



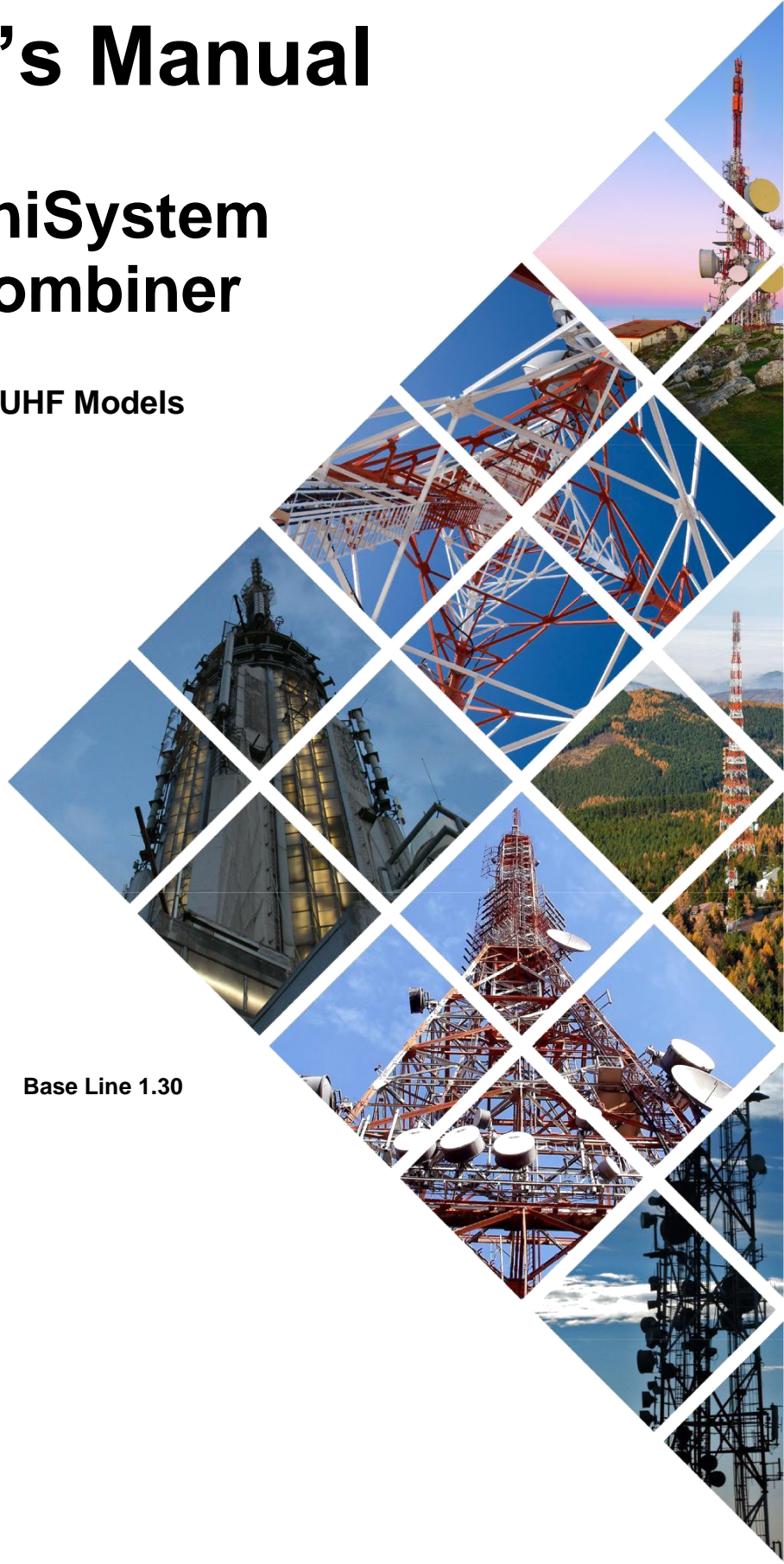
**RFI**  
TECHNOLOGY SOLUTIONS

# User's Manual

## MiniSystem Combiner

UHF Models

Base Line 1.30



## Company Overview

RFI has been serving the needs of the wireless communications market for over 30 years. First founded as a manufacturer of antenna systems, RFI has grown to be a key player in the development, manufacturing and distribution of wireless technology and energy products. Through our extensive network of resellers, systems integrators and retail outlets, RFI is a key supplier to both industry and Government.

Our research and manufacturing facilities have talented people, sophisticated test equipment, state of the art software with class leading manufacturing systems and techniques. Additionally, we have in place a quality management program which is certified to ISO9001, environmental management system certification to ISO14001 and occupational health and safety standard AS4801 giving you complete confidence in everything we do.

RFI's products are truly innovative and as a result we are active around the globe taking our Australian designed and manufactured products to key markets in Asia Pacific, the Americas and EMEA regions via offices 'in-region' in addition to exporting directly to in excess of 50 countries.

One of RFI's key principals is to remain totally customer focused as we recognise our future depends on the success of our customers. We know that to be chosen as your supplier we must add value to your business and to achieve this we will work hard to deliver the best product when and where you need it and back this up with the very best technical support available.

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### ***Disclaimer***

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## **MSxxxx UHF Series MiniSystem Combiner**



### **1. General Description**

The MSxxxx-0x05-xP UHF MiniSystem Combiner (MSC) series is a full featured, high performance, RF combining solution packaged in a compact 19inch rack mount enclosure that simplifies the system design, procurement, installation and maintenance of RF combining for network applications requiring 1-4 channels of RF combining.

The MiniSystem Combiner comprises a multi-channel transmit (Tx) combiner and a multiple-output receiver (Rx) multicouplers. Model configurations are available to provide either;

- an integral bandpass duplexer - to interface the Tx and Rx RF paths to a single (Tx/Rx) antenna, or
- an integral Receiver Preselector and Tx Post Filter - to interface the Tx and Rx RF paths to separate Tx and Rx antennas, or
- no integral duplexer or filters – to allow external filtering to be fitted to suit custom frequencies and or antenna configurations.

#### *Transmit (Tx) Combiner*

The MiniSystem Combiner uses an innovative “shared load” hybrid combiner architecture to combine the multiple transmit frequencies into a single RF path. Dual-stage, low loss, broadband isolators on each Tx input provide excellent Tx-Tx channel isolation and optimum intermodulation (IM) suppression.

The transmit combiner is designed for full output power on all input channels simultaneously, at 100% duty cycle and across the rated operating temperature range. Its integrated design also provides full protection, at full TX input power, for any antenna VSWR fault condition – including an open circuit state.

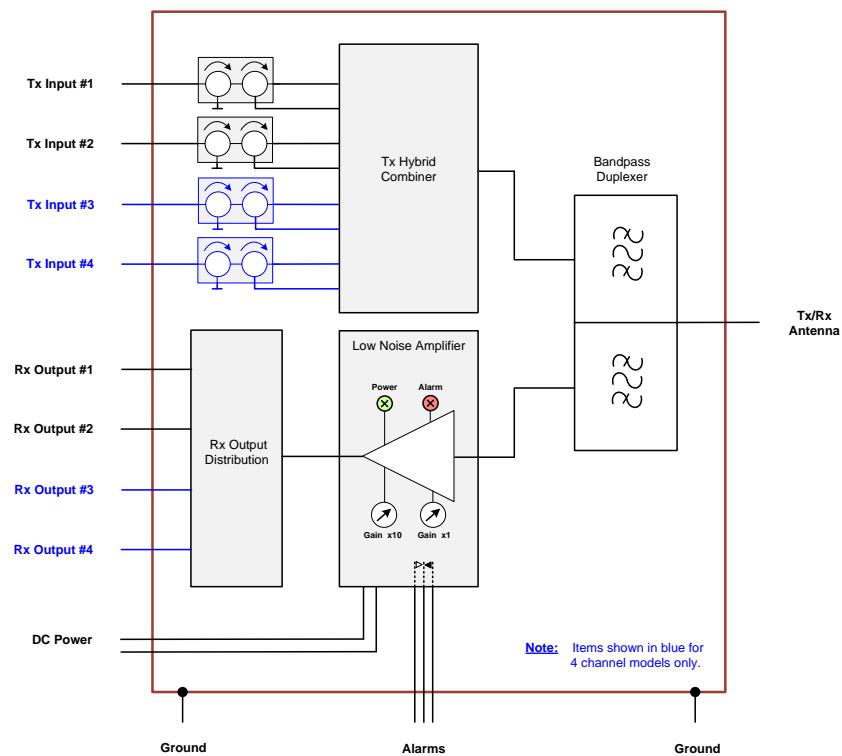
The output of the hybrid combiner is filtered using a full bandpass duplexer, for transmit broadband noise suppression and the prevention of receiver desensitisation, prior to connection to the antenna port(s).

#### *Receive (Rx) Multicoupler*

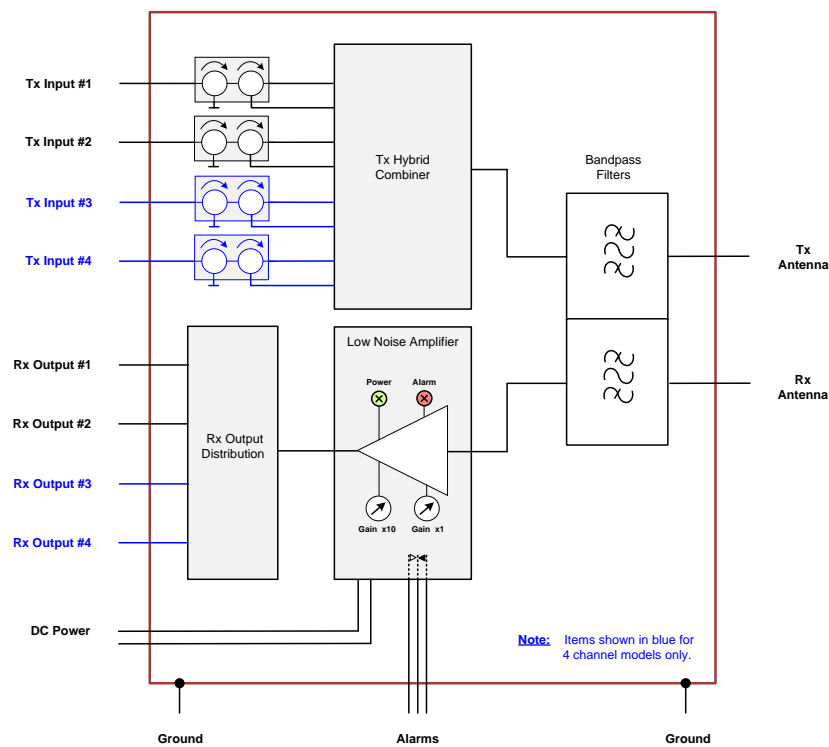
Receive (Rx) signals from the antenna port(s) are preselected and filtered using a full bandpass duplexer, for transmit carrier rejection and the prevention of receiver overload (blocking), prior to connection to the low-noise amplifier (LNA).

This receiver amplifier's exceptional low noise figure optimises the sensitivity of the connected network base stations, and excellent linearity and third order intercept (3OIP) performance enhances intermodulation rejection within the receive sub-system. The LNA's gain is user-configurable, allowing the adjustment of overall receiver sub-system gain for the optimisation of network sensitivity at sites where high receive distribution cabling losses encourages additional Rx multicoupler gain.

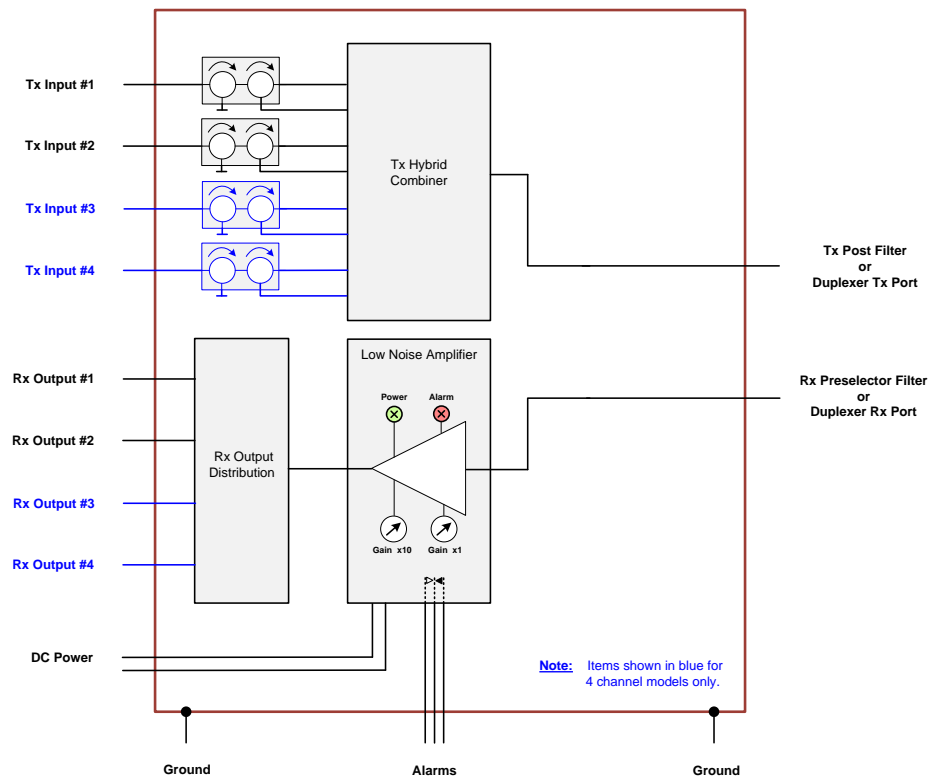
The output of this LNA is connected to an output distribution divider for the distribution of network receive signals to the connected base station receivers.



**Single Antenna ("SP") Model**



**Dual Antenna ("DP") Model**



### No Integral Filters/Duplexer ("NDP") Model

Figure 1 – MiniSystem Block Diagrams

#### Power Supply and Alarm Monitoring

The MiniSystem Combiner features a wide input range DC power supply, with receiver LNA and DC power supply failure monitoring. Form-C dry relay contacts are provided, allowing connection of reported alarms to an external site alarm monitoring system.

100-240VAC Mains Power operation is available using an optional plug pack adapter.

#### Grounding

There are two grounding studs located on the left-hand and right-hand corners of the rear panel, for compatibility with different racking cabling layout preferences.

#### Supporting Documentation

Supporting documents including this User's Manual, a Quick Start Guide (QSG), Product Overview and Application Note are also available from the RFI website.



## 2. Electrical and Mechanical Specifications

### UHF – “SP” Model

Model MSxxxx-0205-SP	3436	3638	3840	4043	4345	4547	4750	5052
Frequency Range (MHz)	340-360	360-380	380-400	400-430	430-450	450-470	470-500	500-520
Filters/Duplexer	Bandpass Duplexer fitted							
Tx Channel Capacity	2ch model = ≤2 4ch model = ≤4							
Tx Input Power	≤ 50Watts							
Tx Duty Cycle	100%							
Tx-Tx Bandwidth	1.2MHz (typ.)							
Tx Insertion Loss	2ch model = <6dB 4ch model = <9dB							
Tx-Tx Isolation	>70dB (typ.)							
Tx Input Return Loss	>20dB							
Tx-Antenna Isolation	>60dB (typ.)							
Tx-Rx Separation	≥5MHz							
Tx-Rx Isolation	>80dB (typ.)							
Rx Channel Capacity	2ch model = ≤2 4ch model = ≤4							
Rx-Rx Bandwidth	1.2MHz							
Rx System Gain	-10dB to +10dB approx. (in 1dB steps)							
Rx-Rx Isolation	>18dB							
Rx LNA Noise Figure	1.2dB typ.							
Rx Max. RF Input Level	-10dBm							
Rx Output Return Loss	>18dB							
Impedance	50ohms							
Alarms	DC Supply Voltage Low, Rx LNA Fail							
Alarm Outputs	Dry Relay Form-C (N.C. / N.O. / CMN)							
Alarm Relay Ratings	50VDC 1A max.							
RF Connectors	Tx Inputs = N (female) Rx Outputs = BNC (female) Antenna Port = N (female)							
DC Connector	2pin 5mm Phoenix (mating plug supplied)							
Alarm Connector	3pin 5mm Phoenix (mating plug supplied)							
Enclosure	3RU 19in Rack Mount (Black)							
DC Power Requirements	+11VDC to +28VDC 3.5W typ. (polarity protected)							
Grounding	5mm and 6mm stainless steel studs							
IP Rating	Indoor Use Only							
Operating Temperature	-30° to +60° C (-122° to +140° F)							
Dimensions (HxWxD)	133x483x430mm (5.23x19x17in)							
Weight	2ch model = 15Kg (33lbs) 4ch model = 19Kg (42lbs)							

**Table 1**

## UHF – “DP” Model

Model MSxxxx-0405-SP	3436	3638	3840	4043	4345	4547	4750	5052
Frequency Range (MHz)	340-360	360-380	380-400	400-430	430-450	450-470	470-500	500-520
Filters/Duplexer	Rx Preselector / Tx Post Filter fitted							
Tx Channel Capacity	2ch model = $\leq 2$ 4ch model = $\leq 4$							
Tx Input Power	$\leq 50$ Watts							
Tx Duty Cycle	100%							
Tx-Tx Bandwidth	1.2MHz (typ.)							
Tx Insertion Loss	2ch model = $< 6$ dB 4ch model = $< 9$ dB							
Tx-Tx Isolation	$> 70$ dB (typ.)							
Tx Input Return Loss	$> 20$ dB							
Tx-Antenna Isolation	$> 60$ dB (typ.)							
Tx-Rx Separation	$\geq 5$ MHz							
Tx-Rx Isolation	$> 80$ dB (typ.) plus as-installed Tx-to-Rx antenna isolation							
Rx Channel Capacity	2ch model = $\leq 2$ 4ch model = $\leq 4$							
Rx-Rx Bandwidth	1.2MHz							
Rx System Gain	$-10$ dB to $+10$ dB approx. (in 1dB steps)							
Rx-Rx Isolation	$> 18$ dB							
Rx LNA Noise Figure	1.2dB typ.							
Rx Max. RF Input Level	$-10$ dBm							
Rx Output Return Loss	$> 18$ dB							
Impedance	50ohms							
Alarms	DC Supply Voltage Low, Rx LNA Fail							
Alarm Outputs	Dry Relay Form-C (N.C. / N.O. / CMN)							
Alarm Relay Ratings	50VDC 1A max.							
RF Connectors	Tx Inputs = N (female) Rx Outputs = BNC (female) Antenna Ports = N (female)							
DC Connector	2pin 5mm Phoenix (mating plug supplied)							
Alarm Connector	3pin 5mm Phoenix (mating plug supplied)							
Enclosure	3RU 19in Rack Mount (Black)							
DC Power Requirements	$+11$ VDC to $+28$ VDC 3.5W typ. (polarity protected)							
Grounding	5mm and 6mm stainless steel studs							
IP Rating	Indoor Use Only							
Operating Temperature	$-30^{\circ}$ to $+60^{\circ}$ C ( $-122^{\circ}$ to $+140^{\circ}$ F)							
Dimensions (HxWxD)	133x483x430mm (5.23x19x17in)							
Weight	2ch model = 15Kg (33lbs) 4ch model = 19Kg (42lbs)							

**Table 2**

## UHF – “NDP” Model

Model MSxxxx-0205-SP	3436	3638	3840	4043	4345	4547	4750	5052
Frequency Range (MHz)	340-360	360-380	380-400	400-430	430-450	450-470	470-500	500-520
Filters/Duplexer	To be supplied and fitted externally to suit custom frequency and or antenna configurations							
Tx Channel Capacity	2ch model = ≤2 4ch model = ≤4							
Tx Input Power	≤ 50Watts							
Tx Duty Cycle	100%							
Tx-Tx Bandwidth	1.2MHz (typ.)							
Tx Insertion Loss	2ch model = <4.5dB 4ch model = <7.5dB							
Tx-Tx Isolation	>70dB (typ.)							
Tx Input Return Loss	>20dB							
Tx-Antenna Isolation	>60dB (typ.)							
Tx-Rx Separation	≥5MHz							
Tx-Rx Isolation	As per fitted filters/duplexer plus as-installed Tx-to-Rx antenna isolation							
Rx Channel Capacity	2ch model = ≤2 4ch model = ≤4							
Rx-Rx Bandwidth	1.2MHz							
Rx System Gain	-10dB to +10dB approx. (in 1dB steps)							
Rx-Rx Isolation	>18dB							
Rx LNA Noise Figure	1.2dB typ.							
Rx Max. RF Input Level	-10dBm							
Rx Output Return Loss	>18dB							
Impedance	50ohms							
Alarms	DC Supply Voltage Low, Rx LNA Fail							
Alarm Outputs	Dry Relay Form-C (N.C. / N.O. / CMN)							
Alarm Relay Ratings	50VDC 1A max.							
RF Connectors	Tx Inputs = N (female) Rx Outputs = BNC (female) Antenna Port = N (female)							
DC Connector	2pin 5mm Phoenix (mating plug supplied)							
Alarm Connector	3pin 5mm Phoenix (mating plug supplied)							
Enclosure	3RU 19in Rack Mount (Black)							
DC Power Requirements	+11VDC to +28VDC 3.5W typ. (polarity protected)							
Grounding	5mm and 6mm stainless steel studs							
IP Rating	Indoor Use Only							
Operating Temperature	-30° to +60° C (-122° to +140° F)							
Dimensions (HxWxD)	133x483x430mm (5.23x19x17in)							
Weight	2ch model = 12Kg (27lbs) 4ch model = 16Kg (35.2lbs)							

**Table 3**

### 3. Ordering Information

Ordering Information	
RFI Part Number	Description
MS3436-0205-SP	340-360MHz - 2 Ch MiniSystem Combiner – Single Antenna operation – with Rx Preamplifier
MS3638-0205-SP	360-380MHz - 2 Ch MiniSystem Combiner – Single Antenna operation – with Rx Preamplifier
MS3840-0205-SP	380-400MHz - 2 Ch MiniSystem Combiner – Single Antenna operation – with Rx Preamplifier
MS4043-0205-SP	400-430MHz - 2 Ch MiniSystem Combiner – Single Antenna operation – with Rx Preamplifier
MS4345-0205-SP	430-450MHz - 2 Ch MiniSystem Combiner – Single Antenna operation – with Rx Preamplifier
MS4547-0205-SP	450-470MHz - 2 Ch MiniSystem Combiner – Single Antenna operation – with Rx Preamplifier
MS4750-0205-SP	470-500MHz - 2 Ch MiniSystem Combiner – Single Antenna operation – with Rx Preamplifier
MS5052-0205-SP	500-520MHz - 2 Ch MiniSystem Combiner – Single Antenna operation – with Rx Preamplifier
MS3436-0405-SP	340-360MHz - 4 Ch MiniSystem Combiner – Single Antenna operation – with Rx Preamplifier
MS3638-0405-SP	360-380MHz - 4 Ch MiniSystem Combiner – Single Antenna operation – with Rx Preamplifier
MS3840-0405-SP	380-400MHz - 4 Ch MiniSystem Combiner – Single Antenna operation – with Rx Preamplifier
MS4043-0405-SP	400-430MHz - 4 Ch MiniSystem Combiner – Single Antenna operation – with Rx Preamplifier
MS4345-0405-SP	430-450MHz - 4 Ch MiniSystem Combiner – Single Antenna operation – with Rx Preamplifier
MS4547-0405-SP	450-470MHz - 4 Ch MiniSystem Combiner – Single Antenna operation – with Rx Preamplifier
MS4750-0405-SP	470-500MHz - 4 Ch MiniSystem Combiner – Single Antenna operation – with Rx Preamplifier
MS5052-0405-SP	500-520MHz - 4 Ch MiniSystem Combiner – Single Antenna operation – with Rx Preamplifier
MS3436-0205-DP	340-360MHz - 2 Ch MiniSystem Combiner – Dual Antenna operation – with Rx Preamplifier
MS3638-0205-DP	360-380MHz - 2 Ch MiniSystem Combiner – Dual Antenna operation – with Rx Preamplifier
MS3840-0205-DP	380-400MHz - 2 Ch MiniSystem Combiner – Dual Antenna operation – with Rx Preamplifier
MS4043-0205-DP	400-430MHz - 2 Ch MiniSystem Combiner – Dual Antenna operation – with Rx Preamplifier
MS4345-0205-DP	430-450MHz - 2 Ch MiniSystem Combiner – Dual Antenna operation – with Rx Preamplifier
MS4547-0205-DP	450-470MHz - 2 Ch MiniSystem Combiner – Dual Antenna operation – with Rx Preamplifier
MS4750-0205-DP	470-500MHz - 2 Ch MiniSystem Combiner – Dual Antenna operation – with Rx Preamplifier
MS5052-0205-DP	500-520MHz - 2 Ch MiniSystem Combiner – Dual Antenna operation – with Rx Preamplifier
MS3436-0405-DP	340-360MHz - 4 Ch MiniSystem Combiner – Dual Antenna operation – with Rx Preamplifier
MS3638-0405-DP	360-380MHz - 4 Ch MiniSystem Combiner – Dual Antenna operation – with Rx Preamplifier
MS3840-0405-DP	380-400MHz - 4 Ch MiniSystem Combiner – Dual Antenna operation – with Rx Preamplifier
MS4043-0405-DP	400-430MHz - 4 Ch MiniSystem Combiner – Dual Antenna operation – with Rx Preamplifier
MS4345-0405-DP	430-450MHz - 4 Ch MiniSystem Combiner – Dual Antenna operation – with Rx Preamplifier
MS4547-0405-DP	450-470MHz - 4 Ch MiniSystem Combiner – Dual Antenna operation – with Rx Preamplifier
MS4750-0405-DP	470-500MHz - 4 Ch MiniSystem Combiner – Dual Antenna operation – with Rx Preamplifier
MS5052-0405-DP	500-520MHz - 4 Ch MiniSystem Combiner – Dual Antenna operation – with Rx Preamplifier

Ordering Information	
RFI Part Number	Description
MS3436-0205-NDP	340-360MHz - 2 Ch MiniSystem Combiner – External Filters/Duplexer – with Rx Preamplifier
MS3638-0205-NDP	360-380MHz - 2 Ch MiniSystem Combiner – External Filters/Duplexer – with Rx Preamplifier
MS3840-0205-NDP	380-400MHz - 2 Ch MiniSystem Combiner – External Filters/Duplexer – with Rx Preamplifier
MS4043-0205-NDP	400-430MHz - 2 Ch MiniSystem Combiner – External Filters/Duplexer – with Rx Preamplifier
MS4345-0205-NDP	430-450MHz - 2 Ch MiniSystem Combiner – External Filters/Duplexer – with Rx Preamplifier
MS4547-0205-NDP	450-470MHz - 2 Ch MiniSystem Combiner – External Filters/Duplexer – with Rx Preamplifier
MS4750-0205-NDP	470-500MHz - 2 Ch MiniSystem Combiner – External Filters/Duplexer – with Rx Preamplifier
MS5052-0205-NDP	500-520MHz - 2 Ch MiniSystem Combiner – External Filters/Duplexer – with Rx Preamplifier
MS3436-0405-NDP	340-360MHz - 4 Ch MiniSystem Combiner – External Filters/Duplexer – with Rx Preamplifier
MS3638-0405-NDP	360-380MHz - 4 Ch MiniSystem Combiner – External Filters/Duplexer – with Rx Preamplifier
MS3840-0405-NDP	380-400MHz - 4 Ch MiniSystem Combiner – External Filters/Duplexer – with Rx Preamplifier
MS4043-0405-NDP	400-430MHz - 4 Ch MiniSystem Combiner – External Filters/Duplexer – with Rx Preamplifier
MS4345-0405-NDP	430-450MHz - 4 Ch MiniSystem Combiner – External Filters/Duplexer – with Rx Preamplifier
MS4547-0405-NDP	450-470MHz - 4 Ch MiniSystem Combiner – External Filters/Duplexer – with Rx Preamplifier
MS4750-0405-NDP	470-500MHz - 4 Ch MiniSystem Combiner – External Filters/Duplexer – with Rx Preamplifier
MS5052-0405-NDP	500-520MHz - 4 Ch MiniSystem Combiner – External Filters/Duplexer – with Rx Preamplifier
RX0000-3000-AC	100-240VAC / 12VDC Mains Power Plug Pack Power Supply
SP0000-6001-11	50ohm BNC (male) Termination for unused Rx Output ports
SP0000-6002-11	50ohm N (male) Termination for unused Tx Input ports

**Table 3**

## 4. Unpacking



**CAUTION:** Take all necessary precautions when lifting heavy items. Incorrect lifting of heavy weights can cause injury. Seek assistance, or use approved lifting devices for safety.

The MiniSystem Combiner is packed and shipped in cardboard packaging. Packed with the unit will be the Factory Test Sheet (FTS), Quick Start Guide (QSG) and User's Manual. Supporting documentation is also available from the RFI website at [www.rfiwireless.com.au](http://www.rfiwireless.com.au).

The packaging used will provide suitable product protection during shipping. However, it is important to report any visible damage to the outside of the packaging to the carrier *immediately* upon delivery.

It is the customers' responsibility in the event of product damage, to lodge a damage claim with the carrier within a short period of time after receipt of the package. The time window for lodging the claim should be ascertained from the specific carrier as this may vary between carriers (typically 1 to 5 days).

Please dispose of all packaging material responsibly.



**RECOMMENDATION:** Please retain and file all Factory Test Sheets and ongoing Periodic Maintenance Inspection results for future reference.

The Factory Test Sheet (FTS) is a reference document that represents the MiniSystem Combiner performance at the time of manufacture.

It is recommended to retain and file the Factory Test Sheet, and any results of ongoing Periodic Maintenance Inspection (PMI) or other maintenance activities' testing, to enable the ongoing performance of the MiniSystem Combiner to be assessed and verified.

## **5. Firmware License Agreement**

This statement must be read in its entirety prior to the loading or use of the Firmware provided by RFI in this product.

### **Introduction.**

*By using or uploading any product related Firmware you agree without reserve with all the conditions as detailed in this RFI Firmware License Agreement.*

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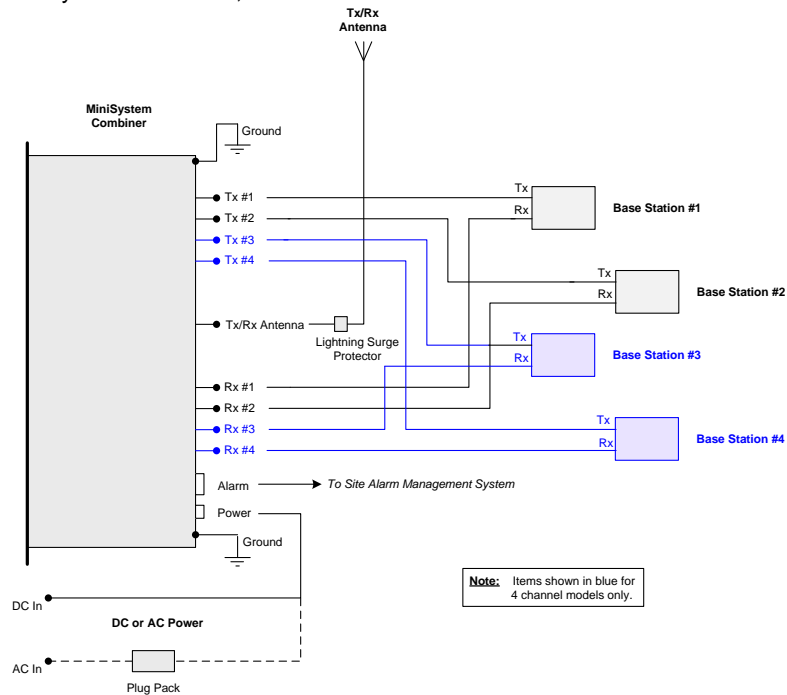
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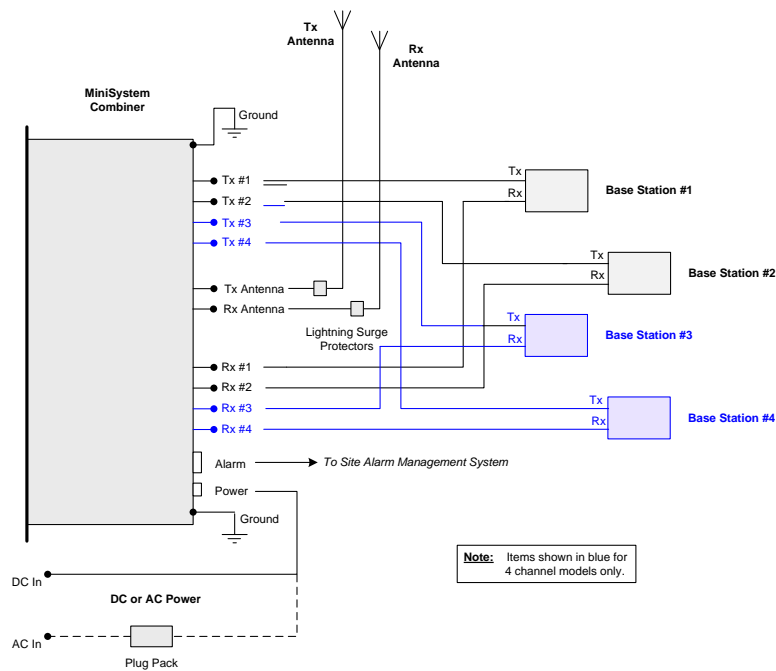
*The failure of RFI to exercise or enforce any right or provision of this Firmware License Agreement shall not constitute a waiver of such right or provision.*

## 6. System Interconnection Diagram

MiniSystem Combiners are designed to be used in a range of channel capacity configurations to suit from 1-4 RF channels. The following system diagram shows the interconnections between the network base station equipment, antenna system and MiniSystem Combiner;

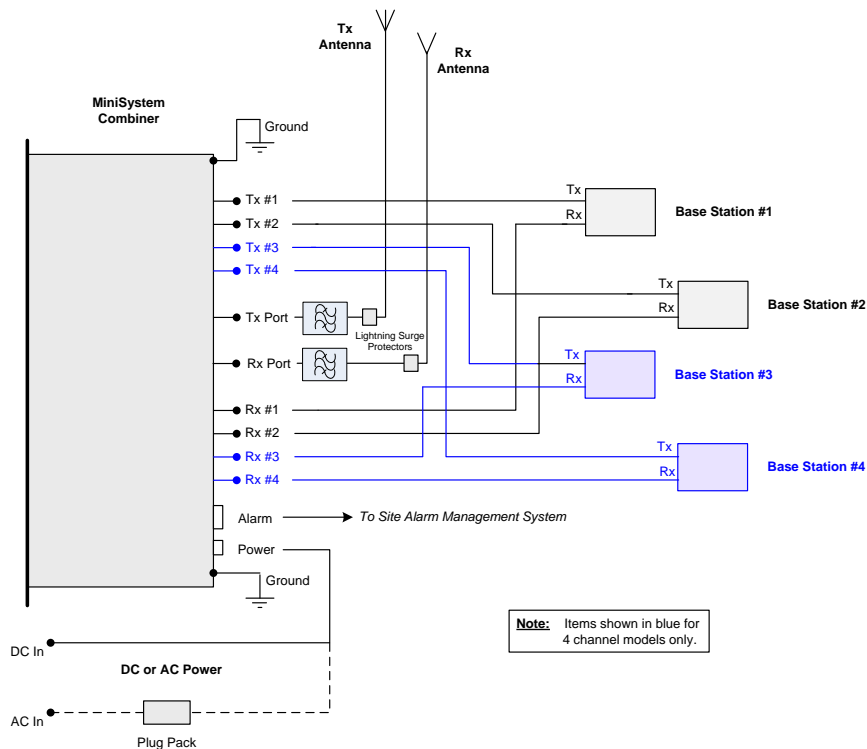
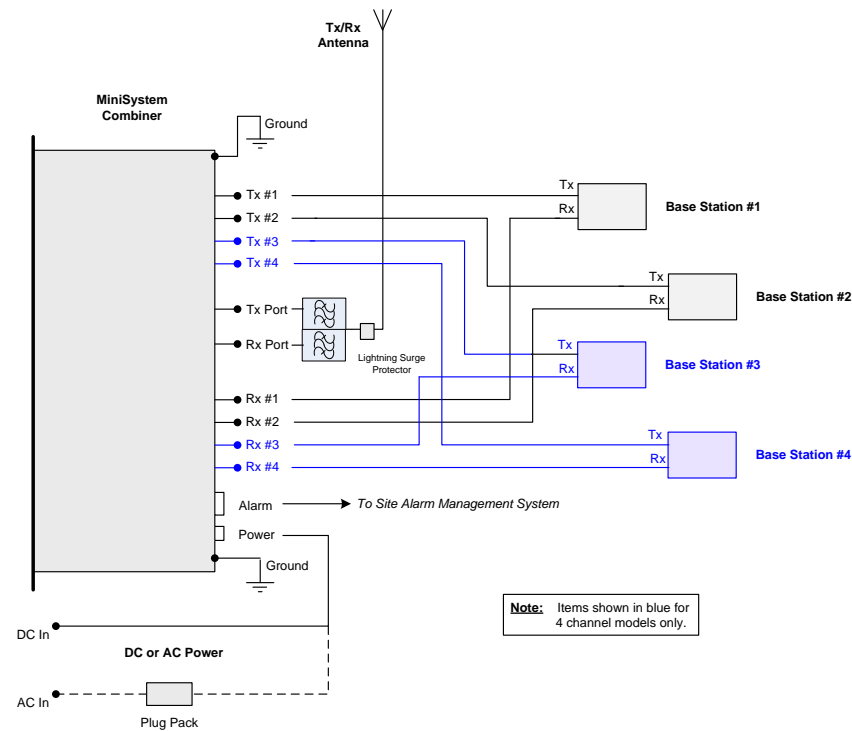


### Single Antenna ("SP") Model



### Dual Antenna ("DP") Model





### External Filters/Duplexer ("NDP") Model

**Figure 2 – MiniSystem Combiner System Interconnection Diagram**

## 7. Installation



**CAUTION:** All installation works should be conducted by qualified personnel and in compliance with recognised standards, workplace safety, and best engineering practices.

### General

The use of appropriate installation mounting hardware that suits the specific racking or other installation style is important.

The MiniSystem Combiner is designed to be installed into standard 19inch rack mount frames or cabinet spaces. Install the unit using four screws that match the 19in racking, ensuring nylon washers are used under the head of the screws to protect the MiniSystem Combiner front panel.



**Figure 3 – MiniSystem Combiner**

To cater for the variety of installation locations and mounting systems, some screws, washers or other miscellaneous hardware items required to complete those installations may need to be supplied by the customer or their installation contractor.

An M6 stud and M5 grounding stud are located on the rear of the MiniSystem Combiner for earthing to the site's lightning protection grounding system with an earthing strap or cable. Both flat and lock washers are supplied on these grounding studs to ensure the cabling can be firmly secured for optimum grounding connection integrity.

This site lightning protection grounding system should be bonded back to the building cable entry bulkhead panel (Refer to Figure 5).

### Interconnecting Cabling

Connect the Base Station transmitters and receivers to the Tx Input and Rx Output ports on the rear of the MiniSystem Combiner using high quality coaxial cable (solid or double-shielded jacket type). The type of interconnecting coaxial feeder cables that may be used between the MiniSystem Combiner, the Base Stations, and Antenna system may vary, but generally their type will be determined by their length and resulting insertion loss.

Unused RF ports on the MiniSystem Combiner should be terminated with 50ohm terminations.

For the MiniSystem Combiner power supply, a cable from the chosen DC power source should be terminated into the supplied 2-pin plug, observing the correct polarity, and then plugged into the polarised 2-pin socket on the rear of the MiniSystem Combiner. For AC Mains powered versions, an AC-to-DC plug pack is available (as an option) with a pre-terminated 2-Pin plug. This should be fitted into the polarised 2-pin socket on the rear of the MiniSystem Combiner.

### Lightning Protection

Lightning protection and grounding of the MiniSystem Combiner and its associated network equipment is important. A lightning suppressor with appropriate operating frequency and power ratings, and suited for multi-carrier combiner operation, should be fitted to the antenna system at the equipment building entry point. This lightning suppressor should be connected to an appropriately designed and installed site lightning grounding system.

### Grounding

Compliance with international electrical safety standards requires that the external Protective Earthing point on this equipment, as indicated by this symbol, be permanently hardwired to the premise's protective earth system using a 1.5mm<sup>2</sup> (14AWG) minimum cross-sectional area conductor. This connection provides protection from hazardous and transient voltages.

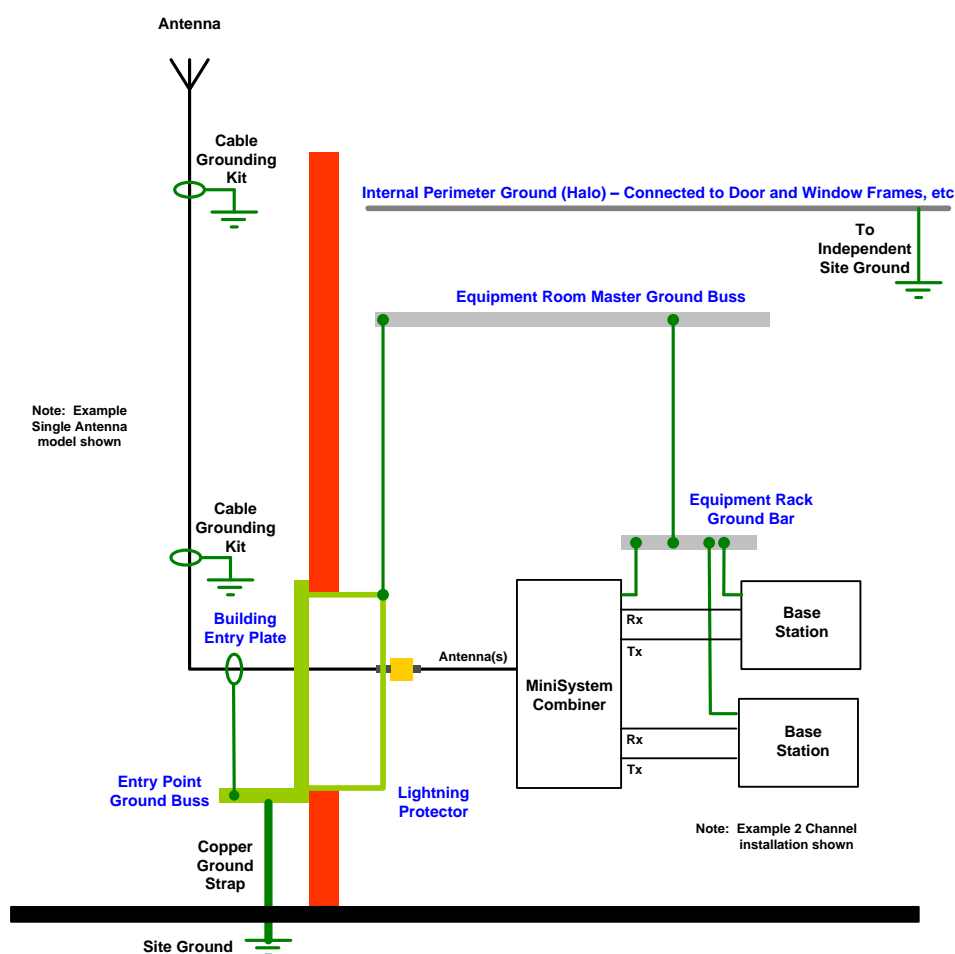


Cable grounding kits, cable installation hardware, antenna mounting hardware and antenna type(s) should be selected to suit the network site, the antenna tower (or building, etc), and network coverage required from the site.

**NOTE:** RFI can provide information and support in the selection of cable, connectors, lightning protectors, cable grounding kits, antennas and related installation items required to support the use of the MiniSystem Combiner.



**Figure 4 – Typical Lightning Protector**



**Figure 5 – Lightning Protection and Site Grounding Recommendations**



**WARNING:** Failure to provide adequate lightning protection and grounding may result in equipment failure caused by electrical surge damage.

### Installation Summary

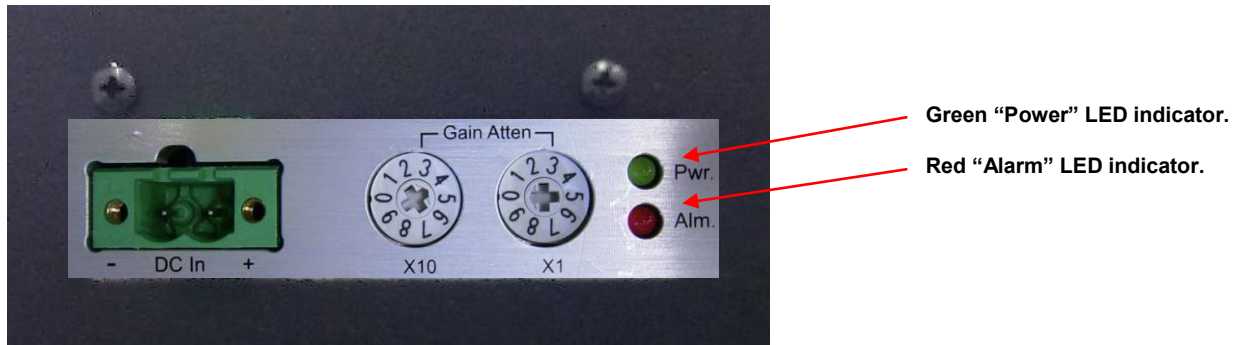
The provision of adequate lightning protection, correct grounding, the appropriate torquing of connectors, and the sealing of terminations are all important elements of any system installation.

Careful attention should be given to these areas of the installation to ensure optimum system performance and prolonged equipment life.

## 8. Operation

Supporting documents including this User Manual, a Quick Start Guide (QSG) and Application Note are supplied with the MiniSystem Combiner.

When the MiniSystem Combiner has been installed and connected to the interconnecting coaxial cables to the network base stations and antenna system, the power source to the MiniSystem Combiner may be connected and switched on.



**Figure 6 – Power and Alarm LED indicators**

Check that the green "Power" LED indicator on the MiniSystem Combiner rear panel is illuminated, and that the adjacent red "Alarm" LED indicator is not illuminated.

The MiniSystem Combiner is now ready for commissioning and operation.

## 9. Commissioning

### General

It is important that the MiniSystem Combiner is commissioned correctly to ensure that optimum system performance is achieved from the connected network base station equipment. The following process outlines the correct procedure for configuring the *Nett Receive System Gain*, and is designed to standardise the installation of these systems.

### Low Noise Amplifier (LNA) Attenuator Settings:

The MiniSystem Combiner LNA provides user-configurable attenuators for setting the *Nett Receive System Gain*. These attenuators are set in the RFI factory during testing to provide a 0dB (unity) nett gain, or as close to this as possible as determined by the available 1dB attenuator steps, and this initial setting is suitable to use in most installations.

This attenuator setting is referred to as the *RFI Factory Default* setting.

Two attenuators are presented for user configuration; a “tens” (X10) setting, and a “units” (X1) setting. A small arrow shape can be seen in the adjustment slot on each attenuator (refer Figure 7), and this arrow points to the associated value represented in the currently selected position.

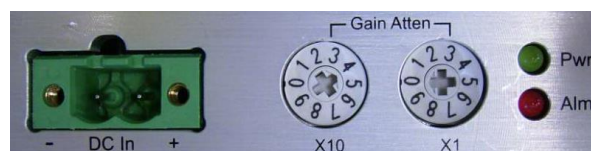


Figure 7 – Gain Attenuators (40dB shown)

These slots should be adjusted carefully, with a well-fitting adjustment tool, to prevent damaging the attenuators.



**CAUTION:** The RF LNA configuration in the MiniSystem Combiners changed in late 2015 to optimise system Receive noise figure performance. The version that a unit has been built to can be confirmed by measuring the Nett Receive System Gain value. The attenuator settings for the measured Nett Receive System Gain will indicate whether the unit is operating under Version 1.00 or 1.10 as per the following attenuator settings tables.

The typical gain settings that should be configured on the Receive LNA attenuators can be calculated as follows;

*System Gain (Version 1.00 units)*

For 2 Channel and 4 Channel MiniSystems;

*LNA Attenuators setting = MiniSystem Combiner “Net Receive System Gain” plus 10dB (approx)*

Nett Receive System Gain	“X10” tens setting	LNA “X1” units setting
~ 0dB	1	0
1dB	1	1
2dB	1	2
3dB	1	3
4dB	1	4
5dB	1	5
6dB	1	6
7dB	1	7
8dB	1	8
9dB	1	9
10dB	2	0
11dB	2	1
Etc	etc	2

System Gain (Version 1.10 units)

For 2 Channel MiniSystems;

LNA Attenuators setting = MiniSystem Combiner "Net Receive System Gain" plus 25dB (approx)

Nett Receive System Gain	"X10" tens setting	LNA "X1" units setting
~ 0dB	2	5
1dB	2	6
2dB	2	7
3dB	2	8
4dB	2	9
5dB	3	0
6dB	3	1
7dB	3	2
8dB	3	3
9dB	3	4
10dB	3	5
11dB	3	6
Etc	etc	etc

For 4 Channel MiniSystems;

LNA Attenuators setting = MiniSystem Combiner "Net Receive System Gain" plus 28dB (approx)

Nett Receive System Gain	"X10" tens setting	LNA "X1" units setting
~ 0dB	2	8
1dB	2	9
2dB	3	0
3dB	3	1
4dB	3	2
5dB	3	3
6dB	3	4
7dB	3	5
8dB	3	6
9dB	3	7
10dB	3	8
11dB	3	9
Etc	etc	etc

Figure 8 – Typical Receive System LNA Gain configurations



**CAUTION:** The correct adjustment of these attenuators is important, as this setting maintains protection of the base station receivers against high level RF signals – while obtaining the optimum available system sensitivity.

### Adjusting the Nett Receive System Gain

The gain of the MiniSystem Combiner LNA is primarily used to overcome the loss of the receive output distribution within the MiniSystem Combiner, and the cabling losses between the MiniSystem Combiner Rx Output ports and the connected network base station receivers - with the objective to provide a nett 0dB (unity) gain from the antenna input of the MiniSystem Combiner, to the input of the base station receiver itself.

In most site installations, the network base stations will be mounted in close proximity to the MiniSystem Combiner, so the insertion loss of the cables from the MiniSystem Combiner Rx Output ports through to the base station receiver ports will be negligible.

However, in some installations, the base station equipment may be located some distance from the MiniSystem Combiner, and in these situations the insertion loss of the cable from the MiniSystem Combiner Rx Output ports to the base station receiver port increases the receive output distribution losses. As the length of these distribution cables to individual base stations may vary, an "average" loss should be estimated based on the cable type and typical length (refer to the manufacturers data sheet for values). In such circumstances, it is recommended to increase the MiniSystem Combine LNA gain, proportionally to the "average" loss of these cables, to recover this additional loss.

In the example shown below, the type/length of these distribution cables represents an increased receive output distribution loss of 2dB (average). To recover this 2dB increased distribution loss, the LNA gain should be increased by 2dB above the *RFI Factory Default* attenuator setting.

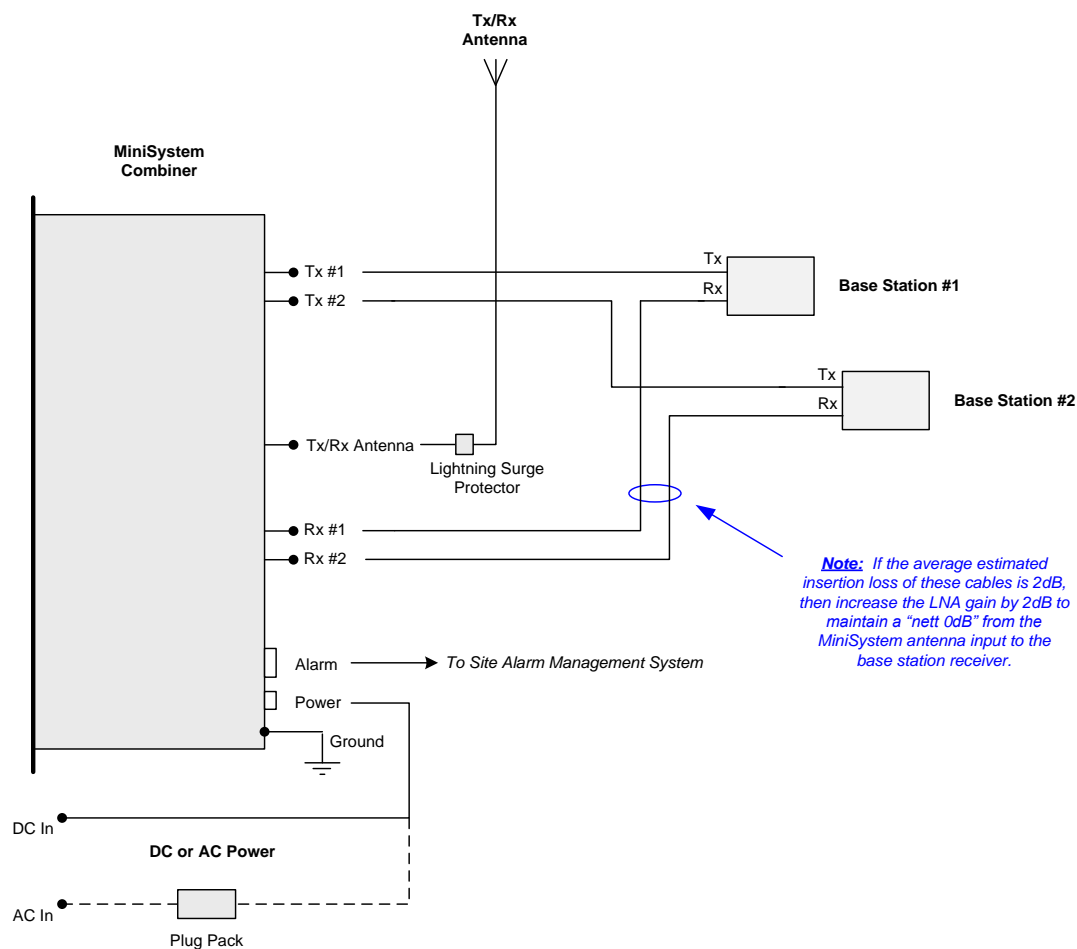
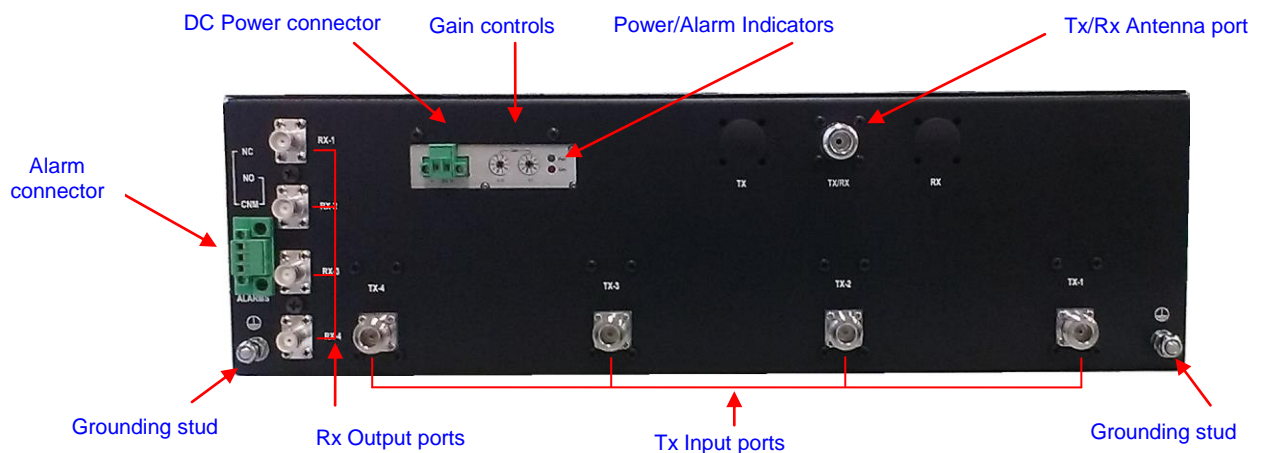
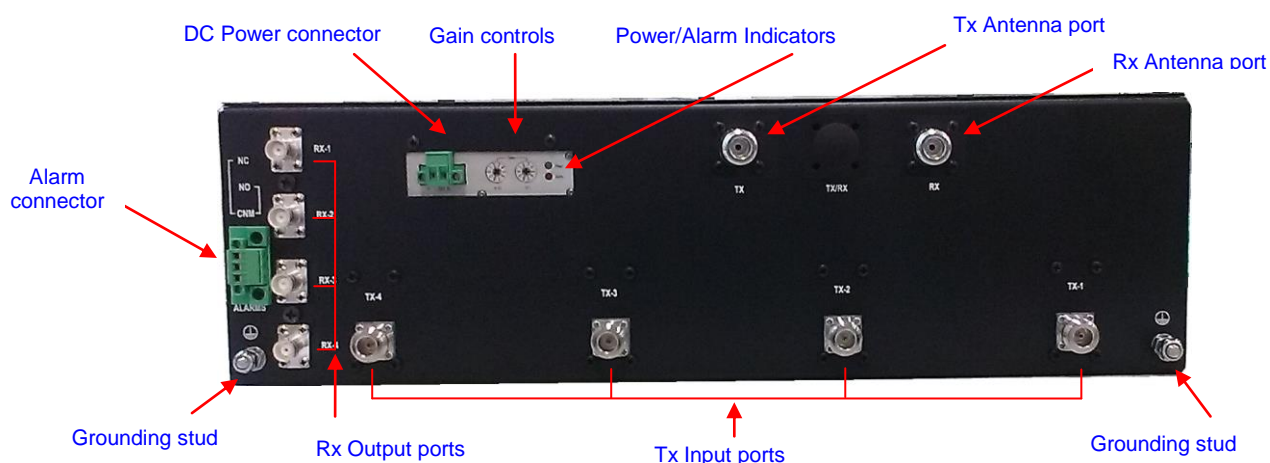


Figure 9 – Adjusting LNA Gain

## 10. Connectors, Controls and Indicators



**Single Antenna ("SP") Model**



**Dual Antenna ("DP") and External Filters/Duplexer ("NDP") Models**

**Figure 10 – MiniSystem Combiner Rear Panel layout (4 Channel model shown)**

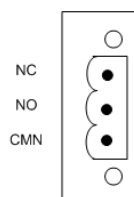
### MiniSystem Combiner DC Power connector (Phoenix 2-pin) pin-out:

The pin configuration of the polarised Phoenix 2-pin connector on the rear of the MiniSystem Combiner is illustrated below.



### MiniSystem Combiner Alarm connector (Phoenix 3-pin) pin-out:

The pin configuration of the polarised Phoenix 3-pin connector on the rear of the MiniSystem Combiner is illustrated below.





## **11. Maintenance, Inspection and Repair Advice**

No special maintenance program is required for the MiniSystem Combiner. Testing and inspection of the MiniSystem Combiner may be included in a Periodic Maintenance Inspection (PMI) program if desired.

Checking that the RF connectors on all coaxial cables are correctly torqued (as per respective manufacturers' recommendations) is considered good practice during any maintenance visit.

All other connectors (power, alarm, etc) must be firmly located into their corresponding mating sockets, with their fastening screws tightened securely.

The MiniSystem Combiner is considered field repairable at a *module level*. Should any module within a MiniSystem Combiner be considered faulty through diagnosis, then it may be replaced by a qualified maintenance technician - or the complete MiniSystem Combiner may be returned to RFI for repair.

## **12. Background Material and other resources**

For Product Datasheets, User Manuals, Quick Start Guides (QSGs), Product Overview, an Application Note and additional information on the RFI range of MiniSystem Combiners and our other products please visit:

<http://www.rfiwireless.com.au>

### **13. Frequently Asked Questions (FAQ)**

Q – Can the MiniSystem Combiner handle continuously keyed base station transmitters on all channels when the network is heavily loaded with traffic?

A – **Yes.** The MiniSystem Combiner is rated for up to 50Watts of Tx Input power on each channel, and the innovative hybrid combiner design is rated for this Tx Input power at 100% duty cycle on all channels and across the stated operating temperature range.

Q – Does the MiniSystem Combiner need to have a full complement of network base stations fitted?

A – **No.** Only the initial number of channels required on the site need be connected. Unused MiniSystems Combiner Tx Input and Rx Output ports may be left for future site capacity expansions. In this way, a 4 channel combiner could be used, with only 2 channels initially fitted, and the remaining 2 channels of combining capacity left for future network growth.

Q – What is the minimum channel spacing possible on a MiniSystem Combiner?

A – **There is no minimum limit.** The MiniSystem Combiner uses an innovative hybrid combining technique that can allow even adjacent Tx and or Rx frequencies to be connected if desired.

Q – What is the maximum channel spacing possible on a MiniSystem Combiner?

A – **1.2MHz (typ.)** All Tx frequencies must be within the Tx-Tx passband width of the bandpass filtering (duplexer) fitted. The Rx frequencies must likewise all be within the Rx-Rx passband width of the bandpass filtering (duplexer) fitted.

Q – Can frequencies that do not fit within the standard specifications deployed using MiniSystem Combiners?

A – **Yes.** The 'NDP' model variant is not fitted with internal filters or duplexer. External filters (or a duplexer) may be added to an NDP model to cater for custom frequencies and or antenna configuration.

Q – What is the minimum Tx-Rx frequency separation possible on the MiniSystem Combiner?

A – **5MHz.** To provide a generic product that can be deployed into the majority of network applications, a 5MHz minimum Tx-Rx spacing specification has been selected and used for the design of the bandpass filter (duplexer) used in the MiniSystem Combiner.

Q – Can the MiniSystem Combiner be expanded?

A – **Not at this time.** The MiniSystem Combiner has been released in both 2 channel and 4 channel capacity formats that cater for a wide range of network applications requiring from 1-4 RF channels. The 2 channel model can be used for small network sites of 1-2 channels, and provides an entry level product for small network sites. The 4 channel model can be used for any network site of 1-4 channels, with unused Tx and Rx ports terminated and available for future network expansion requirements. An expansion option is being developed and will be released at a future date.

Q – Are alarms available from the MiniSystem Combiner?

A – **Yes.** The MiniSystem Combiner provides a Form-C dry relay output that provides status monitoring of both DC Input Power and Rx LNA Failure. This alarm relay output may be connected to a Base station's external alarm input, or existing Site Monitoring equipment, to provide MiniSystem Combiner alarm status monitoring and reporting.

#### **14. User Notes:**



**RFI**  
TECHNOLOGY SOLUTIONS

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