TB9100 base station
P25 CG console gateway

Installation and Operation Manual

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Contents

Preface

Scope of Manual

This manual primarily describes the TB9100 base station but also includes the P25 Console Gateway. When "base station" is referred to, this generally applies to the P25 Console Gateway as well. When "reciter" is referred to, this generally applies also to the gateway module.

This manual is intended for use by experienced technicians familiar with installing and operating base station and console gateway equipment.
It includes a technical description of the equipment, maintenance and troubleshooting information.

Document Conventions

"File > Open" means "click File on the menu bar, then click Open on the list of commands that pops up". "Monitor > Module Details > Channel Module" means "click the Monitor icon on the toolbar, then in the navigation pane find the Module Details group, and select Channel Module from it".

Within this manual, four types of alerts are given to the reader: Warning, Caution, Important and Note. The following paragraphs illustrate each type of alert and its associated symbol.

Warning!! **This alert is used when there is a potential risk of death or serious injury.**

Caution **This alert is used when there is a risk of minor or moderate injury to people.**

Important This alert is used to warn about the risk of equipment damage or malfunction.

Note This alert is used to highlight information that is required to ensure procedures are performed correctly.

Associated Documentation

The current set of TB9100 product documentation is provided in PDF format on the product CD. Updates are made available on the Tait support web. Print copies of the documentation are available on request.

- TB9100 Reciter Service Manual (MBA-00017-xx).
- TB9100 Specifications Manual (MBA-00014-xx).
- TB9100 Customer Service Software User's Manual (MBA-00003-xx) and online Help.
- TB9100 Calibration Software User's Manual (MBA-00004-xx) and online Help.
- TBA0STU/TBA0STP Calibration and Test Unit Operation Manual (MBA-00013-xx).
- TaitNet P25 System Manual (MBA-00032-xx).

Technical notes are published from time to time to describe applications for Tait products, to provide technical details not included in manuals, and to offer solutions for any problems that arise. The product CD includes technical notes that were available at the time of release. Look for new or updated technical notes on Tait's technical support website.

Publication Record

Issue	Publication Date	Description
1	July 2004	First release
2	January 2005	General updates; new photographs; Appendix C added
3	March 2005	General updates; Appendix D added
4	August 2005	General updates for version 1.2 release; Appendix D removed
5	May 2006	General updates for version 2.1 release
6	August 2006	General updates for version 2.2 release; H4 frequency band added; control panel updated; P25 Console Gateway added.
7	January 2007	General updates for version 3.0. DFSI interface, centralized voting, voter and switch redesign. Modulation fidelity test. Recommendations for preventing damage to the PA. Carrying handles.

1 Description

The Tait TB9100 base station/repeater is a robust state-of-the-art digital fixed station that combines Tait's proven strengths in reliability, high performance and modular design with software-based configurability and operation, digital signal processing and voice-over-IP technology. Also available is a standalone P25 Console Gateway, providing full encryption features, but no RF functionality.

The TB9100 base station and P25 Console Gateway are designed for operation in a Project 25 radio network. The base station can be configured as a repeater or as a line-connected base station, for operation in conventional or in trunked networks. The P25 Console Gateway is used where encryption is required on the analog line interface.

The ability of the base station to interoperate in both analog FM and digital P25 modes, to link stations using standard Internet Protocol communications, and to add features through software options ensures that P25 systems designed with the TB9100 are scalable in both size and functionality.

The TB9100 base station and P25 Console Gateway combine industry-leading digital voice quality with rugged design specifications and intuitive user interfaces. These products have been designed to meet the demanding needs of the public safety and public service sectors.

The TB9100 base station's RF interface is dual-mode analog/digital, allowing users of APCO P25 or analog radios to communicate via the network.

Its Ethernet interface provides built-in network connectivity, allowing the TB9100 to join with other TB9100 base stations and P25 Console Gateways to form a channel group. This network supports voice over IP and remote management of all TB9100 base stations and gateways.

The analog line allows the direct connection of third party dispatch systems.

1.1 Features

The following are some of the features of the TB9100 base station:

- Fully compliant with the Project 25 Common Air Interface. Can therefore interoperate with any similarly compliant radios.
- Dual mode. Comprehensive analog and digital features ensure interoperability with analog or digital technology. The TB9100 can switch seamlessly between analog FM and digital P25 communications on a per-call basis.
- Integrated built-in voting facility. No external voter is needed.
- Can be completely managed remotely from a PC running the Tait Customer Service Software: configuration, alarm monitoring, fault diagnosis, feature and firmware upgrades.
- An integrated wiring solution is provided for the system control bus and DC power connections to each reciter.
- Reciters can be replaced without affecting the operation of other reciters in the same subrack.
- Rugged construction with generous heatsinks and fan-forced cooling for continuous operation from −30°C to +60°C (−22°F to +140°F).

The following are some of the features of the P25 Console Gateway:

- Project 25 standard DES or AES encryption and decryption at the analog line interface.
- Support for MDC1200, E & M, and function tone signaling on the analog line.

1.2 Base Station and Console Gateway

Like the base station, the P25 Console Gateway can be unpacked, given an IP address, set up on the bench, and used with a CTU. AC and DC power, the analog line, and Ethernet are connected up in the same way. The console gateway has a front panel with fans and a control panel. It can also be monitored and configured by the CSS, much as a TB9100 base station. Although the gateway has an RF board (as well as a digital board and a network board), that board has no function. The P25 Console Gateway subrack can be populated with multiple gateway modules, in the same way that the base station can be populated with multiple reciters. Faulty gateway modules or PMUs are replaced in the same way.

The control panel operates as for a base station, except that the Carrier button has no effect and the microphone can only transmit via the connected channel group. The speaker can output the channel group's vote winner (if unencrypted), but the Console Gateway cannot itself provide any receive audio.

Any references in this manual to the following do not apply to the P25 Console Gateway:

- Transmitting
- PA
- Receiving

The P25 Console Gateway has one capability that the TB9100 base station does not have. It can serve as an encryption/decryption point. Many references to encryption apply only to the Console Gateway.

When "base station" is referred to, this generally applies to the P25 Console Gateway as well. When "reciter" is referred to, this generally applies also to the gateway module.

1.3 Modules

The TB9100 base station or P25 Console Gateway consists of a subrack with one of the following:

- Up to two transmit/receive channels
- Up to five receive-only or gateway channels with a power management unit (PMU)
- Up to seven receive-only or gateway channels (external power supply required)

The one PMU supplies and manages power to the whole subrack. One reciter or gateway module is needed for each channel and one PA is needed for each transmit/receive channel. There is also a front panel with fans, and a control panel. The modules are interconnected at the front of the subrack. External connections to the modules are located at the rear.

Modules come in different variants depending for example on the RF band or the supply voltage. The PA and the PMU are common to the TB8100 base station. Receive-only base stations and P25 Console Gateways do not need PAs.

Each module is inserted into the TB9100 4U subrack from the front and is secured at the front with a metal clamp. Both clamp and module are easily removed for rapid module replacement. The modules are secured laterally with plastic guides that clip into the top and bottom of the subrack. These guides can be easily repositioned to change the configuration of a subrack. The heavier modules are also secured laterally by metal tabs at the rear of the subrack.

The following provides a brief description of the available modules.

Base Station Reciter

The reciter module comprises the receiver, exciter and digital control circuitry. It also incorporates the network board, which provides the Ethernet interface, the analog line interface, and general purpose digital inputs and outputs.

Reciters are installed in the subrack from right to left (viewed from the front), with the right-hand position corresponding to position 1 on the control panel. Only the reciter in position 1 can communicate with the PMU (if fitted).

It is not possible to convert a reciter to a gateway module.

Gateway Module

The gateway module of the P25 Console Gateway appears identical to a base station reciter. However, they are electronically distinct. The P25 Console Gateway has no RF capability. It performs P25 encryption and decryption at the analog line, which the base station is incapable of.

Gateway modules are installed in the subrack from right to left (viewed from the front), with the right-hand position corresponding to position 1 on the control panel. Only the gateway module in position 1 can communicate with the PMU (if fitted).

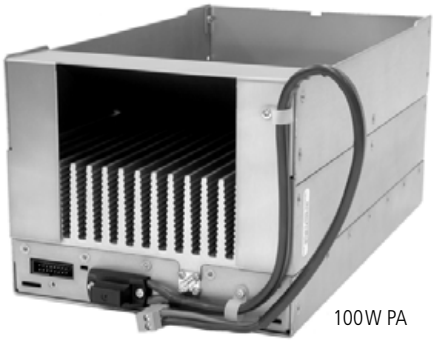
It is not possible to convert a gateway module into a reciter.

Power Amplifier

The power amplifier amplifies the RF output from the reciter and is available in 5 W, 50 W and 100 W models.

The 5 W and 50 W models mount vertically in the subrack, while the 100 W model mounts horizontally as it has a wider heatsink. The 100 W PA is also fitted with an airflow duct.

5/50 W PA



100 W PA

All three models are designed to operate on the 28 VDC output provided by the TB9100 power management unit. In addition, variants of the 5 W and 50 W models are available for DC-only operation. These two 12 V PAs are fitted with an internal boost regulator board, which converts the 12 V nominal DC input to a 28 VDC output to power the PA circuit boards. The boost regulator board also provides a 12 VDC output to power the reciter.

The first 5W or 50 W PA is installed in position 3 of the subrack. The second 5W or 50 W PA is installed in position 5. The 100 W PA shares a connection with the PMU to position 6 of the subrack. PAs are not required in a P25 Console Gateway or receive-only base station.

Power Management Unit

The PMU provides the 28 VDC power supply for the modules in the TB9100. The input voltage can be AC, DC or both AC and DC, depending on the model. An auxiliary DC output is also available when the optional power supply board is fitted. This board is available with an output of 13.65 VDC, 27.3 VDC, or 54.6 VDC.

AC and DC PMU shown

The PMU can only be installed in position 6 of the subrack.

Front Panel

The front panel is mounted onto the subrack with two quick-release fasteners. It incorporates the cooling fans for the PAs and the PMU if these modules are present.

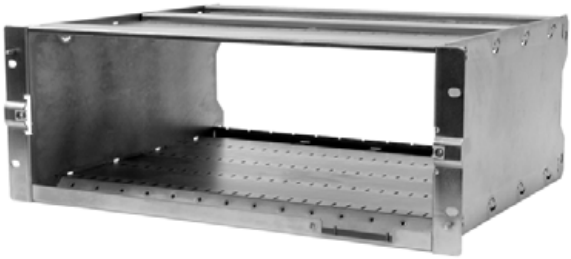
Control Panel

The control panel is mounted onto the subrack and is accessible through an opening in the front panel. The control panel provides some manual control of the channels in the subrack, can display status information for each channel and allows the technician to make and receive calls (refer to "Control Panel" on page 61).

It is a technician tool rather than a user facility.

Subrack

The 4U subrack is made of passivated steel and is designed to fit into a standard 19 inch rack or cabinet.



It is fitted with a configurable subrack interconnect board that provides switching and control logic. The position of a module in the rack is defined by the socket in the subrack interconnect board to which the module is connected by the system control bus.

1.4 Frequency Bands and Sub-bands

Much of the circuitry in the TB9100 base station is common to both frequency bands, and is therefore covered by a single description in this manual. Where the circuitry differs between VHF and UHF, separate descriptions are provided for each frequency band. In some cases the descriptions refer to specific VHF or UHF bands or sub-bands, and these are identified with the letters listed in the following table.

	Frequency Identification	Frequency Band and Sub-band
VHF	B band	B1 = 136MHz to 174MHz B2 = 136MHz to 156MHz B3 = 148MHz to 174MHz
UHF	H band	H0 = 400MHz to 520MHz H1 = 400MHz to 440MHz H2 = 440MHz to 480MHz H3 = 470MHz to 520MHz H4 = 380MHz to 420MHz
	K band	K4 = 762MHz to 870MHz[a]

a. The actual frequency coverage in this band is:
Transmit: 762MHz to 776MHz, and 850MHz to 870MHz
Receive: 792MHz to 824MHz

1.5 Base Station Options

The modular design of the TB9100 base station means that it is available in many variations. A range of features that can be enabled in software adds another level of configurability. Here are some of the different products that result from different module combinations.

Base Station/Repeater

The standard TB9100 combination of modules is suitable for use as a line-connected base station and as a repeater. This is the typical base station configuration described in "Theory of Operation" on page 18. Depending on its PMU, it can operate on AC power, DC power, or a combination of both.

12V DC PA-Only Base Station/Repeater

The TB9100 base station can be provided without a PMU for those who prefer to use an external third party power supply. The 12 V DC input is connected directly to the 12 V PA. This is a variant of the PA that includes a boost regulator board. This board converts the 12V nominal DC input to

a 28 VDC output to power the PA circuit boards. The boost regulator board also provides a 12 VDC output to power the reciter. Customers must provide their own power supply. Without a PMU, the base station can only be powered by DC and cannot carry out its power management functions.

Receive-only Base Station

The TB9100 base station can be provided as a receive-only variant in systems that need sites to enhance the receive coverage. This consists of a single reciter in a subrack, with or without power management. The exciter is present but not licensed to transmit.

P25 Console Gateway

The purpose of the P25 Console Gateway is to provide an encrypt/decrypt point at the analog line. The P25 Console Gateway's analog line connects to the dispatch system, and its Ethernet interface connects to the TaitNet P25 Network. It has no RF functionality.

Encrypted voice quality is indistinguishable from unencrypted.

The P25 Console Gateway supports Project 25 compliant DES (via the basic encryption license) and AES (Advanced Encryption Standard) with the AES license.

Since the control panel is another analog access point, decryption at the control panel could be a point of insecurity in the system. For this reason, there is no encryption or decryption to the control panel. The control panel speaker plays unencrypted speech (if that is present at the gateway). If the gateway is receiving or transmitting encrypted speech, the speaker simply produces encrypted noise.

1.6 Base Station Applications

TB9100 base stations can be used as repeaters or as base stations. They can be connected together as a channel group, to form a wide area repeater or wide area base station. They can be used in trunking systems and in conventional systems with analog or digital dispatch equipment. For more information, see the TaitNet P25 System Manual.

Repeater

The TB9100 base station can function as a standalone repeater. The analog line is not used and the Ethernet line is only used for CSS access.

Line-Connected Base Station

Analog A TB9100 base station can function as a line-connected base station. Analog dispatch equipment is connected to the analog line.

Digital A TB9100 base station can make available a digital fixed station interface (DFSI) for connecting to digital dispatch equipment.

Channel Group

TB9100 base stations that are interconnected over an IP-based linking infrastructure can be configured as a channel group. Together, they operate as a single logical channel, forming a wide area repeater, wide area base station, wide area trunking control channel or trunking traffic channel. P25 Console Gateways can also be channel group members. They connect analog dispatch equipment to the channel group and can act as an encryption/decryption point.

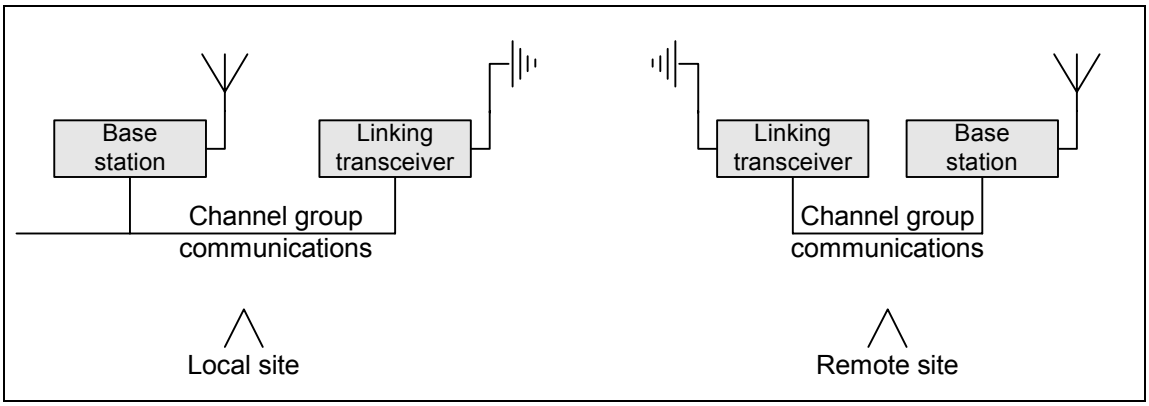
Trunking Control or Traffic Channel

TB9100 base stations can be interfaced to an external trunking site controller. Under instructions from the site controller, they can function as a control channel or a traffic channel.

P25 Linking

A pair of TB9100 base stations can function as linking transceivers and be used to provide an RF link, for example between a channel group and a base station at a remote site.

Figure 1.1 TB9100 base stations as linking transceivers



A TB9100 must be appropriately configured using the CSS before it can function as a linking transceiver. As voting information cannot be carried over the RF link, signals that the linking transceiver provides to its channel group must be assigned a source type and given a fixed impairment value. For details, see the TaitNet P5 System Manual and the CSS manual or online Help.

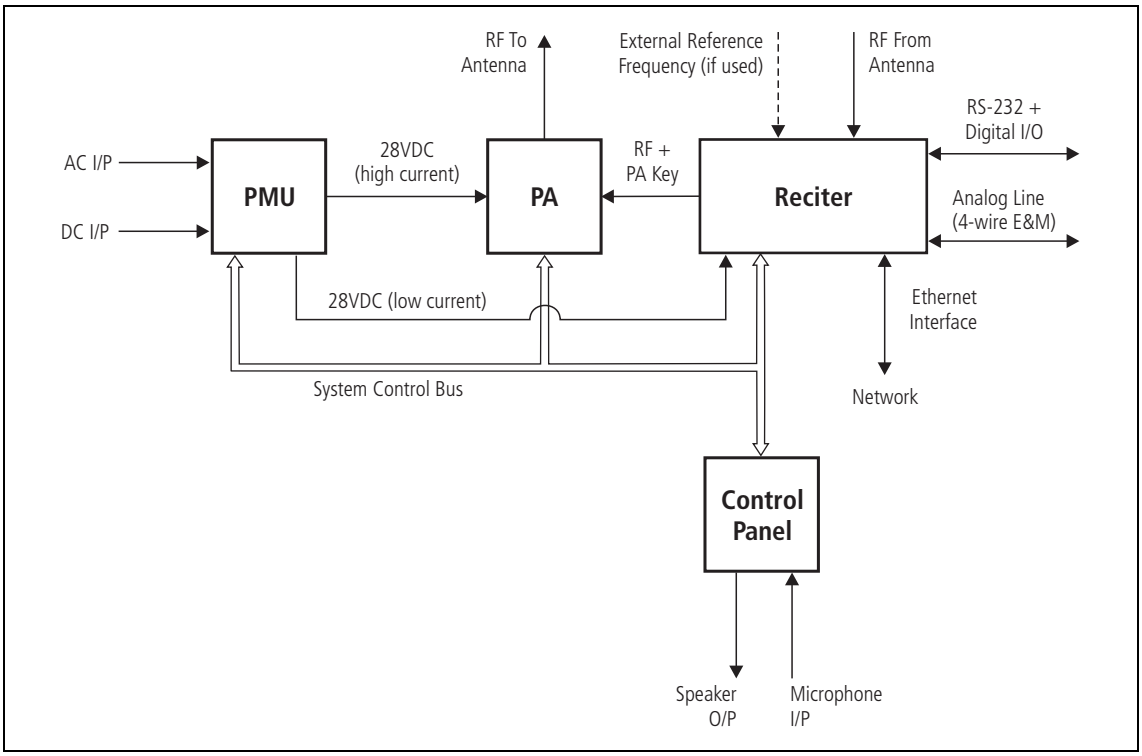
1.7 Theory of Operation

The reciter receives RF signals from its RF input and sends RF from its RF output to the PA, along with a PA key signal. The reciter also receives signals from and sends signals to the analog line, the Ethernet interface, and the control panel (see Figure 1.2).

A system control bus interconnects the modules and carries alarm and control signaling between the reciter and the other modules.

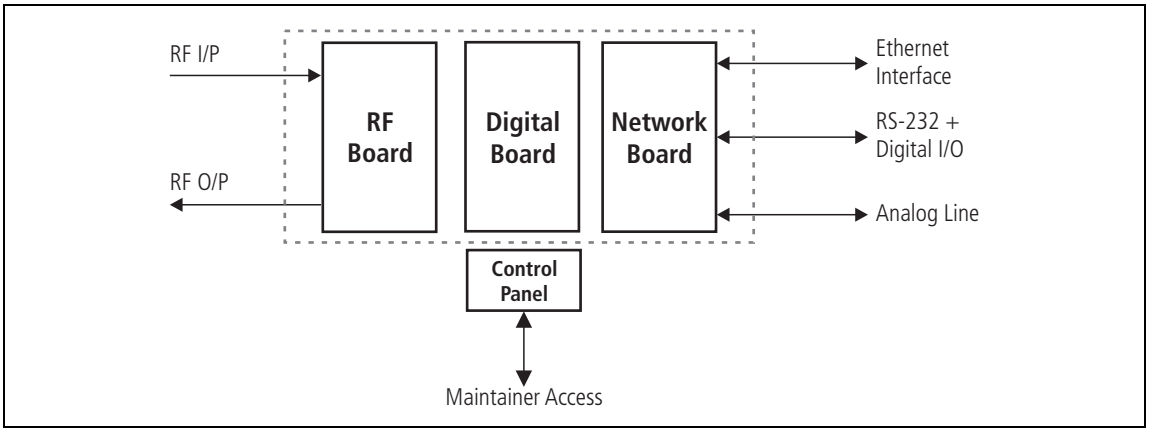
The control panel speaker and microphone enable the base station maintainer to communicate with the dispatcher or with subscriber unit radios. The Ethernet interface carries voice over IP as well as communications with the CSS.

Figure 1.2 Base station high-level diagram



The reciter carries out signal processing and has overall control of the base station. It comprises an RF, a digital, and a network board, as shown in Figure 1.3.

Figure 1.3 Reciter boards



The RF board contains the receiver and exciter circuitry.

The digital board converts information between analog and digital and controls the maintainer's access via the control panel. It also performs the air interface signal processing for both analog FM and digital P25 modes.

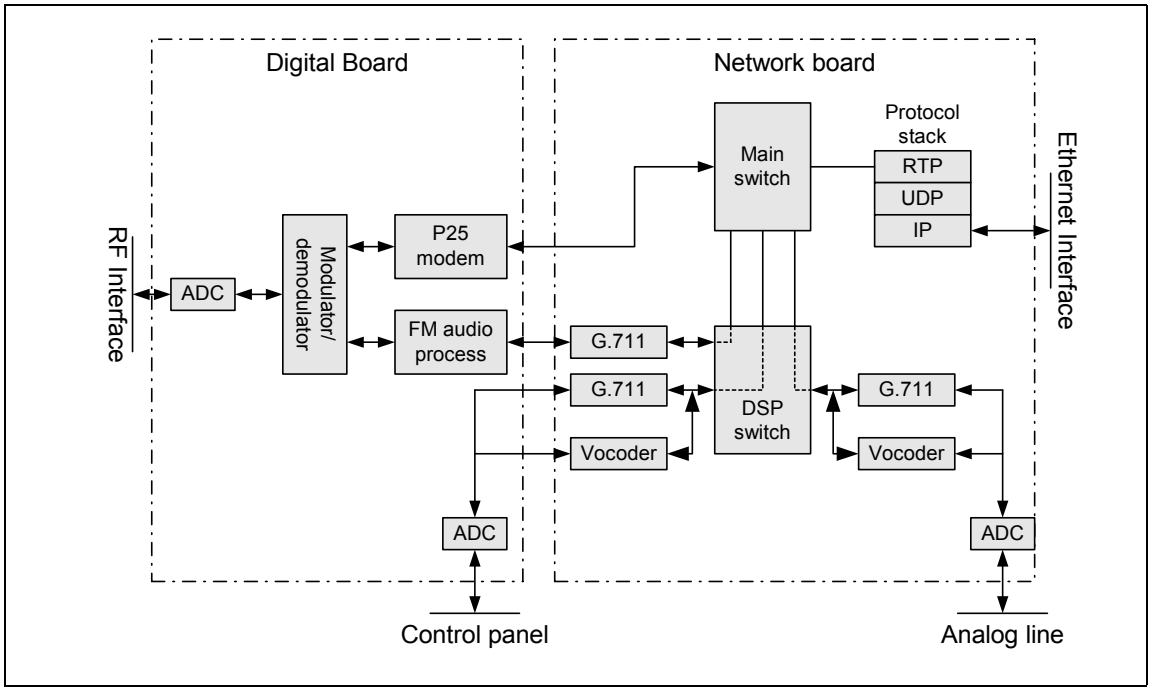
The network board acts as the link between the digital circuitry and the TaitNet P25 Network, and gives the base station an identity as a network element. It also provides the physical connections for the Ethernet, analog and RS-232 serial interfaces.

For more detailed information, see "Technical Description" on page 99.

Signal Paths

Figure 1.4 gives an overview of signal paths within the reciter.

Figure 1.4 Reciter signal paths



1. Incoming signals all go to the main switch.
   a. Digital P25 signals from the RF interface go straight from the digital board to the main switch.
   b. Analog FM signals from the RF interface go from the FM audio processing circuitry via a G.711 encoder to the DSP switch, which routes them to the main switch.
   c. All signals from the channel group go through the protocol stack straight to the main switch.
   d. Signals from the control panel microphone or from the analog line pass first through an ADC, which converts them from analog to a 128 kbit/s digital stream. Then, if they are analog FM, they pass through a G.711 encoder. If they are digital P25, they pass through an IMBE vocoder. The DSP switch then routes them to the main switch.
2. The main switch handles the signals according to the reciter's configuration and role within the channel group. It may vote between RF-originated signals. If there are multiple signals, it selects or prioritizes them.
3. The main switch routes the signals to the appropriate destinations:
   - RF interface (via the digital board), for transmitting P25 over the air)
   - Ethernet interface (via the IP protocol stack), for sending to the other channel group members

- DSP switch, for further routing and for converting back to analog

4. The DSP switch coordinates the DSP processing of the signals and routes them to the RF interface, analog line and/or the control panel speaker).

5. Each destination interface makes available the signal with the highest priority for that interface.

Run and Standby Modes

The base station normally operates in Run mode, but you can use the CSS to put it in Standby mode.

Run mode

In Run mode, the base station performs its normal functions.

Standby mode

When you program the base station or run invasive diagnostic tests, the base station must be in Standby mode. This takes the base station out of service. However, the control panel is still effective; you can use it to send and receive over the air and across the analog line and to receive from the channel group interface.

Dual Mode

The base station can handle analog FM calls as well as digital P25 calls. It is a dual-mode base station. However, it can be configured to always operate in one mode. For example, if only digital P25 radios use the base station, the base station can ignore analog FM calls. Note that at any one time, the base station can only handle one call, either analog FM or digital P25. It cannot receive a call in one mode and repeat it in the other.

Analog FM mode

In Analog FM mode, the base station can receive and transmit over the RF interface using analog FM modulation. Analog FM speech is sent and received over the channel group interface using the G.711 format.

Digital P25 mode

In digital P25 mode, the base station can receive and transmit over the RF interface using digital P25 modulation. Digital speech is in the IMBE (Improved Multi-Band Excitation) format.

Dual mode configuration

Dual mode is configured not for the base station as a whole, but for the inputs at a particular interface. The mode of outputs is not configurable; it can always be either analog FM or digital P25, depending on the input. When the base station receives an input on an interface, it operates in the mode of that input.

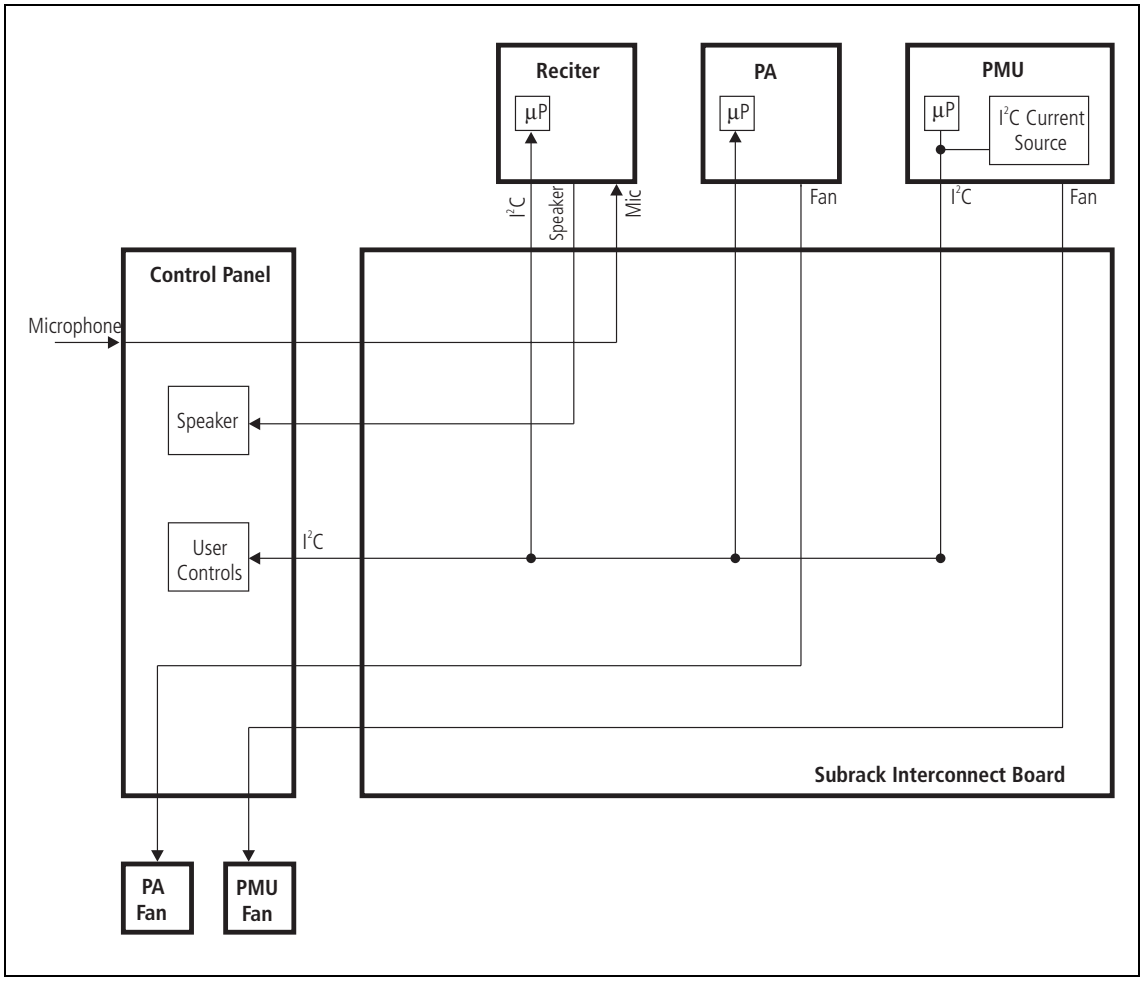
Dual mode is configured or selected at the different inputs in the following way:

Input interface	Description
RF	The RF interface can be configured in channel profiles to receive analog FM speech, digital P25 speech or both (dual mode). In dual mode, the receiver listens for digital P25 signals. If they are detected, the base station operates in digital P25 mode, otherwise in analog FM mode.
Analog Line	The analog line receives analog speech signals from the dispatch console. The current calling profile defines whether the signal is to be handled as digital P25 or analog FM. Different calling profiles can select different modes.
Digital fixed station interface	The DFSI receives speech signals whose mode has already been defined by the FSH. The FSI is always capable of receiving calls in either mode.
Channel group interface	The channel group interface receives speech signals whose mode has already been defined by the channel group member that is the source of the call. The channel group interface is always capable of receiving calls in either mode.
Control Panel	The control panel receives speech from the connected microphone. The user selects digital P25 or analog FM mode using the microphone button. Refer to "Microphone Operation" on page 64 for further details. The destination of the signal is configured by the CSS.

Intermodule Communications

A system control bus and a subrack interconnect board interconnect the modules in the subrack and carry alarm and control signaling between the reciter and the other modules, as shown in Figure 1.5.

Figure 1.5 Intermodule communication paths



Power Management

TB9100 base stations with a PMU manage the supply of power to ensure uninterrupted operation of the base station. A range of parameters is monitored and can trigger alarms that are sent via the reciter to the CSS and a syslog collector.

AC to DC Changeover

When the PMU has an AC and a DC module, the TB9100 can be powered by either the AC (mains) or the DC (battery) supply. The base station will default to the AC supply if both supplies are provided. If the AC supply becomes unavailable, a seamless changeover from the AC to DC supply takes place, providing that the battery voltage is above the configured minimum. You can use the CSS to monitor whether the base station is running on battery or mains power.

DC Operation

When the base station is running off the DC supply and the battery voltage falls below the configured minimum, the base station will enter PMU Shutdown mode to protect the battery and base station equipment. A standby power supply card is required to maintain the power to the PMU microprocessor, while the rest of the PMU is shut down.

When the battery voltage rises to the configured startup setting, power is resumed to the DC supply.

Auxiliary Power Control

If the PMU is fitted with an auxiliary power supply unit, its output can be used to power other site equipment or to recharge the DC battery supply when the base station is running off the AC supply. You will need to configure it to suit your requirements.

Power Distribution

Figure 1.6 shows how power is distributed to modules in the subrack. One method is used if there is a PMU, another if there is a 12 V PA and yet another if there is neither PMU nor PA.

Subracks with a PMU

The TB9100 can receive input power from either the AC or DC input. The PMU provides a 28 V output to the PA and to the reciters. Internal seamless switching between the AC or DC input ensures there are no power interruptions should a changeover occur between the two inputs. The base station will default to the AC input if both AC and DC inputs are provided.

The AC converter has a series switch which isolates the mains input from the converter. The DC input, however, has much higher current ratings, and supports an on/off switch on the converter only.

The outputs from both the AC and DC high power converters are added together and fed to the PA via the PA1 and PA2 outputs. The auxiliary output is also tapped off this summed output.

12 V DC PA-only subracks

In 12 V DC PA-only base stations, the DC power input is connected directly to the PA, where it is fed to the internal boost regulator board. This board provides a 12 VDC output for the reciter and a 28 VDC output for the PA circuit boards.

Subracks with no PA and no PMU

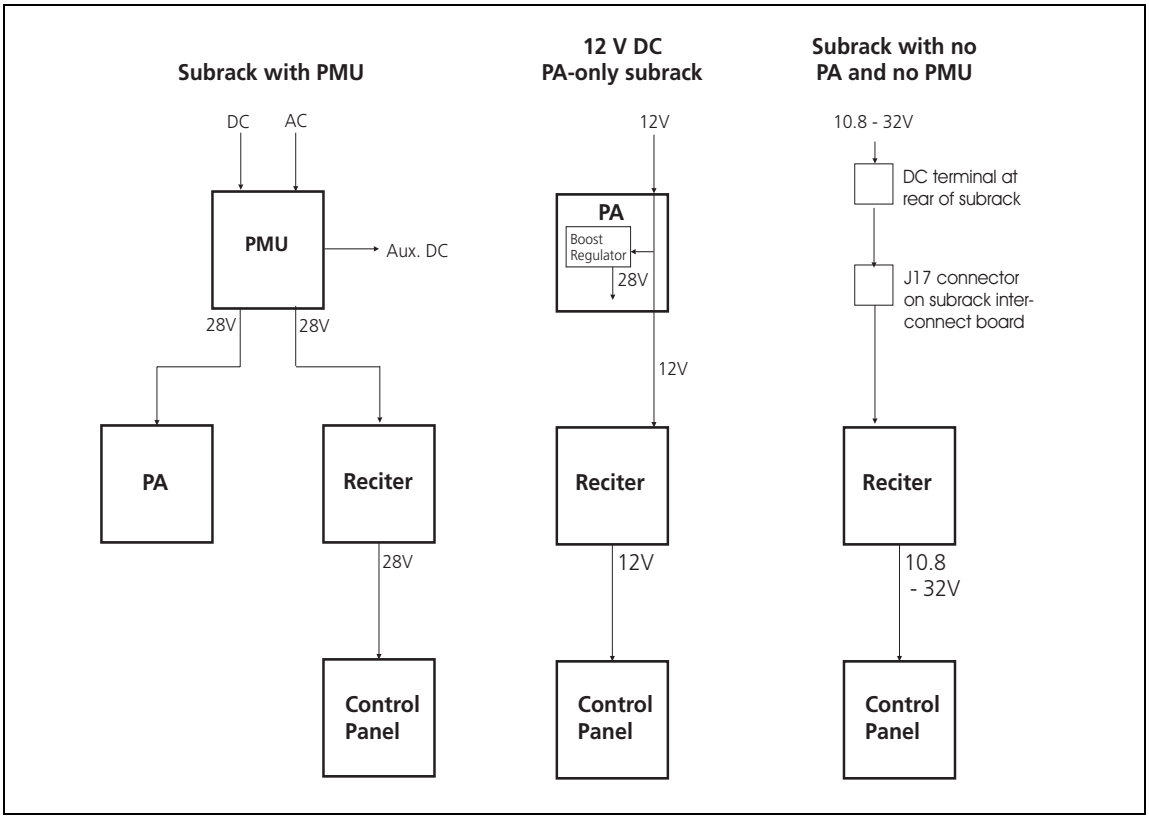
When the subrack has neither PMU or PA, reciters or gateway modules obtain their power from a DC terminal block at the rear of the subrack.

Distribution from the reciter

The reciter input power feed is distributed to all internal reciter boards. Local regulation ensures that noise and common mode interface signals are kept to a minimum between sub-assemblies. Various power supplies in the reciter further power and isolate critical sub-sections.

The reciter also powers the control panel, via a backpower protection diode. The system control bus is used to route power from the reciter to the control panel. When a reciter is powered and plugged into the control bus, if a control panel is connected there will always be a reciter present to drive the control bus functions.

Figure 1.6 TB9100 power distribution



Front Panel Fans

The front panel can be equipped with up to two fans. One fan is for the PMU and the other is for the PAs. (Reciters also have fans, see "Reciter Fan Operation" on page 103.)

Front panel fans do not operate continuously but are switched on and off as needed by the reciter firmware.

When the base station powers up, the fans turn on: the PMU fan runs first, followed by the PA fan (the reciter fans will also power up, after the PA fan). Each fan will run for about 5 seconds before switching off.

Front panel fans must have the correct wiring: power and ground (2-wire fans), or power, ground, and rotation detect (3-wire fans). Both fans in a subrack must be of the same type. If 3-wire fans are fitted, the reciter can monitor whether the fans are rotating and generate an alarm if the fan fails.

The control and monitoring of the fans is performed by the reciter selected at the control panel. We recommend that you enable the fan alarms for reciter 1 and disable the fan alarms for the other reciters.

Configuring Fan Control

The operation of the PA fan is configurable via the CSS; you can specify the threshold temperature at which the fan will be turned on, and set the fan to operate only when the PA is transmitting.

The PMU fan has fixed on/off thresholds and a defined set of duty cycles based on the PMU temperature, as follows:

PMU Temperature	Duty Cycle
<149°F (65°C)	Increases with increasing current draw
149-167°F (65-75°C)	On two minutes, off one minute
>167°F (75°C)	Always on

2 General Safety and Regulatory Information

This chapter provides general information on safety precautions for operating the TB9100 base station.

2.1 Personal Safety

Unpacking and Moving the Base Station

To prevent personal injury and damage to the equipment, we recommend that two people unpack and move the base station.

Caution **A TB9100 base station (subrack complete with modules) can weigh up to 62lb (28kg), or up to 66lb (30kg) complete with packaging. We recommend that you have another person help you unpack and move the base station. The TBAA03-16 carrying handles will make it easier to move the base station once it has been unpacked. If necessary, remove the modules from the subrack before moving it (refer to "Replacing Modules" on page 77). In all cases follow safe lifting practices.**

Lethal Voltages

Warning!! **The PMU contains voltages that may be lethal. Refer to the ratings label on the rear of the module.**

The TB9100 base station must be installed so that the rear of the PMU is located in a service access area. The PMU must be connected to the mains supply source by trained personnel in accordance with local and national regulations.

Disconnect the mains IEC connector and wait for five minutes for the internal voltages to self-discharge before dismantling. The AC power on/off switch does not isolate the PMU from the mains. It breaks only the phase circuit, not the neutral.

The PMU should be serviced only by qualified technicians. There are no user-replaceable parts inside. If the PMU is damaged and does not function

properly, stop the module safely and contact your nearest Tait Dealer or Customer Service Organization immediately.

All servicing should be carried out only when the PMU is powered through a mains isolating transformer of sufficient rating. We **strongly recommend** that the mains power to the whole of the repair and test area is supplied via an earth leakage circuit breaker.

Explosive Environments

Warning!! **Do not operate TB9100 equipment near electrical blasting caps or in an explosive atmosphere. Operating the equipment in these environments is a definite safety hazard.**

Proximity to RF Transmissions

Do not operate the transmitter when someone is standing within 3ft. (90cm) of the antenna. Do not operate the transmitter unless you have checked that all RF connectors are secure.

High Temperatures

Take care when handling a PMU or PA which has been operating recently. Under extreme operating conditions (+140°F [+60°C] ambient air temperature) or high duty cycles, the external surfaces of the PMU and PA can reach temperatures of up to +176°F (+80°C).

2.2 Equipment Safety

Installation and Servicing Personnel

The TB9100 should be installed and serviced only by qualified personnel.

Preventing Damage to the PA

Important Do not remove the load from the PA while it is transmitting.

Load transients (switching or removing the load) or atmospheric disturbances (for example rain static and electrical storms) can damage the PA output stage. See "Protecting the PA" on page 57 for recommendations.

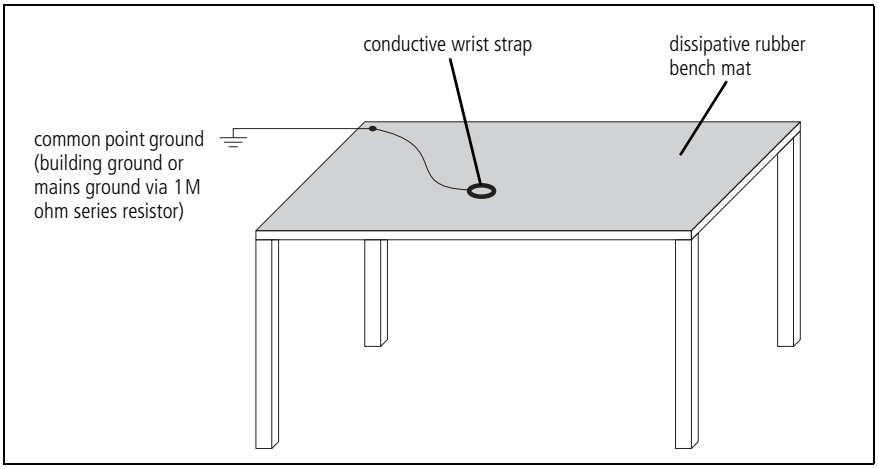
ESD Precautions

Important This equipment contains devices which are susceptible to damage from static charges. You must handle these devices carefully and according to the procedures described in the manufacturers' data books.

We recommend you purchase an antistatic bench kit from a reputable manufacturer and install and test it according to the manufacturer's instructions. Figure 2.1 shows a typical antistatic bench set-up.

You can obtain further information on antistatic precautions and the dangers of electrostatic discharge (ESD) from standards such as ANSI/ESD S20.20-1999 or BS EN 100015-4 1994.

Figure 2.1 Typical antistatic bench set-up



Anti-tampering Devices

All network elements should be physically secured, where possible. This includes the use of locked cabinets and the use of seals on connectors.

All network and audio connectors should be sealed with the stick on type of seal. The purpose of the seals is to detect unauthorized tampering. The seal should reveal if any of the connectors have been unplugged or if any unauthorized equipment has been plugged in.

The seals must be difficult to remove without breaking, and must bridge between the cable and equipment side (plug and socket) of the connection.

Seals must cover any unused network or audio sockets. This includes the Ethernet connector on the front panel, any spare switch ports, and the console port on the router and switch.

The seals must be difficult to reproduce. A sticker initialed or signed by the technician should satisfy this.

Seals must be replaced if they need to be disturbed during maintenance.

2.3 Environmental Conditions

Operating Temperature Range

The operating temperature range of the TB9100 is −22°F to +140°F (−30°C to +60°C) ambient temperature. Ambient temperature is defined as the temperature of the air at the intake to the cooling fans.

Humidity

The humidity should not exceed 95% relative humidity through the specified operating temperature range.

Dust and Dirt

For uncontrolled environments, the level of airborne particulates must not exceed 100µg/m^3.

2.4 Regulatory Information

Distress Frequencies

The 406 to 406.1MHz frequency range is reserved worldwide for use by Distress Beacons. Do **not** program transmitters to operate in this frequency range.

FCC Compliance

This equipment complies with:

- Part 15 Class B of 47CFR: Radiated and conducted emissions, and electromagnetic susceptibility specifications of the Federal Communications Commission (FCC) rules for the United States.

  Operation is subject to the following two conditions:

  a. This device may not cause harmful interference, and

  b. This device must accept any interference received, including interference that may cause undesired operation.

- Part 68 of 47CFR: (Connection of terminal equipment to the telephone network) of the FCC rules and the requirements adopted by ACTA.

  This equipment's FCC certification number (US: 6FPOTNANTBA1PA0) is displayed on the label to be found towards the rear of the left-hand (RF) side of the reciter. If requested, you must provide this number to

the telephone company. (This approval applies solely to the *XBA1PA0 Network Board* in the Reciter.)

TTE Information
USOC Jacks: RJICX (where required)
Service Order Code: 7.0Y
Facility Interface Code: 04N02, TL31E

Warnings:

If the *XBA1PA0 Network Board* in the Reciter causes harm to the telephone network, the telephone company will notify you in advance that temporary discontinuance of service may be required. But if advance notice isn't practical, the telephone company will notify the customer as soon as possible. Also, you will be advised of your right to file a complaint with the FCC if you believe it is necessary.

The telephone company may make changes in its facilities, equipment, operations or procedures that could affect the operation of the equipment. If this happens the telephone company will provide advance notice in order for you to make necessary modifications to maintain uninterrupted service.

Connection to party line service is subject to state tariffs. Contact the state public utility commission, public service commission or corporation commission for information.

If trouble is experienced with the *XBA1PA0 Network Board* in the Reciter, for repair or warranty information, please contact your local Tait Dealer or Customer Service Organization.

Only approved Tait Dealer or Customer Service Organizations equipped with the necessary facilities should perform any servicing. Repairs attempted with incorrect equipment or untrained personnel may result in permanent damage. If the equipment, *XBA1PA0 Network Board* in the Reciter, is causing harm to the telephone network, the telephone company may request that you disconnect the equipment until the problem is solved.

Unauthorized Modifications

Any modifications you make to this equipment which are not authorized by Tait Electronics Ltd may invalidate your compliance authority's approval to operate the equipment.

Health, Safety and Electromagnetic Compatibility in Europe

In the European Community, radio and telecommunications equipment is regulated by Directive 1999/5/EC, also known as Radio and Telecommunications Terminal Equipment (R&TTE) directive. The requirements of this directive include protection of health and safety of users, as well as electromagnetic compatibility.

Intended Purpose of Product

This product is an FM radio transceiver. It is intended for radio communications in the Private Mobile Radio (PMR) or Public Access Mobile Radio (PAMR) services, to be used in all member states of the European Union (EU) and states within the European Economic Area (EEA).

Important This product can be programmed to transmit on frequencies that are not harmonized throughout the EU/EEA, and will require a licence to operate in each member state. Limitations may apply to transmitter power, operating frequency, channel spacing and emission.

Declaration of Conformity

You can download the formal Declaration of Conformity from http://eudocs.taitworld.com/. You can also obtain a signed and dated paper copy of the Declaration of Conformity from Tait Europe Ltd.

3 Installation

This chapter provides information on the site requirements for your TB9100 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 TB9100 base station, we recommend that you read the entire chapter before beginning the actual installation.

3.1 Before You Begin

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 cabinet to prevent unauthorized access.

The base station control panel provides access to the speaker, microphone input and alarm status display. It is important that control panel access is restricted to authorized maintainers only in order to ensure the confidentiality of voice communications and alarm status information.

Grounding and Lightning Protection

Electrical Ground

The TB9100 base station modules are grounded by physical contact between the module case and the subrack. To ensure a good ground connection you must tighten each module retaining clamp securely (refer to "Final Reassembly" on page 97 for the correct torque).

A threaded grounding connector is provided on the rear of the subrack for connection to the site ground point (refer to "Connecting Up the Base Station" on page 52 for more details).

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.

Equipment Ventilation

Always ensure there is adequate ventilation around the TB9100 base station.

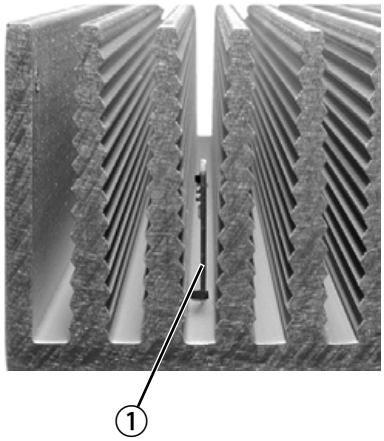
Warning!! **Do not operate it in a sealed cabinet. You must keep the ambient temperature within the specified range, and we strongly recommended that you ensure that the cooling airflow is not restricted.**

Important The cooling fans are mounted on the front panel and will only operate when the panel is fitted correctly to the front of the subrack. To ensure adequate airflow through the base station, do not operate it for more than a few minutes with the front panel removed (e.g. for servicing purposes).

Ambient Air Temperature Sensor

The ambient air temperature reading for the TB9100 base station is provided by the ambient air temperature sensor board ① fitted to the PA control board.

The sensor board is inserted through slots in the control board and heatsink to be positioned between the heatsink fins.



Important If the sensor board is to provide accurate ambient temperature readings, it must have forced airflow and must not come into contact with the metal of the heatsink fins. **Do not stack PAs with the fins together.** It is possible for the fins on one heatsink to slide between the fins on the other heatsink. This can damage the sensor board, and possibly result in the heatsink fins becoming locked together.

Cabinet and Rack Ventilation

The cooling airflow for the TB9100 base station enters through the front panel and exits at the rear of the subrack. For optimum thermal performance, the heated air that has passed through a base station must not 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. Refer to Figure 3.1 on page 36.

To allow enough cooling airflow through a cabinet-mounted base station, we recommend the following:

- an area of at least 23 in^2 (150 cm^2) of unrestricted ventilation slots or holes in front of the air intakes for the fans for each subrack; for example, thirty 0.25 x 3.3 in (6 x 85 mm) slots will allow the recommended airflow
- a vent in the top of the cabinet with an area of approximately 23 in^2 (150 cm^2) per subrack, or a similar area of ventilation per subrack at the rear of the cabinet behind each subrack
- a 2U gap at the top of the cabinet.

Note The ventilation opening must be unrestricted. If the slots or holes are covered with a filter, mesh or grille, the open area must be increased to allow the same airflow as an unrestricted opening.

The maximum ambient temperature entering the cabinet must not exceed +140°F (+60°C).

If you are installing multiple subracks in a cabinet, ensure that there will be enough cooling airflow through the cabinet after the equipment has been installed. For example, the recommended maximum number of subracks in a 38U cabinet is five, as shown in Figure 3.1 on page 36.

If the TB9100 base station is installed in a rack or cabinet with other equipment with different ventilation requirements, we recommend that the TB9100 be positioned below this equipment.

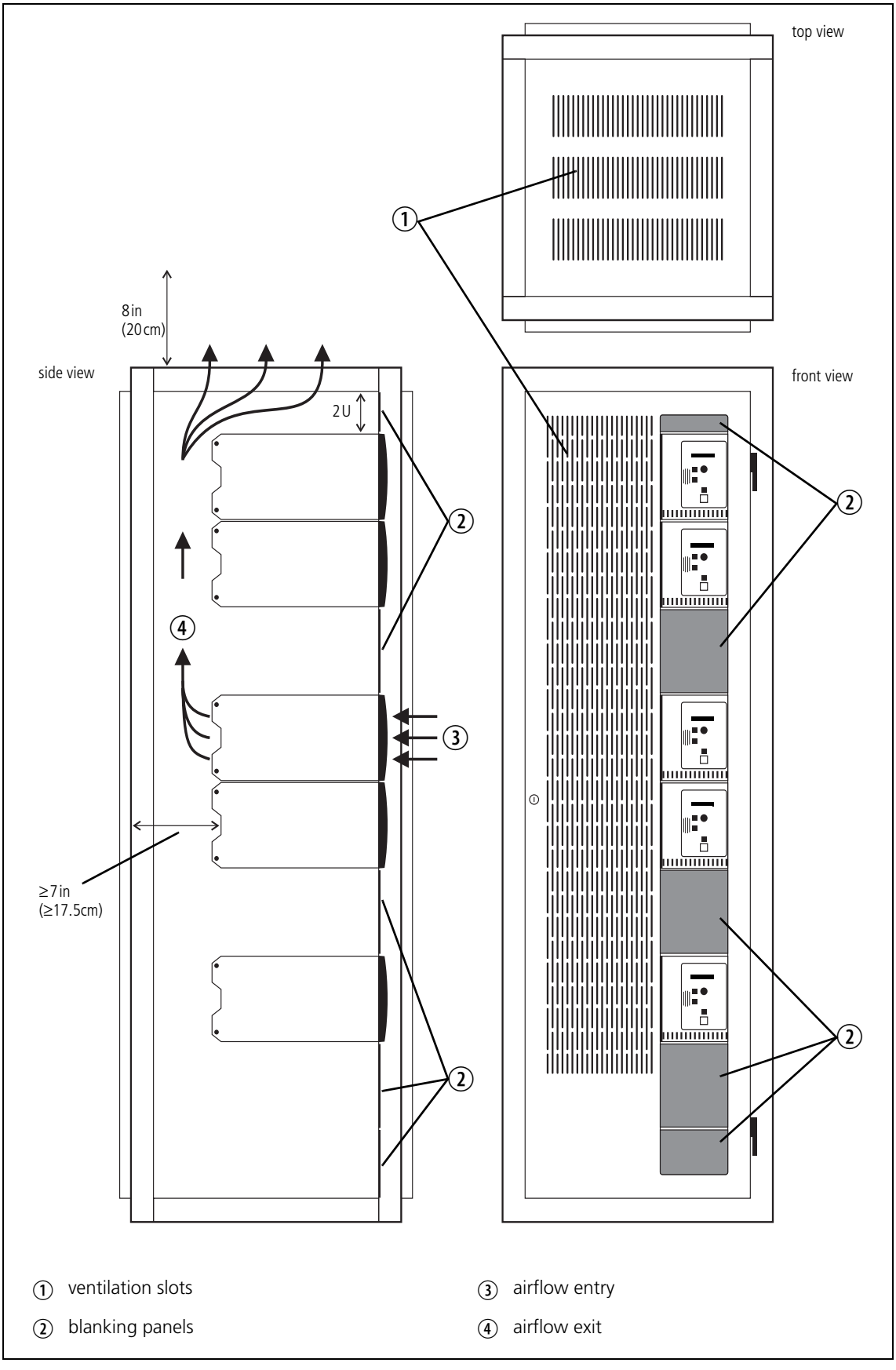
Auxiliary Extractor Fans

The TB9100 base station does not require auxiliary extractor fans mounted in the top of the cabinet. If your cabinet is already fitted with fans, the following procedures apply:

- if there are six or more 4.75 in (12 cm) fans, each capable of extracting 94.2 ft^3 per minute (160 m^3 per hour), they must run continuously
- if there are fewer than six fans, you must remove them and ensure the vent in the top of the cabinet has an area of approximately 23 in^2 (150 cm^2) per subrack.

If you have any other configuration, the performance of your system will depend on how closely you comply with the TB9100 base station airflow requirements described above.

Figure 3.1 Typical cabinet ventilation requirements



3.2 Installing and Setting up the CSS

To monitor and configure the base station, and to carry diagnostic tests on it, you need the CSS. Follow the instructions on the TB9100 CSS CD and install the CSS on a PC.

To install the CSS, you need a registration key. You can obtain a key from Tait. Please contact your technical support representative. If you have previously installed a CSS, you can use the same key.

You also need to set up the PC so that it can handle network communications with base stations. When the base station is on the bench and connected via a hub, the PC can use any IP address and no special routing configuration is needed.

If the PC has a fixed location, refer to the *Customer Service Software User's Manual* for information on how to connect to a base station.

If the PC is a laptop that can be taken on-site, it can be set up so that it can access any base station on the subnet. Maintenance staff use the CSS on their laptops during visits to base stations so that they can adjust the configuration of the base stations they are working on. So that technicians do not need to change the IP address of their laptop every time they visit a different site, a laptop subnet is allocated.

This subnet exists on all site LANs in the network but cannot be routed across the WAN. All routers (unless there are multiple routers on a site LAN) have the same address in the laptop subnet. This will be a secondary address on the routers' LAN connection.

Each laptop can be set up with an address in the laptop subnet and their default gateway equal to the router address in that subnet.

Each router will redirect traffic originating on its local LAN and addressed to the laptop network back to the LAN. New base stations and spare base stations will also be allocated addresses in this subnet to facilitate their setup.

You need to tell the CSS which base stations it can connect to. This is done by editing the host information file. Open conncfg.dat in a text editor or select "Tools > Connections" and add names and IP addresses for each base station.

Setting up CSS Access Codes

The CSS has three different privilege levels: Guest, Maintainer, and Administrator. Access codes can be defined for the Maintainer and Administrator privileges. This is done during the CSS installation process.

When you use the CSS, you automatically have the Guest privilege. If you try to carry out an operation requiring the Maintainer or the Administrator

privilege, you are asked for the corresponding access code, if one has been defined.

Minimum PC Requirements for Running a CSS

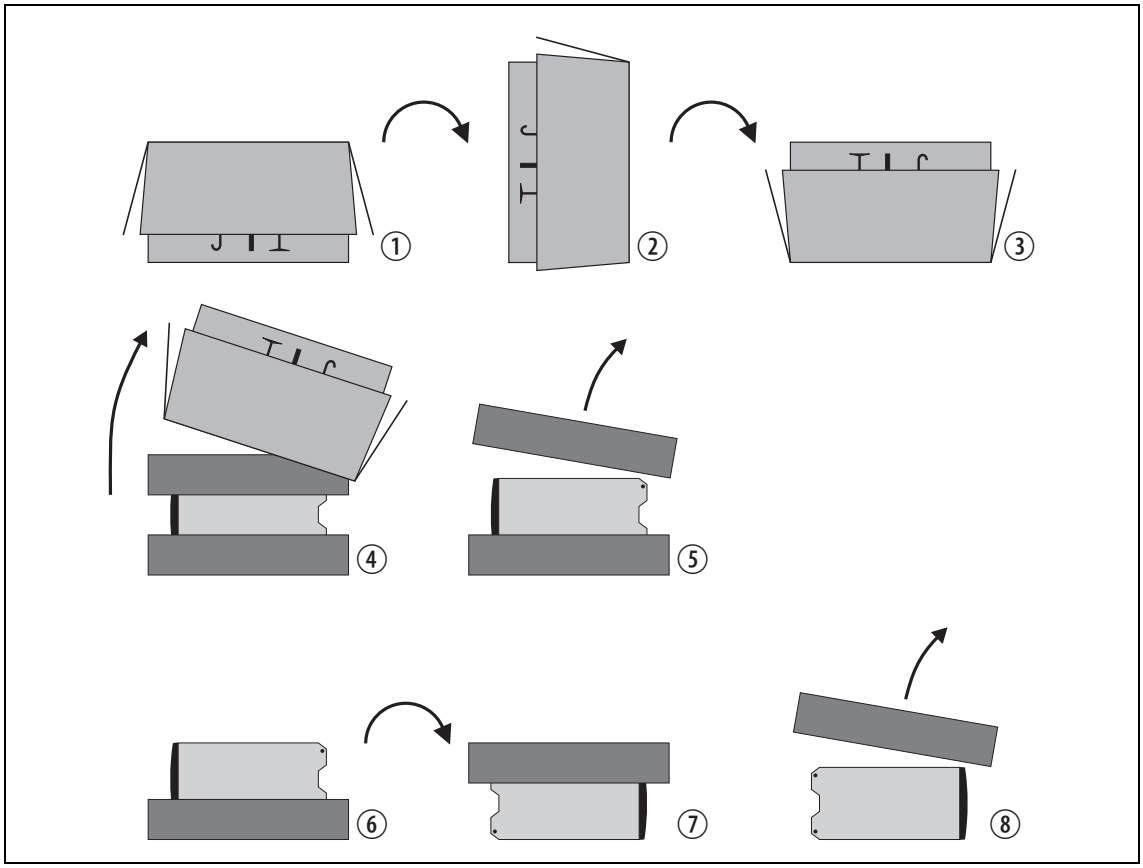
- Pentium 450 MHz
- SVGA Monitor (1024 * 768 minimum)
- Available Serial Port
- 128 Mb RAM
- 100 Mb of free HD Space
- Microsoft Windows 2000 or Windows XP

3.3 Unpacking and Moving the Base Station

The TB9100 base station is packed in a strong corrugated cardboard carton with top and bottom foam cushions. To prevent personal injury and damage to the equipment, we recommend that two people unpack and move the base station. To remove the base station from the carton, follow the procedure illustrated in Figure 3.2.

Caution **A TB9100 base station (subrack complete with modules) can weigh up to 62lb (28kg), or up to 66lb (30kg) complete with packaging. We recommend that you have another person help you unpack and move the base station. The TBAA03-16 carrying handles will make it easier to move the base station once it has been unpacked. If necessary, remove the modules from the subrack before moving it (refer to "Replacing Modules" on page 77). In all cases follow safe lifting practices.**

Figure 3.2 Unpacking the TB9100 base station



1. Cut the tape securing the flaps at the top of the carton and fold them flat against the sides ①.
2. Rotate the carton carefully onto its side ② and then onto its top ③, ensuring that none of the flaps is trapped underneath.
3. Slide the carton upwards over the foam cushions and lift it away ④. Remove the cushion from the bottom of the base station ⑤.
4. Rotate the base station and cushion carefully over the rear of the base station ⑥ so that it is the right way up with the cushion on top ⑦. Remove the cushion from the top of the base station ⑧.

Disposal of Packaging

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

3.4 Setting Up on the Bench

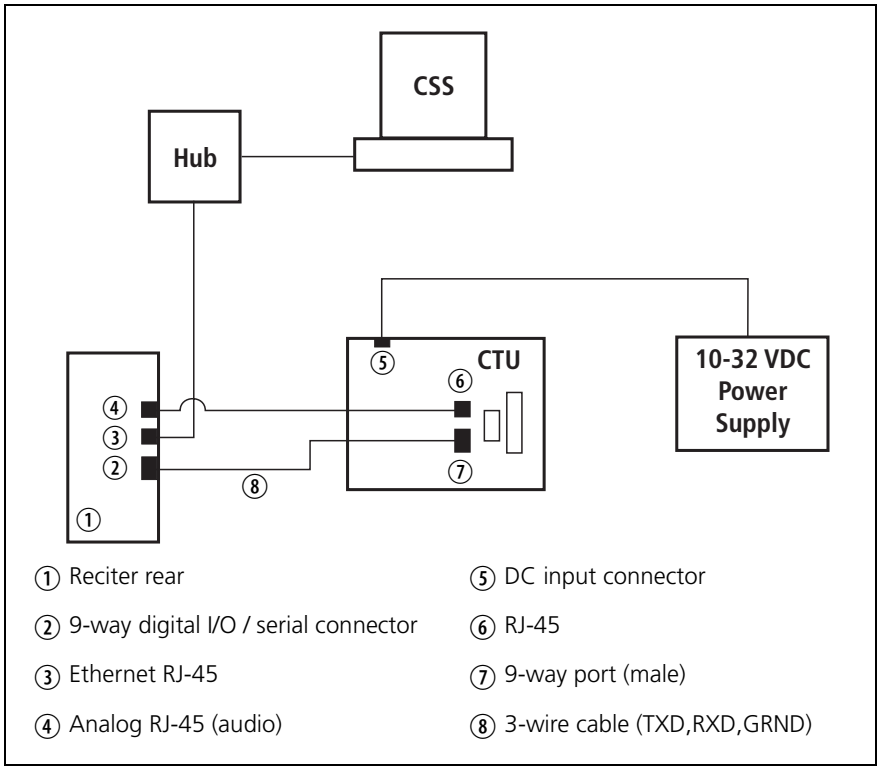
Before installing the base station in the on-site cabinets or racks, it is a good idea to set it up on the bench. You can then verify that it is operating correctly, and tune it if necessary. You can also customize its configuration for the installation it is destined for and verify that the configuration is correct. An important aspect of that configuration is the base station's IP address. The base station comes with a default IP address but needs to be given the IP address required for its position in the TaitNet P25 Network.

Using a Calibration and Test Unit

A Calibration and Test Unit (CTU) can be of great assistance when confirming operation and when tuning and calibrating the base station.

Connect the CTU to the base station or console gateway as follows:

Figure 3.3 TB9100 to CTU connections



Note The CTU is common to TB9100 and TB8100 base stations: some of its connectors and controls are not used with a TB9100. Refer to the Calibration and Test Unit Operation Manual for detailed information about connecting and operating the CTU.

Confirming Operation

To ensure that the TB9100 is working correctly before site installation, you may want to apply power to check for proper operation.

Important Make sure that the RF output is connected to a suitable attenuator or dummy load. Do not remove the load while the PA is transmitting.

Applying Power

1. Before turning the TB9100 base station on, carry out the following tasks:
   - check that the PMU is turned off – ensure that the AC and DC module power switches are both set to 'Off' (refer to Figure 4.5 on page 69)
   - **12V PA only:** check that the battery supply lead is disconnected (refer to "Replacing a Power Amplifier" on page 85)
   - remove the front panel (refer to "Preliminary Disassembly" on page 78)
   - check that all looms and cables at the front and rear of the base station are fitted correctly
   - check that all connectors are secure
   - refit the front panel – ensure that it is fitted correctly so that the fans will operate if needed (refer to "Final Reassembly" on page 97)
2. Apply power by turning on the PMU, or by connecting the battery supply lead to the 12V PA.
3. Check that the base station powers up correctly:
   - check that the cooling fans in the front panel turn on in the correct order after power-up: the PMU fan will run first, followed by the PA fan and then the reciter fan; each fan will run for about five seconds and then switch off (note that the PMU fan is not fitted to a 12V PA base station)
   - check that the LEDs on the control panel come on after about five seconds, and then go off (refer to "Control Panel" on page 61)
   - at this point you can safely press the speaker and microphone button and check that they are operating correctly

Making Test Transmissions

You can verify that the TB9100 is operating correctly by making some test transmissions. (If testing a P25 Console Gateway, audio quality can be tested through the CTU.)

1. Ensure that the base station is correctly connected to an appropriate load and that all RF connectors are secure.
2. Plug the Tait TMAA02-01 microphone supplied with the TB9100 into the RJ-45 socket on the control panel (for a list of the microphone pin allocations refer to "Microphone Connection" on page 122).
3. Use the microphone button to select the speech mode for the transmission. Check that the microphone LED behaves correctly. Refer to "Microphone Operation" on page 64.
4. Turn on the speaker audio by pressing the speaker button.
5. Press the PTT switch on the microphone and make your transmission. Check that:
   - the red transmit LED turns on
   - there are no alarms generated
   - the audio quality on the receiving SU (if testing a base station), or CTU (if testing a P25 Console Gateway) is good
6. When the receiving SU answers your transmission, check that:
   - the green receive LED turns on
   - the audio quality from the speaker in the control panel is good (adjust the speaker volume as required)

Setting the IP Address

Before the base station is installed on site, you need to provide it with a name and its proper IP address. Make sure that you do not lose this address. You must also add the same name and IP address to the CSS connections list, so that you can select the base station when you want to re-connect to it.

1. Run the CSS.
2. You are asked to enter the base station password. Don't enter anything; just click OK. (New base stations have a null password.)
3. Connect to the base station by selecting from the connection list the default entry with the IP address 192.168.1.2.
4. Read the base station's configuration.
5. Select "Configure > Channel Group > Network."
6. Enter the subnet and the IP address specified for this base station by the IP addressing plan for the network. Also enter a suitable name for the base station.

Important Be careful to enter the correct address and subnet, and to keep a written record of them. If you give the base station an unknown IP address or subnet, the CSS will be unable to connect to it.

7. Click **OK** to confirm your entry and exit the configuration form.
8. Click "Tools > Connections" and add an entry to the connections list, consisting of the name and IP address you have entered.
9. Make any other configuration changes that are required, and click Save to save them to file.
10. On the toolbar, click Program to program the information into the base station.
11. Click **Overwrite** to confirm that you really do want to change the IP address.
12. Reset the base station so that the new IP address and name take effect. This disconnects the CSS.
13. Wait for the base station to power up, then on the toolbar, click the Connect icon.
14. Select the entry you added to the connection list and click **Connect**.
15. In the status bar, verify that you are actually connected to the base station

Finding a Lost or Forgotten IP Address

Use the following procedure if an IP address has been lost or forgotten.

1. Connect your PC to the 9-pin serial connector on the back of the reciter.
2. Run a program such as HyperTerminal, Teraterm or minicom.
3. Select the following port settings: 57600 baud, 8 bits, no parity, 1 stop bit, no flow control.
4. Press the 'Enter' key. A login prompt will appear displaying the base station's IP address.

Customizing the Configuration

While the base station is still on the bench, you can configure the settings it requires. The CTU can help you test its operation. The following steps provide an overview of the process. For detailed information and assistance, refer to the CSS online Help or manual.

1. Run the CSS software.
2. Check that the CSS PC is connected to the base station via an Ethernet cable and a hub.
3. On the toolbar, click **Connect**. The Connections dialog box appears.
4. Click on the appropriate entry in the base station list, and then click **Connect**.
5. On the toolbar, click **Read** to read in the configuration settings on the connected base station.
6. On the toolbar, click **Configure**. The navigation tree now gives you access to the available configuration screens.
7. Make the changes needed.
8. Click "File > Save" to save your changes, and then click Program on the toolbar to program these changes into the base station.

Important Make sure that you save the configuration to a file. This provides a backup in case the configuration information becomes lost or corrupted.

Changing the Root Password

The root password to the Linux operating system of the network board 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. The password does not give access to encryption keys, as logging in as a root user causes these keys to be zeroized. If Tait provides support services, it may need to know the password.

Important 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. Password access is required for TFTP firmware upgrades.

To change the root password, follow these steps.

1. Log in from your PC to the base station or P25 Console Gateway using SSH client software such as PuTTY. The user name 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.

Tuning

This section is for TB9100 base stations only, and does not apply to P25 Console Gateways.

Before the TB9100 is installed on site, you may need to tune the reciter. You can use the Calibration Software to carry out the following:

- adjust the switching range of the reciter
- flatten the response across the base station's switching range

The switching range is the range of frequencies that the base station receiver or transmitter is calibrated to operate on. To adjust this range, the reciter will need to be removed from the subrack to gain access to the tuning holes.

For full details on how to carry out the tuning procedures, refer to the Calibration Software documentation. These procedures require a different CTU setup.

Checking the Modulation Fidelity

This section is for TB9100 base stations only, and does not apply to P25 Console Gateways.

Before installation, you may want to carry out a modulation fidelity test. If a P25-capable test set is not available, you can use an FM test set to measure the analog FM deviation instead. Test using the frequency that the base station will transmit on, because changing operating frequency slightly alters the modulation fidelity. If the base station is set up to operate on several channels, test each one.

To carry out a modulation fidelity test using an IFR2975 test set

1. Run the CSS and connect the CSS PC to the base station.
2. Using an RF cable, connect the PA RF output to the T/R input of the test set.
3. On the test set, set up a modulation fidelity test, as follows.
   a. Select the test 'Receiver (Tx test).'
   b. Click the Options menu button, and make sure that the modulation meter is selected for display.

c. Enter the frequency of the transmitter and make sure that the transmit power setting is low enough not to overload the test set.

d. Change the input path to 'T/R' and demodulation to 'P25.'

e. Expand the Modulation fidelity display.

4. Using the CSS, instruct the base station to send the P25 Conformance 1011 Hz test pattern, as follows.

   a. Put the base station in Standby mode.

   b. Select Diagnose > RF Interface > Transmission Tests.

   c. Check that the displayed transmitter frequency is the same as the frequency entered into the IFR2975 and that the transmit power is low enough not to overload the test set.

   d. Under Carrier, click **Start Test**.

   e. Under C4FM, select the test pattern P25_Conformance1011 Hz. (Do not use the C4FM_ModulationFidelity pattern; it is designed for use with a spectrum analyser.)

   f. Click **Start Test**.

5. Check the display in the test set. If the modulation fidelity is > 3.5%, the symbol deviation is outside the range 1620–1980 Hz, or the symbol frequency error is > ± 0.5 ppm, the base station has failed the test. Use the Calibration Software to carry out an FCL and a VCO calibration. If the base station still fails the test, return it to a Tait service center.

To carry out an analog FM transmission test using an Agilent 8920 test set

1. Run the CSS and connect the CSS PC to the base station.

2. Using an RF cable, connect the PA RF output to the test set.

3. On the test set, select Tx test. Select the low pass filter '<20 Hz' and the high pass filter '15 kHz.'

4. Using the CSS, instruct the base station to transmit analog FM at a defined deviation using two different test tones, as follows.

   a. Put the base station in Standby mode.

   b. Select Diagnose > RF Interface > Transmission Tests.

   c. Check that the displayed transmitter frequency is the one you want and that the transmit power setting is low enough not to overload the test set.

   d. Under Carrier, click **Start Test**.

   e. Under FM, set the deviation to 2.5 kHz and the modulation level to 100%.

   f. Set the modulation frequency to 1 kHz, and then click **Start Test**.

   g. Measure the deviation with the test set.

   h. Change the modulation frequency to 30 Hz, and measure the deviation again. In both cases, the deviation should be ± 150 Hz or 6% of 2.5 kHz.

If the base station passes this test, its modulation fidelity in digital P25 mode is very likely to be within specification. If it fails the test, use the Calibration Software to carry out an FCL and a VCO calibration. If it still fails the test, return it to a Tait service center.

Other Operational Tests

The CTU can assist you to carry out the following additional tasks to exercise the base station on the bench.

Task	Instructions
Listen to the analog line output	Turn the switch to 'BALANCED' and adjust the speaker volume.
Monitor the analog line output	Connect test equipment to the LINE OUTPUT.
Provide test inputs on the analog line	Connect test equipment to the LINE INPUT.
Key the transmitter via the E-line	Turn the TX KEY switch to ON. Alternatively, connect a cable to the TX KEY and GND banana sockets and short the cable. (The E-line must be configured to key the transmitter using the CSS).
Check the status of the M-line	View the RX GATE LED. When it is lit, the M-line is low (active).
Monitor the digital output	Connect test equipment to the RSSI.
Turn digital inputs on and off	Switch the DIGITAL INPUTS* 1-4 between OFF and ON. If you have set up Task Manager actions with the digital input value as the input, you can check that the base station responds as expected. * **NB** The TB9100 digital inputs 0-3 are numbered 1-4 on the CTU, and for the TB9100 digital input 4, short the TX RELAY to GND.
Test receiver operation in analog mode	Connect NOISE to the reciter's RF input. Turn the NOISE switch to ON. Alternatively, connect RF test equipment and use it.

3.5 Installing the Base Station on Site

Equipment Required

It is beyond the scope of this manual to list every piece of equipment that an installation technician should carry. However, the following tools are specifically required for installing the TB9100 base station:

- Pozidriv PZ3 screwdriver for the M6 screws used in the DC input terminals on the PMU; M6 (0.25in) screws are also used to secure the subrack to the cabinet in factory-assembled systems
- Pozidriv PZ2 screwdriver for the M4 screws used to secure the module retaining clamps
- 0.25in or 6mm flat blade screwdriver for the fasteners used to secure the front panel to the subrack

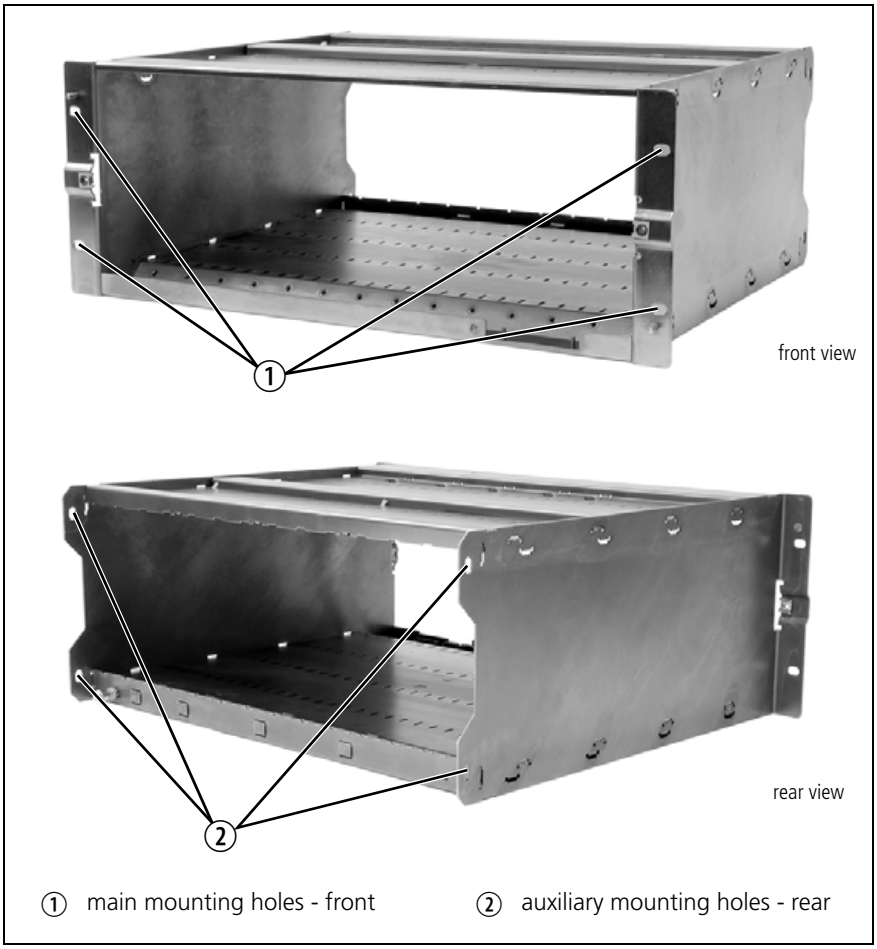
- 8mm AF spanner for the SMA connectors.

You can also obtain the TBA0ST2 tool kit from your nearest Tait Dealer or Customer Service Organization. It contains the basic tools needed to install, tune, and service the TB9100 base station.

Mounting the Subrack

Caution **A TB9100 base station (subrack complete with modules) can weigh up to 62lb (28kg), or up to 66lb (30kg) complete with packaging. We recommend that you have another person help you unpack and move the base station. The TBAA03-16 carrying handles will make it easier to move the base station once it has been unpacked. If necessary, remove the modules from the subrack before moving it (refer to "Replacing Modules" on page 77). In all cases follow safe lifting practices.**

Figure 3.4 Subrack mounting points



1. Remove the front panel, as described in "Preliminary Disassembly" on page 78.

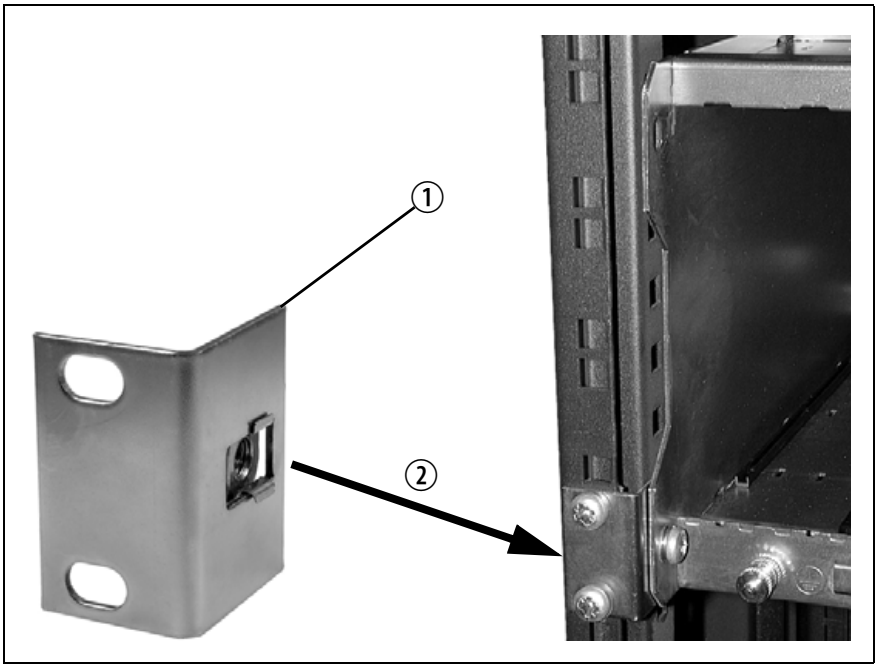
2. Fit the subrack into the cabinet or rack and secure it firmly with an M6 (0.25in) screw, flat and spring washer in each of the four main mounting holes ①, as shown in Figure 3.4.

Note If you need extra mounting security, additional mounting holes ② are provided at the rear of the subrack for auxiliary support brackets.

Auxiliary Support Bracket

TBAA03-13 auxiliary support brackets can be fitted to the rear of the TB9100 subrack to provide additional mounting security. Figure 3.5 shows a standard TBAA03-13 bracket ① fitted in a typical Tait cabinet ②. If you are not using a Tait cabinet, you may have to make your own brackets to suit your installation.

Figure 3.5 Auxiliary support bracket



Important You **must** fit the auxiliary support brackets if you intend to transport a cabinet fitted with a fully built-up TB9100 base station.

We also recommend that you fit the brackets under the following conditions:

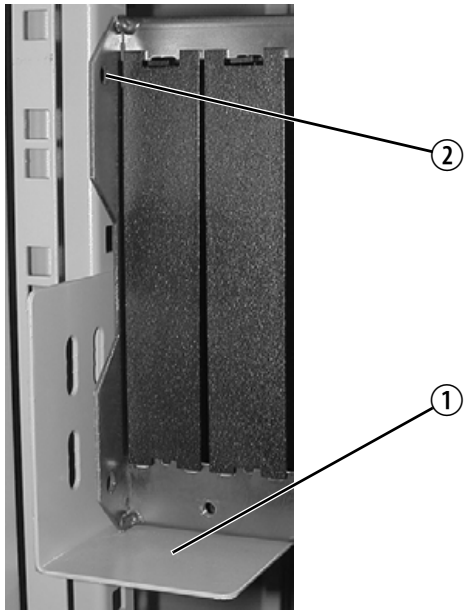
- when the installation is in an area prone to earthquakes
- when third party equipment is installed hard up underneath the TB9100 base station subrack.

Optional Slide Mounting Rails

You can also use TBAA03-14 slide mounting rails ① when mounting the TB9100 base station in a cabinet, as shown in Figure 3.6 on page 50. These rails will support the base station while you slide it into the cabinet.

However, you must still secure the base station to the cabinet with four M6 (0.25in) screws through the main mounting holes on the front of the subrack, as shown in Figure 3.4 on page 48.

Figure 3.6 Optional slide mounting rail - rear view



Important The slide mounting rails are not suitable for transporting a cabinet fitted with a fully built-up TB9100 base station. In this case, you must also fit the TBAA03-13 auxiliary support brackets to the upper set of rear mounting holes ② (support bracket not shown in diagram).

General Cabling

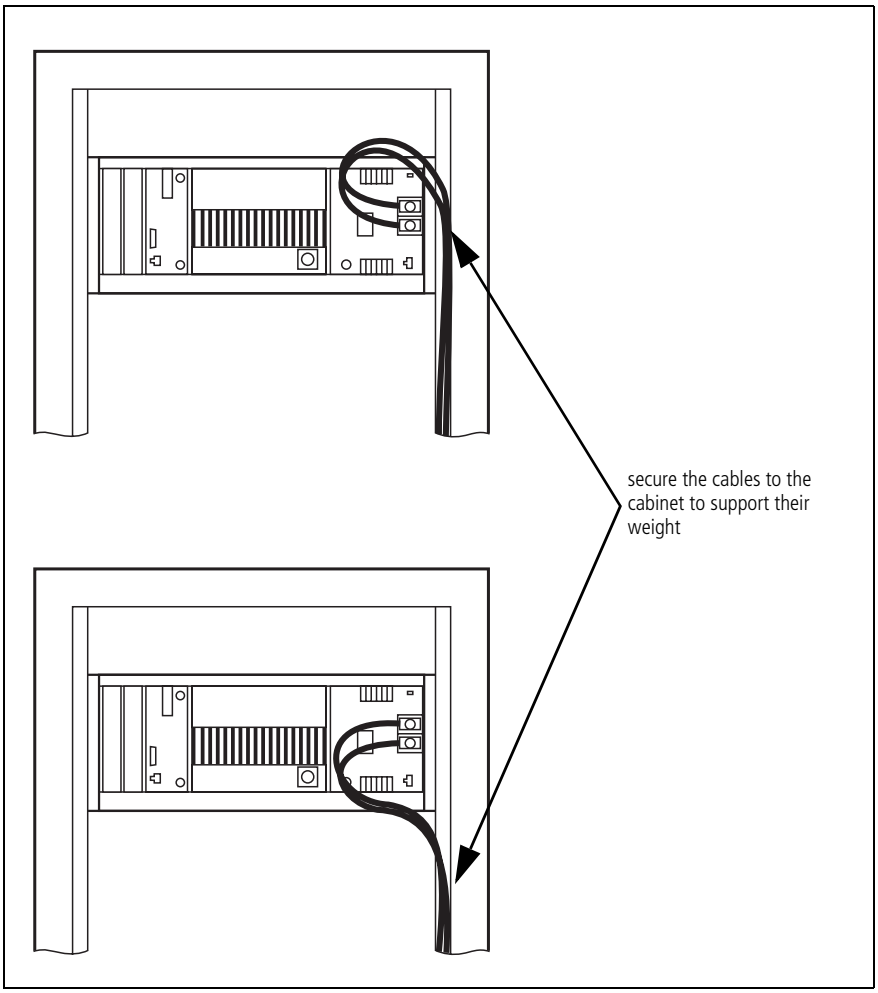
We recommend that you try to route all cables to and from the TB9100 base station along the side of the cabinet so the cooling airflow is not restricted.

DC Power Cabling

DC power cables should be well supported so that the terminals on the PMU and on the ends of the cables do not have to support the full weight of the cables.

Figure 3.7 shows two recommended methods of securing these cables to prevent straining either set of terminals.

Figure 3.7 DC power cabling



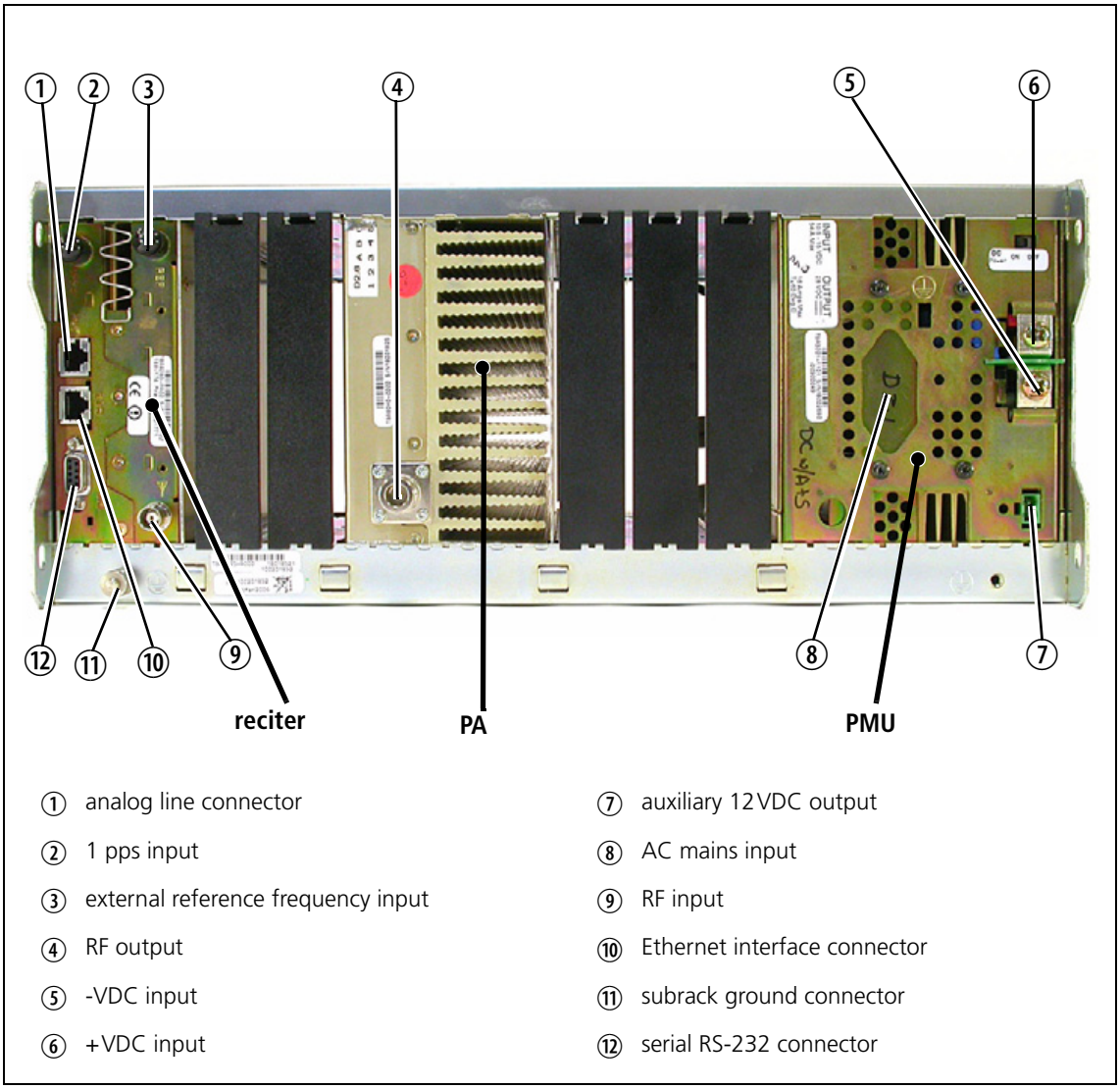
3.6 Connecting Up the Base Station

This section provides information relevant to the task of connecting up the various inputs and outputs of the TB9100 base station.

Connection Overview

The connections at the rear of a single-channel base station with 5 W or 50 W PA are identified in Figure 3.8. External connections are all located at the rear of the subrack.

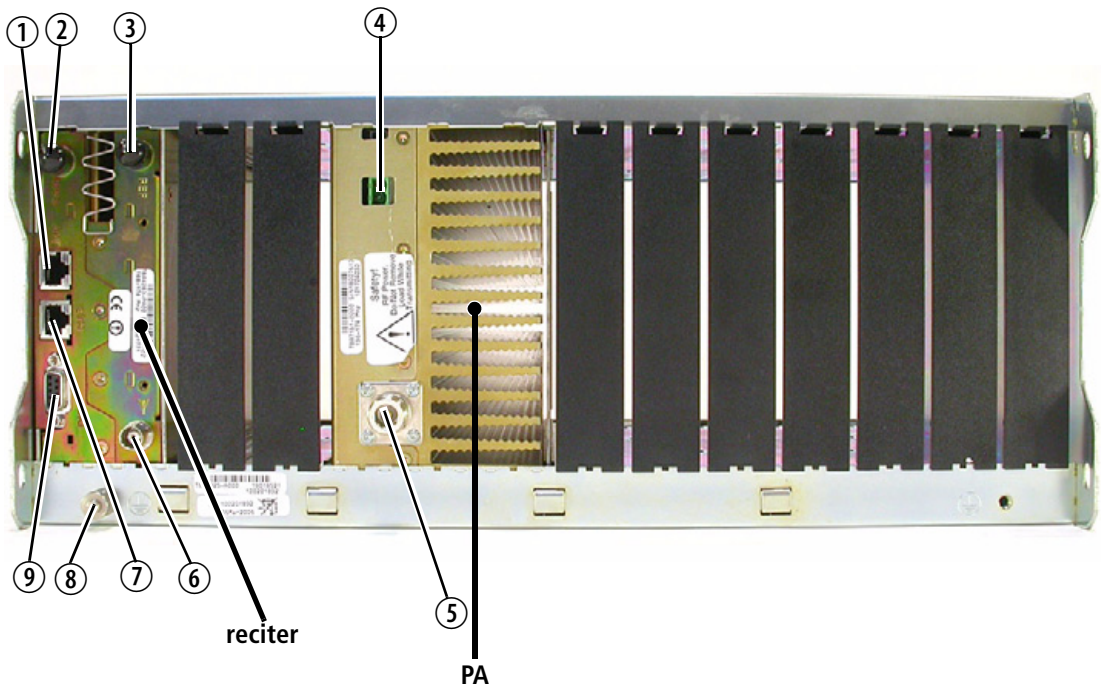
Figure 3.8 5W or 50W base station inputs and outputs



① analog line connector
② 1 pps input
③ external reference frequency input
④ RF output
⑤ -VDC input
⑥ +VDC input
⑦ auxiliary 12 VDC output
⑧ AC mains input
⑨ RF input
⑩ Ethernet interface connector
⑪ subrack ground connector
⑫ serial RS-232 connector

The connections at the rear of a 12V DC PA-only base station with a 5W or 50W PA are identified in Figure 3.9.

Figure 3.9 5W or 50W 12V DC PA-only base station inputs and outputs



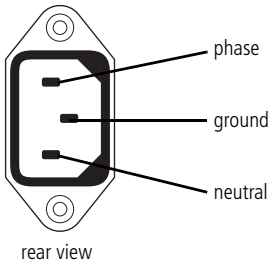
1. analog line connector
2. 1 pps input
3. external reference frequency input
4. +12VDC input
5. RF output
6. RF input
7. Ethernet interface connector
8. subrack ground connector
9. serial RS-232 connector

Connecting AC Power

The TB9100 PMU is designed to accept a mains input of 88 to 264VAC at 45 to 65Hz. We recommend that a 3-wire grounded outlet be used to supply the AC power. The socket outlet must be installed near the equipment and must be easily accessible. This outlet should be connected to an AC power supply capable of providing at least 600W. The requirements of two typical AC supplies are given in the following table.

Nominal Supply	Current Requirement	Circuit Breaker/Fuse Rating
115VAC	8A	10A
230VAC	4A	6A

Your TB9100 base station should come supplied with a power supply cord to connect the male IEC connector on the PMU to the local AC supply. The pins of the IEC connector on the PMU are identified at right.



Connecting DC Power

The way you connect DC power varies, depending on the type of base station.

Base Station with PMU

The TB9100 PMU is designed to accept a nominal 12VDC, 24VDC or 48VDC input (depending on the model) with negative or positive ground. There is a minimum DC startup threshold to prevent damaging a battery which has little capacity left.

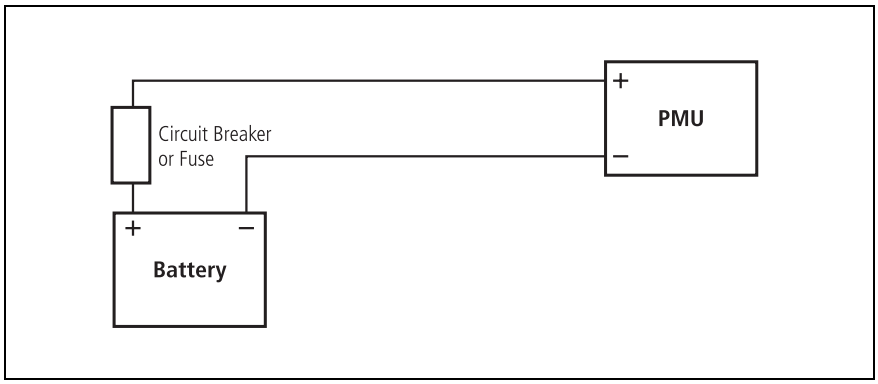
You must connect the DC supply from the battery to the PMU via a fuse or Darted circuit breaker with the appropriate rating, as shown in the table below. The DC input leads should be of a suitable gauge to ensure less than 0.2V drop at maximum load over the required length of lead.

Nominal Supply Voltage	Input Voltage Range	Circuit Breaker/ Fuse Rating	Recommended Wire Gauge[a]
12VDC	10VDC to 16.8VDC	60A	2AWG / 35mm^2
24VDC	20VDC to 33.6VDC	30A	5AWG / 16mm^2
48VDC	40VDC to 60VDC	15A	8AWG / 8mm^2

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

Terminate and insulate the DC input leads to protect them from accidentally shorting to the subrack if the PMU is removed before the leads are disconnected.

Figure 3.10 Recommended DC power connection



We recommend a screw torque of 18–20lbf·in(2–2.25N·m).

12V DC PA-only Base Station

12V DC PA-only base stations have a 12V PA. This is designed to accept a nominal 12V DC input with negative ground. There is a minimum DC startup threshold to prevent damaging a battery which has little capacity left.

You must connect the DC supply from the battery to the PA via 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 0.2V drop at maximum load over the required length of lead.

Nominal Supply Voltage	Input Voltage Range	Circuit Breaker/ Fuse Rating	Recommended Wire Gauge[a]
12VDC	10VDC to 16.8VDC	15A to 18A	8AWG / 8mm^2

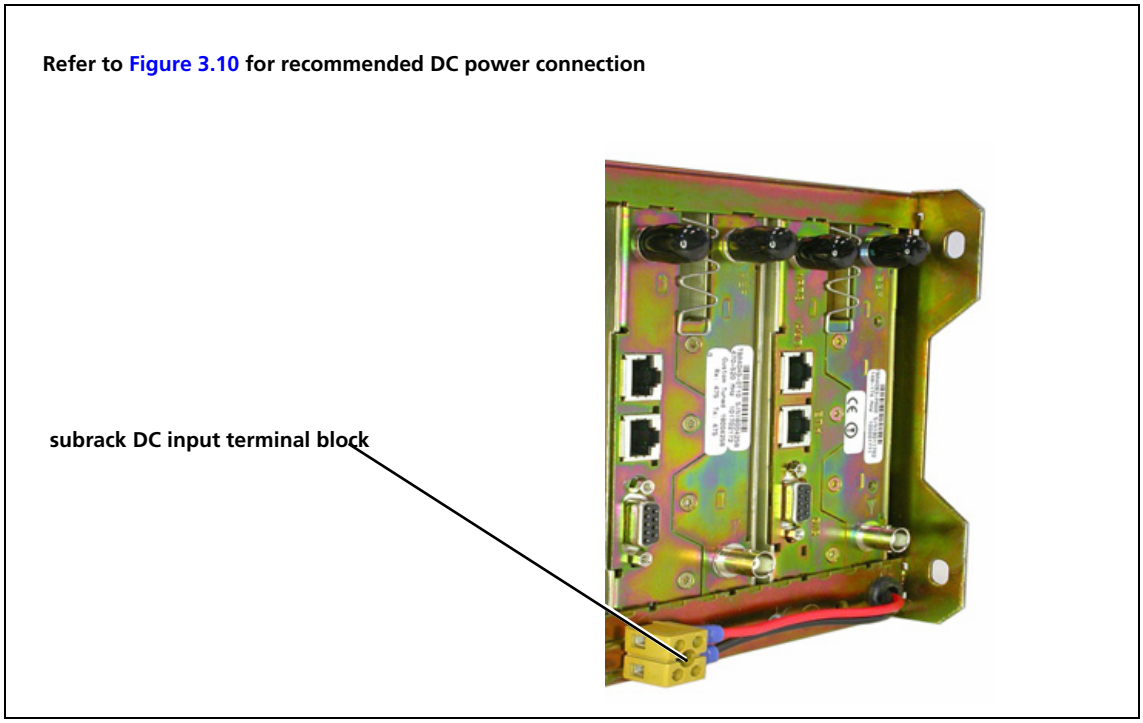
a. For a length of 5ft to 6.5ft (1.5m to 2m) (typical).

We recommend a screw torque of 4.5lbf·in (0.5N·m).

Base Station with no PMU or 12V PA

Base stations with no 12V PA or PMU are designed to accept a DC input of 10.8 VDC to 32 VDC with negative ground. The DC input terminal block is mounted on the rear of the subrack.

Figure 3.11 DC power supply connection



Connecting the Auxiliary DC Power Output

The PMU can provide an auxiliary DC output when it is fitted with the optional auxiliary power supply board. This board is available with an output of 13.65VDC, 27.3VDC, or 54.6VDC (depending on the model), and is

current limited to 3A, 1.5A or 750mA respectively. This optional power supply is available on the auxiliary output connector on the rear panel.

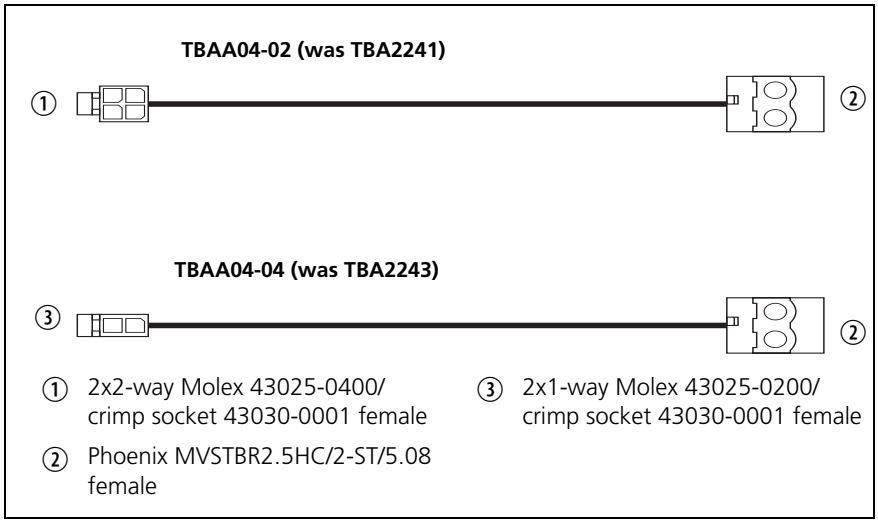
The auxiliary power supply is configured by the CSS. Refer to the "Customer Service Software User's Manual" for more details.

You can connect multiple auxiliary power supply boards in parallel for redundancy purposes, or to provide an output greater than 40W. Although no active current sharing is used, auxiliary boards connected in parallel will current-share before reaching their power limit. The failure (or switching off) of one auxiliary board will not load any other paralleled auxiliary boards in the circuit.

Auxiliary DC Power Output Cabling

Network elements are supplied with a cable kit (TBAA04-02 for TB9100 base stations and TBAA04-04 for P25 Console Gateways), as shown in Figure 3.12. You can use this cable to connect the auxiliary power output to another device. The other socket is designed for TB8100 base stations. Generally, you will need to replace it with a socket suitable for your device.

Figure 3.12 Auxiliary DC power cables



Connecting RF

Important Do not remove the load from the PA while it is transmitting.

The RF input to the TB9100 is via the lower BNC/TNC connector on the rear panel of the reciter. The RF output is via the N-type connector on the rear panel of the PA (refer to Figure 3.8 on page 52).

We recommend that you use dual-screened coaxial cable such as RG223 for the BNC/TNC connections, and RG214 for the N-type connections.

Protecting the PA

While the PA is protected against damage if it is keyed while connected to a mismatched load, it is not protected against load transients (switching or removing the load) while transmitting or atmospheric disturbances (for example, rain static and electrical storms). 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 PA directly to the antenna. Fit an isolator or cavity filter (for example, a duplexer) between the PA and the load.

   Fit the isolator as close as possible to the RF output connector on the PA. Do not connect any switching equipment between the isolator and the PA, 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 TB9100 base station for defects.

Ice on the antenna, or a broken antenna, is unlikely to cause damage to the PA. There should be enough coaxial cable between the antenna and PA to protect it from high VSWR.

5 W PAs will not fail due to a highly mismatched load. They do not use the MRF9060 device.

Explanation

Most base station manufacturers have adopted 28 V LDMOS technology to benefit from its superb wide-band performance and high efficiency. Accordingly, the TB9100 uses the MRF9060 LDMOS FET as the final power device.

However, LDMOS devices have a lower breakdown voltage. The circuit design of 50 W and 100 W PAs protects the MRF9060 from high VSWR. This makes it impossible to damage the 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.

Connecting an External Frequency Reference

For K4 Band, the internal frequency reference accuracy is inadequate, and an external reference (for example, the Tait T801-02) **must** be used. The external reference frequency can be 10MHz or 12.8MHz, with an input level of 300mV pp to 5V pp. The stability of this reference should be better than 50 parts per billion.

If an external reference is required, use the CSS to program the base station for 10MHz or 12.8MHz ("Configure > Network Element > Miscellaneous"), and to enable the external reference "Enable" and "Invalid" alarms ("Configure > Alarms > Control").

Connecting an Antenna Relay

You can connect a base station that will operate in Simplex mode to an coaxial antenna relay. This makes it possible to receive and transmit using the same antenna. A pin in the 9-way D-range needs to be configured as the relay driver.

Important The the isolation of this relay **must** be > 40dB. The relay closing time **must** be < 20ms.

Tait offers an Antenna Relay Kit which comes complete with installation instructions (402-00041-01).

Connecting the Ethernet Line

The RJ-45 socket labeled ETH provides the 10BASE-T Ethernet connection to the other devices in the network. Use Cat-5 cable to connect the ETH RJ-45 socket to the TaitNet network via a hub, router, or switch.

If necessary, refer to "Digital Interface Connection" on page 121 for a list of Ethernet connection pin allocations.

Connecting the Analog Line

The RJ-45 socket labeled AUD can provide a direct audio connection to a local or remote dispatcher. It also provides a basic E&M signaling interface. Refer to "Analog Interface Connection" on page 121 for a list of the analog connection pin allocations.

Important The analog RJ-45 socket is keyed to ensure that the correct cable (one with a keyed plug) is connected. If the analog cable were to be connected to the digital RJ-45 socket, the potentially high voltages on the E&M lines would damage the Ethernet interface.

Before connecting up any E & M or 4-wire audio circuit, consult the Network Installation Guide for information on circuit design and interface protection. On the E & M circuit, the DC current flow must not exceed 150 mA under any conditions. There must also be sufficient suppression to absorb any inductive spikes. If DC is applied to the 4 wire audio lines, it should also be limited to 150 mA. The nominal voltage should not exceed 48 V and the peak voltage must never exceed 58 V.

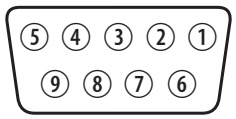
Note Refer to the CSS documentation for information on setting the analog line level.

Connecting General Purpose Inputs and Outputs

The TB9100 has a number of configurable general purpose inputs and outputs. These are connected via the 9-way D-range. Pin 1 and Pin 9 can have different functions: select the function you want using the CSS. Digital inputs and outputs require Task Manager programming before they are operational. Refer to the CSS documentation for further information.

The D-range is used for general purpose inputs and outputs and also as an RS-232 serial port, for example during tuning and calibration. Each pin has only one function, so using the D-range as a serial port does not interfere with the digital inputs and outputs.

The pin allocations for the D-range connector are given in the following table.



front view

Pin	Description
1	digital output 1/ digital input 4/ antenna relay
2	transmit data output
3	receive data input
4	digital input 0
5	ground
6	digital input 1
7	digital input 2
8	digital input 3
9	digital output 0/ RSSI[a]

a. Pin 9 can function as digital output 0 or as an RSSI output (selected using the CSS). If it provides an RSSI output, the range of received signal is configurable between -130 dBm and -60 dBm. The DC output characteristic lies between the fixed points of 0.5 V and 4.5 V.

4 Operation

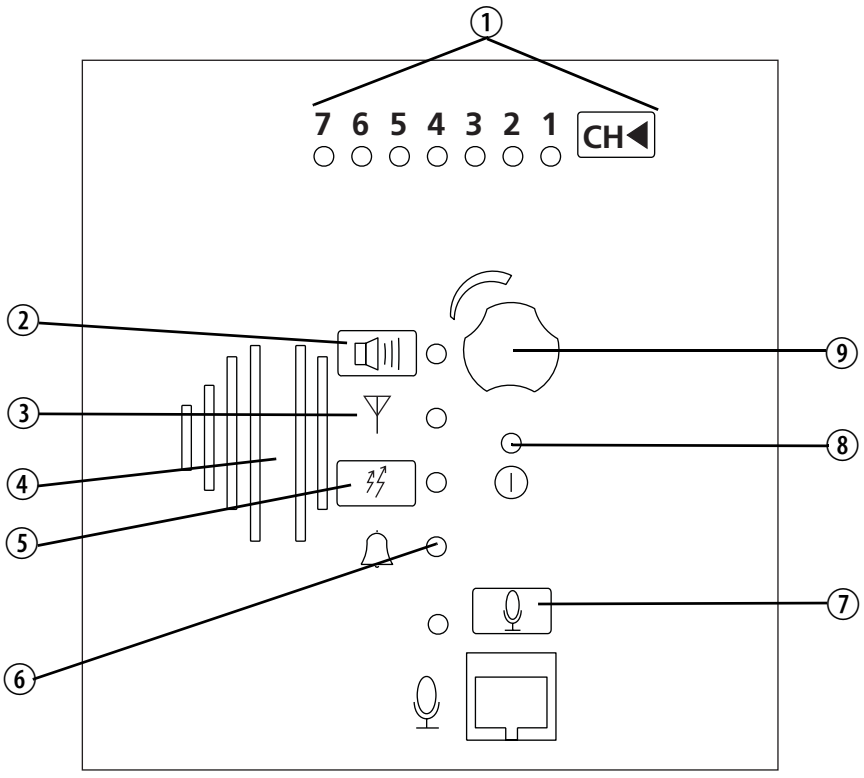
This section describes the control panel and shows how to operate its microphone and speaker. It also indicates how to check that the fans are operational and how to interpret indicator LEDs on modules.

4.1 Control Panel

The operating buttons and indicator LEDs on the control panel are shown in Figure 4.1. They allow some manual control over the base station and monitoring of its operational status. The microphone and speaker allow the maintainer to:

- monitor voice traffic
- communicate with the dispatcher and with SU users

Figure 4.1 Operating controls on the control panel



① channel button and LEDs
② speaker button and LED
③ receive LED
④ speaker
⑤ carrier button and transmit LED
⑥ alarm LED
⑦ microphone button and LED
⑧ power LED
⑨ speaker volume

Channel Button and LEDs

The channel button selects which reciter is connected to the control panel. Repeatedly pressing this button cycles through positions 1 to 7 in the subrack, regardless of whether the position is occupied. The selection defaults to position 1 on power-up.

The channel LEDs have the following states (default settings):

- red indicates which is the currently selected reciter
- green indicates that the reciter is receiving a valid signal
- orange indicates that the selected reciter is currently receiving a valid signal

Important These LEDs can display alarm status instead of the state of the Rx gate. For more information, see "Control Panel" on page 114.

Speaker Button and LED

The speaker button selects the type of speaker output for the currently selected reciter. The green speaker LED indicates the type of speaker output. Refer to "Speaker Operation" on page 63.

Speaker Volume Button

Controls the volume of the speaker mounted behind the control panel. Rotate clockwise to increase the volume, and anticlockwise to decrease the volume.

Speaker

The control panel is fitted with a 0.5W speaker. Audio from the base station can be connected to this speaker.

Receive LED

The green receive LED indicates whether the base station is receiving a valid RF signal.

LED	Description
On (steady)	Base station is receiving a valid signal that has won the vote
Flashing	Base station is receiving a valid signal that has lost the vote
Off	Base station is not receiving a valid RF signals

If the base station is part of a channel group with central voting, the channel group members must be configured with unique receiver numbers for the LED to correctly indicate whether the base station won the vote.

Power LED

The green power LED is lit when the PMU is turned on and supplying power to the subrack.

Carrier Button and Transmit LED

The carrier button is a momentary press switch. When held down, it keys the transmitter of the selected channel. The transmitted signal is unmodulated, i.e. carrier only.

The red transmit LED is lit while the transmitter is transmitting.

Alarm LED

The red alarm LED will flash at a rate of 2 to 5 Hz when an alarm has been generated by any of the TB9100 modules. It will continue to flash until the alarm is canceled, the fault is fixed, or the base station is in Standby mode. Note that only those alarms which are enabled using the CSS will cause this LED to flash.

The alarm LED also indicates when the base station is in Standby mode, as described in the following table:

LED	Description
On (steady)	Base station is in Standby mode (regardless of the presence of any fault)
Flash	Base station is in Run mode, and one or more faults are present
Off	Base station is in Run mode, and no faults are present

Microphone Button and LED

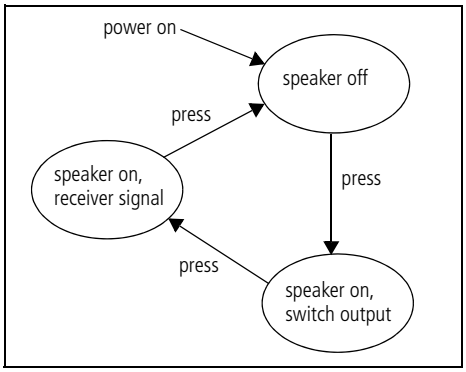
The microphone button selects the speech mode for the microphone transmission. The associated microphone LED indicates the type of speech mode. Refer to "Microphone Operation" on page 64 for more information.

Speaker Operation

The speaker can monitor the switch output or the RF signal received by the base station. Listening to the switch output lets you have a conversation with the dispatcher or with SU users at other base stations in the channel group. The speaker output is controlled using the speaker button.

To set the speaker output:

1. Use the CH button to select the channel you want to listen to.
2. Press the speaker button once to turn the speaker on and play the switch output (the signal with the highest priority).



The green speaker LED flashes. The speaker produces audible speech from digital P25 or analog FM signals.

3. Press the speaker button a second time to play the receiver input. The green speaker LED is lit.

4. Press the speaker button a third time to turn the speaker off.

Note Under particular receiver settings, the speaker only monitors the receiver audio, and not the switch output. If you need to talk to people at other base stations, use an SU, or configure the base station for another mode of operation (such as P25).

Gating and squelch mechanisms are carried out as normal on the switch output.

When the receiver input is monitored, the speaker audio is ungated but the base station still carries out gating and squelch mechanisms on the receiver input to the switch.

To maintain security, the speaker never decrypts encrypted calls. If a call is encrypted, the speaker produces squalks and squeaks. However, if the P25 Console Gateway has an encryption license, the speaker remains silent.

Microphone Operation

The control panel microphone allows the maintainer to talk to the dispatcher and to SU users on the network. This can be done in digital P25 or analog FM mode. This section describes how to set the speech mode for the call. For detailed information about making a control panel call, refer to "Making Test Transmissions" on page 42.

To set the mode for the control panel microphone:

1. Use the CH button to select the channel you want to use.

2. Press the microphone button once to set the mode to analog FM. The green microphone LED is lit.

3. Press the microphone button a second time to set the mode to digital P25. The green microphone LED flashes.

When the mode is digital P25, microphone calls use the NAC (network access code) in the current signaling profile. The call destination is to all units in the channel group.

When the mode is analog FM, calls use the sub-audible signaling in the current signaling profile.

Control panel calls can be made when the base station is in either Standby or Run mode.

Note Transmissions from the microphone override any other calls. Before using the microphone, make sure that the channel is clear. Otherwise, any calls in progress on that channel, including emergency calls, will be terminated.

4.2 Monitoring with the CSS

You can monitor the performance of your TB9100 remotely with the CSS. Use the monitoring forms to view information about the current state of the base station. These forms provide details about the PMU, PA and reciter modules. They also display operational information, such as whether the base station is currently operating in digital P25 or analog FM mode, the status of the network link, and the status of voting.

4.3 Monitoring Front Panel Fan Operation

When you turn a base station on, the PA and PMU fans should turn on and then off. Check that this happens, to make sure that the fans are working.

In an operational base station, you can test that the PA and PMU fans are working by requesting the base station to turn them on. This is done using CSS diagnostic forms and is recommended after fixing a fault or replacing a fan. When you fit a fan, use this test to check that the fan is correctly connected to the appropriate PA or PMU. The CSS will toggle the fan on for a set number of seconds, then the test will end and control of the fan will revert back to the base station.

4.4 Module LED Indicators and Switches

Additional status information is displayed by LEDs in individual modules. The PMU has switches that let you turn the AC and DC modules off.

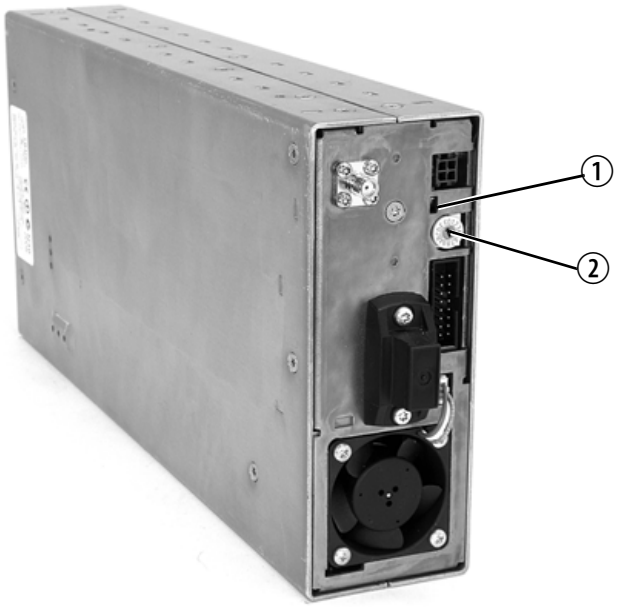
Reciter

The reciter indicator LEDs are located on the front and on the rear.

Front View

The indicator LEDs on the front are visible through a slot in the front panel.

Figure 4.2 Indicator LEDs on the front of the reciter



① indicator LEDs

② hex switch (for future use)

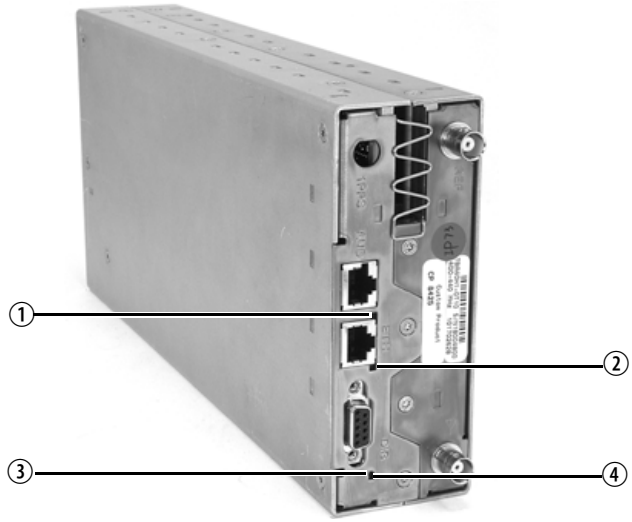
These LEDs provide the following information about the state of the reciter:

- steady green – the reciter is powered up
- flashing red – one or more alarms have been generated; you can use the CSS to find out more details about the alarms.

Rear View

The indicator LEDs on the rear are visible through small holes in the rear panel.

Figure 4.3 Indicator LEDs on the rear of the reciter



① network transmit LED
② network activity LED
③ network board PowerPC LED
④ network board DSP LED

Network Transmit LED

The amber network transmit LED will flash for 1 second when data is transmitted across the Ethernet interface.

Network Activity LED

The green network activity LED is lit when the Ethernet interface is connected. When network activity is detected, the LED will flash on for 1 second and off for 1 second.

Network Board PowerPC LED

The green network board PowerPC LED will flash continuously when the PowerPC is functioning normally.

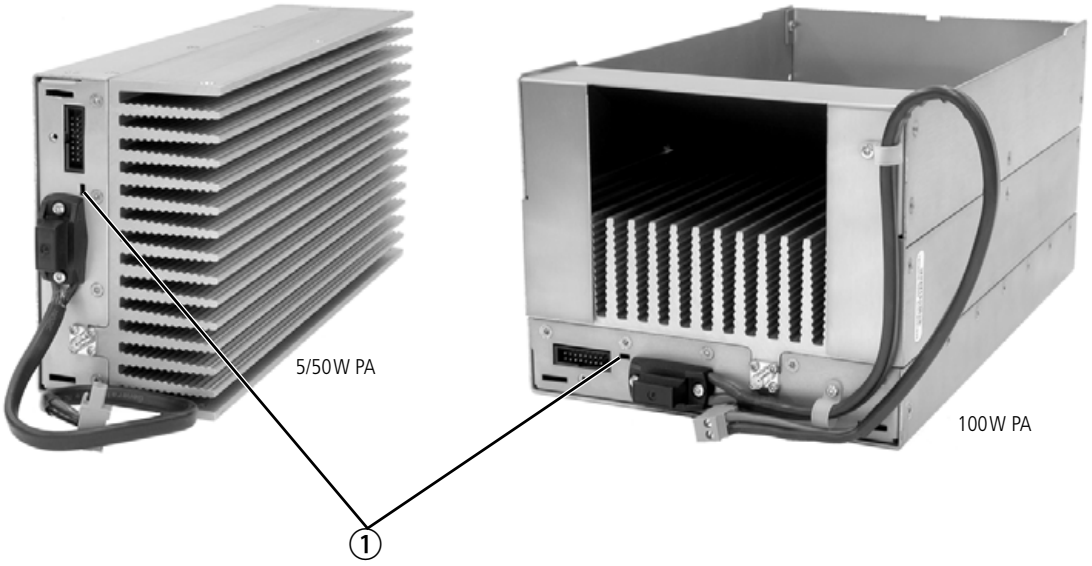
Network Board DSP LED

The amber network board DSP LED will flash continuously when the DSP is functioning normally.

PA

The indicator LEDs on the PA are visible through a slot in the front panel.

Figure 4.4 Indicator LEDs on the PA



① indicator LEDs

Indicator LEDs

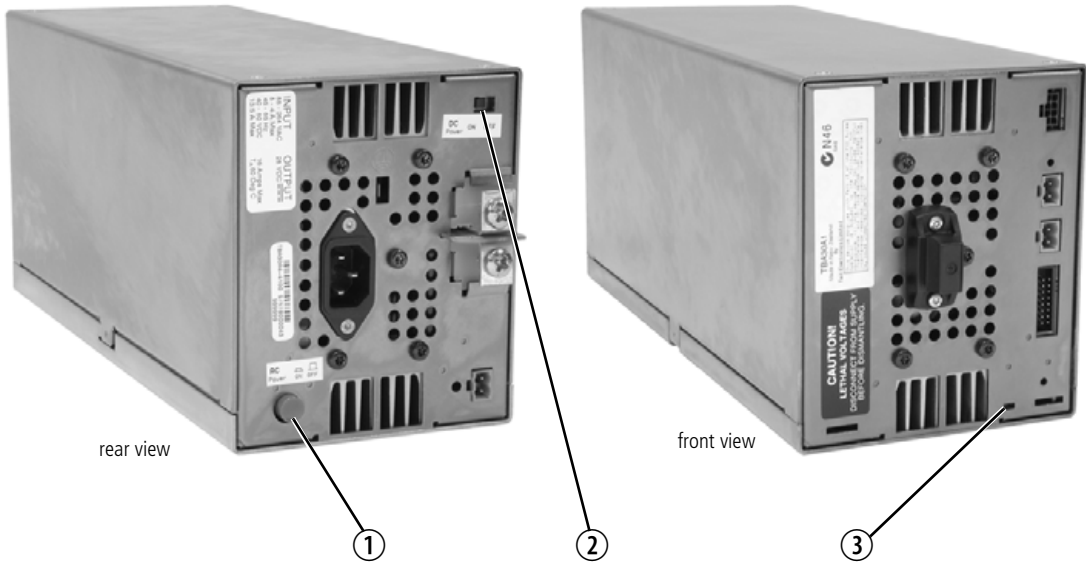
These LEDs provide the following information about the state of the PA:

- steady green - the PA is powered up
- flashing green - the PA has no application firmware loaded; you can use the CSS to download the firmware
- flashing red - one or more alarms have been generated; you can use the CSS to find out more details about the alarms.

PMU

The only controls on the PMU are the on/off switches on the rear panel for the AC and DC modules, and the indicator LEDs visible through a slot in the front panel.

Figure 4.5 Operating controls on the PMU



① AC module on/off switch

② DC module on/off switch

③ indicator LEDs

AC Module On/Off Switch

This switch turns the AC input to the PMU on and off. Note that this switch breaks only the phase circuit, not the neutral.

DC Module On/Off Switch

This switch turns the DC output from the PMU on and off. It is recessed to prevent the DC module being accidentally switched off, thus disabling the battery back-up supply.

Note that this switch disables only the control circuitry – the DC input is still connected to the power circuitry.

Warning!! **These switches do not totally isolate the internal circuitry of the PMU from the AC or DC power supplies. You must disconnect the AC and DC supplies from the PMU before dismantling or carrying out any maintenance. Refer to the service manual for the correct servicing procedures.**

Indicator LEDs

These LEDs provide the following information about the state of the PMU:

- steady green – the PMU is powered up
- flashing green – the PMU has no application firmware loaded; you can use the CSS to download the firmware
- flashing red – one or more alarms have been generated; you can use the CSS to find out more details about the alarms.

5 Maintenance

The TB9100 base station is designed to be very reliable and should require little maintenance. However, performing regular checks will prolong the life of the equipment and prevent problems from happening.

It is beyond the scope of this manual to list every check that you should perform on your base station. The type and frequency of maintenance checks will depend on the location and type of your system. The checks and procedures listed below can be used as a starting point for your maintenance schedule.

Performance Checks

We suggest you monitor the following operational parameters using the CSS:

- VSWR
- DC input voltage, especially on transmit
- receiver sensitivity
- the setting of the receiver gate opening
- any temperature alarms.

These basic checks will provide an overview of how well your base station is operating.

Reciter

Check UHF reciters for frequency drift after 3 months service and annually thereafter. If the drift is > 0.5 ppm, adjust the carrier frequency offset. For details, see the Calibration Software documentation.

Check the modulation fidelity from time to time or if you suspect a degradation in sensitivity on the downlink. For instructions, see "Checking the Modulation Fidelity" on page 45.

PA

There are no special maintenance requirements for the PA.

PMU

There are no special maintenance requirements for the PMU. However, if you are using battery back-up, you should check the batteries regularly in accordance with the manufacturer's recommendations.

Ventilation

The TB9100 base station has been designed to have a front-to-back cooling airflow. We strongly recommend that you periodically check and maintain the ventilation requirements described in "Equipment Ventilation" on page 34 to ensure a long life and trouble-free operation for your base station.

Cooling Fans

The cooling fans have a long service life and have no special maintenance requirements. You can use the CSS to configure the base station to generate an alarm if either of the front panel cooling fans fail. Refer to the CSS documentation for more details.

6 Troubleshooting

Check that all front and rear connectors and cables are in place, and that power switches are on. If problems persist, contact your nearest Tait Dealer or Customer Service Organization.

Symptom	Possible Cause	Action
Alarm LED red and steady (not flashing)	Base station is in Standby mode	Use CSS to put base station in Run mode
All reciter LEDs on	Digital board not communicating with Network board	Replace reciter module and send faulty module for servicing
Desired feature is not operating	Feature license missing	a) Check that you have the necessary feature licenses (see the CSS help or User's Manual). b) Check the system log for messages indicating a missing feature license
	Feature license present but feature is not enabled	Use the CSS to enable the feature.
Front panel speaker transmits unintelligible sounds	An encrypted P25 call is being monitored/received	Turn speaker off or take no action: only other radios with encryption decoder can decrypt encrypted calls
Front panel speaker is silent although calls are being transmitted	An encrypted P25 call is being monitored/received	If the console gateway has an encryption license, the speaker remains silent when encrypted calls are transmitted
Clear warning on transmit	This means that the base station/console gateway transmitted a clear and not encrypted call	You have a non-encryption system and the clear warning hasn't been turned off in the configuration
		You are transmitting clear when you should be transmitting encryption. This could be because: a) your calling profile specifies an encryption key but you don't have a basic encryption license b) your calling profile specifies an encryption key. That key is filled with AES key information but you don't have an AES encryption license.
Mismatch warning on transmit	The base station doesn't transmit/ the console gateway doesn't pass signal on to the network	The calling profile specifies an encryption key, but that key is not loaded
Mismatch warning on receive	The base station doesn't receive/ the console gateway doesn't pass signal on to the network	Use the CSS to monitor calls and check that there is no mismatch between the received call and the current calling profile
Tx stuck on	Tx and Rx frequencies are the same	Reconfigure Tx and Rx with different frequencies

Symptom	Possible Cause	Action
Power LED on control panel is on, but nothing else works	Panel is disabled	Check that the control panel is enabled on the CSS (Configure > Network Element > Miscellaneous)
No power or LEDs on control panel	System control bus not connected to control panel	Check I^2C cable connections
	Pins bent on 15-pin D-range plug on subrack	Replace or repair D-range plug
Can't send microphone audio	Correct buttons have not been pressed on the control panel to select either P25 or Analog mode for the microphone	Check that correct mode is selected
	P25 call being made, but feature not enabled	Check using the CSS that there is a feature license for the P25 common air interface.
Control panel behavior is random, as if buttons are being pressed	I^2C cable is not connected to PMU	Check the I^2C cable connection to the PMU - if the I^2C cable is not connected to the PMU, the system control bus is not properly terminated and will account for any strange behaviour
Base station appears to make random transmissions	CWID feature enabled	No action: CWID transmissions are made according to configuration settings
Supplementary services don't work	Features and permissions have not been enabled correctly	Check service profiles. The service profile attached to the channel enables supplementary services on the RF receiver. The service profile attached to the calling profile enables supplementary services on the analog line in.
PA has low power	Channel is configured to low power	Use the CSS to check the power settings
	PA may have suffered partial damage	Replace module and send faulty module for servicing
Channel group interface not working	Base station does not have a voice networking feature license	Obtain the required license and enable the feature.
	Multicast address incorrect	Check that the CSS still connects to the base station, and that the multicast address is correct
	a) keyed connectors were not used b) the analog line was connected by mistake to the Ethernet interface c) E & M connection has non-current limiting power supply	Replace module and send faulty module for servicing
Test tones can't be heard	IMBE does not pass on tones higher than 400 HZ	Ensure test tones are less than 400 Hz

Symptom	Possible Cause	Action
Static on analog Rx	P25 call is being made on an analog channel	Check configuration on CSS
Base station performs Task Manager actions unexpectedly when going into Run mode	Digital input cable is not attached, the inputs are active low: thus if no cable is attached the base station reads them as all on.	1. Check the cable carrying digital inputs 2. Try to avoid Task Manager tasks that trigger when digital inputs float high
Base station performs Task Manager actions unexpectedly and no longer responds to digital inputs		
Lost or forgotten base station IP address		1. Connect your PC to the 9-pin serial connector on the back of the reciter. 2. Run a program such as HyperTerminal, Teraterm or minicom. 3. Select the following port settings: 57600 baud, 8 bits, no parity, 1 stop bit, no flow control. 4. Press the 'Enter' key. A login prompt will appear displaying the base station's IP address.

7 Replacing Modules

Caution **The TB9100 PA and PMU weigh between 10.1lb (4.6kg) and 12.8lb (5.8kg) each. Take care when handling these modules to avoid personal injury.**

Important The cooling fans are mounted on the front panel and will only operate when the panel is fitted correctly to the front of the subrack. To ensure adequate airflow through the base station, do not operate it for more than a few minutes with the front panel removed (e.g. for servicing purposes). Both the PMU and PA modules have built-in protection mechanisms to prevent damage from overheating.

7.1 Saving the Base Station's Configuration

Before replacing a module in the TB9100 base station, you should decide whether you need to save its configuration data. If you are unsure whether you have a record of the configuration, use the CSS to read the base station and save the configuration file before removing any modules. Once you have replaced the module, you will be able to restore the original configuration by programming the saved configuration back into the base station.

If one or more of the modules is faulty, you may be unable to read the base station. In this case, you will have to restore the configuration from a back-up file. Refer to the CSS documentation for more information.

7.2 Preliminary Disassembly

Hot-pluggable Modules

The reciter, PA and control panel are hot-pluggable and can be removed without powering down the whole base station. These modules can also be removed without disrupting the system control bus communications with the other modules in the subrack.

Important The PMU must be connected to the system control bus at all times. The terminating circuitry for the bus is located in the PMU, and if the PMU is disconnected, the state of much of the bus will be undefined. This may cause corrupted data to be present on the bus when the reciter reads the states of the switches on the control panel. This in turn may result in random actuations of microphone PTT, carrier, or speaker key, causing the base station to transmit or the speaker to be actuated incorrectly.

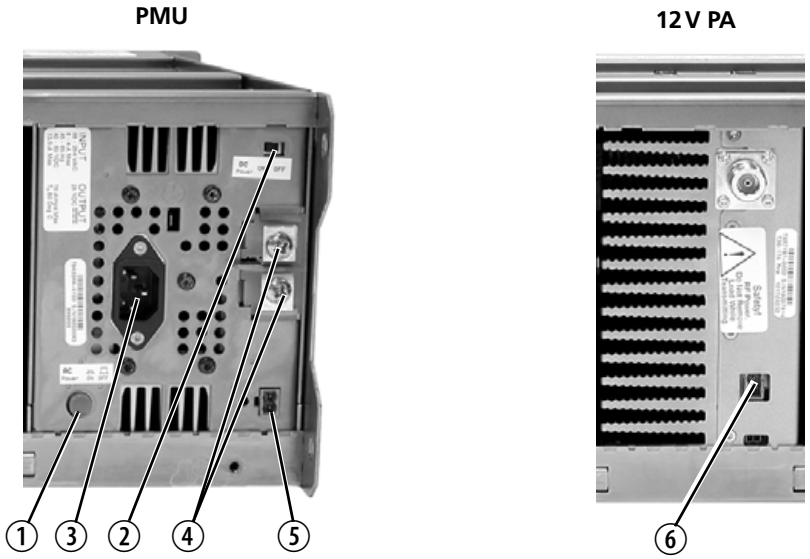
Important Before removing a PA, disconnect the DC input and RF input first, followed by the RF output (and DC output on the 12V PA). After refitting the PA, reconnect the RF output (and DC output on the 12V PA) first, followed by the RF input, and then the DC input.

Disconnecting the Power

If you want to disconnect the power before working on the TB9100, follow these steps.

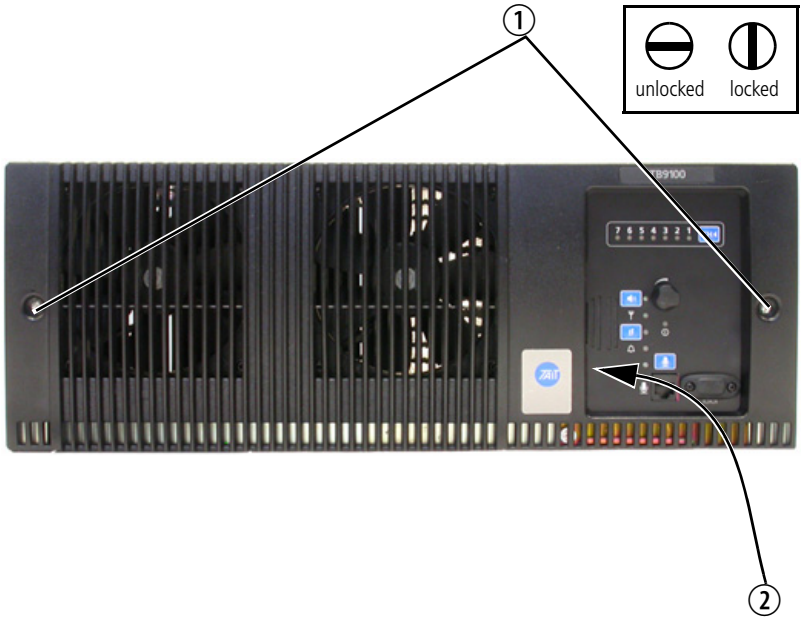
1. Turn off the AC ① and DC ② switches at the rear of the PMU.
2. Also at the rear of the PMU disconnect the mains ③ and battery ④ supply leads, and the auxiliary DC supply lead ⑤ (if fitted).

3. If the base station is using a 12V PA, disconnect the battery supply lead ⑥.



Remove the Front Panel

1. Undo the fastener at each end of the front panel ① with a quarter turn anti-clockwise.

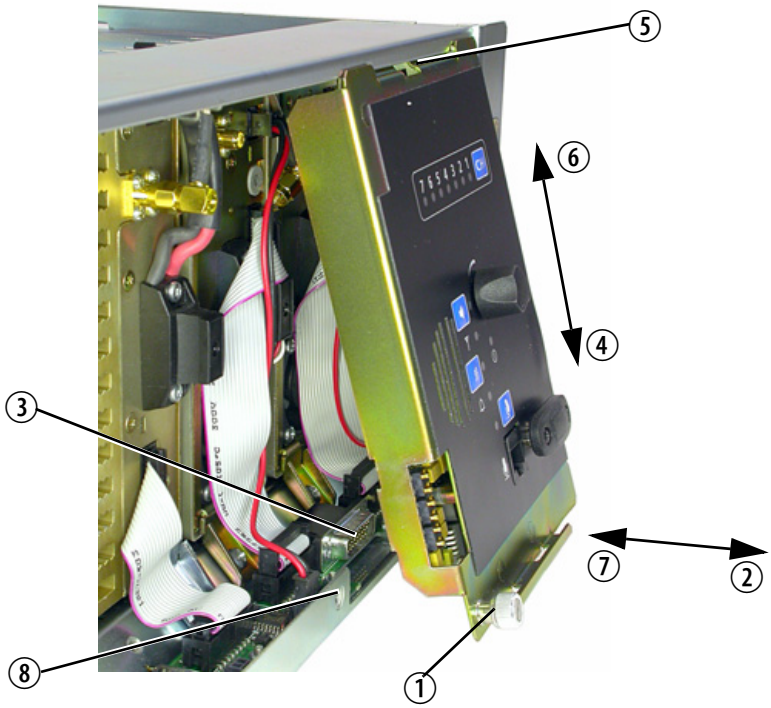


2. While supporting the left end of the front panel, place your fingers in the recess provided on the left side of the control panel opening ② and pull the right end of the front panel away from the subrack. You will need to overcome the resistance of the spring clip securing the front panel to the control panel.

7.3 Replacing the Control Panel

Removal

1. If you have not already done so, carry out the instructions in "Preliminary Disassembly" on page 78.
2. Undo the retaining screw ①. Note that the screw stays attached to the control panel.
3. Pull the bottom of the control panel away from the subrack ② to disconnect the D-range socket on the back of the panel from the plug ③ on the subrack.
4. Pull the control panel down ④ to disengage the center tab ⑤ from the subrack.



Refitting

Before fitting the new control, make sure that it has been configured according to your requirements. See "Configuring the Control Panel Board" on page 81.

1. Fit the top of the control panel to the subrack so that the center tab is behind the lip of the subrack and between the two locating tabs formed in the lip. Push the control panel firmly upwards ⑥.
2. Align the D-range socket on the back of the control panel with the plug on the subrack. Gently push the bottom of the panel home against the subrack ⑦ to engage the plug into the socket.

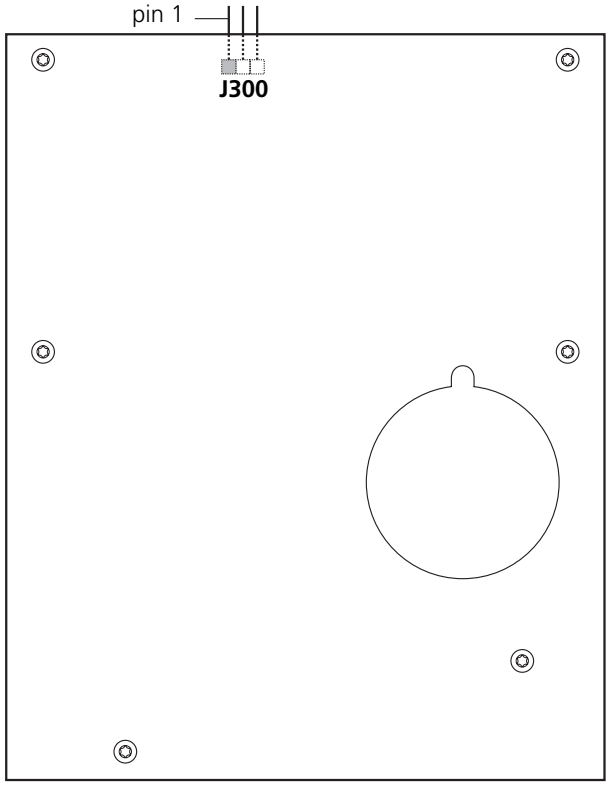
3. Insert the securing screw into the floating nut ⑧ in the subrack and tighten. Note that you may have to push the screw in and down to pick up the floating nut.

4. Carry out the instructions in "Final Reassembly" on page 97.

Configuring the Control Panel Board

A link (J300) is provided on the control panel board which allows you to select the color displayed by the seven channel LEDs (refer to the examples below). This link selects the color for all the channel LEDs.

Note The following diagram shows the bottom side of the board (as seen with the board mounted in the control panel chassis). J300 is mounted on the top side of the board, and is accessible from the top of the control panel assembly.



Examples of LED Colors

Example 1

With the following link settings:

- Subrack interconnect board links set for Rx gate status signal (see "Configuring the Subrack Interconnect Board" on page 94)
- control panel board link across pins 1 and 2

the channel LEDs will have the following states:

- red indicates which is the currently selected reciter (channel)
- green indicates that the reciter is receiving a valid signal
- orange indicates that the currently selected reciter is receiving a valid signal

The link settings described above are the TB9100 factory default settings.

Example 2

With the following link settings:

- subrack interconnect board links set for alarm status signal (see "Configuring the Subrack Interconnect Board" on page 94)
- control panel board link across pins 2 and 3

...the channel LEDs will have the following states:

- green indicates which is the currently selected reciter (channel)
- red indicates that the reciter is generating an alarm
- green, flashing orange indicates that the currently selected reciter is generating an alarm

7.4 Replacing a Reciter

Removal

1. If you have not already done so, carry out the instructions in "Preliminary Disassembly" on page 78, and remove the control panel, as described in "Replacing the Control Panel" on page 80.

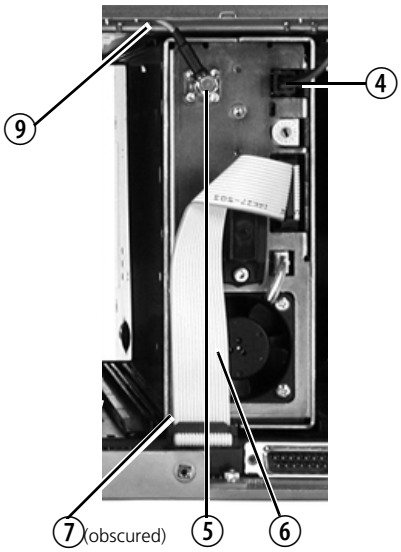
2. At the rear of the reciter, unplug the RF input cable ①, any system cables ② and the external reference cable ③ (if fitted).

3. At the front of the reciter, unplug the DC input cable ④ and the RF output cable ⑤, and move both cables to one side. Unplug both ends of the system control bus loom ⑥ and remove it.

Note The DC output connector on the subrack interconnect board for reciter 2 is located in front of reciter 3. You will need to disconnect reciter 2's power cable from the subrack board before removing reciter 3.

4. Loosen the screw securing the retaining clamp ⑦ and rotate the clamp through 90° to clear the module.

5. Slide the reciter out of the subrack, taking care not to damage any of the cables.



Refitting

1. Slide the replacement reciter into the subrack and secure it with the retaining clamp.

2. Reconnect all the front and rear panel cables previously disconnected. Ensure the front panel cables are retained by the cable retaining clips ⑨ in the top of the subrack.

Important **Do not** force the system control bus behind the reciter handle as this may damage the ribbon cable.

Note If you need to remove any front panel cables, simply pull the front of the cable retaining clip down and then slide it out from the subrack until it reaches the end of its travel.

3. Tighten the nut on the SMA connector to a torque of 8lbf·in (0.9N·m).

4. Refit the control panel, as described in "Replacing the Control Panel" on page 80.

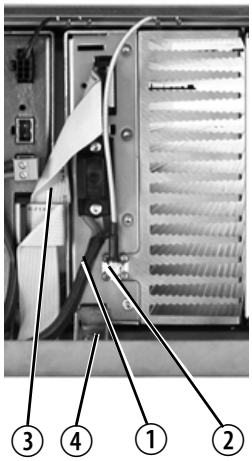
5. Carry out the instructions in "Final Reassembly" on page 97.

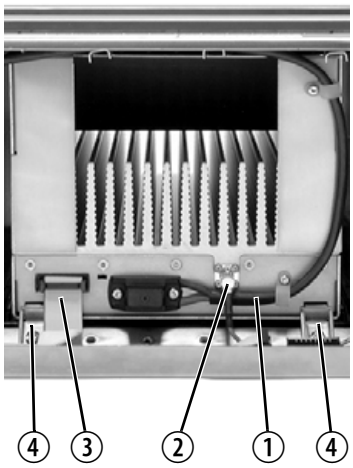
7.5 Replacing a Power Amplifier

Important Before removing a PA, disconnect the DC input and RF input first, followed by the RF output (and DC output on the 12V PA). After refitting the PA, reconnect the RF output (and DC output on the 12V PA) first, followed by the RF input, and then the DC input.

Removal

1. If you have not already done so, carry out the instructions in "Preliminary Disassembly" on page 78. If necessary, remove the control panel, as described in "Replacing the Control Panel" on page 80.
2. At the front of the PA, unplug the DC input cable (DC output cable on the 12V PA) ① and the RF input cable ②, and move both cables to one side. Unplug both ends of the system control bus loom ③ and remove it.
3. At the rear of the PA, unplug the RF output cable. **12V PA only:** also unplug the battery supply lead.
4. Loosen the screw securing the retaining clamp(s) ④ and rotate the clamp(s) through 90° to clear the module.
5. Slide the PA out of the subrack, taking care not to damage any of the cables.





Refitting

1. Slide the replacement PA into the subrack and secure it with the retaining clamp(s).
2. At the rear of the PA, connect the RF output cable.
   12V PA only:
   Also connect the battery supply lead. Tighten the screws to a torque of 4.5lbf·in (0.5N·m).

3. At the front of the PA, connect the RF input cable, followed by the DC input cable (DC output cable on the 12V PA).

4. Reconnect all the other front and rear panel cables previously disconnected. Ensure the front panel cables are retained by the cable retaining clips in the top of the subrack.

Note If you need to remove any front panel cables, simply pull the front of the cable retaining clip down and then slide it out from the subrack until it reaches the end of its travel.

5. Tighten the nut on the SMA connector to a torque of 8lbf·in (0.9N·m).

6. If necessary, refit the control panel, as described in "Replacing the Control Panel" on page 80.

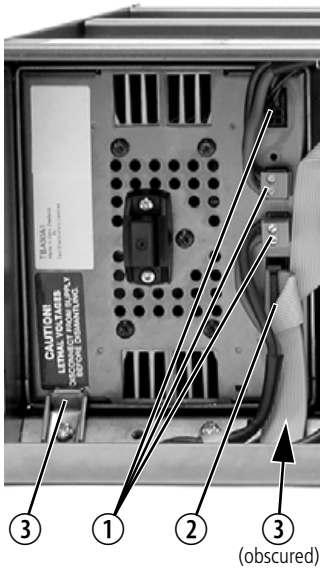
7. Carry out the instructions in "Final Reassembly" on page 97.

7.6 Replacing a Power Management Unit

Important You must disconnect the AC and DC power cables before removing the PMU from the subrack.

Removal

1. If you have not already done so, carry out the instructions in "Preliminary Disassembly" on page 78.
2. At the front of the PMU, unplug the output power cable(s) ① and system control bus loom ②, and move them to one side.
3. Loosen the screw securing the retaining clamps ③ and rotate the clamps through 90° to clear the module.
4. Slide the PMU out of the subrack, taking care not to damage any of the cables.



Refitting

1. Slide the replacement PMU into the subrack and secure it with the retaining clamps.
2. Reconnect all the front and rear panel cables previously disconnected. Connect the DC power cables on the rear panel as shown in Figure 3.7 on page 51. Tighten the screws to a torque of 18–20lbf·in (2–2.25N·m). Ensure the front panel cables are retained by the cable retaining clips in the top of the subrack.

Note If you need to remove any front panel cables, simply pull the front of the cable retaining clip down and then slide it out from the subrack until it reaches the end of its travel.

3. Carry out the instructions in "Final Reassembly" on page 97.

7.7 Replacing the Front Panel Fans

Unless otherwise indicated, the following instructions refer to Figure 7.1 on page 90.

Removal

1. If you have not already done so, carry out the instructions in "Preliminary Disassembly" on page 78.
2. PA Fan
   a. Remove the four screws labeled ① and remove the duct and fan assembly from the front panel.
   b. Unplug the fan from the fan contact board ②.
   c. Remove the fours screws holding the fan into the duct ③ and remove the fan.
3. PMU Fan
   a. Remove the PA fan/duct assembly as described above.
   b. Remove the two screws labeled ④ and remove the PMU fan/duct assembly.
   c. Unplug the fan from the fan contact board ⑤.
   d. Remove the fours screws holding the fan into the duct ⑥ and remove the fan.

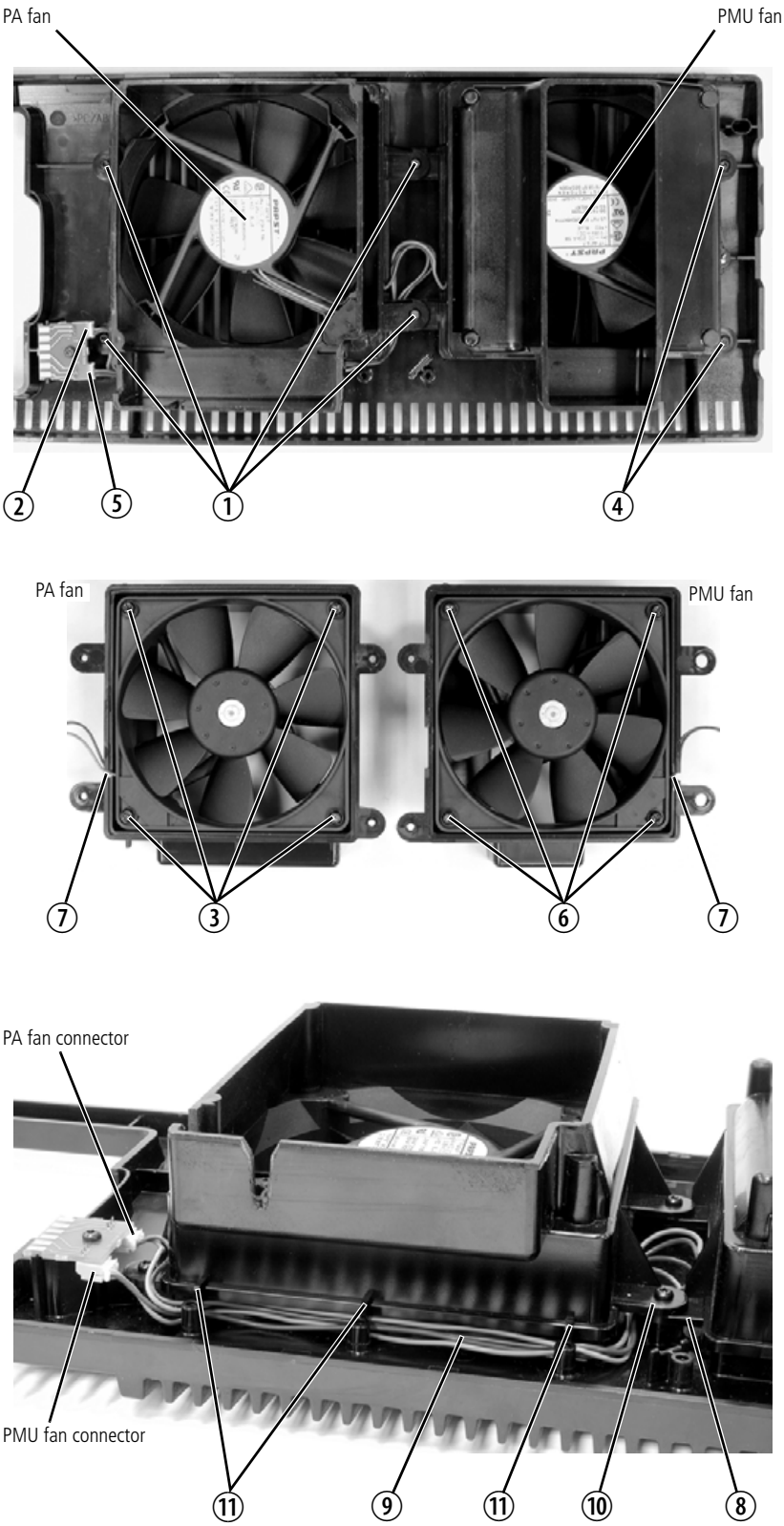
Refitting

1. Fit the replacement fan into the duct with the power wires located in the slot in the side of the duct ⑦.
2. Refit the four screws securing the fan into the duct. **Do not** overtighten these screws or you will distort the fan body.
3. PMU Fan
   a. Refit the PMU fan/duct assembly onto its mounting bosses. Note that the two inner mounting tabs ⑧ fit over the bosses.
   b. Plug the fan into the fan contact board ⑤ and route the wires around the PA fan opening ⑨.
   c. Refit the two screws labeled ④.
   d. Refit the PA fan as described below.
4. PA Fan
   a. Plug the power wires into the fan contact board ② and route the wires around the PA fan opening ⑨.
   b. Refit the PA fan/duct assembly onto its mounting bosses. Note that the two inner mounting tabs ⑩ fit over the inner tabs of the PMU fan. Ensure that all the power wires are secured under the retaining hooks ⑪ and are not crimped.
   c. Refit the fours screws labeled ①.
5. Carry out the instructions in "Final Reassembly" on page 97.

Important You must connect the fans to the correct sockets on the fan contact board. If the fan connections are reversed, the wrong fan will be activated when a module needs cooling. The module may then fold back and shut down. When you power up the TB9100, check that the PMU fan runs first, followed by the PA fan. Each fan will run for about five seconds.

Important You must refit the correct duct to the PA fan. There are several small but important differences between the duct for a 5 W or 50 W PA and the duct for a 100 W PA. Refer to Figure 7.3 on page 97 for more details.

Figure 7.1 Replacing the front panel fans



100W base station front panel shown

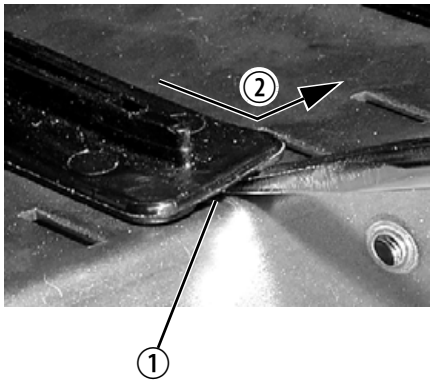
7.8 Replacing the Module Guide Rails

The module guide rails are held in place by four hooks that fit through the slots in the top and bottom of the subrack. There is also a locking tab which prevents the guide rails from working loose.

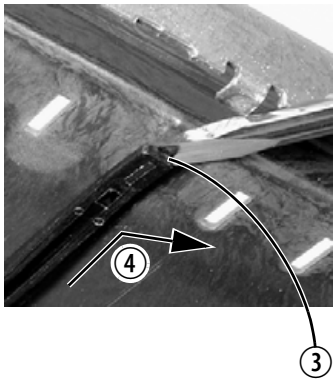
Removal

1. Bottom Guide Rails
   a. Insert a small flat-blade screwdriver under the front end of the guide rail and lift it slightly ①. This will ensure the small locking tab is clear of the slot in the subrack.
   b. Whilst holding the front end of the guide rail up, pull the guide rail towards the front of the subrack ② and lift it clear of the slots.
2. Top Rails
   a. Insert a small flat-blade screwdriver under the rear end of the guide rail and lift it slightly ③. This will ensure the small locking tab is clear of the slot in the subrack.
   b. Whilst holding the rear end of the guide rail up, pull the guide rail towards the rear of the subrack ④ and lift it clear of the slots.

bottom guide rail



top guide rail



Refitting

1. Bottom Guide Rails
   a. With the locating hooks pointing towards the rear of the subrack, insert the hooks into the slots in the subrack.
   b. Push the guide rail towards the rear of the subrack until you hear the locking tab "click" into place.
2. Top Guide Rails
   a. With the locating hooks pointing towards the front of the subrack, insert the hooks into the slots in the subrack.
   b. Push the guide rail towards the front of the subrack until you hear the locking tab "click" into place.

7.9 Replacing the Subrack Interconnect Board

Important Be careful when removing module retaining clamps and screws in a live system. Dropping any metal items onto the subrack interconnect board can cause shorts which may damage the equipment.

Note The DC output connector on the subrack interconnect board for reciter 2 is located in front of reciter 3. You will need to disconnect reciter 2's power cable from the subrack board before removing reciter 3.

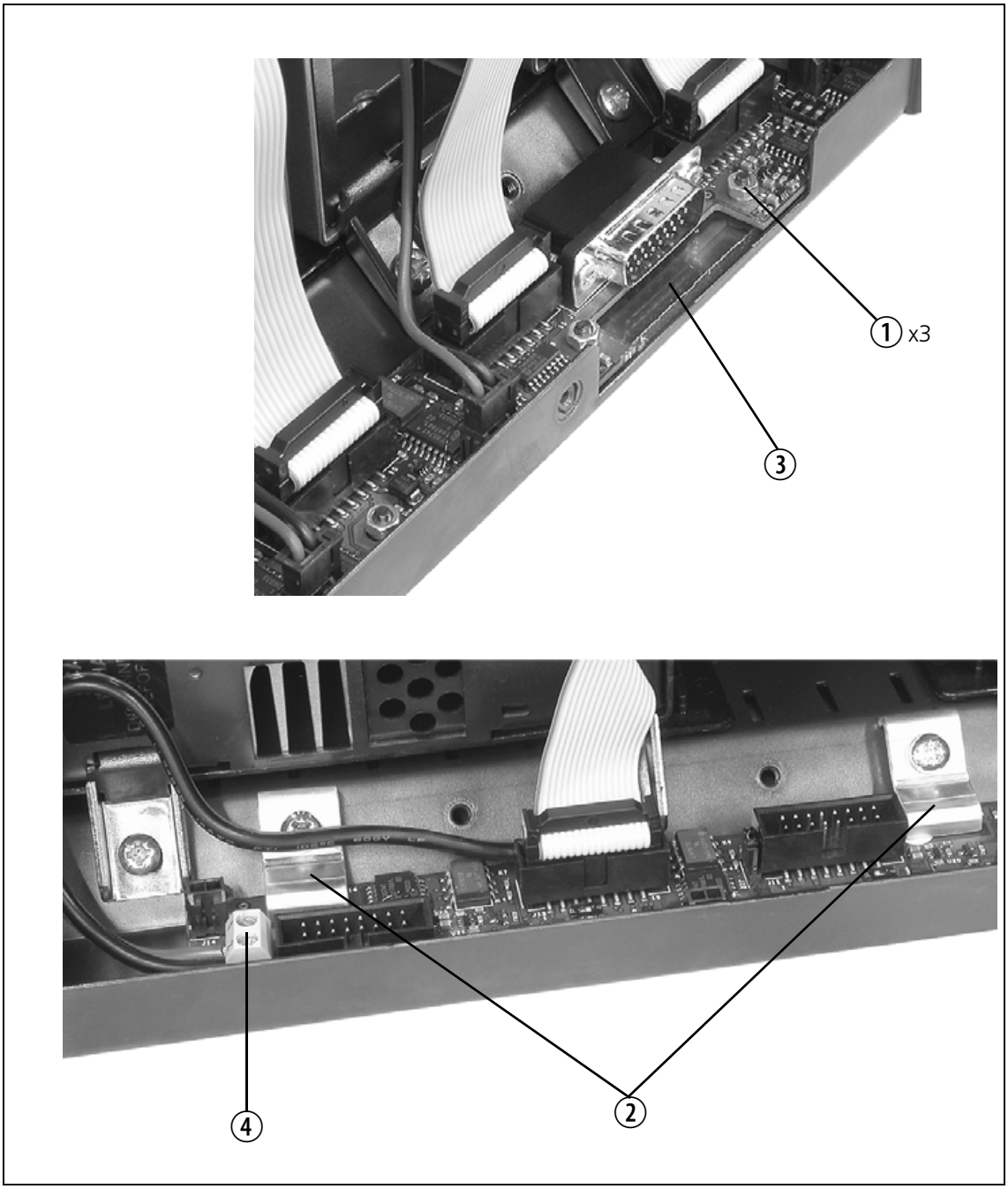
Removal

1. If you have not already done so, carry out the instructions in "Preliminary Disassembly" on page 78, and remove the control panel, as described in "Replacing the Control Panel" on page 80.
2. Disconnect any system control bus cables and DC power cables from the interconnect board.
3. Remove the M3 nuts and spring washers ① securing the right end of the board to the subrack.
4. Remove the two retaining clamps ② securing the left end of the board.
5. Remove the board.

Refitting

1. If previously removed, replace the insulator ③.
2. Reconnect the DC feed wires to connector J17 ④ on the interconnect board (red to + and black to -).
3. Refit the board and secure with the M3 nuts and spring washers. Replace the two retaining clamps.
4. Set the switches and links as described in "Configuring the Subrack Interconnect Board" on page 94.
5. Reconnect the system control bus cables and reciter DC cables as shown in "Appendix B – Inter-Module Connections" on page 123.

Figure 7.2 Replacing the subrack interconnect board



Configuring the Subrack Interconnect Board

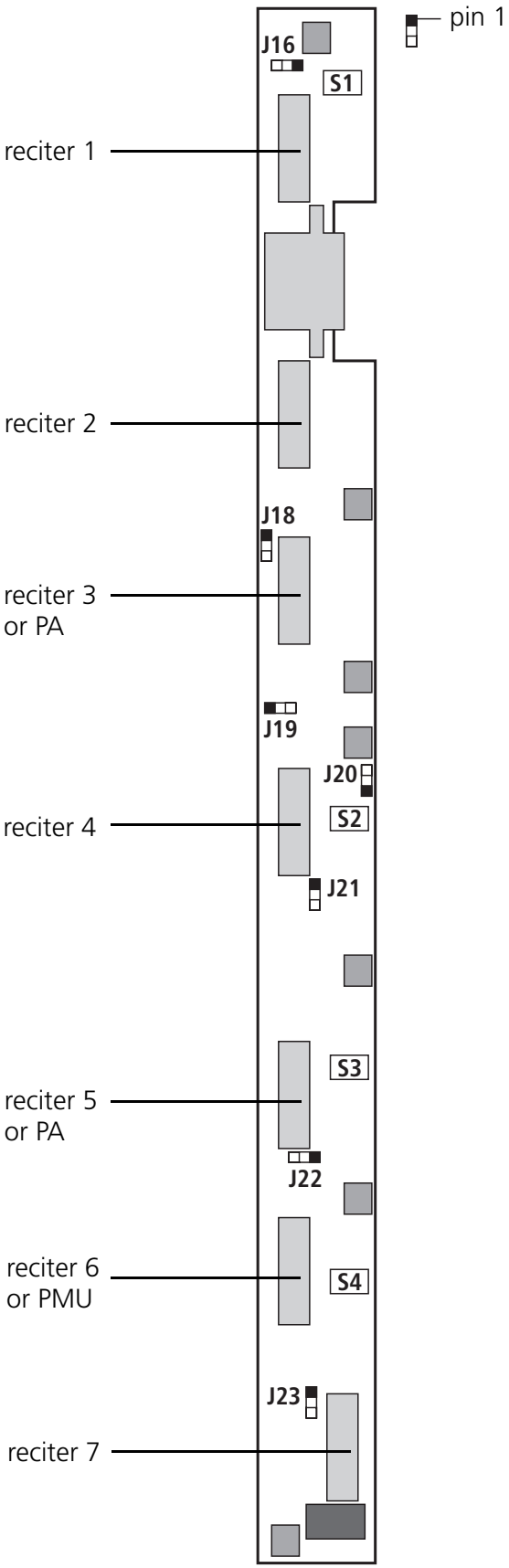
The multi-reciter subrack interconnect board has a set of DIP switches and links that must be set correctly before the equipment is used. The location of these switches and links are shown in the diagram on the following page.

Switch Settings

You must ensure that switches S1, S2, S3 and S4 are set correctly for the type of module installed in the equivalent subrack position. Only subrack positions 3, 5, and 6 are affected. (Subrack positions 1, 2, 4 and 7 are for reciters only and require no switch settings.) The following table gives the switch settings for reciters, PAs, and for the PMU.

Subrack Position	Switch Number	Switch Settings for Reciter	Switch Settings for PA	Switch Settings for 12V PA	Switch Settings for PMU[a]
3	S2:1 S2:2 S2:3 S2:4	OFF OFF ON ON	ON ON OFF OFF	ON ON OFF OFF	
5	S3:1 S3:2 S3:3 S3:4	OFF OFF ON ON	ON ON OFF OFF	ON ON OFF OFF	
6	S4:1 S4:2 S4:3 S4:4	OFF OFF ON ON	ON ON OFF OFF	OFF OFF OFF OFF	ON ON OFF OFF
	S1:1 S1:2 S1:3 S1:4	not used not used ON ON	not used not used OFF OFF	not used not used ON ON	not used not used OFF OFF

a. Note that these settings allow the CSS to communicate with the PMU through reciter 1.



Link Settings

A set of links is provided on the interconnect board for each position in the subrack, as described in Table 1 . You can set these links to connect either the reciter's alarm or Rx gate status signal to the appropriate channel LED on the control panel (refer to "Control Panel" on page 61.

Note There is a link on the control panel board which allows you to select the color displayed by these LEDs. Refer to "Configuring the Control Panel Board" on page 81.

Table 1 Link settings for selecting alarm or Rx gate signals

Subrack Position	Link	Link Settings
1	J16	alarm status signal: link pins 1 & 2 Rx Gate status signal: link pins 2 & 3
2	J18	
3	J19	
4	J20	
5	J21	
6	J22	
7	J23	

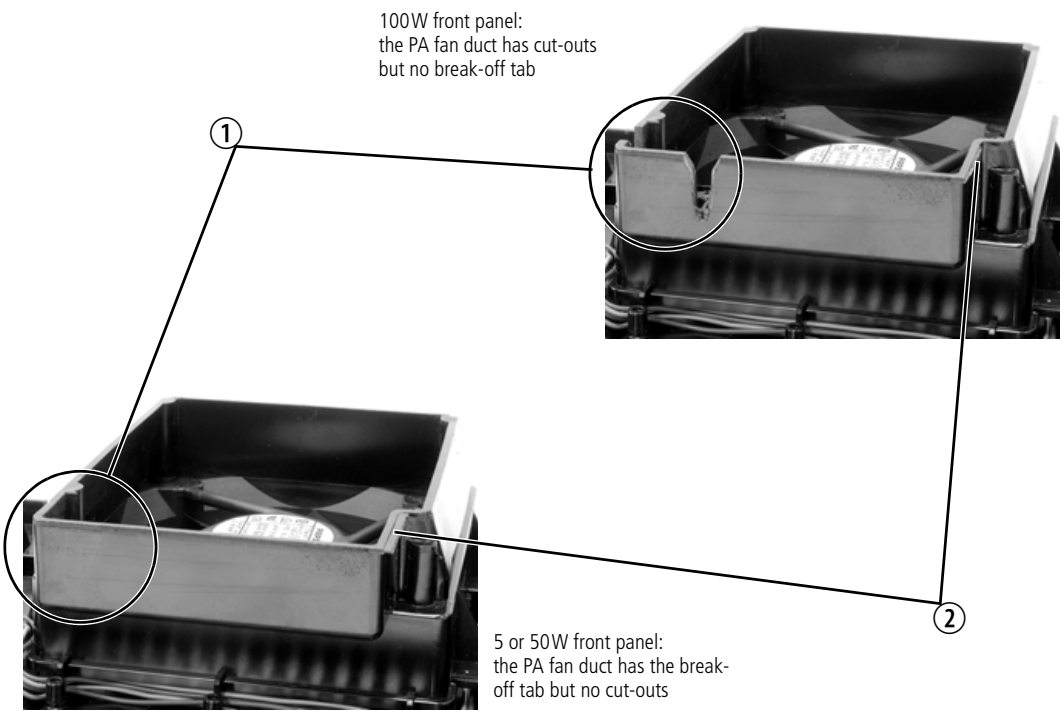
7.10 Final Reassembly

Important You must refit the correct type of front panel to your TB9100 base station. There are several small but important differences between the front panel for a 5 W or 50 W base station and the front panel for a 100 W base station. These differences are in the duct for the PA fan and are described in the following paragraphs.

5W or 50W Front Panel The PA fan duct does not have the cut-outs ① required for the 100 W PA RF and DC cables. The break-off tab ② will also still be present and will jam on the system control bus. Do not try to fit this front panel to a 100 W base station or you will damage these cables and possibly the front panel itself.

100W Front Panel Do not fit this front panel to a 5 W or 50 W base station. The presence of the cut-outs and absence of the break-off tab will allow air to escape and reduce the velocity of air directed through the heatsink.

Figure 7.3 Identifying the correct front panel

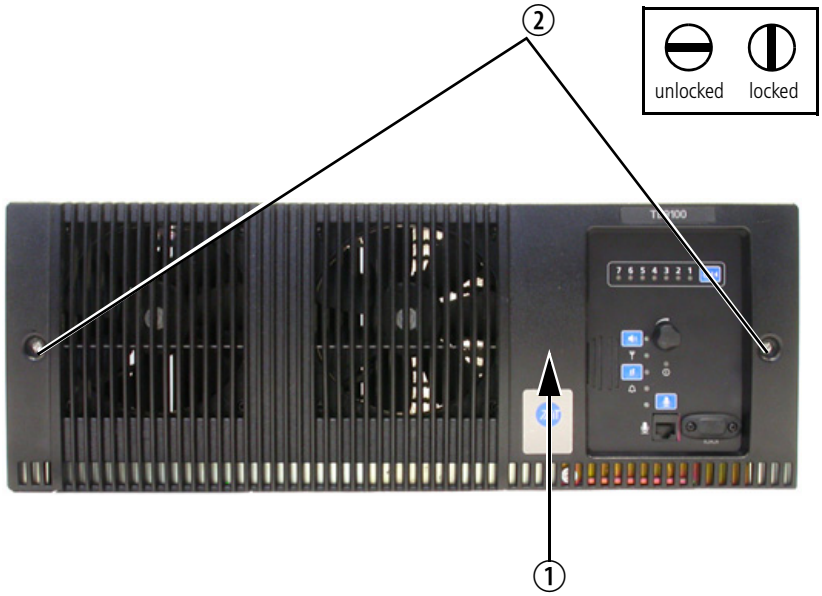


1. Before fitting the front panel, ensure that all cables are secured and positioned correctly so they are clear of the fan ducts (refer to Figure 3.8 on page 52 and "Appendix B – Inter-Module Connections" on page 123). Otherwise the panel may not fit properly, or you may damage the cables.

2. Refit the Front Panel

   a. Fit the front panel onto the locating pegs on the subrack. Fit the left end first, followed by the right end, pressing the panel in the center as shown ① to secure the spring clip behind the control panel.

   b. Secure the fastener at each end ② with a quarter turn clockwise. Align the slot horizontally, then press the fastener in and turn to lock.



3. Before powering up the base station, check that all power, RF and system cables are connected correctly and securely at the rear of the base station.

Important When refitting modules, make sure they are fitted correctly into the subrack and all retaining clamps are securely tightened. The recommended torque for the retaining clamp screws is 17lbf·in (1.9N·m). As well as holding the modules in place, the retaining clamps push the modules hard against the rear rail of the subrack to ensure a good ground connection between the modules and subrack.

8 Technical Description

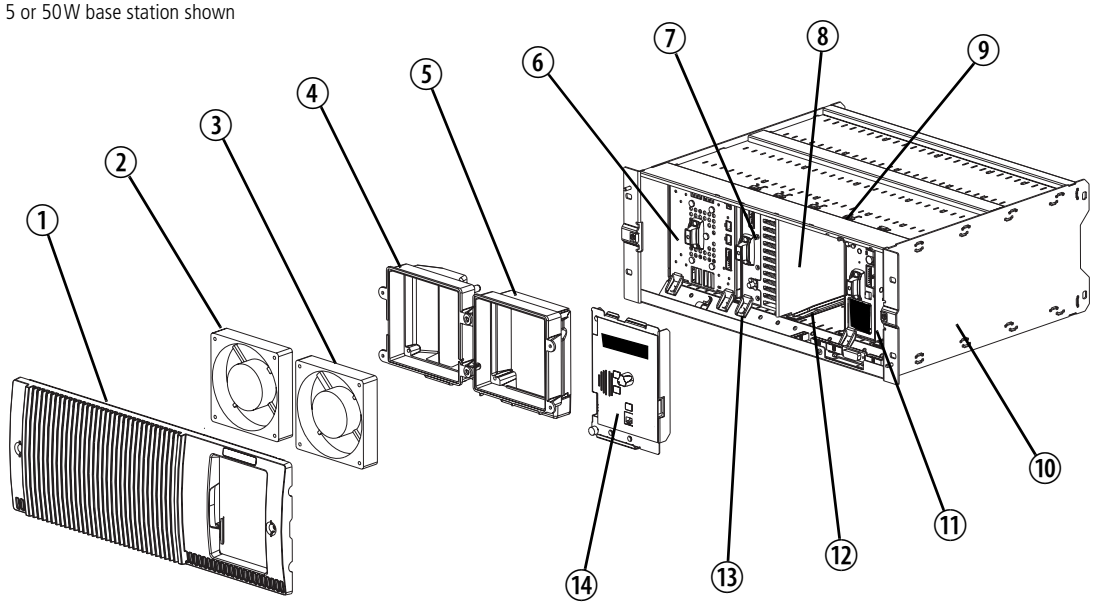
8.1 Mechanical Assembly

This section illustrates the main mechanical components that comprise the TB9100 base station. Figure 8.1 below shows the configuration for a typical 5 W or 50 W base station.

Note Figure 8.1 shows the reciter in position 2 of the subrack only for the clarity of the illustration. Subracks must have a reciter in position 1 for correct operation.

Note Figure 8.1 shows the cooling fans and their ducts detached from the front panel only for the clarity of the illustration. The cooling fans and ducts are normally screwed to the rear of the front panel.

Figure 8.1 Mechanical assembly - front panel, fans and control panel



①	front panel	⑧	airflow separator
②	PMU fan	⑨	cable retaining clip
③	PA fan[a]	⑩	subrack
④	PMU fan duct	⑪	reciter
⑤	PA fan duct[a]	⑫	plastic guide rail
⑥	PMU	⑬	module retaining clamp
⑦	PA[a]	⑭	control panel

a. Not present in a P25 Console Gateway.

The front panel can be easily removed from the subrack by undoing two quick-release fasteners. Once the front panel is removed, the control panel can also be removed from the subrack by undoing a single screw. Refer to "Replacing Modules" on page 77 for more details.

The PMU occupies the slot at the left end of the subrack, with the PA directly beside it. The reciter normally occupies the second slot from the right of the subrack.

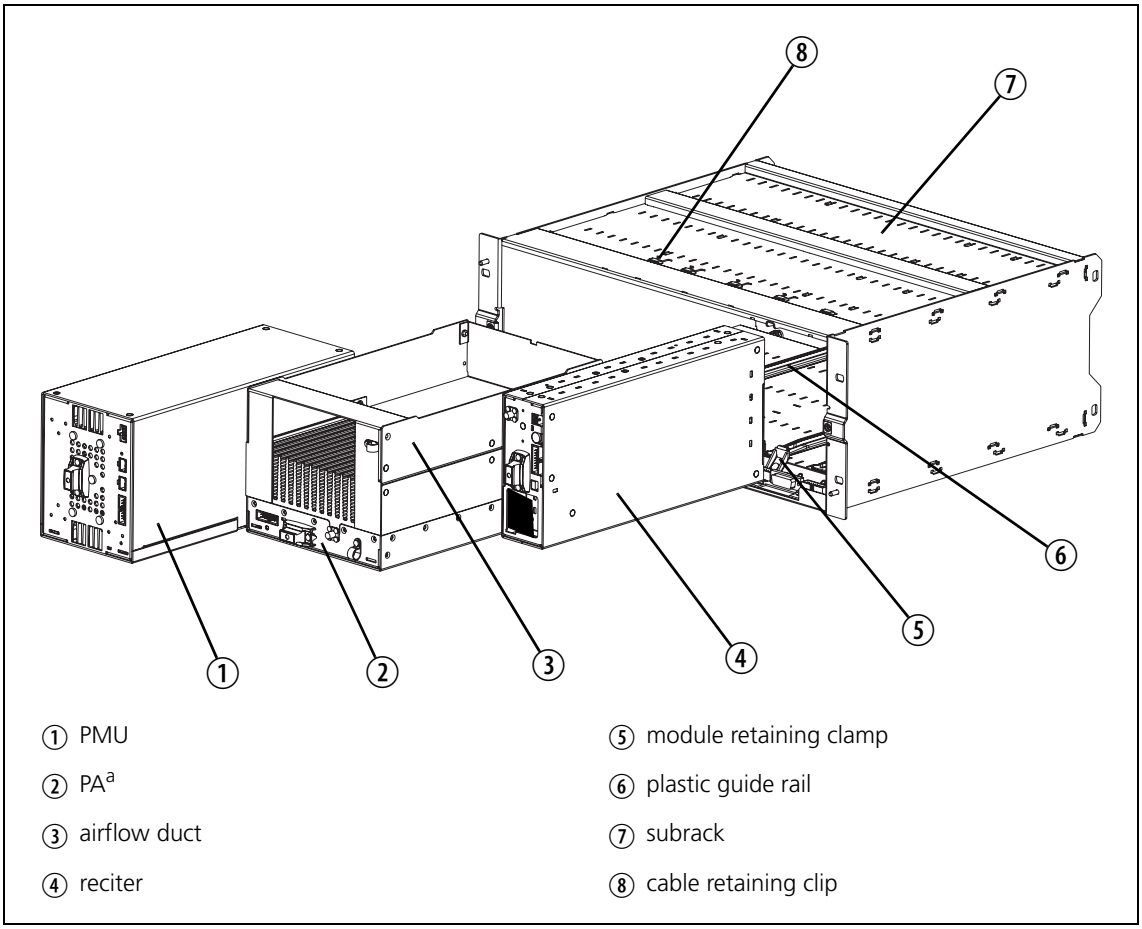
The PA is mounted vertically with the heatsink facing the center of the subrack. This positions the cooling fins directly behind the PA fan. The airflow separator is fitted directly beside the PA to help direct the cooling airflow through the heatsink.

Note The configuration for 12V base stations is the same as shown in Figure 8.1, but the PMU and its cooling fan are not fitted.

Figure 8.2 below shows the configuration for a typical 100 W base station.

Note Figure 8.2 shows the reciter in position 2 of the subrack only for the clarity of the illustration. Subracks must have a reciter in position 1 for correct operation.

Figure 8.2 Mechanical assembly - front of a 100W base station



① PMU
② PA[a]
③ airflow duct
④ reciter
⑤ module retaining clamp
⑥ plastic guide rail
⑦ subrack
⑧ cable retaining clip

a. Not present in a P25 Console gateway.

The PMU occupies its normal slot at the left end of the subrack, with the PA directly beside it. The reciter occupies the slot immediately to the right of the PA. Unlike the 5 W and 50 W PAs, the 100 W PA is mounted horizontally with the heatsink facing upwards. It is also fitted with an airflow duct to channel the airflow from the cooling fan through the heatsink fins.

8.2 Reciter Module Operation

The TB9100 reciter consists of an RF, a digital and a network board. Figure 8.3 on page 104 shows the configuration of the main circuit blocks, and the main inputs and outputs of the reciter.

Receiver RF - VHF Reciter

The incoming RF signal is fed through a low pass filter, then through a band pass "doublet" filter, and finally through a high pass filter. The signal is then amplified and passed through another band pass "doublet" filter before being passed to the mixer, where it is converted down to the 16.9 MHz IF (intermediate frequency). A VCO (voltage controlled oscillator) provides a +17 dBm input to the mixer, and a diplexer terminates the mixer IF port in 50 Ω. The signal from the mixer is fed through a 2-pole crystal filter to the IF amplifier which provides enough gain to drive the digital receiver. Note that there are two 2-pole crystal filters, one for narrow bandwidth and one for wide bandwidth. The appropriate filter is selected by software-controlled PIN switches, according to the bandwidth selected in the CSS. The signal is finally passed to the ADC (analog-to-digital converter) in the digital receiver via an anti-alias filter.

Receiver RF - UHF Reciter

The incoming RF signal is fed through a band-pass filter, followed by a simple low-pass network. It then passes through further stages of filtering, amplification and AGC[1] (automatic gain control) before being fed to the mixer where it is converted down to the 70.1 MHz IF (intermediate frequency). A VCO (voltage controlled oscillator) provides a +17 dBm input to the mixer, and a diplexer terminates the mixer IF port in 50 Ω. The signal from the mixer is fed through a 4-pole crystal filter to the IF amplifier which provides enough gain to drive the digital receiver. The signal is finally passed to the ADC (analog-to-digital converter) in the digital receiver via an anti-alias filter.

Exciter Circuitry

P25 digital or analog FM audio signals from the network, analog line or microphone are fed to the exciter RF circuitry via the digital board DSP (digital signal processor) and CODECs (encoder/decoder). These modulating signals are applied to the exciter at two points (dual point modulation): low frequency modulation is via the FCL (frequency control loop), which modulates the exciter synthesizer's frequency reference, and speech band modulation is supplied directly to the VCO.

1. AGC is available in H-band reciters only. It can be disabled using the CSS.

The VCO is phase-locked to the frequency reference via the synthesizer. The output from the VCO passes through the VCO buffer to the exciter amplifier, which increases the RF signal to +20 dBm. This signal is then attenuated through a pad to +11 dBm. An 8 VDC PA Key signal is mixed in with the RF signal which is then fed to the PA.

Digital Board

The IF from the receiver RF circuitry is passed through an ADC and DDC (digital down-converter) to the digital board DSP. Incoming audio from the network, analog line or microphone is passed to the exciter RF circuitry via the DSP and CODECs.

The main control elements on the digital board are the RISC processor and the DSP. Communication between the two takes place via a host port interface.

The digital board RISC is responsible for the following:

- initializing and supervising the digital board DSP
- controlling the Tx key, Rx gate and PA key
- monitoring the maintainer's access via the control panel microphone.

The digital board DSP operates under the control of the RISC to provide a number of functions, including:

- demodulating incoming FM signal and identifying whether it is P25 digital or analog FM
- modulating an RF signal from a P25 digital or analog FM signal received from the network, analog line or microphone
- implementing the control panel interface: transmitting and receiving speech samples to and from the network board DSP
- generating NAC, CTCSS and DCS
- generating the signal quality information RSSI and SINAD.

Network Board

The network board provides the links between the digital circuitry and the TaitNet digital network. This board is securely mounted to the reciter's chassis and is connected to the digital board by a 40-way flexible connector and a PCB connector. The network board provides the base station with an identity as a network element.

The network board has a DSP and a RISC processor. The RISC provides the main control functions of the board. It communicates with the DSP via a host port interface.

The network DSP provides a number of functions, including:

- performing forward error correction (FEC) encode/decode on P25 signal to/from the RF interface
- encoding P25 digital signals into IMBE speech packets
- encoding analog FM signals into G.711 speech packets

- carrying out the switching to send signals to the RF, analog and control panel interfaces, based on the voting output.

The network RISC is responsible for the following:

- inserting header information into P25 signals originating from the control panel and analog line
- performing the signal voting and switching
- inserting RTP (Real-time Transport Protocol) frame information into IMBE and G.711 speech packets
- transmitting and receiving RTP frames over the IP network.

Power Supply

The reciter operates off a +28 VDC supply. The supply is fed to two separate power supplies, one on the RF board and a second on the digital board. The power supply on the RF board also powers some of the circuitry on the network board.

The power supply on the RF board provides 5.3 V and 8.5 V regulated supplies. This 5.3 V supply is boosted to 23 V and also provides a 3.3 V regulated supply. The power supply on the digital board provides 3.3 V and 5.3 V regulated supplies. It is also fed through to provide a 2.5 V supply.

The network board requires the internal supply voltages of +6 V, +3.3 V, +1.8 V and +1.6 V. These are all derived from the main +28 V supply rail:

- the +3.3 V and +1.8 V supplies are acquired from the +28 V supply using a dual-phase switching converter
- the +1.6 V supply is acquired from the +3.3 V supply using an adjustable output switching regulator
- the +6 V low current auxiliary supply is acquired from the +28 V supply using a linear regulator.

Reciter Fan Operation

The reciter fan has a temperature sensor that reads the temperature on the component side of the digital board.

The reciter fan will operate briefly at start up, after the PMU and PA fans. This provides a simple diagnostic capability, and the ability to raise or clear faults.

No configuration is necessary for the reciter fan, it has fixed on/off thresholds:

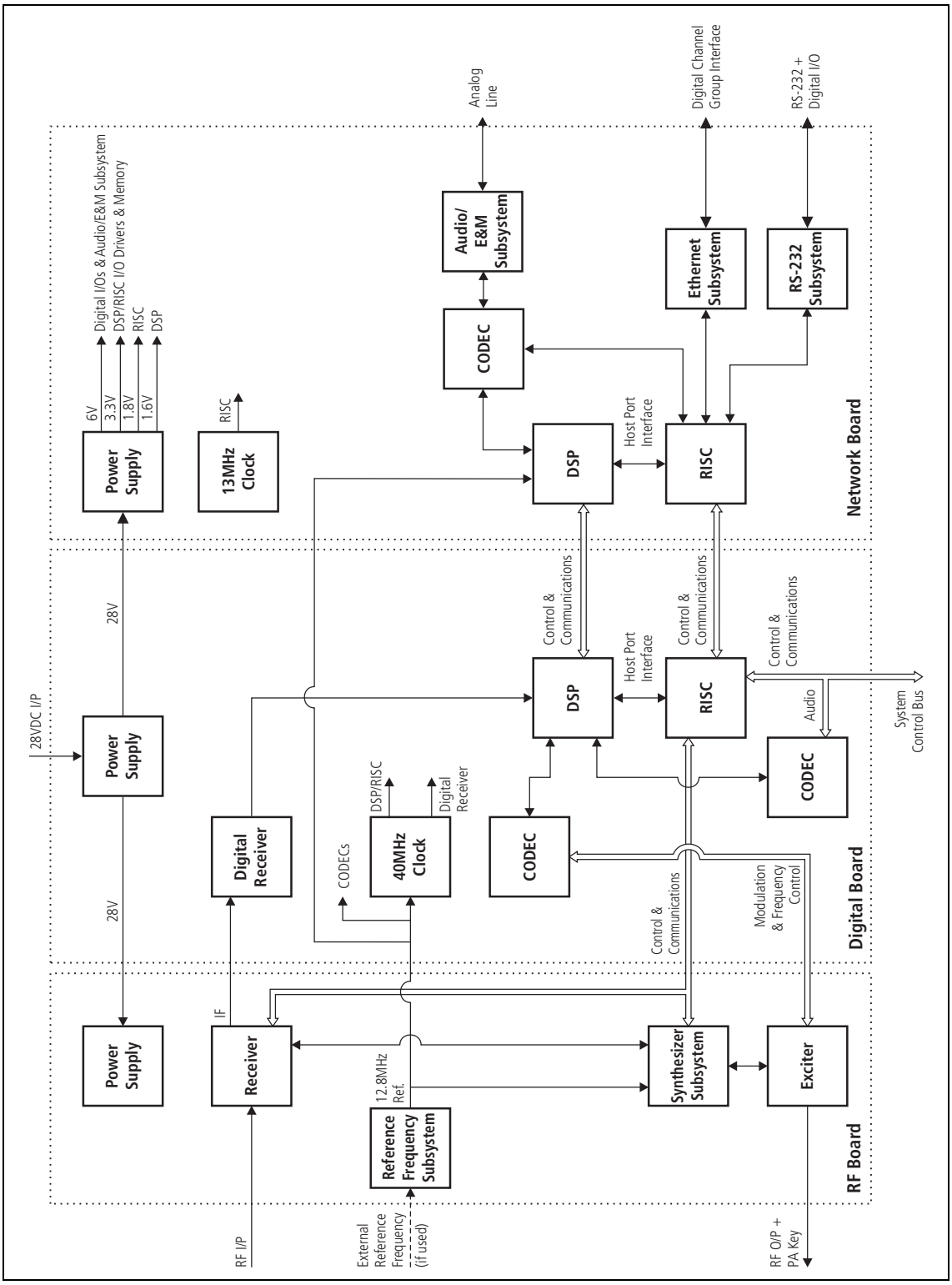
- Fan on threshold: 57°C
- Fan off threshold: 46°C

A 'fan failed' alarm is raised when the reciter reaches a temperature of 72.5°C.

For monitoring purposes, the following information is displayed on the CSS Monitor Reciter screen:

- Reciter temperature
- Fan on/off state
- Fan rotation state (the fan must have a 3-wire connection to detect rotation, as well as power and ground)

Figure 8.3 Reciter high-level diagram



8.3 PA Module Operation

The TB9100 PA is a modular design with the circuitry divided among separate boards which are assembled in different configurations in different models. Interconnect boards are used in certain models to connect boards that are physically separated on the heatsink. The 5, 50 and 100 W PAs are available for operation on 28 VDC, while the 5 and 50 W PAs are also available for operation on 12 VDC.

Figure 8.4 on page 107 shows the configurations of a 100W 28V PA and a 50W 12V PA, along with the main inputs and outputs for power, RF and control signals.

PAs can only be installed in position 3 or position 5 of the subrack. Refer to "Configuring the Subrack Interconnect Board" on page 94 for more information.

RF Circuitry

The RF output from the reciter is fed first to the 6 W driver board. In the 100 W model the output from the 6 W driver board is fed into a −3 dB hybrid coupler on a separate splitter board and then to two 60 W final boards in quadrature. The outputs from these two boards are then combined by another −3 dB hybrid coupler on a separate combiner board before being fed to the low-pass filter (LPF)/directional coupler board.

In the 50 W model, the output from the 6 W driver board is fed to one 60 W final board and then to the LPF/directional coupler board. In the 5 W model, the output from the 6 W driver board is fed directly to the LPF/directional coupler board.

Control Circuitry

The microprocessor located on the control board monitors and controls the operation of the PA. There are no manual adjustments in the PA because all the calibration voltages and currents required to control and protect the PA are monitored by the microprocessor. The software also automatically detects the PA configuration and controls the PA accordingly.

If any of the monitored conditions exceeds its normal range of values, the microprocessor will generate an alarm and reduce the output power to a preset level (foldback). If the measured values do not return within the normal range after foldback, the PA will be shut down.

The alarms and diagnostic functions are accessed through I^2C bus messages on the system control bus via the reciter, control panel and CSS. Some measurements are logged by the microprocessor and this information can also be accessed through the system control bus.

The operation of the cooling fan mounted on the front panel is determined by the temperature limits set in the PA software.

Power Supply

The 100 W PA operates off a 28 VDC external power supply only, while the 5 and 50 W PAs can operate off a 28 VDC or 12 VDC external power supply,

depending on the model. The 12V PAs are fitted with an internal boost regulator board (refer to "Boost Regulator" below).

The PA also has four internal power supplies located on the control board which produce –3, +2.5, +5 and +10VDC.

Boost Regulator

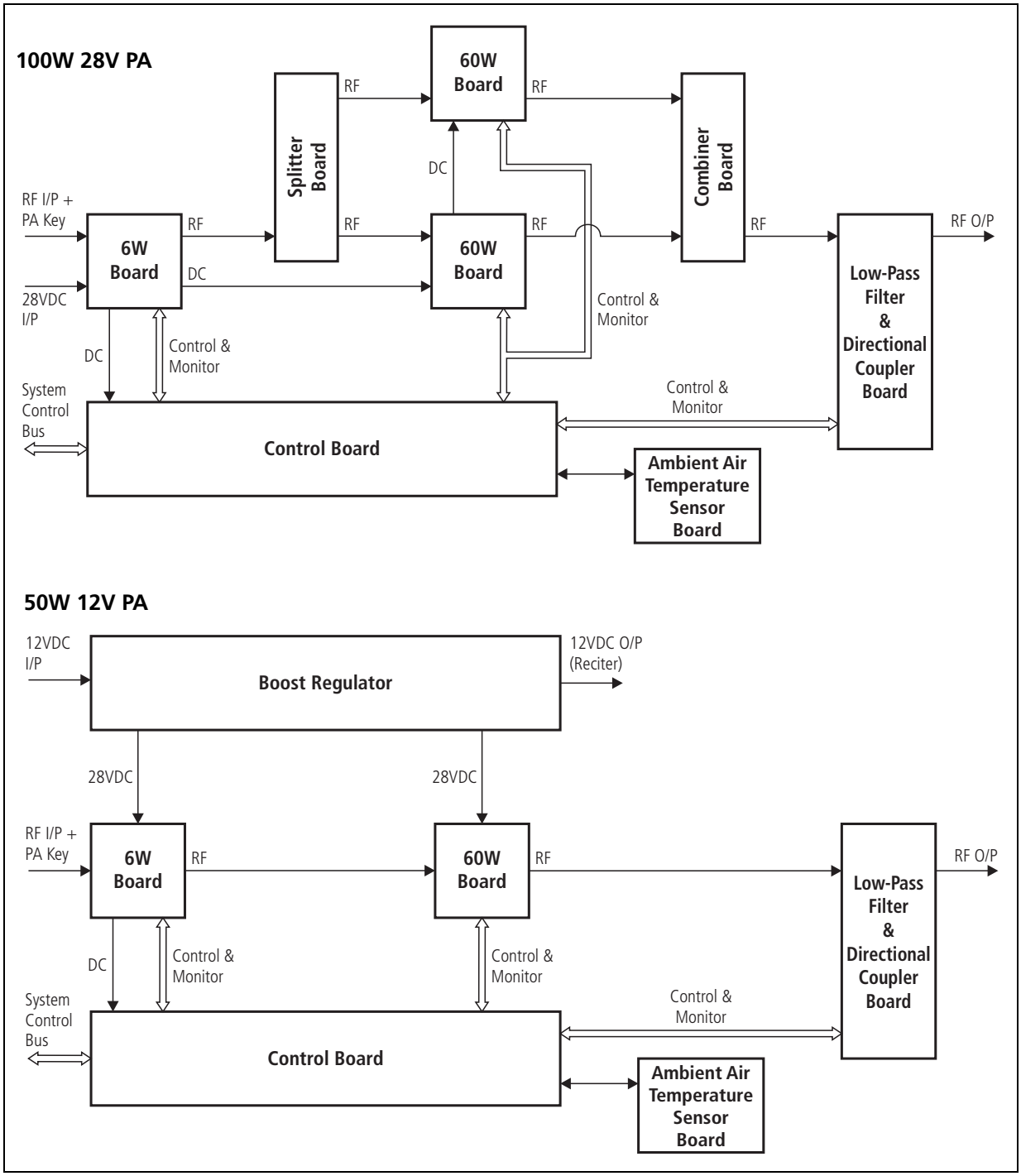
5 and 50W 12V PAs are fitted with a boost regulator board. Figure 8.4 on page 107 shows the configuration for a 50W 12V PA, along with the main inputs and outputs for power, RF and control signals. Note that the 60W board is only fitted to the 50W PA.

The boost regulator board accepts an input of 12VDC nominal. The input is firstly fed through the DC input filter, and then through an output filter and switch which is controlled by a battery control circuit. This output is fed to the reciter, which operates from 12VDC instead of the standard 28VDC provided when a PMU is used. The output from the DC input filter is also fed to the power stage where the voltage is boosted to 28VDC, and is then fed through an output filter to provide the 28VDC output for the PA circuit boards.

The battery control circuitry monitors the DC input voltage from the battery. Protection is provided against the wrong input voltage being supplied. Reverse polarity protection is provided by a diode between positive and ground, and requires a user-provided fuse or circuit breaker in series with the DC input line. The fuse or circuit breaker should be rated at 15A to 18A at 30VDC.

The minimum turn-on voltage is 12VDC. Once started, the boost regulator will operate down to 10.5VDC $\pm$0.25V before it shuts down to prevent deep discharge of the battery. The startup voltage and operating voltage range are fixed in hardware and are not user-adjustable.

Figure 8.4 PA high-level block diagrams



8.4 PMU Module Operation

The PMU is available in three main configurations:

- AC PMU (AC input only)
- DC PMU (DC input only)
- AC and DC PMU (both AC and DC converters are fitted to allow both AC and DC inputs).

PMUs can only be installed in position 6 of the subrack. Refer to "Configuring the Subrack Interconnect Board" on page 94 for more information.

Figure 8.5 shows the configurations for an AC and DC PMU, along with the main inputs and outputs for power and control signals.

AC Module

The AC module accepts an input of 115/230 VAC 50/60 Hz nominal. The input is fed via the PFC (power factor control) input stage to the HVDC (high voltage DC) stage on the AC converter board. The HVDC circuitry generates the final 28 VDC outputs and provides galvanic isolation between the mains input and DC output. The output stage on the AC converter board provides a common output filter and current monitoring circuit which is used by both AC and DC modules.

Each power stage is controlled by its own plug-in control card. The microprocessor is also located on the HVDC control card. The microprocessor is used by both the AC and DC modules and is fitted to all PMU models.

The leaded high-power components are situated on the AC converter board, while the plug-in cards have only SMD control components.

DC Module

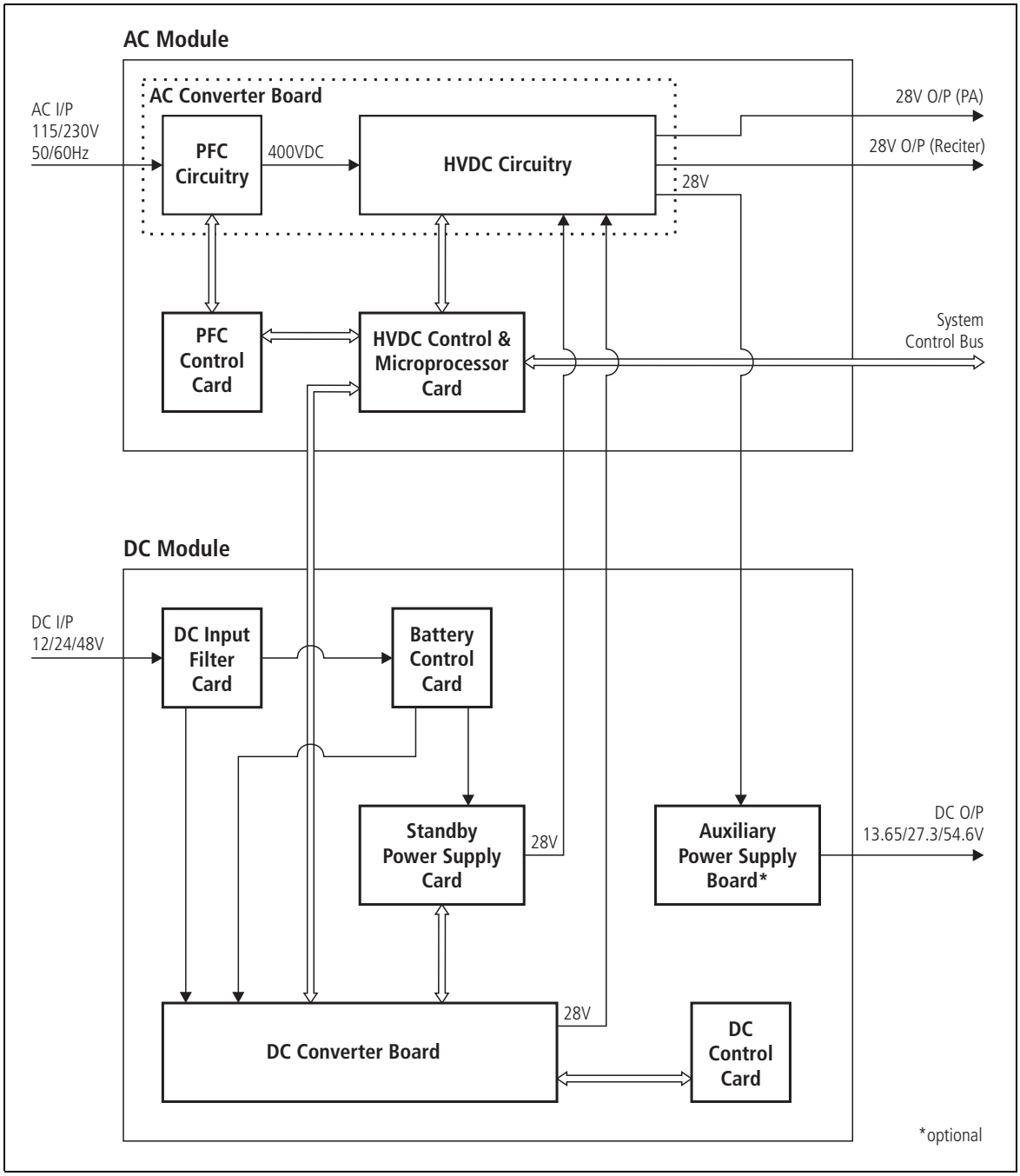
The DC module accepts an input of 12, 24 or 48 VDC nominal. The input is fed through the DC input filter to the input of the power stage on the DC converter board. This circuitry provides PWM (pulse width modulation) conversion to produce the final DC output. It also provides galvanic isolation, allowing the DC input to be positive or negative ground. The final DC output is fed back to the output stage on the AC convertor board.

The battery control card monitors the DC input voltage and prevents the PMU from starting if an incorrect input voltage is applied. It also operates as a fail-safe to prevent deep discharge of the battery, and provides information to the microprocessor to allow the CSS to display information about the battery.

The DC control card controls the power stage of the DC converter. It also provides protection from overload and short circuit conditions.

The leaded high-power components are situated on the DC converter board, while the plug-in cards have only SMD control components.

Figure 8.5 PMU high-level diagram



Standby Power Supply

The standby power supply card plugs into the DC converter board and provides power to the reciter output. This allows the main DC unit to be switched off to reduce current consumption in low-power situations, e.g. when the PA is not transmitting.

Also, when battery capacity is low, it will maintain the power supply to the microprocessor and shut down the rest of the PMU. Refer to "Power Management" on page 24 for further details.

Auxiliary Power Supply

This optional power supply board is mounted on the DC module. The input power is provided from the high current 28 VDC output from the AC converter or DC converter (depending on which is operating. It provides a regulated 13.65 VDC, 27.3 VDC or 54.6 VDC output (depending on the model) of up to 40 W to power external accessory equipment. Alternatively, it can be used as a trickle charger to maintain the charge in already charged batteries. It can be configured using the CSS to operate whenever AC mains voltage is available, or under Task Manager control.

Note While the auxiliary power output can be used for more than one purpose at once, this is generally not recommended. It can result in a short-circuit and equipment damage. The output is floating. If it is connected to a negatively earthed battery and to positively earthed auxiliary equipment, it will short-circuit.

Microprocessor

The microprocessor on the HVDC control card monitors and controls the operation of the PMU. There are no manual adjustments in the PMU because all the calibration voltages and currents required to control and protect the PMU are monitored by the microprocessor. The software also automatically detects the PMU configuration and controls the PMU accordingly.

If any of the monitored conditions exceeds its normal range of values, the microprocessor will generate an alarm and take appropriate action, depending on the configuration of the PMU.

The alarms and diagnostic functions are accessed through I^2C bus messages on the system control bus via the reciter, control panel and CSS.

The operation of the cooling fan mounted on the front panel is determined by the temperature limits set in the PMU software.

Important In base station systems that use a PMU, the PMU must be connected to the system control bus at all times. The I^2C current source is located in the PMU, and if the PMU is disconnected, the state of much of the bus will be undefined. This may cause corrupted data to be present on the bus when the reciter reads the states of the switches on the control panel. This in turn may result in random actuations of microphone PTT, and carrier or speaker key, causing the base station to transmit, or the speaker to be actuated, incorrectly.

Indicator LEDs

The indicator LEDs on the front panel are used to indicate the state of the PMU and its microprocessor. There are two LEDs, one red and one green. Each LED can be on, off, or flashing at two rates (fast or slow). The state of these LEDs can indicate a number of operating modes or fault conditions, as described in Table 8.1 on page 111.

Table 8.1 PMU indicator LED states

Green	Red	PMU condition
off	off	power off (input above or below safe operating range)
flashing (3 Hz)	off	no application firmware loaded; use the CSS to download the firmware
on	off	the microprocessor is operating; no alarm detected
on	flashing (3 Hz)	one or more alarm conditions indicated: ■ output is overvoltage ■ output is undervoltage ■ output is current-limiting ■ overtemperature ■ mains failure ■ battery voltage is low ■ battery voltage is high ■ shutdown is imminent ■ DC converter is faulty ■ battery is faulty, or DC converter is switched off ■ auxiliary power supply is faulty ■ PMU is not calibrated ■ self-test has failed ■ PMU is not configured
flashing (on 300ms, off 2700ms)	flashing (on 300ms, off 2700ms)	PMU is in battery protection mode
flashing (on 300ms, off 4700ms)	flashing (on 300ms, off 4700ms)	PMU is in Deep Sleep mode
flashing (3 Hz)	flashing (3 Hz)	CSS LED test - LEDs flash alternately

PMU Operation on DC Input

The operation of the PMU on DC input is controlled by three sets of parameters:

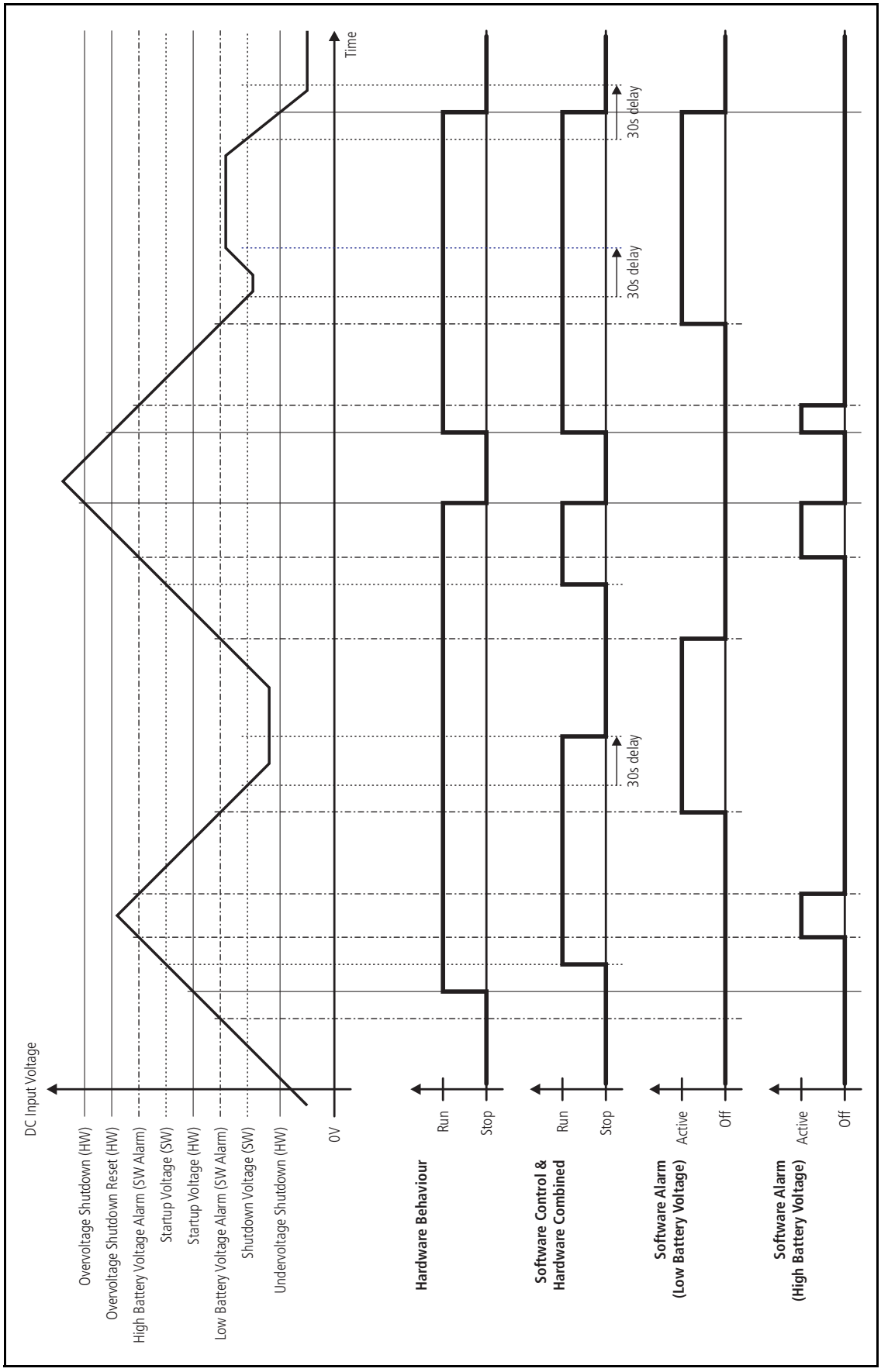
- user-programmable alarms
- user-programmable startup and shutdown limits
- battery protection limits

The voltage range for each of these parameters is provided in Table 8.2 on page 113. Figure 8.6 on page 112 illustrates how these parameters interact, and how they control the operation of the PMU over a range of DC input voltages.

Alarms

User-programmable alarms can be set for low or high battery voltage. The alarms will be triggered when the set voltage levels are reached.

Figure 8.6 PMU alarm thresholds and voltage limits when operating on DC



Startup and Shutdown Limits

The user-programmable startup and shutdown limits allow for adjustable startup and shutdown voltages. These limits can be adjusted for different numbers of battery cells, or for the particular requirements of the base station operation. Once the limits are reached, the PMU will shut down.

Battery Protection Limits

The battery protection limits are set in hardware at the factory, and cannot be adjusted by the user. These limits will not be reached under normal operation conditions, but are provided as "fail-safe" measures to protect the battery from deep discharge. They also remove the need for low-voltage disconnect modules.

Table 8.2 PMU DC voltage limits[a]

Parameter	Voltage Range		
	12V PMU	**24V PMU**	**48V PMU**
User-programmable Alarms[b]			
Low Battery Voltage	10V to 14V	20V to 28V	40V to 56V
High Battery Voltage	14V to 17.5V	28V to 35V	56V to 70V
User-programmable Limits[bc]			
Startup Voltage (after shutdown)	12V to 15V	23.9V to 30V	47.8V to 60V
Shutdown Voltage	10V to 13.5V	20V to 27V	40V to 54V
Battery Protection (Fail-safe) Limits			
Startup Voltage	12.0V ±0.3V	24.0V ±0.5V	48V ±1V
Undervoltage Shutdown	9.5V ±0.3V	19V ±0.5V	38V ±1V
Overvoltage Shutdown	18.1V ±0.3V	36.2V ±0.5V	72.4V ±1V
Overvoltage Shutdown Reset	17.1V ±0.3V	34.2V ±0.5V	68.4V ±1V

a. The information in this table is extracted from the TB9100 Specifications Manual. Refer to the latest issue of this manual (MBA-00014-xx) for the most up-to-date and complete PMU specifications.

b. Using the CSS

c. Only available if the standby power supply card is fitted.

8.5 Control Panel

The control panel is designed to be the link between the user and the modules in the subrack. The circuitry for the operation of the control panel is located on a board mounted behind its front face. All communication between the modules and the control panel is via the system control bus.

The control panel allows you to select which reciter is connected to the control panel. This reciter will then drive the status LEDs, and respond to inputs from the controls on the control panel.

Note When a reciter is not fitted and that subrack position is selected, the status LEDs will reflect the status of the channel which was selected before the change was made. This is because there is no reciter present in the newly selected position to update or clear the status of the LEDs.

The channel LEDs use different colors to indicate the currently selected reciter. They also provide real-time status information for any reciter installed in the subrack. Any reciter can update (in real time) the channel LEDs to display one of two possible reciter status signals:

- Rx gate
- alarm

Links on the multi-reciter subrack interconnect board allow you to choose which status signal (either Rx gate or alarm) is connected to the channel LEDs. Links on the control panel board also allow you to select which color (either red or green) will be used for the selected status signal. The other color will then be used to indicate the currently selected reciter. The default colors for TB9100 are:

- green for Rx gate
- red for alarm

If the LED for the currently selected reciter receives a status signal, it will change to orange. Refer to "Configuring the Control Panel Board" on page 81 and "Configuring the Subrack Interconnect Board" on page 94 for more information.

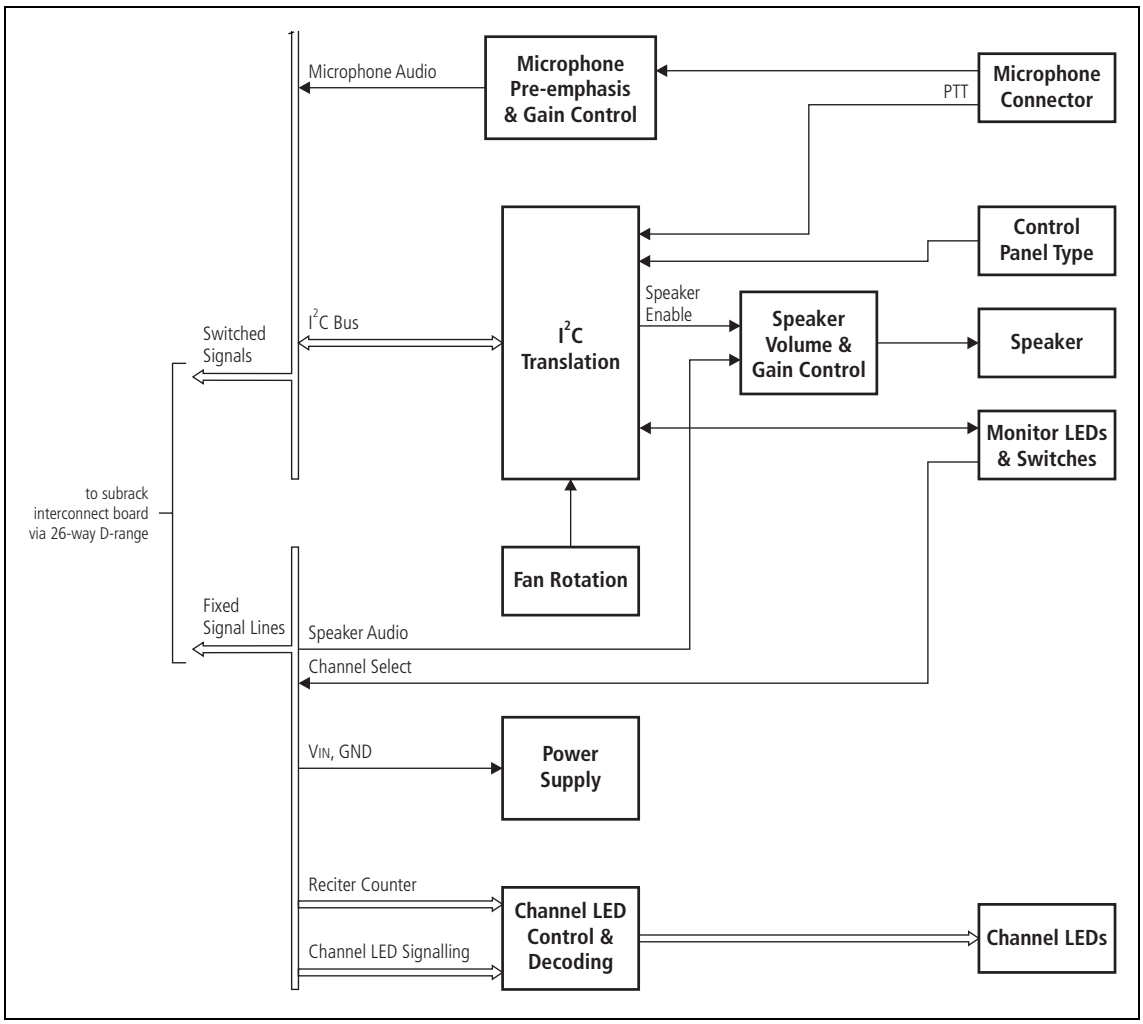
Control Circuitry

The control panel board translates:

- I^2C messages from the reciter into an appropriate response on the LEDs
- control panel button inputs (except the channel button) and fan rotation inputs from both fans into appropriate I^2C messages.

Figure 8.7 shows the configuration of the main circuit blocks, and the main inputs and outputs for power, audio and control signals.

Figure 8.7 Control panel high-level diagram



Audio Circuitry

The volume of the speaker is controlled by the volume control knob. In addition, the control panel performs gain control so that, with an input of 167 mV pp, the power output into a 16 Ω speaker is ≥0.5 W at the maximum position of the knob, and 0 W at the minimum position of the knob. Speaker audio is from the currently selected reciter only. An LED indicates when the speaker is on.

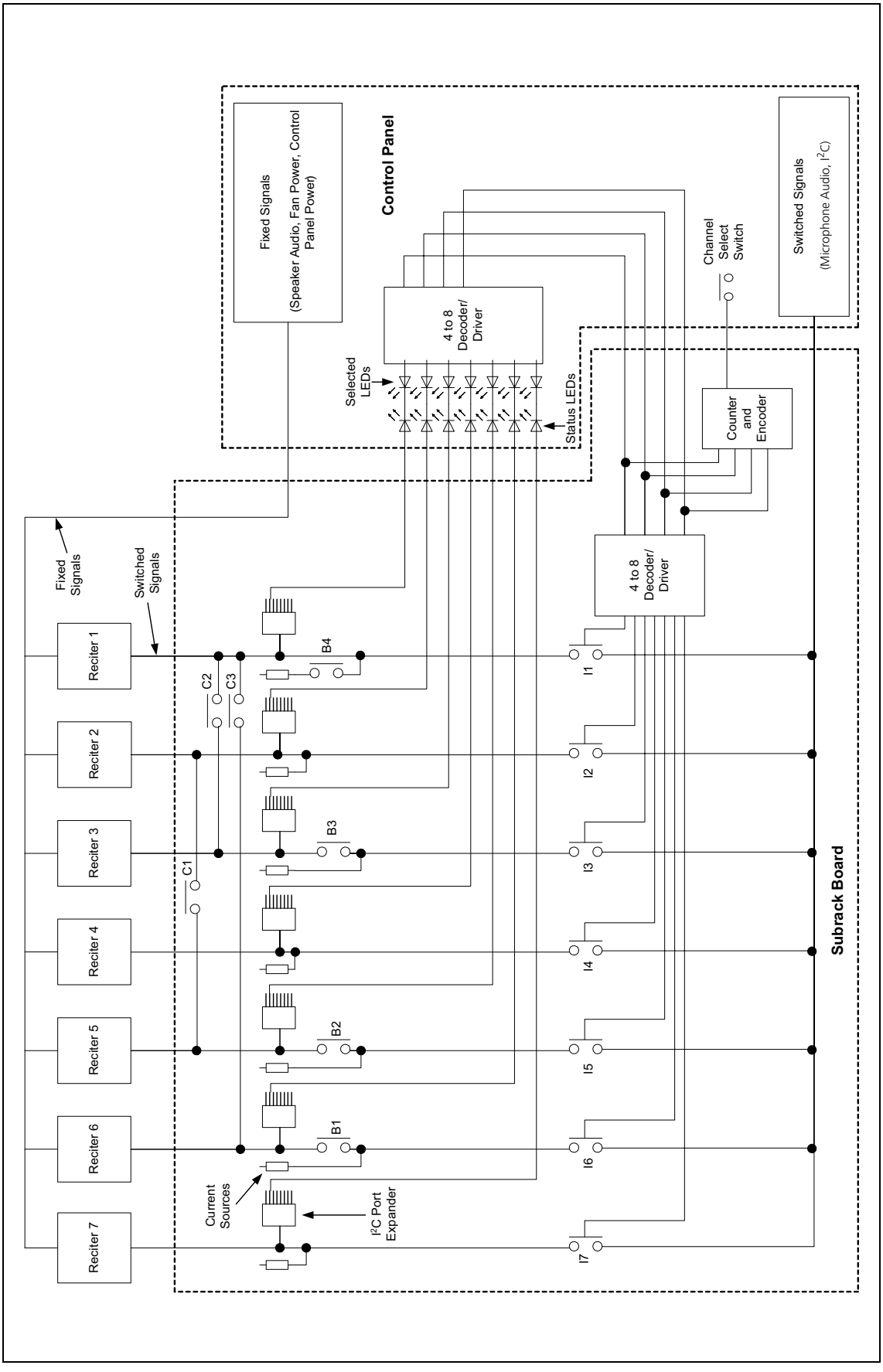
The control panel is designed to work with an electret microphone with an input range of 80 dB SPL to 115 dB SPL.

Signal Switching

Speaker audio and power for the control panel are common signals for all reciters in the subrack. The remaining signals (microphone audio, I2C messages, and fan power) are switched so that only one reciter is connected to the control panel at a time. This switching takes place on the subrack interconnect board and is controlled by the channel button on the control panel.

Figure 8.8 shows signal paths and switching operations performed between the control panel and subrack interconnect board.

Figure 8.8 Multi-reciter functional block diagram



Power Supply

The control panel is powered from the subrack interconnect board. 28 VDC is supplied to the subrack board from the PMU (if fitted). If no PMU is fitted, 10.5 VDC to 32 VDC is supplied to the subrack board from the DC input connector at the rear of the subrack. The power supply for the cooling fans mounted on the front panel is fed through the control board. When power is applied to the subrack, the control panel will default to reciter position 1.

8.6 System Control Bus

The system control bus provides the following physical paths:

- I^2C communications between modules
- RS-232 communications between the reciter and Calibration Software
- fan power from the PA and PMU
- speaker and microphone signals to and from the control panel
- power connections for the control panel.

The system control bus has been designed so that, if a major fault occurs on the bus, the basic operation of the base station is unaffected, but some features will not operate correctly. For example, if the PA is disconnected from the bus:

- the 'PA not detected' alarm is generated in the reciter; however, transmission still takes place because the transmit RF and key signals are transmitted from the reciter to the PA via the interconnecting coaxial cable
- the PA is unable to turn on its fan. Depending on the ambient temperature at the site and the transmit duty cycle, this could allow the PA to heat up to the point where it reaches the upper temperature threshold. At this point it will begin power foldback, protecting the equipment from damage.

The PMU behaves in a similar way to the PA.

The system control bus has been designed to operate only within the TB9100 subrack. It has not been designed for use outside the subrack or to interconnect two subracks.

I^2C Signals

The TB9100 base station uses the I^2C bus and a proprietary software protocol to provide communications between any modules connected to the bus. Typically this involves the reciter assuming 'server' status, and PA and PMU 'client' status. The reciter co-ordinates the entire subrack operation, reading from and writing to all modules, including the control panel. The I^2C bus allows the reciter to perform the following functions:

- monitoring (e.g. operating status, module details, operating temperatures etc.)
- diagnostics (execution of tests to confirm correct operation)

- firmware upgrades
- configuration (of operational parameters).

The I^2C current source is located in the PMU so that the TB9100 base station can operate with the control panel removed. However, the PMU must be powered up to enable the I^2C communications to operate. Base stations which use the 12V PA do not require a PMU, and in this case the I^2C current source is located on the base station subrack interconnect board.

RS-232 Signals

Calibration Software serial communications occur directly between the connected computer (or modem) and the reciter over the RS-232 serial lines. When the connected computer needs to communicate with the PA, PMU or control panel, the reciter routes the RS-232 data stream to the I^2C bus. Only reciters use the RS-232 interface.

Because RS-232 is a peer-to-peer physical interface, the control panel converts RS-232 to open collector logic. Open collector logic allows the control panel to communicate with the reciter. This same logic level conversion is also performed in the Calibration Test Unit when the control bus interface is connected directly to the reciter.

Fan Signals

The power and ground signals for the PA and PMU fans are routed from the modules to the front panel (via the control panel) along the system control bus. These signals are electrically isolated from all other system signals to ensure fan noise is not transferred to other sensitive system components.

Although the PA and PMU modules provide the power and ground for their respective fans, the fan rotation detection is performed in the control panel. The result is then read and processed by the reciter via the I^2C interface. The PA and PMU do not know if their fan has been correctly enabled, however, if there is a fault in the fan circuitry, each module is protected from overheating by its internal foldback circuitry.

Speaker Signal

Received audio can be sent from the reciter to the control panel. This function is controlled by the speaker button on the control panel. The audio signal is then amplified and passed to the control panel speaker for monitoring purposes. The audio output impedance of the reciter is fixed at approximately 2k Ω.

Microphone Signal

When you press the microphone PTT button, the reciter enables the transmitter and connects the audio signal from the microphone input to the modulator. The microphone PTT signal is read via the control panel using the I^2C bus and this then enables the transmitter. Note that the PTT response times are slower than the response times for the Channel Seize input from the analog interface.

Power and Ground

The PMU provides power to the control panel via the reciter. The reciter has a series diode to 'diode OR' the power to the control panel, but not to backpower a reciter that does not have a power cable connected.

Pin Allocations

The subrack interconnect board at the front of the TB9100 subrack provides a parallel interconnection between all connectors on the board.

The following table gives the pin allocations for the IDC connectors to the reciter, PA and PMU, and for the D-range connector to the control panel.

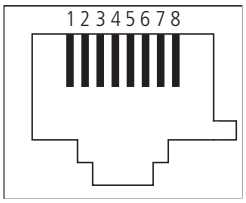
Signal	Reciter, PA & PMU IDC Pin	Control Panel D-range Pin
I^2C interrupt (not used)	1	8
I^2C data	2	15
ground (I^2C)	3	no connection
I^2C clock	4	7
+28V (control panel power)	5	14
RS-232 Tx data	6	6
ground (control panel power)	7	13
RS-232 Rx data	8	5
ground (analog)	9	12
control panel speaker	10	4
control panel microphone	11	11
PSU back-up (not used)	12	3
+24V switched (PA fan)	13	2
ground (PA fan)	14	10
+24V switched (PMU fan)	15	9
ground (PMU fan)	16	1

Appendix A – Interface Pin Assignments

D-range Connector

For the pin allocations for the D-range connector, see "Connecting General Purpose Inputs and Outputs" on page 59.

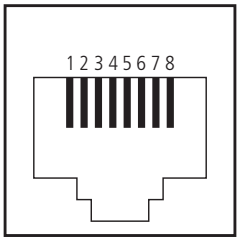
Analog Interface Connection



front view

Pin	Description
1	E & M signaling input
2	E & M signaling input
3	audio output
4	audio output
5	audio input
6	audio input
7	E & M signaling output
8	E & M signaling output

Digital Interface Connection

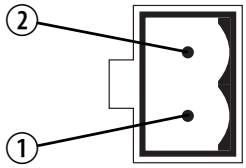


front view

Pin	Description
1	transmit output
2	transmit output
3	receive input
4	not connected
5	not connected
6	receive input
7	not connected
8	not connected

PMU Auxiliary DC Output

The pin allocations for the auxiliary DC output on the PMU are given in the following table.

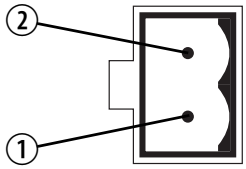


2-pin connector - rear view

Pin	Description
1	+V output
2	ground

DC Input to 12V PA

The pin allocations for the 2-way DC input connector are shown below.

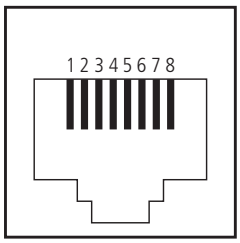


2-pin connector - rear view

Pin	Description
1	+V output
2	ground

Microphone Connection

The pin allocations for the microphone socket are given in the following table.



front view

Pin	Description
1	not connected
2	not connected
3	not connected
4	PTT
5	voice band (microphone) input
6	microphone ground
7	not connected
8	not connected

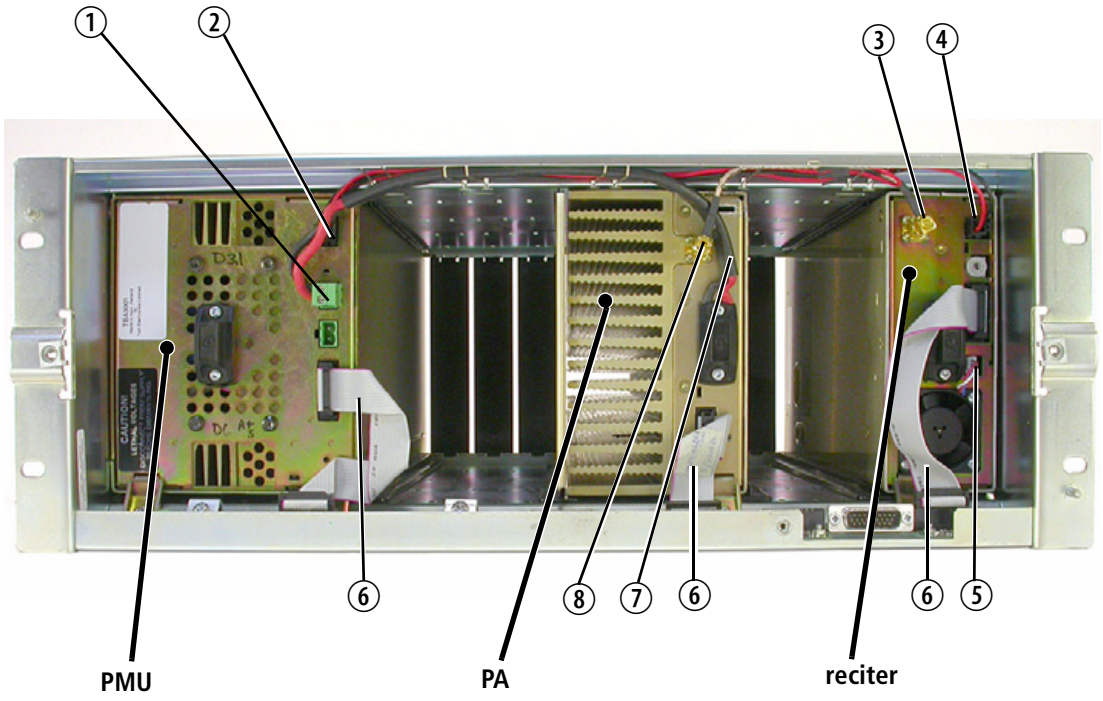
Appendix B – Inter-Module Connections

Note In the following sample photographs, note that the system control bus cables for the reciters are carefully bent around the reciter fans, to ensure an adequate air supply.

5 or 50W Base Station

The connections between modules at the front of a 5 or 50W base station are shown below.

5 or 50W base station internal connections

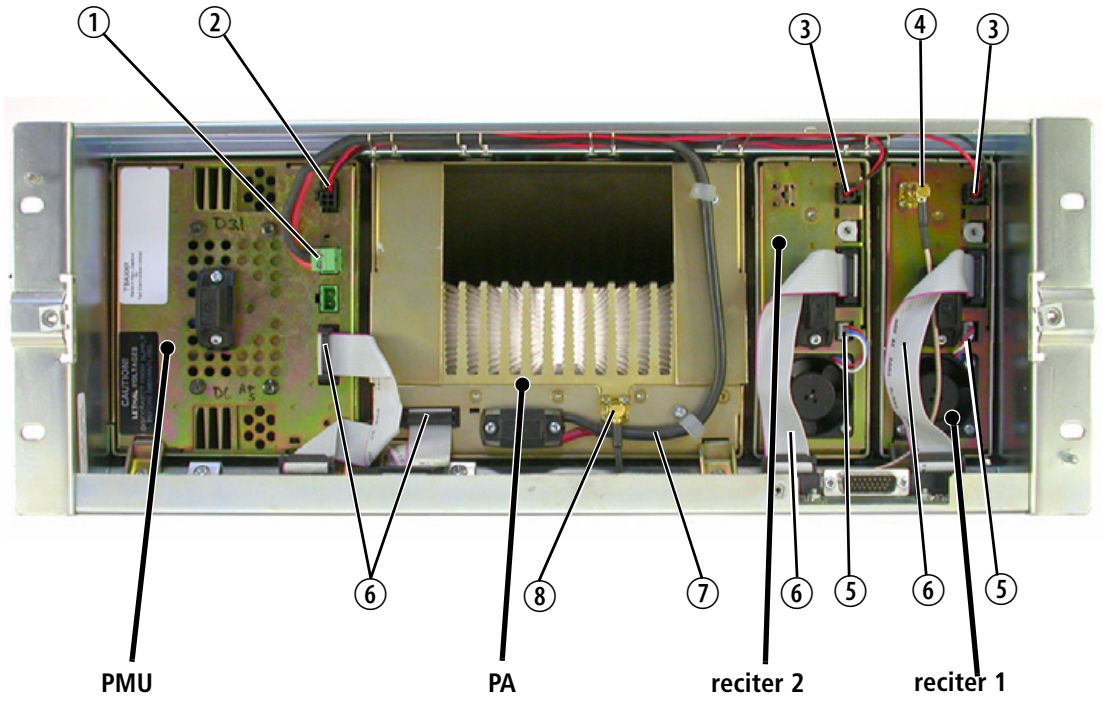


1. 28VDC high current output for PA
2. 28VDC low current output for reciter (obscured)
3. RF output to PA
4. 28VDC low current input from PMU
5. DC output for reciter fan
6. system control bus
7. 28VDC high current input cable from PMU
8. RF input from reciter

100W Base Station

The connections between modules at the front of a 100W base station are shown below.

100W base station internal connections



① 28VDC high current output for PA
② 28VDC low current output for reciter
③ 28VDC low current input from PMU
④ RF output to PA
⑤ DC output for reciter fan
⑥ system control bus
⑦ 28VDC high current input cable from PMU
⑧ RF input from reciter

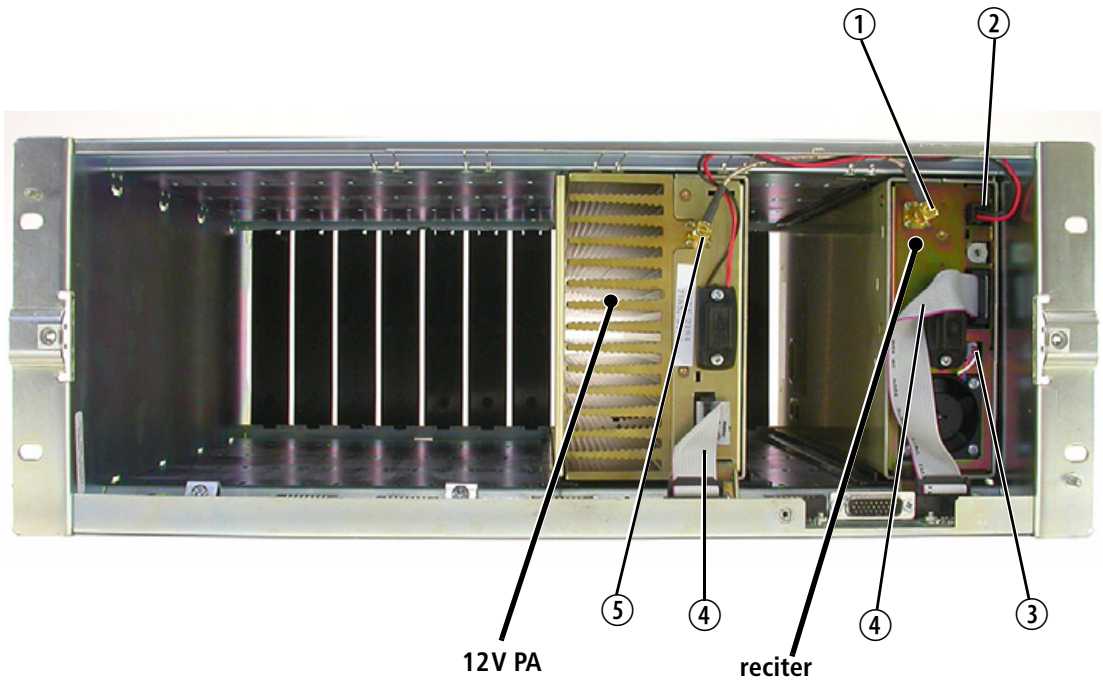
Important The PMU must be connected to the system control bus at all times. The terminating circuitry for the bus is located in the PMU, and if the PMU is disconnected, the state of much of the bus will be undefined. This may cause corrupted data to be present on the bus when the reciter reads the states of the switches on the control panel. This in turn may result in random actuations of microphone PTT, carrier, or speaker key, causing the base station to transmit or the speaker to be actuated incorrectly.

Note The above illustration is an example of a 100W base station with two reciters. However, the second reciter is not a requirement of a typical 100W base station.

12V PA Base Station

The connections between modules at the front of a 12V PA base station are shown below.

12V PA base station internal connections



① RF output to PA

② 12VDC input from PA

③ DC output for reciter fan

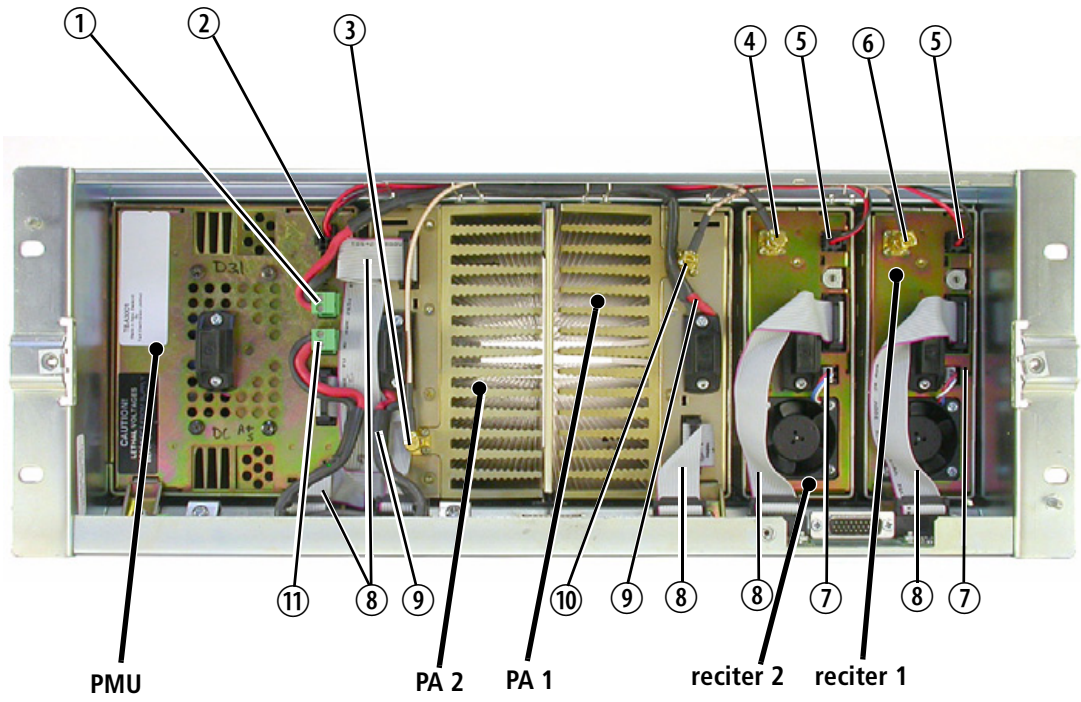
④ system control bus

⑤ RF input from reciter

Dual Channel 5 or 50W Base Station

The connections between modules at the front of a 5 or 50W base station with two channels are shown below.

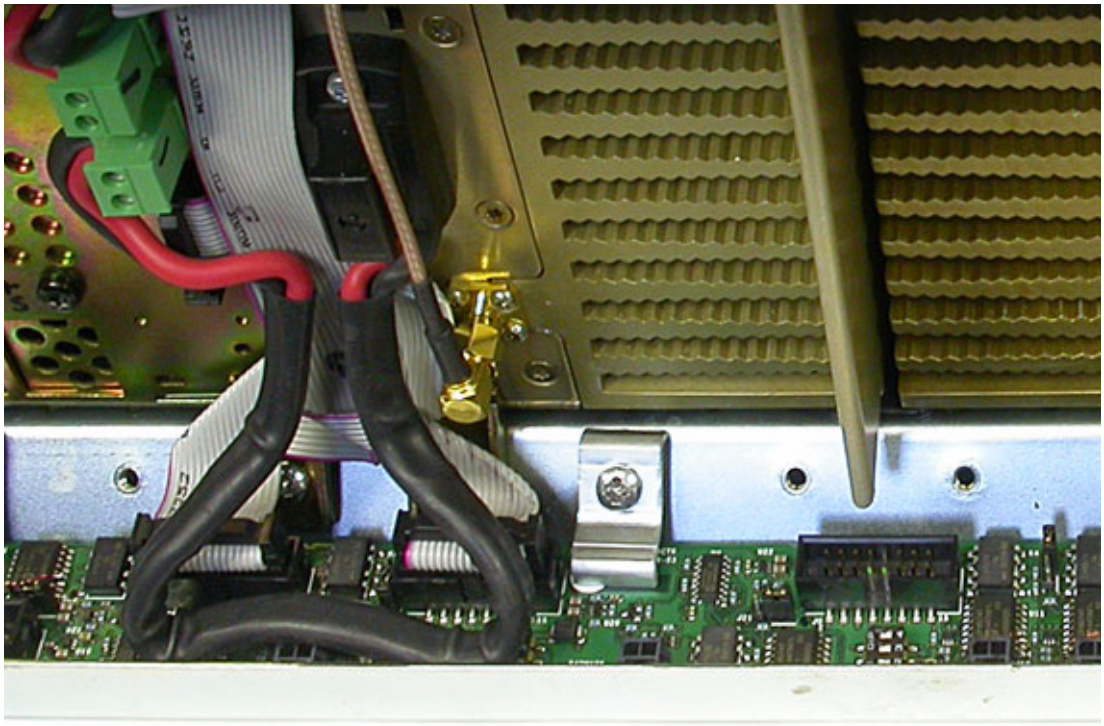
5 or 50W base station internal connections



① 28VDC high current output for PA 1
② 28VDC low current output for reciters (obscured)
③ RF input from reciter 2
④ RF output to PA 2
⑤ 28VDC low current input from PMU
⑥ RF output to PA 1
⑦ DC output for reciter fan
⑧ system control bus
⑨ 28VDC high current input cable from PMU
⑩ RF input from reciter 1
⑪ 28VDC high current output for PA 2

Special care should be taken when connecting the power cable from the PMU to PA 2. The cable should be shaped in such a way that it does not come into contact with the subrack interconnect board. Refer to the diagram below for more detail.

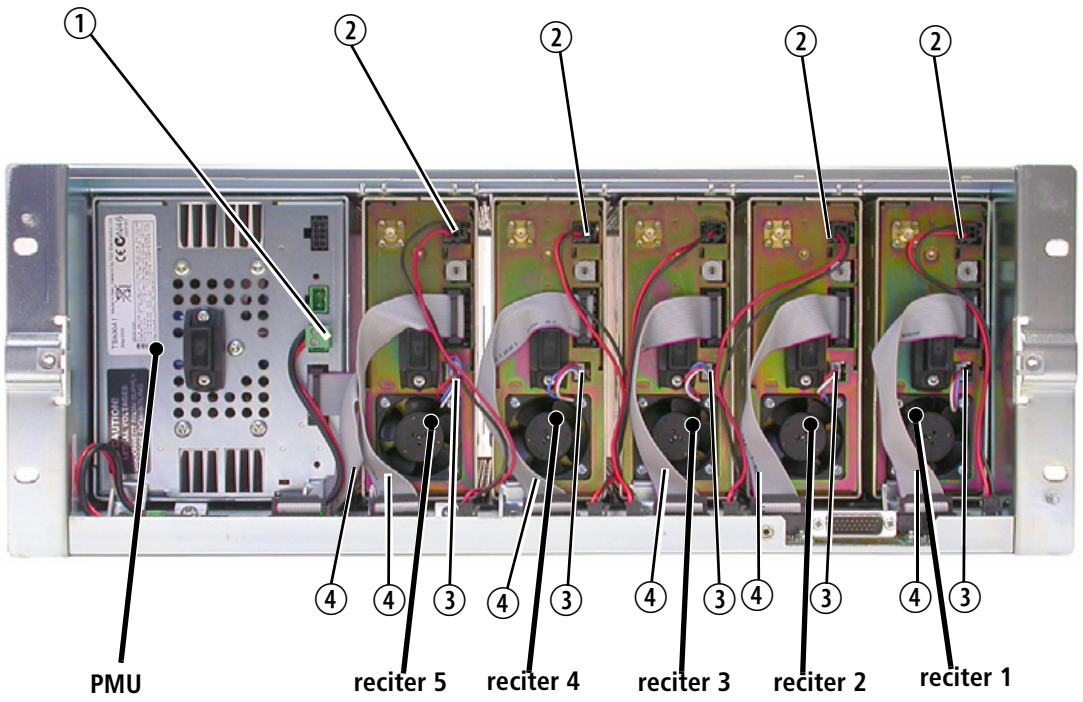
Detail of cabling from PMU to PA 2



Five Reciters and One PMU

The connections between modules at the front of a base station with five reciters are shown below.

5 or 50W base station internal connections



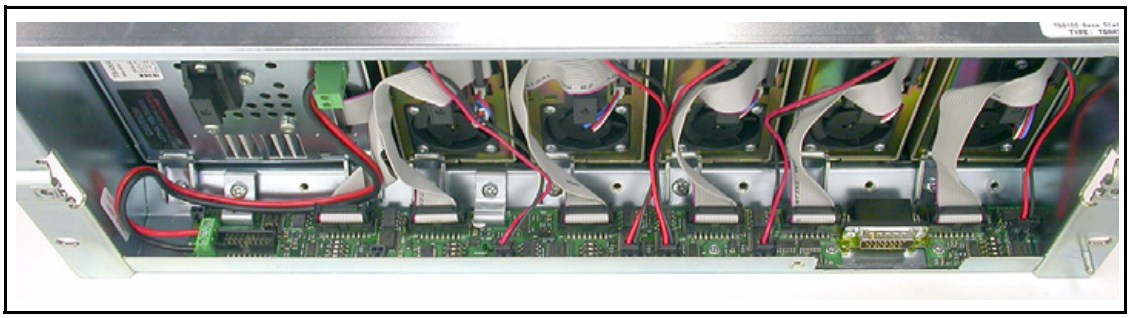
① 28VDC high current output to subrack interconnect board

② 28VDC low current input from subrack interconnect board

③ DC output for reciter fan

④ system control bus

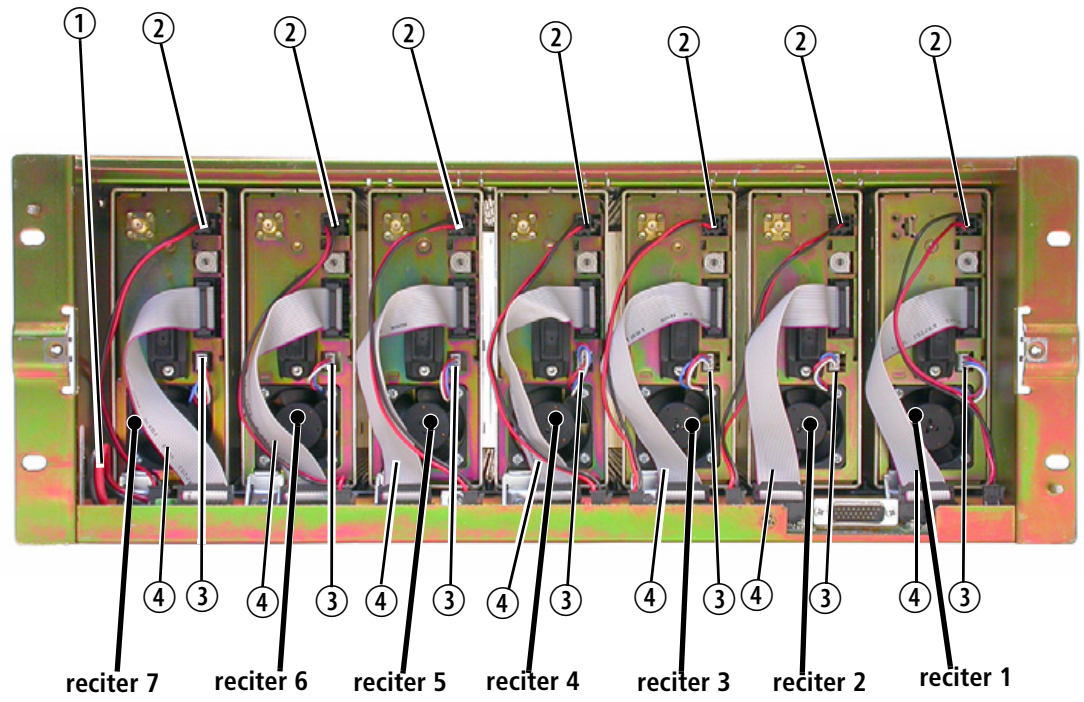
The following diagram shows the subrack interconnect board connections for this configuration.



Seven Reciters

The connections between modules at the front of a base station with seven reciters are shown below.

5 or 50W base station internal connections



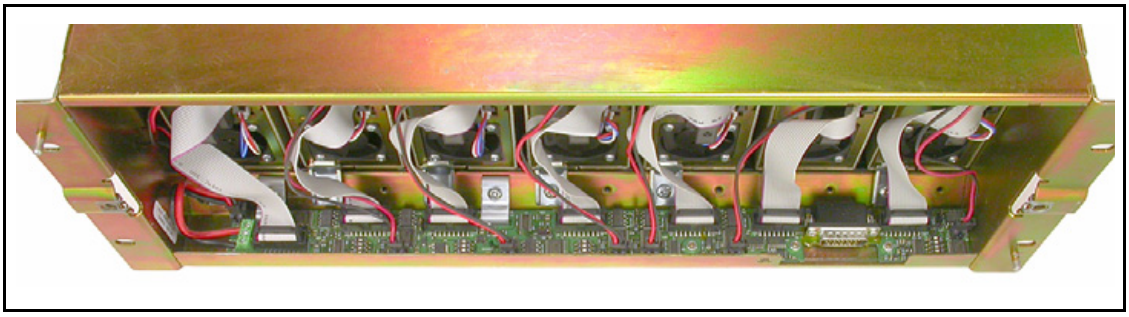
① 28VDC high current input from DC input terminal block

② 28VDC low current input from subrack interconnect board

③ DC output for reciter fan

④ system control bus

The following diagram shows the subrack interconnect board connections for this configuration.



TaitNet P25 Glossary

This glossary contains an alphabetical list of terms and abbreviations related to the TaitNet P25 network, the CSS, the TB9100 base station, and the P25 Console Gateway.

A

administrator — A special type of access to CSS functions, used for activities such as changing passwords.

access code — A password required to gain access to a set of privileges.

ADC — Analog-to-Digital Converter. A device for converting an analog signal to a digital signal that represents the same information.

AES — AES (Advanced Encryption Standard) is an encryption algorithm that uses keys of up to 256 bits.

AGC — Automatic Gain Control. A device that optimizes signal level.

Algorithm ID — The Algorithm ID is an identifier that specifies an encryption algorithm (for example, DES or AES).

analog FM mode — A mode of operation in which the RF interface transmits and receives analog FM signal. The network element's channel group interface sends and receives the analog signal as G. 711 speech packets.

analog valid — Analog valid is a signal that indicates that the TB9100 base station or P25 Console Gateway is presenting a valid output on the analog line. This output can originate from an analog FM or from a digital P25 call. The M-line carries the analog valid signal.

ANI — Automatic Number Identification. A service that provides the receiver of a call with a numerical identifier or alphanumeric label of the caller.

antenna relay — A DC-powered device that switches the antenna as needed between the base station's receiver and transmitter. With an antenna relay, a simplex base station only needs one antenna.

APCO — The Association of Public Safety Communications Officials in the United States. The APCO Project 25 standards committee defined the P25 digital radio standard. The standard is often referred to as APCO or P25.

ARP — ARP (Address Resolution Protocol) is a IP protocol used to map IP network addresses to the hardware addresses used by a data link protocol.

B

Base station — A radio receiver and transmitter that is located in a specific place (at a site) that enables a two-way radio to communicate with a dispatcher or over a larger range with other two-way radios. Specifically, Tait TB9100 equipment in a subrack.

Battery protection mode — A PMU enters battery protection mode when it has AC power but its DC power is below the configured power shutdown voltage. In battery protection mode, the PMU will shut down to protect the battery if it loses AC power.

BCD — BCD (binary coded decimal) is a code in which a string of four binary digits represents a decimal number.

bearer network — Telecom equipment that is used to carry user data.

BER — Bit Error Rate. A measure of the quality of digital transmission, expressed as a percentage. The BER indicates the proportion of errors to correctly received digits in a received signal.

C

C4FM — Compatible Four-level Frequency Modulation. A modulation scheme defined in the P25 CAI standard for 12.5 kHz bandwidth.

CAI — Common Air Interface. The over-the-air data formats and protocols defined by the APCO P25 committee.

Calibration Software — The TB9100 Calibration Software is a utility for defining the switching ranges of the receiver and the exciter and for flattening the receiver response across its switching range. It can also be used to calibrate TB9100 modules.

call — A complete exchange of information between two or more parties. A call requires a receive signal path and a transmit signal path. In trunked systems, a call may be a conversation, made up of a number of overs, but in conventional systems, a call is an over.

calling profile — A group of configuration settings that defines the properties of the TB9100 analog line, which can be regarded as equivalent to a SU on the network.

central voting — Voting that is centralized at one member of the channel group.

channel

A channel is:
1. A path through which signals can flow.
2. In the RF domain, a frequency pair (or just a single frequency in a simplex system).
3. A set of configuration information that defines the frequency pair and other related settings (a channel configuration). 'Channel' has this meaning in the CSS.

channel coordinator

A software module within the reciter or gateway module that propagates dispatcher channel control commands to the channel group. The channel coordinator also ensures that all channel group members have consistent states so that they work together properly.

channel group

A channel group is a single logical channel consisting of a set of base stations. P25 Console Gateways can also be members. The members of a channel group are linked by an IP network and share a common multicast IP address.

channel module

Channel module is a common term used to refer to reciters and gateway modules. TB9100 base stations have reciters and P25 Console Gateways have gateway modules.

channel profile

A channel profile is a named group of configuration settings that help to define the properties of a channel. Each channel in the channel table must have a channel profile assigned to it.

channel seize

Channel seize is a signal received at the analog line interface, requesting the base station or P25 Console Gateway to accept the signal on the analog line as an input into the channel group. An asserted E-line, LLGT, or LLGT following MDC1200 signaling can function as a channel seize signal.

channel spacing

Channel spacing is the bandwidth that a channel nominally occupies. If a base station has a channel spacing of 12.5 kHz, there must be a separation of at least 12.5 kHz between its operating frequencies and those of any other equipment.

channel table

The channel table is the base station's database of channel configurations.

CKR

The CKR (common key reference) is a number used by the key fill device and by the CSS to indirectly refer to an encryption key without using its Key ID or Algorithm ID.

circuit domain

The part of the base station processing functionality that processes speech signal as a continuous stream of bits – a digital circuit. The opposite of packet domain.

community repeater

Repeater that is shared by several user groups.

CODEC

A device which combines analog-to-digital conversion (coding) and digital-to-analog conversion (decoding).

configuration file A configuration file consists of all the configuration settings needed for a base station or P25 Console Gateway, stored as a file in the configurations folder. Configuration files have the extension *.apc.

connection list A connection list contains the names and IP addresses of base stations and P25 Console Gateways that the CSS can connect to.

control bus The control bus is used for communications between modules in a subrack. It is an I2C bus, a bi-directional two-wire serial bus which is used to connect integrated circuits (ICs). I2C is a multi-master bus, which means that multiple chips can be connected to the same bus, and each one can act as a master by initiating a data transfer.

control panel The control panel is an area at the front of the base station or P25 Console Gateway with buttons, LEDs and other controls that let a maintainer interact with the network element.

conventional network Conventional networks are systems that do not have centralized management of channel access. System operation is entirely controlled by system end users.

CRTP Compressed RTP.

crypto module Module for securely storing encryption keys and for encrypting and decrypting signals.

CSS Customer Service Software. Tait PC-based software for monitoring, configuring, and diagnosing a Tait TB9100 base station or P25 Console Gateway.

CTCSS CTCSS (continuous tone controlled squelch system), also known as PL (private line) is a type of signaling that uses subaudible tones to segregate groups of users.

custom action A custom action is a user-defined Task Manager action that consists of more than one pre-defined action.

custom input A custom input is a user-defined Task Manager input that consists of a set of pre-defined inputs that are combined using Boolean logic.

CWID CWID (**C**ontinuous **W**ave **ID**entification) is a method of automatically identifying the base station using a Morse code. Continuous wave means transmission of a signal with a single frequency that is either on or off, as opposed to a modulated carrier.

D

DAC Digital-to-Analog Converter. A device for converting a digital signal to an analog signal that represents the same information.

DCS DCS (digital coded squelch), also known as DPL (digital private line), is a type of subaudible signaling used for segregating groups of users. DCS codes are identified by a three-digit octal number, which forms part of the continuously repeating codeword. When assigning DCS signaling for a channel, you specify the three-digit code.

de-emphasis De-emphasis is a process in the receiver that restores pre-emphasized audio to its original relative proportions.

DES DES (Data Encryption Standard) is an encryption algorithm selected by the P25 standard.

DDC Digital Down Converter. A device which converts the digitized IF signal of the receiver down to a lower frequency (complex baseband) to suit the DSP.

DFSI The Digital Fixed Station Interface connects digital dispatch equipment with a base station or channel group. It is defined in the Project 25 TIA standard.

digital input value A value that the TB9100 base station computes from the state of a configured number of digital inputs. The digital input value is an input into Task Manager.

digital P25 mode A mode of operation in which the RF interface transmits and receives digital signal as defined by the APCO P25 CAI. The digital line sends and receives IMBE speech packets.

dispatcher A dispatcher is a person who gives official instructions by radio to one or more SU users.

distributed voting Voting for the best RF signal that is carried out separately by each channel group member using the same voting algorithm.

dotted quad A method for writing IPv4 addresses. The form is DDD.DDD.DDD.DDD where DDD is an 8-bit decimal number.

downlink The transmission path from fixed equipment to SUs.

DSP Digital Signal Processor.

dual mode The ability to operate as a transceiver in two different ways: analog FM and P25 digital. Dual mode equipment can be configured to support either mode or to switch between modes from one over to another.

duplex Providing transmission and reception in both directions simultaneously.

duty cycle Duty cycle is used in relation to the PA. It is the proportion of time (expressed as a percentage) during which the PA is transmitting.

E

E & M — A pair of wires used for DC signaling. For example, the signal to set up a call is often sent from the 'M' (mouth) end of a wire to the other 'E' (ear) end by grounding the wire.

EIA — Electronic Industries Alliance. Accredited by the American National Standards Institute (ANSI) and responsible for developing telecommunications and electronics standards in the USA.

encryption — The coding of voice (or data) into unintelligible forms for secure transmission.

EMC — Electromagnetic Compatibility. The ability of equipment to operate in its electromagnetic environment without creating interference with other devices.

ETSI — European Telecommunications Standards Institute. The non-profit organization responsible for producing European telecommunications standards.

F

FCC — Federal Communications Commission. The FCC is an independent United States government agency that regulates interstate and international radio communications.

Feature Code — Code that identifies a software feature license that can be enabled or disabled using the Software Feature Enabler.

Feature Code Sequence Number — Number that indicates how many times a software feature license has been enabled or disabled.

Feature license key — A set of digits purchased from Tait that is required to enable a software feature license.

FEC — Forward Error Correction. A method of encoding data so that the receiving end is able to correct transmission errors.

fill-in receiver — An additional receiver placed within the coverage area of a base station to receive SU transmissions that are too weak to be received by that base station.

FFSK — Fast Frequency Shift Keying. A modem encoding scheme for carrying data on FM radios.

flag — A flag is a programming term for a "yes/no" indicator used to represent the current status of something. The network element has a set of flags that Task Manager can set and clear.

FLASH Electrically block erasable and programmable read-only memory.

FM Frequency Modulation. Often used as an adjective to denote analog radio transmission.

frequency band The range of frequencies that the equipment is capable of operating on.

front panel The cover over the front of the TB9100 base station containing fans for the PA and PMU.

FSH Fixed Station Host.

function code A value that Task Manager can send to the channel group that can serve as an input to Task Manager actions at other channel group members.

G

G. 711 The name of the ITU standard that defines how speech is digitally encoded (64 kbit, A-law or u-law). When the TB9100 base station is in analog FM mode, G. 711 speech is sent and received on the channel group interface.

gating Gating is the process of opening and closing the receiver gate. When a valid signal is received, the receiver gate opens, letting the signal through.

group call A group call is a call that is sent to more than one SUs simultaneously.

H

heartbeat message A message whose purpose is to indicate to the receiver that the sender is operational.

hiccup mode Many power supplies switch off in the event of a short-circuit and try to start again after a short time (usually after a few seconds). This "hiccup"-type of switching off and on is repeated until the problem is eliminated.

HLGT High level guard tone. A tone that announces the beginning of tone remote signaling.

hostname The unique name by which a network element is known on the network.

hub A unit for connecting hosts together. It sends all incoming Ethernet packets to all the other hosts.

hysteresis Hysteresis is the difference between the upper and lower trigger points. For example, the receiver unmutes when the upper trigger point is reached, but will mute again until the level falls to the lower trigger point. An adequate hysteresis prevents the receiver gate from repeatedly muting and unmuting when the level varies around the trigger point.

I

IMBE Improved Multiband Excitation. A voice compression technology patented by Digital Voice Systems, Inc and used in the vocoders of P25 radios.

impairment A measure of signal quality used in channel group voting. Impairment is inversely related to signal quality. The lowest impairment (0) indicates the highest signal quality. The highest impairment (15) indicates the worst signal quality.

inbound Inbound describes the direction of a signal: from a subscriber unit over the air interface to the fixed station.

inhibit A control command that can be sent across the CAI to inhibit a SU. An inhibited SU appears to the user as if it is powered off.

IP Internet Protocol. IP is a protocol for sending data packets between hosts.

isolator An isolator is a passive two-port device which transmits power in one direction, and absorbs power in the other direction. It is used in a PA to prevent damage to the RF circuitry from high reverse power.

K

kernel The kernel is the core executable of an operating system.

key ID The Key ID is the identifier for an encryption key variable.

key fill device A device such as a Motorola KVL3000+ for defining encryption keys and transferring them into P25 equipment.

keytone A signaling tone that accompanies voice on the analog line and is used to key the transmitter. Also referred to as LLGT.

key variable The key variable is a parameter used by the encryption algorithm to encrypt or decrypt a message.

L

LAN Local Area Network

LDU Link Data Unit. Voice calls are sent over the CAI as a series of LDUs.

LED Light Emitting Diode. Also the screen representation of a physical LED.

LLGT Low level guard tone. One of a set of tones used to remotely control base stations.

M

MDC1200 MDC1200 is a proprietary signaling protocol developed by Motorola and used in analog PMR to provide subscriber signaling.

monitor The Monitor function unmutes the receiver, so that the user can hear all traffic on a channel.

multicast group The group of hosts associated with a specific IP multicast address.

multicast IP address An IP address that refers to a group of hosts rather than a single host. These hosts will all accept packets with this IP address.

mute A mute prevents audio from being passed to the radio's speaker.

N

NAC Network Access Code. The 12 most significant bits of the network identifier information that precedes every packet sent on the CAI. The NAC identifies which network the data belongs to, allowing base stations and mobiles to ignore packets belonging to interfering networks.

NAT NAT (network address translation) allows the use of a single IP address for a whole network of computers. A NAT sits between the public Internet and the network it serves, and works by rewriting IP addresses and port numbers in IP headers on the fly so the packets all appear to be coming from (or going to) the single public IP address of the NAT device instead of the actual source or destination.

navigation pane The navigation pane is the left-hand pane of the CSS application window. It displays a hierarchical list of items. When you click an item, the main pane displays the corresponding form.

network element A network element is any device that is network-connected. A TaitNet digital network consists of a number of network elements. The TB9100 base station and the P25 Console Gateway are network elements designed and manufactured by Tait.

normal squelch A type of squelch operation in which the receiver unmutes on any signal with the correct NAC (digital P25) or subaudible signaling (analog FM).

O

octet A set of 8 bits.

outbound Outbound describes the direction of a signal: from a fixed station over the air interface to a SU.

over A single transmission, which begins when a user presses PTT and ends when the user stops pressing.

P

P25 Project 25. A suite of standards and requirements endorsed by the TIA and intended for digital public safety radio communications systems.

P25 Console Gateway A Tait network element that acts as a gateway between an analog dispatch console and a channel group.

PA The PA (power amplifier) is a base station module that boosts the exciter output to the required transmit level.

packet domain The speech processing area that deals with speech data that has been collected up into a packet. IP networks convey packets. The opposite of circuit domain.

PCB Printed Circuit Board

PMU The PMU (power management unit) is a module in the TB9100 base station that provides power to the subrack and monitors power conditions. P25 Console Gateways can also have a PMU.

preamble A well-defined signal that is transmitted at the beginning of digital P25 calls to facilitate downlink voting and to allow the transmit buffer to fill.

pre-emphasis Pre-emphasis is a process in the transmitter that boosts higher audio frequencies to improve the audio quality.

privileges A set of access rights to CSS functions. There are Guest, Maintainer, and Administrator privileges.

program The act of sending a configuration data set from the CSS to the TB9100 base station or P25 Console Gateway.

Project 25 A project set up by APCO (the Association of Public Safety Communications Officials International), together with other US governmental organizations, to develop standards for interoperable digital radios to meet the needs of public safety users.

PSTN Public Switched Telephone Network: The public telephone network.

PTT Push To Talk. The button on a SU that keys the transmitter.

Q

QoS Quality Of Service. A router feature that gives real-time data such as voice calls priority over other data.

R

receiver number A unique number assigned to the members of a channel group and used by the DFSI interface.

reciter The reciter is a module of a TB9100 base station that provides both receiver and exciter functionality.

repeater talkaround Repeater talkaround allows the SU user to bypass repeater operation and so communicate directly with other SUs. While repeater talkaround is active, all transmissions are made on the receive frequency programmed for the channel.

reverse tone burst Reverse tone bursts can be used with CTCSS. When reverse tone bursts are enabled, the phase of the generated tones is reversed for a number of cycles just before transmission ceases. If the receiver is configured for reverse tone burst, it responds by closing its gate.

RISC Reduced instruction set computer. A type of microprocessor that recognizes a relatively limited number of instructions. The reciter's digital board and network board both have RISC microprocessors.

router A router is an internetwork packet switch that switches data packets from an input interface to an output interface. The interfaces can be of different types.

RS-232 A protocol for serial communications between DTE (data terminal equipment) and DCE (data communications equipment).

RSSI RSSI (Received Signal Strength Indicator) is a level that indicates the strength of the received signal.

RTP RTP (Real Time Protocol) is an Internet protocol that supports the real-time transmission of voice and data.

Run mode Run mode is the normal operating mode of the TB9100 base station or P25 Console Gateway.

Rx Receiver.

S

satellite voter A channel group member that has delegated voting activity to a central voter.

SAW filter Surface Acoustic Wave filter. A band pass filter that can be used to filter both RF and IF frequencies. A SAW filter uses the piezoelectric effect to turn the input signal into vibrations that are turned back into electrical signals in the desired frequency range.

selectivity The ability of a radio receiver to select the wanted signal and reject unwanted signals on adjacent channels (expressed as a ratio).

selective squelch A type of squelch operation in which the receiver unmutes only on signals that are explicitly addressed to that receiver. This can be done through a talk group ID or unit ID (digital P25) or through MDC1200 signaling (analog FM).

sensitivity The sensitivity of a radio receiver is the minimum input signal strength required to provide a usable signal.

signaling profile A signaling profile is a named set of configuration items related to signaling that can be applied to any channel. Items include subaudible signaling and transmit timers.

simplex Able to provide transmission and reception only in one direction at a time.

SINAD SINAD (Signal plus Noise and Distortion) is a measure of signal quality. It is the ratio of (signal + noise + distortion) to (noise + distortion). A SINAD of 12 dB corresponds to a signal to noise ratio of 4:1.

site 1. The base station equipment at a particular location. This includes power supplies, transmitters, receivers, network interfaces and controllers. 2. The location of that equipment.

SMR Specialized Mobile Radio. A communications system used by police, ambulances, taxis, trucks and other delivery vehicles.

squelch Squelch is a feature of radio equipment. It ensures that the speaker only unmutes when a valid signal is received. To be valid, it must, for example, have the correct NAC.

SSRC Synchronization source. The SSRC is a large number specified by the trunking controller in its connection message. It uniquely identifies voice streams sent from the master base station.

Standby mode Standby mode is a mode of operation in which active service is suspended so that special operations can be carried out, such as programming in a new configuration or carrying out invasive diagnostic tests.

SU Abbreviation for subscriber unit. This is the term used in the APCO P25 standard documents for a two-way radio (generally a mobile or a portable radio) conforming to the CAI specifications.

subaudible signaling Subaudible signaling is signaling that is at the bottom end of the range of audible frequencies. The TB9100 base station supports CTCSS and DCS subaudible signaling.

subtone A subtone (subaudible signaling tone) is a CTCSS tone or a DCS code.

supplementary service A term used in the P25 standards. It refers to a group of services that is additional to the basic service that a telecommunications network provides. Examples include encryption and SU monitoring.

switching range The switching range is the range of frequencies (about 10 MHz) that the radio equipment is tuned to operate on. This is a subset of the equipment's frequency band.

syslog protocol syslog is a standard protocol used for the transmission of event notification messages across IP networks. TB9100 base stations and P25 Console Gateways can send messages such as alarms to an IP address on the TaitNet P25 Network. The base station's logs store messages in the syslog format.

syslog collector A program that can receive, display, and log syslog messages from many devices.

T

TaitNet Brand name for any PMR network designed and manufactured by Tait Electronics Limited.

TaitNet P25 network A set of Tait base stations interconnected by an IP network that can carry voice and data traffic.

TB9100 Base Station A P25-compliant base station consisting of the equipment necessary to receive and transmit on one channel. Generally, this means a reciter, a PA, and a PMU. Often abbreviated to TB9100 or base station.

Task action A task action is the second part of a Task Manager task. It specifies what the network element must do when the first part (the input) becomes true.

Task input A task input is the first part of a Task Manager task. It specifies what must become true before the network element carries out the second part.

Task Manager Task Manager is a part of the network element firmware that carries out tasks in response to inputs. These tasks are formulated using the CSS.

TCCP Trunking Channel Control Protocol. A proprietary protocol operating over IP for the exchange of channel control messages between a TB9100 base station and a trunking site controller.

TCP Transmission Control Protocol. A complex protocol on top of IP for sending reliable streams of data with flow control.

TELCO Telephone company.

TIA Telecommunications Industry Association

toggle The term toggle is used to describe the switching between two states. If something is on, toggling it turns it off. If it is off, toggling it turns it on.

tone A tone is a sound wave of a particular frequency.

tone remote function tone An audio tone used for signaling to a TB9100 base station or P25 Console Gateway on the analog line.

TSBK A TSBK (trunking signaling block) is an over-the-air message format used in digital P25 mode for setting up trunked calls and for supplementary services such as messaging and status updates.

Tx Transmitter.

U

uninhibit A control command that can be sent across the CAI to restore an inhibited SU to normal functioning.

UDP User Datagram Protocol. A simple protocol on top of IP for sending streams of data.

uplink The transmission path from SUs to fixed equipment.

UTC Coordinated Universal Time (word order from French). An international time standard that has replaced Greenwich Mean Time.

V

valid signal A valid signal is a signal that the receiver unmutes to. A signal is valid, for example, when it is strong enough to be decoded and when it has the specified NAC.

vocoder Voice encoder/decoder. A processing element that compresses/decompresses the digital voice signal.

voice stream A digitized voice signal that passes through the main switch.

VoIP Voice over IP. The name for the technology that puts speech signals in packets and then routes them over an IP backbone network.

voting Voting is the systematic sampling of a group of channels for the channel with the greatest signal strength. Voting provides wide-area coverage and ensures that as the user moves throughout the coverage area the strongest channel is always available for a call.

VPN Virtual private network. A private communications network used to communicate confidentially over a non-private network.

VSWR Voltage Standing Wave Ratio (VSWR) is the ratio of the maximum peak voltage anywhere on the transmission line to the minimum value anywhere on the transmission line. A perfectly matched line has a VSWR of 1:1. A high ratio indicates that the antenna subsystem is poorly matched.

W

watchdog A watchdog circuit checks that the system is still responding. If the system does not respond (because the firmware has locked up), the circuit generally resets the system.

Z

zeroize To zeroize one or more encryption keys is to render them useless by overwriting the key data with zeros.

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