz)

This parameter displays the current Channel Width in kHz.

Network ID

This parameter is the network ID of this base station node and its remote / repeater stations in the network. The entry is four hex chars (not case sensitive).

Node Address

The Node Address of the base station is 0000.

If the Node Address shown is FFFE, this radio is a remote station or repeater station but has not been registered with the base station.

The base station will automatically allocate a Node Address to all its registered repeater station and remote station radios. This address can be between 000B to 01FE.

Network Radius

This parameter displays the maximum number of hops in this network.

Network Repeaters Proximity

This parameter displays the proximity of repeaters in the network.

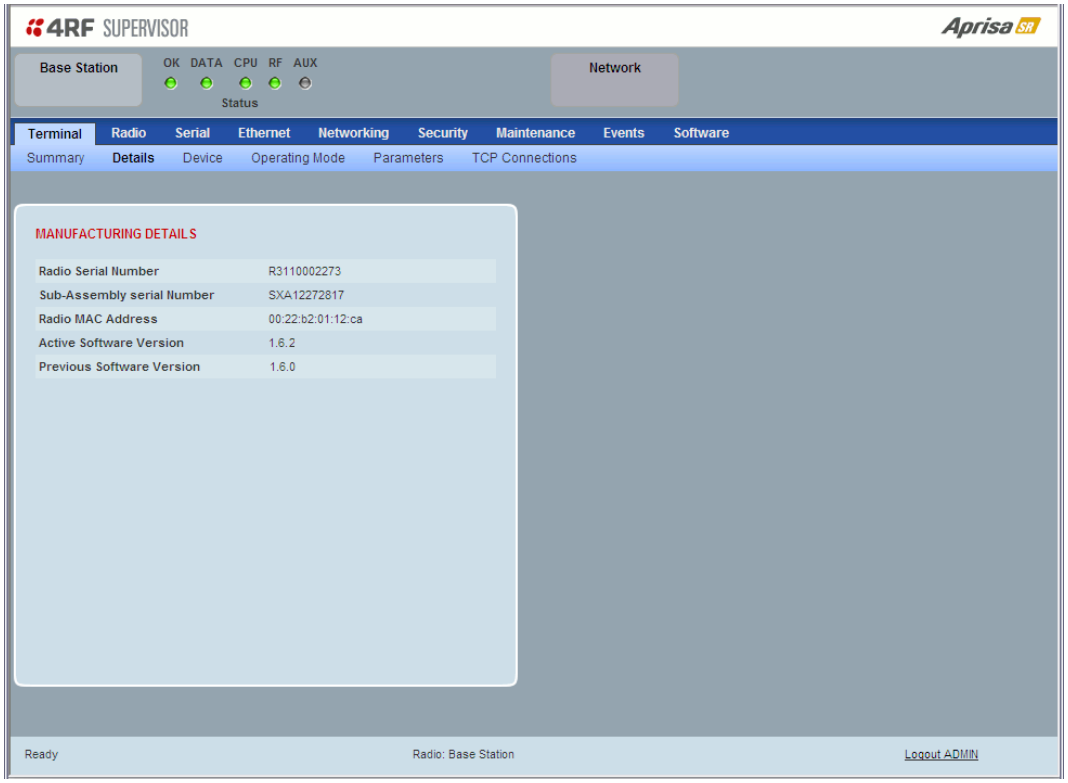
Inband Management

This parameter displays the status of the Inband Management option.

Inband Management Timeout (sec)

This parameter displays the number of seconds that the base station waits for a response from a Remote or repeater station before aborting the Inband Management request.

Terminal > Details



MANUFACTURING DETAILS

Radio Serial Number

This parameter displays the Serial Number of the radio (shown on the enclosure label).

Sub-Assembly Serial Number

This parameter displays the Serial Number of the printed circuit board assembly (shown on the PCB label).

Radio MAC Address

This parameter displays the MAC address of the radio.

Active Software Version

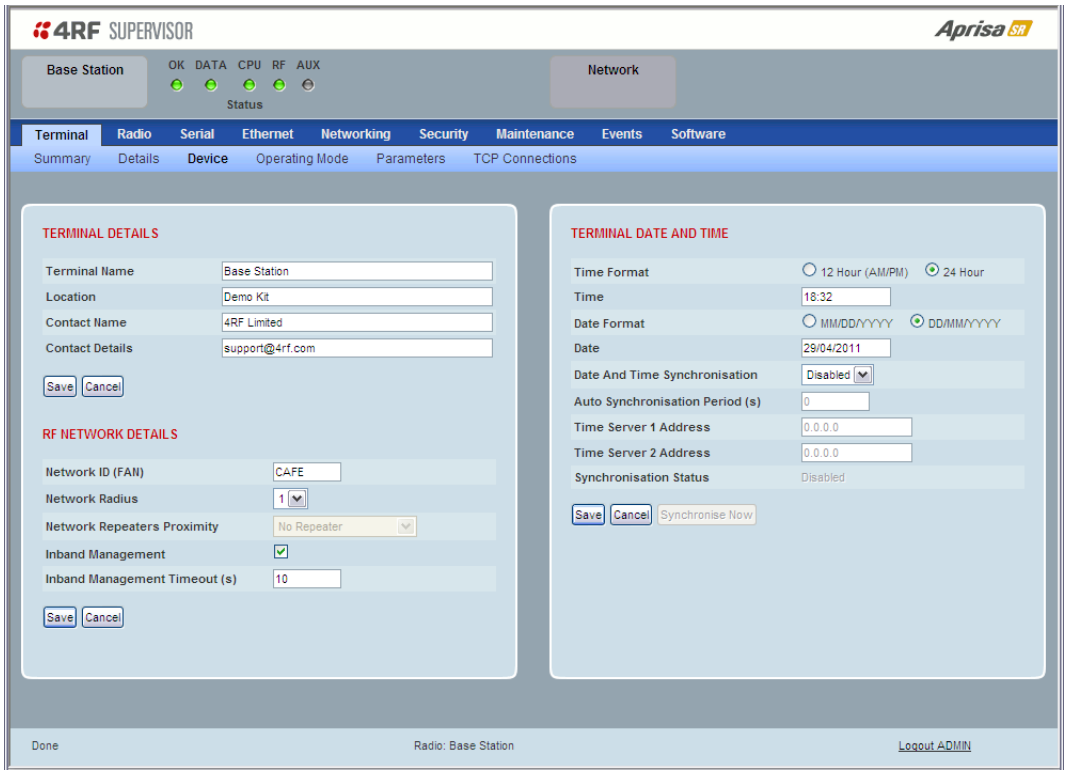
This parameter displays the version of the software currently operating the radio.

Previous Software Version

This parameter displays the software version that was running on the radio prior to the current software being activated.

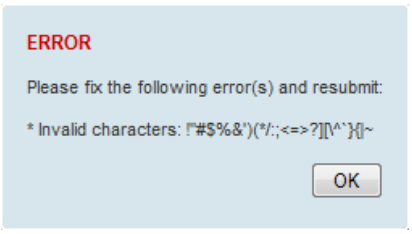
A new radio from the factory will display ‘None’ for the Previous SW Version.

Terminal > Device



TERMINAL DETAILS

The data entry in the next four fields can be up to 40 characters but cannot contain invalid characters. A popup warns of the invalid characters:



1. Enter the Terminal Name.
2. Enter the Location of the radio.
3. Enter a Contact Name. The default value is ‘support@4RF.com’.
4. Enter the Contact Details.

RF NETWORK DETAILS

Network ID (network)

This parameter sets the network ID of this base station node and its remote / repeater stations in the network. The entry is four hexadecimal chars (not case sensitive). The default setting is CAFE.

Network Radius

This parameter sets the maximum number of hops in this network e.g. if the Network Radius is set to 2, a message from that node will only pass 2 hops before it is blocked. The default setting is 1.

All stations in the network should be set to the same value.

Network Repeaters Proximity

This parameter is set in base stations and repeater stations to indicate the proximity of repeaters in the network. It has no affect if the Network Radius is set to 1.

The default setting is Separated Coverage.

Option	Function
No Repeater	Use when there are no repeaters in the network.
Single Repeater Only	Use when there is only one repeater in the network.
Overlapping Coverage	Use for multiple one hop repeaters where the remote station can see more than one repeater or repeaters can see each other. The communication protocol is slower because each repeater is addressed individually and in-turn.
Separated Coverage	Use for multiple one hop repeaters where the remote station can only see one repeater and the repeaters can't see each other. This option provides better network downlink performance than the Overlapping Coverage option. However, if the repeaters can see each other, the resultant collisions will cause corruptions and dramatically reduce network downlink performance.

Inband Management

This parameter sets the Inband Management option.

If the Inband Management option is enabled, SuperVisor operating on a base station can also manage all the remote / repeater stations in the network.

Inband Management Timeout (sec)

This parameter sets the Inband Management timeout period. This determines the time the base station waits for a response from a Remote or repeater station before aborting the Inband Management request. The default setting is 10 seconds.

TERMINAL DATE AND TIME

Set the Time Format, Time, Date Format and Date. This information is controlled from a software clock.

Date and Time Synchronization

This Date and Time Synchronization feature allows a radio to synchronize its date and time from an SNTP server. It would predominantly be used on the base station but could be used on a remote station.

Using the SNTP feature will ensure that all radios in the network has the same date and time required for accurate network diagnostics.

For high availability time/date synchronization, SNTP can be synchronized from two SNTP servers for server backup.

The default setting is Disabled.

Option	Function
Disabled	No SNTP Date and Time Synchronization
SNTP	Date and Time will be synchronized to a SNTP server

The base station periodically sends a broadcast message to the remote stations to synchronize the radio date and time.

Auto Synchronization Period (s)

This parameter sets the number of seconds between the end of the last synchronization and the next synchronization attempt. The minimum period is 60 seconds. A period of 0 seconds will disable synchronization attempts.

Time Server 1 Address

This parameter sets the IP address of the first priority SNTP server. If the synchronization is successful to this server, Time Server 2 Address will not be used.

Time Server 2 Address

This parameter sets the IP address of the second priority SNTP server. If the synchronization fails using the SNTP server on Time Server 1 Address, synchronization will be attempted to the SNTP server on this address.

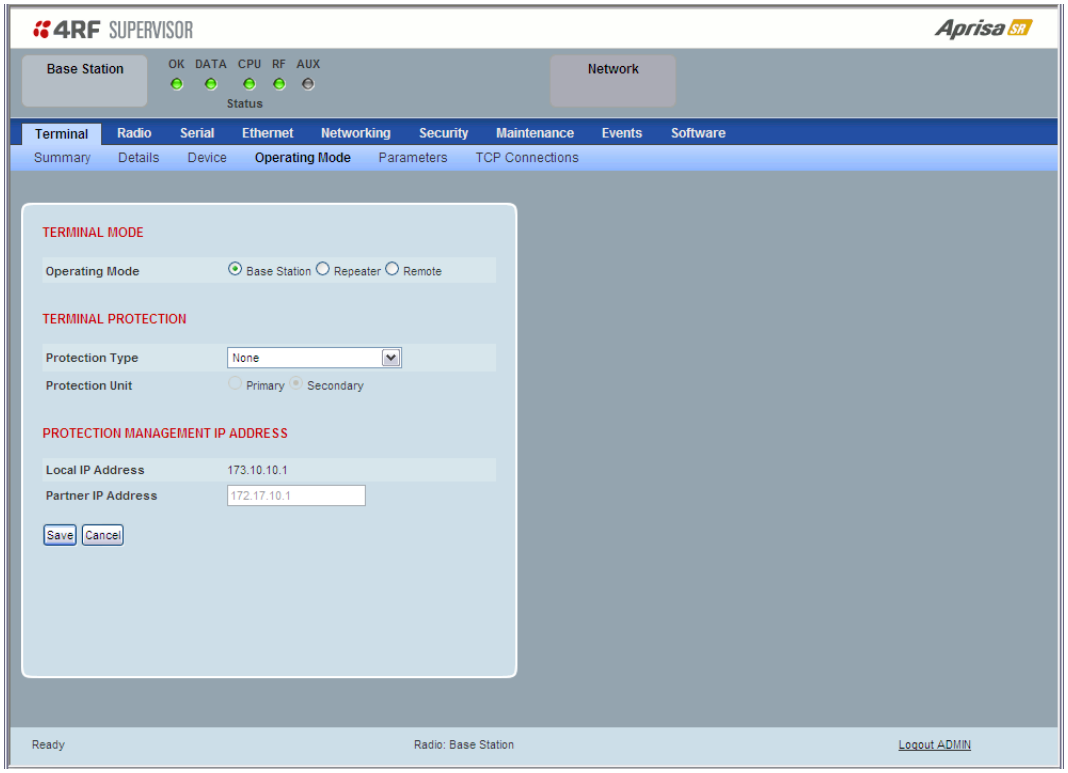
Synchronization Status

This field shows the status of the current synchronization or the result of the last synchronization.

Synchronize Now

This Synchronize Now button provides manual Synchronization.

Terminal > Operating Mode



TERMINAL MODE

Operating Mode

The Operating Mode can be set to base station, repeater station or remote station. The default setting is remote station.

TERMINAL PROTECTION

Protection Type

The Protection Type defines if a radio is a stand-alone radio or part of an Aprisa SR Protected Station. The default setting is None.

Option	Function
None	The SR radio is stand alone radio (not part of an Aprisa SR Protected Station).
Redundant (Protected Station)	Set to make this SR radio part of an Aprisa SR Protected Station. The RF ports and interface ports from two standard Aprisa SR Radios are switched to the standby radio if there is a failure in the active radio
Serial Data Driven Switching	Set to make this SR radio part of an Aprisa SR Data Driven Protected Station. Provides radio and RS-232 serial port user interface protection for Aprisa SR radios.

Protection Unit

The Protection Unit defines if this radio is the primary radio or secondary radio in a Protected Station.

One radio in the Protected Station is set to Primary and the other radio to Secondary.

It is recommended that radio A (the left radio) be configured as the Primary and that radio B (the right radio) be configured as the Secondary. The default setting is Primary.

This menu item is only applicable if this radio is to become part of an Aprisa SR Protected Station.

PROTECTION MANAGEMENT IP ADDRESS

Local IP Address

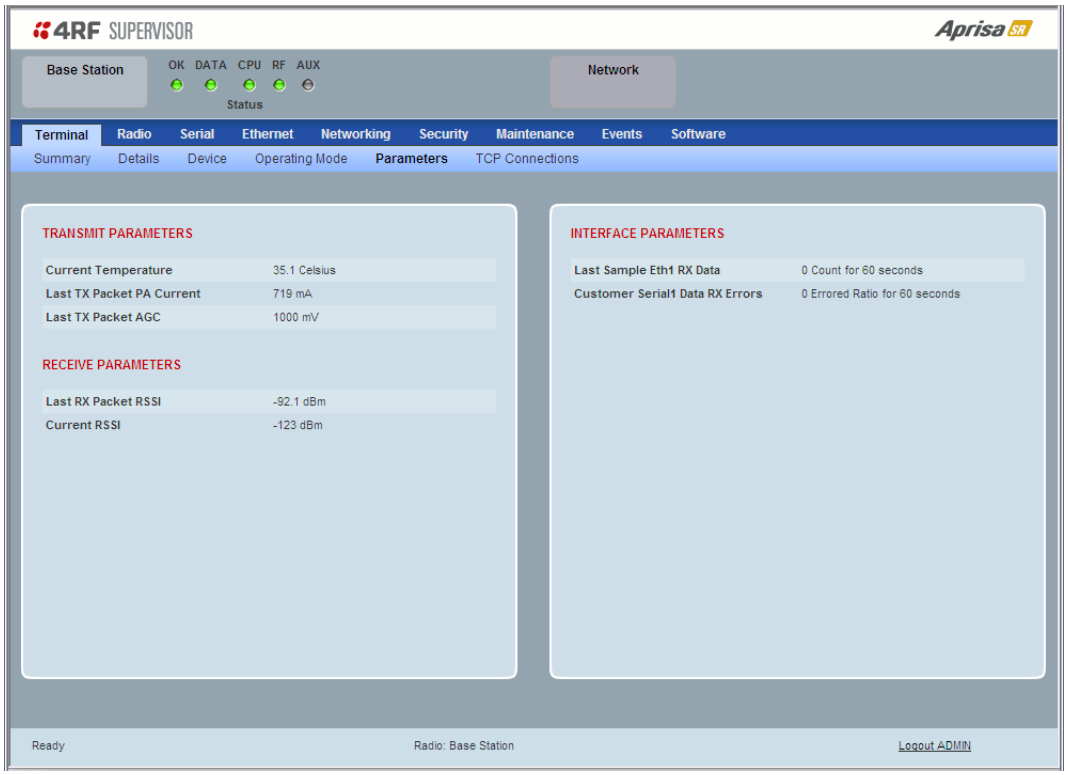
The Local IP Address shows the IP address of this radio.

Partner IP Address

The Partner IP Address parameter is used to set the partner IP address if this radio is to become part of a Protected Station.

Terminal > Parameters

The Parameters page is a dynamic page that will display the parameters associated with the active alarms, set on 'Events > Events Setup' on page 146. The screenshot below shows a small amount of monitored alarms as an example.



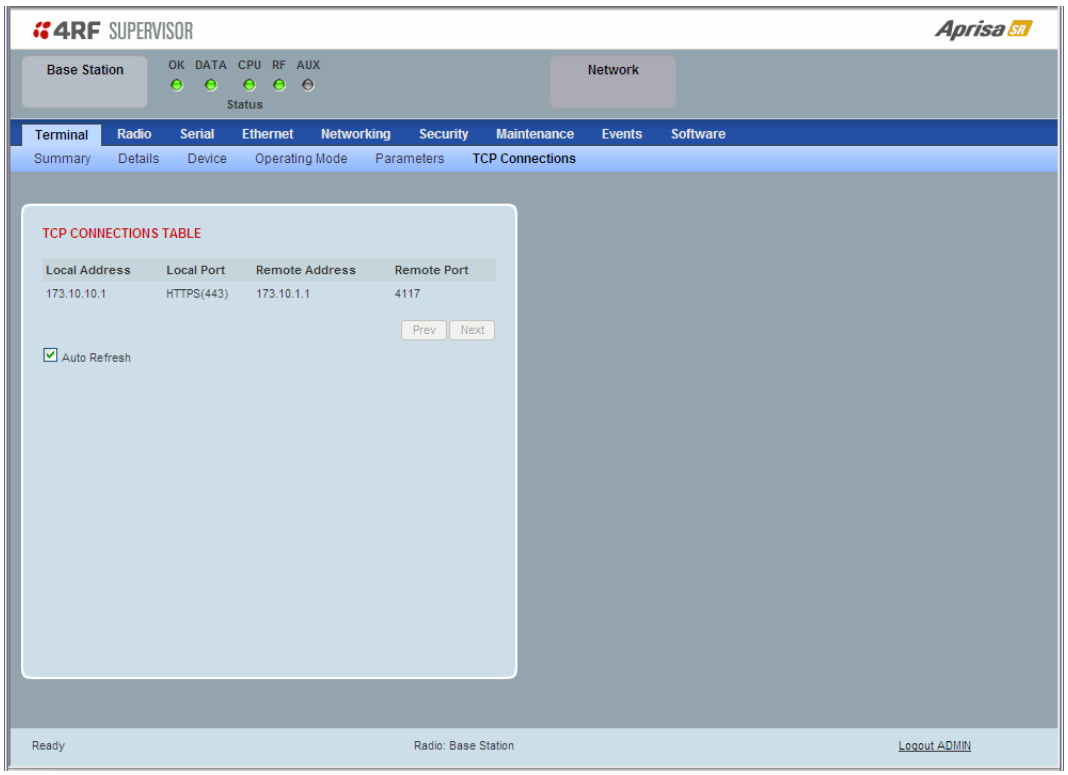
The following is a list of alarm events that are monitored:

Monitored Parameter	Unit	Event ID	Event Display Text
Current Temperature	Celsius	4	Temperature Threshold
Last RX Packet RSSI	dBm	7	RSSI Threshold
Last Sample RX CRC Error	Ratio	9	RX CRC Errors
Last Sample RF RX Data	Count	34	RF No Receive Data
Last Sample Eth1 RX Data	Count	10	Port 1 Eth No Receive Data
Customer Eth1 Data RX Errors	Ratio	11	Port 1 Eth Receive Errors
Customer Eth1 Data TX Errors	Ratio	12	Port 1 Eth Transmit Errors
Last Sample Eth2 RX Data	Count	35	Port 2 Eth No Receive Data
Customer Eth2 Data RX Errors	Ratio	36	Port 2 Eth Receive Errors
Customer Eth2 Data TX Errors	Ratio	37	Port 2 Eth Transmit Errors
Last Sample Serial1 RX Data	Count	13	Port1 Serial Data No RX Data
Customer Serial1 Data RX Errors	Ratio	14	Port1 Serial Data RX Errors
Customer USB Ser Data RX Errors	Ratio	14	Port1 Serial Data RX Errors
Last Sample USB Ser RX Data	Ratio	14	USB Port Serial Data No RX Data
Last TX Packet PA Current	mA	None	
Last TX Packet AGC	mV	None	
Last TX Packet Reverse Power	dB	None	
Current RSSI	dBm	None	

If an associated alarm event occurs, the Parameters table will display the current value for that parameter. The refresh time is 12 seconds.

Terminal > TCP Connections

The TCP Connections page displays the list of active TCP connections on the radio.



TCP CONNECTIONS TABLE

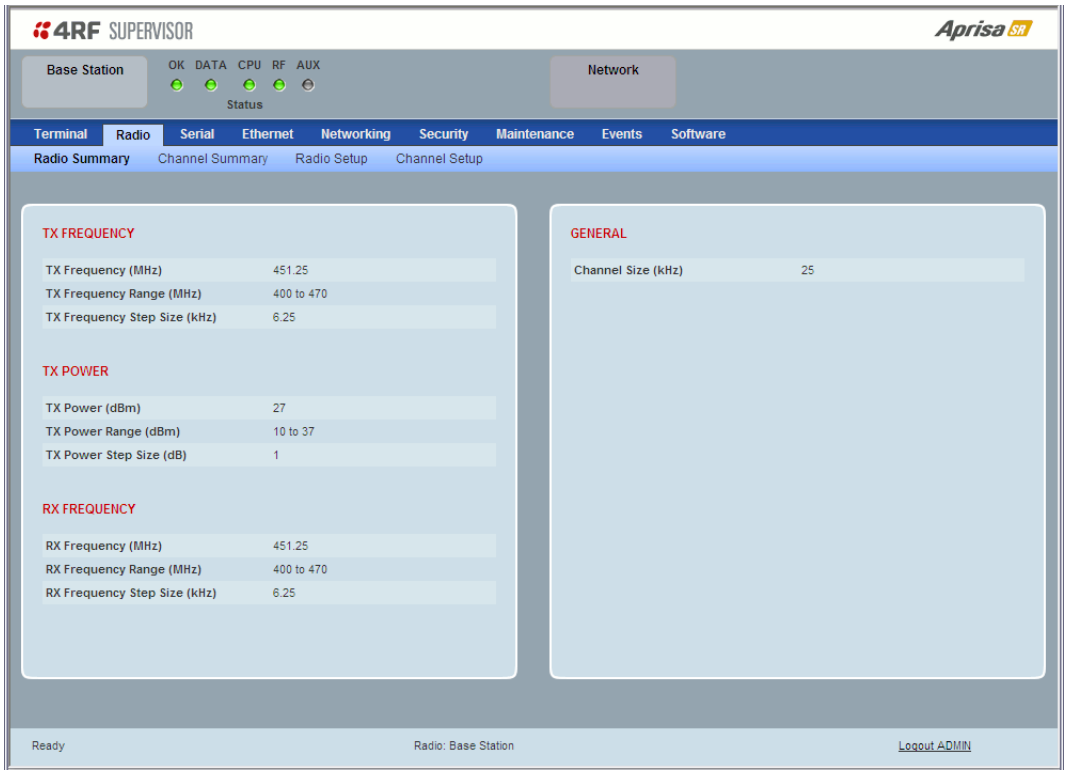
The Next button will display the next page of 8 connections and the Prev button will display the previous page of 8 connections.

If the Auto Refresh option is ticked, the TCP Connections table will refresh every 12 seconds.

Radio

Radio > Radio Summary

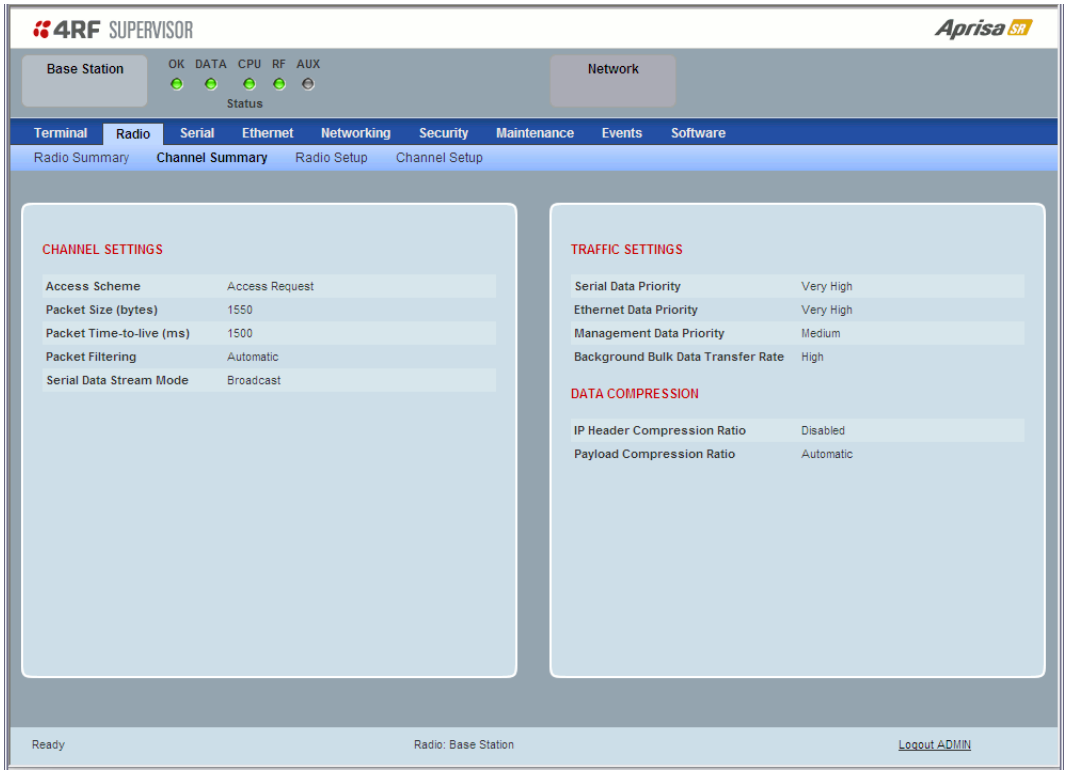
This page displays the current settings for the Radio parameters.



See ‘Radio > Radio Setup’ for setting details.

Radio > Channel Summary

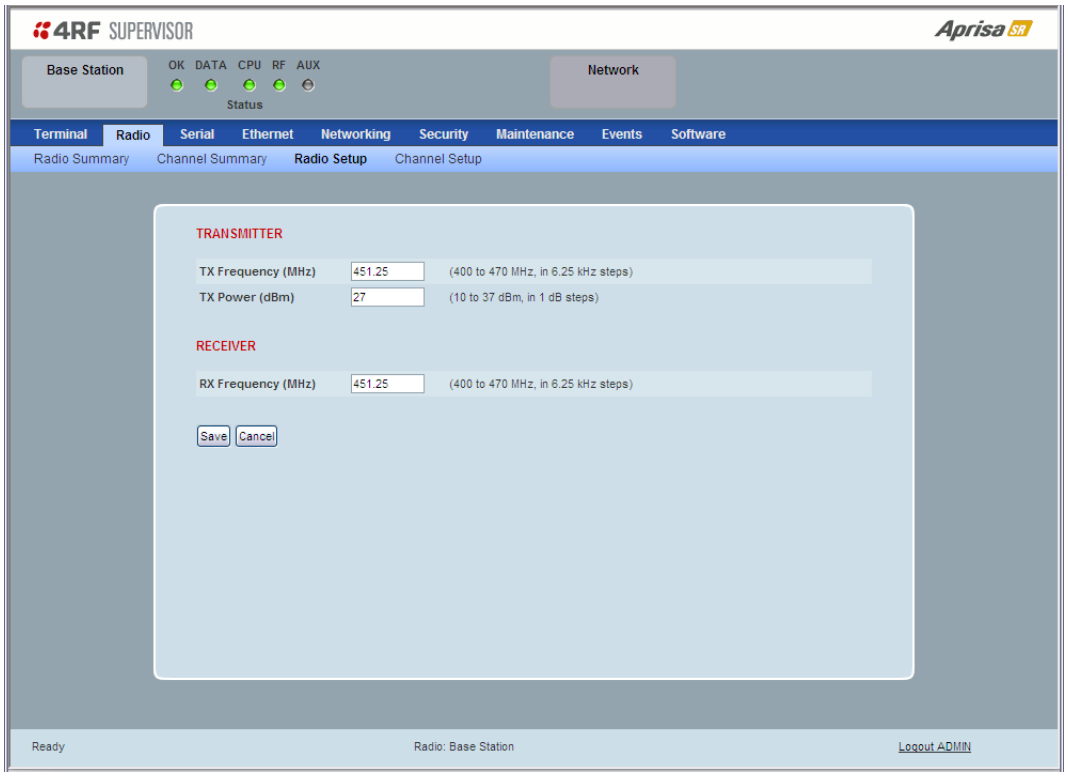
This page displays the current settings for the Channel parameters.



See ‘Radio > Channel Setup’ for setting details.

Radio > Radio Setup

Transmit frequency, transmit power and channel size would normally be defined by a local regulatory body and licensed to a particular user. Refer to your site license details when setting these fields.



TRANSMITTER / RECEIVER

Important:

1. Changing the remote / repeater station frequencies will disable all management communication to the remote / repeater stations but then by changing the base station to match the remote / repeater stations, the radio links will be restored as will the management communication.

2. Enter the TX frequency and the RX frequency and then click 'Save'. This is to prevent remote management communication from being lost before both frequencies have been changed in the remote stations.

TX and RX Frequencies.

The TX and RX frequencies entered must be within the frequency tuning range of the product frequency band (see 'Frequency Bands' on page 232).

If the frequency entered is not resolvable to the synthesizer step size for the frequency band it is rejected. For example; a 400 MHz radio has a synthesizer step size of 6.250 kHz.

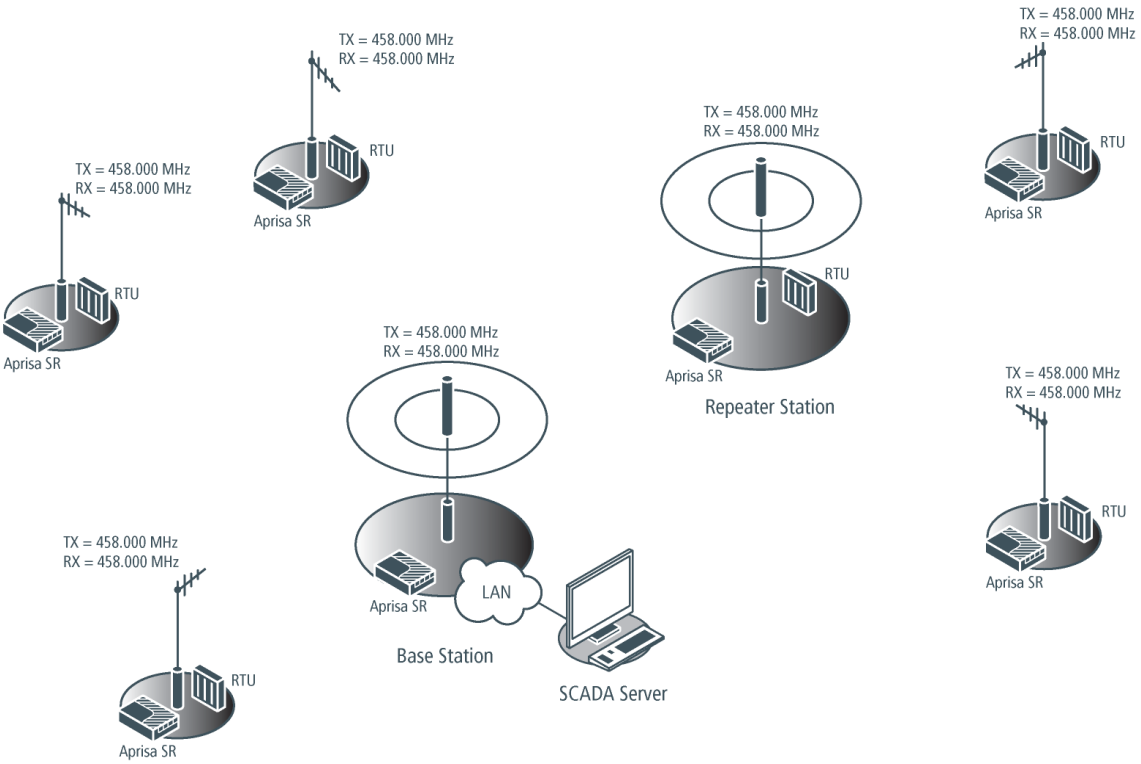
The default setting is 330 MHz for a UHF radio and 136 MHz for VHF radio.

The TX and RX frequencies can be single frequency ½ duplex or dual frequency ½ duplex. Dual frequency ½ duplex is often used for reasons of:

- Channel Planning
- Network Efficiencies
- Regulatory rules

Single Frequency Operation

The TX and RX frequencies of the base station, repeater station and all the remote stations are on the same frequency.



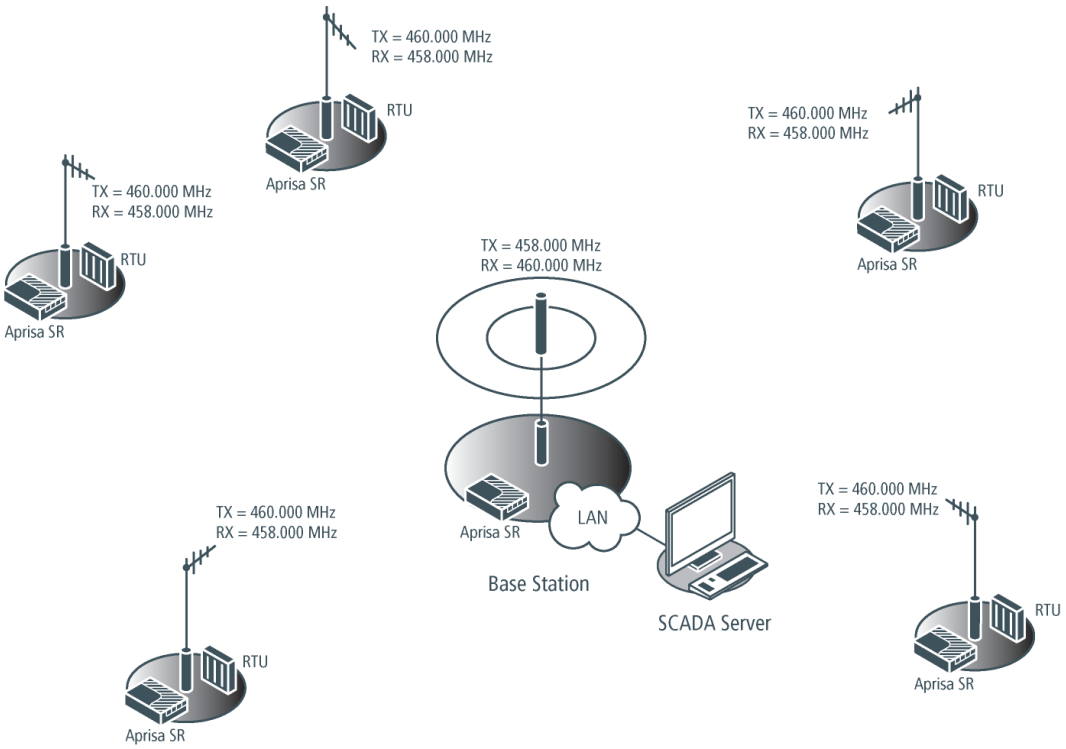
To change the TX and RX frequencies:

1. Change the TX and RX frequencies of the remote stations operating from the repeater station to the new frequency. The radio links to these remote stations will fail.
2. Change the TX and RX frequencies of the repeater station operating from the base station to the new frequency. The radio links to the repeater station and its remote stations will fail.
3. Change the TX and RX frequencies of the remote stations operating from the base station to the new frequency. The radio links to these remote stations will fail.
4. Change the TX and RX frequencies of the base station to the new frequency. The radio links to all stations will restore.

Dual Frequency No Repeater

The TX frequency of all the remote stations matches the RX frequency of the base station.

The RX frequency of all the remote stations matches the TX frequency of the base station.



To change the TX and RX frequencies:

1. For all the remote stations, change the RX frequency to frequency A and the TX frequency to frequency B. The radio links to the remote stations will fail.
2. For the base station, change the TX frequency to frequency A and the RX frequency to frequency B. The radio links to the remote stations will restore.

Dual Frequency with Repeater

The TX frequency of the remote stations associated with the base station matches the RX frequency of the base station.

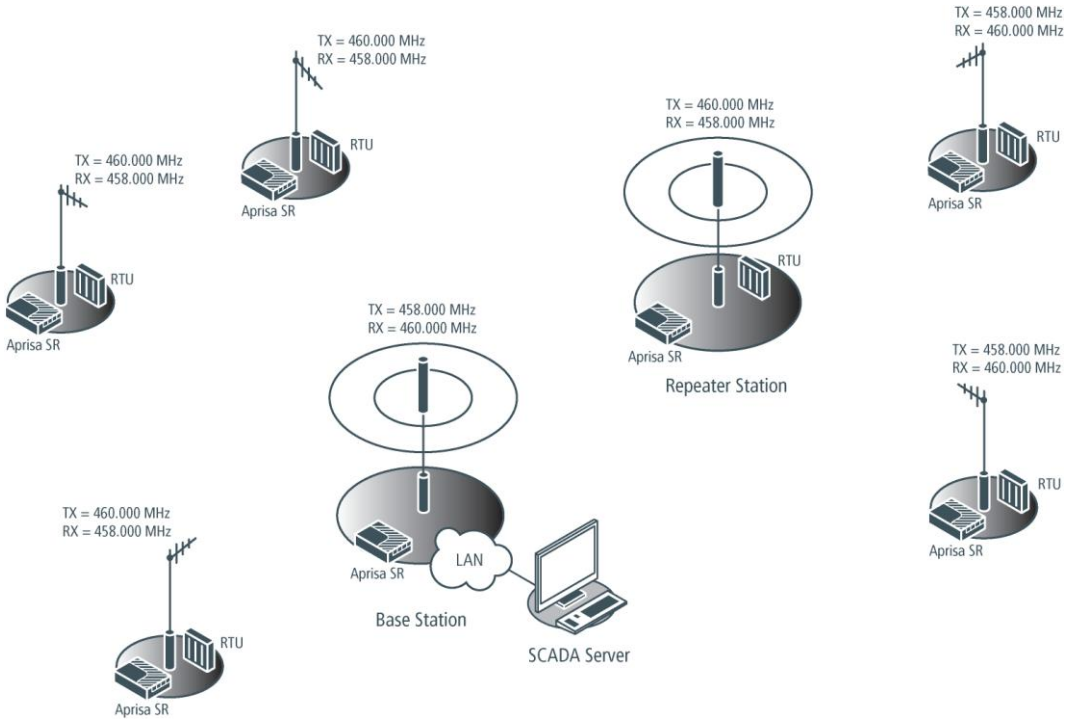
The TX frequency of the repeater station associated with the base station matches the RX frequency of the base station.

The TX frequency of the remote stations associated with the repeater station matches the RX frequency of the repeater station.

The RX frequency of the remote stations associated with the base station matches the TX frequency of the base station.

The RX frequency of the repeater station associated with the base station matches the TX frequency of the base station.

The RX frequency of the remote stations associated with the repeater station matches the TX frequency of the repeater station.



To change the TX and RX frequencies:

1. For all the remote stations operating from the repeater station, change the RX frequency to frequency A and the TX frequency to frequency B. The radio links to these remote stations will fail.
2. For the repeater station, change the TX frequency to frequency A and the RX frequency to frequency B.
3. For the base station, change the RX frequency to frequency A and the TX frequency to frequency B. The radio links to the remote stations operating from the repeater station will restore.
4. For all the remote stations operating from the base station, change the TX frequency to frequency A and the RX frequency to frequency B.

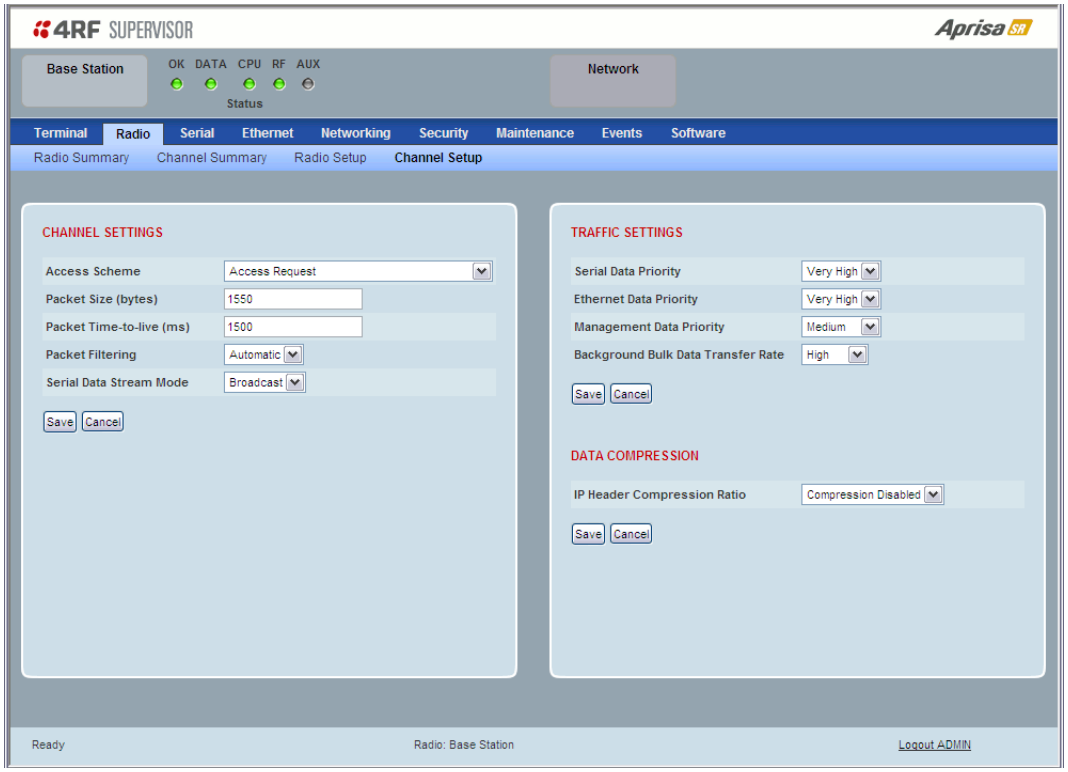
TX Power

The transmitter power is the power measured at the antenna output port when transmitting. The transmitter power has a direct impact on the radio power consumption (see ‘Power Consumption’ on page 236) and ‘Save’ the change.

The default setting is +37 dBm.

Note: The Aprisa SR transmitter contains power amplifier protection which allows the antenna to be disconnected from the antenna port without product damage.

Radio > Channel Setup



CHANNEL SETTINGS

Access Scheme

This parameter sets the Media Access Control (MAC) used by the radio for over the air communication.

Option	Function
Access Request	Channel access scheme where the base stations controls the communication on the channel. Remotes ask for access to the channel, and the base station grants access if the channel is not occupied. This mode is a general purpose access method for high and low load networks.
Listen Before Send without Acknowledgement	Channel access scheme where network elements listen to ensure the channel is clear, before trying to access the channel. This mode is optimised for low load networks and repeated networks. Acknowledgements are disabled.
Listen Before Send with Acknowledgement	Channel access scheme where network elements listen to ensure the channel is clear, before trying to access the channel. This mode is optimised for low load networks and repeated networks. With Acknowledgement, unicast requests from the remote station are acknowledged by the base station to ensure that the transmission has been successful. If the remote station does not receive an acknowledgement, then random back-offs are used to reschedule the next transmission. Enabling acknowledgments increases reliability of transport but reduces available channel capacity so if application has the capability to handle lost or duplicate messages, the Access Scheme should be set to Listen Before Send without Acknowledgement.

The default setting is Access Request.