5 Installation

This chapter provides information on the site requirements for your TB7300 equipment and also describes how to install the base station in a standard 19inch rack or cabinet.

If this is your first time installing a TB7300 base station, we recommend that you read the entire chapter before beginning the actual installation.

5.1 Before You Begin

5.1.1 Equipment Security

The security of your base station equipment is a high priority. If the site is not fully secure, the base station should at least be locked in a secure, ventilated cabinet to prevent unauthorized access.

5.1.2 Grounding and Lightning Protection

Electrical Ground

A threaded grounding connector is provided on the rear of the tray for permanent connection to the site protective ground point (refer to "Connecting the Base Station" on page 51 for more details). The minimum wire gauge for this connection is 1.35 mm²/16 AWG.

Lightning Ground

It is extremely important for the security of the site and its equipment that you take adequate precautions against lightning strike. Because it is outside the scope of this manual to provide comprehensive information on this subject, we recommend that you conform to your country's standards organization or regulatory body.

Norway and Sweden

Norsk
Utstyr som er koplet til beskyttelsesjord via nettplugg og/eller via annet jordtilkoplet utstyr - og er tilkoplet et kabel-TV nett, kan forårsake brannfare. For å unngå dette skal det ved tilkopling av utstyret til kabel-TV nettet installeres en galvanisk isolator mellom utstyret og kabel-TV nettet.

Svenska
Utrustning som är kopplad till skyddsjord via jordat vägguttag och/eller via annan utrustning och samtidigt är kopplad till kabel-TV nät kan i vissa fall medföra risk för brand. För att undvika detta skall vid anslutning av utrustningen till kabel-TV nät galvanisk isolator finnas mellan utrustningen och kabel-TV nätet.

5.1.3 Equipment Ventilation

Always ensure there is adequate ventilation around the base station (refer to "Cabinet and Rack Ventilation" on page 40).

Notice **Do not** operate equipment in a sealed cabinet. The ambient temperature **must** stay within the specified range. We recommend **strongly** that you ensure the cooling airflow is not restricted.

Notice The cooling fans are mounted behind the front panel. To ensure adequate airflow through the base station, do not operate it for more than a few minutes with the fans disconnected (such as when the base station is being serviced).

5.1.4 Ambient Temperature Sensor

The ambient temperature reading for the base station is provided by the temperature sensor located inside the chassis.

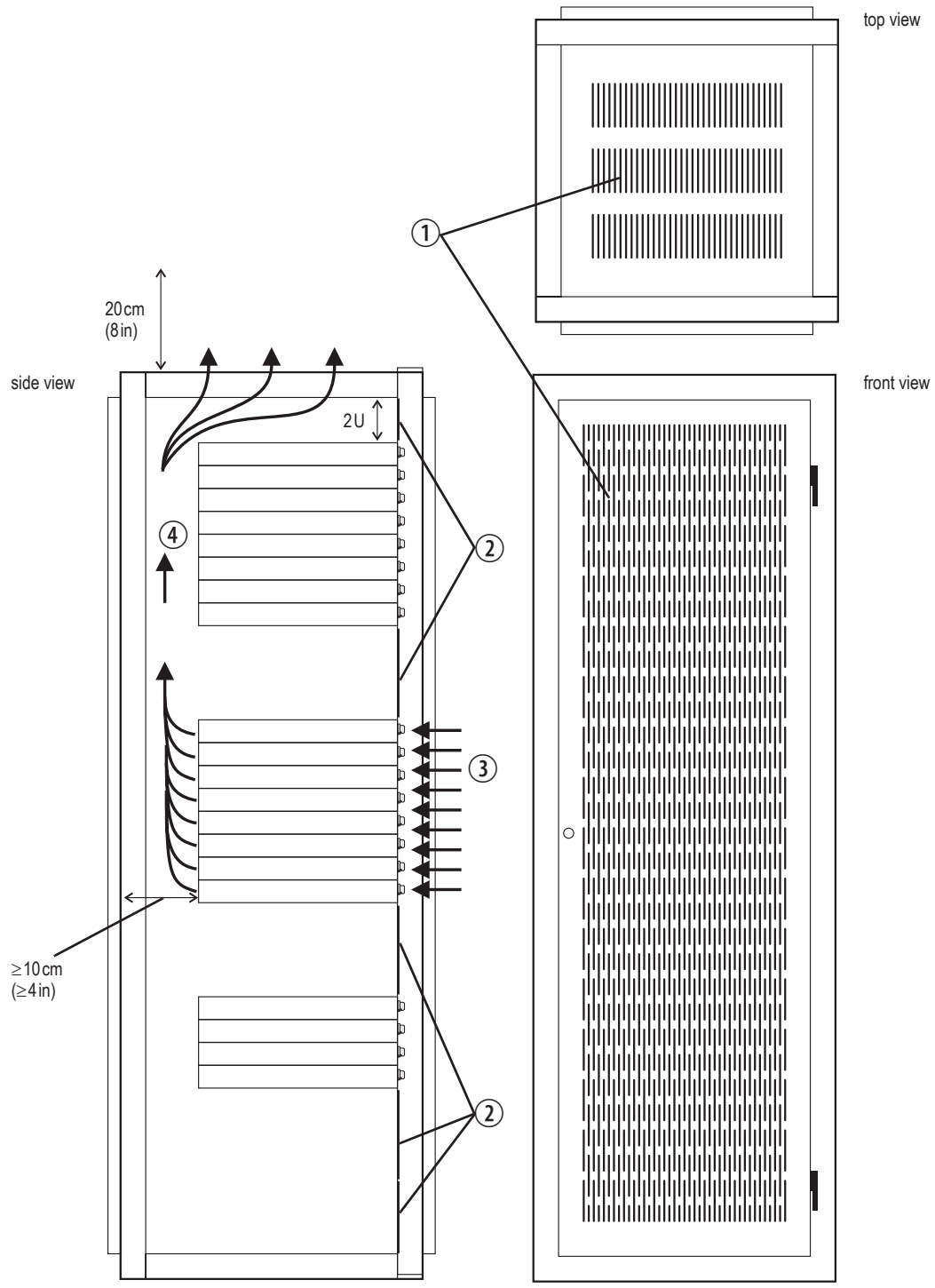
5.1.5 Cabinet and Rack Ventilation

The cooling airflow for the subrack enters through the front panel and exits at the rear. For optimum thermal performance, the heated air that passes through a base station must never be allowed to re-enter the air-intakes on the front panel. Any space at the front of the cabinet not occupied by equipment should be covered by a blanking panel. See Figure 5.1 on page 41.

Equipment installation should observe the following guidelines:

- The recommended maximum number of subracks in a 38U cabinet is five, as illustrated in Figure 5.1 on page 41.
- Any space at the front of the cabinet not occupied by equipment should be covered by a blanking panel. Refer to Figure 5.1 on page 41.
- Subrack placement in the cabinet should include a 2U gap at the top of the cabinet.
- To allow enough cooling airflow through a cabinet-mounted base station, the cabinet should allow for 50 cu.ft/min for each subrack (0.024 cu.m/s).
- To ensure adequate ventilation, the cabinet should have a vent at the top with an area of approximately 23in² (150cm²) per subrack, or a similar area of ventilation at the rear of the cabinet behind each subrack.
- The maximum ambient temperature at the base station front panels must not exceed +140°F (+60°C).

Figure 5.1 Typical cabinet ventilation requirements



5.2 Unpacking the Equipment

Unpacking the Base Station

The base station is packed in a strong corrugated cardboard carton with top and bottom cushions.

1. Cut the tape securing the flaps at the top of the carton and fold them flat against the sides.
2. Rotate the carton carefully onto its side and then onto its top, ensuring that none of the flaps are trapped underneath.
3. Slide the carton upwards over the cushions and lift it away. Remove the cushion from the bottom of the base station.
4. Lift the base station clear of the remaining cushion.

Disposal of Packaging

If you do not need to keep the packaging, we recommend that you recycle it according to local recycling methods. The cushions are CFC- and HCFC-free and may be burnt in a suitable waste-to-energy combustion facility, or compacted in landfill.

5.3 Identifying the Equipment

You can identify the model and hardware configuration of the TB7300 by referring to the product code printed on a label at the rear of the base station. The meaning of each character in the product code is explained in the table below.

This explanation of product codes is not intended to suggest that any combination of features is necessarily available in any one product. Consult your regional Tait office for more information regarding the availability of specific models and options.

Product Code	Description
TB73**XX**-XXXX-XXXX-XXXX-10	10 = single 40/50 W base station/repeater
TB73XX-**XX**XX-XXXX-XXXX-10	**Frequency Band** B3 = 148 MHz to 174 MHz H3 = 470 MHz to 520 MHz H5 = 400 MHz to 470 MHz
TB73XX-XX**X**X-XXXX-XXXX-10	B = 40/50 W
TB73XX-XXX**X**-XXXX-XXXX-10	0 = default
TB73XX-XXXX-**XXXX**-XXXX-10	0 = default
TB73XX-XXXX-XXXX-**X**XXX-10	0 = 13.8 VDC (nominal) input
TB73XX-XXXX-XXXX-X**X**XX-10	0 = default
TB73XX-XXXX-XXXX-XX**XX**-10	**Feature License** 00 = None [Default: Analog (TBAS301)] AC = DMR Express SFE License with TDMA operation (TBAS302) AD = DMR Access SFE License with TDMA operation (TBAS303) AE = DMR conventional (TBAS304)
TB73XX-XXXX-XXXX-XXXX-**10**	10 = default

5.4 Initial Setting Up

Before putting the base station into service, you may want to carry out some basic functional testing, configuration, and tuning (if required). This section provides an overview of these procedures:

- checking that the base station powers up correctly
- checking the basic functionality of the base station by using the tests available in the web interface
- customizing the configuration for the intended installation and verifying that the configuration is correct
- changing the root password
- tuning the base station, if required

5.4.1 Confirming Operation

Notice The RF output **must** be connected to a suitable attenuator or dummy load. **Do not** remove the load while the PA is transmitting as this may damage the PA output stage.

Applying Power

1. Apply power to the TB7300.
2. Check that the base station powers up correctly:

   All LEDs turn on initially, then the transmit and receive LEDs turn off, leaving the green power LED on, and the red alarm LED flashing. The alarm LED will turn off when the base station has finished its start-up sequence.

Functional Tests

The following table provides an overview of the tests available using the web interface. Refer to the base station Help for full details of these tests.

Test	Notes	Menu
receiver operation	requires a suitable RF source	Diagnose > RF Interface > Receiver
transmitter operation	requires connection to the network	Diagnose > RF Interface > Transmitter
ping	checks the IP connection to another device with an IP address	Diagnose > Connection > Network
NTP query	checks if the NTP-based time synchronization is working	

5.4.2 Working with Configurations

The Web UI page Tools > Files > Configuration allows you to manage your base station configuration.

You can:

- Back up a configuration. This stores a snapshot of the base station's current configuration. It is advisable to back up the current configuration before making significant configuration changes.
- Upload a configuration. This copies a configuration from your computer to the base station. You can develop a master configuration and upload it to all the base stations in the network.
- Restore a configuration. This activates the selected configuration after making it compatible with the current software. You can restore configurations that have been backed up on the base station.
- Download a configuration. This copies the selected configuration to your computer so that you can store it.

5.4.3 Customizing the Configuration

The following steps provide an overview of the process used to configure the base station with the settings it needs. Refer to the Help for detailed information.

1. Log in to the base station (refer to "Connecting Your PC to the Base Station" on page 24 for more details).

2. Select 'Configure.' The base station has many different settings that can be configured before it is put into operation, such as:
   - channel configurations
   - alarm control and SNMP agent
   - network interfaces
   - quality of service
   - CWID
   - miscellaneous items such as NTP and package servers

3. Make the changes needed in each form and click, **'Save.'** All changes made in the form will only be applied when the form is saved.

   Notice Before making changes, you should save the configuration to your PC or network; this provides a baseline which can be restored to the base station if the configuration information becomes lost or corrupted.
   You should also back up the configuration before downgrading to a different software release. Note that if you downgrade and then upgrade software, configuration values for new features may reset to default.

5.4.4 Restricted Port Numbers

Certain configuration settings in the base station's web interface require you to enter a port number (for example, the trunking interface).

Two ranges of port numbers are unavailable for use with the base station. The web interface will prevent you from entering a number from these ranges, as explained below.

Restricted Port Numbers	Details
0 – 1023	The "well-known ports", commonly used by other devices in a network. Using a port number in this range could cause compatibility problems with other devices.
12000 – 14999	Reserved for internal use in the base station. Using a port number in this range could cause the base station to malfunction.

5.4.5 Changing the Root Password

Notice The following procedure can be carried out only if secure shell access (SSH) is enabled. Secure shell access to the base station is disabled by default from version 1.35 onwards. To enable SSH, select Tools > Settings > Secure shell and click '**Start'**.

The root password to the Linux operating system of the base station is a possible security risk. The equipment is delivered with a default password that is well known. Knowledge of the password could be used to render the equipment inoperable, for example, by deleting files. If you are concerned about the security risk that this poses, change the password. If Tait provides support services, they will likely need to know the password.

Notice If you change the password and then lose it, the equipment must be returned to Tait. Make sure that you store the password securely and do not lose it.

To change the root password, follow these steps.

1. Log in from your PC to the base station using SSH client software such as PuTTY. The username is *root* and the default password is *k1w1*.
2. At the # prompt, enter the command *passwd*.
3. Follow the on-screen instructions.
4. Record the password in a secure location.

Tait networks are deployed with default weak passwords. For the sake of security, Tait **strongly** recommends changing the default password where applicable.

5.4.6 Tuning the Receiver

Before the base station is installed on site, you may need to tune the receiver front end. The receiver front end requires tuning if the receive frequency is shifted more than 2 MHz away from the previously set frequency, or the RSSI level of the new frequency is more than 1 dB lower than the RSSI level of the previously set frequency. Manual tuning is not required for the H5 (400MHz to 470MHz) model.

The receiver in the B-band base station covers one of the following frequency bands, depending on the model:

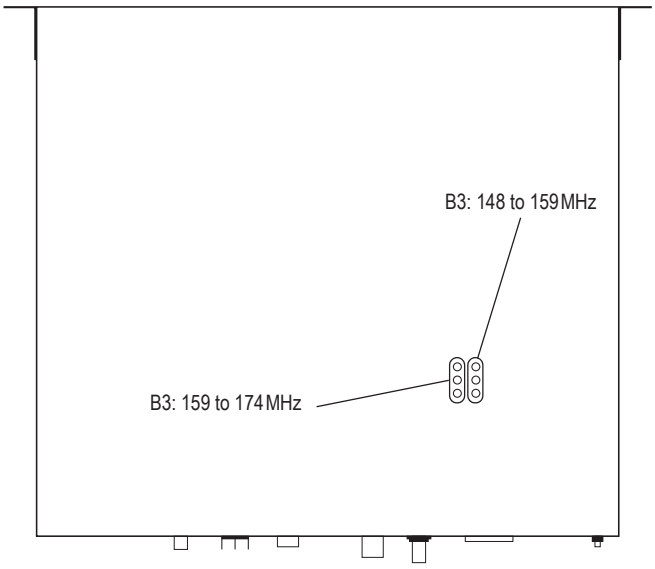
- B3 - 148 to 174 MHz

Each of these bands is split into 2 sub-bands:

- B3 - 148 to 159 MHz and 159 to 174 MHz

Each sub-band has its own helical filter (shown in Figure 5.2 below) which is electronically switched in or out of circuit depending on the frequency programmed into the base station. The bandwidth of these helical filters is approximately ±1.5 MHz.

Figure 5.2 Identifying the B-band receiver front end helical filters



To check the RSSI level and tune the receiver front end (if required), follow these steps:

1. Place the base station on its side or upside down to allow access to the holes on the base to tune the helical filters.

2. Log in to the TB7300 and select Monitor > Interfaces > RF Interface. For information on connecting directly to the base station, refer to "Connecting a Networked PC to a Base Station" on page 25.

3. Feed a signal at the currently tuned receive frequency and at a level of –80 dBm into the RF input. Check that the RSSI reading on the RF Interface page is –80 dBm ± 1 dB.

4. Set the TB7300 to the new receive frequency.

5. Change the RF input signal to the new receive frequency at –80 dBm. Check that the RSSI reading is –80 dBm ± 1 dB. If it is, the receiver front end does not require tuning. If it is not, go to the next step.

6. Using the Johanson tuning tool[1], adjust the correct helical filter for the new frequency (as shown in Figure 5.2) to obtain a peak RSSI reading. This reading should be within 1 dB of the reading at the previous frequency.

   Adjust the center resonator of the filter first, followed by the two outer resonators (in any order). Each resonator should require approximately the same amount of adjustment when tuning.

A change in frequency of 5 MHz requires approximately one turn of the tuning slug. If tuning to a lower frequency, turn the slug clockwise; for a higher frequency, turn the slug anti-clockwise.

7. Change the RF input signal and the receive frequency to 0.5 MHz above and below the required frequency and check that the RSSI reading does not drop by more than 0.5 dB from the reading at the required frequency.

8. Recalibrate the RSSI at the new frequency (Calibrate > Calibrate > RSSI).

If you wish to confirm the accuracy of the tuning procedure, carry out a sensitivity measurement at the new frequency.

1. Included in the TBA0ST2 tool kit. Also available separately as part number 937-00013-00.

5.5 Installing the Base Station on Site

5.5.1 Base Stations for Trunked Systems

When installing base stations that are part of a trunked system, it is important to observe good site engineering rules. This is especially true when the channels are combined into a single antenna.

If possible, the RF planner should avoid frequency plans in which the Rx to Tx spacing is an exact multiple of the trunked channel spacing, thus forcing Tx intermodulation products to fall outside the Rx channels.

Cables and antennas should be of high quality. Solid shield heliax cables are best, but if braided shield cables must be used for short distances, their braids must be silver-plated. Isolators **must** be used at all transmitter outputs.

When the outputs of more than one transmitter are combined, their voltages add, and the resulting peak envelope power is not simply the sum of their powers, but is equal to the power of one of them multiplied by the square of the number of sources. Cables, components, and hardware must be rated to withstand the peak envelope power.

During the commissioning process, all transmitters should be activated together using a diagnostic test tone, while the receiver RSSI is monitored. There should be no discernible increase in RSSI while the transmitters are active.

5.5.2 Equipment Required

It is beyond the scope of this manual to list every tool that an installation technician should carry. However, the following tools are specifically required for installing the base station:

- Philips #2 tip screwdriver used to connect the DC power cables to the DC power terminals
- Pozidriv PZ3 screwdriver for the M6 screws used to secure the tray to the cabinet in Tait factory-assembled systems
- 8 mm spanner for the M5 nut on the ground connector

You can also obtain the TBA0ST2 tool kit from your regional Tait office. It contains the basic tools needed to install, tune, and service the base station.

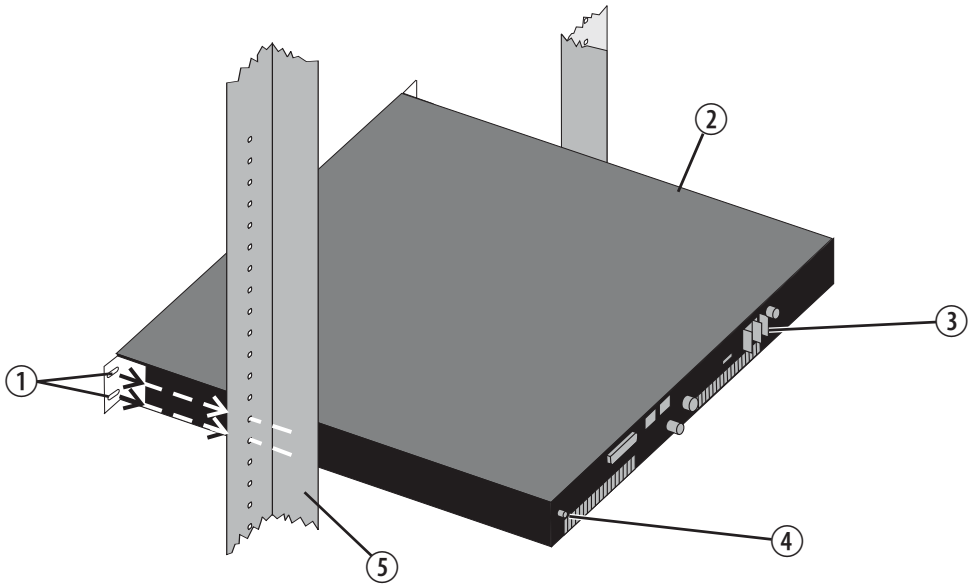
5.5.3 Mounting the Base Station

1. Fit the base station into the cabinet or rack and secure it firmly with an M6 (or 0.25 in if using the imperial system) screw, flat and spring washer in each of the four main mounting holes ①, as shown in Figure 5.3 on page 50.

2. The base station can be wall-mounted by rotating the front mounting brackets and fitting the optional rear brackets (TBBA03-01). When the base station is wall-mounted ensure the airflow is from bottom to top (front panel mounted down) or side to side.

3. For transport or in installations subject to vibration, the base station should be supported at the rear using a transit bracket (Tait recommends using the TBBA03-04 transit bracket).

Figure 5.3 Base station mounting points



① main mounting holes
② base station
③ DC power connector
④ ground point
⑤ rack frame

Cabling

Tait recommends you route all cables to and from the base station along the side of the cabinet so the cooling airflow is not restricted.

Cables should be well supported so that the connectors or terminals on the base station and on the ends of the cables do not have to support the full weight of the cables.

Cables must be routed so that they do not restrict the air outlets at the rear of the base station.

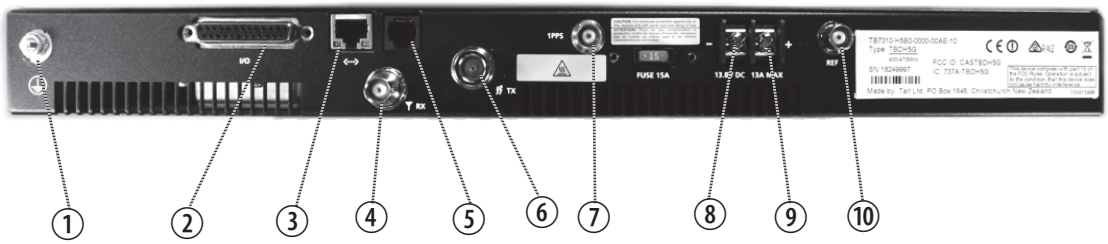
5.6 Connecting the Base Station

This section provides information relevant to the task of connecting up the various inputs and outputs of the base station.

5.6.1 Connection Overview

External connections are all located at the rear of the base station. See Figure 5.4 below.

Figure 5.4 Base station inputs and outputs



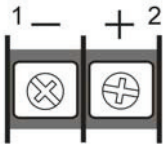
① ground connector
② system interface connector
③ Ethernet interface connector
④ RF input
⑤ serial RS-232 connector
⑥ RF output
⑦ 1PPS input connector
⑧ -VDC input
⑨ +VDC input
⑩ External reference input

5.6.2 Connecting DC Power

The base station is designed to accept a nominal 13.8 V DC, with negative ground.

Notice Any mains power supply used to power the base station is required to meet the isolation separation for reinforced insulation of 3000 Vrms or 4242 VDC.

The DC power connector at the rear of the base station is a heavy-duty M4 screw terminal connector suitable for many forms of connection.

Pin	Signal Name	Signal Type	Notes	External View
1	ground	input	The maximum current for each band: ■ B band: 50 W 9.6 A Typical ■ H band: 40 W 8.1 A Typical	
2	13.8 VDC	input		

You must connect the DC supply from the battery to the base station via a readily accessible disconnect device such as a fuse or DC-rated circuit breaker with the appropriate rating, as shown in the table below.

The DC input leads should be of a suitable gauge to ensure less than 0.2 V drop at maximum load over the required length of lead. Use only flexible copper cables.

Nominal Supply Voltage	Input Voltage Range	Circuit Breaker/ Fuse Rating	Recommended Wire Gauge[a]
13.8 VDC	11.8 VDC to 14.4 VDC	20 A	12 AWG / 3.3 mm[a]

a. For a length of 1.5 m to 2 m (5 ft to 6.5 ft) (typical).

Terminate the DC input leads with a suitable crimp connector for attaching to the M4 screws of the DC power connector.

5.6.3 Connecting RF

Notice **Do not** remove the load from the base station while it is transmitting as this may damage the PA output stage. Before disconnecting RF cables, put the base station into 'Offline' mode to prevent any transmissions.

The RF input to the base station is via the marked BNC connector on the rear panel. The RF output is via the N-type connector on the rear panel (refer to Figure 5.4 on page 51).

Cables and antennas should be of high quality. Solid shield heliax type cables are best, but if braided shield cables must be used for short distances, their braids must be silver-plated.

Recommendations for Installing the Base Station

We recommend the following installation procedures, which should protect the PA from damage under all but the most extreme operating conditions

1. **Do not** connect the base station directly to the antenna. Fit an isolator or duplexer between the base station and the load. Fit the isolator as close as possible to the RF output connector on the base station. Do not connect any switching equipment between the isolator and the base station, unless the switch **cannot** operate while there is RF present (i.e. the base station is transmitting).
2. Fit a surge suppressor to the antenna cabling where it enters the building.
3. Inspect all cables and equipment connected to the base station for defects.

A broken antenna or ice is unlikely to cause damage to the PA.

Explanation

The circuit design of the PA protects the circuitry from high VSWR. This makes it difficult to damage the RF power device by keying the PA into a mismatched load, or if the load deteriorates over even a short period of time (milliseconds).

However, it is possible to damage the device if **all** the following conditions happen **at the same time**:

- there is a step change in the PA load (for example, the load is removed)
- the PA is transmitting
- the feed line loss between the PA and the mismatch is <1 dB

The effect of such conditions is variable: some devices will not be destroyed, and some may fail after repeated load interruptions.

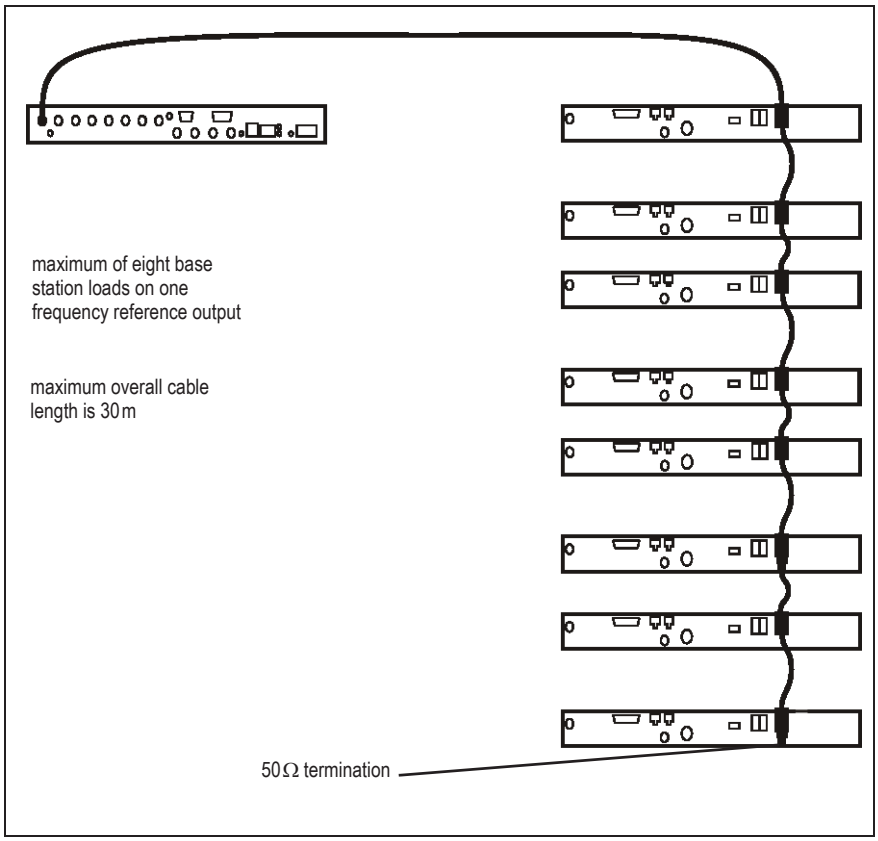
5.6.4 Connecting an External Frequency Reference

An external reference frequency is not normally required for B band. However, an external reference can be used when you need to maximize the range of the base station. The external reference frequency can be 10 MHz or 12.8 MHz, with an input level of 300 mV_{pp} to 5 V_{pp}. The stability of this reference should be better than 100 parts per billion. The base station automatically detects the frequency of the external reference and configures itself accordingly.

If an external reference is required, enable the external reference "external reference absent" alarm (Configure > Alarms > Control).

Use a 50Ω coaxial cable (RG58 or RG223) to connect the external reference to the base station's external reference frequency input. You can daisy-chain up to eight base stations using T-junctions. The maximum overall cable length is 30 m. Terminate the last connection (including single base stations) with a 50Ω load.

Figure 5.5 Daisy-chaining an external frequency reference input

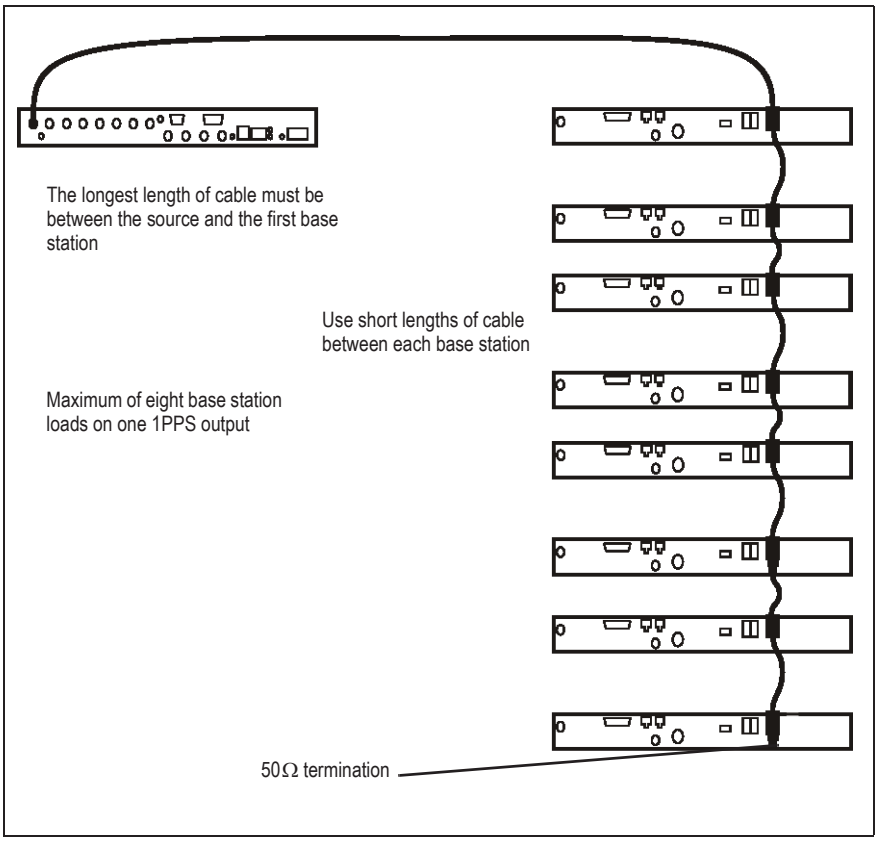


5.6.5 Connecting a 1PPS Source

A 1PPS signal is required for simulcast base stations. Use a 50Ω coaxial cable (RG58 or RG223) to connect the source to the base station's 1PPS input. You can daisy-chain up to eight base stations using T-junctions. We recommend that the cable length between the first and last load is kept to a minimum. This will reduce any propagation variation between base stations. The maximum overall cable length is 30m. Terminate the last connection with a 50Ω resistor, otherwise reflections of the 1PPS pulse may occur.

Notice If 1PPS is used, then 1PPS and NTP must both be derived from the same time base. Normally this will be a GPS disciplined source.

Figure 5.6 Daisy-chaining a 1PPS input



5.6.6 Ethernet Connection

The RJ-45 socket on the reciter's rear panel provides the 10 BASE-T or 100 BASE-T Ethernet connection to the other devices in the network. Use a Cat-5 cable to connect this socket to the Tait Network via a router or switch.

The Web UI allows you to set the Ethernet port speed auto-negotiation to 10/100 Mbit/s or to negotiate a maximum 10 Mbit/s. Tait recommends that you keep the port speed at the factory default setting of 10 Mbit/s. The reciter hardware and software are scaled to meet the performance requirements of processing multiple voice streams along with supervisory control and management communications. 10 Mbit/s is ample for those requirements. The 10/100 Mbit/s setting is provided for compatibility reasons, but it is possible under high traffic conditions at 100 Mbit/s for traffic arriving at the reciter at the full rate within a small timing window to overflow internal buffers and therefore suffer packet loss. If you set the port speed to 100 Mbit/s and observe QoS lost packet alarms, then review your Ethernet port speed settings.

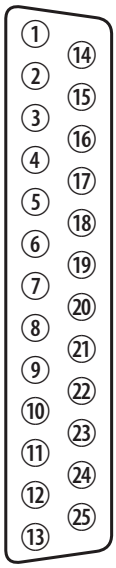
With the port speed at 10 Mbit/s it is particularly important to set the voice QoS on the reciter port of your site router or switch to a strict priority queue policy - which is the same policy that you should also be setting for your site link ports. The default QoS settings restrict the voice bandwidth to 1/25th of the port speed which is smaller than the required bandwidth for typical systems at 10 Mbit/s.

If necessary, refer to "Ethernet Connector" on page 60 for a list of Ethernet connection pin allocations.

5.6.7 Connecting General Purpose Inputs

The base station has a number of general purpose inputs and outputs. These are connected via the 25-way D-range on the rear panel.

The pin allocations for the D-range connector are given in the following table. Not all pins are used in this release of the base station.



external view

Pin	Signal Name	Signal Type	Notes
1	not used		reserved for future use
2			
3			
4			
5			
6			
7			
8			
9			
10			
11	digital in 1	input	5V TTL logic active low
12	digital in 2		
13	+5.2VDC output	power output	maximum current 200mA
14	digital in 3	input	5V TTL logic active low
15	digital in 4		
16	digital in 5		
17	digital in 6		
18	digital in 7		
19	digital in 8		
20	digital in 9		
21	digital in 10		
22	digital in 11		
23	digital in 12		
24	**not used**		**reserved for future use**
25	ground	ground	