



**SYMPHONY WIRELESS INTERCOM
BASE STATION
OPERATING INSTRUCTIONS
1892 1272**

1 INTRODUCTION

The Symphony Wireless Intercom Base Station forms part of the Wood & Douglas wireless intercom (studio talkback) family of products. The range consists of the Duo transceiver, the Solo receive only, the Trio transmit-only beltpack units, and the Symphony base station. These products all have synthesised operating frequency programming and are available in different versions across the 400MHz to 900MHz frequency band.

Symphony has evolved from earlier Wood & Douglas products and reflects many years of experience of the use of radio in the broadcast studio. While conceived for use in the broadcast industry, Symphony will find use in other applications areas where a quality low-power duplex base station is required.

These operating instructions are intended to provide the user with sufficient information to operate the unit correctly in service in the studio environment, and also gives details of how adjust key parameters.

The Symphony comprises a simple 1U (44 mm) high 19 inch rack mountable item.

The rear panel of the unit accommodates the majority of the user connections, adjustments and mains power input. The front panel contains an LCD display and four push-buttons. The front panel also has a 5 pin Lemo socket which allows the connection of a Duo headset. This connection allows the user to monitor the received audio locally and to inject audio into the transmitter.

Operating functions can be controlled in two ways, using closing contacts to a rear-panel connector or via the front panel display and buttons. The front panel can also be used to set the unit up, for example to desired channel frequencies.

Figure 1 shows the front panel layout and Figure 2 shows the rear panel connections and adjustments.

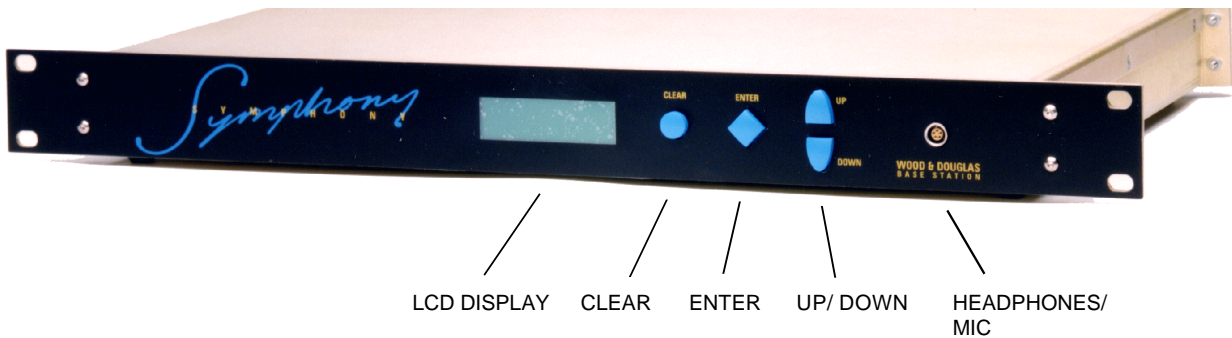


Figure 1 Symphony Front Panel Layout

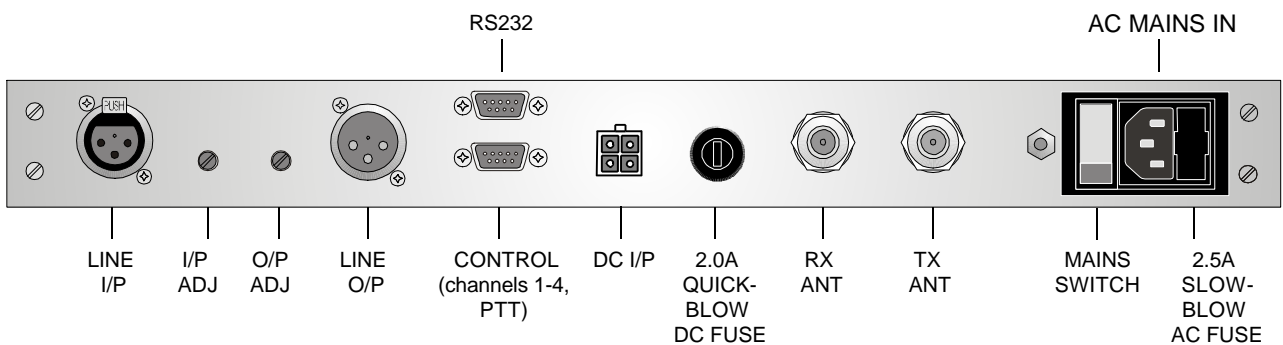


Figure 2 Symphony Rear Panel Layout

3 OPTIONS AT TIME OF ORDERING

Symphony is available in one- and two-antenna versions for different applications, and with corresponding internal or external diplexers or notch filters. Isolators, antenna combiners and post amplifiers are also available. These configurations and options need to be specified when the Symphony is ordered. You will find more information about these options in section 8 (page 16).

Contact the Sales Office at Wood & Douglas for further assistance in choosing the right options for your application.

4 CONNECTIONS

4.1 Antenna

The single UHF antenna connection is provided by a 50Ω 'N' type jack labelled **TX ANT**. Where dual antennas are used the receive antenna is a 50Ω 'N' type jack labelled **RX ANT**.

4.2 Audio

The **LINE I/P** connector is a three pin female XLR socket which provides a high impedance balanced mono audio feed input. The pinouts for the connector are the industry standard connections as shown in the following table:

PIN	FUNCTION
1	0 Volts
2	AF Input +
3	AF Input -

The **LINE O/P** connector is a three pin male XLR socket which provides a low impedance balanced mono audio feed output. The pinouts for the connector are the industry standard connections as shown in the following table:

PIN	FUNCTION
1	0 Volts
2	AF Output +
3	AF Output -

4.3 CNTRL Connector

This 9-way D-type male connector on the rear panel provides a low-current 12 volt supply output and remote control connections.

These are logic inputs which are pulled high internally, and must be closed to 0V by an external switch to impose logic low, and left open to impose logic high. (Alternatively, they may be supplied with a logic low or high by external logic.)

Connections are shown in the table below:

PIN	FUNCTION
1	+12V output (current limited to 400mA) (Note 1)
2	0V
3	PTT (TXE, transmit key)
4	Remote enable
5	CS0 - channel select 0
6	CS1 - channel select 1
7	n/c
8	0V
9	n/c

Note 1: 12V supply only when mains power is present.

Connections to the CNTRL connector

PTT (Transmit on/off) and channel select (first four channels only) can be remote-controlled via the CNTRL connector if desired. The way the inputs operate depends on the levels at the inputs during power-on. The operation of these features is described in part 7 on page 14, and the logic is summarised below.

During power-up				During normal operation	
Remote Enable	PTT	CS0	CS1	Transmit	Channel Select
high	high	X	X	Controlled by front panel (transmit ON at power-up)	Controlled by front panel
high	low	X	X	Controlled by PTT (transmit ON at power-up)	Controlled by front panel
low	high	X	X	Controlled by PTT (transmit OFF at power-up)	Remote controlled by CS1, CS0
low	low	X	X	Controlled by PTT (transmit ON at power-up)	Remote controlled by CS1, CS0

X = don't care

How remote operation depends on input levels at power-on

The Remote Enable input is only looked at and acted upon at power-on. If the mode of operation needs to change, then the power to the Symphony must be turned off and back on again.

Channel Select inputs CS0 and CS1 select one of four channels as follows:

CS1	CS0	CHANNEL
open	open	1
open	0V	2
0V	open	3
0V	0V	4

When the Channel Select inputs are used, the Tx and Rx channels are the same and are switched together.

These features are either controlled by the front panel or the CNTRL inputs, never both.

4.4 RS232 Connector

This 9-way D-type female connector provides a serial interface port which can be used to control the rack, or to control further racks in a Master/Slave configuration. Connections are shown in the table below.

PIN	FUNCTION
1	
2	RXD Data Output
3	TXD Data Input
4	
5	0V
6	
7	RTS Input
8	CTS Output
9	

4.5 Front Panel Audio Connector

The single Lemo connector on the front panel is for a headset, mic and PTT. The headset audio can be switched to monitor the audio output from the receiver under software control. The mic audio is combined with the Line input audio after the soft limiter. The mic audio is turned on and off using the front panel configuration software.

Warning: There is no audio limiter on the headset audio output. Take care when connecting a headset when the Audio Monitor Function is turned on and off.

Note: The mic and audio monitor should be turned off when not in use to ensure no possible interference with the transmitter and receiver.

The connections of the Lemo connector are as follows:

Pin No	Function	Description
1	AF+	Balanced audio output to earpiece with impedance of 8Ω or greater. The output level can be changed using the front panel configuration software
2	GND	Return for PTT and MIC inputs
3	MIC	Microphone input; 600Ω nominal input impedance. The input gain of the mic can be changed using the front panel configuration software. The input will accept electret or moving coil microphone types.
4	PTT	Not used at present
5	AF-	Balanced audio output to earpiece with impedance of 8Ω or greater. The output level can be changed using the front panel configuration software

The pinouts for the Lemo connector (as viewed looking at the Lemo socket, or at the rear of the mating plug) are as shown in the following figure:

Red dot / keyway

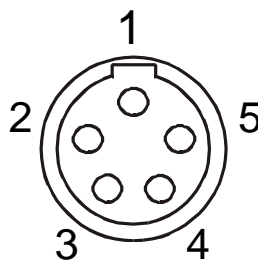


Figure 3 Lemo Pin Configuration

5 POWER SUPPLY CONNECTIONS

5.1 AC Input

The Symphony has an illuminated, switched IEC input connector on the rear panel. The connector has an integral fuse, 2.5A slow-blow 20mm type.

The switched mode power supply accepts any AC input from 90V - 132V AC or 180V - 264V AC at 47 - 63Hz, and auto-selects the correct range without any intervention.

5.2 External DC Supply Detail

The Symphony base station may be powered by an external 12 volt source via a four-pin Molex type 5569 connector on the rear panel.

This supply is automatically connected to the unit when there is an AC mains failure using an internal relay.

The external DC power source is protected by a fuse (20mm 2A quick blow) which is located on the rear panel. The negative input of this supply is connected to rack earth.

The pinouts for the Molex connector are shown in Figure 4.

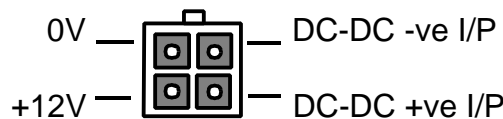


Figure 4 - DC I/P Connector viewed from the rear panel

The other 2 connections on this connector are for an optional DC-DC power supply which can be fitted in place of the AC power supply.

Note that the +12V supply on the CNTRL connector is only present when the mains power supply is operating.

5.3 Rear Panel Adjustments

I/P ADJ is a rear panel mounted pre-set adjacent to the Line Input connector, which sets the line input level as required. This level will normally be +8dBm i.e. Peak Programme, allowing for maximum carrier deviation. Note that the Symphony unit has a soft limiter circuit included. This ensures that any level above +8dBm is held without distorting so that the on air quality of the signal is not degraded.

O/P ADJ, a second pre-set adjustment, adjacent to the Line Output connector, sets the line output level as required.

6 FRONT PANEL OPERATION

6.1 Introduction

Symphony is a flexible base station offering a number of choices and able to provide the user with information about its operation. The front panel LCD display and buttons are used to control and monitor the unit's activity using a system of menus.

Note: The front panel controls should not be used to control transmit/receive or channel when the rear panel switches are controlling these functions. The front panel display does not show the selections made by the switches.

There are 4 buttons adjacent to the display: *UP*, *DOWN*, *ENTER* and *CLEAR*. To move the cursor or increment/decrement use the *UP/DOWN* keys. To select a function use the *ENTER* key which will accept the data and return to the next menu level up. To ignore an input and return to the next menu level up, press the *CLEAR* key.

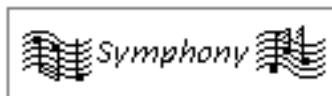
Note: it is recommended that the display be left on the top level menu in normal use as a parameter may be accidentally changed if a lower level menu is displayed (e.g. Channel Change).

6.2 Symphony Configuration

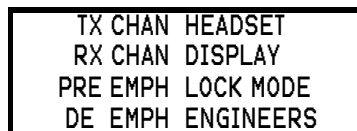
All the configurable parameters that are described in this section are stored in a non-volatile EEPROM. Should a unit fail, a technician can move this memory IC (which is mounted on the rear of the display PCB in an IC socket) from the faulty unit to a good unit, which will immediately take on the old unit's configuration.

6.3 Top Level Menu

When power is first applied the following display is shown:



When a button is pressed, the main menu screen is displayed as follows



The *UP/DOWN* keys will move the cursor (shown by inverse text). When an option is highlighted, press the *ENTER* key to execute the function or display the menu.

6.4 Lock Mode

To prevent unauthorised alterations to the Symphony settings, they can be locked using a 3-digit password which you can set. When the settings are locked, a small key symbol is displayed in the bottom right-hand corner of the display on all screens. All settings (with the exception of the password) can be displayed to see how the Symphony is configured, but no value can be changed.

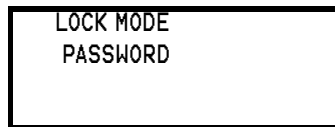
When you use this facility for the first time, you should change the password from its default value (1 1 1) to one which you choose. You can use the same sequence to change the password at any future time. Three steps are necessary: enter the existing password, enter a new password, and turn Lockmode on.

1. Move the cursor to *LOCKMODE* on the top level menu screen and press *ENTER*. The following screen is displayed:



- The password is always required for Lockmode functions.

Press the *UP* button one or more times to display the first digit of the existing password (1 is the default) and press *ENTER*. Repeat this for the next 2 digits to enter the current password (default 1 1 1). On the third *ENTER*, the following screen is displayed:



2. To enter a new password, move the cursor to *PASSWORD* and press *ENTER*. The existing password is displayed (default 1 1 1). Use the *UP/DOWN* and *ENTER* keys to enter a new password. When the 3 digits are entered the previous screen will be displayed.
3. To lock or unlock the settings, select *LOCKMODE*. This will display the following screen:



Highlight *OFF* or *ON* using the *UP/DOWN* keys and press *ENTER*.

The display will return to the previous screen and if locked, a small key symbol is displayed at the bottom right of each screen. Use the *CLEAR* button to return to the main menu.

To turn Lockmode on or off without changing the password, follow steps 1 and 3 of the above sequence.

- **You cannot unlock the unit, or lock it, unless you know the password.**

6.5 Changing a Channel or Frequency

A set of up to eight TX and RX frequencies are programmed into the unit at the factory. These are stored as individual transmit and receive frequencies to give the maximum flexibility to the Symphony. To ensure that the frequency cannot be set outside the limitations of the transmitter and receiver modules, the frequency entered through the front panel is checked against the upper and lower frequency limits of the modules.

The stored channels can be selected and their frequencies changed. To select a channel, select *RX* or *TX CHAN* from the top level menu. This will display *TX* or *RX CHAN 1 - 8* as follows.

RX CHAN 1	RX CHAN 5
RX CHAN 2	RX CHAN 6
RX CHAN 3	RX CHAN 7
RX CHAN 4	RX CHAN 8

Move the cursor to the a channel number using the *UP/DOWN* buttons and press *ENTER*. This will display the frequency for that channel as follows:

Tx Channel 1
■■■■.■■■■ MHz

If the frequency needs to be changed, use the *UP/DOWN* keys which will alter the frequency by 12.5kHz per step. When the correct frequency is displayed, press the *ENTER* key to store the changed value and return to the previous menu. Alternatively, press the *CLEAR* button to return to the previous menu with no change.

6.6 TX/RX Audio Characteristics

The pre-emphasis settings of the transmitter and the de-emphasis settings of the receiver can both be changed between Off (flat), 6dB and 50µs. Select *PRE-EMPH* (for the transmitter) or *DE-EMPH* (for the receiver) from the top level menu using the *UP/DOWN* and *ENTER* buttons. The display will show the three options with the selected option as inverse video. To change the mode, use the *UP/DOWN* buttons to move the cursor. When the correct option has been selected press the *ENTER* button to store the changed value and return to the previous menu. Alternatively, press *CLEAR* to return to the previous menu. The two displays are shown below:



6.7 Display Characteristics

The Contrast and Brightness of the LCD display/backlight can be changed. Select the *Display* menu and press the *ENTER* button. A sub-menu will be displayed showing *CONTRAST* and *BRIGHTNESS* as follows:



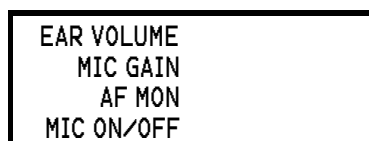
Use the *UP/DOWN* keys to select *CONTRAST*, to change the viewing angle of the display or *BRIGHTNESS* to change the brightness of the backlight, and press the *ENTER* button.



The chosen function is displayed: use the *UP/DOWN* buttons to change the value, and press *ENTER* to accept it.

6.8 Front Panel Audio

To control the front panel audio, select the *HEADSET* option from the top level menu. When this is selected a sub-menu is with the options *EAR VOLUME*, *MIC GAIN*, *AF MON* and *MIC ON/OFF* is displayed as follows:



To change the level of the earpiece audio, select *EAR VOLUME* and use the *UP/DOWN* buttons to change the level. Press the *ENTER* button to accept the level, or *CLEAR* to abandon the change and go back to the previous menu page. The mic gain is changed in a similar way by selecting *MIC GAIN*.

To monitor the received audio through the front panel connector, select *AF MONITOR* from the top level menu. The status of the monitor (OFF/ON) will be displayed as inverse text.



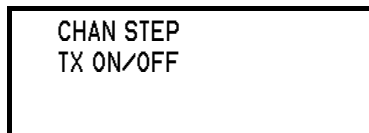
Use the *UP/DOWN* buttons to toggle the ON/OFF followed by the *ENTER* button to accept the change and return to the top level menu.

To turn the mic on and off select *MIC ON/OFF* and then toggle the on/off setting using the *UP/DOWN* buttons. Press the *ENTER* button to accept the change or *CLEAR* to abandon the change and go back up to the menu page.

Note that both the *MIC* and *AF MON* are OFF when the Symphony is first turned on.

6.9 Engineers

The Engineering Mode allows changes to be made to the channel step size and the TX on/off selection. When selected a sub-menu is displayed showing CHAN STEP and TX ON/OFF as follows:



When CHAN STEP is selected 10kHz or 12.5kHz can be selected. The default channel step size is 12.5kHz and the design is optimised for this. The 10kHz step gives access to frequencies which are not an exact multiple of 12.5kHz. When selecting, the unit will convert all frequencies inside to the nearest channel. Note also that changing to and from 10kHz takes a short while (10 - 15 seconds).

The TX ON/OFF can be used to override the remote PTT input on the CNTRL connector. Care must be taken when using this function as the display can become out of step with the TX status of the transmitter. When the remote PTT input is used, the front panel display does NOT show the transmitter module TX state.

7.1 Remote Control

Basic channel select and PTT operations can be controlled either via the front panel menu system, or remotely via logic levels on the CNTRL connector on the rear panel. In order to use remote control, the Remote Enable and PTT inputs must be held at the correct level when the Symphony is powered up. The correct levels are described in the following sections.

7.2 PTT Options

As supplied by Wood & Douglas, the Symphony is shipped enabled for continuous transmission. Users wishing to provide a "push-to-talk" facility simply need to add a switch between pins 2 and 3 of the CNTRL connector (closed contacts to transmit) and ensure that the correct levels are present on the Remote Enable and/or PTT inputs when the Symphony is powered up.

If the Remote Enable input is high (pin 4 is open circuit) at power-on, the PTT behaviour depends on the state of the PTT input at power-on:

- If PTT is low (closed contacts between pins 2 and 3) at power-on, then the Symphony will accept PTT control on the PTT input.
- If PTT is high (open circuit) at power-on, then the Symphony ignores the PTT input, and transmission is controlled from the front panel (initially on at power-up).

If the Remote Enable input is low (closed contacts between pins 4 and 2) at power-on, the Symphony will always accept control on the PTT input, and it must be held low to transmit.

Front panel control and display of the TX status can become out of step with the actual state of the TX module. Care must be taken in how the remote connection is used. For continuous transmit, it is best to use the front panel control and leave the rear panel PTT line open circuit.

Note that the rise time for the transmitter from when power is applied is <10 seconds.

7.3 Remote Channel Select

Channels 1 to 4 may be remotely selected via pins 5 and 6 of the rear panel CNTRL connector, as follows:

CS1 (pin 6)	CS0 (pin 5)	CHANNEL
high	high	1
high	low	2
low	high	3
low	low	4

0V (logic low) is available on pin 2 of the connector. Pins are pulled logic high when they are left open circuit.

Users wishing to select channels in this way must ensure that the Remote Enable input is low (closed contacts between pins 4 and 2) at power-on.

If the Remote Enable input is high (pin 4 is open circuit) at power-on, remote channel select lines will be ignored, and the Symphony will use the channel specified via the front panel menus.

7.4 Duty Cycle and Power Dissipation

The Symphony unit is designed for continuous operation 24 hours a day. If the unit is operating in a high ambient temperature because of climate or adjacent equipment, and especially if the unit is running at its full rated output of 3W, then a single 1U spacing gap should be allowed below the Symphony rack to provide adequate cooling.

7.5 Set up and test

1. Connect an antenna or two antennas dependent on version purchased. In a two-antenna version ensure that the correct antenna is connected to the correct port on the rear panel.
2. Connect the audio Line Input to the Line Output using a jumper lead.
3. Connect an AC or DC supply as appropriate.
4. Switch on the unit.
5. Using a matching portable unit (Duo or Solo / Trio combination) check that audio is heard from the base station when the portable transmitter is keyed.
6. To assess the coverage of the area of operation, a simple walk test is now possible allowing you to 'listen to yourself' as you move around the studio complex.
7. Re-position the antenna if there are dead spots that require coverage. If these are serious contact our sales support team for details of possible alternative antennas or the use of splitters for low-level in-fill coverage.

8.1 Single and Dual Antenna Configurations

The Symphony can be supplied for single or dual antenna working. Which version is required depends on the application within the studio environment, as explained below.

- UHF (400 - 470MHz) Operation

The frequencies normally allocated to this band will have a duplex split of between 5MHz and 13MHz. If the transmit and receive signals are to share a common antenna connection, a diplexing filter will be needed. This combines the two signals via a series of special filters. The Symphony rack has been designed to allow this device to be fitted internally. In these circumstances only a single antenna connection will be present on the rear panel.

- 'In-Band' (470 - 860MHz) Operation

Unlike the UHF version, the duplex frequencies used for In Band operation could have widely differing splits. Early allocations had a fixed 80MHz difference (this being based upon 10 'old style' TV channels). Because of congestion this may no longer be the case in some parts of the UK.

Such a wide split had advantages and disadvantages. A key problem was that it was difficult to source an antenna that would be a good 50Ω match at both TX and RX frequencies. Independent TX and RX antenna ports were therefore provided to allow separate antennae to be used. The wide split did allow duplex transmit and receive operation to take place without mutual interference taking place (i.e. sufficient isolation could be achieved in the receiver to reject the transmit signal without resorting to complex diplexer type filters).

There is, however, a need to ensure that there is around 45dB isolation between antennae. It was for these reasons that the DPAU double plate patch antenna was designed. This gives two antennae under one radome and with good inter-antenna isolation. The main disadvantage to two-antenna working is the need to run two co-ax feeders to the remote antenna location.

There is a further situation where two-antenna operation is attractive. This is where a studio has a number of Symphony units that need to be combined into one transmit or receive antenna. This could be at UHF or In Band. Having two separate connections makes the engineering of the combiner rack much less complex.

The dual antenna version is therefore available in two configurations: one with an internal notch filter fitted, for widely-split 'In Band' operation, and the other where a larger external diplexing filter has to be used for situations where the duplex split is less than 5.5 MHz.

In summary:

- Single antenna port – generally for UHF operation, 5 to 13MHz duplex split, internal diplexer fitted.
- Dual antenna port – mainly for In Band operation, wider split makes common antenna matching difficult.
- Dual antenna port – also for applications where multiple base stations are combined into one antenna for TX or RX (In Band or UHF).

8.2 Isolators

An isolator can be regarded as an 'RF diode'. It allows RF to pass in one direction but not the other. (See W&D application note 7000 0009.) If a system is being used in a studio with other units or other sources of RF there is a danger of the Symphony transmitter antenna picking up these other signals and for them to be churned up in the transmitter output stage. This leads to an effect called *intermodulation*, which creates undesirable spurious emissions. Fitting an isolator will reduce this problem as it will stop reverse signals getting back into the transmitter. The Symphony has been designed to allow an isolator to be fitted internally. If the Symphony is being used with other Symphony units and is being combined in a W&D combiner rack, each Symphony must have an isolator fitted.

8.3 Antenna

Antenna choice depends on the frequency of operation and the physical location of the system. W&D manufacture a plate antenna called the PAU. This is a printed patch radiator protected by a plastic radome. For UHF, this is a single patch. For In Band use, it is a double patch, one element for transmit, the other for receive. Other antennas can of course be used but some consideration must be given to what is required from the antenna. In the studio environment, there is a lot of metallic clutter. This gives rise to an effect called multipath. This is where several copies of the transmitted signal arrive at slightly different times via different routes at the receiver antenna, due to being split and reflected by the metal clutter. It can be heard as a momentary 'bubbling' or buzzing noise, and is very sensitive to precise location in the studio area as well as movements of people and objects. Multipath can be reduced by making the antenna more directional, but if it is too directional, this causes coverage problems. So both omnidirectional and highly directional antennas can cause problems. The PAU has a 90 degree forward-radiating pattern (shaped like a large wedge of cake). The ideal location therefore is across a corner of the studio so that the beam floods the full studio area. It is important that any antenna is mounted at a height on the studio wall that has the least amount of metallic clutter directly in front of it. One prime source of this is the lighting grid. The PAU should therefore be below this and logically around a metre above head height.

8.4 Feeder Cables

There is little point in having a high transmitter power output and sensitive receiver if all the benefit is lost in poor quality coaxial cable feeding the antenna. All Symphony units are fitted with 'N' type RF antenna connectors, for which the 'normal' cable is RG213. However, this has a high loss at UHF, as can be seen from the following table, and W&D recommend the use of Westflex 103 Low Loss co-ax, whose performance is also shown.

Frequency, MHz	RG213/URM67 (Mil Spec)	Westflex 103
100	7	3.2
144	8.5	4.5
200	10	5.4
300	13	6.2
432	15.8	7.5
1000	27	13

Loss per 100m of cable expressed in dB at various frequencies

As Westflex 103 is very similar and the same size as RG213U, no special connector instructions are needed. Normal N plugs will fit. In the case of N plugs we strongly advise the high-quality silver-plated British pressure sleeve types. It will be found in most cases that a slight filing down of the centre conductor of Westflex 103 is needed to fit the centre pin of N plugs, but as this is only a very minor cleaning up of the conductor it will not affect performance in any way. The top hat type ferrule is pushed under the copper foil next to the dielectric. Normal careful waterproofing of any outside connectors is most important, and both self-amalgamating and Denso tape are recommended. Single-centre-conductor cables such as Westflex 103 are not recommended for applications where they will be constantly flexed, such as patch leads or around rotators.

8.5 Combiners

Wood & Douglas manufacture combiner units that allow a number of Symphony base stations to be combined into a single antenna connection. Prices for these can be quoted on application. Note that the physics of this process introduces an attenuation of the transmit and receive signals, and careful design engineering is needed to accommodate this.

8.6 Combiner Amplifiers and Preamplifiers

Specially engineered transmit amplifiers and receiver preamplifiers are available for extreme situations where cable or combiner losses are excessive. Consult the W&D Sales Office for assistance in these situations.

General

Frequency range	400 - 900MHz (in banded versions)	
Number of RF channels	Up to 8 selectable via front panel display (Rear panel serial interface for remote selection of 1-4)	
Mode of operation	400 - 470 MHz	Dual or single aerial duplex (internal duplexing filter)
	470 - 860 MHz	Dual aerial duplex working (with optional internal notch filter)
Transmit / receive spacing	5.5MHz minimum (with an internal diplexer)	
Line input level	High impedance input, soft limited at +8dBm maximum	
Line output level	Low Impedance output, 0dBm into 600Ω (+8dBm max)	
Pre / de-emphasis	50µs / 6dB per octave / flat (software configurable)	
Supply voltage	90 - 132V AC or 180 - 264V AC, 47 - 63Hz, auto-selecting or +12V DC negative earth	
Connectors	Antenna	N type(s)
	Line in	3 pin XLR socket
	Line out	3 pin XLR plug
	Power	AC - IEC male; DC - 4 pin Molex 5569
	Front panel audio	5 pin Lemo socket
Operating temperature	-20°C to +55°C	
Size	480 x 320 x 45mm (19"x 12.6"x 1.8")	
Weight	6kg (13.2lbs)	

Transmitter

R F power output (±1 dB)	400 - 470 MHz	3W max. adjusting down to 10mW
	470 - 860 MHz	1W maximum
Frequency stability	± 2.5 ppm	
Spurious emissions	To ETS 300 086	
Deviation	25kHz	± 3 kHz nom.
	12.5kHz	± 1.5 kHz nom.
Adjacent channel power	< 200 nW	
Audio bandwidth	20Hz - 3.4kHz (-3dB)	
S/N ratio	>47dB (3kHz deviation & 50µs pre / de-emph)	
Distortion	<1% (with 0.3 - 3.4kHz filter)	

Receiver

Sensitivity	< -115 dBm for 12 dB SINAD (with weighting filter)	
Frequency stability	± 2.0 ppm	
Spurious and image rejection	>70dB	
Adjacent channel selectivity	>70dB	
Intermodulation rejection	>65dB	
S/N ratio @ -50dBm RF input	>50dB (3kHz deviation & 50µs pre / de-emph)	
Distortion	<1% (with 0.3 - 3.4kHz filter)	
Display and Control Functions	Frequency selection & frequency changing Audio parameters (pre/de-emphasis, 6dB or 50µs, or flat) RS232 I/O port enabling PC programming/external control	