TB8100 base station

Service Manual

MBA-00016-02
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To Our European Customers

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Preface

Scope of Manual

This manual contains information on servicing the TB8100 base station. Included are circuit descriptions, fault finding procedures, and mechanical assembly drawings for each module.

Note TB9100 PAs and PMUs can also be serviced using this manual. TB9100 reciters can be serviced using this manual in conjunction with the TB9100 Reciter Service Manual (MBA-00017-xx). The TB9100 Reciter Service Manual contains information on the network board, and provides additional information specific to the operation of a reciter in a TB9100 system.

The 100W PA is not available in all markets. A lower power level is also available if required. Consult your nearest Tait Dealer or Customer Service Organisation for more 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 > Reciter” means “click the Monitor icon on the toolbar, then in the navigation pane find the Module Details group, and select Reciter 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 following associated documentation is available for this product:

- MBA-00001-**xx** TB8100 Specifications Manual.
- MBA-00005-**xx** TB8100 Installation and Operation Manual.
- MBA-00009-**xx** TB8100 Installation Guide. This is a subset of the Installation and Operation Manual.
- MBA-00010-**xx** TB8100 Service Kit User's Manual.
- MBA-00011-**xx** TB8100 Calibration Kit User's Manual.
- MB8100-80-00-806 TB8100 Alarm Center User's Manual.
- MBA-00013-**xx** TBA0STU/TBA0STP Calibration and Test Unit Operation Manual.

The characters **xx** represent the issue number of the documentation.

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.

All available TB8100 product documentation is provided on the Product CD supplied with the base station. Updates may also be published on the Tait Technical Support website (http://support.taitworld.com).

Publication Record

Issue	Publication Date	Description
1	April 2004	first release
2	September 2006 (MBA-00016-02)	Fault Finding chapters added for the reciter, PA, and PMU
		information added for the following frequency bands: B, C, H4, K and L
		information added for the following products: ■ 12V PA ■ multi-reciter subrack and control panel ■ TaitNet Ethernet and TaitNet RS-232 system interface boards ■ spare parts
		Servicing chapters for the reciter, PA and PMU divided into three new chapters: ■ Disassembly and Reassembly ■ Board Replacement ■ Spare Parts
		minor corrections and additions

1 Safety and Servicing Information

This chapter contains general information on safety and servicing procedures for the TB8100 base station modules:

- reciter
- power amplifier (PA)
- power management unit (PMU)
- control panel.

You will find specific safety and servicing information about individual modules in the appropriate chapters.

1.1 Personal Safety

1.1.1 Lethal Voltages

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

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 DC power on/off 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.**

The PMU should be serviced only by qualified technicians. 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.

1.1.2 Explosive Environments

Warning!! **Do not operate TB8100 equipment near electrical blasting caps or in an explosive atmosphere. Operating the equipment in these environments is a definite safety hazard.**

1.1.3 Beryllium Oxide

Caution **Beryllium Oxide**
The termination resistors used in the 100W power amplifier contain some beryllium oxide. This substance is perfectly harmless in its normal solid form, but can become a severe health hazard when it has been reduced to dust. For this reason the termination resistors should not be broken open, mutilated, filed, machined, or physically damaged in any way that can produce dust particles. You should safely dispose of all used or obsolete components according to your local regulations.

1.1.4 Proximity to RF Transmissions

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

1.1.5 High Temperatures

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

Caution **The magnetics and power devices attached to the heatsink in the PMU get hot when they are operating. Take care when working on a PMU that has been in recent use.**

Caution **Touching high-power RF components or circuits can cause serious burns. We strongly recommend you do not touch any RF components or tracks in the PA while it is transmitting.**

1.2 Equipment Safety

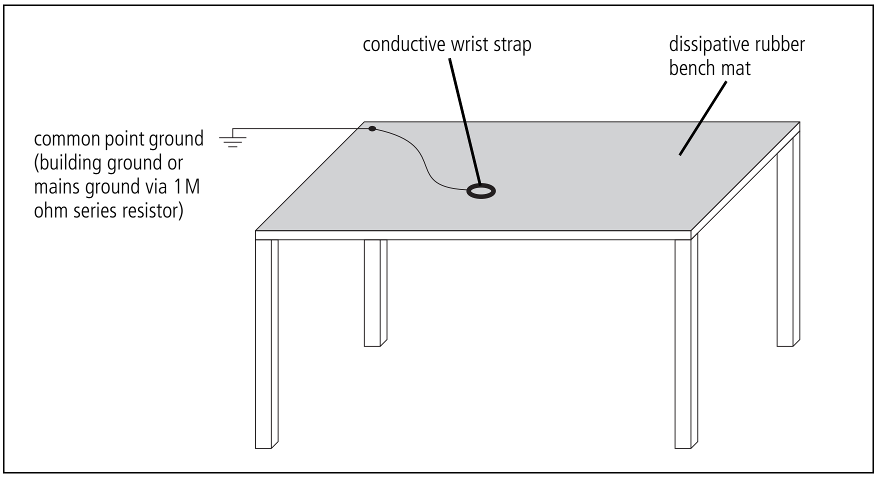
1.2.1 ESD Precautions

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 1.1 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. The Electrostactic Discharge Association website is http://www.esda.org.

Figure 1.1 Typical antistatic bench set-up



1.2.2 Antenna Load

Important The PA may be damaged if the load is removed or switched while the PA is transmitting.

To protect the PA output stage from load transients (i.e. switching or removing the load), we recommend that you fit an isolator 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 or combining equipment between the isolator and the PA.

1.3 Regulatory Information

1.3.1 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.

1.3.2 FCC Compliance[1]

This device complies with part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.

1.3.3 Unauthorised Modifications

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

1. Refer to the TB8100 Specifications Manual (MBA-00001-xx) for more information on the compliance standards to which TB8100 equipment has been tested and approved.

1.4 General Servicing Information

1.4.1 Repair Levels

This manual covers level-1 and specific level-2 repairs of TB8100 equipment. Level-1 repairs comprise the replacement of circuit boards and plug-in cards; level-2 repairs comprise replacement of the RF power transistors in the PA.

1.4.2 Accreditation of Service Centres

Service centres that wish to achieve Accredited Service Centre (ASC) status should contact Technical Support. They will need to provide evidence that they meet the criteria required for accreditation; Technical Support will supply details of these criteria. These centres must then make available suitable staff for training by Tait Electronics Limited personnel, allow their service facilities to be assessed, and provide adequate documentation of their processes. They will be accorded ASC status and endorsed for repairs of TB8100 equipment after their staff have been trained and their facilities confirmed as suitable. Existing ASCs need to apply for and be granted an endorsement for repairs of TB8100 equipment. All ASCs with the necessary endorsements may carry out level-1 and level-2 repairs of TB8100 equipment, whether under warranty or not.

1.4.3 Skills and Resources for Level-1 Repairs

For level-1 repairs basic electronic repair skills are sufficient. Apart from the standard tools and equipment of any service centre, certain torque drivers are required, as well as a Service Kit, Calibration Kit (with dongle), and Calibration and Test Unit (CTU).

1.4.4 Skills and Resources for Level-2 Repairs

For level-2 repairs expertise is required in handling and replacing insulated gate FET transistors.

1.4.5 Website Access

To carry out level-1 and level-2 repairs, service centres need access to the secured portion of the Tait Technical Support website (http://support.taitworld.com). There are different access levels; those required for level-1 and level-2 repairs are:

- level-1 repairs: associate access
- level-2 repairs: ASC and Tait-only access

Log-in passwords are needed for associate and Tait-only access; Technical Support supplies service centres with the necessary log-in information. The unsecured portion of the Technical Support website is accessible to the general public. This type of access is called public access, and no log-in password is required.

1.4.6 Items Available on Website

The information available on the website is summarized in the following list. The PCB information is discussed in more detail below.

Note Access to some types of information will depend on your level of accreditation. Contact your nearest Customer Service Organisation for more details.

- Application Notes
- Firmware
- Fitting Instructions
- Installation Guides
- Installation and Operation Manuals
- PCB Information
- Product Alerts
- Programming Software
- Programming User Manuals
- Service Kit Templates
- Service Manual
- Software Release Notes
- Specifications
- Technical Notes

1.4.7 PCB Information

All PCBs are identified by a unique 10 digit IPN (internal part number) which is printed onto the PCB (usually on the top side), as shown in the example below.

220-02008-04

The last two digits of this number define the issue status, which starts at 01 and increments through 02, 03, 04 etc. as the PCB is updated.

PCB information for a particular circuit board consists of the relevant BOMs, PCB layouts, and circuit diagrams. Contact your nearest Customer Service Organisation for more details on the availability of PCB information (refer to “Contact Information” on page 2).

1.4.8 Tait FOCUS Database

An additional source of information to service centres is the Tait FOCUS call-logging database. This is also accessible on the Technical Support website. All customer-related technical issues regarding TB8100 equipment are recorded on this database. These issues may be raised by both customers and service centres. Technical Support resolves the issues and informs the customer or service centre concerned of the outcome. All issues and their solutions are available for review by all service centres.

1.5 Recommended Tools

It is beyond the scope of this manual to list every tool that a service technician should carry. However, the tools specifically required for servicing TB8100 equipment are listed in the table below. You can also obtain the TBA0ST2 tool kit from your nearest Tait Dealer or Customer Service Organisation. It contains the basic tools needed to install, tune and service TB8100 equipment.

Driver/ Spanner	Size	Location / Function
Torx T8[a]	M2.5	secure the SMA connector to the reciter and PA front panel
Torx T10[a]	M3	all M3 screws
Torx T20[a]	M4	all M4 screws
Pozidriv PZ1	M2	secure the VHF splitter and combiner boards to the PA heatsink
Pozidriv PZ3	M6	DC input terminals on the PMU
3/32 in Allen key	4-40 UNC	secure the RF power transistors to the PA heatsink
5.5 mm AF[a]	M3	secure the speaker to the control panel chassis
11 mm AF		secure the BNC/TNC connectors to the reciter rear panel
5/16 in AF[a]		secure the RF coaxial cables to the SMA connectors on the PA and reciter

a. Included in the TBA0ST2 tool kit.

Important We **strongly recommend** that you use the TB8100 card remover (as shown in Figure 15.1 on page 263) for removing the plug-in cards in the PMU. The card remover is included in the TBA0ST2 tool kit, and is also available separately as part number 220-02034-01.

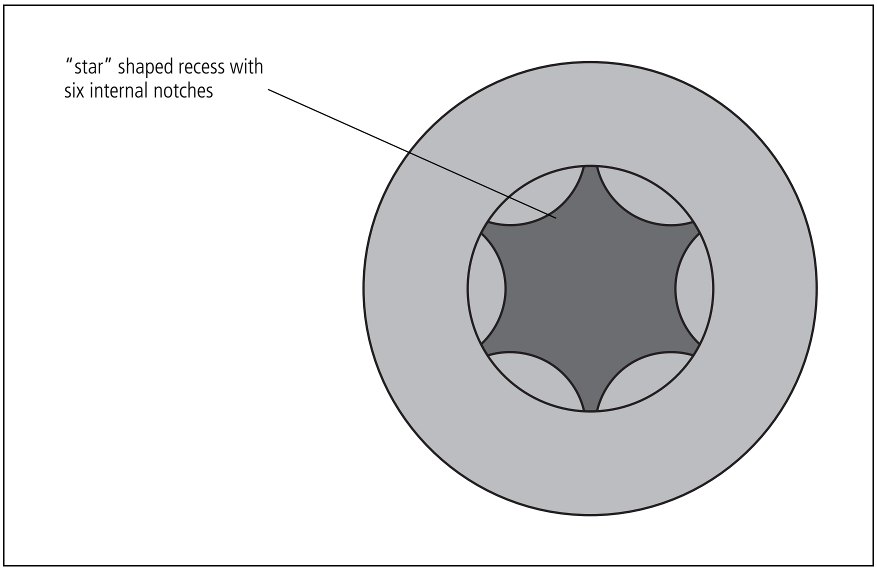
1.6 Identifying Screw Types

1.6.1 Torx Recess Head Screws

Torx recess head screws are the standard type of screw used in all TB8100 equipment, although Pozidriv and Allen recess head screws are also used in a few special applications.

Figure 1.2 below shows a typical Torx recess head screw (actual hardware may differ slightly from this illustration due to variations in manufacturing techniques).

Figure 1.2 Identifying Torx screws



1.6.2 Allen Recess Head UNC Screws

Allen recess head 4-40 UNC thread screws are used to secure the RF power transistors in the TB8100 power amplifier and cannot be interchanged with M3 screws (refer to Figure 11.1 on page 197).

1.6.3 Pozidriv Recess Head Screws

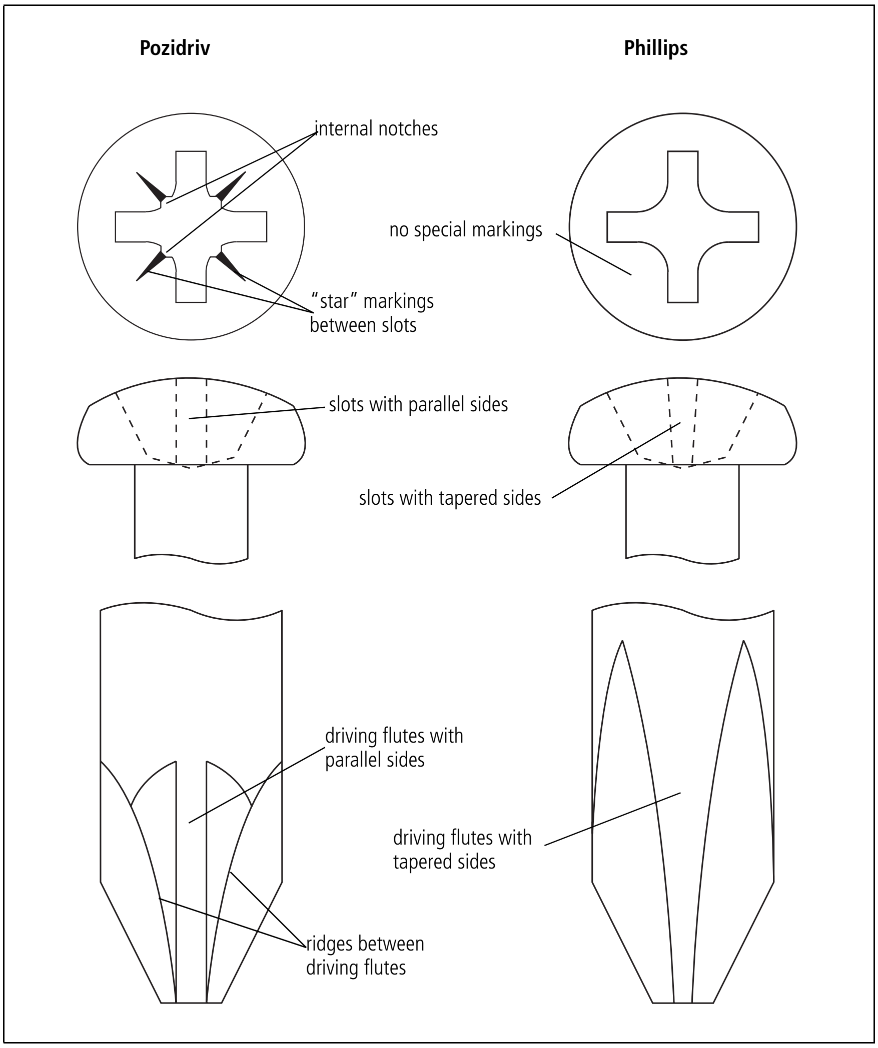
Pozidriv recess head screws are used in TB8100 equipment in a few special applications. It is important that you use the correct type and size screwdriver to avoid damaging the screw head.

It is particularly important that you do not use Phillips screwdrivers on Pozidriv screw heads as the tapered driving flutes of the Phillips screwdriver do not engage correctly with the parallel-sided slots in the Pozidriv screw head. This can result in considerable damage to the screw head if the screwdriver tip turns inside the recess.

Note If you find you need excessive downwards pressure to keep the screwdriver tip in the Pozidriv screw head, you are probably using the wrong type or size screwdriver.

Figure 1.3 below shows the main differences between typical Pozidriv and Phillips screw heads and screwdriver tips (actual hardware may differ slightly from these illustrations due to variations in manufacturing techniques).

Figure 1.3 Identifying Pozidriv and Phillips screws and screwdrivers



1.7 Replacing Components

Ensure that any replacement components are of the same type and specifications as the originals. This will prevent the performance and safety of the TB8100 equipment from being degraded.

1.7.1 Surface Mount Devices

Important Surface mount devices (SMDs) require special storage, handling, removal and replacement techniques. This equipment should be serviced only by an approved Tait Dealer or Customer Service Organisation equipped with the necessary facilities. Repairs attempted with incorrect equipment or by untrained personnel may result in permanent damage. If in doubt, contact your nearest Tait Dealer or Customer Service Organisation.

1.7.2 Leaded Components

Whenever you are doing any work on the PCB that involves removing or fitting components, you must take care not to damage the copper tracks or pads. The two satisfactory methods of removing components from plated-through hole (PTH) PCBs are detailed below.

Desoldering Iron Method

This method requires the use of a desoldering station.

1. Place the tip over the lead and, as the solder starts to melt, move the tip in a circular motion.
1. Start the suction and continue the movement until three or four circles have been completed.
2. Remove the tip while continuing suction to ensure that all solder is removed from the joint, then stop the suction.
3. **Before** pulling the lead out, ensure it is not stuck to the plating.
4. If the lead is still not free, resolder the joint and try again.

Note The desoldering iron does not usually have enough heat to desolder leads from the ground plane. Additional heat may be applied by holding a soldering iron on the tip of the desoldering iron (this may require some additional help).

Component Cutting Method

1. Cut the leads on the component side of the PCB.

1. Heat the solder joint **sufficiently** to allow **easy** removal of the lead by drawing it out from the component side: do **not** use undue force.

2. Fill the hole with solder and then clear with solderwick.

1.7.3 Cased Mica Capacitors

Cased mica capacitors can be removed by heating the top with a heavy-duty soldering iron and gently lifting the capacitor off the PCB with a solder-resistant spike or equivalent. Make sure that the solder at the tab solder joint is melted or removed before attempting to lift the capacitor.

2 Reciter Circuit Description

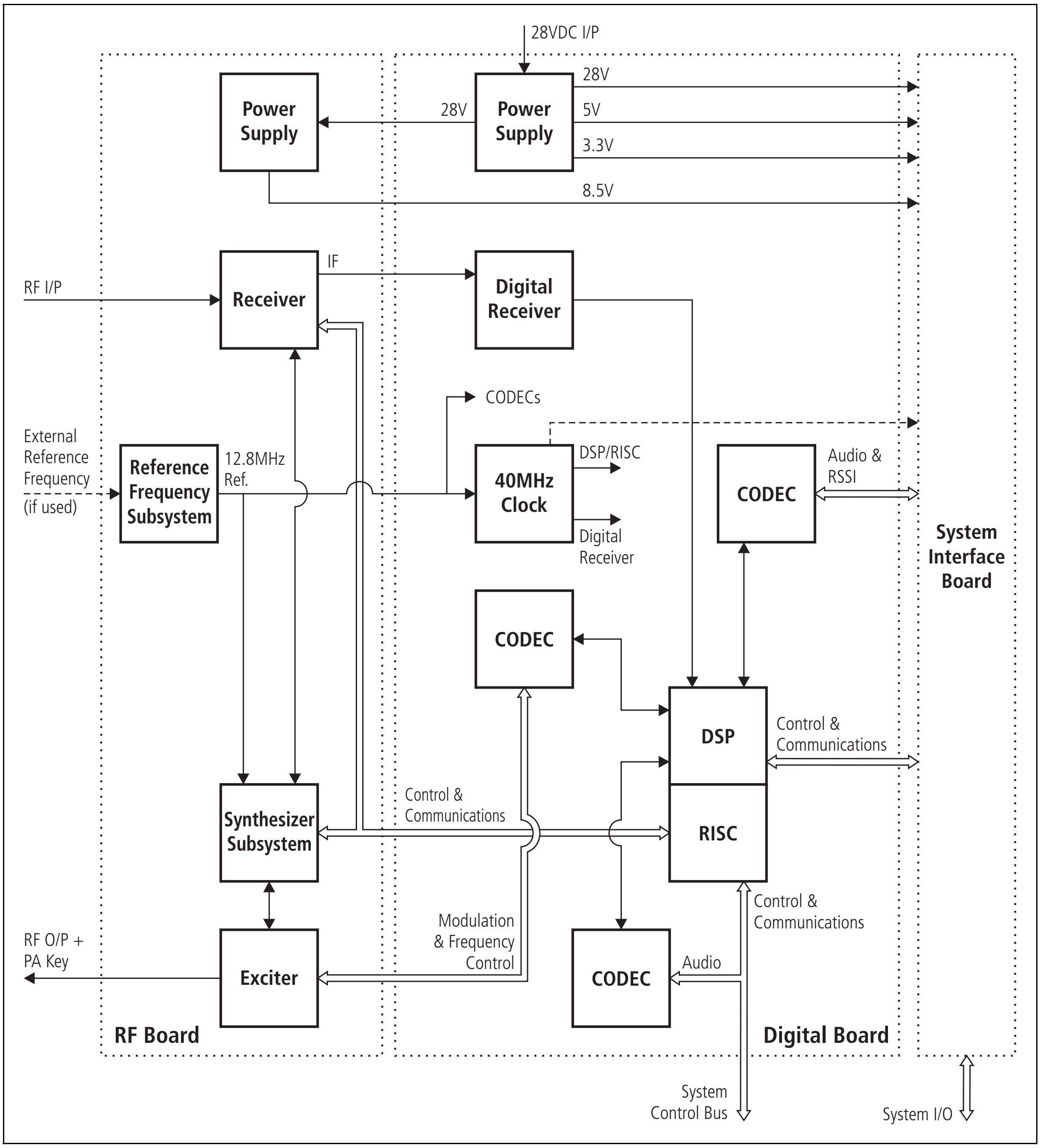
This chapter describes the circuitry used in VHF and UHF reciters. Much of this circuitry is common to both frequency bands, and is therefore covered by a single description in this chapter. Where the circuitry differs between VHF and UHF, separate descriptions are provided for each frequency band. In 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 (refer to "Identifying the Reciter" on page 70 for more details).

	Frequency Identification	Frequency Band and Sub-band
VHF	B band	B2 = 136 MHz to 156 MHz B3 = 148 MHz to 174 MHz
VHF	C band	C1 = 174 MHz to 193 MHz C2 = 193 MHz to 225 MHz
UHF	H band	H1 = 400 MHz to 440 MHz H2 = 440 MHz to 480 MHz H3 = 470 MHz to 520 MHz H4 = 380 MHz to 420 MHz
UHF	K band	K4 = 762 MHz to 870 MHz[a]
UHF	L Band	L1 = 852 MHz to 854 MHz, and 928MHz to 930 MHz L2 = 896 MHz to 902 MHz (receive only) L2 = 927 MHz to 941 MHz (transmit only)

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

The reciter comprises three boards: an RF board, a digital board, and an optional system interface board. These boards are mounted on a central chassis/heatsink. Figure 2.1 on page 28 shows the configuration of the main circuit blocks, and the main inputs and outputs for power, RF and control signals. The locations of the main circuit blocks on the boards are shown in Figure 2.14 on page 61, Figure 2.15 on page 63, Figure 2.16 on page 65, and Figure 2.17 on page 67.

Figure 2.1 Reciter high level block diagram



2.1 Digital Circuitry

Refer to Figure 2.2 on page 31.

2.1.1 Digital IF

VHF Reciter

The heart of the digital IF system is the 14-bit analogue-to-digital converter (ADC). This is a high-speed device, with a multi-staged "pipeline" architecture, which is clocked and outputs samples at 40 MSPS (megasamples per second). The analogue IF input of the ADC is a differential structure, and the output is via a 14-bit parallel bus.

The band-limited 16.9 MHz IF signal is sampled by the ADC at 40 MSPS. The sampling process results in images of the input signal appearing at other frequencies so that the ADC behaves in a similar fashion to a mixer. The digital output therefore contains the wanted signal and the images, which can be digitally processed to extract one of the many signals. The desired IF is at 16.9 MHz.

The digital downconverter (DDC) digitally downconverts the 16.9 MHz IF to baseband. This is achieved by digital mixing with a numerically controlled oscillator (NCO). The mixing process is done using in-phase and quadrature methods to achieve image rejection, and allows channel filtering to be applied before the signal is passed to the digital signal processor (DSP) for demodulation. The digital channel filtering also decimates the sample rate down to 50 kSPS (kilosamples per second) for the DSP.

UHF Reciter

The heart of the digital IF system is the 14-bit analogue-to-digital converter (ADC). This is a high-speed device, with a multi-staged "pipeline" architecture, which is clocked and outputs samples at 40 MSPS (megasamples per second). The analogue IF input of the ADC is a differential structure, and the output is via a 14-bit parallel bus.

The band-limited 70.1 MHz IF signal is sub-sampled by the ADC at 40 MSPS. The sub-sampling results in images of the input signal appearing at other frequencies so that the ADC behaves in a similar fashion to a mixer. The digital output therefore contains information in the form of images, which can be digitally processed to extract one of the many signals. The lowest frequency image for the 70.1 MHz IF and 40 MHz clock is at 9.9 MHz.

The digital downconverter (DDC) digitally downconverts the desired image (9.9 MHz) to baseband. This is achieved by digital mixing with a numerically controlled oscillator (NCO). The mixing process is done using in-phase and quadrature methods to achieve image rejection, and allows channel filtering to be applied before the signal is passed to the digital signal processor (DSP) for demodulation. The digital channel filtering also decimates the sample rate down to 50 kSPS (kilosamples per second) for the DSP.

2.1.2 Digital Signal Processor (DSP)

The DSP is responsible for software processing of digitised signals in the receiver and transmitter. The processing word width is 16-bit fixed point. There are 96 kilobytes of on-chip program memory, and 64 kilobytes of on-chip data memory. Although no external memory is used, the external memory interface is connected to the DDC for initialisation and configuration.

Transmit Functions

The DSP performs the following transmit functions:

- CTCSS and DCS sub-audible signal generation
- CWID generation
- pip tone generation
- audio filtering: including removal of sub-audible components, pre-emphasis and low pass filtering
- signal path switching
- signal level adjustment
- peak FM deviation limiting
- FM signal generation by controlling the dual point modulator
- calibration parameter estimation
- line level monitoring.

Receive Functions

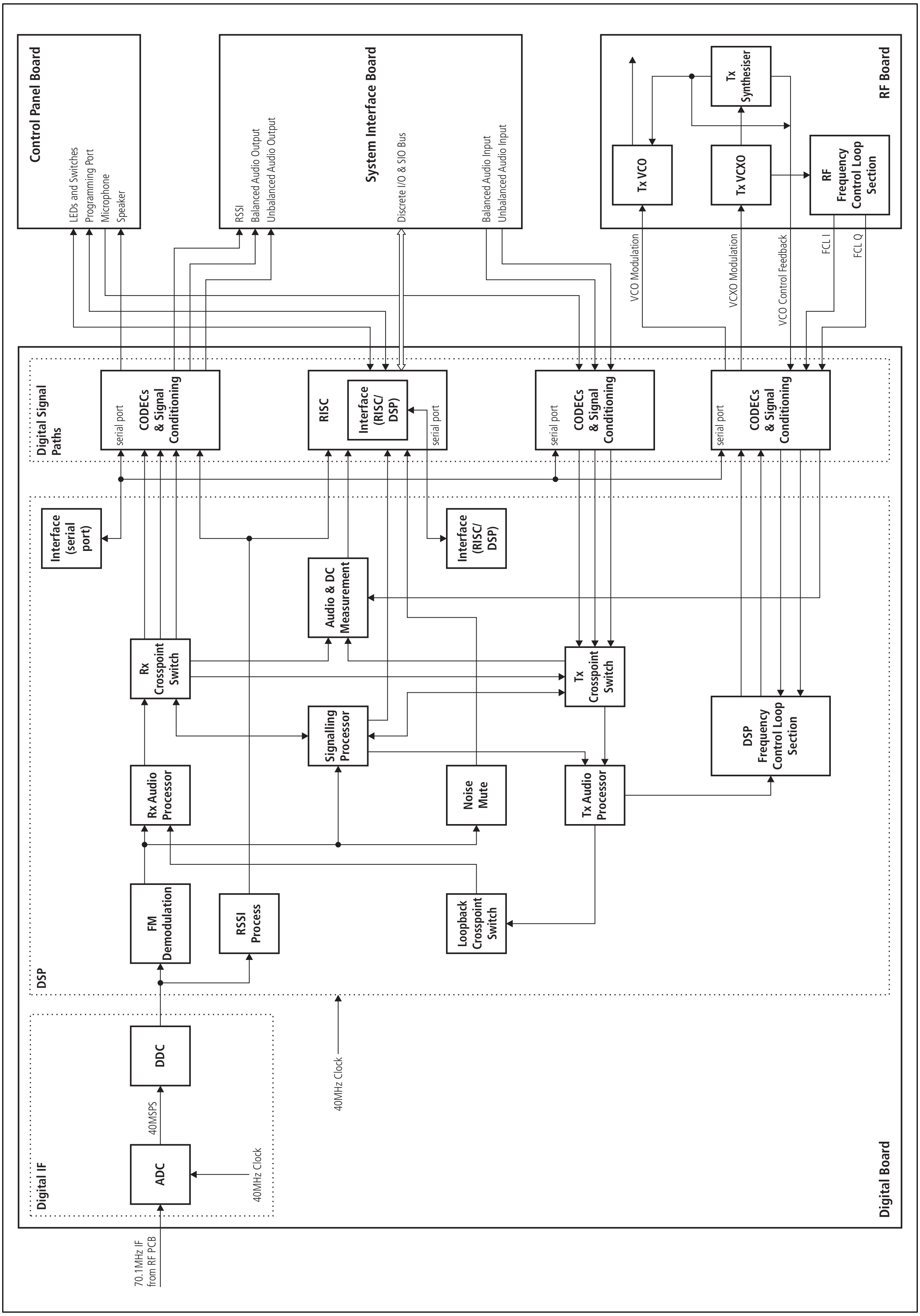
The DSP performs the following receive functions:

- detection of CTCSS and DCS signalling
- audio filtering: including removal of sub-audible components, de-emphasis and low pass filtering
- signal path switching
- signal level adjustment
- FM demodulation of the base band signal
- RSSI measurement for monitoring and RSSI signal voltage output
- SINAD measurement
- measurement and detection for control of the audio mute
- calibration parameter estimation
- line level monitoring.

Serial Ports

The DSP has three synchronous serial ports. Serial port 1 is connected to the DDC and receives base band samples. Serial port 2 is connected to the three CODECs (encoder/decoder). Serial port 3 is not used.

Figure 2.2 Reciter digital circuitry block diagram



CODECs

The three CODECs provide the audio frequency analogue interface to the reciter. There are six analogue input and six analogue output paths. The sample rate on all paths is 25 kSPS and the sampling resolution is 16 bits.

The CODEC inputs are as follows:

- two input signals from the frequency control loop (FCL)
- balanced line input
- unbalanced line input
- microphone input
- synthesizer loop control voltage.

The CODEC outputs are as follows:

- VCO voltage control line
- VCXO voltage control line
- balanced line output
- unbalanced line output
- speaker output
- RSSI voltage indicator.

2.1.3 Reduced Instruction Set Computer (RISC)

Refer to Figure 2.3 on page 33.

Hardware and I/O

The RISC processor engine is a Samsung S3C3410X processor with a 40 MHz external clock. It has 4 megabytes of flash memory containing the following:

- bootloader
- application code
- DSP code
- non-volatile data
- 2 megabytes of RAM for run-time variables.

The discrete digital inputs and outputs are as follows:

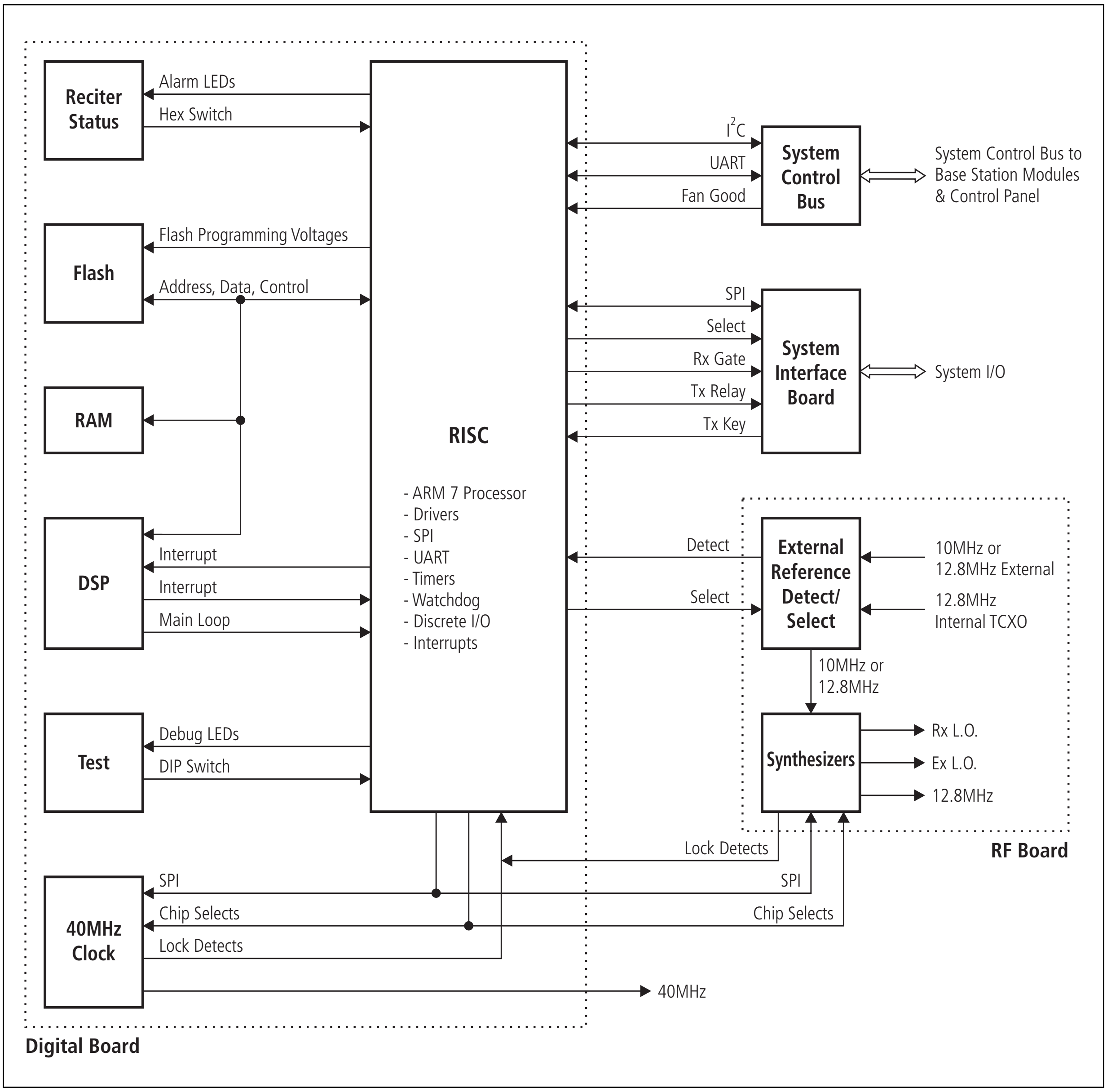
- chip select signals to synthesizers
- out-of-lock signals from synthesizers
- external reference detection
- internal/external reference selection
- Rx Gate output
- Tx Relay output
- reciter hex switch
- reciter alarm LED
- DIP switch for manufacturing testing

- debug LEDs
- fan good input
- flash programming voltage control.

The RISC has the following serial interfaces:

- asynchronous serial port for communication with the Service Kit, Calibration Kit, Alarm Center, and Ethernet interface
- serial peripheral interface (SPI) for programming the synthesizers
- SPI for communication with the system interface board
- I^2C for communication with the control panel and other modules in the subrack.

Figure 2.3 Reciter RISC functional block diagram



Responsibilities

The RISC communicates with the DSP's shared memory via a host port interface. It loads the DSP code and monitors and controls the following DSP operations:

- receive path
- transmit path
- crosspoint switches
- power supplies
- PA Key output.

The RISC controls the frequency generation subsystem. It detects an external reference source and selects internal or external reference. It also programs, and handles out-of-lock signals for, the following synthesizers:

- 12.8MHz external reference synthesizer
- 40MHz digital clock synthesizer
- receiver synthesizer
- exciter synthesizer.

The RISC communicates with the control panel via I^2C bus to:

- read the button states
- read the microphone PTT state
- control the LEDs
- turn the speaker amplifier on and off
- turn the microphone amplifier on and off.

The following signals go via the control panel for signal conditioning:

- Service Kit communication via the RS-232 interface
- fan-good indication (front panel fans).

Note that the volume control on the control panel is analogue only and is not controlled by the RISC.

The RISC communicates with the other modules in the subrack via I^2C in order to:

- verify that they are present
- write configuration settings
- read their current status.

The RISC subsystem communicates with the system interface board via SPI to:

- set input and output gains
- mute and unmute outputs
- read digital inputs
- write digital outputs.

The Rx Gate and Tx Relay lines go via the system interface board for signal conditioning.

2.1.4 40MHz Digital Clock

The 40MHz synthesized digital clock is situated on the digital board. It is used to drive the entire digital circuitry.

The 40MHz frequency synthesizer is implemented using an Integer_N-based phase locked loop (PLL) IC. The PLL is a negative feedback loop, which continuously monitors and maintains the 40MHz VCXO to a fixed frequency and constant phase relationship with respect to a 12.8MHz reference. The 40MHz VCXO oscillator is electrically tuned using two varactors. The oscillator output is buffered before being distributed to the digital circuitry.

2.2 Reference Switch

Refer to Figure 2.4 on page 37.

2.2.1 Synthesizer

The external reference synthesizer consists of a programmable frequency synthesizer IC, a 12.8MHz VCXO, and a stable 10MHz or 12.8MHz reference frequency supplied to the reciter externally via a BNC connector on the rear panel.

The synthesizer uses a phase-locked loop to lock the 12.8MHz VCXO to the external reference frequency. The synthesizer IC receives the divider and control information from the RISC processor via a 3-wire serial bus (clock, data and enable). When the data bits are latched in, the synthesizer processes incoming signals from the 12.8MHz VCXO feedback buffer (f_{vcxofb}) and the external reference buffer (f_{ref}).

A transistor is used as a unity gain 12.8MHz VCXO feedback buffer for the prescaler within the synthesizer IC.

The 10MHz or 12.8MHz externally supplied reference is detected, buffered and divided down to the 100kHz divider reference within the synthesizer IC. The same divider reference is maintained by dividing the 12.8MHz VCXO feedback buffered signal using the programmable dividers of the synthesizer IC. Phase lock is achieved when both divider references have the same phase and frequency content (i.e. their difference is zero or DC). This is achieved by the digital phase detector (part of the synthesizer IC), which compares both divider references and delivers an error signal. A ±1mA charge pump circuit (also part of the synthesizer IC) and the passive loop filter circuit convert this error signal to a DC voltage (0 to 3V) to tune the 12.8MHz VCXO for correction. A loop filter with a bandwidth of 180Hz further filters the VCO control line reference side bands and spurious signals.

Note The VCXO frequency increases as the control line voltage increases.

2.2.2 VCXO

The VCXO is implemented by using a varactor to linearly tune a 12.8MHz crystal unit over a specified frequency range. The frequency range provided will cover frequency drifts due to calibration, the temperature tolerance of the crystal unit, and the frequency stability of the externally supplied reference.

2.2.3 Reference Switch

The reference switch consists of the external reference detector, the hardware switch, and the digital switch.

External Reference Detector

A discrete NPN dual transistor pair is used as a low level signal detector. The Syn_Ref_Det signal has a high logic level when the externally supplied signal has the correct level.

Hardware Switch

The hardware switch is implemented using a discrete dual transistor pair. When the switch is off (default), it powers up the internal reference 12.8MHz TCXO and shuts down the external reference 12.8MHz VCXO. When the switch is on, it powers up the external reference 12.8MHz VCXO and shuts down the internal reference 12.8MHz TCXO.

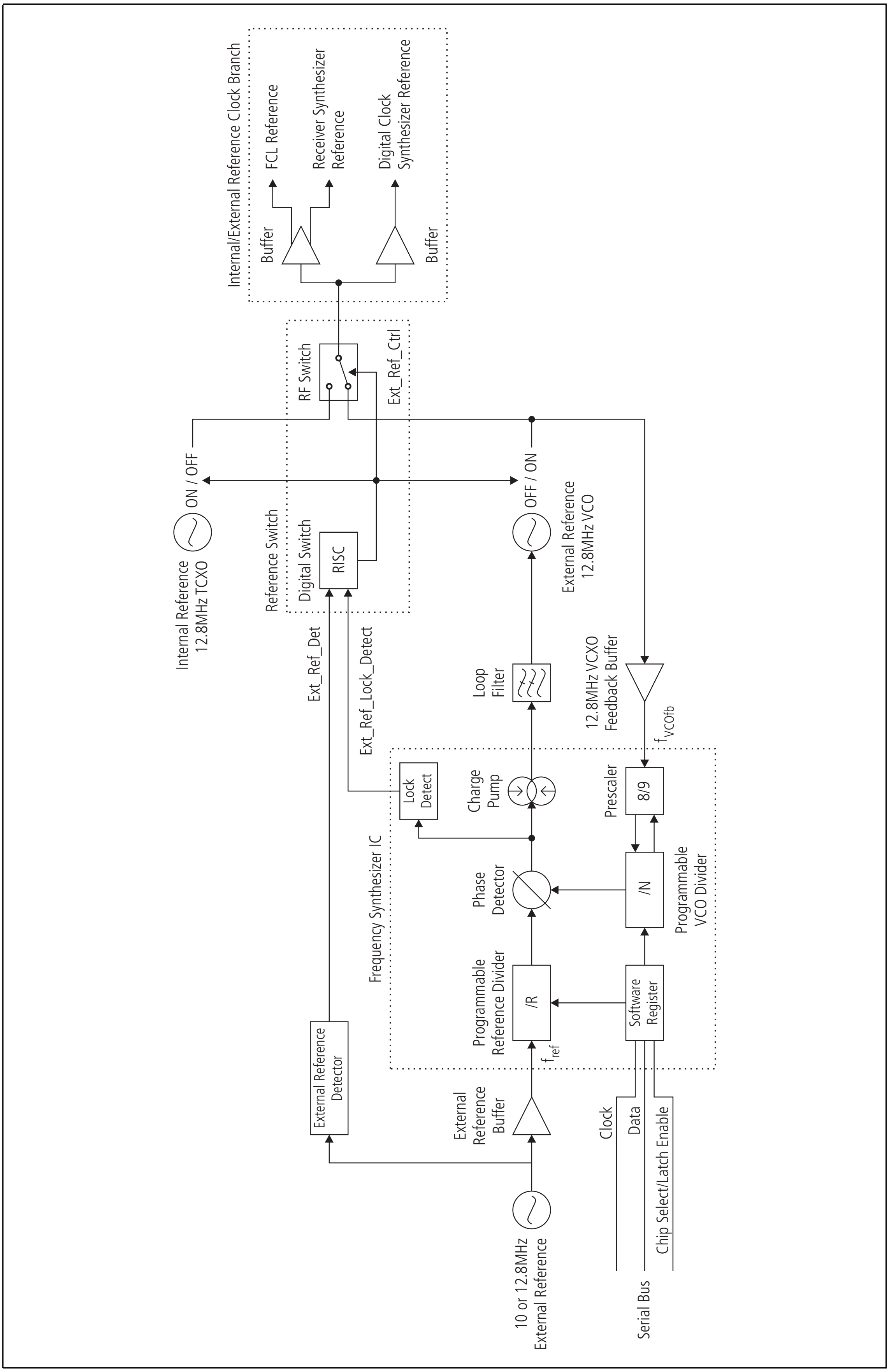
Digital Switch

The digital switch is controlled by the RISC, which processes the Syn_Ref_Det and Lock Detect signals from the external reference synthesizer. The RISC controls the hardware switch using the Syn_Ref_Ctrl signal. The hardware switch is on if the Syn_Ref_Det **and** Lock Detect signals have a high logic level for a set time. In all other conditions the hardware switch is off.

Internal/External Reference Clock Branch

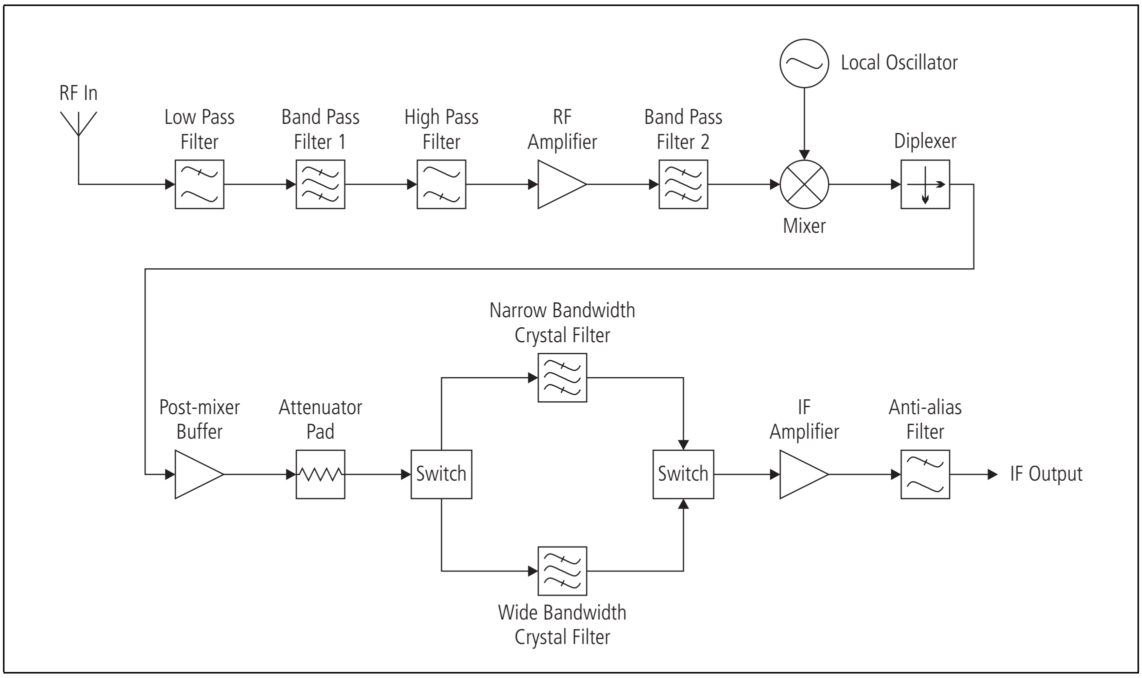
A complementary emitter follower, using NPN/PNP dual transistors, forms two clock buffer branches which distribute the internal or external references to the rest of the system. The branches provide a reasonable drive level at low impedance.

Figure 2.4 Reciter external reference block diagram



2.3 Receiver RF Circuitry - VHF Reciter

Figure 2.5 Reciter VHF receiver RF circuitry block diagram



2.3.1 Front End

The incoming signal from the BNC connector is fed through a low pass filter, then through a band pass "doublet" filter, and finally through a high pass filter. These networks attenuate harmonics and spurious responses. The signal is then amplified and passed through another band pass "doublet" filter before being passed to the mixer.

2.3.2 Mixer

The RF signal from the front end is converted down to the 16.9 MHz IF by a high level (+17 dBm local oscillator) mixer. The voltage controlled oscillator (VCO) generates a level of 20 dBm which is fed to the mixer through an attenuator pad. A diplexer terminates the IF port of the mixer in 50 Ω, thus ensuring a good match for all mixing products, as well as enhancing the linearity. The post-mixer buffer amplifier provides gain and isolation between the mixer and crystal filter. It also compensates for the insertion loss of the crystal filter.

2.3.3 IF Circuitry

The signal from the mixer is fed to the IF amplifier through a 2-pole crystal filter which provides protection from strong off-channel signals. 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 Service Kit (Configure > Base Station > Channel Profiles > General tab).

The IF amplifier is a two-transistor design with voltage and current feedback, which provides sufficient gain to drive the digital receiver. The 16.9MHz signal is finally passed to the analogue-to-digital converter (ADC) in the digital receiver via an anti-alias filter. This filter prevents IF noise at frequencies above 16.9MHz, generated in the amplifier, from being sampled by the ADC at other Nyquist zones.

2.3.4 Synthesizer

The receiver synthesizer consists of a programmable frequency synthesizer IC, the receiver VCO, and a stable known reference.

The synthesizer uses a phase-locked loop to lock the receiver VCO to a stable known frequency reference. The synthesizer IC receives the divider and control information from the RISC processor via a 3-wire serial bus (clock, data and enable). When the data bits are latched in, the synthesizer processes the incoming signals from the VCO feedback signal (f_{vcofb}) and the reference oscillator (f_{ref}).

The VCO feedback attenuator is a resistive divider that terminates the VCO feedback signal in a fixed low impedance (50Ω). This attenuates the VCO RF level down to a level suitable for the RF prescaler (within the synthesizer IC).

A 12.8MHz temperature controlled crystal oscillator (TCXO) is used as the internal reference oscillator. When the TCXO is active, the receiver synthesizer is locked to an “internal reference mode” (by default). Alternatively, a phase-locked 12.8MHz voltage controlled crystal oscillator (VCXO) can be used as the external reference oscillator. When the VCXO is active, the receiver synthesizer is locked to an “external reference mode”. In operation only one oscillator is active at any given time. Refer to “Reference Switch” on page 35 for details on the phase-locked 12.8MHz external reference oscillator.

The reference oscillators are buffered, branched, and divided down to the 3.125kHz (default) or 2.5kHz divider reference within the synthesizer IC. The same divider reference is maintained by dividing the VCO feedback signal using the prescaler and programmable dividers of the synthesizer IC. Phase lock is achieved when both divider references have the same phase and frequency content (i.e. their difference is zero or DC). This is achieved by the phase detector (part of the synthesizer IC), which compares both divider references and delivers an error signal. A ±4mA charge pump circuit (also part of the synthesizer IC) and the active loop filter circuit convert this error signal to a DC voltage (0 to 22V[1]) to tune the VCO for correction. The

1. The normal lock range is between 3V and 16V.

loop filter has a bandwidth of 150 Hz and filters the VCO control lines, reference side bands and spurious signals.

Note The VCO frequency increases as the control line voltage increases.

2.3.5 VCO

The receiver VCO consists of a high Q VCO, low noise amplifier, harmonic filter, fixed slope attenuator, and a final driver. Refer to Figure 2.6 on page 41.

High Q VCO

The VCO BJT transistor operates in a common emitter, Colpitts oscillator configuration (virtual ground at the base). The LC resonator is coupled between the collector and base. A high Q trimmer is coupled to the base end, and varactor diodes are coupled to the collector end. This forms a high Q resonator which is both mechanically and electronically tunable. Mechanical tuning is possible by adjusting the trimmer. Changes in the control voltage from the loop filter are applied to the varactors to facilitate electronic tuning.

Low Noise Amplifier

A BJT cascode amplifier is used as a broad band isolator and low noise amplifier. This has internal self-bias circuitry, and the output provides enough RF power to drive the following stages.

Harmonic Filter

The VCO has a relatively high harmonic content. A third order low pass elliptic filter is used to attenuate this content.

Fixed Slope Attenuator and Final Driver

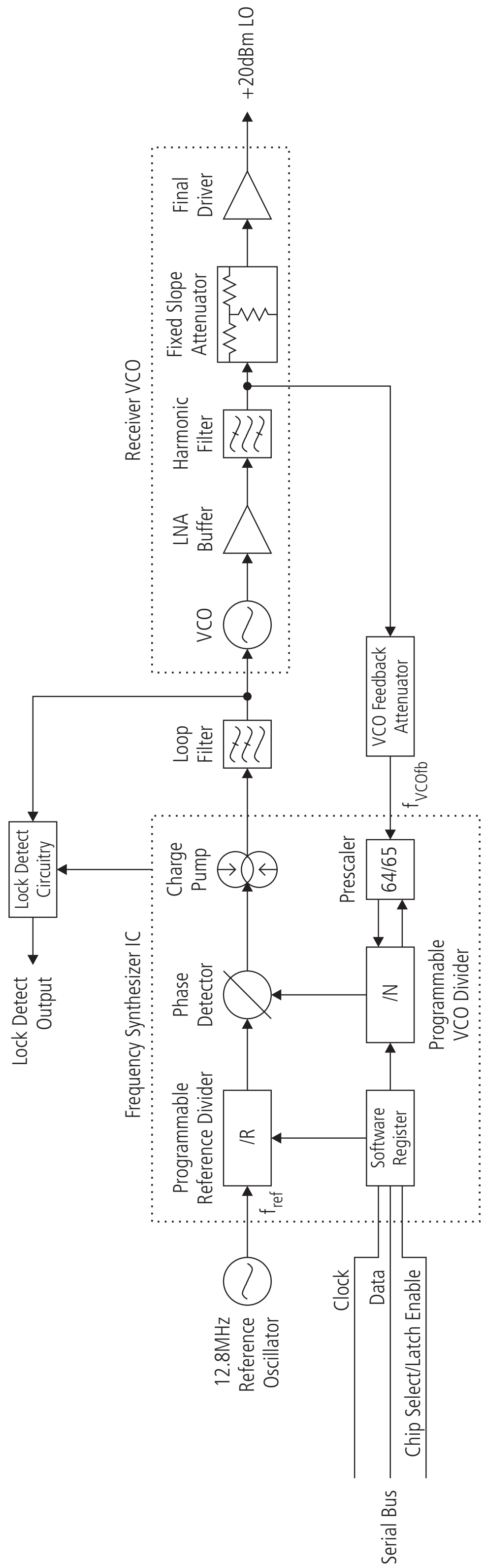
A silicon BJT is used as a broad band matched Class A final driver to drive the +20 dBm local oscillator port of the mixer. To maintain a fixed output level, a fixed slope attenuator is introduced at the input to the final driver so that the attenuation rate (slope) increases with an increase in frequency.

The B-band VCO frequency spans from either 152.9 MHz to 164.9 MHz, or 164.9 MHz to 190.9 MHz, according to the product type. The VCO is tuned to 16.9 MHz above (high side injection) to produce the 16.9 MHz IF signal at the output of the mixer.

The C-band VCO frequency spans from either 190.9 MHz to 209.9 MHz, or 209.9 MHz to 241.9 MHz, according to the product type. The VCO is tuned to 16.9 MHz above (high side injection) to produce the 16.9 MHz IF signal at the output of the mixer.

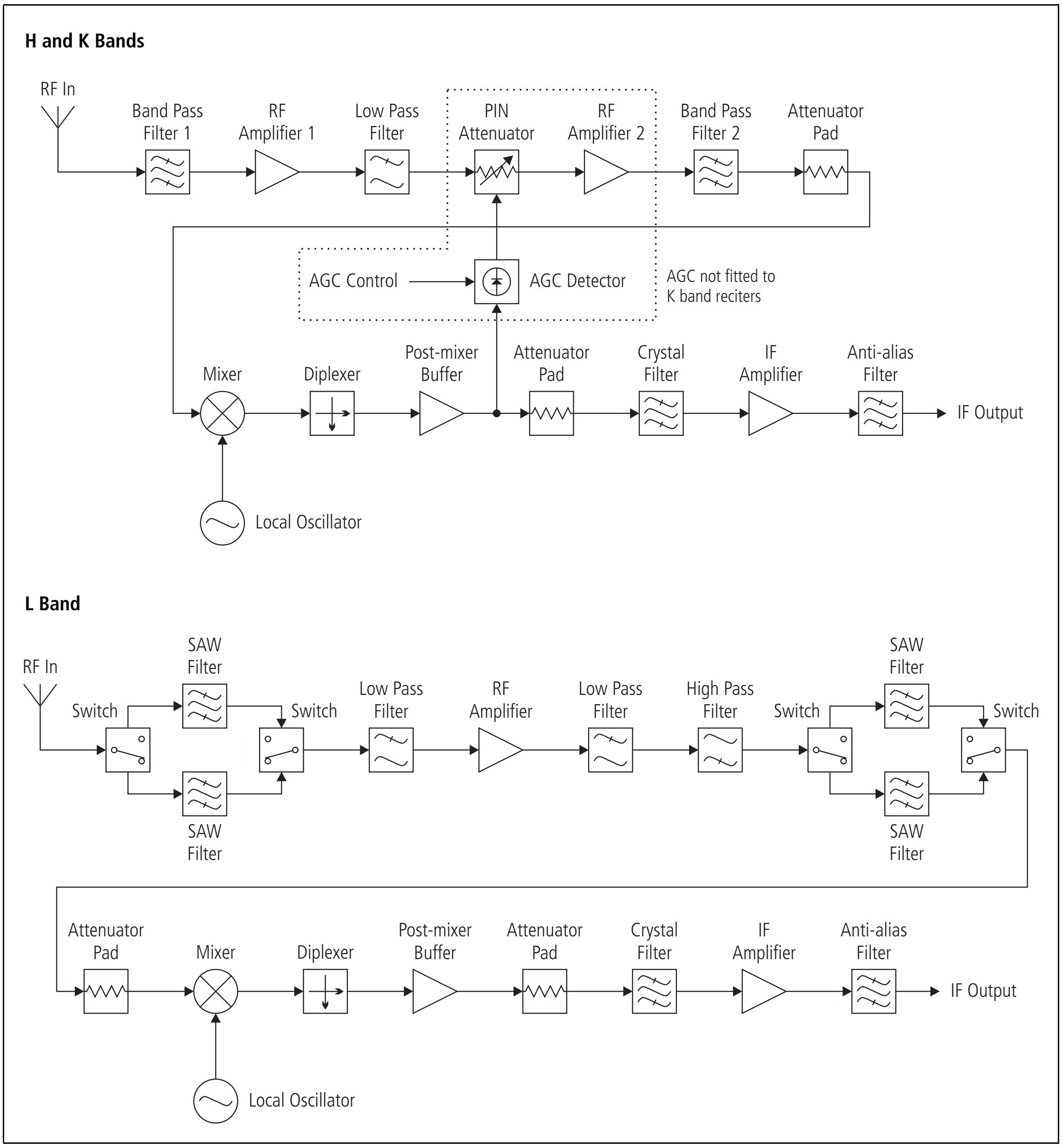
Refer to "Identifying the Reciter" on page 70 for more information on reciter product types.

Figure 2.6 Reciter receiver synthesizer block diagram



2.4 Receiver RF Circuitry - UHF Reciter

Figure 2.7 Reciter UHF receiver RF circuitry block diagram



2.4.1 Front End

H-Band Reciter

The incoming signal from the BNC connector is fed through a triplet helical filter, followed by a simple low pass network which attenuates harmonics and spurious responses from the preceding filter. The signal is then amplified and passed through a low pass filter which provides immunity to interference from higher frequency out-of-band signals. Automatic gain control (AGC) is provided at this point by a PIN diode attenuator. The signal is now amplified again in a second RF amplifier, and is then fed through a band pass filter and attenuator pad to the mixer.

K-Band Reciter

The incoming signal from the BNC connector is fed through a triplet helical filter, followed by a simple low pass network which attenuates harmonics and spurious responses from the preceding filter. The signal is then amplified and passed through a low pass filter, which provides immunity to interference from higher frequency out-of-band signals, and is then fed through a band pass filter and pad to the mixer.

L-Band Reciter

The incoming signal from the BNC connector is fed via a switch to a SAW filter, followed by a simple low pass network which attenuates harmonics and spurious responses from the preceding filter. The signal is then amplified and passed through a low pass filter, which provides immunity to interference from higher frequency out-of-band signals, and is then fed through another SAW filter and pad to the mixer.

2.4.2 Mixer

The RF signal from the front end is converted down to the 70.1 MHz IF by a high level (+17 dBm local oscillator) mixer. The voltage controlled oscillator (VCO) generates a level of 20 dBM which is fed to the mixer through an attenuator pad. A diplexer terminates the IF port of the mixer in 50 Ω, thus ensuring a good match for all mixing products, as well as enhancing the linearity. The post-mixer buffer amplifier compensates for the insertion loss of the crystal filter, and any excess gain is reduced by the following attenuator pad.

2.4.3 IF Circuitry

The signal from the mixer is fed to the IF amplifier through a 4-pole crystal filter which provides protection from strong off-channel signals. The IF amplifier is a two-transistor design with voltage and current feedback, which provides sufficient gain to drive the digital receiver. The 70.1 MHz signal is finally passed to the analogue-to-digital converter (ADC) in the digital receiver via an anti-alias filter. This filter prevents IF noise at frequencies other than 70.1 MHz, generated in the amplifier, from being sampled by the ADC at other Nyquist zones.

2.4.4 Synthesizer

The receiver synthesizer consists of a programmable frequency synthesizer IC, the receiver VCO, and a stable known reference.

The synthesizer uses a phase-locked loop to lock the receiver VCO to a stable known frequency reference. The synthesizer IC receives the divider and control information from the RISC processor via a 3-wire serial bus (clock, data and enable). When the data bits are latched in, the synthesizer processes the incoming signals from the VCO feedback signal (f_{vcofb}) and the reference oscillator (f_{ref}).

The VCO feedback attenuator is a resistive divider that terminates the VCO feedback signal in a fixed low impedance (50 Ω). This attenuates the VCO RF level down to a level suitable for the RF prescaler (within the synthesizer IC).

A 12.8 MHz temperature controlled crystal oscillator (TCXO) is used as the internal reference oscillator. When the TCXO is active, the receiver synthesizer is locked to an "internal reference mode" (by default). Alternatively, a phase-locked 12.8 MHz voltage controlled crystal oscillator (VCXO) can be used as the external reference oscillator. When the VCXO is active, the receiver synthesizer is locked to an "external reference mode". In operation only one oscillator is active at any given time. Refer to "Reference Switch" on page 35 for details on the phase-locked 12.8 MHz external reference oscillator.

The reference oscillators are buffered, branched, and divided down to the 6.25 kHz (default) or 5 kHz divider reference within the synthesizer IC. The same divider reference is maintained by dividing the VCO feedback signal using the prescaler and programmable dividers of the synthesizer IC. Phase lock is achieved when both divider references have the same phase and frequency content (i.e. their difference is zero or DC). This is achieved by the phase detector (part of the synthesizer IC), which compares both divider references and delivers an error signal. A ±4 mA charge pump circuit (also part of the synthesizer IC) and the active loop filter circuit convert this error signal to a DC voltage (0 to 22 V[1]) to tune the VCO for correction. The loop filter has a bandwidth of 150 Hz and filters the VCO control lines, reference side bands and spurious signals.

Note The VCO frequency increases as the control line voltage increases.

2.4.5 VCO

The receiver VCO consists of a high Q VCO, low noise amplifier, harmonic filter, fixed slope attenuator, and a final driver. Refer to Figure 2.8 on page 45.

High Q VCO

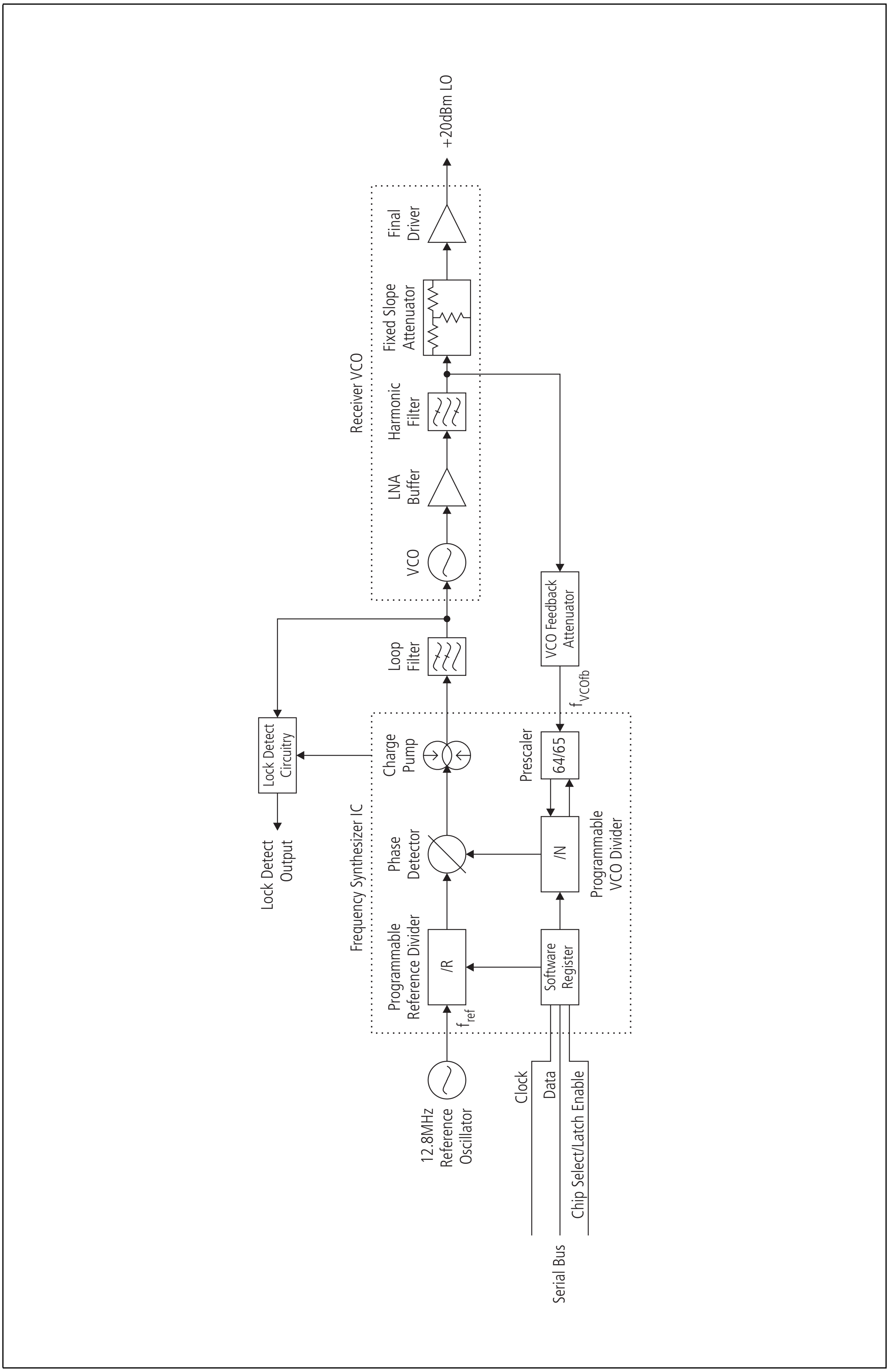
The VCO BJT transistor operates in a common collector, Colpitts oscillator configuration, and uses a shorted quarter-wave ceramic coaxial resonator. The open end of the resonator is terminated by a combination of a high Q trimmer and varactor diodes. This forms a high Q resonator which is both mechanically and electronically tunable. Mechanical tuning is possible by adjusting the trimmer. Changes in the control voltage from the loop filter are applied to the varactors to facilitate electronic tuning.

Low Noise Amplifier

An N-channel dual gate MOSFET is used as a broad band matched Class A low noise amplifier. It has internal self-bias circuitry, and the output provides enough RF power to drive the following stages.

1. The normal lock range is between 3 V and 16 V.

Figure 2.8 Reciter receiver synthesizer block diagram



Harmonic Filter

The VCO has a high second harmonic content. A third order low pass elliptic filter is used to attenuate this content.

Fixed Slope Attenuator and Final Driver

A silicon-based BJT transistor is used as a broad band matched Class A final driver to drive the +20dBm local oscillator port of the mixer. To maintain a fixed input level, a fixed slope attenuator is introduced at the input to the final driver so that the attenuation rate (slope) decreases with an increase in frequency.

The H-band VCO frequency spans the following frequency ranges, according to the product type:

- H1 – 470.1MHz to 510.1MHz (high side)
- H2 – 369.9MHz to 409.9MHz (low side)
- H3 – 399.9MHz to 449.9MHz (low side
- H4 – 450.1MHz to 490.1MHz (high side).

The VCO is tuned to either 70.1MHz below (low side injection) or above (high side injection) to produce the 70.1MHz IF signal at the output of the mixer.

The K-band VCO frequency spans from 721.9MHz to 753.9MHz. The VCO is tuned to 70.1MHz below (low side injection) to produce the 70.1MHz IF signal at the output of the mixer.

The L-band VCO frequency spans from 781.9MHz to 859.9MHz. The VCO is tuned to 70.1MHz below (low side injection) to produce the 70.1MHz IF signal at the output of the mixer.

Refer to “Identifying the Reciter” on page 70 for more information on reciter product types.

2.4.6 AGC (H Band Only)

The AGC is used to prevent the ADC from being overloaded by strong interfering signals present at the receiver antenna port. The AGC loop consists of a PIN diode attenuator, AGC buffer, and detector. The pick-off point for the AGC is the output of the post-mixer buffer. The input signal to the AGC is buffered, amplified and then detected. The detected DC voltage is buffered and fed to PIN_CTRL to control the attenuation of the PIN attenuator.

To prevent overload of the ADC, the peak level at its input should not exceed 0dBm. This corresponds to −30dBm at the antenna connector, and approximately −22dBm at the AGC pick-off point. The AGC operates over a range of approximately 11dB.

The AGC circuit can be enabled or disabled using the Service Kit (Configure > Base Station > Channel Profiles > General tab).

2.5 Exciter RF Circuitry

Refer to Figure 2.10 on page 49 and Figure 2.11 on page 50.

2.5.1 Frequency Control Loop

Audio modulation of the exciter synthesizer is implemented in the frequency control loop (FCL). It uses a three-point modulation scheme involving the FCL_VCXO and VCO signals.

The FCL consists of reference oscillators, clock buffers, twisted ring counter phase detectors, low pass filters (LPFs), ADCs, the FCL processor and digital-to-analogue converters (DACs).

Reference Oscillators

Modulation to the FCL_VCXO reference oscillator requires the use of the FCL_VCXO_CTRL and SYN_VCO_MOD signals to apply:

- a constant DC offset to the FCL_VCXO signal until it achieves frequency lock to the internal referenced TCXO;
- frequency modulation to the FCL_VCXO and VCO simultaneously from the transmit audio signal; the transmit audio signal has a range of 0 to 3kHz.

The modulated signal from the VCXO is attenuated by the bandwidth of the loop filter in the low pass filter (i.e. 150Hz). To obtain flat modulation across the audio band, the VCO is also modulated simultaneously to obtain a composite high pass filter response. Figure 2.9 shows the relationships between the frequency modulation gain characteristics of the VCXO and VCO.

Clock Buffers

The TCXO and VCXO signals are squared up and buffered as digital signals using hex inverters.

Twisted Ring Counter

The VCXO and TCXO signals are phase shifted and multiplied by XOR (exclusive_or) logic. This is achieved using a twisted ring counter, which also divides both signals by four.

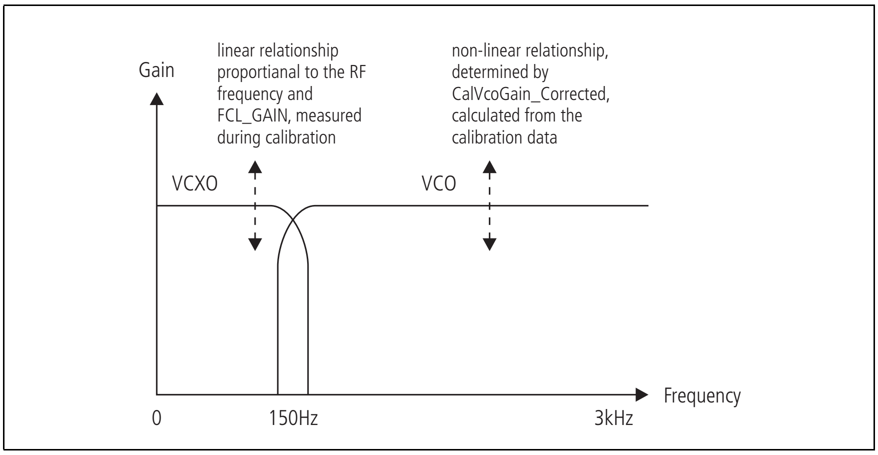
Low Pass Filter

There are two output signals from the twisted ring counter. Both signals have the sum and difference frequency contents of the TCXO and VCXO signals, but there is a 90° phase difference between them.

I and Q low pass filters capture the difference frequency contents down to DC and integrate them to form two triangular waves, which are 90° out of phase with each other. This frequency is equal to a quarter of the difference frequency content of the TCXO and VCXO signals.

The in-phase triangle frequency is referred to as “I channel” and the quadrature-phase triangle frequency is referred to as “Q channel”.

Figure 2.9 Comparison of VCXO and VCO modulation responses



ADC

The I_Q channel triangular analogue waveforms are sampled and transformed to digits using a 16-bit ADC with a signal-to-noise ratio of 75 dB.

FCL Processor and DAC

The FCL processor runs a DSP-based algorithm which takes the digitised signals, I_Q and transmit audio, and compares them to the transmit modulation calibration data.

Using the compared results it attempts to lock FCL_VCXO to the TCXO, as well as modulate the FCL_VCXO and VCO signals to achieve modulation flatness across the transmit audio and VCO RF bands.

The FCL processor achieves this by sending the digitised modulation code through a16-bit DAC. Here the code is translated to analogue signals which modulate FCL_VCXO and the VCO. The DAC has a signal-to-noise ratio of 70 dB.

2.5.2 Synthesizer

The exciter synthesizer consists of a programmable frequency synthesizer IC, the exciter VCO, and a modulatable frequency reference.

The synthesizer uses a phase-locked loop to lock the exciter VCO to a modulatable frequency reference. The synthesizer IC receives the divider and control information from the RISC processor via a 3-wire serial bus (clock, data and enable). When the data bits are latched in, the synthesizer processes the incoming signals from the VCO feedback signal (f_{vcofb}) and the reference oscillator (f_{ref}).

The VCO feedback attenuator is a resistive divider that terminates the VCO feedback signal in a fixed low impedance (50 Ω). This attenuates the VCO RF level down to a level suitable for the RF prescaler (within the synthesizer IC).

Figure 2.10 Reciter exciter synthesizer modulator block diagram - B, C and H bands

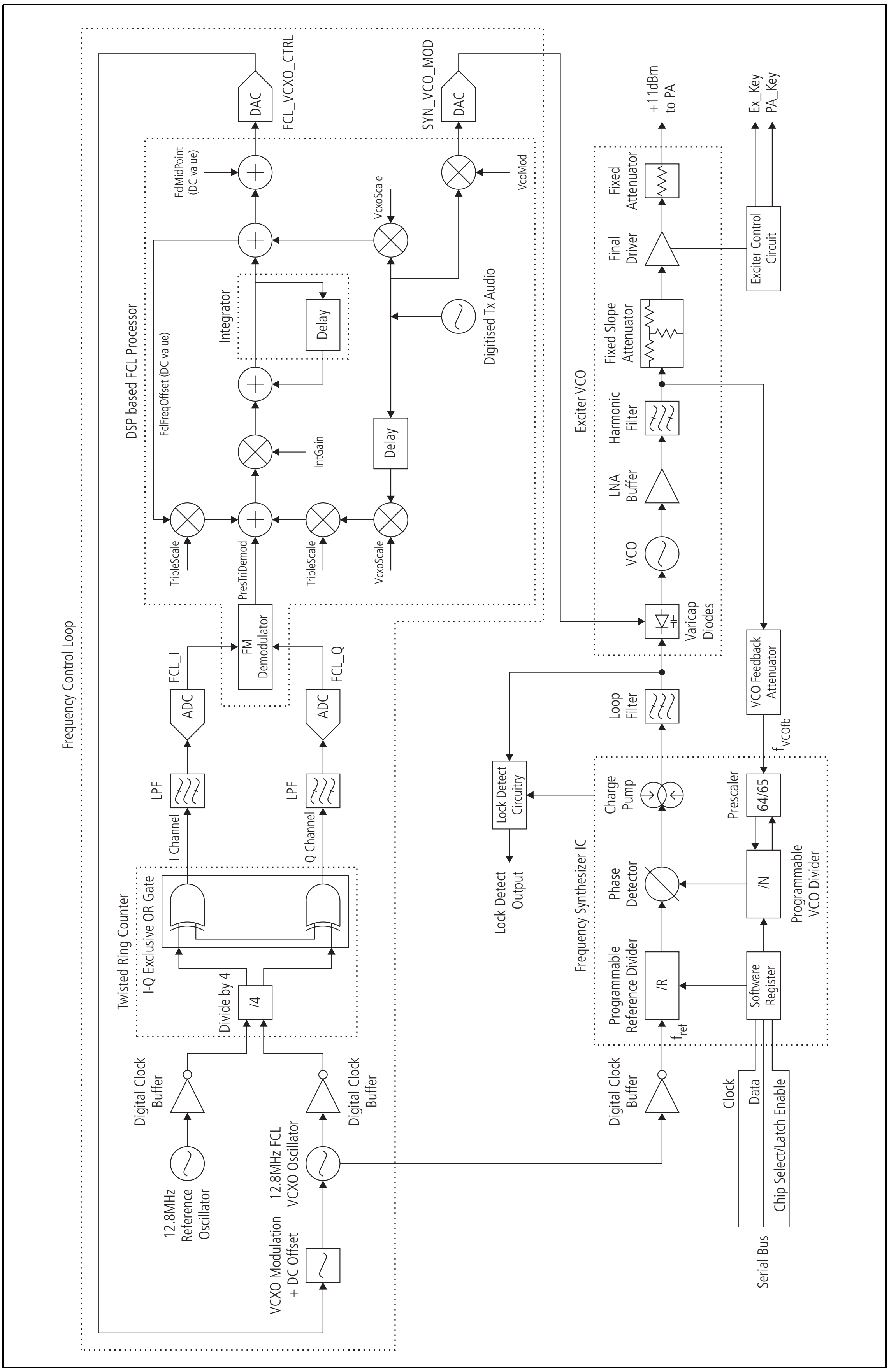
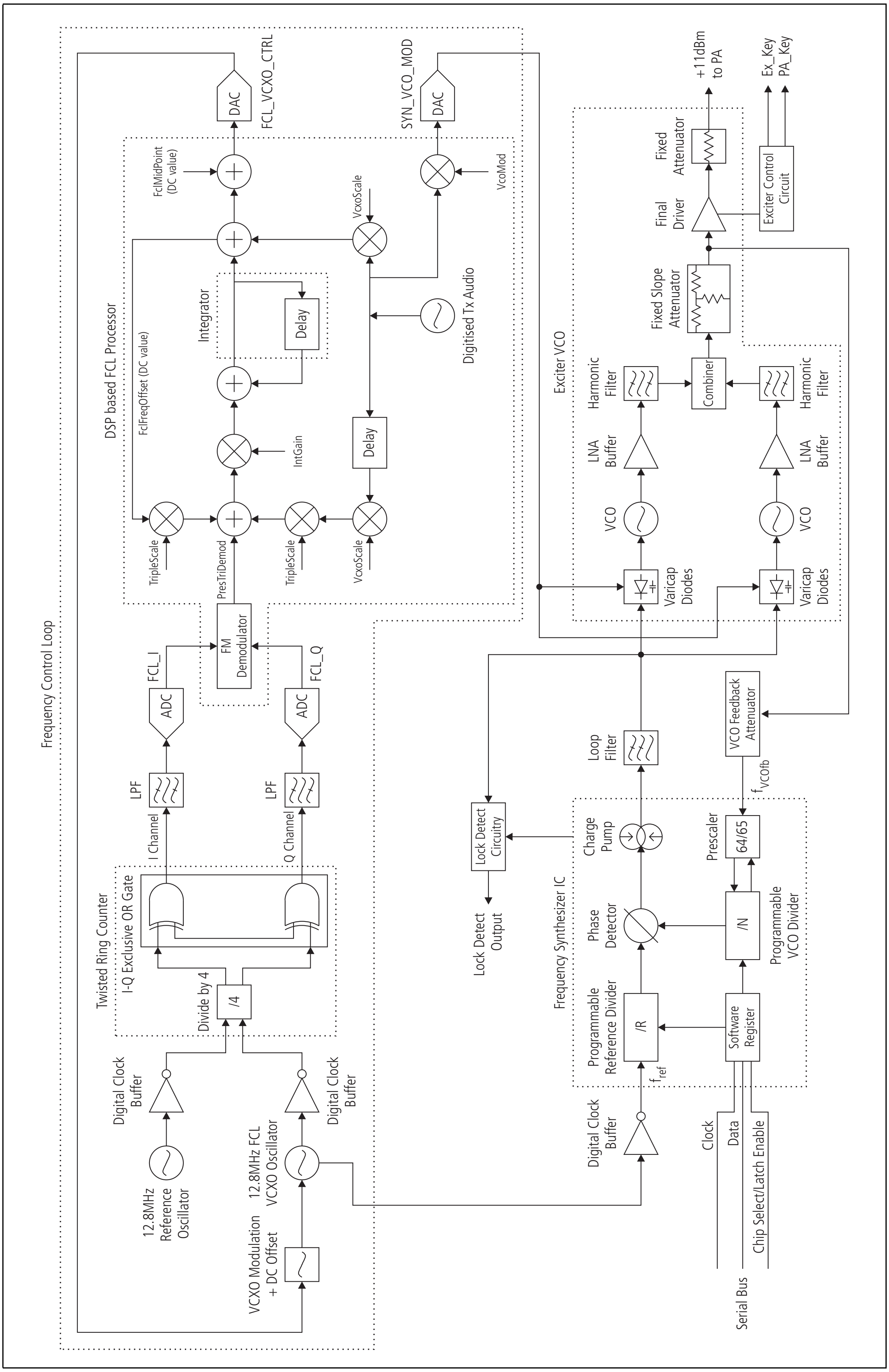


Figure 2.11 Reciter exciter synthesizer modulator block diagram - K and L bands



The FCL_VCXO reference oscillator is modulated by the FCL. The FCL itself is locked to an internal reference 12.8MHz TCXO. When the TCXO is active, the exciter synthesizer is locked to an "internal reference mode" (by default). Alternatively, the FCL is locked to a phase locked 12.8MHz external reference oscillator. When this external oscillator is active, the exciter synthesizer is locked to an "external reference mode". In operation only one reference oscillator is active at any given time. Refer to "Reference Switch" on page 35 for details on the phase-locked 12.8MHz external reference oscillator.

The FCL_VCXO reference oscillator is buffered and divided down to the appropriate divider reference within the synthesizer IC:

- VHF - 3.125kHz (default) or 2.5kHz
- UHF - 6.25kHz (default) or 5kHz.

The same divider reference is maintained by dividing the VCO feedback signal using the prescaler and programmable dividers of the synthesizer IC. Phase lock is achieved when both divider references have same phase and frequency content (i.e. their difference is zero or DC). This is achieved by the phase detector (part of the synthesizer IC), which compares both divider references and delivers an error signal. A ±4mA charge pump circuit (also part of the synthesizer IC) and the active loop filter circuit convert this error signal to a DC voltage (0 to 22V[1]) to tune the VCO for correction. The loop filter has a bandwidth of 150Hz and filters the VCO control lines, reference side bands and spurious signals.

Note The VCO frequency increases as the control line voltage increases.

2.5.3 VCO - VHF Reciter

The exciter VCO consists of a high Q VCO, modulation based on varicap diodes, low noise amplifier, harmonic filter, fixed slope attenuator, final driver and a fixed attenuator.

High Q VCO

The VCO BJT transistor operates in a common emitter, Colpitts oscillator configuration (virtual ground at the base). The LC resonator is coupled between the collector and base. A high Q trimmer is coupled to the base end, and varactor diodes are coupled to the collector end. This forms a high Q resonator which is both mechanically and electronically tunable. Mechanical tuning is possible by adjusting the trimmer. Changes in the control voltage from the loop filter are applied to the varactors to facilitate electronic tuning.

1. The normal lock range is between 3V and 16V.

Modulation Based on Varicap Diodes

Modulation on the VCO is provided by an auxiliary varicap-based control circuit which provides a modulation gain of 5kHz/V_p.

Low Noise Amplifier

A BJT cascode amplifier is used as a broad band isolator and low noise amplifier. This has internal self-bias circuitry, and the output provides enough RF power to drive the following stages.

Harmonic Filter

The VCO has a relatively high harmonic content. A third order low pass elliptic filter is used to attenuate this content.

Fixed Slope Attenuator, Final Driver and Fixed Attenuator

A silicon BJT is used as a broad band matched Class A final driver to drive the +20dBm local oscillator port of the mixer. To maintain a fixed output level, a fixed slope attenuator is introduced at the input to the final driver so that the attenuation rate (slope) increases with an increase in frequency. A fixed attenuator provides a signal level of +11dBm ±2dB to the input port of the PA, providing better reverse isolation.

The B-band VCO frequency spans from either 136MHz to 156MHz, or 148MHz to 174MHz, according to the product type.

The C-band VCO frequency spans from either 174MHz to 193MHz, or 193MHz to 225MHz, according to the product type.

Refer to "Identifying the Reciter" on page 70 for more information on reciter product types.

2.5.4 VCO - UHF Reciter

The exciter VCO consists of a high Q VCO, modulation based on varicap diodes, low noise amplifier, harmonic filter, fixed slope attenuator, final driver and a fixed attenuator.

Note that the K-band reciter uses two VCOs (refer to Figure 2.11 on page 50), with the appropriate VCO stage being selected for operation according to the frequency of the channel in use. Only one VCO can be operational at any one time.

High Q VCO

The VCO BJT transistor operates in a common collector, Colpitts oscillator configuration, and uses a shorted quarter-wave ceramic coaxial resonator. The open end of the resonator is terminated by a combination of a high Q trimmer and varactor diodes. This forms a high Q resonator which is both mechanically and electronically tunable. Mechanical tuning is possible by adjusting the trimmer. Changes in the control voltage from the loop filter are applied to the varactors to facilitate electronic tuning.

Modulation Based on Varicap Diodes

Modulation on the VCO is provided by an auxiliary varicap-based control circuit which provides a modulation gain of 5kHz/V_p.

Low Noise Amplifier

An N-channel dual gate MOSFET is used as a broad band matched Class A low noise amplifier. It has internal self-bias circuitry, and the output provides enough RF power to drive the following stages.

Harmonic Filter

The VCO has a high second harmonic content. A third order low pass elliptic filter is used to attenuate this content.

Fixed Slope Attenuator, Final Driver and Fixed Attenuator

To provide a drive of +20dBm, a silicon-based BJT transistor is used as a broad band matched Class A final driver. To maintain a fixed input level, a fixed slope attenuator is introduced at the input to the final driver so that the attenuation rate (slope) decreases with an increase in frequency. A fixed attenuator provides a signal level of +11dBm ±2dB to the input port of the PA, providing better reverse isolation.

The H-band VCO frequency spans from either 380MHz to 420MHz, 400MHz to 440MHz, 440MHz to 480MHz, or 470MHz to 520MHz, according to the product type.

The K-band reciter uses two VCOs to span from either 762MHz to 776MHz, or 850MHz to 870MHz, according to the product type.

The L-band reciter uses two VCOs to span from either 850MHz to 870MHz, or 927MHz to 941MHz, according to the product type.

Refer to "Identifying the Reciter" on page 70 for more information on reciter product types.

2.5.5 Exciter Control Circuit

This circuit powers up and shuts down the exciter final driver in a controlled manner. During transient and cycling keying conditions, the exciter must power up and shut down in a specified time sequence to reduce adjacent channel power. The exciter control circuit uses Ex_Key to power up or shut down the VCO final driver, and PA_Key to power up or shut down the PA driver.

2.6 System Interface Boards

The reciter can be fitted with an optional system interface board which provides the links between the reciter's internal circuitry and external equipment. This board is securely mounted to the reciter's chassis and is connected to the digital board with a flexible connector. The system interface board is fitted with industry-standard connectors and several standard types are available for different applications.

The circuitry on the system interface board provides additional signal processing so that the outputs meet standard system requirements. It also enables the board to identify itself to the reciter control circuitry.

The system interface board is removable, which makes it possible to change the application of a reciter by removing one type of board and fitting another. Only one system interface board can be fitted to a reciter at any one time.

The following section provides an overview of all the system interface circuitry. However, not all the circuitry described here will be fitted to any particular system interface board. The different types of board and their main features are listed in Table 2.1 on page 55. Refer also to Figure 2.12 on page 56.

Table 2.1 Main features of the system interface boards

	System Interface Board					
Feature	**Standard[a]**	**Isolated**	**Isolated E & M**	**TaitNet**	**TaitNet RS-232**	**TaitNet Ethernet[b]**
balanced audio	non-isolated	isolated	isolated	isolated	isolated	isolated
unbalanced audio	✓	✓	✓	✓	✓	✓
unbalanced audio input	AC coupled			version 0: AC coupled[c] version 1: DC coupled		DC coupled
RSSI	✓	✓	✓			✓
Rx Gate	✓	✓	✓	✓	✓	✓
Tx Key	✓	✓	✓	✓	✓	✓
digital inputs	6	6	2	1	1	
digital outputs	2	2	2	3	3	
bidirectional digital inputs/outputs	4[d]	4[d]	4[d]			4[e]
Tx relay output	✓	✓	✓			✓
auxiliary power	✓	✓	✓	✓	✓	✓
opto-coupled input			✓			✓
opto-coupled output			✓			✓
third-party connector	✓	✓	✓	✓	✓	✓
RS-232 serial port					✓	
Ethernet connector						✓

a. No longer available. Production of this board ended in 2004.

b. On the TaitNet Ethernet system interface board, some pins on the system interface connector can be configured to provide different signals (selectable by switch). For more details refer to Application Note TN-1142-AN.

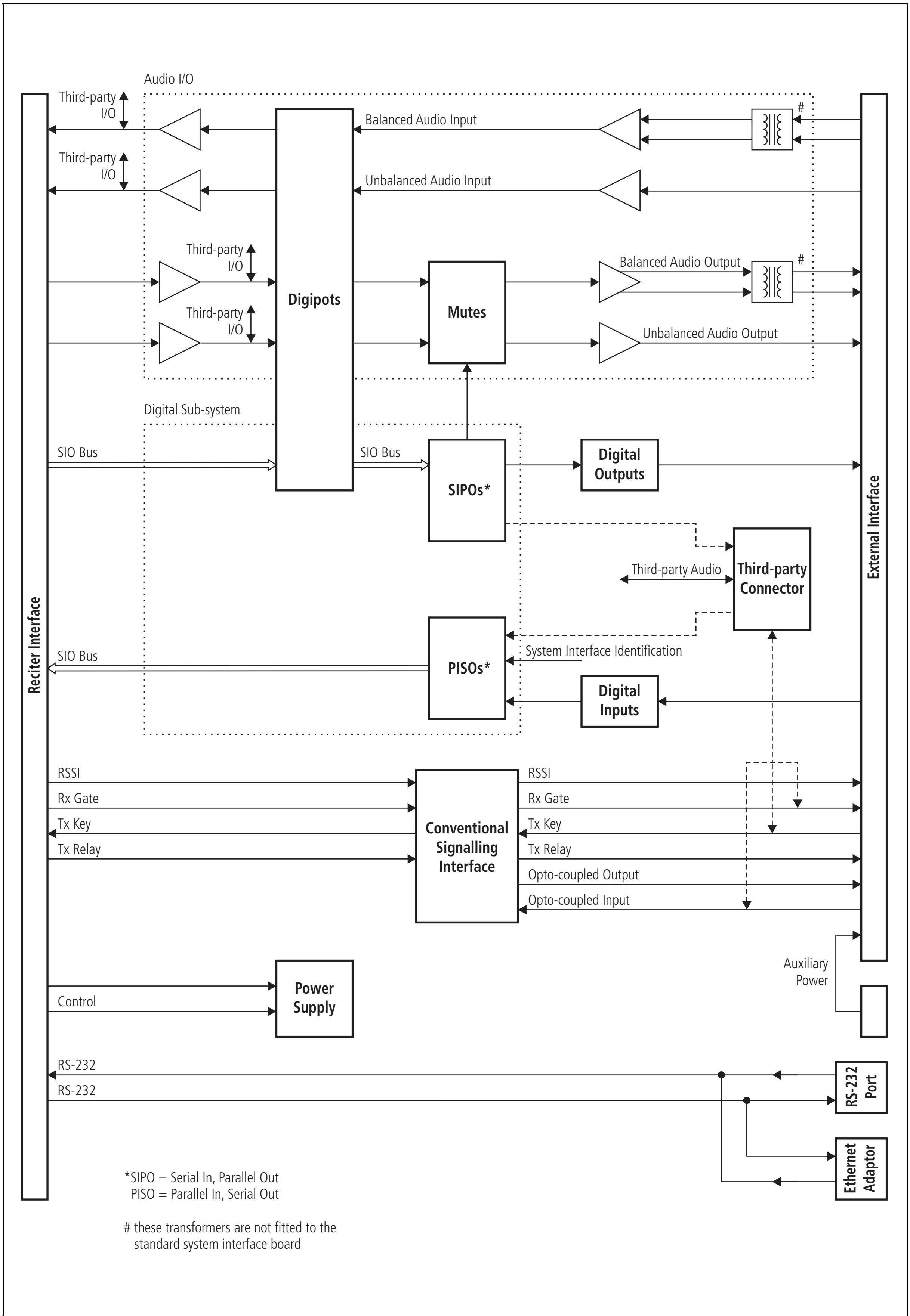
c. The unbalanced input on these boards was changed from AC to DC coupled in August 2005. This change was made for paging, and the version of these boards was changed from 0 to 1. To check the version of a system interface board, run the Service Kit and select Monitor > Module Details > Reciter. In the **Versions** area, the **System Interface** field displays the version number.

d. On version 1 and later system interface boards, digital inputs 3, 4, 5, and 6 may also be configured as outputs using a Task Manager statement. For more details refer to the "Connection" chapter in the Installation and Operation Manual, and to the Service Kit documentation.

e. On the TaitNet Ethernet system interface board, digital inputs 1, 2, 3, and 4 may also be configured as outputs using a Task Manager statement. For more details refer to the "Connection" chapter in the Installation and Operation Manual, the Service Kit documentation, and to Application Note TN-1142-AN.

Note This section provides details on the system interface boards available at the time of publication. Other types may be developed for future applications.

Figure 2.12 Reciter system interface board block diagram



Connections to the Reciter

The system interface board has two connections to the reciter: a 40-way flexible connection, and a high-speed connection.

The 40-way connection is essential to the system interface board's operation. It provides power and communications from the reciter, along with all the other system interface inputs and outputs.

The high-speed connection is only used on system interface boards which require a high rate data connection to the reciter processor.

Balanced Audio Output

The balanced audio output is a 600 Ω audio interface. The output level can be set over the range −20 dBm to +10 dBm, for 60% modulation. The output level can be set with a resolution of 0.1 dB. This output may be either transformer isolated or just AC coupled.

Unbalanced Audio Output

The unbalanced audio output should only be used with high impedance loads (greater than 10 kΩ). The output level can be set over the range 0.3 Vpp to 3.0 Vpp, for 60% modulation. The output level can be set with a resolution of 0.1 Vpp. This output is AC coupled.

Balanced Audio Input

The balanced audio input is a 600 Ω audio interface. The input level can be set over the range −20 dBm to +10 dBm, for 60% modulation. The input level can be set with a resolution of 0.1 dB. This input may be either transformer isolated or just AC coupled.

Unbalanced Audio Input

The unbalanced audio input is a high impedance input (greater than 10 kΩ). The input level can be set over the range 0.3 Vpp to 3.0 Vpp, for 60% modulation. The input level can be set with a resolution of 0.1 Vpp. This input can be either AC coupled or DC coupled, depending on the type of board (refer to Table 2.1 on page 55).

RSSI

The RSSI output is DC coupled and provides a voltage proportional to the received signal strength with a user-defined characteristic.

Rx Gate

The Rx Gate output is an open collector output. The transistor is on when a valid signal is received. The maximum current rating of this output is 100 mA. The maximum voltage that should be applied to this output is 30 V.

Tx Key

The Tx Key input has a high input threshold guaranteed to be greater than 5 V. The low input threshold is 2 V. A low input keys the transmitter.

Digital Inputs

The digital inputs have 5 V logic thresholds and are active low. The maximum external pull-up voltage on these inputs is 20 V.

Digital Outputs

The digital outputs are open collector outputs. The maximum current rating of these outputs is 100mA. The maximum voltage that should be applied to these outputs is 30V.

Tx Relay Driver Output

The Tx relay driver output is an open collector output. The maximum current rating of this output is 250mA. The maximum voltage that should be applied to this output is 30V.

Opto-coupled Keying Input

This input operates in parallel with the Tx Key input. Although it has the same functionality as the Tx Key input, it is electrically isolated. The input may be driven with a voltage in the range ±10V to ±60V. The input current is regulated to 10mA.

Opto-coupled Gate Output

This output operates in parallel with the Rx Gate output. Although it has the same functionality as the Rx Gate output, it is electrically isolated. The maximum output current is 120mA. The maximum voltage that should be applied across this output is ±350V.

Third-party Connector

The third-party connector provides access to audio, keying, gating and digital I/O signals to allow the integration of third-party modules such as scramblers.

RS-232 Serial Port

The TaitNet RS-232 system interface board is fitted with an RS-232 serial port (9-way female D-range connector). Note that when a reciter fitted with a TaitNet RS-232 system interface board is used in a TB8100 base station, the RS-232 port on the control panel is disabled. In this situation you must connect to the RS-232 port at the rear of the reciter.

Ethernet Adaptor

The TaitNet Ethernet system interface board is fitted with an Ethernet adaptor which provides Ethernet connectivity via a standard RJ45 connector. Note that when a reciter fitted with a TaitNet Ethernet system interface board is used in a TB8100 base station, connection via the RS-232 port on the control panel is only available when the base station first powers up. Refer to Application Note TN-1142-AN for more details.

Power Supplies

The system interface board is powered via the 40-way flexible connection to the reciter.

2.7 Power Supply

Refer to Figure 2.13 on page 60.

The reciter is designed to operate from the +28V regulated supply provided by the PMU. The nominal +28V supply enters the reciter digital board and passes through an overcurrent and overvoltage protection section before being distributed. The protected +28V output supplies the control comparators, fan switch, and main regulators. There is one regulator on the digital board and another on the RF board.

RF Board

The main regulator is a switched mode converter that has two outputs: the flyback portion generates +8.5V, and the buck portion generates +5.3V.

The +8.5V supply is regulated to +8.0V for reticulation to the RF circuits, either directly, or via switching circuits used in power saving modes. The +8.5V supply is also used to power the analogue sections of the system interface board (via the digital board).

The +5.3V supply is regulated to +3.3V to power the RF synthesizers.

The RF board has a charge pump converter that generates +23V from both the +5.3V and +8.5V supplies. This is used to supply the active loop filters of the RF synthesizers. The +8.5V output and the +5.3V supply to the charge pump can be switched as part of the power saving modes.

Digital Board

The main regulator is a switched mode converter that has two outputs: the flyback portion generates +5.3V, and the buck portion generates +3.3V.

The +5.3V output supplies the op amps associated with the CODECs and is distributed with regulators: +5V for the ADC, +5V for the system, and +3V for the 40MHz clock circuitry. The +5.3V and +5V regulated supplies can be switched as part of the power saving modes.

The +3.3V output is distributed to the remaining circuitry and to the +2.5V regulator for the DSP. These are switched as part of the power saving modes. The +3.3V output is also supplied to the system interface board via a protection circuit.

Figure 2.13 Reciter power supply block diagram

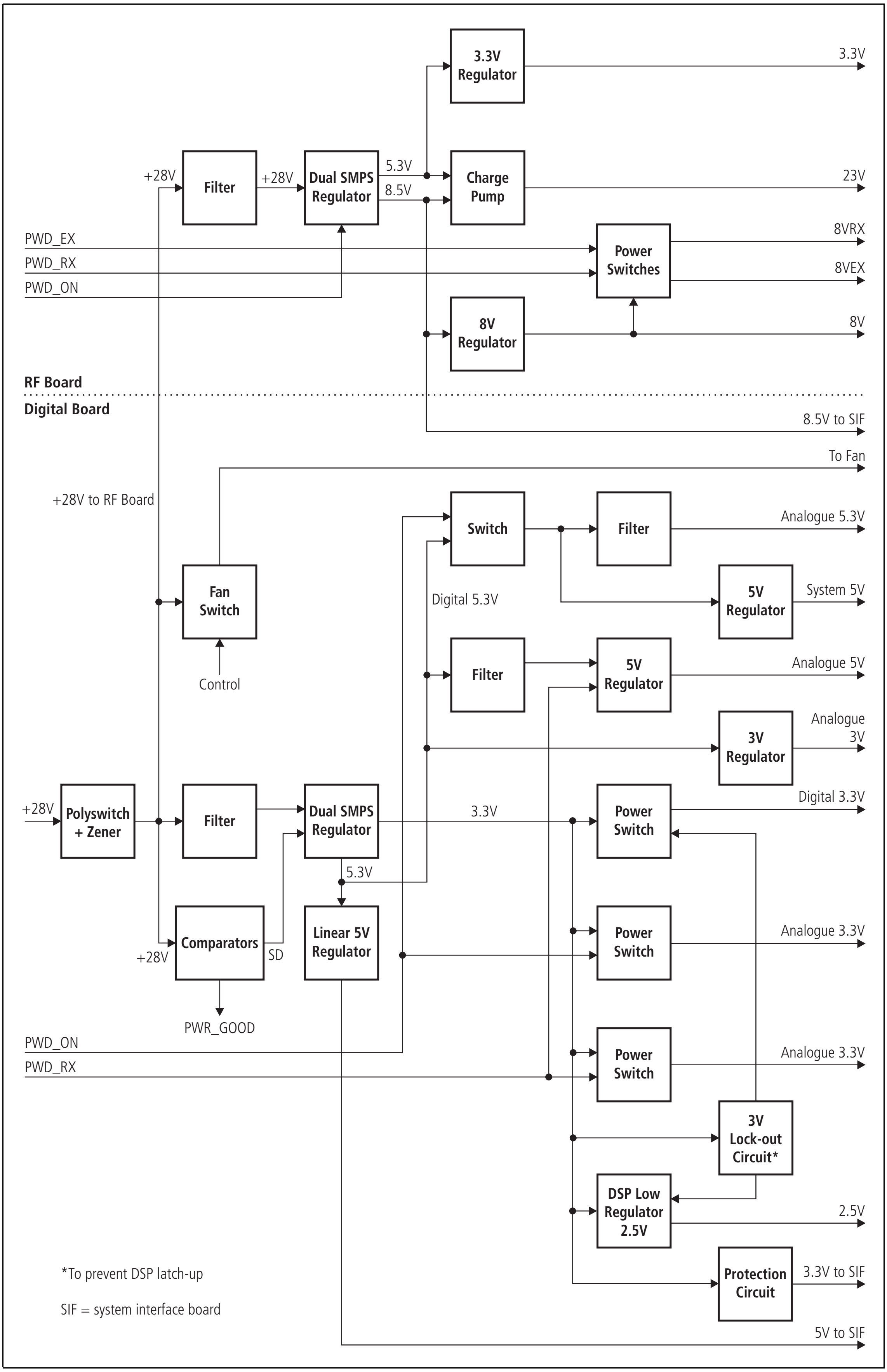
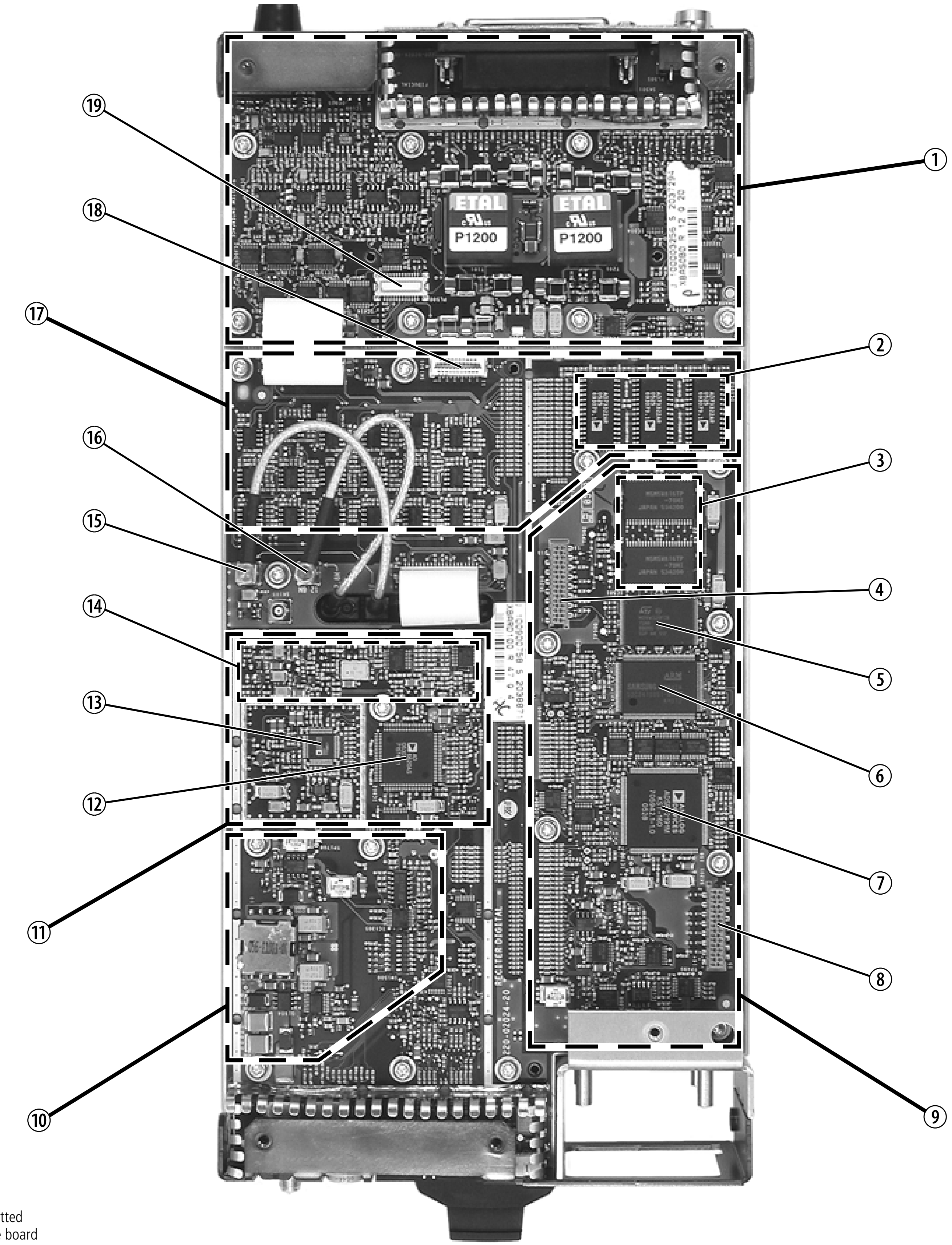


Figure 2.14 Identifying the circuitry on the digital and system interface boards

① system interface board
② CODECs
③ SRAM
④ RISC JTAG connector (factory use only)
⑤ flash memory
⑥ RISC
⑦ DSP
⑧ DSP JTAG connector (factory use only)
⑨ main digital system
⑩ power supply
⑪ digital IF and clock
⑫ DDC
⑬ ADC
⑭ 40MHz digital clock
⑮ 16.9MHz IF (VHF) / 70.1MHz IF (UHF)
⑯ 12.8MHz reference
⑰ audio
⑱ high speed data connector
⑲ third-party connector



VHF (B-band) reciter shown fitted
with isolated system interface board

Figure 2.15 Identifying the circuitry on the RF board - B and C bands

① external reference input
② mixer and post-mixer buffer
③ receiver VCO
④ receiver VCO trimmer
⑤ IF tuning elements - narrow bandwidth
⑥ IF tuning elements - wide bandwidth
⑦ receiver synthesizer
⑧ IF
⑨ TCXO
⑩ audio buffers
⑪ exciter VCO
⑫ exciter VCO trimmer
⑬ exciter synthesizer
⑭ exciter RF output
⑮ FCL
⑯ FCL buffers
⑰ power supply
⑱ external reference switch/internal VCXO reference
⑲ front end second doublet
⑳ front end second doublet trimmers
㉑ front end
㉒ front end first doublet
㉓ front end first doublet trimmers
㉔ low pass filter
㉕ receiver RF input

Note:
In order to show as much of the circuitry as possible in the photograph, the SMD shields have been removed. The photograph shows a B-band reciter. The layout of the C-band reciter circuitry is identical.

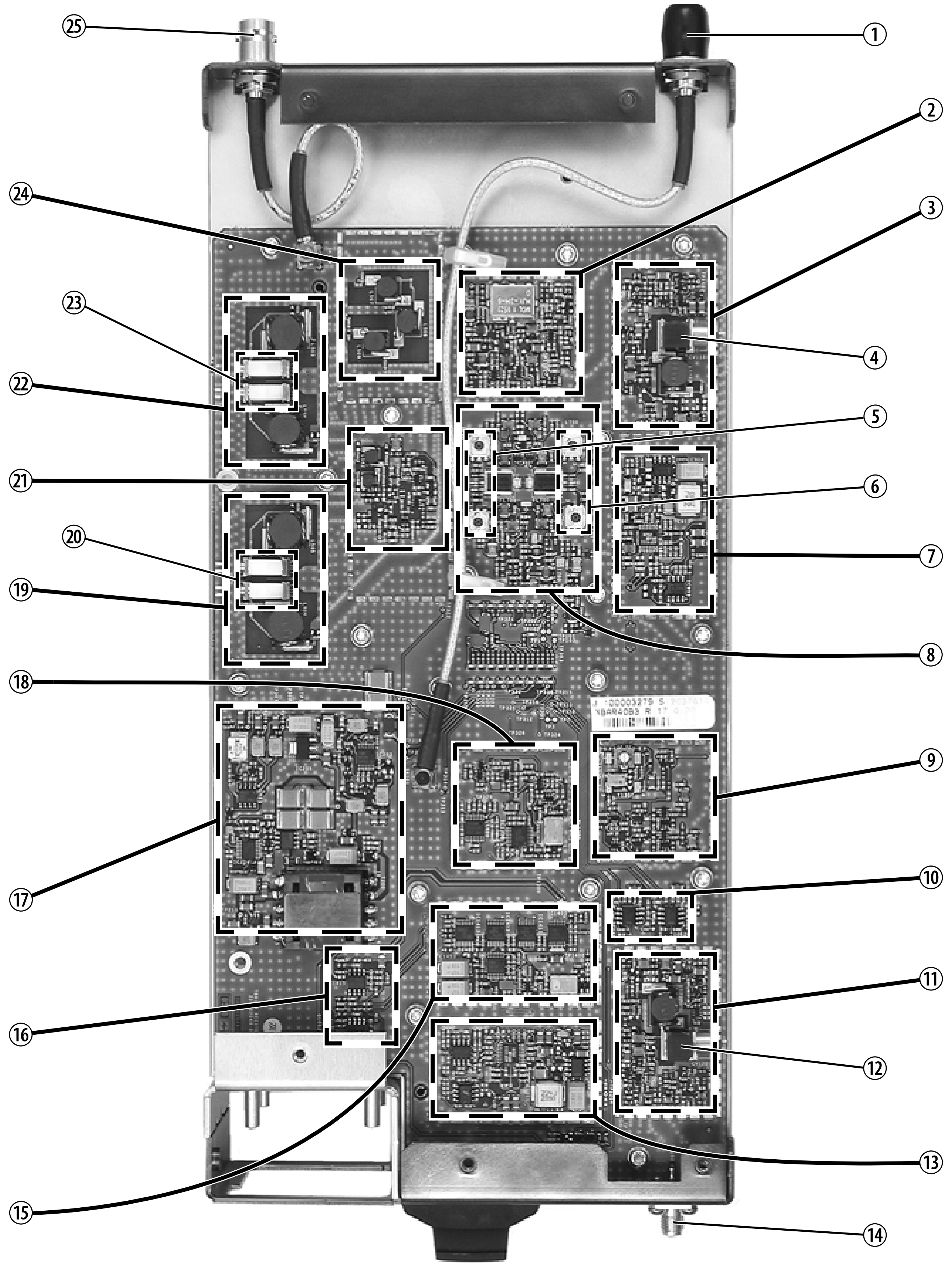
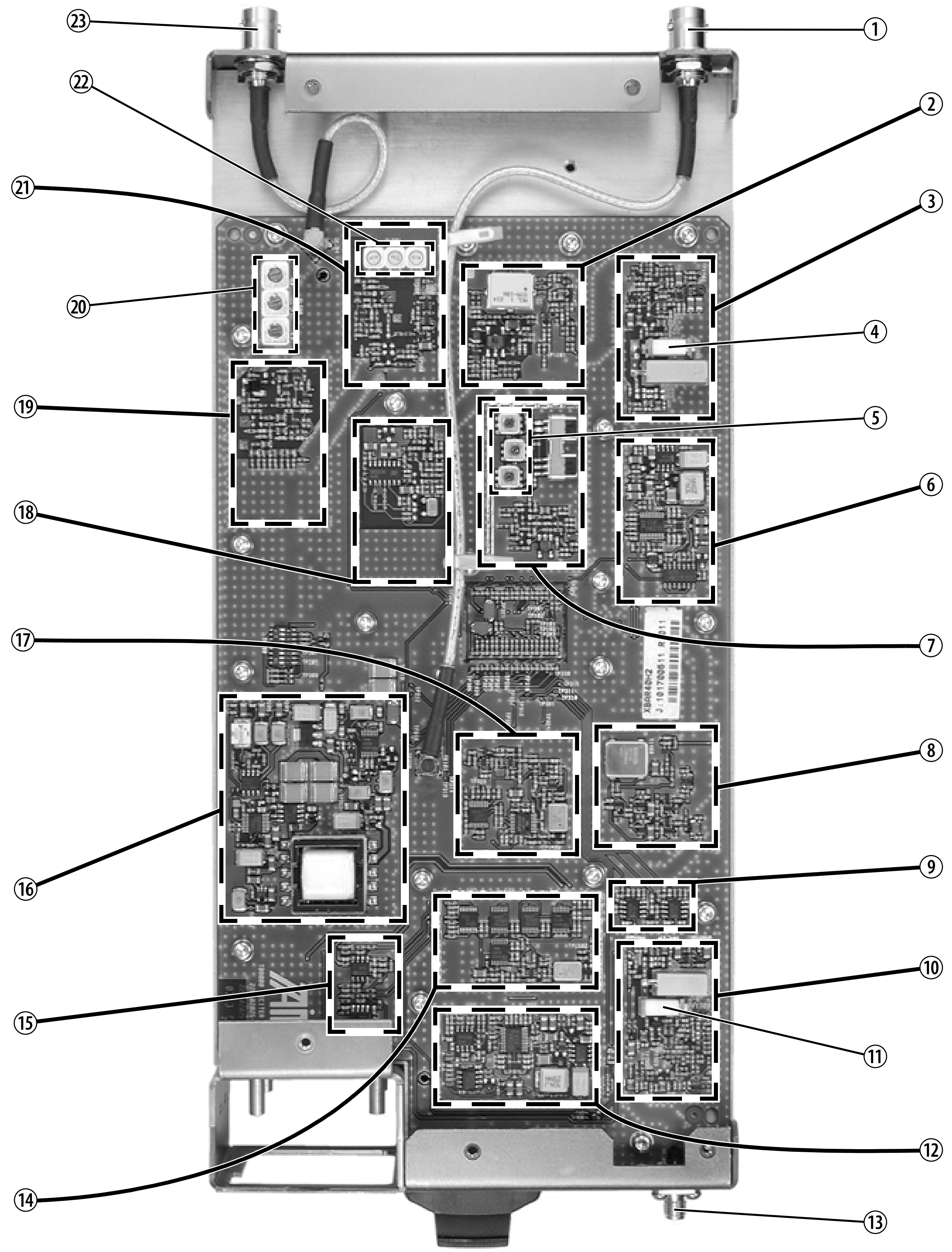


Figure 2.16 Identifying the circuitry on the RF board - H band



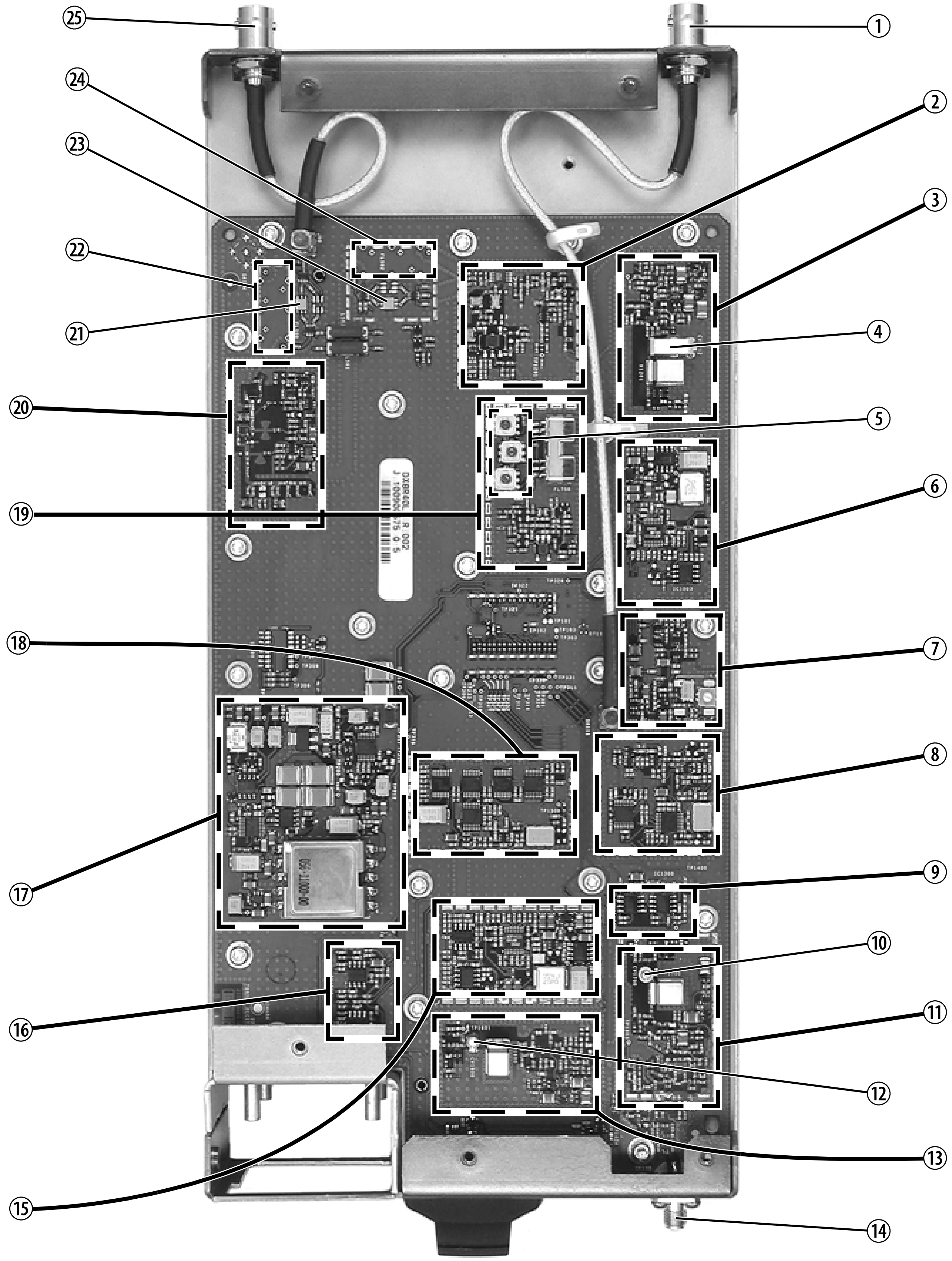
1. external reference input
2. mixer and post-mixer buffer
3. receiver VCO
4. receiver VCO trimmer
5. IF tuning elements
6. receiver synthesizer
7. IF
8. TCXO
9. audio buffers
10. exciter VCO
11. exciter VCO trimmer
12. exciter synthesizer
13. exciter RF output
14. FCL
15. FCL buffers
16. power supply
17. external reference switch/internal VCXO reference
18. AGC
19. front end 1
20. front end first helicals
21. front end 2
22. front end second helicals
23. receiver RF input

Note:
In order to show as much of the circuitry as possible in the photograph, the SMD shields have been removed.

Figure 2.17 Identifying the circuitry on the RF board - K and L bands

① external reference input
② mixer and post-mixer buffer
③ receiver VCO
④ receiver VCO trimmer
⑤ IF tuning elements
⑥ receiver synthesizer
⑦ TCXO
⑧ external reference switch/internal VCXO reference
⑨ audio buffers
⑩ exciter VCO 1 trimmer
⑪ exciter VCO 1
⑫ exciter VCO 2 trimmer
⑬ exciter VCO 2
⑭ exciter RF output
⑮ exciter synthesizer
⑯ FCL buffers
⑰ power supply
⑱ FCL
⑲ IF
⑳ front end
㉑ SAW filter (L band only)
㉒ front end first helicals (K band only)
㉓ SAW filter (L band only)
㉔ front end second helicals (K band only)
㉕ receiver RF input

Note:
In order to show as much of the circuitry as possible in the photograph, the SMD shields have been removed. The photograph shows an L-band reciter. The layout of the K-band reciter circuitry is identical except where noted.



3 Reciter Fault Finding

Important This equipment contains devices which are susceptible to damage from static charges. Refer to "ESD Precautions" on page 17 for more information on antistatic procedures when handling these devices.

This chapter provides enough fault finding information to allow you to trace the fault to an individual board in the reciter. A faulty system interface board can be replaced in the field. However, if the digital board or RF board is faulty, you must return the complete reciter to your nearest Customer Service Organisation for repair or replacement.

The fault finding procedures provided in this chapter assume you are familiar with the operation of the TB8100 Service Kit and Calibration Kit.

Figure 3.1 on page 71 identifies the individual boards. "Identifying the Reciter" on page 70 explains how to identify the model and hardware configuration of a reciter from its product code.

Note For the sake of simplicity and clarity, the instructions and illustrations in this chapter refer to a UHF (H-band) reciter fitted with an isolated system interface board. However, the same basic procedures and techniques apply to other models of reciter and system interface board.

3.1 Identifying the Reciter

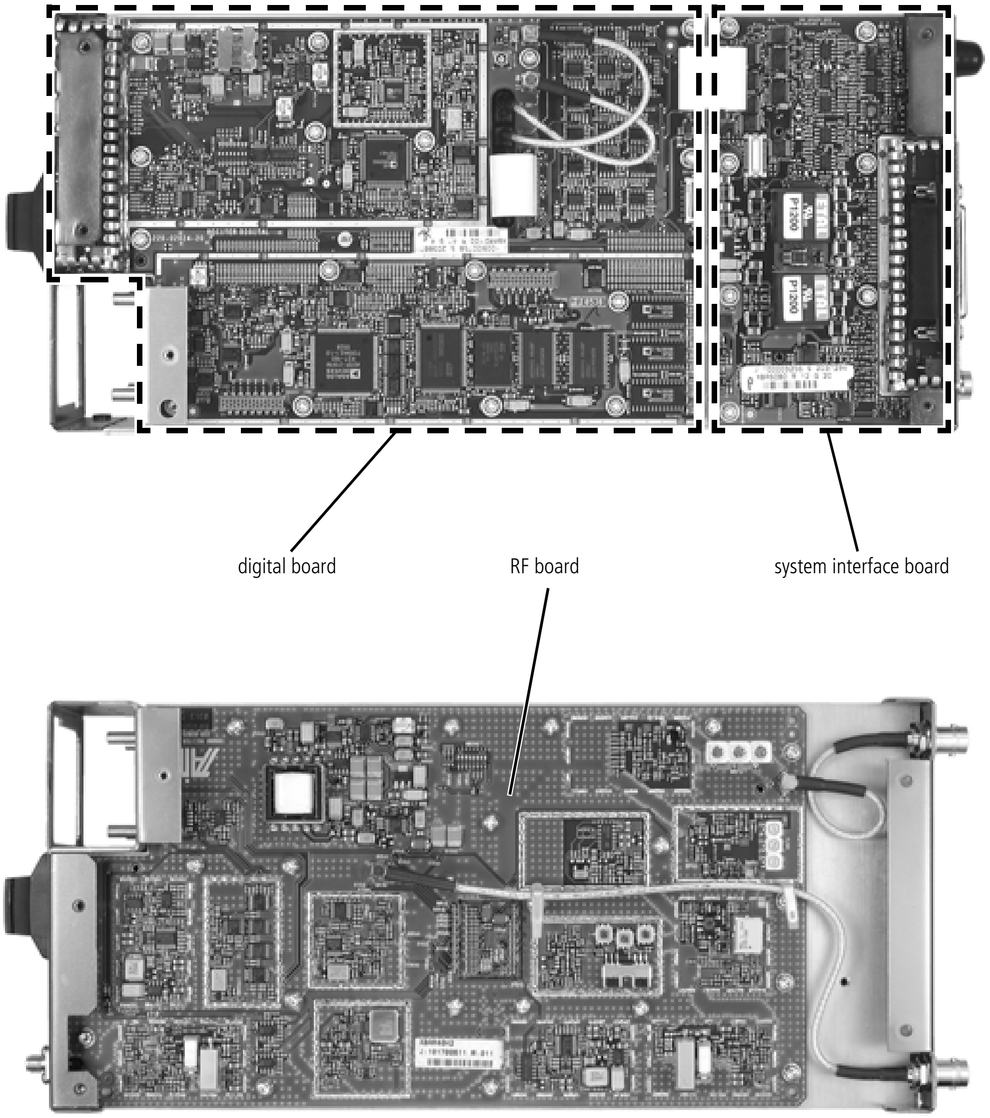
You can identify the model and hardware configuration of a reciter by referring to the product code printed on a label on the rear panel. The meaning of each character in the product code is explained in the table below.

Note This explanation of reciter product codes is not intended to suggest that any combination of features is necessarily available in any one reciter. Consult your nearest Tait Dealer or Customer Service Organisation (CSO) for more information regarding the availability of specific models and options.

Product Code	Description
TBA**X**XXX-XXXX	4 = reciter 5 = receive-only reciter
TBAX**X**XX-XXXX	0 = default
TBAXX**XX**-XXXX	**Frequency Band and Sub-band** B2 = 136 MHz to 156 MHz B3 = 148 MHz to 174 MHz C1 = 174 MHz to 193 MHz C2 = 193 MHz to 225 MHz H1 = 400 MHz to 440 MHz H2 = 440 MHz to 480 MHz H3 = 470 MHz to 520 MHz H4 = 380 MHz to 420 MHz K4 = 762 MHz to 870 MHz[a] L1 = 852 MHz to 854 MHz and 928 MHz to 930 MHz L2 = 896 MHz to 902 MHz (receive only) L2 = 927 MHz to 941 MHz (transmit only)
TBAXXXX-**XXX**X	**System Interface Board** 000 = no system interface board fitted 0A0 = standard 0B0 = isolated 0C0 = isolated E & M 0K0 = TaitNet Ethernet 0L0 = TaitNet RS-232 0T1 = TaitNet
TBAXXXX-XXX**X**	0 = default

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

Figure 3.1 Identifying the reciter boards



reciter shown fitted with isolated system interface board; UHF (H-band) RF board shown with shields removed for clarity

3.2 Test Equipment

Recommended Test Equipment

The following test equipment is required for carrying out the reciter fault finding procedures:

- PC with the latest version of the TB8100 Service Kit (refer to "Software and Firmware Compatibility" on page 74).

Note The Calibration Kit is also installed when you install the Service Kit. If you need to reprogram any factory parameters into the reciter, you will need to use a dongle with the Calibration Kit.

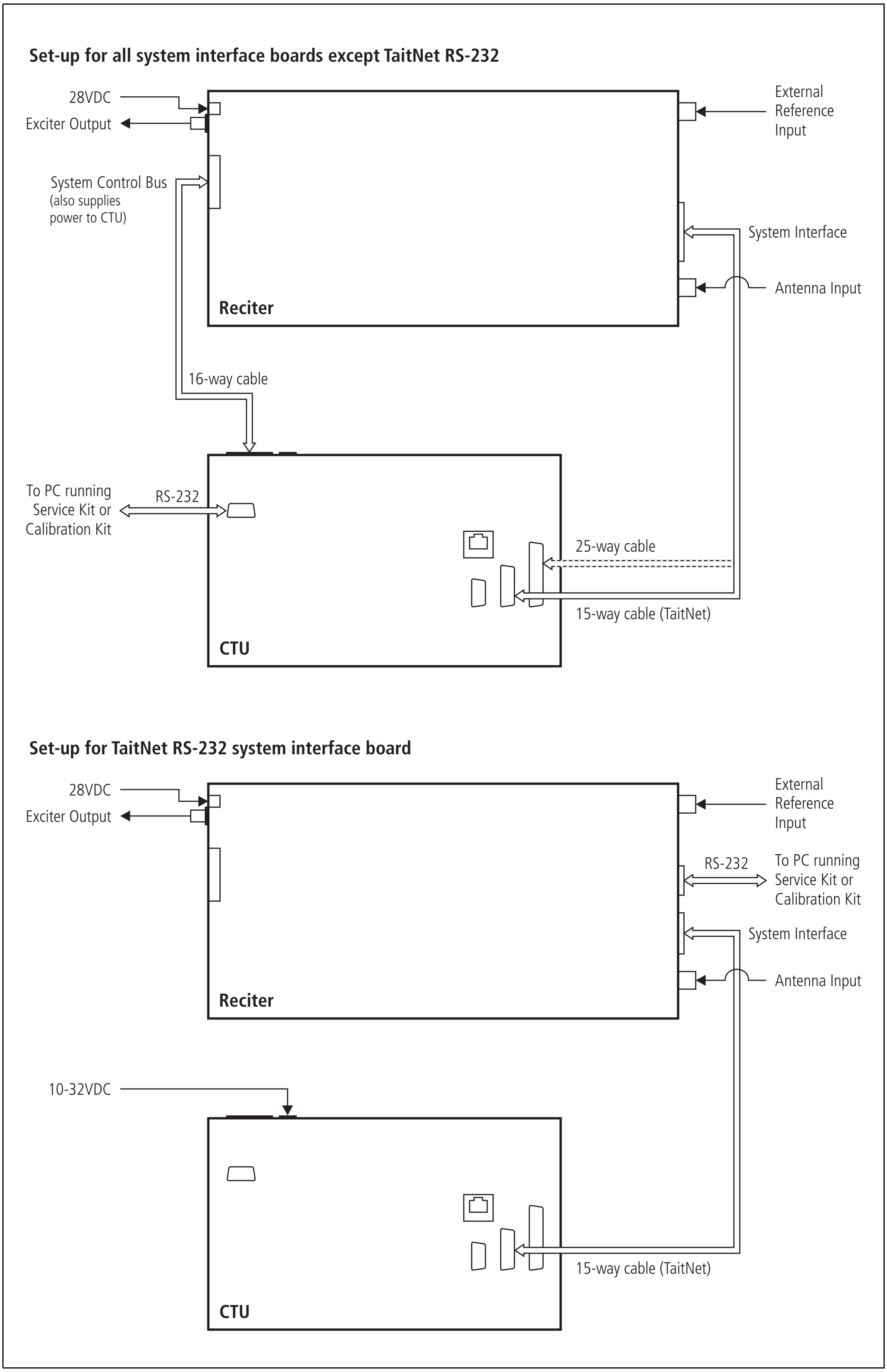
- TBA0ST1, TBA0STU or TBA0STP calibration and test unit (CTU) with supplied cables.
- Desktop power supply capable of providing 12V to 28V at 300mA
  or
  PMU with ammeter capable of measuring 300mA.
- RF test set
  or
  equivalent individual instruments: RF power meter, modulation analyser, oscilloscope, audio signal generator, and SINAD meter.

Recommended Test Equipment Set-up

The recommended test equipment set-up is shown in Figure 3.2. The operation of the CTU is described in the TBA0STU/TBA0STP Calibration and Test Unit Operation Manual (MBA-00013-xx).

Note If the reciter is fitted with a TaitNet Ethernet system interface board, and the PC is connected to the CTU, run the Service Kit and connect to the reciter, then power up the reciter. Refer to TN-1142-AN for full Ethernet connection details.

Figure 3.2 Recommended test equipment set-up



3.3 Software and Firmware Compatibility

Service Kit

We recommend that you use the latest version of the Service Kit when carrying out these fault finding procedures. The latest version is available from the Tait Technical Support website (http://support.taitworld.com).

Calibration Kit

You must use the version of the Calibration Kit which is compatible with the version of firmware loaded into the reciter.

1. To find out the firmware version, run the Service Kit and connect to the reciter. Select Monitor > Module Details > Reciter. The firmware version is displayed in the **Versions** area.

2. To find out which version of the Calibration Kit to use, refer to the Compatibility Table in the TB8100 Base Station Release Notes. These Release Notes are on the TB8100 Product CD, and the latest version is also available from the Tait Technical Support website.

Firmware

If you are testing a reciter separately from the other modules in the customer's base station, we recommend you consult the customer before changing the reciter's firmware version. The new firmware may not be compatible with the other modules in the customer's base station.

Compatibility with TB8100 Modules Used in Testing

Ensure that any TB8100 modules used to test the functionality of the reciter under repair are loaded with compatible firmware. Details of compatible firmware combinations are provided in the Compatibility Table in the TB8100 Base Station Release Notes.

3.4 Board Replacement

Replacing Faulty Boards

At certain stages during the fault finding procedure, you will be instructed to replace the system interface board. In these cases, go to "Reciter Board Replacement" on page 103 and carry out the board replacement procedures described there. The full procedure will normally involve:

- removing the faulty board
- fitting a new board
- carrying out the specified reprogramming and recalibration tasks using the Calibration Kit
- carrying out the procedures described in "Final Tasks" on page 95.

Refer to "Reciter Spare Parts" on page 109 for a full description of the spares available for the reciter.

Disposing of Faulty Boards

We recommend that you dispose of faulty boards according to your local environmental and safety regulations. Otherwise, return them to your nearest CSO for appropriate disposal.

3.5 Initial Checks

These initial checks will verify whether:

- the reciter powers up correctly
- the reciter is correctly configured
- any alarms have been generated
- the 12.8 MHz clock is running.

Task 1 — Check DC Supply

1. Before starting any of these fault finding procedures, you must identify the model and hardware configuration of the reciter under test. "Identifying the Reciter" on page 70 explains how to identify a reciter from the product code printed on a label on the rear panel.

2. Set up the test equipment as shown in Figure 3.2 on page 73.

3. Power up the reciter using the standard test voltage of 28VDC.

4. Check that the current drawn is within the specified limits. The current should be as listed in Table 3.1. If the current drawn is correct, go to Task 2. If it is incorrect, go to "Visual Inspection" on page 82.

Note All measurements must be made at least 20 seconds after power-up. This allows the DSP and RISC to power up and initialise the reciter. Any measurements made during the first 20 seconds after power-up will be incorrect.

Table 3.1 Typical operating current figures for the reciter

Reciter Configuration		Typical Current
digital board only		90 mA ±5 mA
complete reciter[a], Rx and Tx on	B and C bands H band K and L bands	285 mA ±5 mA 290 mA ±5 mA 286 mA ±5 mA

a. Digital board, RF board, and system interface board fitted and operational.

Task 2 — Check Configuration and Alarms

1. Run the Service Kit and connect to the reciter. If the connection is successful, check the state of the reciter. If it is in Run mode or Standby mode, go to Step 4. If it is in Download mode, go to Step 3. If the connection is unsuccessful, go to Step 2.

2. If the connection is unsuccessful, and the current measured in Task 1 is correct, proceed as follows:
   - Check that the communications port on the PC is configured correctly.
   - Check that the connecting cables are fitted correctly, and the Service Kit is set up correctly.
   - Check that the reciter is **not** in CCI mode. Try connecting to the reciter at each of the different baud rates available in the Service Kit. Start with the fastest speed, then try each slower speed in turn. If the connection is successful, take the reciter out of CCI mode and go to Step 4. If it is not, continue with this Step.
   - Check that the 12.8MHz clock is present (go to Task 4).

   If the connection is now successful, check the state of the reciter. If it is in Run mode or Standby mode, go to Step 4. If it is in Download mode, go to Step 3. If the connection is still unsuccessful, return the complete reciter to your nearest CSO for repair or replacement.

Note If the Service Kit locks up during connection, use Windows Task Manager to shut it down.

3. Program the default profile into the reciter. Press Reset Base Station, reset the power, and reconnect. If the connection is successful, go to Step 4. If it is not, return the complete reciter to your nearest CSO for repair or replacement.

4. Once connected to the reciter, ensure it is in Standby Mode.

5. Read the reciter and save the customer's configuration file so that it can be reloaded later if required. Record any feature sets that are enabled so that they can be re-enabled before the reciter is returned to the customer. Also check that there are no Task Manager statements in the configuration which may affect the operation of the reciter during testing.

6. Select Monitor > Module Details > Reciter and check that the module details are correct. If they are, go to Step 7. If they are not, return the complete reciter to your nearest CSO for repair or replacement.

7. Select Monitor > Monitoring > Channel and check that the reciter is set to the correct channel. If it is, go to Step 8. If it is not, proceed as follows:

   - Select Configure > Base Station > Channel Profiles and check that the reciter is configured correctly.
   - Select Configure > Base Station > System Interface and check that the settings in the **Channel selection** area are correct. If external channel selection is enabled, check that no external equipment (e.g. CTU) is selecting an invalid channel, as this will result in a "channel invalid" alarm.
   - make sure that it does not interfere with the operation of the reciter
   - Select Configure > Base Station > General and check that the default channel is the correct channel required.
   - Check that the digital input switches on the CTU are set correctly.

8. Select Alarms > Current Alarm Status and check for alarms. If there are alarms, go to Task 3. If there are no alarms, go to "Visual Inspection" on page 82.

Note Select Alarms > Reported Alarms to check the alarm history. The alarm history may indicate which part of the reciter needs further investigation. You can save these details to a file if required. Note that the alarm history is erased when the reciter is powered down.

Task 3 — Check Reported Alarms

Any alarms generated by the reciter under test will appear in the Alarms > Current Alarm Status screen in the Service Kit. These alarms are described in more detail below.

Power Up Failure

1. Check that the 28VDC supply is present and that all connections are secure.
2. Reset the power. If the alarm is still present, return the complete reciter to your nearest CSO for repair or replacement.

Channel Invalid

1. Carry out the instructions provided in the online Help (Alarms > Monitoring Alarms > Reciter).
2. Check that the digital input switches on the CTU are set correctly.
3. Select Configure > Base Station > General and check that a valid channel is selected.
4. Reset the power. If the alarm is still present, return the complete reciter to your nearest CSO for repair or replacement.

Synthesizer Out of Lock: Digital

1. Carry out the instructions provided in the online Help (Alarms > Monitoring Alarms > Reciter).
2. Check that the 12.8MHz coaxial cable is connected securely and correctly (② in Figure 3.5 on page 83).
3. Check the 12.8MHz clock, as described in Task 4.
4. If an external reference is being used, check that its output is stable.
5. If the alarm is still present, return the complete reciter to your nearest CSO for repair or replacement.

Synthesizer Out of Lock: Exciter

Go to “Exciter” on page 86.

Synthesizer Out of Lock: Receiver

Go to “Receiver” on page 85.

Task 4 — Check 12.8MHz Clock

Refer to Figure 3.3 and Figure 3.4 on page 81. The circled number in the following instructions refers to Figure 3.4.

1. Disconnect the power from the reciter, and remove the RF side cover.
2. Power up the reciter.
3. Using an oscilloscope, check the 12.8MHz clock signal at the test point ① on the RF board.
4. Check for a clean wave form with the following specifications:

frequency	12.8MHz
voltage	1.2 V_{pp} (approximately)
duty cycle	50% (approximately)

If the wave form meets these specifications, return to Task 2. If it does not, return the complete reciter to your nearest CSO for repair or replacement.

Figure 3.3 Typical 12.8MHz clock wave form

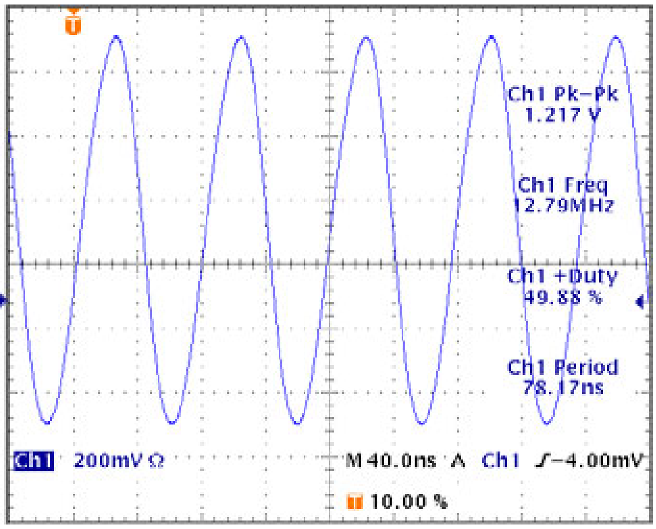
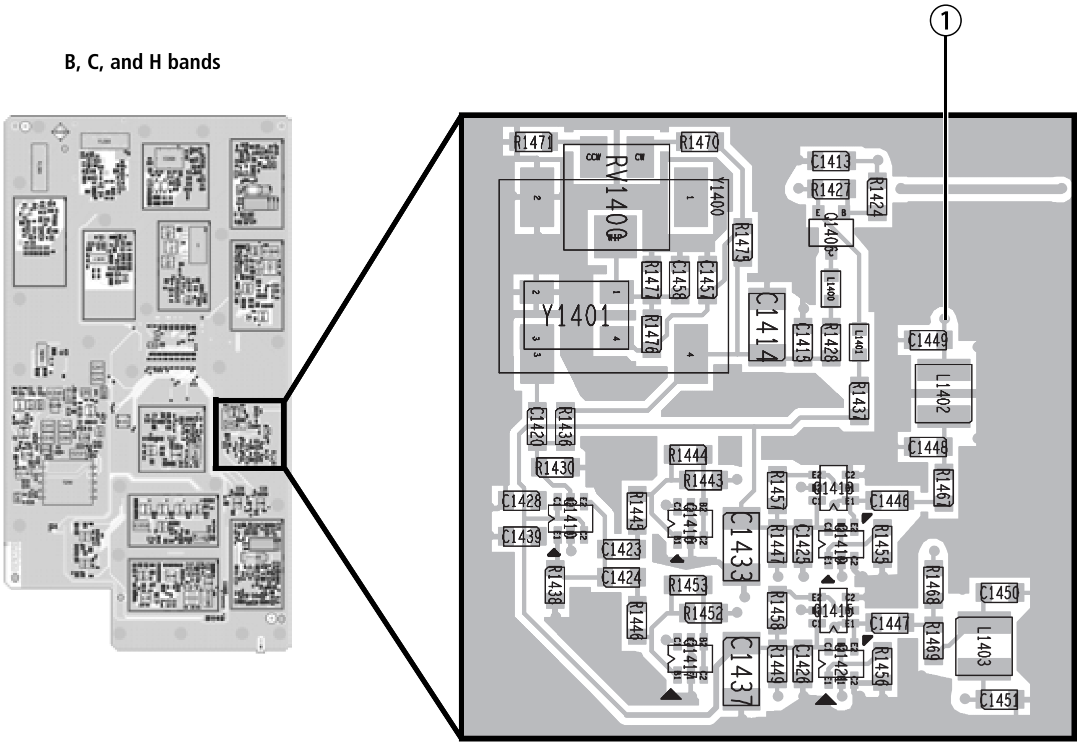
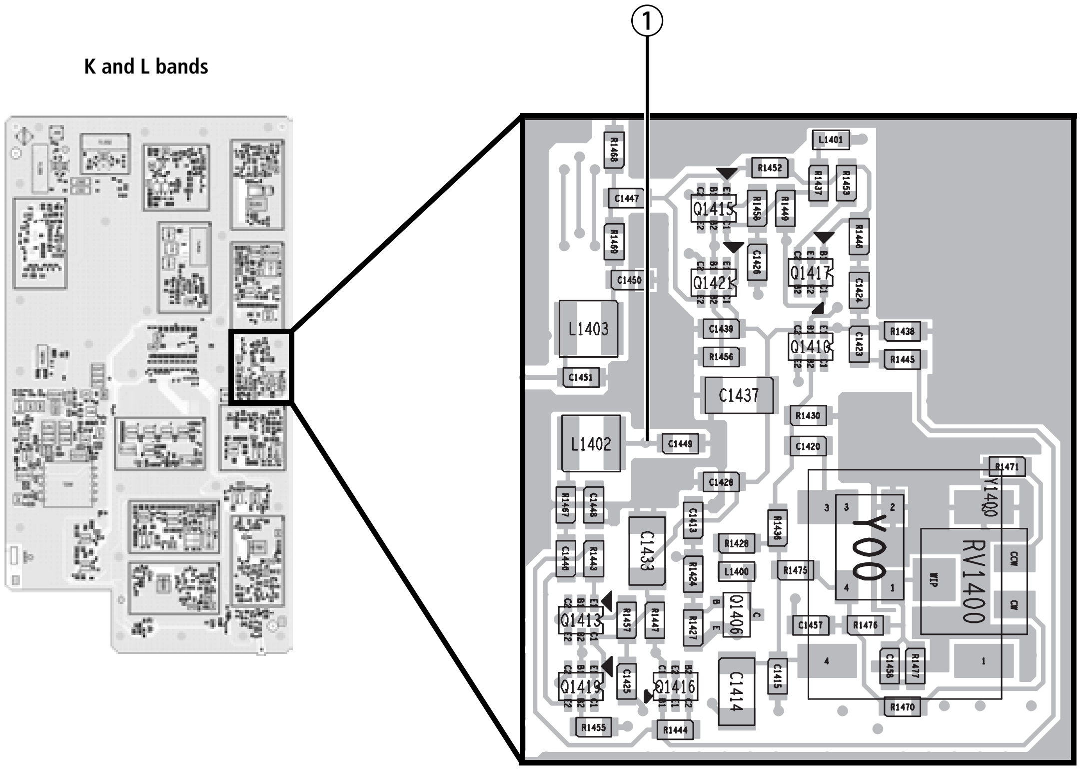


Figure 3.4 Location of the 12.8MHz clock test point on the RF board

B, C, and H bands



K and L bands



3.6 Visual Inspection

The following procedures are intended as a guide for quickly finding basic faults in the reciter before proceeding to the more detailed checks. The circled numbers in the following instructions refer to Figure 3.5 on page 83.

Task 1 — Check for Physical Damage, Missing or Misplaced Components

1. Remove the covers.
2. Has the reciter been dropped? Inspect the covers, front and rear panels, and heatsink for damage. Check each board for loose or missing components. If the digital board or RF board is damaged, return the complete reciter to your nearest CSO for repair or replacement.
3. Check that the flexible connectors ① are correctly positioned and latched in their sockets (refer to Figure 5.2 on page 107).
4. Check that all coaxial cables ② ③ ④ are connected securely to the correct connectors.
5. Check that all screws are in place and secured correctly. Refer to "Screw Torque Settings" on page 100.

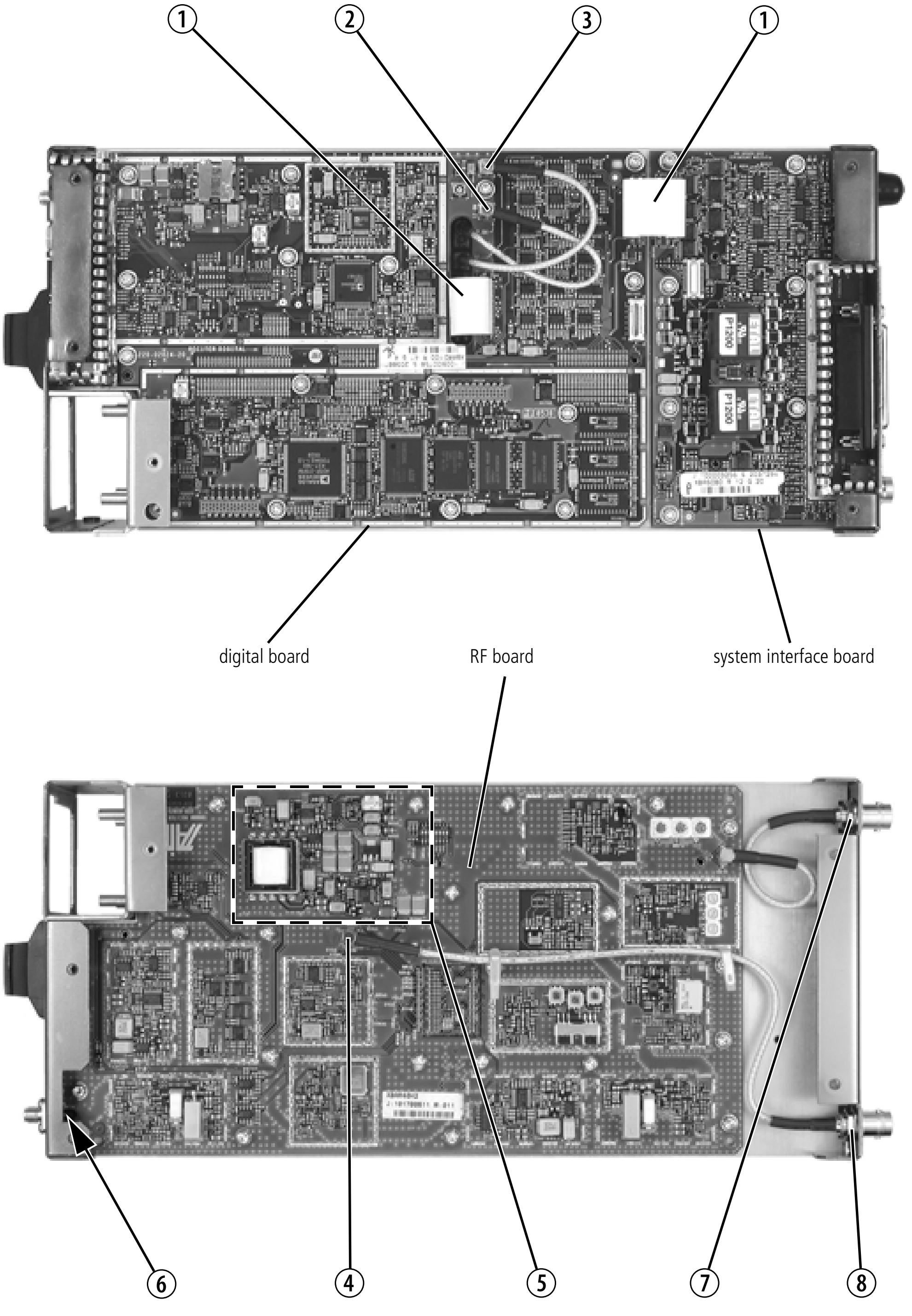
Task 2 — Check Quality of Solder Joints

1. Check the power supply circuitry ⑤ on the RF board for shorts or dry joints.
2. Check the pins of the large ICs on the digital board for shorts or faulty solder joints.
3. Check the overall quality of the solder joints.

Task 3 — Check RF Connectors

1. Check the SMA connector solder joint ⑥.
2. Check that the nuts securing the BNC/TNC connectors ⑦ ⑧ are tightened correctly. Refer to "Screw Torque Settings" on page 100.

Figure 3.5 Visual inspection points for the reciter



UHF (H-band) reciter shown fitted with isolated system interface board; RF board shown with shields removed for clarity

3.7 Digital IF

These checks will verify whether the digital IF circuitry is operational. The circled numbers in the following instructions refer to Figure 3.5 on page 83.

1. If you have not already done so, disconnect the power from the reciter, and remove both side covers.

2. Disconnect the external reference coaxial cable from the connector ④ on the RF board.

3. Disconnect the coaxial cable from the IF input connector ③ on the digital board, and connect the external reference cable in its place.

4. Connect a signal generator to the external reference input connector ⑧ and inject a signal at −98 dBm ±2 dBm (2.2 µV to 3.5 µV) at the correct IF frequency:
   - VHF = 16.9 MHz
   - UHF = 70.1 MHz.

5. Power up the reciter and put it into Run Mode. Select Monitor > Monitoring > Reciter and note the signal level displayed on the **RSSI** gauge in the Received signal area. The signal level should be −98 dBm ±2 dBm (2.2 µV to 3.5 µV). If it is, go to Step 6. If it is not, the digital board is faulty. Return the complete reciter to your nearest CSO for repair or replacement.

6. Change the level of the input signal and check that the RSSI signal level changes accordingly. If it does change, go to “Receiver” on page 85. If it does not change, the digital board is faulty. Return the complete reciter to your nearest CSO for repair or replacement.

Note The RSSI is only accurate down to a signal level of −98 dBm (2.2 µV).

3.8 Receiver

These checks will verify whether:

- the receiver synthesizer is locked
- the sensitivity is correct.

Task 1 — Check Synthesizer

1. Set up the test equipment as shown in Figure 3.2 on page 73.
2. Run the Service Kit and connect to the reciter. Put the reciter in Standby mode. Select Diagnose > Reciter > Synthesizers.
3. Check that the receiver synthesizer is locked. If it is, go to Task 2. If it is not, go to Step 4.
4. Click **Start Test** in the receiver row.
5. Check that the synthesizer lock range matches the frequencies displayed in the **Receiver setting** box in the Monitor > Module Details > Reciter form. If the two frequency ranges match, go to Task 2. If they do not match, adjust the receiver lock band using the Calibration Kit and repeat this task.

Task 2 — Check Sensitivity

1. Select Diagnose > Reciter > Receiver.
2. Inject an RF test signal (1 kHz audio, 60% modulation) of the required frequency at −117 dBm (0.32 µV) into the antenna input.
3. In the Receiver values area, check that the **Current RSSI** value matches the level of the test signal, and the **Current SINAD** value is greater than 12 dB. If the levels are correct, go to Step 5. If they are not, go to Step 4.

Note The sensitivity for de-emphasised response will be different from flat response (refer to Table 3.2 on page 96).

4. Retune the receiver front end and recalibrate the RSSI using the Calibration Kit. Repeat the test. If the levels are correct, go to Step 5. If they are not, the digital board is faulty. Return the complete reciter to your nearest CSO for repair or replacement.
5. Check the SINAD sensitivity and RSSI at −60 dBm (223.6 µV), −100 dBm (2.2 µV), and −117 dBm (0.32 µV).

   The RSSI reading in the Service Kit should be within ±1 dB of the signal level of the test set. If it is not, recalibrate the RSSI using the Calibration Kit and repeat the test.

   The SINAD sensitivity should be at least 12 dB at −117 dBm. If it is not, and the digital IF is not faulty (Section 3.7), the RF board is faulty. Return the complete reciter to your nearest CSO for repair or replacement.

   If the RSSI and sensitivity are correct, go to "Exciter" on page 86.

3.9 Exciter

These checks will verify whether:

- the exciter synthesizer is locked
- the exciter output meets the required specifications.

Task 1 — Check Synthesizer

1. Set up the test equipment as shown in Figure 3.2 on page 73.
2. Run the Service Kit and connect to the reciter. Put the reciter in Standby mode. Select Diagnose > Reciter > Synthesizers.
3. Check that the exciter synthesizer is locked. If it is, go to Task 2. If it is not, got to Step 4.
4. Click **Start Test** in the exciter row.
5. Check that the synthesizer lock range matches the frequencies displayed in the **Exciter setting** box in the Monitor > Module Details > Reciter form. If the two frequency ranges match, go to Task 2. If they do not match, adjust the exciter lock band using the Calibration Kit and repeat this task.

Task 2 — Check Exciter Output

1. Put the reciter in Run Mode and set the TX KEY switch on the CTU to ON.
2. Select Diagnose > Reciter > Digital I/O and check that the **Tx Key input** is active (Service Kit "LED" is green). If it is active, go to Step 3. If it is inactive ("LED" is red), return the complete reciter to your nearest CSO for repair or replacement.
3. Use the Service Kit to set up the reciter as a repeater. Inject an RF test signal (1 kHz audio, 60% modulation) of the required frequency at −80 dBm (22.4 µV):
   - narrow bandwidth 1.5 kHz ±125 Hz
   - mid bandwidth[1] 2.4 kHz ±200 Hz
   - wide bandwidth 3 kHz ±250 Hz
4. Check that the performance of the exciter meets the following specifications:
   - RF output power +11 dBm ±2 dB (8 mW to 20 mW)
   - deviation 60%
   - frequency accuracy ±0.5 ppm or ±1 ppm.

Note All reciters with hardware version 0.03 or later have a frequency stability of 0.5 ppm (VCTCXO). Reciters with hardware version 0.02 or earlier have a frequency stability of 1 ppm (TCXO).

1. H band only.

If the reciter's performance meets all these specifications, go to Task 3. If the deviation is incorrect, go to Task 4. If the RF output power is incorrect, return the complete reciter to your nearest CSO for repair or replacement. If the output frequency is incorrect, adjust the carrier frequency offset using the Calibration Kit and repeat the test. If the output frequency is still incorrect, return the complete reciter to your nearest CSO for repair or replacement.

Task 3 — Check Deviation (as Line Controlled Base Station)

1. Use the Service Kit to disable the reciter's talk through functionality. (Select Configure > Base Station > Channel Profiles. In the Edit Channel Profile screen, go to the Signal Path tab.)

2. Inject an audio test signal into the LINE INPUT on the CTU. Set the signal level to the level configured in the channel profile.

3. Put the reciter in Run Mode and set the TX KEY switch on the CTU to ON.

4. Check that the deviation of the exciter is as follows:
   - narrow bandwidth 1.5kHz ±125Hz
   - mid bandwidth[1] 2.4kHz ±200Hz
   - wide bandwidth 3kHz ±250Hz

Note The deviation will depend on the bandwidth of the currently selected channel. You do not have to test the other bandwidth(s) available.

5. If the deviation is correct, go to "Audio" on page 89. If it is not, go to Task 4.

1. H band only.

Task 4 — Deviation Diagnostics Test

Important You must use version 03.04 or later of the Service Kit to carry out this test.

1. Put the reciter in Standby Mode and select Diagnose > Power Amplifier > Transmission Tests. In the **Manual transmission** area, set up the test as follows:
   - Set the transmission frequency as required.
   - Set the modulation to **Modulation on**.
   - Set the deviation to 5 kHz, the modulation level to 60%, and the modulation frequency to 1000 Hz.
2. Click **Start Transmission** and check that the deviation is 3 kHz. If the deviation is correct, repeat your previous task as follows:
   - If your previous task was Task 2, repeat Task 2.
   - If your previous task was Task 3, carry out the audio calibration procedures using the Calibration Kit, and then repeat Task 3. If the deviation is still incorrect, return the complete reciter to your nearest CSO for repair or replacement.

Note Before repeating your previous task, check that the reciter's configuration is correct; for example, for Task 2 check that the talk through repeater gain is 0 dB.

If the deviation is incorrect, recalibrate the exciter using the Calibration Kit and then repeat your previous task. If the deviation is still incorrect, return the complete reciter to your nearest CSO for repair or replacement.

3.10 Audio

These checks will verify whether the input and output line levels are correct. Figure 3.6 on page 90 shows the recommended test equipment set-up. Figure 3.7 on page 91 shows the location of test points on the digital board, and Figure 3.8 on page 94 shows the location of test points on the system interface board.

Task 1 — Check Audio Output Using Internal Test Tone

1. Set up the test equipment as shown in Figure 3.6.

2. Run the Service Kit and connect to the reciter. Put the reciter in Standby mode. Select Diagnose > Reciter > Audio I/O.

3. In the Output area, select **Balanced line out** or **Unbalanced line out**.

Note Terminate the balanced line output into 600Ω Ensure there is only a single load when running the test. Don't use the CTU's internal load **and** an external termination.

4. Click **Start Test**.

5. View the **Audio Output** gauge and check that the measured output level is the same as the level displayed on the gauge.

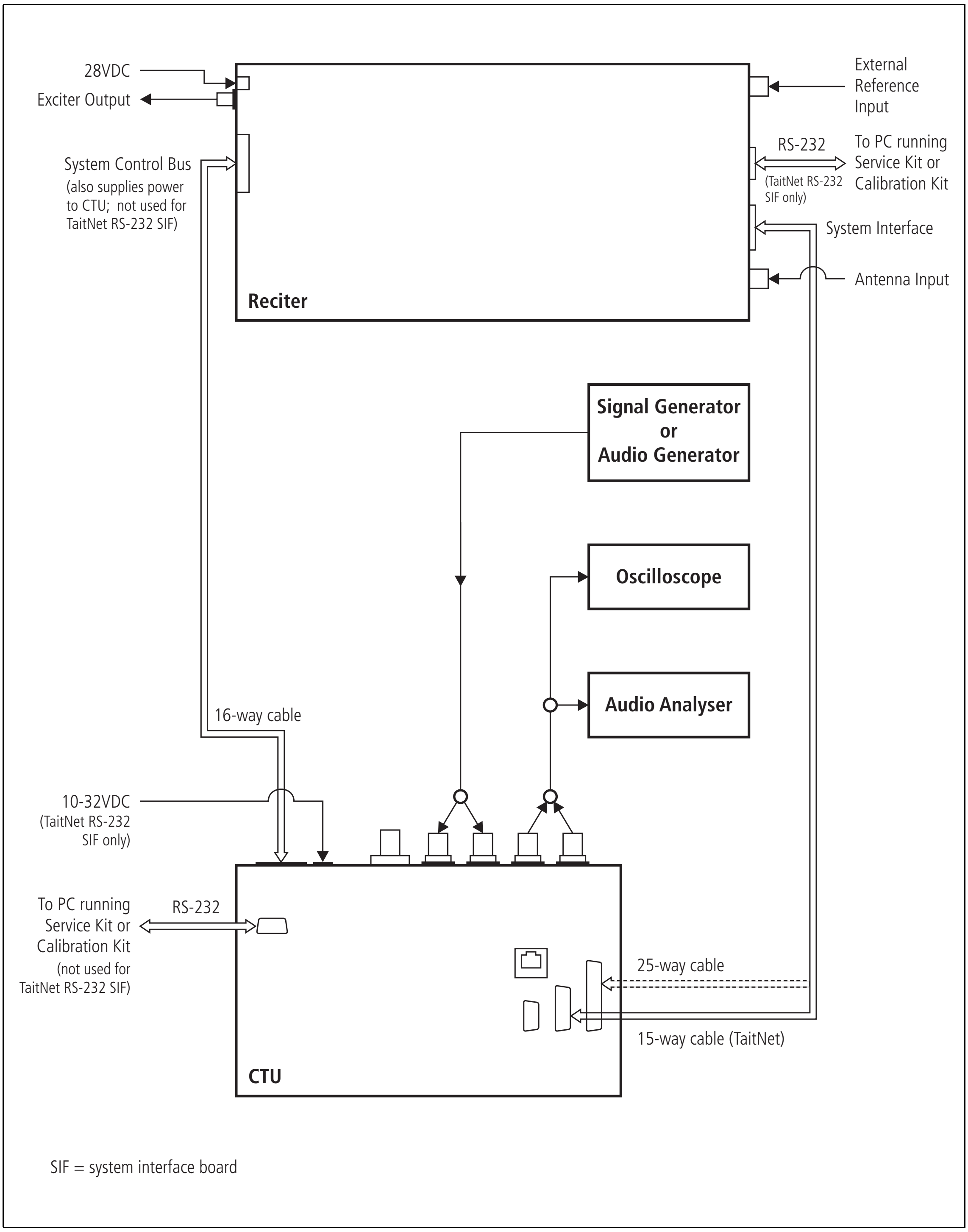
Note The **Level** box displays the line sensitivity of the currently selected channel. The audio output will be set to this level when the test is started.

6. Click **Stop Test**. If the levels are correct, go to Task 2. If they are incorrect, go to Step 7.

7. Check the test set-up and repeat the test. If the levels are correct, go to Task 2. If they are incorrect, recalibrate the line levels using the Calibration Kit and repeat the test. If the line levels are now correct, go to Task 2.

   If the line levels are still incorrect, either the digital board or system interface board is faulty. If the measured output voltage is greater than the voltage displayed on the gauge, go to Step 8. If the measured output voltage is less than the voltage displayed on the gauge, go to Step 9.

Figure 3.6 Recommended test equipment set-up for audio checks



Note If the reciter is fitted with a TaitNet Ethernet system interface board, and the PC is connected to the CTU, run the Service Kit and connect to the reciter, then power up the reciter. Refer to TN-1142-AN for full Ethernet connection details.

8. Measure the audio voltages at the following test points on the digital board:

balanced line out	IC1020 pin 1 IC1026 pin 1
unbalanced line out	IC1005 pin 1 IC1026 pin 7.

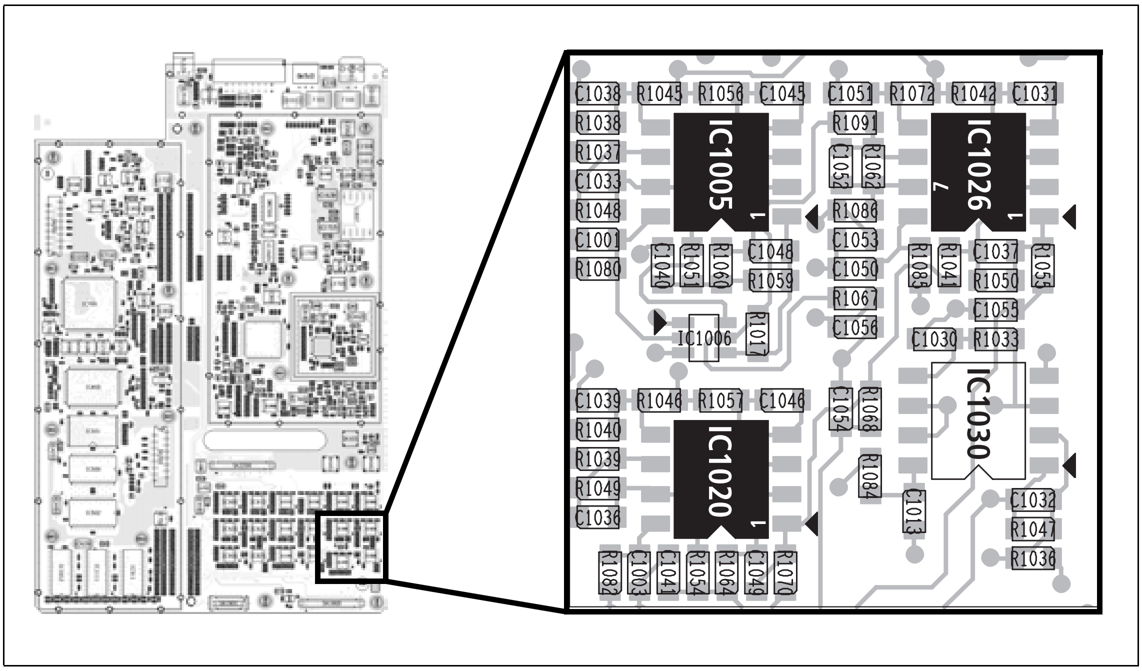
Both voltages should be approximately 1 V_{pp}. If the voltages are greater than 1 V_{pp}, the digital board is faulty. Return the complete reciter to your nearest CSO for repair or replacement. If the voltages are 1 V_{pp} or less, replace the system interface board.

9. Measure the audio voltages at the following test points on the digital board:

balanced line out	IC1020 pin 1 IC1026 pin 1
unbalanced line out	IC1005 pin 1 IC1026 pin 7.

Both voltages should be approximately 1 V_{pp}. If the voltages are 1 V_{pp} or higher, replace the system interface board. If the voltages are less than 1 V_{pp}, the digital board is faulty. Return the complete reciter to your nearest CSO for repair or replacement.

Figure 3.7 Location of audio test points on the digital board



Task 2 — Check Audio Output Using External Signal

1. Inject an RF test signal (1 kHz audio, 60% modulation) of the required frequency at −80 dBm (22.4 µV) into the antenna input.

2. Run the Service Kit and connect to the reciter. Put the reciter in Standby mode. Select Diagnose > Reciter > Audio I/O and check that the measured output level is the same as the level displayed on the **Audio Output** gauge.

Note The gauge will display the audio level of the balanced or unbalanced line out, whichever is selected in the profile of the currently selected channel. The **Level** box displays the line sensitivity of the currently selected channel. The audio output will be set to this level during this test.

If the levels are correct, go to Task 3. If they are incorrect, recalibrate the line levels using the Calibration Kit and repeat the test. If the line levels are now correct, go to Task 3.

If the line levels are still incorrect, either the digital board or system interface board is faulty. If the measured output voltage is greater than the voltage displayed on the gauge, go to Step 3. If the measured output voltage is less than the voltage displayed on the gauge, go to Step 4.

3. Measure the audio voltages at the following test points on the digital board:

balanced line out	IC1020 pin 1 IC1026 pin 1
unbalanced line out	IC1005 pin 1 IC1026 pin 7.

Both voltages should be approximately $1\,V_{pp}$. If the voltages are greater than $1\,V_{pp}$, the digital board is faulty. Return the complete reciter to your nearest CSO for repair or replacement. If the voltages are $1\,V_{pp}$ or less, replace the system interface board.

4. Measure the audio voltages at the following test points on the digital board:

balanced line out	IC1020 pin 1 IC1026 pin 1
unbalanced line out	IC1005 pin 1 IC1026 pin 7.

Both voltages should be approximately $1\,V_{pp}$. If the voltages are $1\,V_{pp}$ or higher, replace the system interface board. If the voltages are less than $1\,V_{pp}$, the digital board is faulty. Return the complete reciter to your nearest CSO for repair or replacement.

Task 3 — Check Audio Input

1. Connect a 1 kHz audio signal to the balanced input (LINE INPUT) on the CTU. Set the level of the audio signal to the level of audio input sensitivity of the currently selected channel.

Note To view the audio input sensitivity of the currently selected channel, select Configure > Base Station > Channel Profiles. In the Edit Channel Profile screen, go to the Signal Path tab. The sensitivity is normally −10 dBm for the balanced input, and 1 V_{pp} for the unbalanced input.

2. Run the Service Kit and connect to the reciter. Put the reciter in Standby mode. Select Diagnose > Reciter > Audio I/O and check that the level displayed in the **Audio Input** gauge is the same as the input level of the audio signal.

3. Reconnect the audio signal to the unbalanced input (UB INPUT) on the CTU.

4. Select Diagnose > Reciter > Audio I/O and check that the level displayed in the **Audio Input** gauge is the same as the input level of the audio signal.

5. If either audio input level is incorrect, recalibrate the line levels using the Calibration Kit and repeat the test. If the line levels are now correct, go to "Final Tasks" on page 95.

   If the line levels are still incorrect, either the digital board or system interface board is faulty. If the voltage displayed on the gauge is greater than the measured input voltage, go to Step 6. If the voltage displayed on the gauge is less than the measured input voltage, go to Step 7.

6. Measure the audio voltages at the following test points on the system interface board:

balanced line in	IC206 pin 1 IC211 pin 7
unbalanced line in	IC202 pin 7

   Both balanced line in voltages should be approximately 0.5 V_{pp}. If the voltages are greater than 0.5 V_{pp}, replace the system interface board. If the voltages are 0.5 V_{pp} or less, the digital board is faulty. Return the complete reciter to your nearest CSO for repair or replacement.

   The unbalanced line in voltage should be approximately 1 V_{pp}. If the voltage is greater than 1 V_{pp}, replace the system interface board. If the voltage is 1 V_{pp} or less, the digital board is faulty. Return the complete reciter to your nearest CSO for repair or replacement.

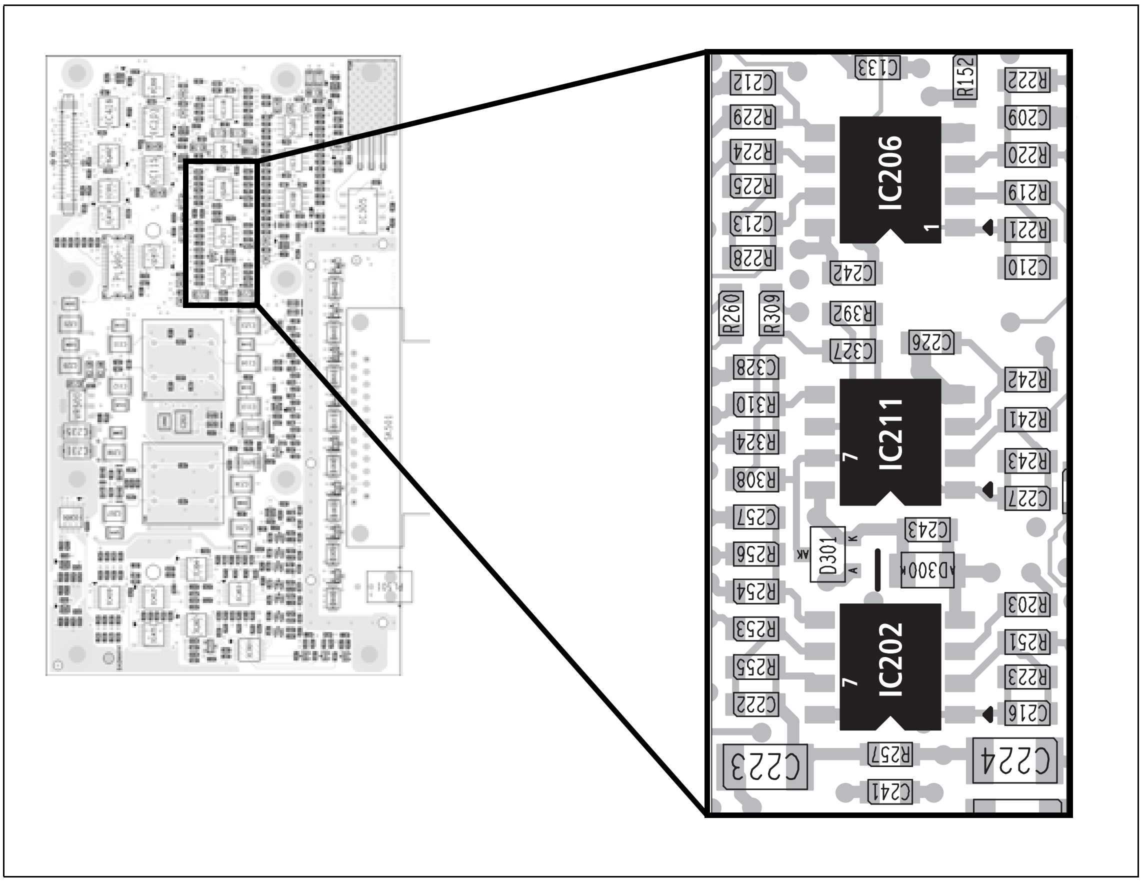
7. Measure the audio voltages at the following test points on the system interface board:

balanced line in	IC206 pin 1 IC211 pin 7
unbalanced line in	IC202 pin 7

Both balanced line in voltages should be approximately $0.5\,V_{pp}$. If the voltages are $0.5\,V_{pp}$ or higher, the digital board is faulty. Return the complete reciter to your nearest CSO for repair or replacement. If the voltages are less than $0.5\,V_{pp}$, replace the system interface board.

The unbalanced line in voltage should be approximately $1\,V_{pp}$. If the voltage is $1\,V_{pp}$ or higher, the digital board is faulty. Return the complete reciter to your nearest CSO for repair or replacement. If the voltage is less than $1\,V_{pp}$, replace the system interface board.

Figure 3.8 Location of audio test points on the system interface board



Note Figure 3.8 shows an isolated system interface board. The test points are in the same locations on the other models of system interface board.

3.11 Final Tasks

Once you have completed the testing and repair (if required) of the reciter, carry out the following tasks.

Task 1 — Final Tests

Test the reciter to confirm that it is fully functional again. The recommended tests are listed below:

1. Reprogram the customer's configuration into the reciter, and re-enable the customer's feature sets (if necessary).
2. Select a correctly configured channel.
3. Check that no alarms are generated.
4. Check that the DC supply current is correct (refer to Table 3.1 on page 76).
5. Inject an RF test signal (1 kHz audio, 60% modulation) of the required frequency at −80 dBm (22.4 µV). Check that the performance of the receiver meets the specifications in Table 3.2 on page 96.
6. Key the exciter and check that the performance meets the specifications in Table 3.3 on page 97.
7. Inspect the reciter to make sure that nothing has been damaged during any test or repair procedures. Make sure all screws securing the cover to the heatsink are in place and tightened to the correct torque.

It is good practice to record the test results on a separate test sheet. You can then supply a copy of the test sheet to the customer as confirmation of the repair.

Task 2 — Final Administration

The final administration tasks are the standard workshop procedures for updating the fault database and returning the repaired reciter to the customer with confirmation of the repair.

If the reciter could not be repaired for one of the following reasons:

- fault not located
- repair of fault failed

Level-1 service centres should return the faulty reciter to the nearest Accredited Service Centre, and level-2 service centres should return the reciter to the International Service Centre. Supply details of the customer, the fault and, if applicable, the attempted repair.

Note The information in these tables is extracted from the TB8100 Specifications Manual. Refer to the latest issue of this manual (MBA-00001-xx) for the most up-to-date and complete specifications.

Table 3.2 Final tests for the receiver

<table>
<tr><th>Test</th><th colspan="2">Limits</th></tr>
<tr><td>Switching Range</td><td colspan="2">>2% of the centre frequency
For example:
B Band 3MHz at 150MHz
C Band 4MHz at 200MHz
H Band 10MHz at 500MHz
K Band 792MHz to 824MHz
L1 Band 852MHz to 854MHz
928MHz to 930MHz
L2 Band 896MHz to 902MHz</td></tr>
<tr><td>RSSI</td><td colspan="2">–120dBm to –60dBm (0.22µV to 223.6µV), 0.5V to 6V, programmable slope</td></tr>
<tr><td>Sensitivity[a,b]

De-emphasised Response
Centre of Switching Range
Edge of Switching Range

Flat Response
Centre of Switching Range
Edge of Switching Range
a. 12dB SINAD
b. up to 2dB degradation at extremes of temperature</td><td colspan="2">

<–119dBm (0.25µV) at 25°C
<–117dBm (0.32µV) at 25°C

<–117.5dBm (0.30µV) at 25°C
<–115.5dBm (0.38µV) at 25°C</td></tr>
<tr><td>De-emphasised Response

Bandwidth

Response

c. H band only</td><td colspan="2">

300Hz to 2.55kHz (NB)
300Hz to 3.4kHz (MB)[c]
300Hz to 3.4kHz (WB)
within +1, –3dB of a –6dB/octave de-emphasis curve (ref. 1kHz)</td></tr>
<tr><td>Flat Response

Bandwidth

Response

d. H band only</td><td>Balanced Audio

67Hz to 2.55kHz (NB)
67Hz to 3.4kHz (MB)[d]
67Hz to 3.4kHz (WB)
within +1, –3dB of output level at 1kHz</td><td>Unbalanced Audio

10Hz to 2.55kHz (NB)
10Hz to 3.4kHz (MB)[d]
10Hz to 3.4kHz (WB)
within +1, –1dB of output level at 1kHz</td></tr>
</table>

Table 3.3 Final tests for the exciter

Test		Limits
Switching Range		
	B and C Bands	8 MHz
	H Band	10 MHz
	K Band	762 MHz to 776 MHz and 850 MHz to 870 MHz
	L1 Band	852 MHz to 854 MHz and 928 MHz to 930 MHz
	L2 Band	927 MHz to 941 MHz
Frequency Stability		
	Hardware Version 0.02 (or earlier)	±1 ppm −30°C to +60°C (−22°F to +140°F)
	Hardware Version 0.03 (or later)	±0.5 ppm −30°C to +60°C (−22°F to +140°F)
Power Output		+11 dBm ±2 dB
Microphone Input		
	Input Level Range[a]	80 dB SPL to 115 dB SPL
	Impedance	600 Ω
	Compressor	
	Attack Time	10 ms
	Decay Time	800 ms
	Dynamic Range	35 dB
	Distortion	≤3%
a. 60% modulation at 1 kHz		
Line Input - Balanced		
	Input Level Range[b]	−20 dBm to +10 dBm
	Impedance	600 Ω balanced
b. 60% modulation at 1 kHz		
Line Input - Unbalanced		
	Input Level Range	0.3 Vpp to 3 Vpp
	Impedance	>10 kΩ

4 Reciter Disassembly and Reassembly

Important This equipment contains devices which are susceptible to damage from static charges. Refer to "ESD Precautions" on page 17 for more information on antistatic procedures when handling these devices.

This chapter provides information on how to remove and refit the covers and front and rear panels.

Note Unless otherwise noted, for the sake of simplicity and clarity, the instructions and illustrations in this chapter refer to a UHF (H-band) reciter fitted with an isolated system interface board. However, the same basic procedures and techniques apply to other models of reciter and system interface board.

4.1 Screw Torque Settings

The recommended torque settings for the screws and nuts used in the reciter are as follows:

Location / Function	Torque	Driver/ Spanner	Size
■ securing the side covers to the heatsink and front and rear panels ■ securing the front and rear panels to the heatsink ■ securing the handle to the front panel ■ securing the boards to the heatsink	0.5 N·m / 4.5 lbf·in	T10	M3
securing the SMA connector to the front panel	0.3 N·m / 2.5 lbf·in	T8	M2.5
securing the BNC/TNC connectors to the rear panel	1.7 N·m / 15 lbf·in	11 mm AF	

4.2 Removing the Covers

1. Remove the M3 Torx screws securing the covers to the heatsink, and to the front and rear panels. Lift off the covers.

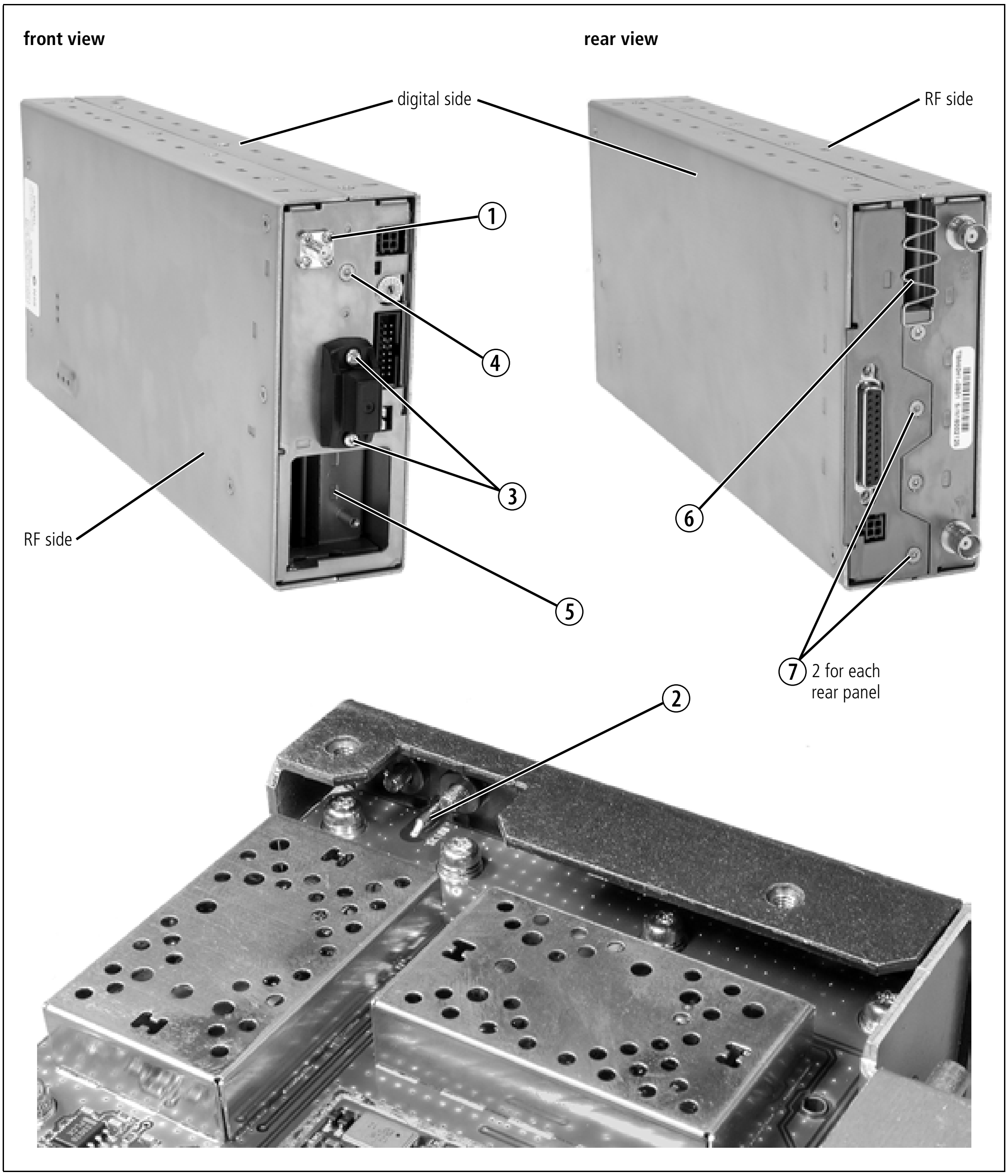
4.3 Removing the Front and Rear Panels

The circled numbers in the following instructions refer to Figure 4.1.

1. Remove the four M2.5 Torx screws ① securing the SMA connector to the heatsink and to the front panel.
2. Desolder the centre pin of the SMA connector ② from the RF board and remove the connector.
3. Remove the two M3 Torx screws ③ securing the handle to the heatsink.
4. Remove the M3 screw ④ securing the front panel to the heatsink, and remove the front panel.
5. If necessary, remove the two M3 screws securing the fan duct ⑤ to the heatsink.
6. Remove the vent guard clip ⑥ from the rear panel.

7. Remove the two M3 Torx screws ⑦ securing each rear panel to the heatsink. If you want to remove the rear panel on the RF side, first unplug the coaxial cables from the RF board.

Figure 4.1 Removing the front and rear panels



4.4 Refitting the Front and Rear Panels

The circled numbers in the following instructions refer to Figure 4.1.

1. If removed previously, refit the fan duct ⑤ to the heatsink and secure with the two M3 Torx screws.

2. Refit the front panel and secure to the heatsink with the M3 Torx screw ④.

3. Secure the handle to the heatsink with the two M3 Torx screws ③.

4. Secure the SMA connector to the heatsink and front panel with the four M2.5 Torx screws ①.

5. Resolder the centre pin of the SMA connector ② to the RF board.

6. Refit the rear panel to the heatsink and secure with the two M3 Torx screws ⑦. If you have removed the rear panel on the RF side, reconnect the coaxial cables to the RF board.

7. Refit the vent guard clip ⑥.

4.5 Refitting the Covers

1. Slide each cover into place over the front and rear panels. Make sure the holes in the covers line up with the threaded holes in the heatsink and front and rear panels.

2. Press the covers firmly into place and secure with the M3 Torx screws.

Note The covers are not interchangeable. Each cover must be fitted to the correct side and in the correct orientation.

5 Reciter Board Replacement

Important This equipment contains devices which are susceptible to damage from static charges. Refer to "ESD Precautions" on page 17 for more information on antistatic procedures when handling these devices.

This chapter provides information on how to remove and replace the system interface board.

Note Unless otherwise noted, for the sake of simplicity and clarity, the instructions and illustrations in this chapter refer to a UHF (H-band) reciter fitted with an isolated system interface board. However, the same basic procedures and techniques apply to other models of reciter and system interface board.

5.1 Replacing the System Interface Board

Important You must reprogram and recalibrate the reciter after replacing the system interface board. Refer to "Reprogramming and Recalibration" on page 105.

Refer to "Reciter Disassembly and Reassembly" on page 99 for details on removing and refitting the covers and front and rear panels. The circled numbers in the following instructions refer to Figure 5.1 on page 106.

Compatibility

When fitting a replacement system interface board, you must make sure the new board is compatible with the firmware version loaded into the reciter, as described in the following table.

System Interface Board	Compatible Reciter Firmware Versions
standard, isolated, isolated E&M, and TaitNet: version 1 and later	02.02 or later
TaitNet RS-232	02.02 or later
TaitNet Ethernet	03.00 or later

Removal

1. Remove the digital side cover and rear panel.
2. Disconnect the flexible connector to the digital board ① from the socket on the system interface board.
3. Remove the M3 Torx screws securing the board to the heatsink.
4. Carefully lift the board upwards off the locating pins ② and remove it from the heatsink.

Refitting

1. To refit the board, follow the removal instructions in reverse order.

Important Make sure the insulator sheet is correctly positioned and flat on the heatsink. Although this sheet is an electrical insulator, it is also thermally conductive and must allow the board to sit as flat as possible to provide effective heatsinking. **Operating the reciter without the insulator sheet in place will result in permanent damage to the digital or system interface boards.**

Important Make sure the flexible connector is correctly positioned and latched in its socket, as shown in Figure 5.2 on page 107.

Note Before tightening the screws, press the board down over the locating pins so that it is firmly seated against the heatsink. Then tighten the M3 Torx screws to the correct torque, working from the centre of the board to the edges.

Reprogramming and Recalibration

If you have replaced the system interface board, you will have to reprogram and recalibrate the reciter. The actual procedures required will depend on whether or not the replacement board is the same type as the original, as shown in the table below.

Board Type	Procedure	Details
when the replacement system interface board is a different type from the original	■ reprogram the product code ■ reprogram the reciter type	reprogram this information into the reciter using the Calibration Kit[a]; refer to the Calibration Kit documentation for more details
	calibrate the audio	carry out this procedure using the Calibration Kit; refer to the Calibration Kit documentation for more details
when the replacement system interface board is the same type as the original	calibrate the audio	carry out this procedure using the Calibration Kit; refer to the Calibration Kit documentation for more details

a. To reprogram this information into the reciter, you will need to use a dongle with the Calibration Kit.

Figure 5.1 Replacing the system interface board

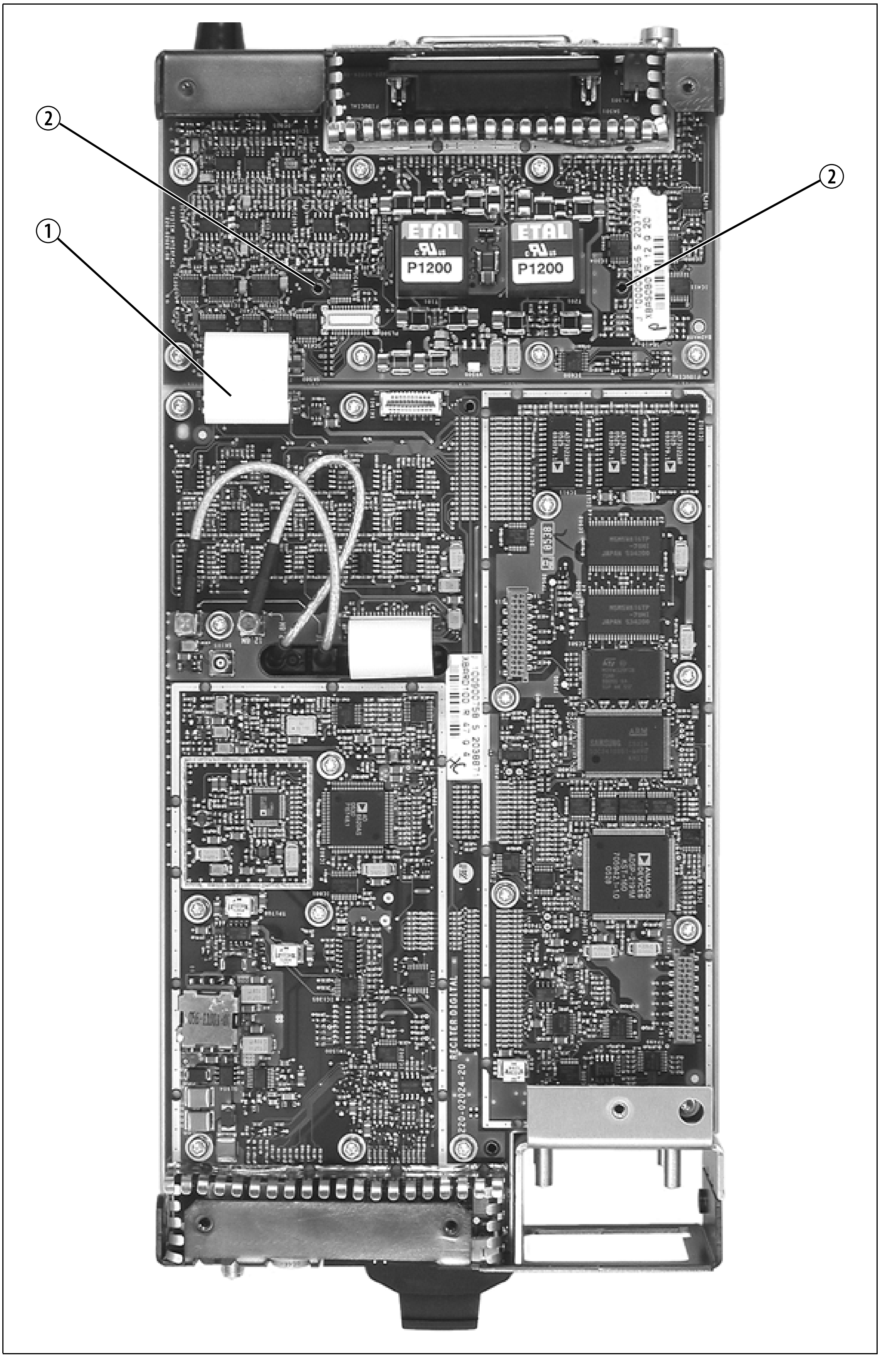
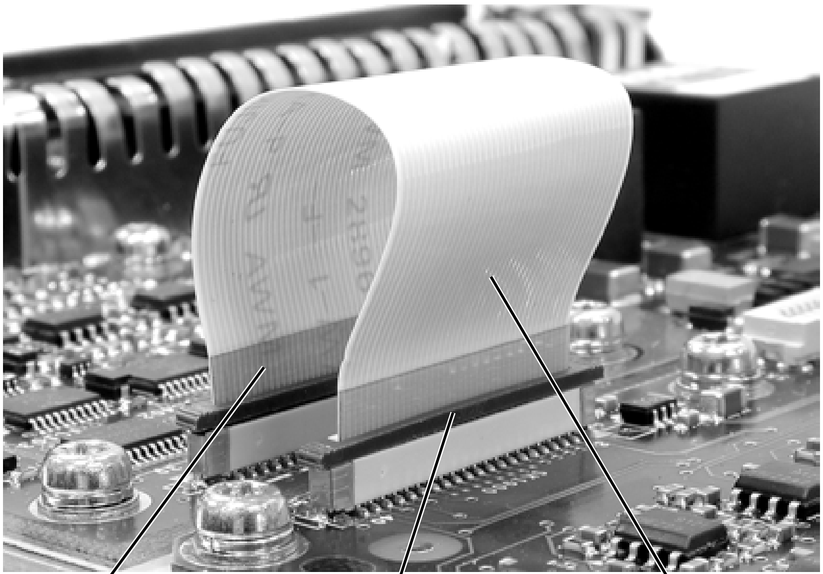


Figure 5.2 Reconnecting the flexible connector



6 Reciter Spare Parts

This chapter lists the spare parts available for the TB8100 reciter at the time this manual was published.

- Spare circuit board assemblies are listed in Table 6.1.
- Mechanical parts are listed in Figure 6.1 on page 111.

Other items may become available as spares at a later date. Consult your nearest Tait Dealer or Customer Service Organisation regarding the availability of specific items.

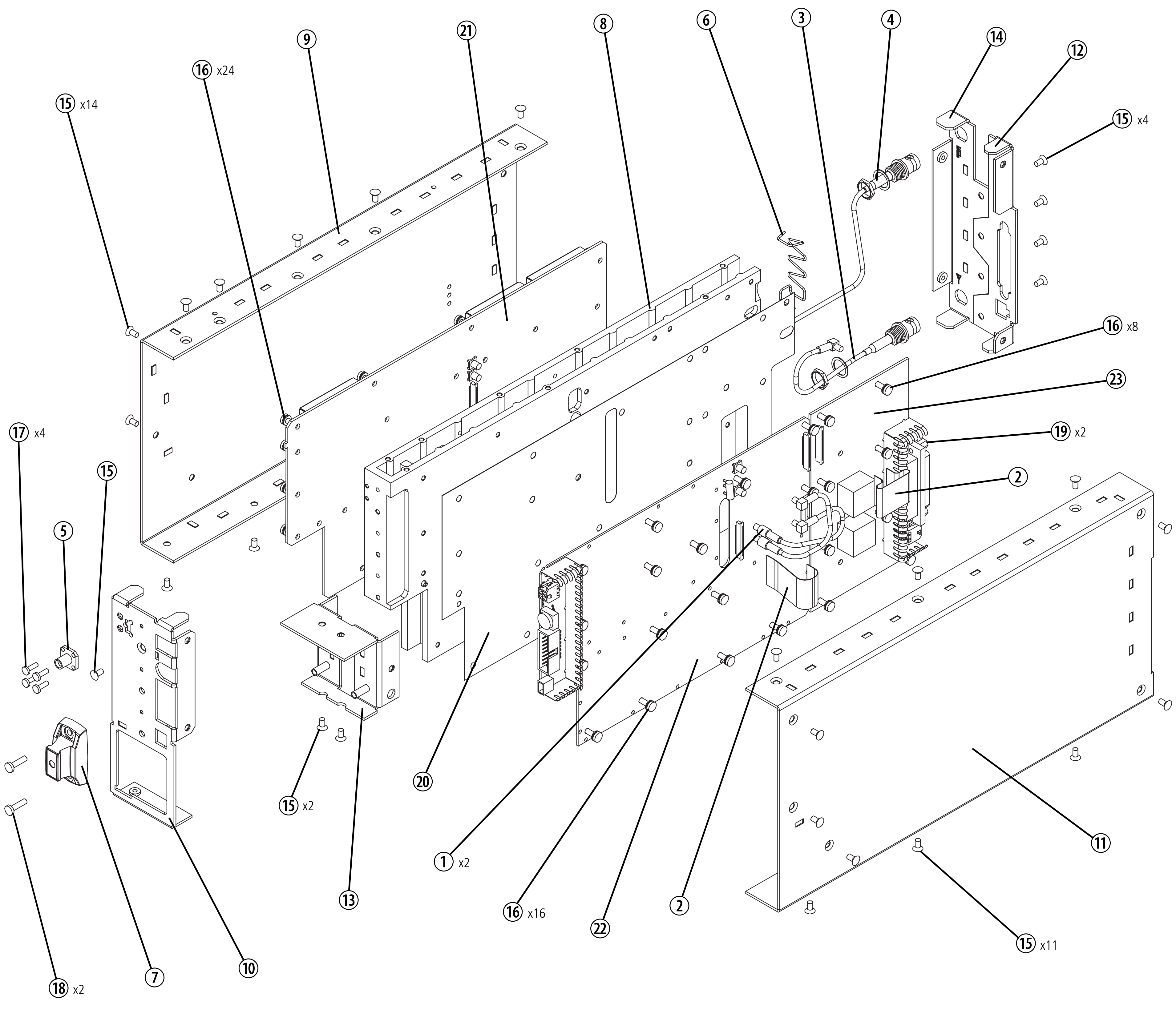
Table 6.1 Spare circuit boards for the reciter

Description		Spares Code
system interface board	isolated	TBA-SP-S0B0
	isolated E & M	TBA-SP-S0C0
	TaitNet Ethernet	TBA-SP-S0K0
	TaitNet RS-232	TBA-SP-S0L0
	TaitNet	TBA-SP-S0T1

Figure 6.1 Reciter mechanical assembly

	Description	IPN
1	70.1MHz IF and 12.8MHz reference coaxial cables	219-02849-XX
2	flexible connector	219-02850-XX
3	RF input coaxial cable	219-02851-XX
4	external reference coaxial cable	219-02852-XX
5	SMA connector	240-02155-XX
6	vent guard clip	303-50108-XX
7	handle	308-01065-XX
8	heatsink	308-13148-XX
9	RF side cover	316-06795-XX
10	front panel	316-06796-XX
11	digital side cover	316-06797-XX
12	rear panel - digital side; changes according to the system interface board fitted:	
	none	316-06802-XX
	standard, isolated, isolated E & M	316-06798-XX
	TaitNet	316-21279-XX
	TaitNet Ethernet	316-06865-XX
	TaitNet RS-232	316-02023-XX
13	fan duct	316-06804-XX
14	rear panel - RF side	316-06805-XX
	rear panel - RF side (with PEMs)	316-06847-XX
15	M3x6mm countersunk Torx screw	345-40460-XX
16	M3x8mm pan head Torx screw with spring & flat washers	345-40470-XX
17	M2.5x8mm pan head Torx screw	345-40490-XX
18	M3x12mm pan head Torx Taptite screw	349-02065-XX
19	4–40 UNC screw lock	354-01043-XX
20	thermally conductive insulator sheet	362-01120-XX
21	RF board	
22	digital board	
23	system interface board	

Note:
The characters XX in an IPN (Tait Internal Part Number) stand for the issue number of the part. Only the latest issue of each part will normally be available for ordering as spare or replacement parts.



7 Power Amplifier Circuit Description

The TB8100 power amplifier (PA) is a modular design with the circuitry divided between separate boards. These boards are assembled onto a heatsink in different configurations in different models.

Figure 7.1 on page 114 shows the configurations for a 100 W 28 V PA and 50 W 12 V PA, along with the main inputs and outputs for power, RF and control signals. The 100 W PA consists of:

- a 6 W board
- two quadrature-combined 60 W boards
- a splitter board and a combiner board
- a low pass filter and directional coupler board
- a control board.

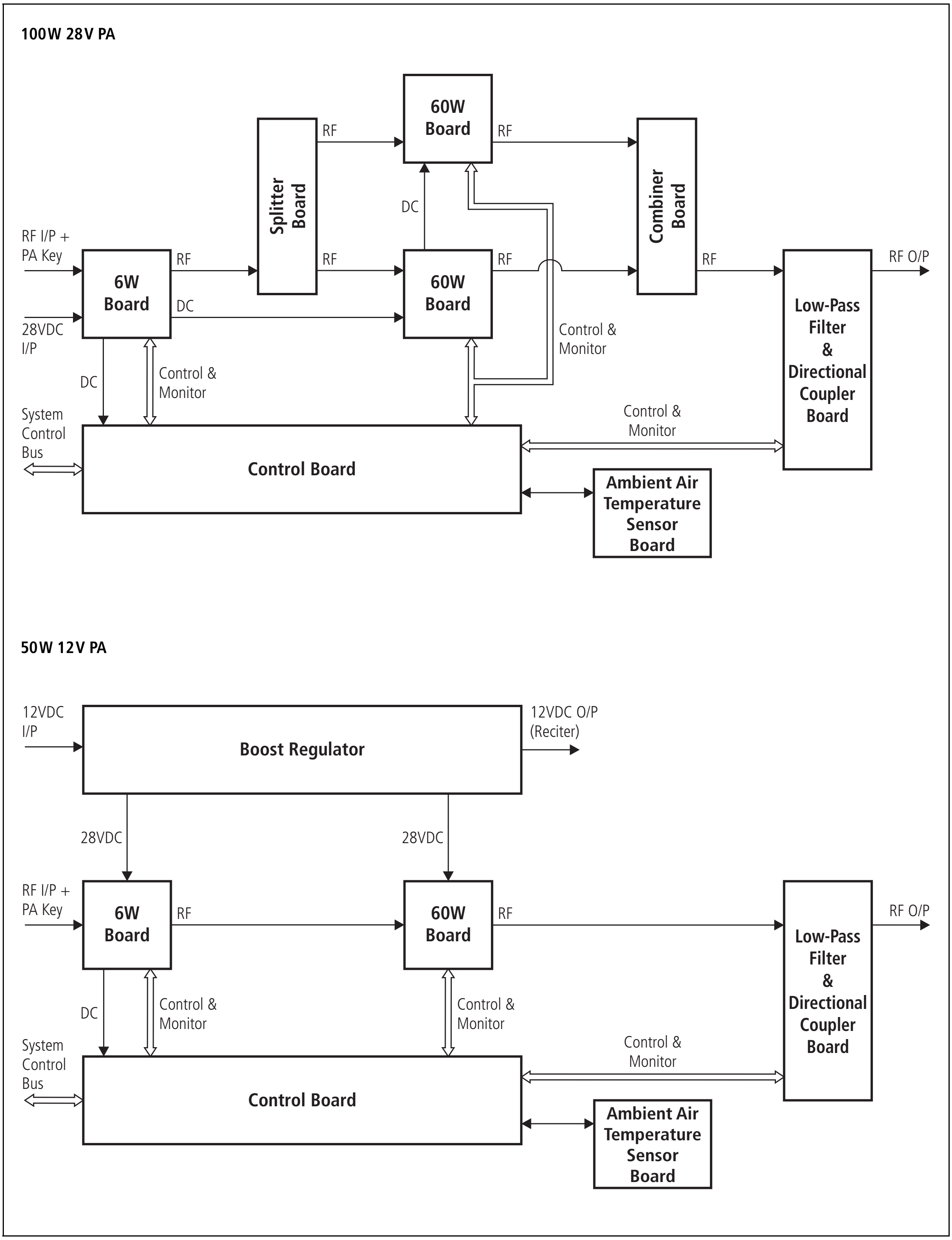
The configuration of the 50 W PA is similar, but it uses only one 60 W board and does not require the splitter or combiner boards. The 5 W PA does not use the 60 W, splitter or combiner boards.

The 12 V PA is fitted with an internal boost regulator board, which converts the 12 VDC nominal supply to the 28 VDC required by the PA. Apart from this boost regulator board, the circuitry of 12 V PAs is identical to the standard 28 V models. Only 5 W and 50 W PAs are available for operation on 12 VDC.

RF interconnect boards are also used in some configurations to connect the boards together. The type of interconnect board used depends on the configuration of the PA. Figure 8.1 on page 130 and Figure 8.2 on page 131 show the different configurations used in different models.

The locations of the main circuit blocks on the boards are shown in Figure 7.3 on page 123 and Figure 7.4 on page 125.

Figure 7.1 PA high level block diagrams



7.1 Microprocessor Control Circuitry

Refer to Figure 7.2 on page 117.

The PA has a microprocessor which performs the following functions:

- monitors the operating conditions of the PA
- controls the RF power level
- reports faults (by generating alarms)
- takes preventative action to protect the PA under fault conditions.

The alarms and diagnostics are accessed through I^2C bus messages via the reciter, control panel and Service Kit.

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.

7.1.1 Diagnostics and Alarms

The diagnostic functions and alarms monitored by the PA include:

- the temperature of the 6 W board
- the temperatures of 60 W board 1 (50 W and 100 W PAs) and 60 W board 2 (100 W PA)
- the ambient temperature of the intake air (ambient temperature is defined as the temperature of the air from the cooling fan; the PA fan must be in position and running to get an accurate reading in the Service Kit)
- forward and reverse power
- load VSWR
- the transmit current of the 6 W driver transistor
- the transmit current of the final transistors on 60 W board 1 (50 W and 100 W PAs) and 60 W board 2 (100 W PA)
- the current imbalance between the final transistors on 60 W boards 1 and 2 (100 W PA)
- the supply voltage
- the summary alarm.

Most alarms have two thresholds. The first threshold activates the alarm and is usually set by the user via the Service Kit. The second threshold defines the limit of operation of the PA and the software will either foldback the RF transmit power or suspend transmission until the fault condition is recovered. The values for the second threshold are set in the factory and cannot be changed. In all instances there is a small amount of hysteresis between the value at which the alarm, foldback or shutdown activates and the value at which the alarm or shutdown is cleared.

A red LED visible from the front panel of the PA will light to indicate a summary alarm.

For a more detailed description of alarms and diagnostics refer to the Service Kit User's Manual or on-line help.

7.1.2 PA-Key

The PA is keyed by a +8VDC signal which is superimposed on the RF signal on the coaxial input cable.

The key-up sequence requires the RF input (+11dBm) to be turned on and stable before the PA is keyed on. When the PA is keyed off, the RF input is turned off only when the key-down sequence is complete.

7.1.3 Power Foldback

The PA control circuitry will reduce the RF output power to P_{min} when any one of the following fault conditions occurs:[1]

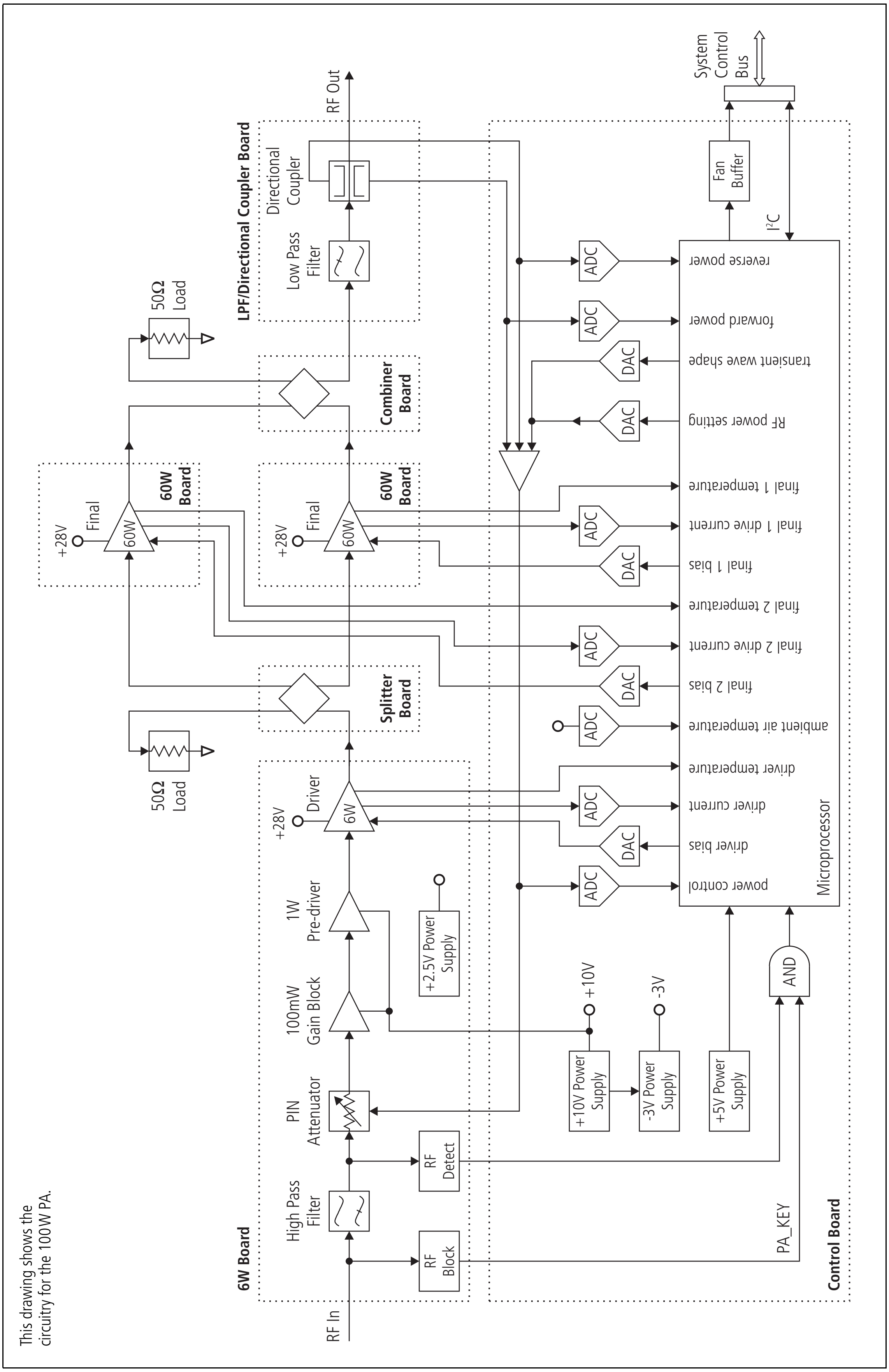
- the temperature of the 6W board, 60W board 1 or 60W board 2 exceeds the maximum allowable temperature
- the supply voltage drops to between 24 and 26VDC or rises to between 30 and 32VDC
- the load VSWR is ≥10:1 (foldback is deactivated when the VSWR is less than 5:1)
- the transmit current of the 6W driver transistor, 60W final transistor 1 or 60W final transistor 2 exceeds the maximum allowable current.

P_{min} is defined as follows:

Model	P_{min}
5W	1W
50W	5W
100W	10W

1. The accuracy of the measurement of the parameter values is subject to the tolerances listed in the Specifications Manual.

Figure 7.2 PA control, RF and power supply circuitry block diagram



7.1.4 Shutdown

The PA software will prevent transmission under the following conditions:

- the following calibration procedures were not completed successfully:
  - 6 W driver transistor, 60 W final transistor 1 or 60 W final transistor 2 bias
  - detector bias
  - supply voltage
  - output power
- the supply voltage drops below 24 VDC or exceeds 32 VDC
- the transmit current of the 6 W driver and 60 W final transistors does not reduce to a safe level after foldback
- the configuration of the PA is invalid.

7.1.5 Power Control

The PA has a power control circuit which keeps the output power constant and protects the PA from VSWR mismatch conditions. The control circuit monitors forward and reverse power and these measurements are used to:

- determine forward and reverse power
- keep the output power constant
- foldback the power under mismatch conditions
- calculate VSWR.

The power level is set by requesting the power level in watts via an I^2C bus message. The minimum size of a power step is 1 W and the range of output power settings is:

Model	Output Power Range
5 W	1 W to 5 W
50 W	5 W to 50 W
100 W	10 W to 100 W

The forward power, reverse power and load VSWR measurements may also be requested via I^2C bus messages.

The foldback loop is analogue until the VSWR reaches 10:1, at which point the microprocessor initiates foldback.

The microprocessor and control loop are also used to shape the RF signal envelope during key-on and key-off transients.

7.1.6 Fan Control

The fan is supplied from a +24V controlled supply on pin 13 of the IDC connector (ground is on pin 14). The status of the fan supply voltage is dependent on the operating temperature of the PA. The fan is turned on when the PA operating temperature exceeds the user-defined thresholds set using the Service Kit. The Service Kit also has an option to turn the fan on only when the operating temperature exceeds the thresholds **and** the PA is transmitting. The fan remains on until the operating temperature of the PA falls to 5°C below the threshold temperature.

Power is supplied to the fan via the 16-way ribbon cable from the PA to the subrack interconnect board. From there it is fed through the control panel to the fan. If two PAs are fitted in a subrack, either PA will turn on the fan when required.

Note The PA fan must be in position and running to get an accurate reading on the Air intake temperature gauge in the Service Kit. You can use the fan test (Diagnose > Power Amplifier > Control Tests) to make the fan run. Note also that the reading displayed for a 100W PA may be slightly high, due to the location of the temperature sensor board in the heatsink airflow.

7.1.7 Power Supplies

The PA operates off a single +28VDC external power supply. The normal range of operation is +26 to +30VDC. If the supply voltage falls to between +24 and +26VDC or rises to between +30 and +32VDC, the PA will reduce its output power to foldback levels. If the supply voltage falls below +24VDC or rises above +32VDC, the PA will cease transmission (shutdown).

The PA also has four internal power supplies to produce –3, +2.5, +5 and +10VDC.

7.1.8 Temperature Monitoring

The PA monitors the temperatures of the 6W board, 60W board 1 and 60W board 2. The operating temperatures can be requested via an I^2C bus message.

If any board reaches the designated maximum temperature, the PA software will report an alarm via the I^2C bus. The maximum temperature thresholds may be set using the Service Kit. In addition to activating alarms, the board temperatures are also used to activate the PA fan, and power foldback. The foldback thresholds are set in the factory and cannot be adjusted by the user. A recovery hysteresis of 5°C is applied to all temperature thresholds.

7.1.9 Ambient Air Temperature Sensor

The PA ambient air temperature sensor board may be fitted in one of two positions. It is inserted through the appropriate slot in the control board and plugs into a 3-way connector. The sensor board is positioned between the heatsink fins and requires forced airflow to perform an accurate measurement.

Note You must fit the sensor board in the correct location to ensure that the temperature of the airflow over the sensor is nearest the ambient temperature of the air from the cooling fan. Figure 8.1 on page 130 and Figure 8.2 on page 131 show the correct location of the sensor board in each model of PA.

7.2 RF Circuitry

Refer to Figure 7.2 on page 117.

7.2.1 6 W Board

The 11 dBm (±2 dB) RF input is fed to the variable PIN diode attenuator which provides power control. From the PIN diode attenuator the signal is fed via a 100 mW gain block and a 1 W gain stage to a 6 W transistor where it is amplified to the final output level of 6 W. This 6 W transistor forms the output stage of the 5 W PA and is the driver stage for the 50 W and 100 W PAs.

The gain block and 1 W transistor operate off a +10 V switched supply, while the 6 W driver transistor operates off a +28 V supply.

The 6 W board also has circuitry to monitor the drain current and temperature of the 6 W transistor, and the presence of an RF input signal.

7.2.2 60 W Board

The output from the 6 W board is fed to the 60 W final transistor which amplifies the signal to an output power of 60 W. The 60 W transistor operates off a +28 V supply.

The 60 W board also has circuitry to monitor the drain current and temperature of the 60 W transistor.

7.2.3 Low Pass Filter and Directional Coupler Board

The output from the 60W board is fed to the RF output connector via a low pass filter (LPF), to attenuate harmonics, and a dual directional coupler.

The directional coupler senses forward and reverse power which is rectified and passed to the control circuitry for metering, alarm and power control. The directional coupler is on the output side of the LPF to measure true forward and reflected power.

7.2.4 Splitter and Combiner Boards

In the 100W PA the output from the 6W board is split through a 3dB hybrid coupler on the splitter board to drive two 60W boards in quadrature. The outputs from these two boards are then combined by another 3dB hybrid coupler on the combiner board before being fed to the LPF/ directional coupler board.

7.2.5 Interconnect Boards

Because of the modular design of the PA, interconnect boards are used in certain models to connect boards that are physically separated on the heatsink. They have no components and their only function is to link two parts of the circuit together. The interconnect boards are shown in Figure 8.1 on page 130 and Figure 8.2 on page 131.

7.3 Boost Regulator Circuitry (12V PA Only)

5W and 50W 12V PAs are fitted with a boost regulator board. Figure 7.1 on page 114 shows the configuration for a 50W 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 startup voltage is 12VDC or higher. Once started, the boost regulator will operate down to 10.5VDC ±0.25V before it shuts down to prevent deep discharge of the battery.

Note These limits are set in hardware at the factory and cannot be adjusted by the user.

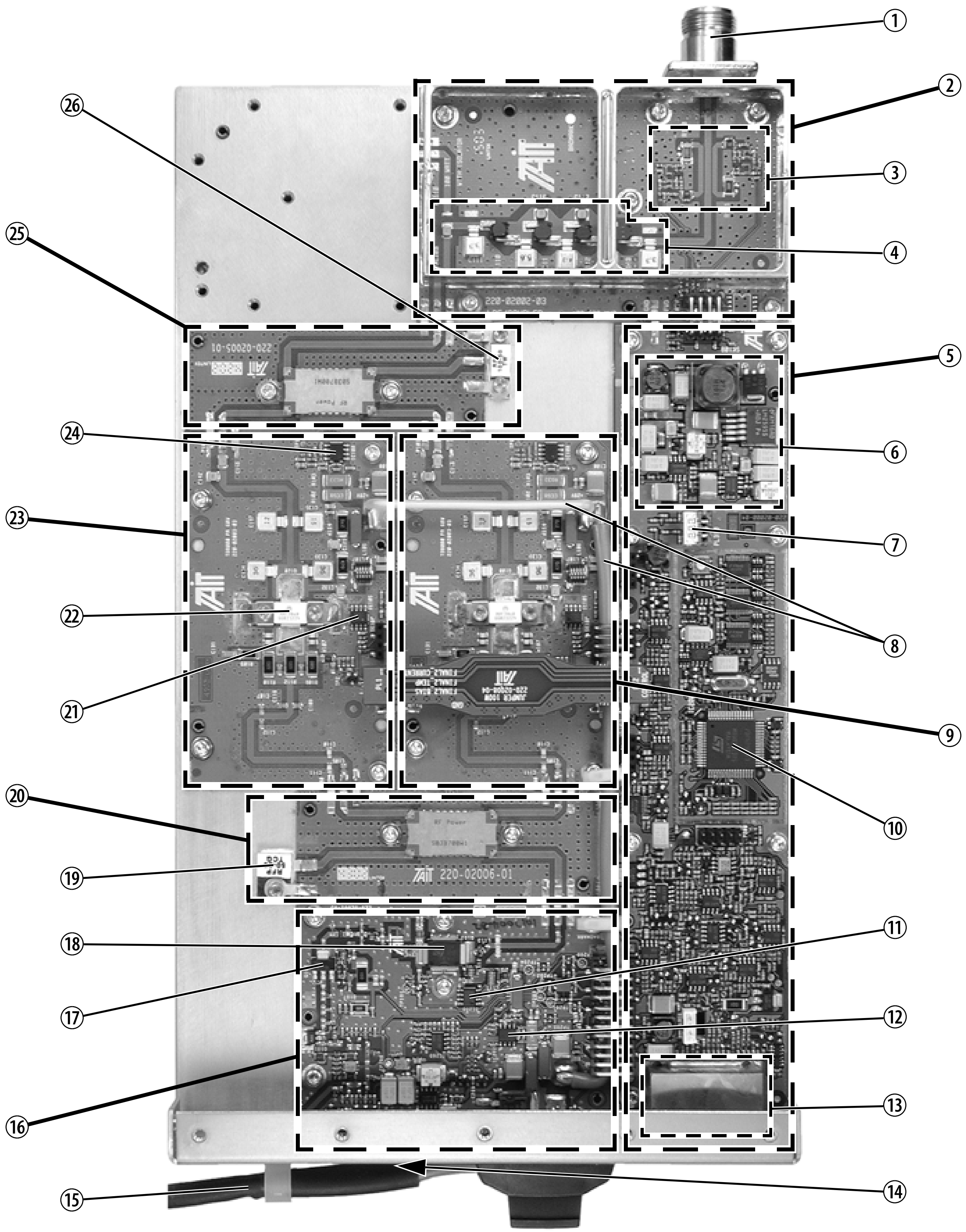
Power Saving Operation

Power Saving is also available in base stations using a 12V PA. Both Sleep and Deep Sleep modes can be configured, with the same receiver cycling and Tx keyup options as a base station with a PMU. In Deep Sleep mode, the reciter shuts down the PA by shutting down the boost regulator board in the PA (via an external control cable[1], as shown in Figure 19.4 on page 292). The 12VDC output from the boost regulator board is unswitched and continues to power the reciter even when the rest of the circuitry on the board is shut down.

1. Refer to the TB8100 Installation and Operation Manual (MBA-00005-xx) for more information on this connection.

Figure 7.3 Identifying the circuitry on the 28V PA boards

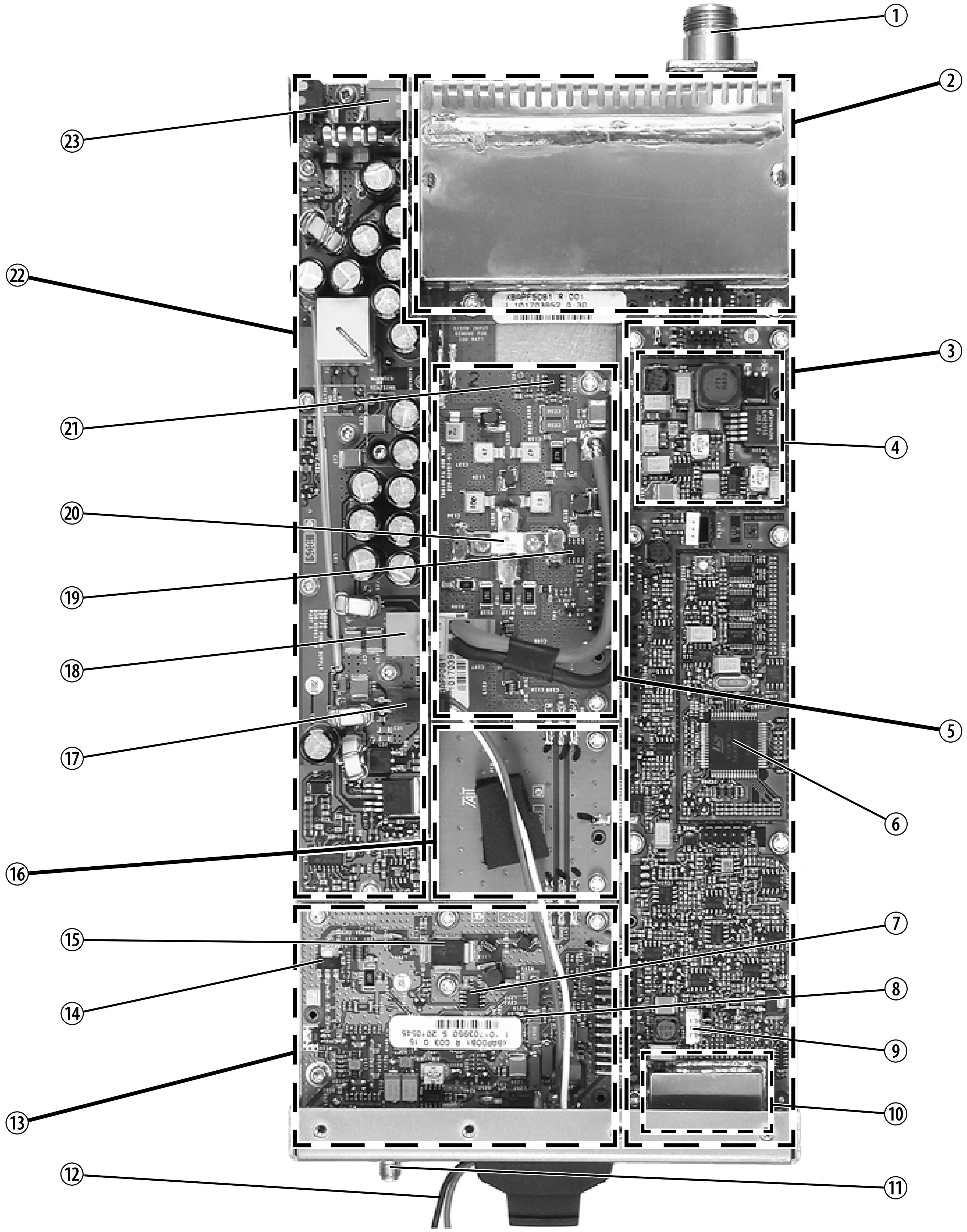
1. RF output
2. low pass filter/directional coupler board
3. directional coupler
4. low pass filter
5. control board
6. power supply
7. ambient air temperature board
8. 28VDC power feed
9. 60W board
10. microprocessor
11. 6W board temperature sense
12. 6W driver transistor drain current sense
13. I^2C signal filtering
14. RF input (obscured)
15. 28VDC input
16. 6W board
17. pre-driver transistor
18. 6W driver transistor
19. termination resistor (50Ω load)
20. splitter board
21. 60W board temperature sense
22. 60W final transistor
23. 60W board
24. 60W final transistor drain current sense
25. combiner board
26. termination resistor (50Ω load)



Note:
This drawing shows a 100W UHF (H-band) PA. The configuration of other models is shown in Figure 8.1 on page 130 and Figure 8.2 on page 131.

Figure 7.4 Identifying the circuitry on the 12V PA boards

① RF output
② low pass filter/directional coupler board
③ control board
④ power supply
⑤ 60W board
⑥ microprocessor
⑦ 6W board temperature sense
⑧ 6W driver transistor drain current sense
⑨ ambient air temperature board
⑩ I^2C signal filtering
⑪ RF input
⑫ 12VDC output for reciter
⑬ 6W board
⑭ pre-driver transistor
⑮ 6W driver transistor
⑯ 50W interconnect board
⑰ 12VDC output
⑱ 28VDC output
⑲ 60W board temperature sense
⑳ 60W final transistor
㉑ 60W final transistor drain current sense
㉒ boost regulator board
㉓ 12VDC input



Note:
This drawing shows a 50W VHF (B-band) 12V PA. The 5W 12V PA has the same configuration, except the 5W interconnect board is fitted in place of the 50W interconnect board and 60W board.

8 Power Amplifier Fault Finding

This chapter provides enough fault finding information to allow you to trace the fault to an individual board in the PA. It does not provide any information to allow fault finding down to component level, except for replacing the RF power transistors. When the fault has been traced to a particular board, the standard procedure is to discard the faulty board and fit a new one.

The fault finding procedures provided in this chapter assume you are familiar with the operation of the TB8100 Service Kit and Calibration Kit.

Figure 8.1 on page 130 and Figure 8.2 on page 131 identify the individual boards and show how they are configured in different models. "Identifying the PA" on page 129 explains how to identify the model and hardware configuration of a PA from its product code.

Note Unless otherwise noted, the instructions and illustrations in this chapter refer to a 100 W UHF (H-band) PA. However, the same basic procedures and techniques apply to other models of PA.

8.1 Safety Precautions

8.1.1 Personal Safety

Caution

Beryllium Oxide
The termination resistors used in the 100W power amplifier contain some beryllium oxide. This substance is perfectly harmless in its normal solid form, but can become a severe health hazard when it has been reduced to dust. For this reason the termination resistors should not be broken open, mutilated, filed, machined, or physically damaged in any way that can produce dust particles. You should safely dispose of all used or obsolete components according to your local regulations.

Caution

Touching high-power RF components or circuits can cause serious burns. We strongly recommend you do not touch any RF components or tracks in the PA while it is transmitting.

Caution

The TB8100 power amplifier (PA) weighs between 4.8kg (10.6lb) and 5.8kg (12.8lb). Take care when handling the PA to avoid personal injury.

8.1.2 Equipment Safety

Important

This equipment contains devices which are susceptible to damage from static charges. Refer to "ESD Precautions" on page 17 for more information on antistatic procedures when handling these devices.

Important

The PA is fully calibrated in the factory and will need to be recalibrated only if it has been repaired. You **do not** need to recalibrate the PA if the transmit frequency is changed.

8.2 Identifying the PA

You can identify the model and hardware configuration of a PA by referring to the product code printed on labels on the heatsink and rear of the cover. The meaning of each character in the product code is explained in the table below.

Note This explanation of PA product codes is not intended to suggest that any combination of features is necessarily available in any one PA. Consult your nearest Tait Dealer or Customer Service Organisation (CSO) for more information regarding the availability of specific models and options.

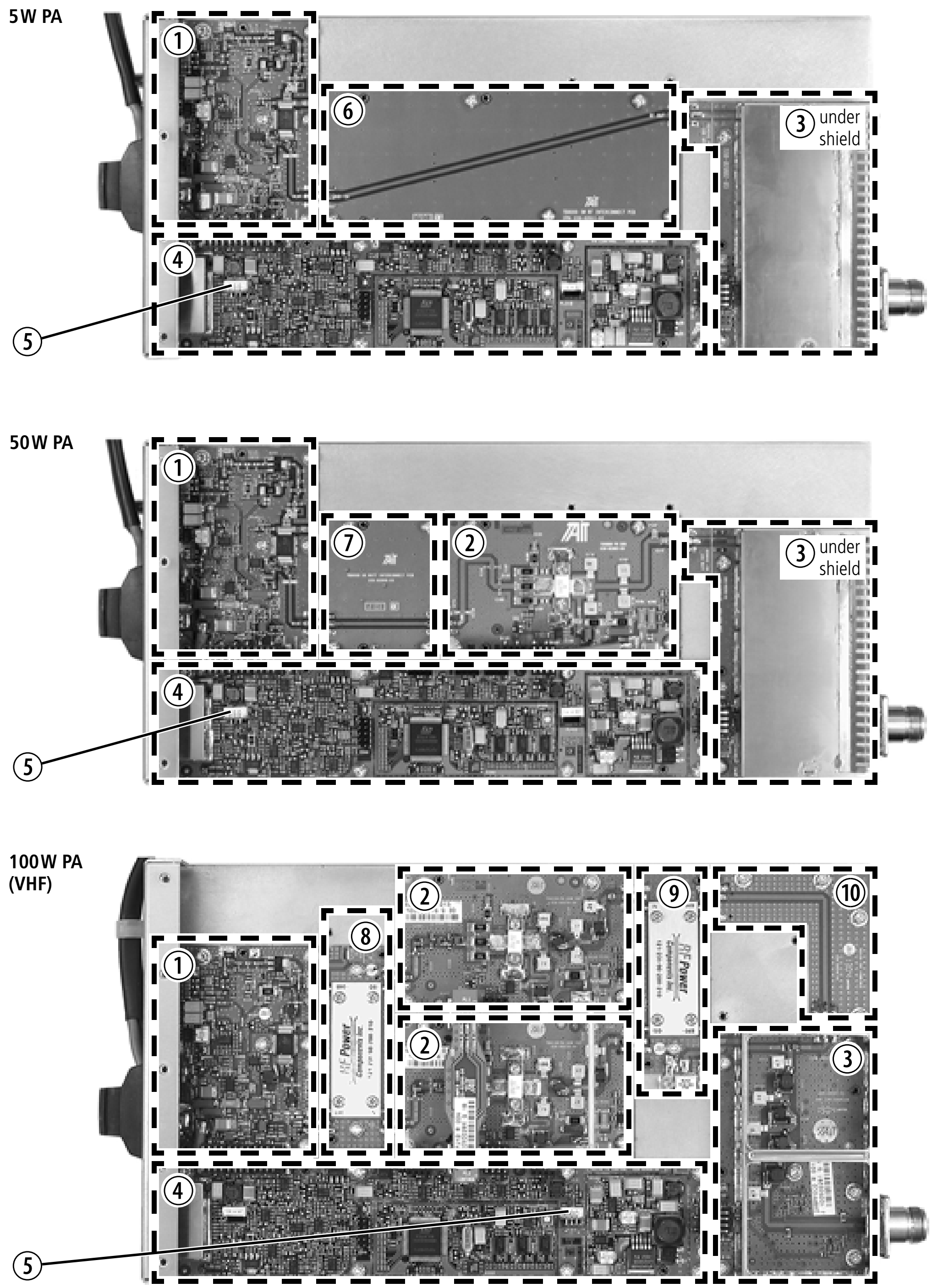
Product Code	Description
TBA**X**XXX-XXXX	7 = 5W 8 = 50W 9 = 100W
TBAX**X**XX-XXXX	0 = default 1 = 12V PA
TBAXX**XX**-XXXX	**Frequency Band and Sub-band** B1 = 136MHz to 174MHz C0 = 174MHz to 225MHz H0 = 380MHz to 520MHz[a] K2 = 760MHz to 870MHz[b] L0 = 850MHz to 960MHz[c]
TBAXXXX-**X**XXX	0 = default
TBAXXXX-X**X**XX	0 = default
TBAXXXX-XX**X**X	0 = default
TBAXXXX-XXX**X**	0 = default

a. Only PAs with hardware version 00.02 and later can operate from 380MHz to 520MHz. PAs with hardware version 00.01 and earlier can only operate from 400MHz to 520MHz.

b. The actual frequency coverage in this band when used with a K-band TB8100 reciter is 762MHz to 776MHz, and 850MHz to 870MHz.

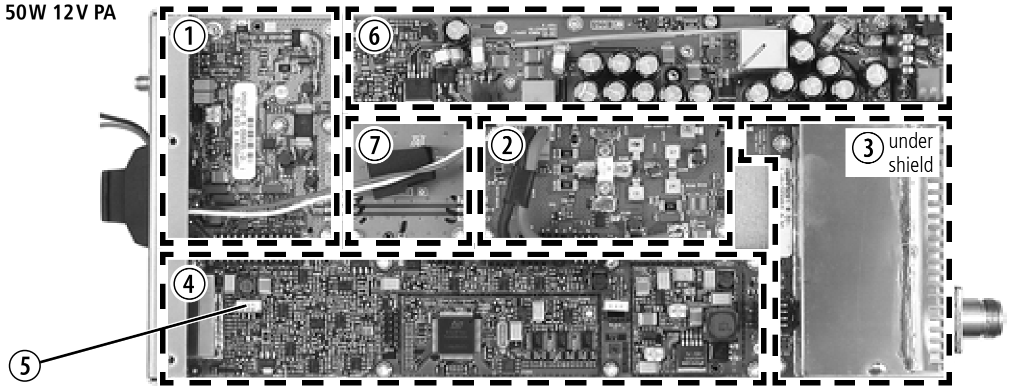
c. The actual frequency coverage in this band when used with an L-band TB8100 reciter is:
852MHz to 854MHz and 928MHz to 930MHz
927MHz to 941MHz (transmit only)

Figure 8.1 Identifying the circuit boards in a 28V PA



1. 6W board
2. 60W board
3. low pass filter/directional coupler board
4. control board
5. ambient air temperature sensor board
6. 5W interconnect board
7. 50W interconnect board
8. splitter board
9. combiner board
10. 100W interconnect board (VHF only)

Figure 8.2 Identifying the circuit boards in a 12V PA



The 5W 12V PA has the same configuration, except the 5W interconnect board is fitted in place of the 50W interconnect board and 60W board.

1. 6W board
2. 60W board
3. low pass filter/directional coupler board
4. control board
5. ambient air temperature sensor board
6. boost regulator board
7. 50W interconnect board

8.3 Test Equipment

Important The PA has been calibrated in the factory to within 0.1 dB at the N-type connector into a load of less than 1.2:1 VSWR. Measurements will vary according to the type of test equipment used, and the length and quality of the RF leads used. We recommend that you verify the accuracy of your test equipment before calibrating the PA.

Recommended Test Equipment

The following test equipment is required for carrying out the PA fault finding procedures:

- PC with the latest version of the TB8100 Service Kit (refer to "Software and Firmware Compatibility" on page 136).

Note The Calibration Kit is also installed when you install the Service Kit. If you need to reprogram any factory parameters into the PA, you will need to use a dongle with the Calibration Kit.

- Operational and calibrated reciter of the same frequency band as the PA under test (refer to "Software and Firmware Compatibility" on page 136).
- Operational and calibrated PMU.
- TB8100 subrack complete with control panel, front panel, and appropriate interconnecting cables.
- TBA0ST1, TBA0STU or TBA0STP calibration and test unit (CTU) with supplied cables.
- Oscilloscope.
- RF power meter capable of measuring 150 W.
- Multimeter.
- 50 Ω load (power rating greater than 150W, input VSWR less than 1.2:1).
- Coaxial flying lead for checking the RF output power from the 6 W or 60 W board (connects between the PCB and RF power meter).

12V

The following items of equipment are also specifically required for testing a 12V PA:

- DC power supply capable of providing at least 12.5V at 11 A (the standard test voltage is 12.5 V).
- Subrack fitted with a dual base station subrack interconnect board (IPN 220-02037-04 or later). Refer to "Replacing the Subrack Interconnect Board" in the Installation and Operation Manual (MBA-00005-xx) for more details about this board and its switch settings.

Recommended Test Equipment Set-up

The recommended test equipment set-up for the initial checks is shown in Figure 8.3 on page 134 (28 V PA) and Figure 8.4 on page 135 (12 V PA). The operation of the CTU is described in the TBA0STU/TBA0STP Calibration and Test Unit Operation Manual (MBA-00013-xx).

Important Ensure that the reciter is configured and calibrated correctly, and is of the same frequency band as the PA under test.
When using a desktop power supply to power a 12 V PA, ensure the supply leads are of a suitable gauge to prevent excess voltage drop. The recommended gauge is 8AWG or 8 mm².

Note If the reciter is fitted with a TaitNet RS-232 system interface board, connect the PC directly to the reciter (refer to Figure 3.2 on page 73).

Note If the reciter is fitted with a TaitNet Ethernet system interface board, and the PC is connected to the control panel, run the Service Kit and connect to the base station, then power up the base station. Refer to TN-1142-AN for full Ethernet connection details.

Figure 8.3 Recommended test equipment set-up for initial checks - 28 V PA

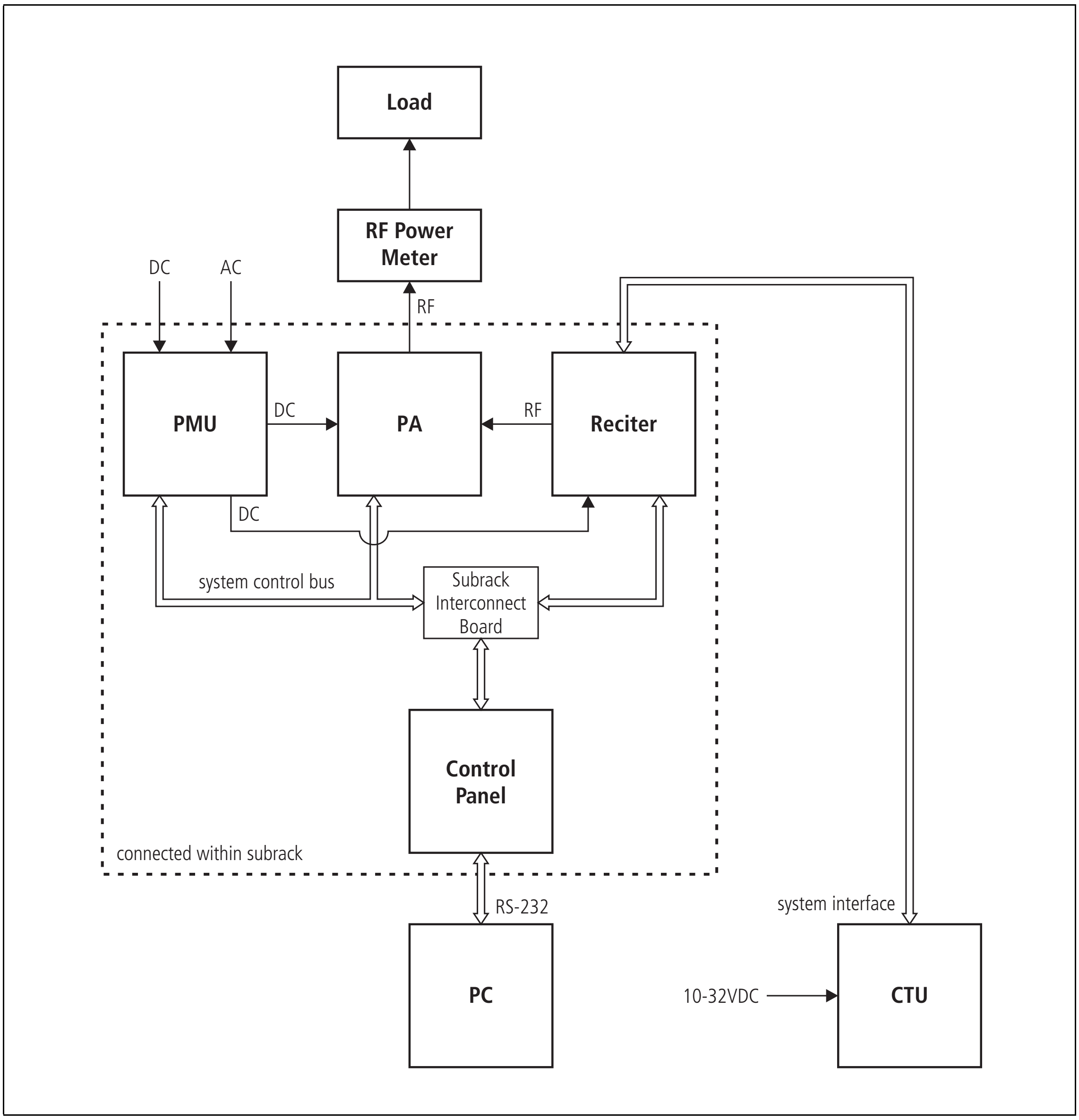
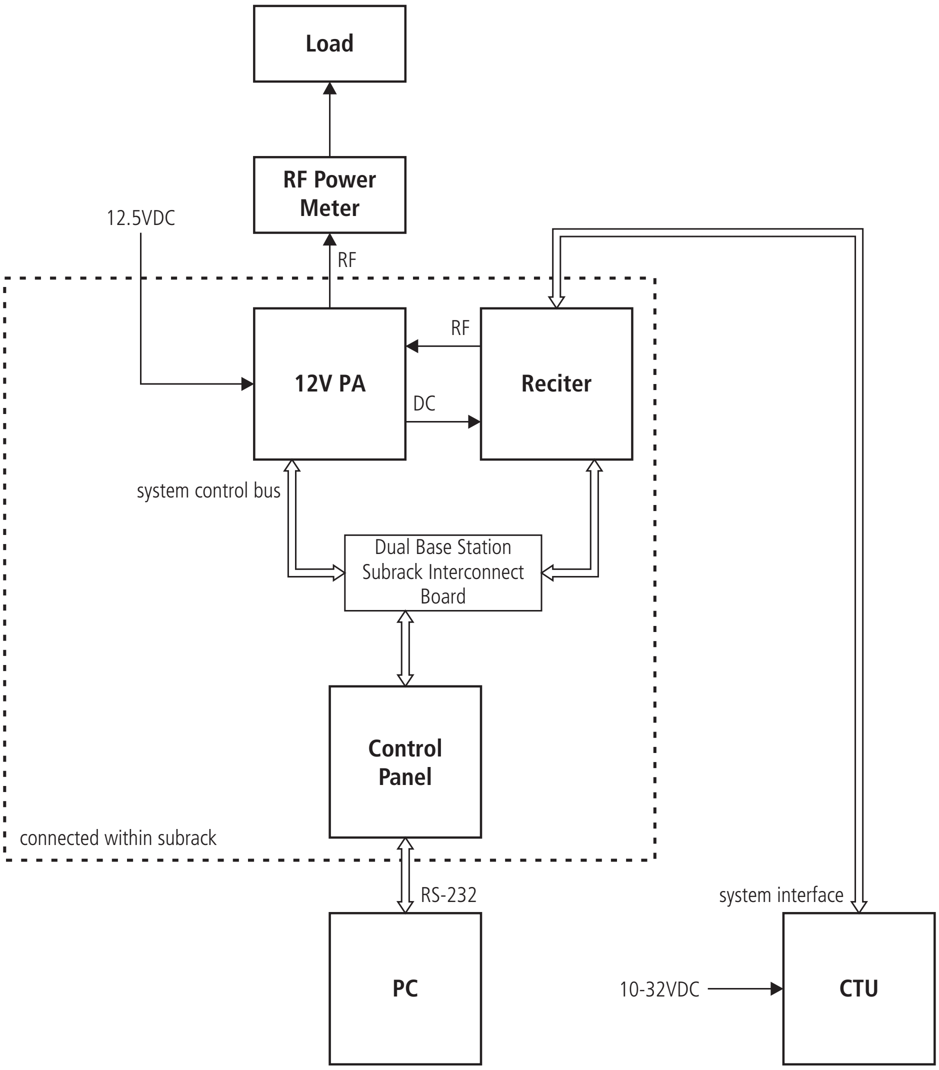
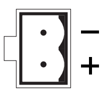


Figure 8.4 Recommended test equipment set-up for initial checks - 12V PA



12V PA DC input connector



The matching socket for this connector is available as part number 240-00022-11 (Phoenix MVSTBR2.5HC/2-ST/5.08 female).

8.4 Software and Firmware Compatibility

Service Kit

We recommend that you use the latest version of the Service Kit when carrying out these fault finding procedures. The latest version is available from the Tait Technical Support website (http://support.taitworld.com).

Calibration Kit

You must use the version of the Calibration Kit which is compatible with the version of firmware loaded into the PA.

1. To find out the firmware version, run the Service Kit and connect to the base station. Select Monitor > Module Details > Power Amplifier. The firmware version is displayed in the **Versions** area.

2. To find out which version of the Calibration Kit to use, refer to the Compatibility Table in the TB8100 Base Station Release Notes. These Release Notes are on the TB8100 Product CD, and the latest version is also available from the Tait Technical Support website.

Firmware

If you are testing a PA separately from the other modules in the customer's base station, we recommend you consult the customer before changing the PA's firmware version. The new firmware may not be compatible with the other modules in the customer's base station.

Compatibility with TB8100 Modules Used in Testing

Ensure that any TB8100 modules used to test the functionality of the PA under repair are loaded with compatible firmware. Details of compatible firmware combinations are provided in the Compatibility Table in the TB8100 Base Station Release Notes.

8.5 Board Replacement

Replacing Faulty Boards

At certain stages during the fault finding procedure, you will be instructed to replace a particular circuit board. In these cases, go to the appropriate section in "Power Amplifier Board Replacement" on page 179 and carry out the board replacement procedures described there. The full procedure will normally involve:

- removing the faulty board
- fitting a new board
- carrying out the specified reprogramming and recalibration tasks using the Calibration Kit
- carrying out the procedures described in "Final Tasks" on page 170.

Refer to "Power Amplifier Spare Parts" on page 195 for a full description of the spares available for the PA.

Disposing of Faulty Boards

We recommend that you dispose of faulty boards according to your local environmental and safety regulations. Otherwise, return them to your nearest CSO for appropriate disposal.

8.6 Initial Checks

You can use the TB8100 Service Kit and Calibration Kit to check the basic operation of the PA without removing the cover.

- To check whether the PA powers up correctly and generates any alarms, carry out Task 1, Task 2, and Task 3.
- If the PA has low RF output power, go to Task 4.
- To check the operation of the ambient air temperature sensor board, go to Task 5.

Task 1 — Check Power-up and LEDs

1. Before starting any of these fault finding procedures, you must identify the model and hardware configuration of the PA under test. "Identifying the PA" on page 129 explains how to identify a PA from the product code printed on a label on the rear panel.

2. Set up the test equipment as shown in Figure 8.3 on page 134 (28V PA) or Figure 8.4 on page 135 (12V PA). Do not fit the front panel to the subrack.

3. Power up the test set-up and check the LEDs on the front panel of the PA. 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; use the Service Kit to download the latest version of firmware, recalibrate the PA, and repeat this step.
   - flashing red – one or more alarms have been generated; use the Service Kit to find out more details about the alarms.

   If the PA powers up, go to Task 2. If it does not, go to "Visual Inspection" on page 144.

Task 2 — Check Configuration and Alarms

1. Fit the front panel to the subrack.

2. Run the Service Kit and connect to the base station. Once connected to the base station, ensure that it is in Run Mode.

3. If you are testing a customer's complete base station, read the base station to load the PA's configuration information into the Service Kit.

   If you have only the customer's PA, and you are testing it in a test base station, program the default profile into the test base station. Change the default frequency as required.

4. Select Configure > Base Station > Channel Profiles. In the Edit Channel Profile screen go to the Power Saving tab and check that:

   - the Tx Keyup time is 2ms
   - Sleep or Deep Sleep modes are **not** selected.

5. Select Configure > Base Station > Channel Table and check that the output power is set to the rated power of the PA: either 5 W, 50 W, or 100 W.

6. Select Configure > Alarms > Thresholds and check that:
   - the minimum PA power output is set to 3 W for a 5 W PA, 40 W for a 50 W PA, or 90 W for a 100 W PA
   - the maximum PA reverse power output is set to 2 W for a 5 W PA, or 10 W for a 50 W and 100 W PA
   - the maximum PA VSWR is set to 1.5:1
   - the maximum PA final temperature is set to 90°C
   - the maximum PA driver temperature is set to 80°C
   - the PA air intake temperature is set to a maximum of 60°C and a minimum of −20°C.

   These are the default settings.

7. Select Monitor > Module Details > Power Amplifier and check that the module details are correct.

8. Key the PA using the TX KEY switch on the CTU. Check that the output power is correct for the model of PA. If it is, go to "Final Tasks" on page 170. If it is not, go to Task 4. If the PA has generated any alarms, go to Task 3.

Task 3 — Check Reported Alarms

Any alarms generated by the PA under test will appear in the Alarms > Current Alarm Status screen in the Service Kit. The most likely alarms are described in more detail below.

No PA Detected

1. Check that the correct DC supply is present at the PA.

2. Check whether the power supply is current limiting (the PMU will raise a Current high alarm). If it is, go to "6 W Board" on page 155. If it is not, go to Step 3.

3. Check that the system control bus is undamaged and correctly connected (refer to the TB8100 Installation and Operation Manual for details [MBA-00005-xx]).

4. Check that the I^2C current source for the system control bus is present. The I^2C current source for a 28 V PA is in the PMU, and for a 12 V PA it is on the dual base station subrack interconnect board.

5. Check the state of the green indicator LED. If it is on and steady, continue with the alarm checks. If it is off, go to "Control Board" on page 148. If it is flashing, reload the firmware and return to Task 1.

Fan Failure

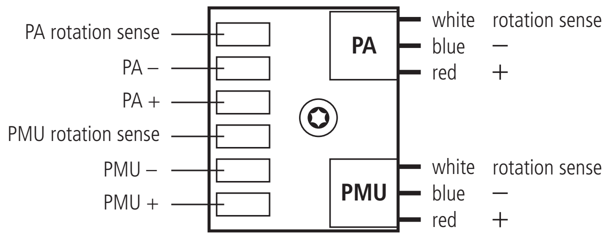
1. Fit the front panel to the subrack (if not already fitted). Run the fan test and check that the fan works (Diagnose > Power Amplifier > Control Tests). If it does not, go to Step 2. If it does, the control panel may be faulty. Fit another control panel and repeat the test.

2. Check that all cables are connected securely and correctly.

3. Check that the fan itself is in working order. Figure 8.5 identifies the connections on the fan contact board on the front panel.

   If it is working, go to "Control Board" on page 148. If it is not, replace the fan and repeat the test.

Figure 8.5 Connections on the fan contact board



Shutdown

The PA has detected a fault condition and has disabled the transmitter to prevent damage. Check the other alarms to see what fault condition or conditions have caused this.

VSWR High

The VSWR is above the configured threshold. Check that the alarm threshold is not too low (Configure > Alarms > Thresholds). If the threshold is below the default value of 1.5:1, increase the value and check whether the alarm is still present. If it is not present, go to "Visual Inspection" on page 144. If it is still present, proceed as follows:

- check all test equipment connections
- check the N-type connector is correctly soldered (refer to "Visual Inspection" on page 144)
- check the directional coupler (refer to "Low Pass Filter and Directional Coupler Board" on page 165.

Power Foldback

The PA has detected a fault condition and has reduced its power output to a minimal level to prevent damage. Check the other alarms to see what fault condition or conditions have caused this.

Forward Power Low

The output power is below the configured threshold. Check that the alarm threshold is not too high (Configure > Alarms > Thresholds). If the threshold is above the recommended value given in Task 2, decrease the value and check whether the alarm is still present. If it is, go to Task 4. If it is not, go to "Visual Inspection" on page 144.

Reverse Power High

The reverse power output is above the configured threshold. Check that the alarm threshold is not too low (Configure > Alarms > Thresholds). If the threshold is below the recommended value given in Task 2, increase the value and check whether the alarm is still present. If it is not present, go to "Visual Inspection" on page 144. If it is still present, proceed as follows:

- check the load is not faulty
- check the low pass filter (refer to "Low Pass Filter and Directional Coupler Board" on page 165).

Calibration Invalid

Recalibrate the PA as described in the Calibration Kit documentation and return to Task 1.

Hardware Configuration Invalid

Select Monitor > Module Details > Power Amplifier and check that the module details programmed into the PA are correct and match the actual hardware configuration. If they are correct, it is possible there is a break in the connectivity between boards. Go to "Visual Inspection" on page 144. If they are not correct, reprogram the correct details into the PA using the Calibration Kit (this requires a dongle) and then recalibrate the PA.

Driver Current High

Go to "6W Board" on page 155.

Final 1 or 2 Current High / Current Imbalance

1. Check that the load is not faulty.

2. Go to "60 W Board" on page 162. If you are testing a 100 W PA, we recommend testing the splitter and combiner boards first (refer to "Splitter and Combiner Boards (100 W PA Only)" on page 160).

Supply Voltage High or Low

12V Measure the supply voltage to the PA. If it is 10.8 VDC to 16 VDC, go to "Boost Regulator Board (12V PA Only)" on page 168. If it is not, check the power supply. Note that the standard test voltage is 12.5 VDC.

28V Measure the supply voltage to the PA. If it is 28 VDC ±2 V, go to "Control Board" on page 148. If it is not, check the PMU or power supply.

Driver Temperature High

1. Check that the alarm threshold is not too low (Configure > Alarms > Thresholds). If the threshold is below the default value of 80°C, increase the value and check whether the alarm is still present. If it is, go to Step 2. If it is not, go to "Visual Inspection" on page 144.

2. Check the temperature of the PA with the Service Kit (Monitor > Monitoring > Power Amplifier). If the temperature is too high, go to "6 W Board" on page 155. If it is not, go to Step 3.

3. If the alarm threshold and PA temperature are correct, and the alarm is still present, go to "6 W Board" on page 155.

Final 1 or 2 Temperature High

1. Check that the alarm threshold is not too low (Configure > Alarms > Thresholds). If the threshold is below the default value of 90°C, increase the value and check whether the alarm is still present. If it is, go to Step 2. If it is not, go to "Visual Inspection" on page 144.

2. Check the temperature of the PA with the Service Kit (Monitor > Monitoring > Power Amplifier). If the temperature is too high, go to "60 W Board" on page 162. If it is not, go to Step 3.

3. If the alarm threshold and PA temperature are correct and the alarm is still present, go to "60 W Board" on page 162.

Task 4 — Check Calibration

You can also use the Calibration Kit to help identify which section of the PA is faulty. Refer to the Calibration Kit documentation for full details of the calibration procedures.

1. Calibrate the PA bias. If the calibration is successful, go to Step 2. If the stage bias calibration fails, proceed as follows:
   - check that the correct DC supply is present at the PA
   - use the Service Kit to check the temperature of the driver, final 1 and final 2 transistors (Diagnose > Power Amplifier > Control Tests)
   - check the final 1 and final 2 transistors (if fitted), as described in Task 3 on page 163
   - if the final transistors are not faulty, check the driver transistor, as described in Task 3 on page 157.

2. Calibrate the forward and reverse detector bias voltages. If the calibration is successful, go to Step 3. If the calibration fails, go to "Low Pass Filter and Directional Coupler Board" on page 165.

3. Calibrate the PA power. If the calibration is successful, go to "Final Tasks" on page 170. If the output power is low, go to "6 W Board" on page 155. If there is no power output, go to "Control Board" on page 148.

Task 5 — Check Ambient Air Temperature Sensor Board

1. Run the Service Kit and connect to the base station.

2. Select Monitor > Monitoring > Power Amplifier and check that the reading on the Air intake temperature gauge matches ambient temperature. If it does not match, replace the ambient air temperature sensor board.

Note The PA fan must be in position and running to get an accurate reading on the Air intake temperature gauge in the Service Kit. You can use the fan test (Diagnose > Power Amplifier > Control Tests) to make the fan run. Note also that the reading displayed for a 100 W PA may be slightly high, due to the location of the temperature sensor board in the heatsink airflow.

8.7 Visual Inspection

The following procedures are intended as a guide for quickly finding basic faults in the PA before proceeding to the more detailed checks. As some of these checks apply only to particular models of PA, you only need to carry out the checks which are appropriate for the model of PA under test. Unless otherwise indicated, the circled numbers in the following instructions refer to Figure 8.6 on page 146.

Task 1 — Check for Physical Damage, Missing or Misplaced Components

1. Remove the cover, as described in "Power Amplifier Disassembly and Reassembly" on page 173.
2. Has the PA been dropped? Inspect the cover and heatsink for damage. Check each board for loose or missing components. Replace any defective board.
3. Has the PA been too hot? Check the boards and heatsink for discoloration. Replace any defective board.
4. Check for loose bridging links ①, and missing or loose RF links ②. The quantity and location of these links will depend on the model of PA.
5. Check that all screws are in place and secured correctly. Refer to "Screw Torque Settings" on page 174.
6. Check that the ambient air temperature sensor board ③ is fitted properly and in the correct place. Replace the board if it is damaged.

Task 2 — Check Quality of Solder Joints

1. Check that the RF power transistor (MRF9060) ④ on the 60 W board(s) is soldered correctly. Refer to "Replacing the 60 W RF Power Transistor" on page 184.
2. Check the overall quality of the solder joints. Repair cracked or dry joints as necessary.

Task 3 — Check DC Supply

1. Check whether the reverse polarity protection diode ⑤ has failed (short circuit). If it has, replace the 6 W board.
2. Check the DC supply ⑥ to the 6 W board.
3. Check the DC supply ⑦ to the 60 W board(s).

Task 4 — Check RF Connectors

1. Check the SMA connector ⑧ solder joint. Also check the components near this joint (e.g. C100 and L100).
2. Check the N-type connector solder joint ⑨. This requires the removal of the shield lid. Refer to "Replacing the Low Pass Filter/ Directional Coupler Board" on page 188 for a description of mounting and soldering the N-type connector.

Task 5 — Additional Checks for 12 V PA

The circled numbers in the following instructions refer to Figure 8.7 on page 147.

1. Check the DC input filter capacitors ① on the boost regulator board for damage (e.g. overvoltage).

2. Check the DC supply ② to the 6 W board.

3. Check the DC supply ③ to the 60 W board, including the ground connection ④.

Figure 8.6 Visual inspection points for a 28V PA

VHF (C-band)
100W PA shown

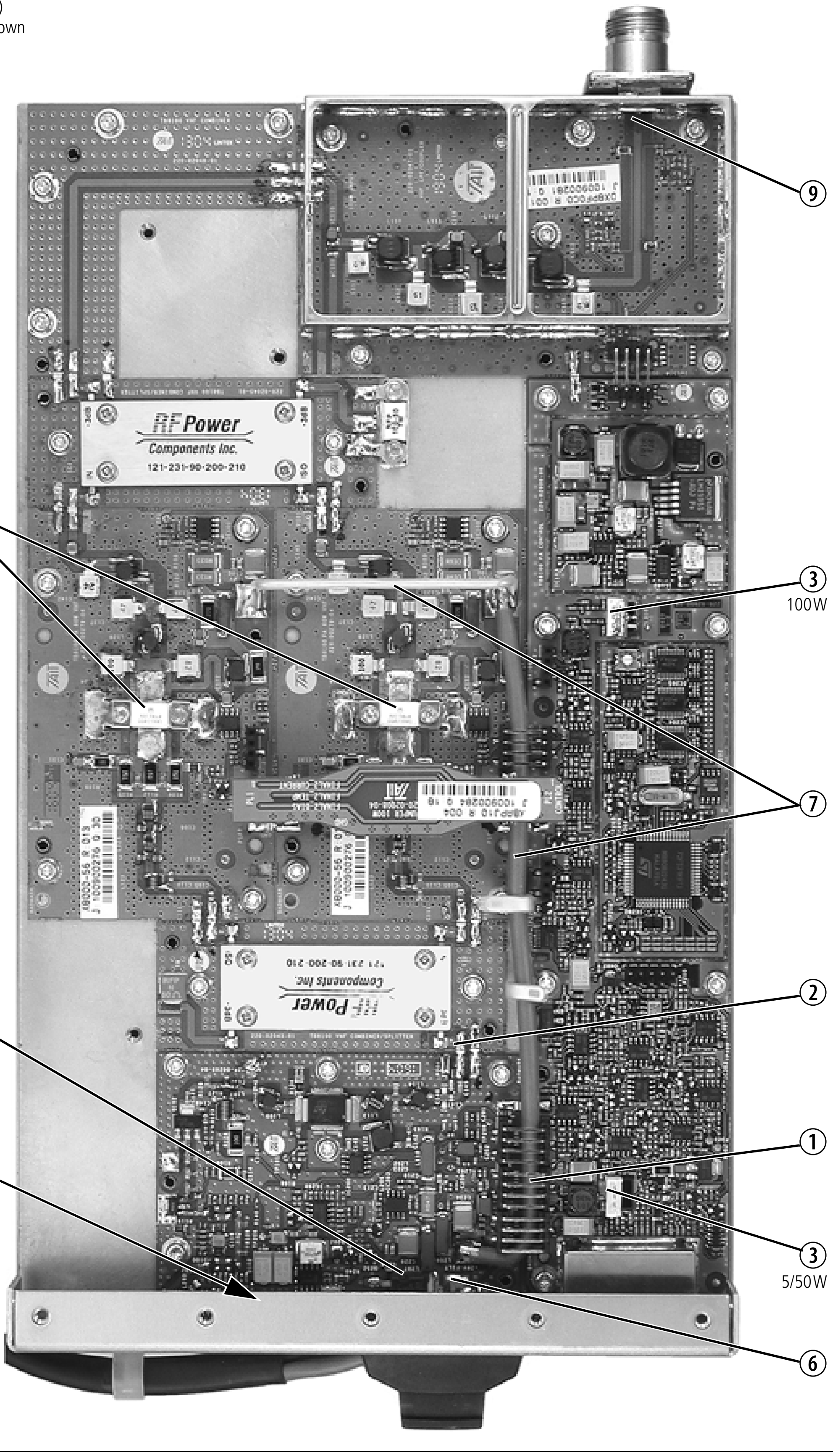
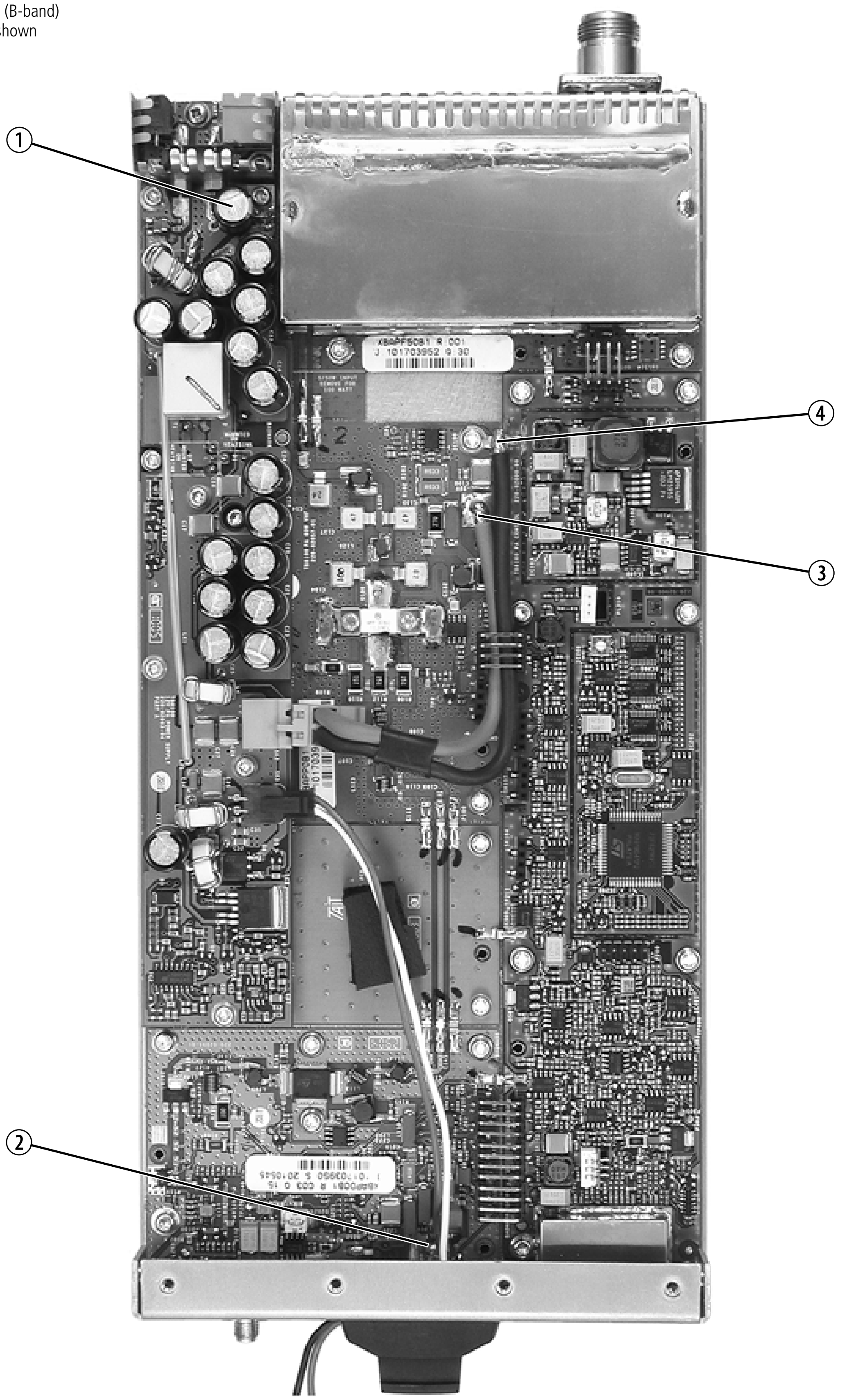


Figure 8.7 Additional visual inspection points for a 12 V PA

VHF (B-band)
PA shown



8.8 Control Board

These checks will verify that:

- the PA powers up and transmits without raising any alarms
- the DC supply voltages are correct
- the correct voltage levels are present at selected test points.

Figure 8.10 on page 153 shows the location of the test points on the control board. Refer also to Table 8.1 on page 154 for a list of test points and their associated voltage levels.

The recommended test equipment set-up is shown in Figure 8.8 on page 149 (28 V PA) and Figure 8.9 on page 150 (12 V PA).

Note If the reciter is fitted with a TaitNet RS-232 system interface board, connect the PC directly to the reciter (refer to Figure 3.2 on page 73).

Note If the reciter is fitted with a TaitNet Ethernet system interface board, and the PC is connected to the control panel, run the Service Kit and connect to the base station, then power up the base station. Refer to TN-1142-AN for full Ethernet connection details.

Figure 8.8 Recommended test equipment set-up for circuit board checks - 28 V PA

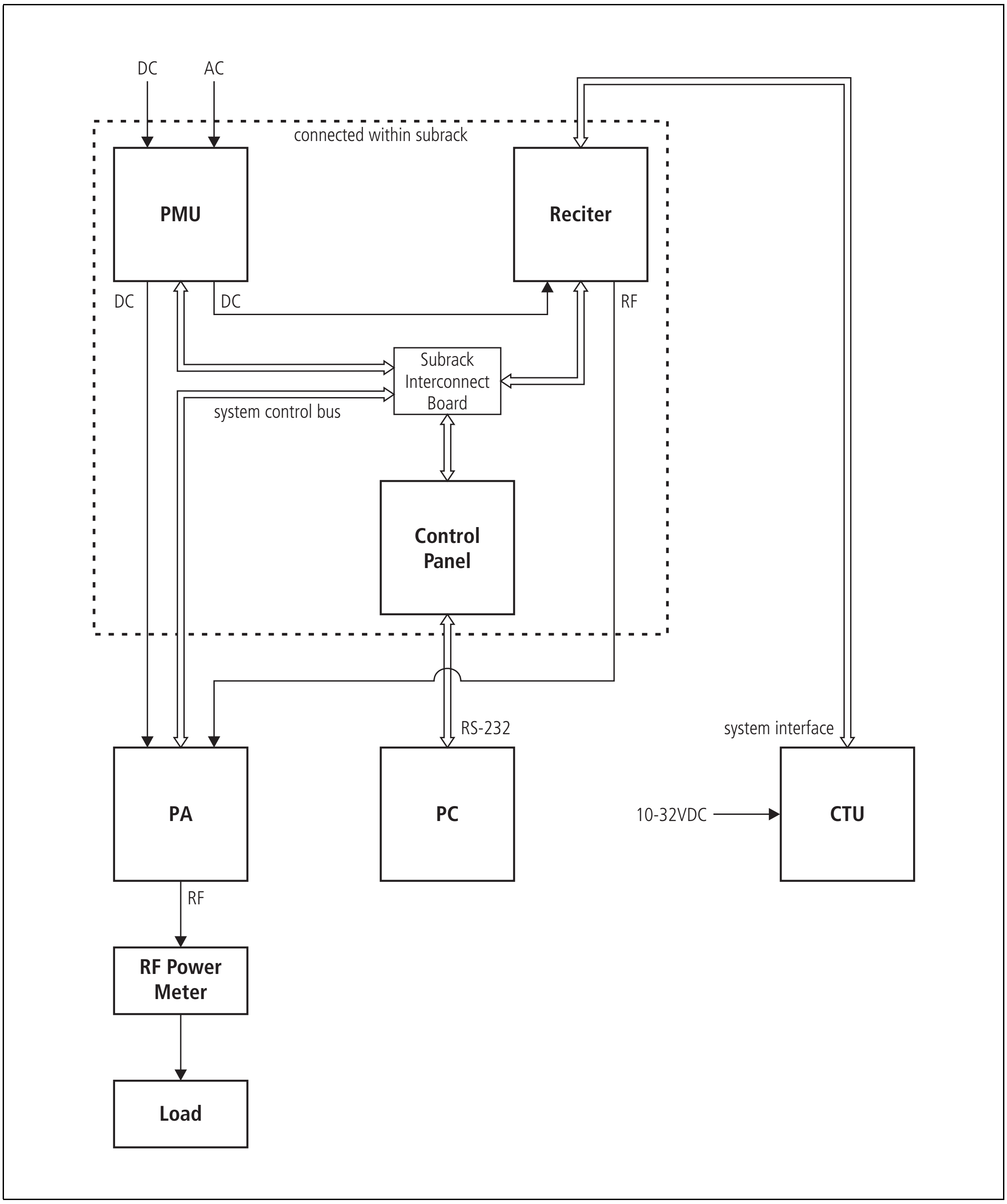
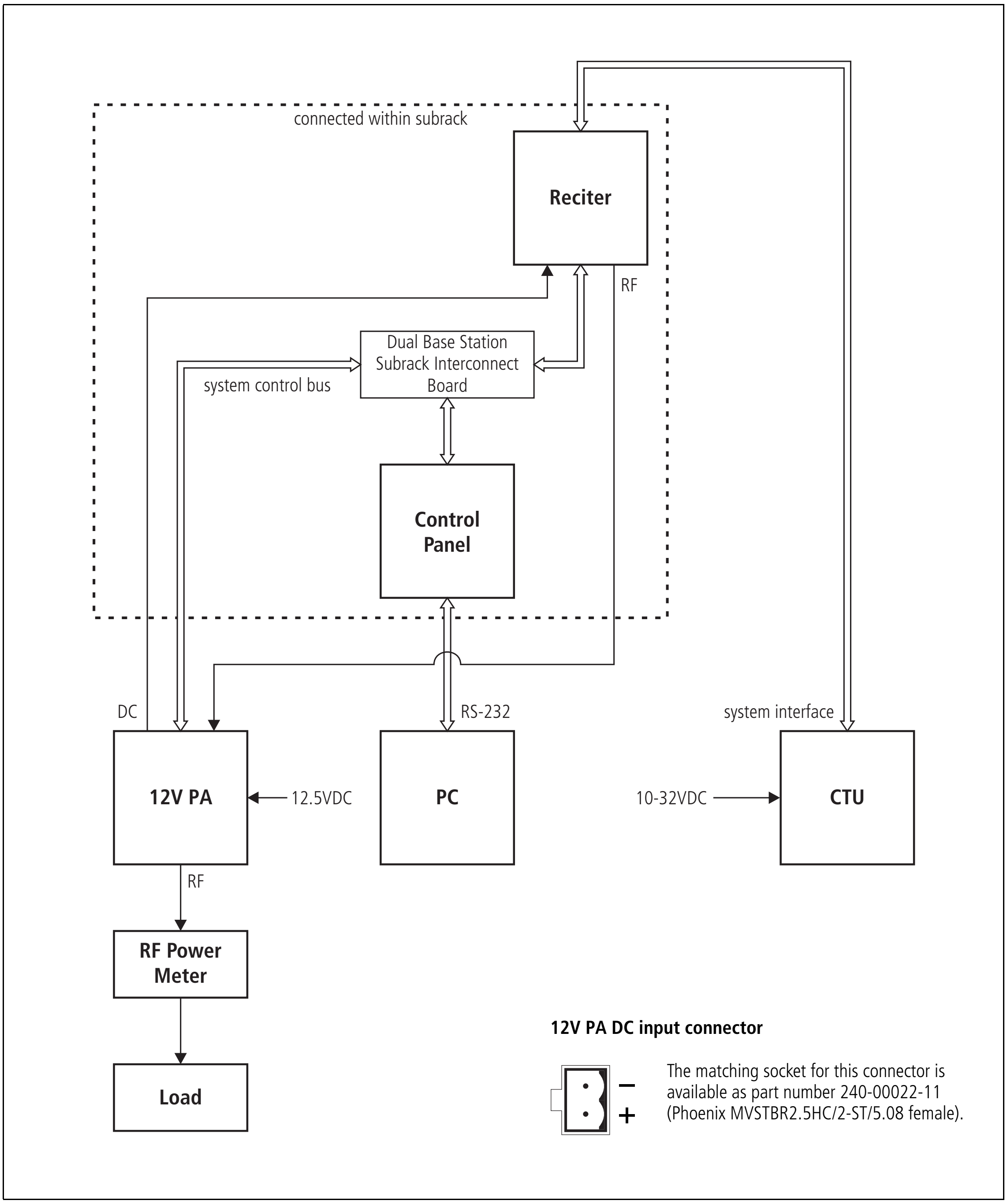


Figure 8.9 Recommended test equipment set-up for circuit board checks - 12 V PA



Task 1 — Check Alarms

1. Set up the test equipment as shown in Figure 8.8 on page 149 (28 V PA) or Figure 8.9 on page 150 (12 V PA).
2. Run the Service Kit and connect to the base station.
3. Once connected to the base station, ensure it is in Run Mode.
4. Key the PA using the TX KEY switch on the CTU.
5. Select Alarms > Current Alarm Status and check there are no supply voltage or temperature alarms. If there are, go to Task 3 on page 139. If there are no alarms, go to Task 2.

Task 2 — Check DC Supplies

1. Measure the filtered DC supply to the control board at pin 2 or pin 3 of SK101. The voltage should be 28 V ±2 V. If it is, go to Step 2. If it is not, go to "6 W Board" on page 155.
2. Check that the regulated supply output voltages are present at the following test points:
   - TP100 +5 V (digital circuitry)
   - TP102 +10 V
   - TP103 −3 V

   If they are all present, go to Task 3. If one or more is not present, go to "6 W Board" on page 155.

Task 3 — Check Voltage Levels

1. Measure the RF-DET voltage at pin 2 of SK102. The voltage should be less than 0.8 V. If it is, go to Step 2. If it is not, go to "6 W Board" on page 155.
2. Measure the PA-KEY-COAX voltage at pin 3 of SK102. The voltage should be less than 0.5 V. If it is, go to Step 3. If it is not, go to "6 W Board" on page 155.
3. Measure the scaled voltage supply at TP206. The voltage should be 1.5 V to 2.45 V (1.96 V typical). If it is, go to Step 4. If it is not, replace the control board.
4. Measure the POWER-LEVEL voltage at TP204. The voltage should be between 0 V and 4.5 V, depending on the rated output power of the PA. If it is, go to Step 5. If it is not, replace the control board.
5. Measure the KEY-CONT voltage at TP211. The voltage should be greater than 4 V. If it is, go to Step 6. If it is not, replace the control board.
6. Measure the DRIVER-BIAS-MICRO voltage of the driver transistor at pin 3 of SK103. The voltage should be 3.37 V (typical). If it is, go to Step 7. If it is 0 V, replace the control board. If it is greater than 0 V, but less than 3.37 V (typical), go to "6 W Board" on page 155.

7. Measure the FINAL**X**[1]-BIAS-MICRO voltage of the final transistor(s) at the following test points:

- 50 W PA — pin 2 of SK106
- 100 W PA final 1 — pin 2 of SK105
- 100 W PA final 2 — pin 2 of SK107.

The voltage should be 4 V (typical). If it is, go to "6 W Board" on page 155. If it is 0 V, replace the control board. If it is greater than 0 V, but less than 4 V (typical), go to "60 W Board" on page 162.

1. X = final 1 or final 2.

Figure 8.10 Location of test points on the control board

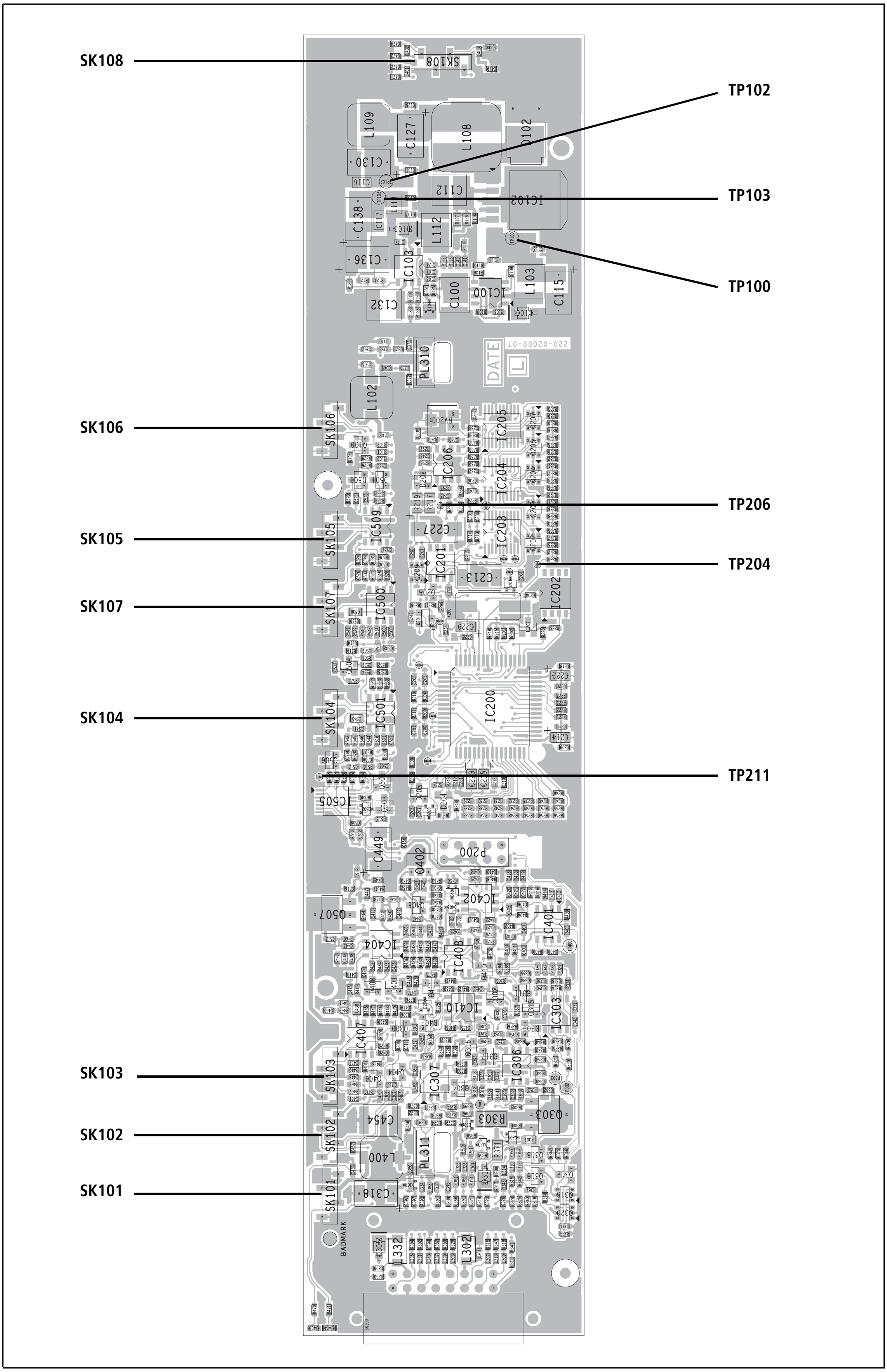


Table 8.1 Test point voltages on the control board

Test Point	Pin	Pin Name	Tx Off Voltage	Tx On Voltage[a]	Notes
SK101	1 & 4	GND			ground
	2 & 3	+28V-FILT-CONTROL	26V to 30V	26V to 30V	filtered supply
SK102	1	POWER-CONTROL	<0.5V	1.5V to 6V	analogue voltage
	2	RF-DET	>6.0V	<0.8V	RF drive present, +11dBm
	3	PA-KEY-COAX	>4.0V	<0.5V	logic level
	4	DRIVER-TEMP	digital	digital	digital signal, 0V and 5V
SK103	1	STANDBY	<0.5V	<0.5V	logic level
	2	DRIVER-CURRENT-MICRO	<0.05V	>0.5V <1.1V	current = measured voltage ÷ 2
	3	DRIVER-BIAS-MICRO	<0.05V	3.37V	typical analogue voltage
	4	+10V-SWITCHED	0.05V	10V	10V regulated supply to 6W board
SK104 SK105 SK106 SK107	1	FINAL**X**-CURRENT-MICRO[b]	<0.05V	2V typical	current = measured voltage × 2
	2	FINAL**X**-BIAS-MICRO[b]	<0.05V	4V typical	typical analogue voltage
	3	FINALX-TEMP[b]	digital	digital	digital signal, 0V and 5V
	4	GND			signal ground
SK108	1	FWD-PWR-DC	0.27V	2.5V	Analogue, proportional to forward power
	2	REV-PWR-DC	0.27V	<0.6V	Analogue, proportional to reverse power
	3	+10V-LPF	10V	10V	10V regulated
	4	GND			ground
TP100		+5V-DIG	5V	5V	regulated supply
TP102		+10V	10V	10V	regulated supply
TP103		–3V	–3V	–3V	regulated supply
TP204		POWER-LEVEL	<0.05V	>0V <4.5V	analogue, will vary with set power
TP206		scaled voltage supply	1.96V typical	1.96V typical	analogue, 1.5V to 2.45V
TP211		KEY-CONT	<0.05V	>4V	digital

a. Measured when the PA is set to its rated RF output power (i.e. 5W, 50W, or 100W according to model).

b. X = final 1 or final 2.

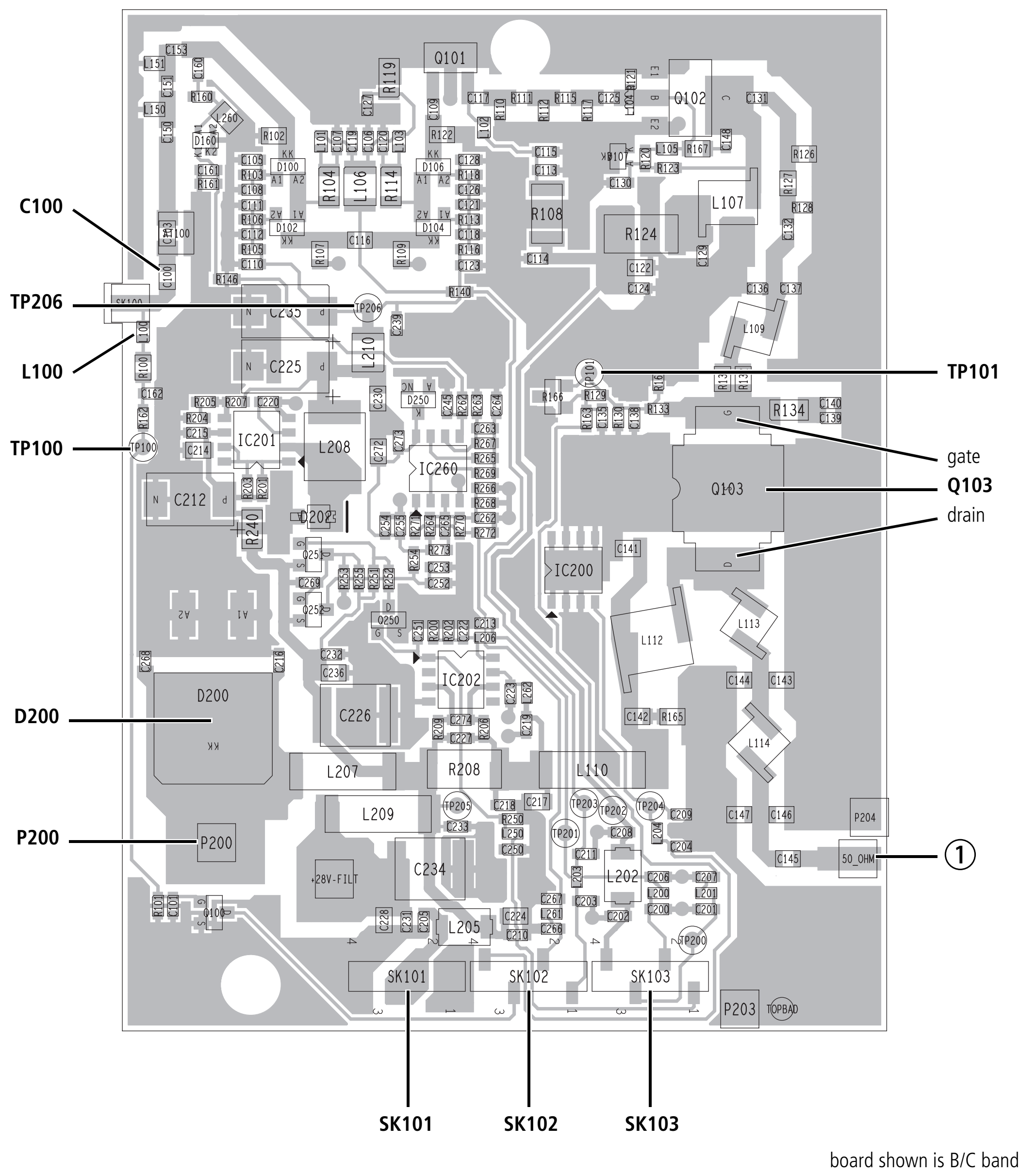
8.9 6W Board

These checks will verify that:

- the DC supply voltages are correct
- the correct voltage levels are present at selected test points
- the driver transistor and Tx Key circuitry are functioning correctly
- the output power is correct.

Figure 8.11 shows the location of the test points on the 6W board. Refer also to Table 8.2 on page 159 for a list of test points and their associated voltage levels.

Figure 8.11 Location of test points on the 6W board



Task 1 — Check Voltage Levels

1. Set up the test equipment as shown in Figure 8.8 on page 149 (28 V PA) or Figure 8.9 on page 150 (12 V PA).

2. Run the Service Kit and connect to the base station.

3. Once connected to the base station, ensure it is in Run Mode.

12V 28V

4. Measure the voltage at pins 2 and 3 of SK101:
   - For a 12 V PA, if the voltage is 28 V ±1 V, go to Step 9. If it is not, go to Step 5.
   - For a 28 V PA, if the voltage is 28 V ±2 V, go to Step 9. If it is not, go to Step 6.

12V

5. Measure the voltage at P200 (where the DC supply wire is soldered to the board). The voltage should be 28 V. If it is, replace the 6 W board. If it is not, go to "Boost Regulator Board (12V PA Only)" on page 168.

28V

6. Measure the voltage at the pin of the DC input feedthrough filter. The voltage should be 28 V. If it is, go to Step 7. If it is not, check the connection from the power supply to the PA.

7. Check the connection between the pin of the feedthrough filter and the board. If the connection is not faulty, go to Step 8. If it is faulty, repair and then go to Step 8.

8. Measure the voltage at pins 2 and 3 of SK101 again. The voltage should be 28 V. If it is, go to Step 9. If it is not, replace the 6 W board.

9. Measure the voltage at TP206 (PIN-BIAS). The voltage should be between 2 V and 2.5 V. If it is, go to Task 2. If it is not, replace the 6 W board.

Task 2 — Check Driver Temperature Sensor

1. Select Diagnose > Power Amplifier > Control Tests and check that the driver temperature reading is correct (e.g. if the PA is at ambient room temperature and not transmitting, the reading on the gauge should be approximately the same as the ambient temperature). If it is, go to Task 3. If it is not, go to Step 2.

2. Remove the links from SK102. Using an oscilloscope, check that data is present on pin 4 of the control board connector. If it is, replace the 6 W board. If it is not, replace the control board and go to Task 3.

Task 3 — Check Driver Transistor

Also carry out this task if you have tried to calibrate the PA bias in Task 4 on page 143 and the driver calibration failed.

1. Disconnect the DC supply from the PA.
2. Measure the DC resistance between the gate of Q103 and ground. If the resistance is greater than 5k ohms, go to Step 4. If it is less than 5k ohms, replace the 6W board.
3. Reconnect the DC supply to the PA.
4. Check that 28V is present on the drain of Q103. If it is, go to Step 5. If it is not, replace the 6W board.
5. Connect an oscilloscope across pin 3 of SK103 (DRIVER-BIAS-CONT) and ground.
6. Use the Calibration Kit to calibrate the PA bias. Check that the DRIVER-BIAS-CONT voltage ramps from 0V to 5V during calibration. If it does, replace the 6W board. If it does not, replace the control board and go to Task 4.

Task 4 — Check Tx Key

1. Check that the PA is set to its rated output power (i.e. 5W, 50W, or 100W according to model).
2. Put the base station in Run Mode and key the PA using the TX KEY switch on the CTU.
3. Measure the RF detect voltage at pin 2 of SK102. The voltage should be less than 0.8V. Measure the PA_KEY_COAX voltage at pin 3 of SK102 (or TP100). The voltage should be less than 0.5V. If both voltages are correct, go to Step 6. If one of these voltages is incorrect (or both are incorrect), go to Step 4.
4. Check that both the RF signal and DC key voltage are present on the coaxial cable from the reciter. If they are, go to Step 5. If they are not, check the coax and/or reciter and then repeat the test.

Note A DC bias voltage is present on the reciter's RF output signal. Take care that this does not damage your test equipment.

5. Check that the SMA RF input connector and nearby components (e.g. C100, L100) are correctly soldered and undamaged. If they are, replace the 6W board. If they are not, repair and repeat the test.
6. Check that the +10V_SWITCHED_CONT voltage is present on pin 4 of SK103. If it is, go to Step 7. If it is not, go to "Control Board" on page 148.
7. Measure the voltage at TP101. The voltage should be between 2.9V and 3.4V. If it is, go to Step 8. If it is not, and the control board is not faulty, replace the 6W board.

8. Measure the voltage at pin 2 of SK103. The voltage should be greater than 40 mV. If it is, go to Task 5. If it is not, replace the 6 W board.

Task 5 — Check Output Power

This task assumes that:

- you have calibrated the PA bias and the driver calibration was successful
- you have verified that Tx Key is working correctly (refer to Task 4).

1. Check that the PA is set to its rated output power (i.e. 5 W, 50 W, or 100 W according to model).

2. Connect an RF power meter to the output from the 6 W board:
   - Remove the bridging link from the RF output 50 Ω track (① in Figure 8.11 on page 155).
   - Solder the inner conductor of the test lead to the 50 Ω track.
   - Solder the braid of the test lead to ground.

3. Put the base station in Run Mode and key the PA using the TX KEY switch on the CTU.

4. Check that the RF output power is as follows:
   - 5 W and 100 W PAs greater than 6 W
   - 50 W PA greater than 3 W.

   If the output power is as stated above, the 6 W board is not faulty. Proceed to "60 W Board" on page 162 if the PA under test is 5 W or 50 W, or to "Splitter and Combiner Boards (100 W PA Only)" on page 160 if it is a 100 W PA.

   If the RF output power is less than stated above, go to Step 5.

5. Check that the RF input power from the reciter is greater than +9 dBm. If it is, replace the 6 W board. If it is not, check the reciter and repeat the test.

Table 8.2 Test point voltages on the 6W board

Test Point	Pin	Pin Name	Voltage	Notes
SK101	1 & 4	GND		ground
	2 & 3	+28V-FILT1	26V to 30V	filtered supply
SK102	1	POWER-CONTROL-CONT	<0.5V	analogue voltage
	2	RF detect	<0.8V	RF drive present, +11 dBm
	3	PA-KEY-COAX	>4.0V	logic level
	4	driver temperature	digital	digital signal, 0V and 5V
SK103	1	standby	<0.5V	logic level
	2	driver current	<0.05V	current = measured voltage ÷ 2
	3	DRIVER-BIAS-CONT	<0.05V	typical analogue voltage
	4	+10V-SWITCHED-CONT	0.05V	10V regulated supply to 6W board
TP101		DRIVER-BIAS-CONT	2.9V to 3.4V	
TP206		PIN-BIAS	2V to 2.5V	

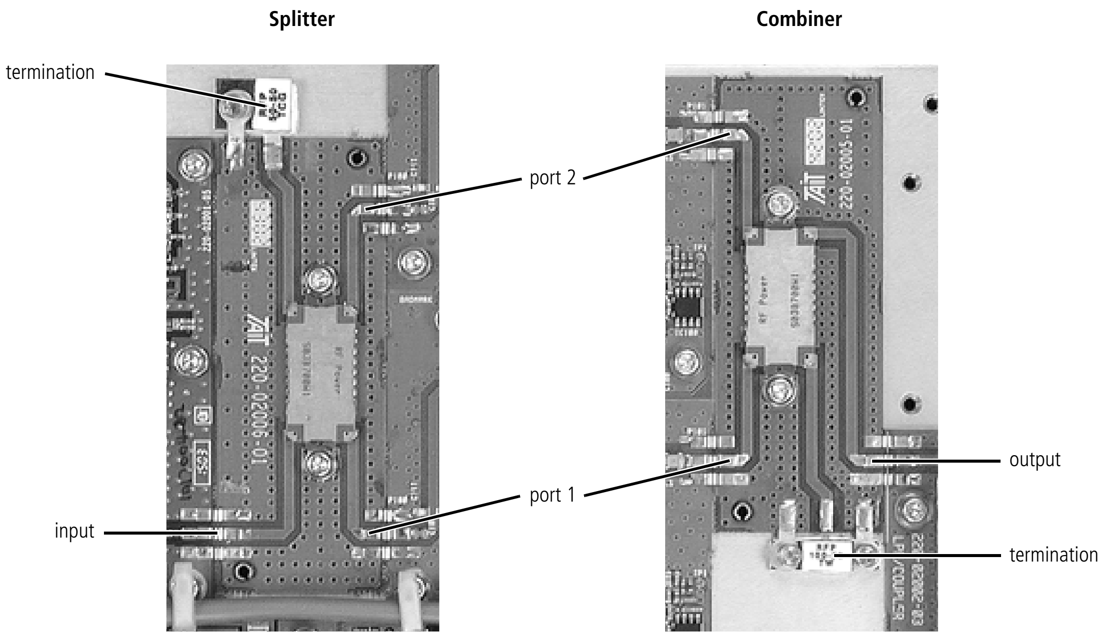
8.10 Splitter and Combiner Boards (100 W PA Only)

These checks will identify any faults present in:

- the continuity of the boards
- the splitter and combiner modules
- the termination resistors.

Figure 8.12 shows the location of the test points on the splitter and combiner boards.

Figure 8.12 Location of test points on the splitter and combiner boards



Some models of PA have an SMD termination resistor on the splitter board.

Task 1 — Check the Splitter Board

1. Check the DC continuity from the input to port 2, and from the termination resistor to port 1. If there is continuity, go to Step 3. If there is not, go to Step 2.

2. Check for faulty solder joints between the splitter and the PCB. If the solder joints are not faulty, replace the splitter board. If there is a faulty joint, repair as necessary and repeat Step 1. If there is still no continuity, replace the splitter board.

3. Check that there is no DC short to ground on each of the four ports. If there is a short, replace the splitter board. If there is not, go to Step 4.

4. Measure the resistance of the termination resistor to ground. It should be 50Ω. If it is, the splitter board is not faulty. Proceed to "60 W Board" on page 162. If it is not, proceed as follows:
   - if the resistor is SMD, replace the splitter board
   - if the resistor is mounted on the heatsink, replace the resistor and repeat the test (refer to "Replacing the Splitter/Combiner Boards" on page 190).

Task 2 — Check the Combiner Board

1. Check the DC continuity from port 1 to the output, and from port 2 to the termination resistor. If there is continuity, go to Step 3. If there is not, go to Step 2.
2. Check for faulty solder joints between the combiner and the PCB. If the solder joints are not faulty, replace the combiner board. If there is a faulty joint, repair as necessary and repeat Step 1. If there is still no continuity, replace the combiner board.
3. Check that there is no DC short to ground on each of the four ports. If there is a short, replace the combiner board. If there is not, go to Step 4.
4. Measure the resistance of the termination resistor to ground. It should be 50Ω. If it is, the combiner board is not faulty. Proceed to "60 W Board" on page 162. If it is not, replace the termination resistor and repeat the test (refer to "Replacing the Splitter/Combiner Boards" on page 190).

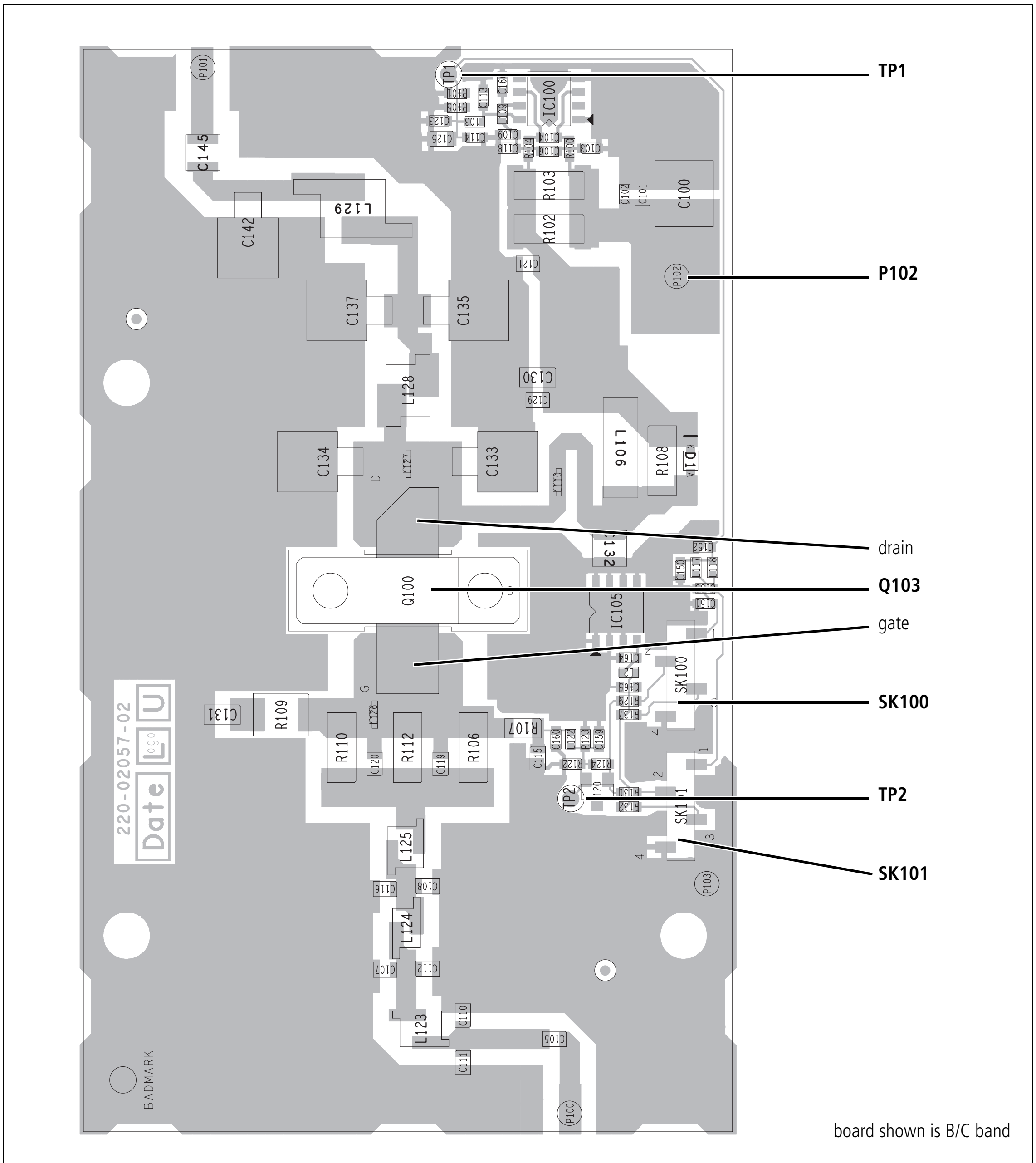
8.11 60 W Board

These checks will verify that:

- the DC supply voltages are correct
- the correct voltage levels are present at selected test points
- the final transistor is functioning correctly
- the output power is correct.

Figure 8.13 shows the location of the test points on the 60 W board. Refer also to Table 8.3 on page 164 for a list of test points and their associated voltage levels.

Figure 8.13 Location of test points on the 60 W board



Task 1 — Check Supply Voltage

1. Set up the test equipment as shown in Figure 8.8 on page 149 (28V PA) or Figure 8.9 on page 150 (12V PA).

2. Run the Service Kit and connect to the base station.

3. Once connected to the base station, ensure it is in Run Mode.

4. Measure the voltage at the drain of Q100. The voltage should be 28V. If it is, go to Task 2. If it is not, go to Step 5.

5. Measure the voltage at P102 (where the DC supply wire is soldered to the board). The voltage should be 28V. If it is, go to Task 2. If it is not, go to "6W Board" on page 155.

Task 2 — Check Final Temperature Sensor

1. Select Diagnose > Power Amplifier > Control Tests and check that the final temperature reading is correct (e.g. if the PA is at ambient room temperature and not transmitting, the reading on the gauge should be approximately the same as the ambient temperature). If it is, go to Task 3. If it is not, go to Step 2.

2. Remove the links from SK100 (final 1) or SK101 (final 2). Using an oscilloscope, check that data is present on pin 3 of the control board connector. If it is, replace the 60W board. If it is not, replace the control board and go to Task 3.

Task 3 — Check Final Transistor

Also carry out this task if you have tried to calibrate the PA bias in Task 4 on page 143 and the final calibration failed.

1. Disconnect the DC supply from the PA.

2. Measure the DC resistance between the gate of Q100 and ground (in a 100W PA check both final transistors before going to Step 3). If the resistance is greater than 5k ohms, go to Step 3. If it is less than 5k ohms, replace Q100 and repeat this test (refer to "Replacing the 60W RF Power Transistor" on page 184).

3. Reconnect the DC supply to the PA.

4. Check that 28V is present on the drain of Q100. If it is, go to Step 5. If it is not, replace the 60W board.

5. Connect an oscilloscope across pin 2 of SK100 or SK101 (FINAL-BIAS) and ground.

6. Use the Calibration Kit to calibrate the PA bias. Check that the FINAL-BIAS voltage ramps from 0V to 5V during calibration. If it does, replace the 60W board. If it does not, replace the control board and go to Task 4.

Task 4 — Check Output Power

This task assumes that:

- you have calibrated the PA bias and the final calibration was successful
- you have verified that Tx Key is working correctly (refer to "6 W Board" on page 155)
- you have verified that the 6 W board is operating correctly.

1. Check that the PA is set to its rated output power (i.e. 5 W, 50 W, or 100 W according to model).

2. Put the base station in Run Mode and key the PA using the TX KEY switch on the CTU.

3. Check that the output power shown on the RF power meter is correct. If it is, go to "Final Tasks" on page 170. If it is not, measure the voltage at TP1. The voltage should be 1.25 V to 2.25 V. If it is, go to "Low Pass Filter and Directional Coupler Board" on page 165. If it is not, replace the 60 W board.

Table 8.3 Test point voltages on the 60 W board

Test Point	Pin	Pin Name	Voltage	Notes
SK100/ SK101	1	final current	1.25 V to 2.25 V	typical voltage when transmitting at rated power; current = measured voltage × 2
	2	FINAL_BIAS	4.0 V to 4.2 V	typical voltage when keyed on
	3	final temperature	digital	digital signal, 0 V and 5 V
	4	ground		ground
P102		DC input voltage	28 V	filtered supply
TP1		final current	1.25 V to 2.25 V	typical voltage when transmitting at rated power; current = measured voltage × 2
TP2		final bias	3.5 V to 3.8 V	typical voltage when keyed on

8.12 Low Pass Filter and Directional Coupler Board

These checks will verify that:

- components are correctly placed and soldered
- the correct voltage levels are present at selected test points.

Figure 8.14 on page 166 shows the location of the test points on the LPF/ directional coupler board. Refer also to Table 8.5 on page 167 for a list of test points and their associated voltage levels.

Task 1 — Visual Inspection

1. Check that the bridging links are correctly fitted to SK100.
2. Desolder the two tabs and remove the shield lid.
3. Check the board for any faulty solder joints, including the N-type connector joint.
4. Check that the RF input coupling components are placed in the correct location(s) on the board. These components are:
   - B, C, H and K bands   C109 or C110
   - L band   R138/R139 or R145/R146.

Important These components **must** be correctly placed, or the PA may be damaged when it is keyed.

   Figure 8.14 on page 166 shows the location of these components, and Table 8.4 on page 167 lists when they are fitted. If the components are correctly placed, go to Task 2. If they are not, place them correctly as shown in Figure 8.14 and go to Task 2.

Task 2 — Check Voltage Levels

1. Set up the test equipment as shown in Figure 8.8 on page 149 (28V PA) or Figure 8.9 on page 150 (12V PA).
2. Power up the PA and check that the 10V regulated supply is present at TP103 (or pin 3 of SK100). If it is, go to Step 5. If it is not, got to Step 3.
3. Check that the 10V regulated supply is present at pin 3 of SK108 on the control board. If it is not, replace the control board. If it is, check the continuity of the connector, and replace if necessary. Then repeat Step 2.
4. Run the Service Kit and connect to the base station.
5. Put the base station in Run Mode and key the PA using the TX KEY switch on the CTU.
6. Measure the forward power analogue voltage at TP101 (or pin 1 of SK100). The voltage should be greater than 0.27V. If it is, go to Step 7. If it is not, replace the LPF/directional coupler board.

7. Measure the reverse power analogue voltage at TP102 (or pin 2 of SK100). The voltage should be less than 0.5 V. If it is, go to "Final Tasks" on page 170. If it is not, replace the LPF/directional coupler board.

Figure 8.14 Location of the test points and input coupling components on the LPF/directional coupler board

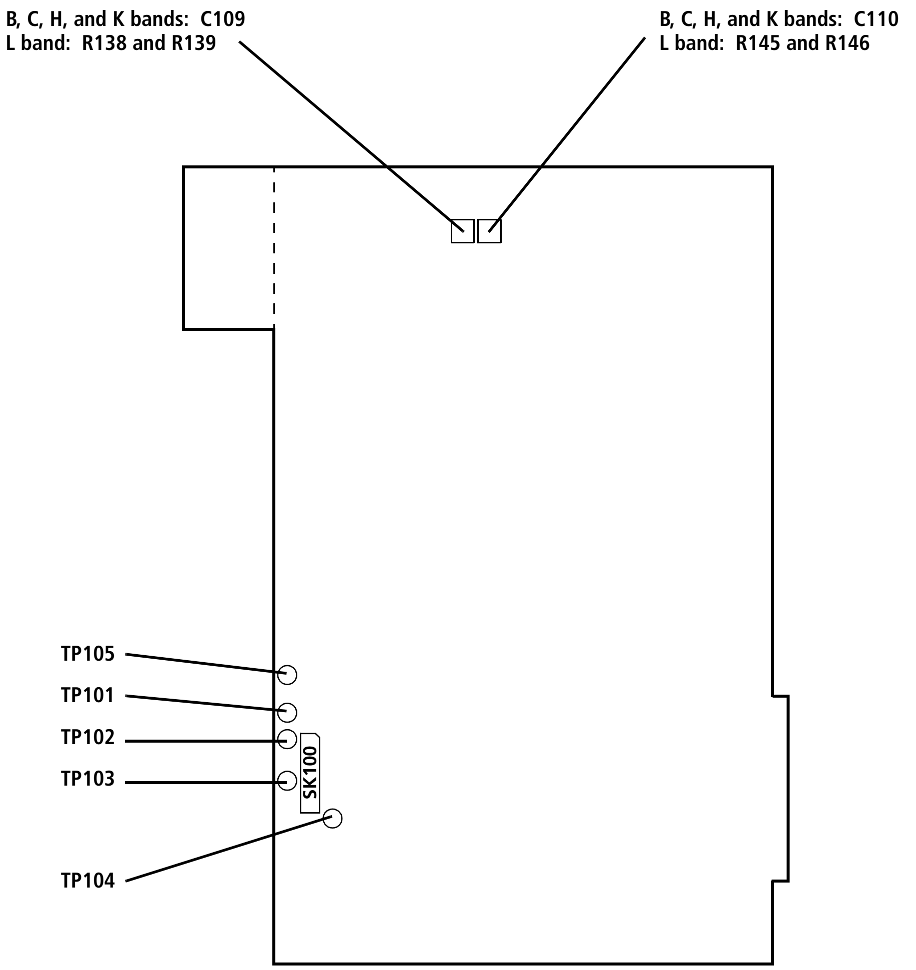


Table 8.4 Placement of the input coupling components according to frequency band

Band	5W		50W		100W		100W + Isolator		Component Type
	C109	C110	C109	C110	C109	C110	C109	C110	
B	✓		✓			✓		✓	IPN 018-11820-10 CAP 0603 8p2 50V NPO ±0.1pF
C	✓		✓			✓		✓	IPN 018-11820-10 CAP 0603 8p2 50V NPO ±0.1pF
H	✓		✓		✓			✓	IPN 018-11330-10 CAP 0603 3p3 50V NPO ±0.1pF
K	✓		✓		✓			✓	IPN 015-21100-05 CAP cer 1p0 ±0.1pF 200V 0805
	R138/ R139	**R145/ R146**	**R138/ R139**	**R145/ R146**	**R138/ R139**	**R145/ R146**	**R138/ R139**	**R145/ R146**	
L	✓		✓		✓			✓	IPN 036-10000-00 RES 0805 0R 1/8W

Table 8.5 Test point voltages on the LPF/directional coupler board

Test Point	Pin Name	Tx Off Voltage	Tx On Voltage[a]	Notes
TP101	FWD-PWR-ANA	0.27V	>0.27V	analogue voltage, proportional to forward power
TP102	REV-PWR-ANA	0.27V	<0.5V	analogue voltage, proportional to reverse power
TP103	+10V	10V	10V	regulated 10V to bias the directional coupler diodes
TP104	LPF-DC-ROM (OR to ground)	0V	0V	the microprocessor senses this input to verify the presence of the LPF/ directional coupler board
TP105	GND			ground

a. Measured when the PA is set to its rated RF output power (i.e. 5W, 50W, or 100W according to model).

8.13 Boost Regulator Board (12 V PA Only)

These checks will verify that:

- the DC output voltages are correct
- Power Saving operation is correct.

Figure 8.15 on page 169 shows the recommended test equipment set-up. Figure 8.16 on page 169 shows the location of the test points on the boost regulator board. The circled numbers in the following instructions refer to Figure 8.16.

Task 1 — Check Output Voltages

1. If you have not already done so, remove the cover as described in "Power Amplifier Disassembly and Reassembly" on page 173.

2. Set up the test equipment as shown in Figure 8.15 and power up the PA.

3. Check that the output voltages from the boost regulator board are as listed below:
   - ① output to reciter: 12 VDC[1] (approximately)
   - ② output to 6 W board: 28 VDC (approximately)
   - ③ output to 60 W board: 28 VDC (approximately)

   If the voltages are correct, go to Task 2. If they are incorrect, replace the boost regulator board.

Task 2 — Check Power Saving Operation

This will check that the boost regulator board operates correctly in Power Saving mode.

1. Short pins 1 and 2 of J1 ④ together and check that the output voltages are as listed below:
   - ① output to reciter: 12 VDC[1] (approximately)
   - ② output to 6 W board: 0 VDC
   - ③ output to 60 W board: 12 VDC[1] (approximately)

   If the voltages are correct, go to Task 3. If they are incorrect, replace the boost regulator board.

Note Power Saving mode does not shut down the reciter output. It also does not isolate the 60 W board output from the input. Any voltage present on the input will appear on the output to the 60 W board.

Task 3 — Check Alarms

1. Set up the test equipment as shown in "Recommended test equipment set-up for initial checks - 28 V PA" on page 134.

2. Run the Service Kit and connect to the base station.

1. 0.5 V lower than the input voltage.

3. Once connected to the base station, ensure it is in Run Mode.

4. Select Alarms > Current Alarm Status and check there are no alarms. If there are, go to "Control Board" on page 148. If there are no alarms, go to "Final Tasks" on page 170.

Figure 8.15 Test equipment set-up for the boost regulator board

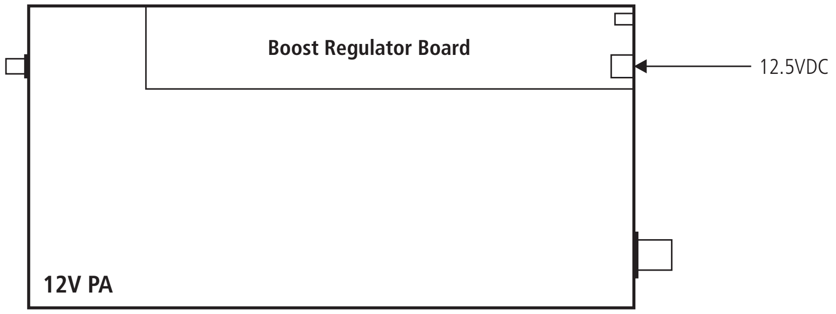
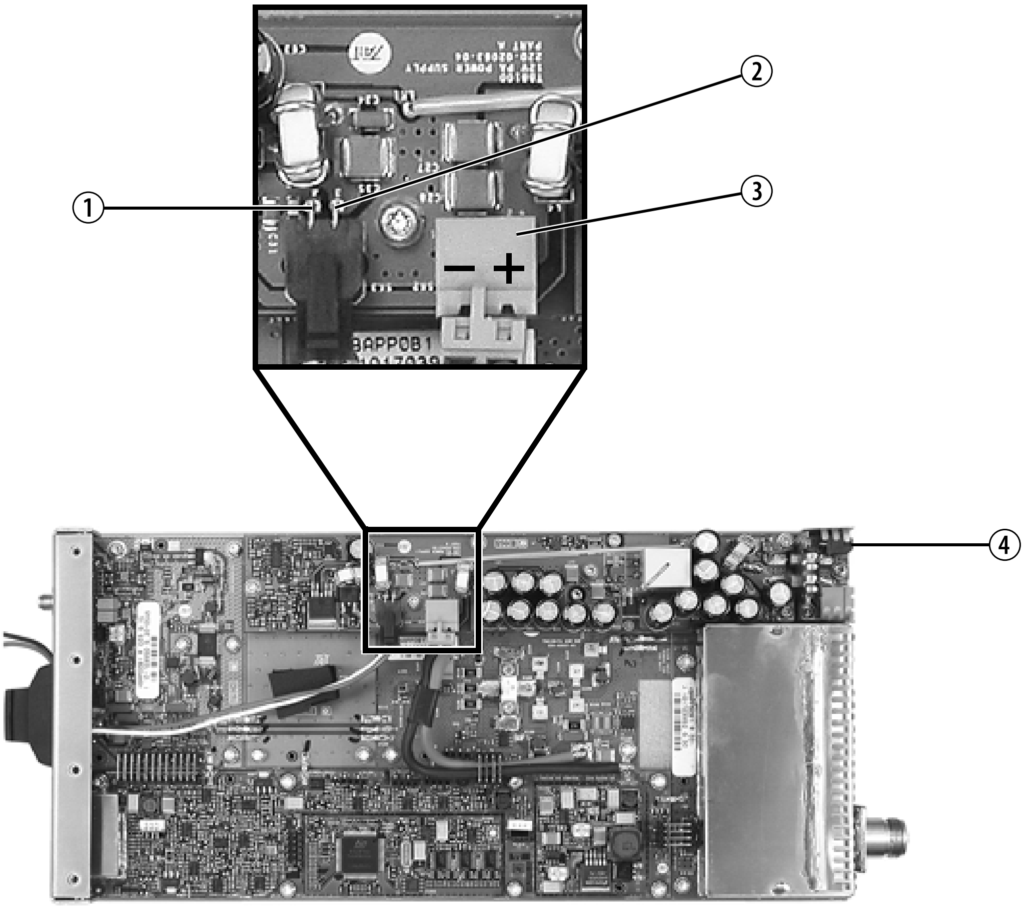


Figure 8.16 Location of test points on the boost regulator board



8.14 Final Tasks

Once you have completed the testing and repair (if required) of the PA, carry out the following tasks.

Task 1 — Final Tests

Test the PA to confirm that it is fully functional again. The recommended tests are listed below:

1. Check that the RF output power is correct when the PA is set to its rated power.

2. Verify that the Service Kit shows the same RF output power (±10%) as the power meter.

3. Check that the temperature readings displayed in the Service Kit are within normal operating limits and no alarms have been generated. For example:
   - If the PA is at ambient room temperature and not transmitting, the readings in the Service Kit should match the ambient temperature.
   - If the PA has been transmitting recently, the readings should not exceed the set thresholds.

4. Check that the DC supply current is within the specified limits when transmitting and not transmitting (refer to Table 8.6 on page 171).

5. Inspect the PA to make sure that nothing has been damaged during any test or repair procedures. Make sure all screws securing the cover to the heatsink are in place and tightened to the correct torque.

It is good practice to record the test results on a separate test sheet. You can then supply a copy of the test sheet to the customer as confirmation of the repair.

Task 2 — Final Administration

The final administration tasks are the standard workshop procedures for updating the fault database and returning the repaired PA to the customer with confirmation of the repair.

If the PA could not be repaired for one of the following reasons:

- fault not located
- repair of fault failed

Level-1 service centres should return the faulty PA to the nearest Accredited Service Centre, and level-2 service centres should return the PA to the International Service Centre. Supply details of the customer, the fault and, if applicable, the attempted repair.

Note The information in this table is extracted from the TB8100 Specifications Manual. Refer to the latest issue of this manual (MBA-00001-xx) for the most up-to-date and complete specifications.

Table 8.6 Supply current specifications

Test	Limits: Maximum	Limits: Typical
Supply Current - 12V PA[a]	Maximum	Typical
Standby	200mA	165mA
Transmit		
5W PA at 5W	1.5A	1.2A
50W PA at 50W	10.2A	9.2A
Supply Current - 28V PA	Maximum	Typical
Standby	50mA	42mA
Transmit - B, C and H Bands[b]		
5W PA at 5W	600mA	530mA
50W PA at 50W	5A	4.2A
100W PA at 100W	10A	8.3A
Transmit - K and L Bands[b]		
5W PA at 5W	600mA	530mA
50W PA at 50W[c]	5A	4.2A
100W PA at 100W	11A	8.5A

a. measured at 12.5VDC input
b. into a 50Ω load
c. 50W model unavailable in L band

9 Power Amplifier Disassembly and Reassembly

Caution **Touching high-power RF components or circuits can cause serious burns. We strongly recommend you do not touch any RF components or tracks in the PA while it is transmitting.**

Caution **The TB8100 power amplifier (PA) weighs between 4.8kg (10.6lb) and 5.8kg (12.8lb). Take care when handling the PA to avoid personal injury.**

Important This equipment contains devices which are susceptible to damage from static charges. Refer to "ESD Precautions" on page 17 for more information on antistatic procedures when handling these devices.

This chapter provides information on how to remove and replace the airflow duct, cover, and front panel.

Note Unless otherwise noted, the instructions and illustrations in this chapter refer to a 100W UHF (H-band) PA. However, the same basic procedures and techniques apply to other models of PA.

9.1 Screw Torque Settings

The recommended torque settings for the screws used in the PA are as follows:

Location / Function	Torque	Driver	Size
secure the RF power transistors to the heatsink	0.6N·m / 5.0lbf·in	3/32in Allen key	4–40 UNC
secure the VHF splitter and combiner boards to the heatsink	0.23N·m / 2.0lbf·in	PZ1	M2
secure the SMA connector to the front panel	0.3N·m / 2.5lbf·in	T8	M2.5
M3 screws are used in all other locations	0.5N·m / 4.5lbf·in	T10	M3

9.2 Removing the Airflow Duct and Cover

The circled numbers in the following instructions refer to Figure 9.1.

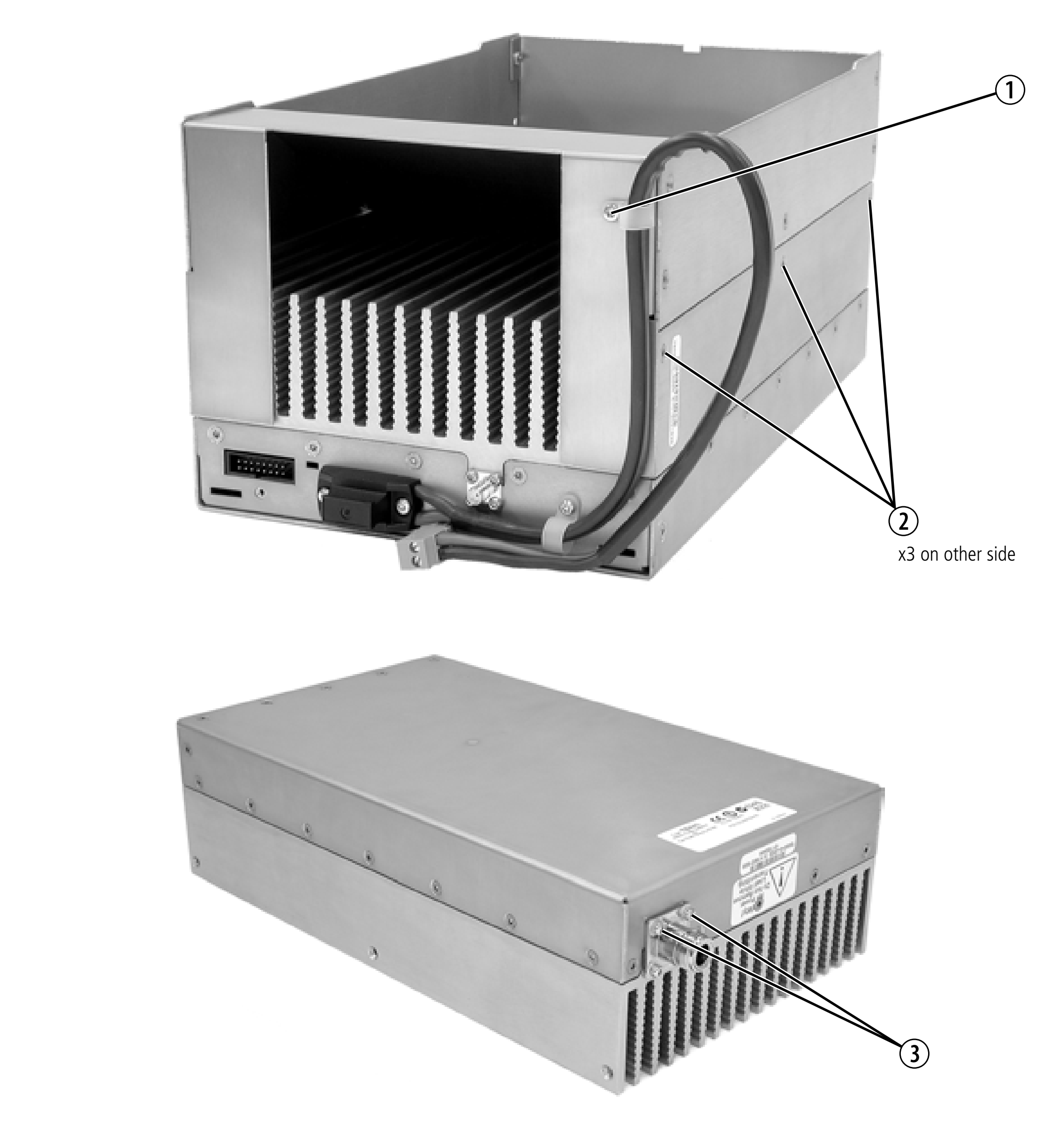
Airflow Duct (100W PA Only)

1. Remove the M3 Torx screw ① securing the P-clip and DC input cable to the airflow duct.
2. Remove the M3 Torx screws ② securing the airflow duct to the heatsink. Lift the airflow duct off the heatsink.

Cover

1. Remove the M3 Torx screws securing the cover to the heatsink and to the front panel.
2. Remove the two M3 Torx screws securing the N-type connector to the cover ③.
3. Carefully lift the cover straight up off the heatsink, being careful not to put any strain on the N-type connector.

Figure 9.1 Removing the airflow duct and cover



9.3 Removing the Front Panel

The circled numbers in the following instructions refer to Figure 9.2.

12V 28V

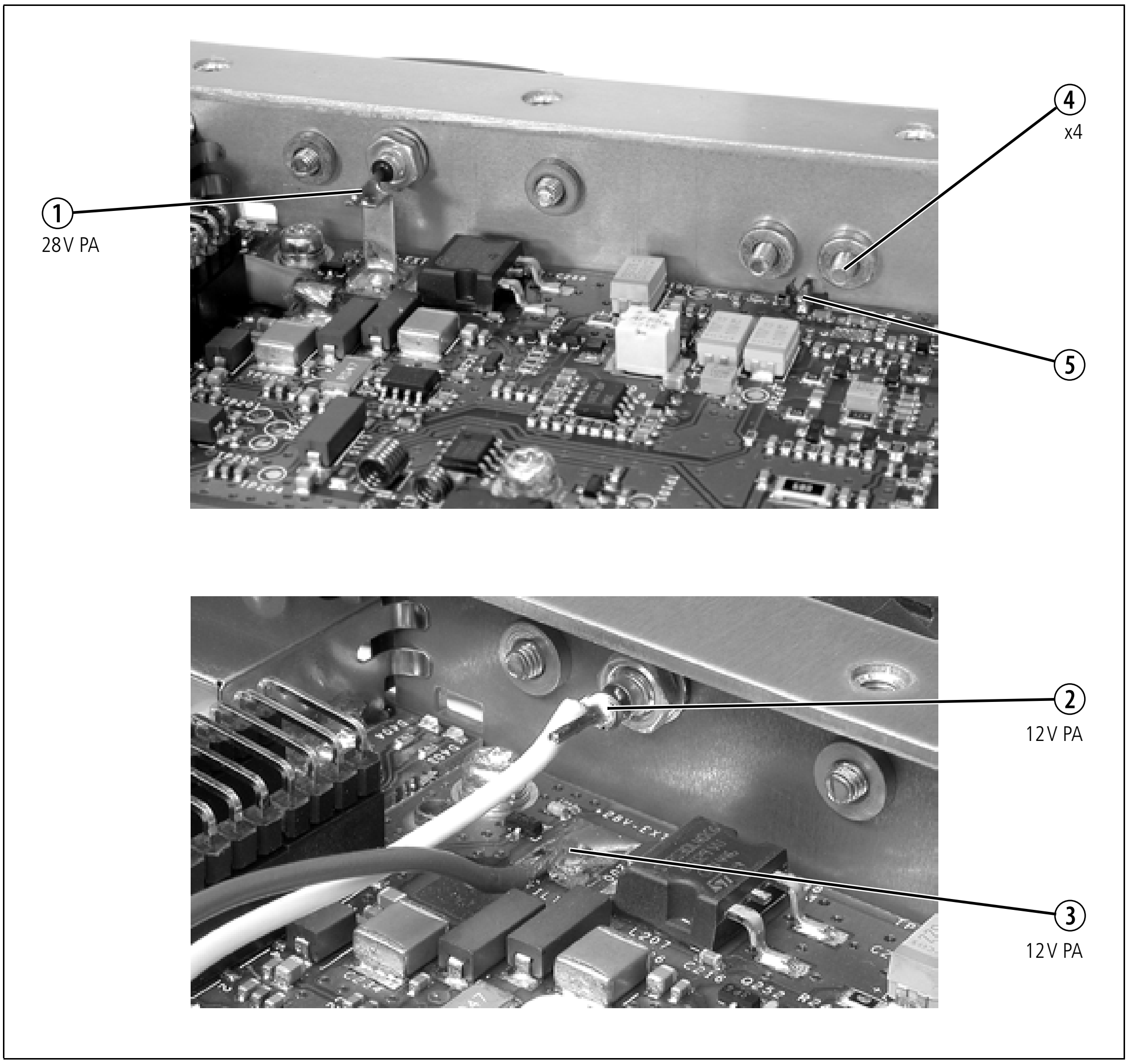
1. On a 28V PA, disconnect the +28VDC power feed by desoldering the feedthrough capacitor from the metal strap ① soldered to the 6W board. On a 12V PA, desolder the white DC output wire ② from the feedthrough capacitor, and desolder the red DC output wire ③ from the 6W board.

2. Remove the four M2.5 Torx screws ④ securing the SMA connector to the heatsink and to the front panel.

3. Desolder the centre pin of the SMA connector ⑤ from the 6W board and remove the connector. Ensure that C100 and L100 are not affected.

4. Remove the M3 Torx screws securing the front panel to the heatsink and remove the panel.

Figure 9.2 Removing the front panel



9.4 Refitting the Front Panel

The circled numbers in the following instructions refer to Figure 9.2.

1. Refit the front panel and secure it to the heatsink with the M3 Torx screws.

2. Insert the SMA connector through the front panel and secure it to the heatsink and front panel with the four M2.5 Torx screws ④.

3. Resolder the centre pin of the SMA connector ⑤ to the 6 W board. Check that C100 and L100 are still correctly soldered and are not damaged.

12V 28V

4. On a 28 V PA, resolder the +28 VDC feedthrough capacitor to the metal strap ① soldered to the 6 W board. On a 12 V PA, resolder the white DC output wire ② to the feedthrough capacitor, and resolder the red DC output wire ③ to the 6 W board.

9.5 Refitting the Cover and Airflow Duct

The circled numbers in the following instructions refer to Figure 9.1 on page 175.

Cover

1. Slide the cover into place on the heatsink. Make sure the cover is seated correctly between the heatsink and N-type connector.

2. Secure the cover with the M3 Torx screws.

Note Fit the two screws ③ securing the N-type connector to the cover first, followed by the screws securing the cover to the heatsink.

Airflow Duct (100 W PA Only)

1. Slide the airflow duct into place on the heatsink and secure with the M3 Torx screws.

2. Secure the DC input cable to the airflow duct with the P-clip and M3 Torx screw ①.

10 Power Amplifier Board Replacement

Caution **Beryllium Oxide**
The termination resistors used in the 100W power amplifier contain some beryllium oxide. This substance is perfectly harmless in its normal solid form, but can become a severe health hazard when it has been reduced to dust. For this reason the termination resistors should not be broken open, mutilated, filed, machined, or physically damaged in any way that can produce dust particles. You should safely dispose of all used or obsolete components according to your local regulations.

Caution **Touching high-power RF components or circuits can cause serious burns. We strongly recommend you do not touch any RF components or tracks in the PA while it is transmitting.**

Caution **The TB8100 power amplifier (PA) weighs between 4.8kg (10.6lb) and 5.8kg (12.8lb). Take care when handling the PA to avoid personal injury.**

Important This equipment contains devices which are susceptible to damage from static charges. Refer to "ESD Precautions" on page 17 for more information on antistatic procedures when handling these devices.

The TB8100 PA is a modular design with the circuitry divided between separate circuit boards which are assembled in different configurations in different models.

This chapter provides information on how to remove and replace individual boards.

Note Unless otherwise noted, the instructions and illustrations in this chapter refer to a 100W UHF (H-band) PA. However, the same basic procedures and techniques apply to other models of PA.

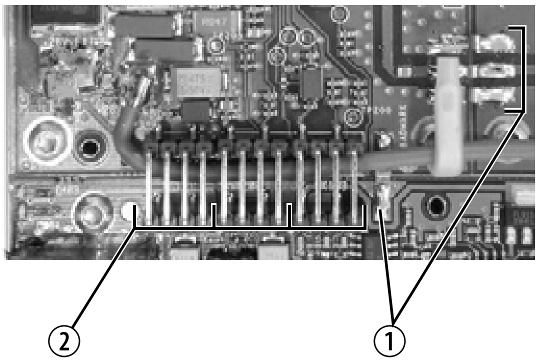
10.1 Circuit Board Connecting Links

There are two types of link used to connect individual boards in the PA:

- RF links ① are used to carry RF signals from one board to another
- bridging links ② are used to carry control signals from one board to another.

Figure 10.1 shows typical examples of both types of links.

Figure 10.1 Circuit board connecting links



10.2 Replacing the 6W Board

Important There is heatsink compound between the board and the heatsink under certain components. Any objects caught in the heatsink compound underneath the board which prevent effective heatsinking may cause these components to fail.

Important If you replace the 6W board, you must recalibrate the PA bias using the Calibration Kit. Refer to the Calibration Kit documentation for more details.

Refer to “Power Amplifier Disassembly and Reassembly” on page 173 for details on removing and refitting the cover and front panel, and for screw torque settings. The circled numbers in the following instructions refer to Figure 10.2 on page 181. Figure 10.2 shows a 50W UHF (H-band) PA. The exact number and location of links may differ in other models.

Removal

1. Remove the cover and front panel.
2. Remove the bridging links ① connecting the board to the control board.

3. If necessary, desolder the +28VDC power feed wire ②.

4. Desolder the RF links ③ connecting the board to any adjacent boards.

5. Remove the M3 Torx screws securing the board to the heatsink.

6. Carefully lift the board directly upwards off the locating pins ④ and remove it from the heatsink.

Refitting

1. Ensure the heatsink and bottom of the board are clean. Remove any old heatsink compound.

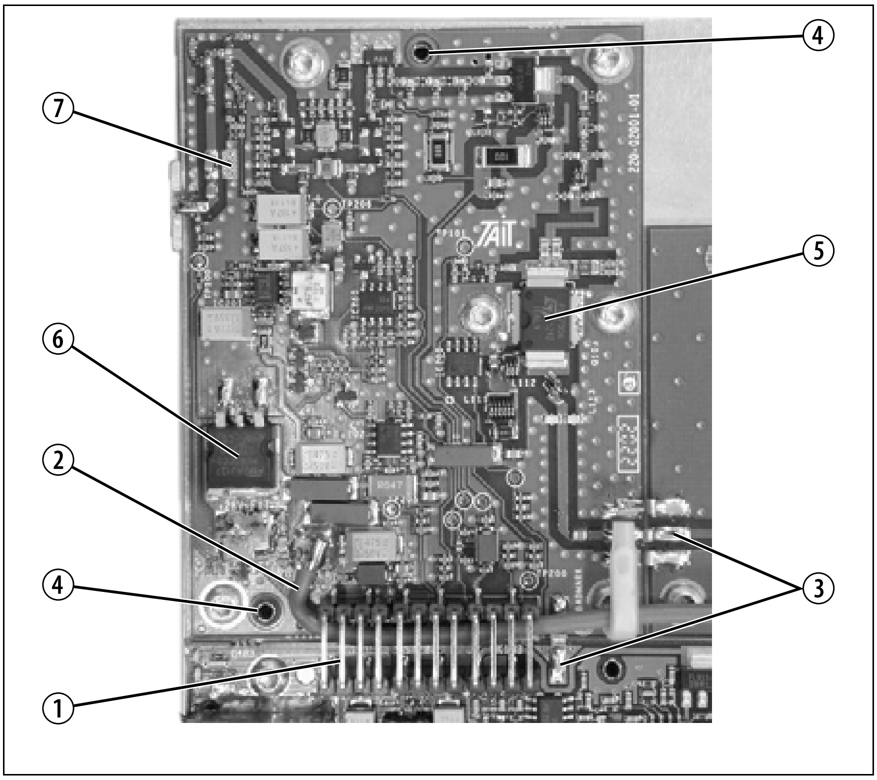
2. Apply a thin layer of fresh heatsink compound to the bottom of the board underneath Q103 ⑤, D200 ⑥ and AT100 ⑦ (if fitted). Use as little as possible, while still covering the whole of the mounting area of each component.

3. Refit the board, following the removal instructions in reverse order.

Note Before tightening the screws, press the board down over the locating pins so that it is firmly seated against the heatsink. Then tighten the M3 Torx screws to the correct torque.

4. Refit the front panel and cover.

Figure 10.2 Replacing the 6W board



10.3 Replacing the 60 W Board

Important There is heatsink compound between the RF power transistor and the heatsink. You may need to carefully prise the transistor away from the heatsink with a small screwdriver. Any objects caught in the heatsink compound underneath the transistor which prevent effective grounding and/or heatsinking may cause the transistor to fail.

Important If you replace the 60 W board, you must recalibrate the PA bias using the Calibration Kit. Refer to the Calibration Kit documentation for more details.

Refer to "Power Amplifier Disassembly and Reassembly" on page 173 for details on removing and refitting the cover, and for screw torque settings. The circled numbers in the following instructions refer to Figure 10.3 on page 183.

Removal

1. Remove the cover.
2. [12V] On a 12V 50 W PA, remove the boost regulator board (as described in "Replacing the Boost Regulator Board in a 12V PA" on page 193).
3. Remove the bridging links ① connecting the board to the control board.
4. [12V] [28V] Desolder the red +28 VDC power feed wire ②. On a 12V PA, also disconnect the black earth wire.
5. Desolder the RF links ③ connecting the board to any adjacent boards.
6. Remove the 4-40 UNC Allen screws ④ securing the RF power transistor ⑤ to the heatsink.
7. Remove the M3 Torx screws securing the board to the heatsink.
8. Carefully lift the board directly upwards off the locating pins ⑥ and remove it from the heatsink.

Refitting the Original Board and Transistor

Use the following instructions if you are fitting the original 60 W board and RF power transistor, and haven't disturbed any of the solder joints around the transistor.

1. Ensure the heatsink and bottom of the transistor are clean. Remove any old heatsink compound.
2. Apply a thin layer of fresh heatsink compound to the bottom of the transistor. Use as little as possible, while still covering the whole of the mounting area of the transistor.

3. Refit the board, following the removal instructions in reverse order.

Note Before tightening the screws, press the board down over the locating pins so that it is firmly seated against the heatsink. Then tighten the M3 Torx screws to the correct torque.

4. Progressively tighten each 4–40 UNC screw, alternating from side to side, to the correct torque. Retorque the screws after eight hours of operation.

5. Refit the cover.

Refitting a New Board and Transistor

Use the following instructions if you are fitting a new 60W board, a new RF power transistor, or have disturbed any of the solder joints around the transistor.

1. Remove any old heatsink compound from the heatsink.

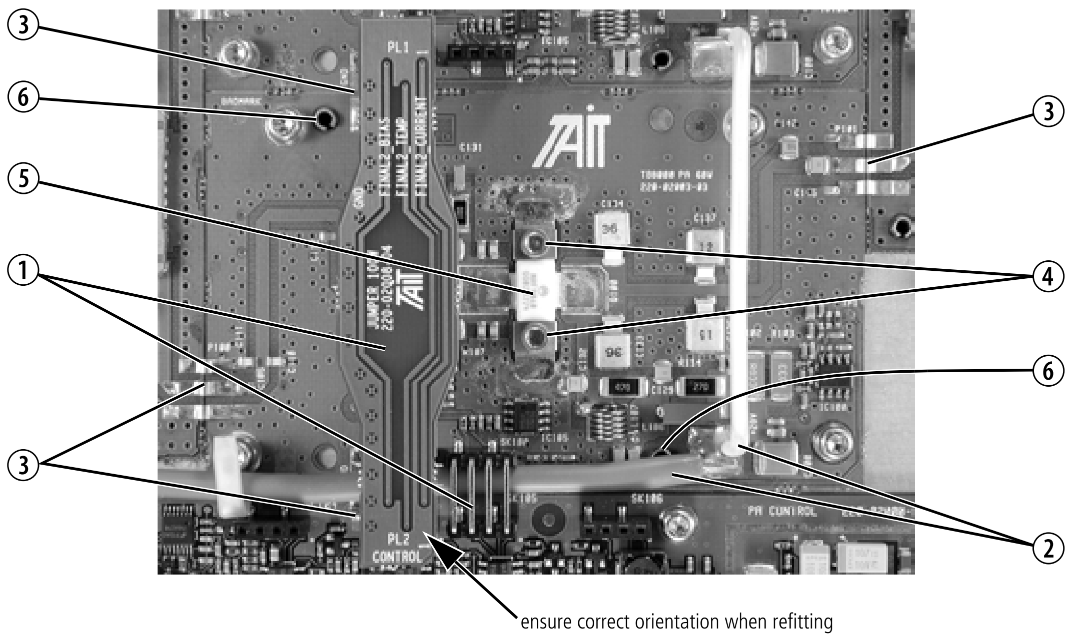
2. Refit the board, following the removal instructions in reverse order.

Note Before tightening the screws, press the board down over the locating pins so that it is firmly seated against the heatsink. Then tighten the M3 Torx screws to the correct torque.

3. Fit the new RF power transistor as described in the “Refitting” section of “Replacing the 60W RF Power Transistor” on page 184.

4. Refit the cover.

Figure 10.3 Replacing the 60W board



10.4 Replacing the 60W RF Power Transistor

Important If you do not follow these procedures correctly, the transistor may fail because of poor heatsinking.

Important Do not apply too much heat or pressure to the PCB pads and tracks as you may damage them or lift them from the PCB. This will permanently damage the PA.

Important Insulated gate FET transistors are susceptible to damage from static charges, due to their extremely high input resistance. To avoid possible damage to the device during handling, testing or actual operation, we recommend you follow these procedures: avoid unnecessary handling; when handling the device, pick it up by the cap, not the leads; do not insert or remove the device while the power is on; avoid contact with non-conductive plastic or non-conductive styrofoam.

Important If you replace an RF power transistor, you must recalibrate the PA bias using the Calibration Kit. Refer to the Calibration Kit documentation for more details.

Refer to “Power Amplifier Disassembly and Reassembly” on page 173 for details on removing and refitting the cover, and for screw torque settings. The circled numbers in the following instructions refer to Figure 10.4 on page 185.

Removal

1. Remove the cover.
2. Remove the two 4–40 UNC Allen recess head screws ① securing the transistor to the heatsink.
3. Desolder and remove the two ground tags ②.
4. Desolder the transistor tabs ③ by heating them with a soldering iron and then carefully lifting them away from the PCB with a screwdriver or thin stainless steel spike. When the tabs are completely free of the PCB, remove the transistor.
5. Remove any excess solder from the PCB pads with solder wick.
6. Remove any old heatsink compound from the heatsink.

Refitting

1. Lightly tin the underside of the transistor tabs. Remove any excess solder to leave a thin, even layer of solder on the tabs.
2. Apply a small amount of heatsink compound (Dow-Corning 340 or equivalent) to the transistor mounting surface. Use as little as possible

to provide a very thin, but even, film over the entire mounting surface.

3. Place the transistor on the PCB in the correct orientation and ensure the tabs are flush with the surface.

Important Make sure the heatsink compound is clean. Any objects caught in the heatsink compound underneath the transistor which prevent effective heatsinking may cause the transistor to fail.

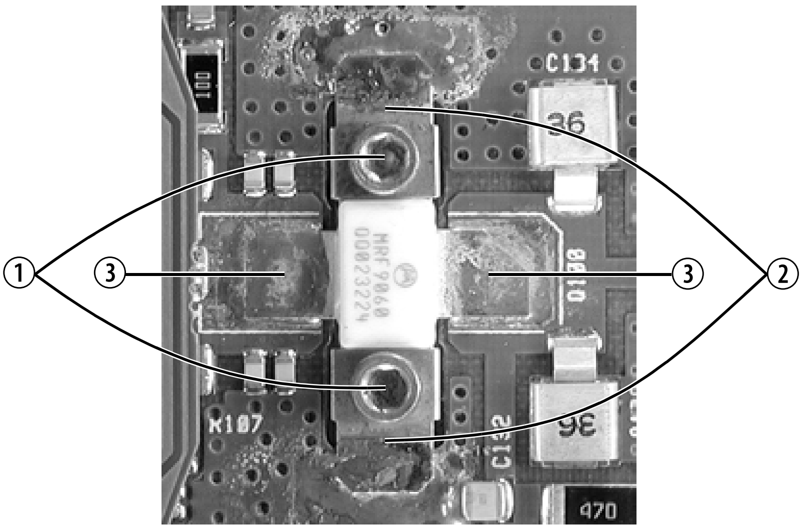
4. Refit the two ground tags and secure the transistor to the heatsink with the two 4–40 UNC screws. Progressively tighten each screw, alternating from side to side, to the correct torque.

5. Solder the ground tags and transistor tabs to the PCB. While soldering the transistor tabs, gently press down on them with a ceramic trimming tool to ensure they are as close as possible to the pads on the PCB.

6. Retorque the 4–40 UNC screws after eight hours of operation.

7. Refit the cover.

Figure 10.4 Replacing the 60W RF power transistor



10.5 Replacing the Control Board

Important You must reprogram and recalibrate the PA after replacing the control board. Refer to "Reprogramming and Recalibration" on page 187.

Refer to "Power Amplifier Disassembly and Reassembly" on page 173 for details on removing and refitting the cover and front panel, and for screw torque settings. The circled numbers in the following instructions refer to Figure 10.5 on page 187.

Removal

1. Remove the cover and front panel.
2. Remove the ambient air temperature sensor board ①.
3. Remove the bridging links ② connecting the board to any adjacent boards.
4. Desolder the RF links ③ connecting the board to any adjacent boards. You may need to move the +28V power feed wire ④ out of the way first.
5. Remove the M3 Torx screws securing the board to the heatsink.
6. Carefully lift the board directly upwards off the locating pins ⑤ and remove it from the heatsink.

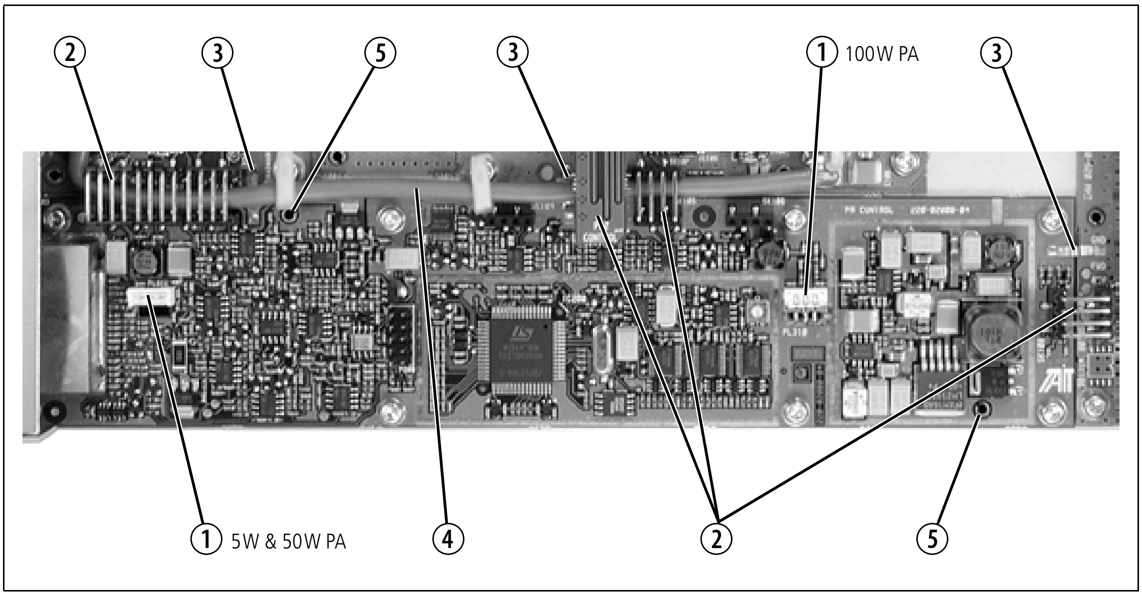
Refitting

1. To refit the board, follow the removal instructions in reverse order.

Important When refitting the ambient air temperature sensor board, make sure that it fits properly into the correct hole provided in the heatsink (refer to Figure 10.5). You must fit the sensor board in the correct location to ensure that the temperature of the airflow over the sensor is nearest the ambient temperature of the air from the cooling fan. The sensor board must not come into contact with the metal of the heatsink fins. Note that you may feel some resistance as you push the sensor board through the slot in the foam dust seal located under the control board.

Note Before tightening the screws, press the board down over the locating pins so that it is firmly seated against the heatsink. Then tighten the M3 Torx screws to the correct torque.

Figure 10.5 Replacing the control board



Reprogramming and Recalibration

If you have replaced the control board, you will have to reprogram and recalibrate the PA as described in the table below.

Procedure	Details
■ reprogram the product code ■ reprogram the PA type ■ reprogram the serial number	reprogram this information into the PA using the Calibration Kit[a]; refer to the Calibration Kit documentation for more details
■ calibrate the stage bias ■ calibrate the forward and reverse detector bias voltages ■ calibrate the PA output power	carry out these procedures using the Calibration Kit; refer to the Calibration Kit documentation for more details

a. To reprogram this information into the PA, you will need to use a dongle with the Calibration Kit.

10.6 Replacing the Low Pass Filter/Directional Coupler Board

Important If you replace the LPF/directional coupler board, you must recalibrate the detector bias voltages and PA output power using the Calibration Kit. Refer to the Calibration Kit documentation for more details.

Important When replacing the LPF/directional coupler board, check that the RF input coupling components are placed in the correct location(s) on the replacement board. These components **must** be correctly placed, or the PA may be damaged when it is keyed. Figure 8.14 on page 166 shows the location of these components, and Table 8.4 on page 167 lists when they are fitted.

Refer to "Power Amplifier Disassembly and Reassembly" on page 173 for details on removing and refitting the cover, and for screw torque settings. The circled numbers in the following instructions refer to Figure 10.6 on page 189.

Removal

1. Remove the cover.
2. 12V On a 12V PA, remove the boost regulator board (as described in "Replacing the Boost Regulator Board in a 12V PA" on page 193).
3. Desolder the two tabs and remove the shield lid.
4. Remove the bridging links ① connecting the board to the control board.
5. Desolder the RF links ② connecting the board to any adjacent boards.
6. Remove the M3 Torx screws securing the N-type connector to the heatsink.
7. Desolder and remove the N-type connector, leaving the ground plate ③ soldered in place on the shield wall.
8. Remove the M3 Torx screws securing the board to the heatsink.
9. Carefully lift the board directly upwards off the locating pins ④ and remove it from the heatsink.

Refitting

1. Refit the board onto the heatsink, ensuring it is correctly positioned on the locating pins.
2. Secure the board to the heatsink with the M3 Torx screws and tighten to the correct torque.

3. If the ground plate ③ is already soldered to the shield wall:
   - fit the N-type connector and tighten the two M3 Torx screws to the correct torque
   - solder the N-type connector to the PCB.

   If the ground plate is not already soldered to the shield wall:
   - fit the ground plate and N-type connector to the heatsink, ensuring that the tab on the ground plate fits through the slot in the shield wall
   - tighten the two M3 Torx screws to the correct torque
   - solder the N-type connector to the PCB
   - solder the tag on the ground plate to the inside of the shield wall.

Note In both cases make sure that the ground plate sits flat against the base of the N-type connector, otherwise the cover may not fit correctly.

4. Replace the RF links ② and bridging links ①.

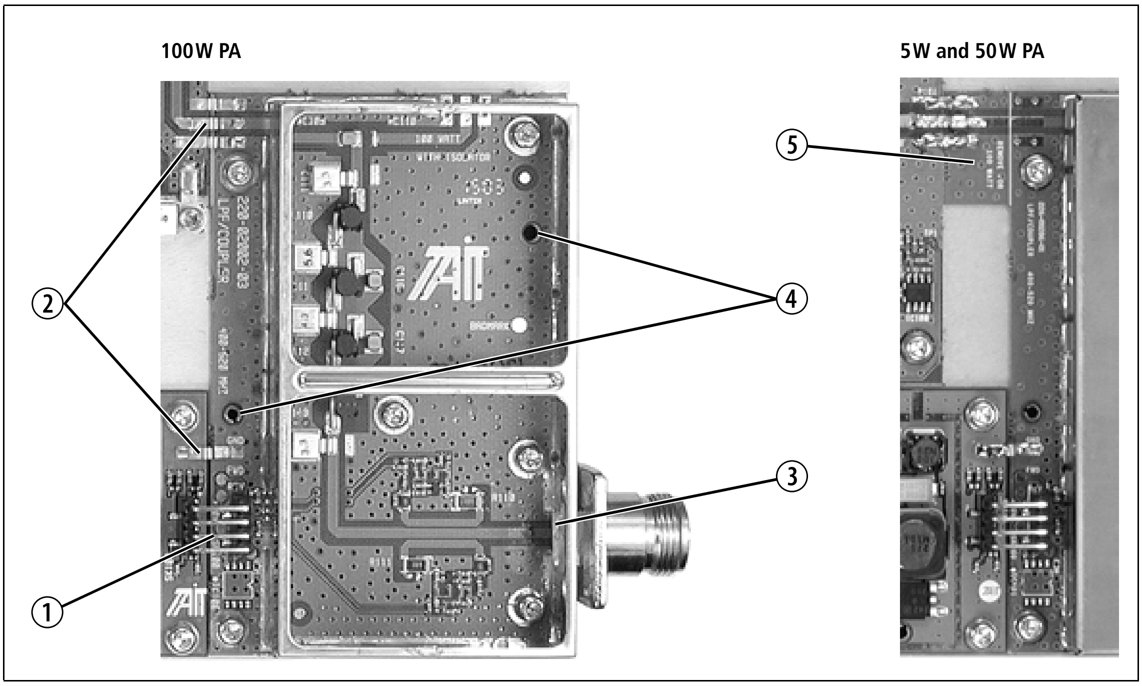
5. Refit the shield lid and resolder the two tabs.

6. On a 12V PA, refit the boost regulator board (as described in "Replacing the Boost Regulator Board in a 12V PA" on page 193).

7. Refit the cover.

Note If you are fitting a new board, make sure that the RF input tab ⑤ is left in place for a 5W or 50W PA, and removed for a 100W PA. If you have to remove the tab, cut it off **cleanly** with a **sharp** cutting tool (such as tin snips or a guillotine).

Figure 10.6 Replacing the LPF/directional coupler board



10.7 Replacing the Splitter/Combiner Boards

Important There is heatsink compound between the termination resistors and the heatsink. You may need to carefully prise the resistors away from the heatsink with a small screwdriver. Any objects caught in the heatsink compound underneath the resistors which prevent effective grounding and/or heatsinking may cause the resistors to fail. There is also heatsink compound between the board and the heatsink under the splitter and combiner devices. Any objects caught in the heatsink compound underneath the board which prevent effective heatsinking may cause these components to fail.

Important Do not apply too much heat or pressure to the PCB pads and tracks as you may damage them or lift them from the PCB. This will permanently damage the PA.

Refer to "Power Amplifier Disassembly and Reassembly" on page 173 for details on removing and refitting the cover, and for screw torque settings. The circled numbers in the following instructions refer to Figure 10.7 on page 191.

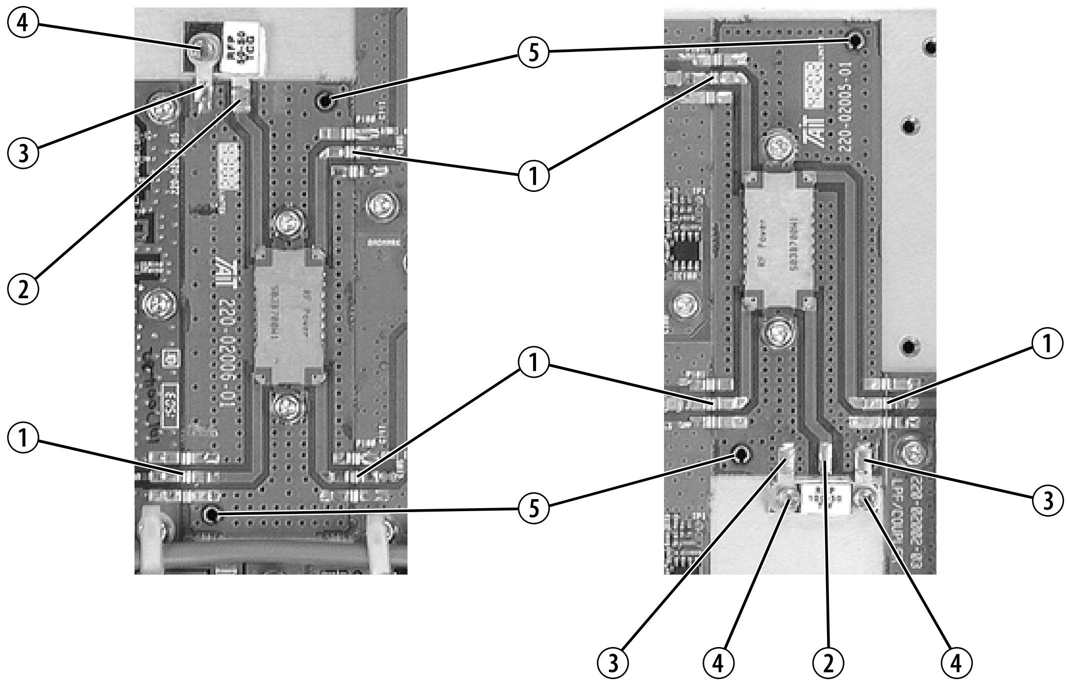
Removal

1. Remove the cover.
2. Desolder the RF links ① connecting the board to any adjacent boards.

Note Some models of PA have an SMD termination resistor. If the PA under repair has an SMD resistor, proceed to Step 6.

3. Desolder the tab of the termination resistor ② and carefully lift it away from the PCB with a screwdriver or thin stainless steel spike.
4. Desolder the termination resistor ground tag(s) ③ and carefully lift away from the PCB with a screwdriver or thin stainless steel spike.
5. Remove the 4-40 UNC Allen screw(s) ④ securing the termination resistor to the heatsink and carefully remove the resistor and ground tag(s).
6. Remove the M3 Torx screws (and M2 Pozidriv on VHF PAs) securing the board to the heatsink.
7. Carefully lift the board directly upwards off the locating pins ⑤ and remove it from the heatsink.

Figure 10.7 Replacing the splitter/combiner boards



Refitting

1. Ensure the heatsink and bottom of the board are clean. Remove any old heatsink compound.

2. Apply a thin layer of fresh heatsink compound (Dow-Corning 340 or equivalent) to the bottom of the board underneath the splitter or combiner. Use as little as possible, while still covering the whole of the mounting area of the component.

3. Refit the board onto the heatsink, ensuring it is correctly positioned on the locating pins.

4. Secure the board to the heatsink with the M3 Torx screws (and M2 Pozidriv on VHF) and tighten to the correct torque.

Important Do not overtighten the M2 Pozidriv screws or you may strip the threads.

Note Some models of PA have an SMD termination resistor. If the PA under repair has an SMD resistor, proceed to Step 10.

5. Apply a small amount of heatsink compound to the termination resistor mounting surface. Use as little as possible to provide a very thin, but even, film over the entire mounting surface.

6. Place the resistor on the heatsink and ensure the tab is flush with the surface of the PCB.

Important Make sure the heatsink compound is clean. Any objects caught in the heatsink compound underneath the resistor which prevent effective heatsinking may cause it to fail.

7. Refit the ground tag(s) and secure the resistor to the heatsink with the 4–40 UNC screw(s). If there are two screws, progressively tighten each screw, alternating from side to side, to the correct torque.

8. Solder the ground tag(s) and resistor tab to the PCB. While soldering the resistor tabs, gently press down on them with a ceramic trimming tool to ensure they are as close as possible to the pads on the PCB.

9. Retorque the 4–40 UNC screws after eight hours of operation.

10. Refit the cover.

10.8 Replacing the Interconnect Boards

Refer to "Power Amplifier Disassembly and Reassembly" on page 173 for details on removing and refitting the cover, and for screw torque settings.

Removal

1. Remove the cover.

2. Desolder the RF links connecting the board to any adjacent boards. You may need to move the +28VDC power feed wire out of the way first.

3. Remove the M3 Torx screws securing the board to the heatsink.

4. Carefully lift the board directly upwards off the locating pins and remove it from the heatsink.

Refitting

1. To refit the board, follow the removal instructions in reverse order.

Note Before tightening the screws, press the board down over the locating pins so that it is firmly seated against the heatsink. Then tighten the M3 Torx screws to the correct torque.

10.9 Replacing the Boost Regulator Board in a 12V PA

Refer to "Power Amplifier Disassembly and Reassembly" on page 173 for details on removing and refitting the cover, and for screw torque settings. The circled numbers in the following instructions refer to Figure 10.8 on page 194.

Removal

1. Remove the cover.
2. Disconnect the 12VDC ① and 28VDC ② output cables from their sockets on the boost regulator board.
3. Remove the M3 Torx screws securing Q3 ③ and D1 ④ to the heatsink.
4. Remove the M3 Torx screws securing the board to the heatsink and spacers. Note that the two screws ⑤ in the DC input filter compartment are longer than the other screws.
5. Carefully lift the board off the spacers and heatsink.

Refitting the Original Board

1. If you are refitting the original board, follow the removal instructions in reverse order.
2. If necessary, check the board is working correctly (refer to "Boost Regulator Board (12V PA Only)" on page 168).
3. Refit the cover.

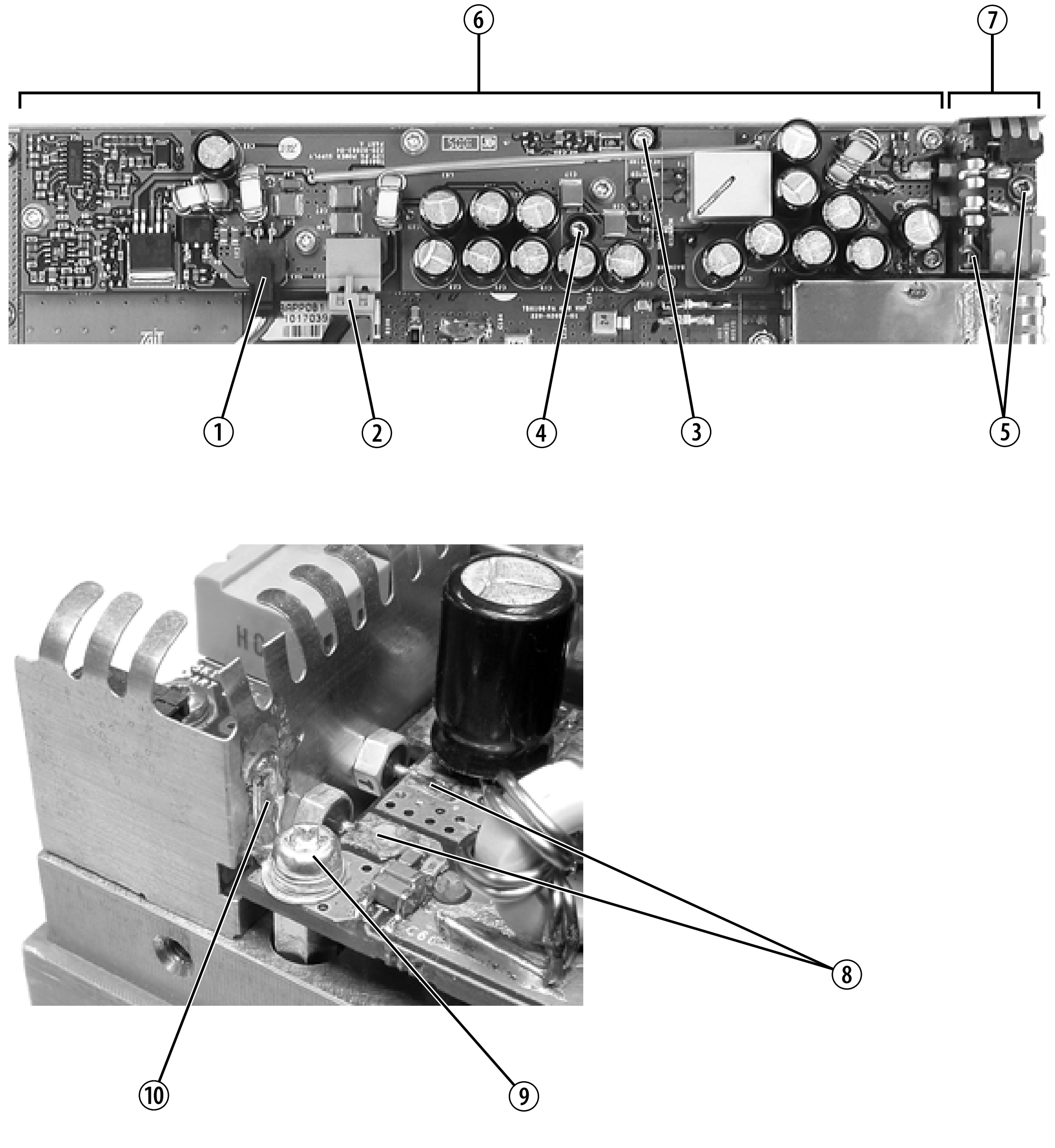
Refitting a New Board

Replacement boost regulator boards are supplied as two separate assemblies: the main boost regulator board ⑥, and the DC input filter board ⑦. You must mount both boards to the heatsink before soldering them together.

1. Position the main board on the spacers. Align the mounting holes for Q3, D1, and the board itself, then fit the M3 Torx screws. Tighten the screws to the correct torque.
2. Position the DC input filter board on the heatsink and secure with the M3 Torx screws. Ensure the legs of the two feedthrough capacitors ⑧ are correctly positioned in the slots on the main board. Tighten the screws to the correct torque.
3. Solder the legs of the two feedthrough capacitors to the main board.
4. Fit the solder tag under the M3 Torx screw labelled ⑨ as shown. Tighten the screw to the correct torque and solder the tag to the shield ⑩.
5. Reconnect the 12VDC and 28VDC output cables.
6. If necessary, check the board is working correctly (refer to "Boost Regulator Board (12V PA Only)" on page 168).

7. Refit the cover.

Figure 10.8 Replacing the boost regulator board in a 12 V PA



11 Power Amplifier Spare Parts

This chapter lists the spare parts available for the TB8100 PA at the time this manual was published.

- Spare circuit board assemblies are listed in Table 11.1.
- Replacement components are listed in Table 11.2 on page 196.
- Mechanical parts are listed in Figure 11.1 on page 197, Figure 11.2 on page 198, and Figure 11.3 on page 199.

Other items may become available as spares at a later date. Consult your nearest Tait Dealer or Customer Service Organisation regarding the availability of specific items.

Table 11.1 Spare circuit boards for the PA

Description		Spares Code
6W board	B and C bands H band K band L band	TBA-SP-PD0B1 TBA-SP-PD0H0 TBA-SP-PD0K2 TBA-SP-PD0L0
60W board	B and C bands H band K band L band	TBA-SP-PP0B1 TBA-SP-PP0H0 TBA-SP-PP0K2 TBA-SP-PP0L0
control board		TBA-SP-PC010
LPF/directional coupler board	B band 50W B band 100W C band 50W C band 100W H band K band L band	TBA-SP-PF50B1 TBA-SP-PF100B1 TBA-SP-PF50C0 TBA-SP-PF100C0 TBA-SP-PF0H0 TBA-SP-PF0K2 TBA-SP-PF0L0
splitter board	B and C bands H, K, and L bands	TBA-SP-PSB1 TBA-SP-PSH0
combiner board	B and C bands H, K, and L bands	TBA-SP-PBB1 TBA-SP-PBH0
boost regulator board		TBA-SP-PW000
ambient air temperature sensor board		TBA-SP-PT10

Table 11.2 Replacement components for the PA

Description	IPN
60W board final transistor (MRF9060)	000-10090-60
splitter board termination resistor (heatsink mounting)	039-50500-00
combiner board termination resistor	039-00100-50

Figure 11.1 PA mechanical assembly - 28 V PAs

	Description	IPN
1	DC input feedthrough capacitor	012-04100-07
2	DC power link	051-00640-XX
3	DC input cable - 5/50W DC input cable - 100W	219-02854-XX 219-02855-XX
4	bridging links	240-00020-61
5	N-type connector	240-02100-64
6	SMA connector	240-02155-20
7	P-clip	303-50107-XX
8	handle	308-01065-XX
9	heatsink - 5/50W heatsink - 100W	308-13144-XX 308-13145-XX
10	front panel - 5/50W front panel - 100W	316-06815-XX 316-06817-XX
11	LPF/directional coupler shield lid	319-01247-XX
12	N-type connector ground plate	319-01249-XX
13	LPF/directional coupler shield lid spring contacts	319-01259-XX
14	M3x6mm countersunk Torx screw	345-40460-XX
15	M3x8mm pan head Torx screw + spring/flat washers	345-40470-XX
16	M2.5x8mm pan head Torx screw	345-40490-XX
17	M3x10mm pan head Torx Taptite screw	349-02066-XX
18	4–40x5/16 UNC Allen recess head screw	349-20460-XX
19	3mm solder tag - short	356-00010-01
20	3mm solder tag - long	356-00010-03
21	4mm right-angle solder tag	356-00010-74
22	RF link	356-01080-XX
23	ground tag for 60W RF power transistor	356-01081-XX
24	metal strap for feedthrough capacitor	356-01082-XX
25	insulating washer for feedthrough capacitor	362-00010-51
26	dust seal for ambient air temperature sensor board	362-01036-XX
27	control board	
28	6W board	
29	LPF/directional coupler board	
30	60W board	
31	ambient air temperature sensor board	
32	combiner board	
33	splitter board	
34	bridging link board 5W interconnect board* 50W interconnect board* 100W VHF interconnect board*	

*Not shown in this drawing. Refer to Figure 8.1 on page 130.

Note:
The characters XX in an IPN (Tait Internal Part Number) stand for the issue number of the part. Only the latest issue of each part will normally be available for ordering as spare or replacement parts.

Note:
This drawing shows a 100W 28V PA. Any differences between the 100W, 5W and 50W 28V PAs are indicated in the description of the parts. Parts which are unique to the 12V PAs are shown in Figure 11.2.

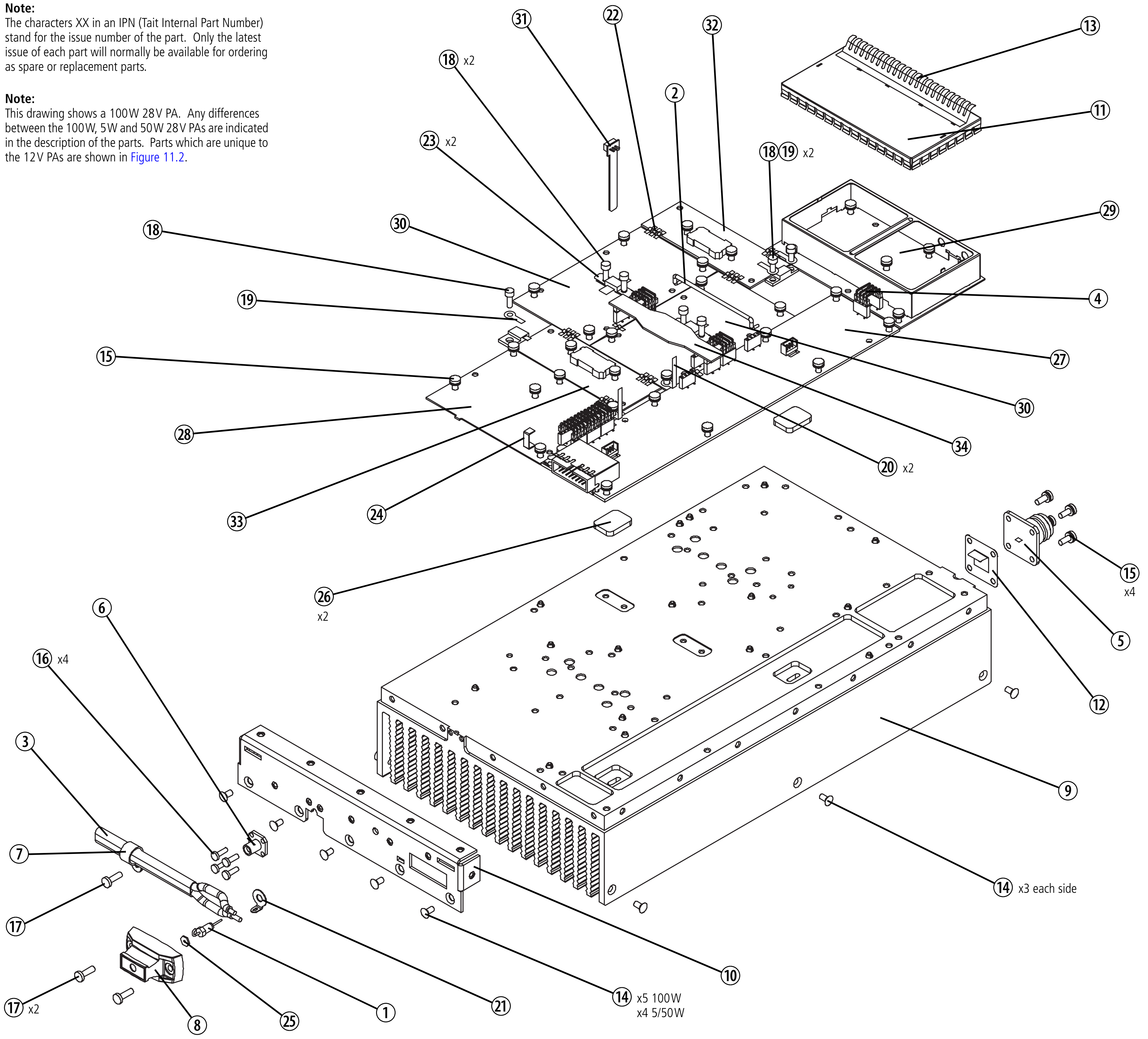


Figure 11.2 PA mechanical assembly - 12V PAs

	Description	IPN
①	28VDC output cable (not shown)	219-02963-XX
②	12VDC output cable to reciter	219-02964-XX
③	12VDC output cable (not shown)	219-02965-XX
④	heatsink	308-10010-XX
⑤	insulator board	309-02012-XX
⑥	M3x8mm spacer	316-87073-XX
⑦	M3x8mm pan head Torx screw + spring/flat washers	345-40470-XX
⑧	M3x12mm pan head Torx screw	349-02065-XX
⑨	boost regulator board	

Note:
The characters XX in an IPN (Tait Internal Part Number) stand for the issue number of the part. Only the latest issue of each part will normally be available for ordering as spare or replacement parts.

Note:
This drawing shows a 50W 12V PA. The parts shown in this drawing are unique to the 12V PAs. All other parts are the same as the equivalent 28V PAs and are shown in Figure 11.1.

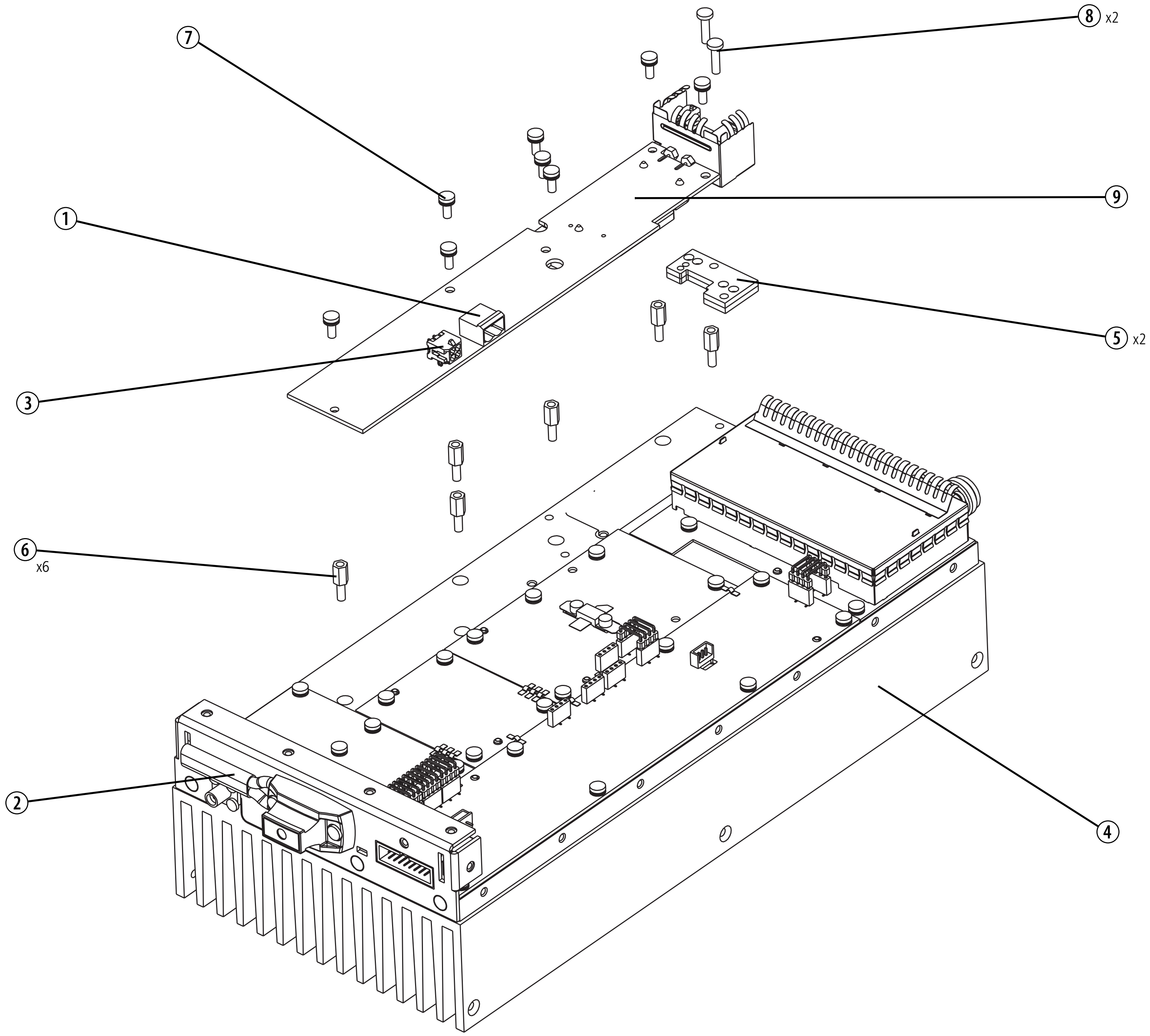
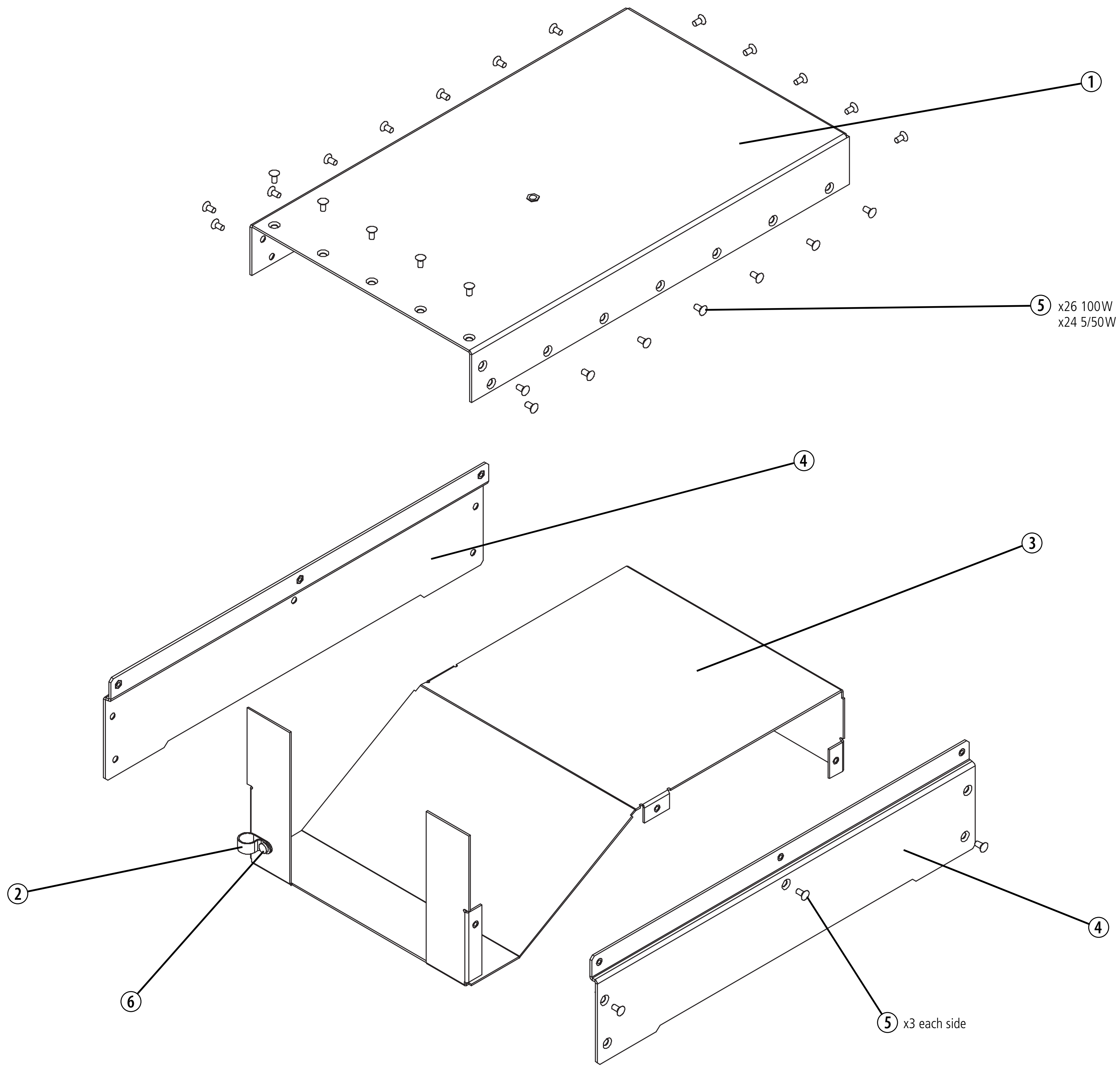


Figure 11.3 PA mechanical assembly - covers and airflow duct

	Description	IPN
①	cover - 5/50W 28V cover - 5/50W 12V cover - 100W	303-03070-XX 303-20081-XX 303-03071-XX
②	P-clip	303-50107-XX
③	airflow duct centre panel	316-06818-XX
④	airflow duct side panel	316-06819-XX
⑤	M3x6mm countersunk Torx screw	345-40460-XX
⑥	M3x10mm pan head Torx Taptite screw	349-02066-XX

Note:
The characters XX in an IPN (Tait Internal Part Number) stand for the issue number of the part. Only the latest issue of each part will normally be available for ordering as spare or replacement parts.



12 Power Management Unit Circuit Description

The TB8100 power management unit (PMU) provides stable, low-noise 28 VDC outputs to power the TB8100 base station. The PMU is made up of a number of individual boards and cards which comprise two main modules, the AC module and the DC module. The auxiliary power supply board is optional.

The AC module accepts an input of 115/230 VAC 50/60 Hz nominal, and the DC module accepts an input of 12 VDC, 24 VDC or 48 VDC[1] nominal (depending on the model). Both modules provide the following outputs:

- 28 VDC high current (PA)
- 28 VDC low current (reciter)
- 13.65 VDC, 27.3 VDC or 54.6 VDC low current (with the optional auxiliary power supply board).

The PMU is available in three main configurations:

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

If both the AC and DC modules are fitted, the PMU uses the AC input by default, and provides battery back-up by operating from the DC input if the AC input is interrupted. The changeover from AC to DC input, and from DC back to AC input, is breakless. This allows the base station to operate without interruption.

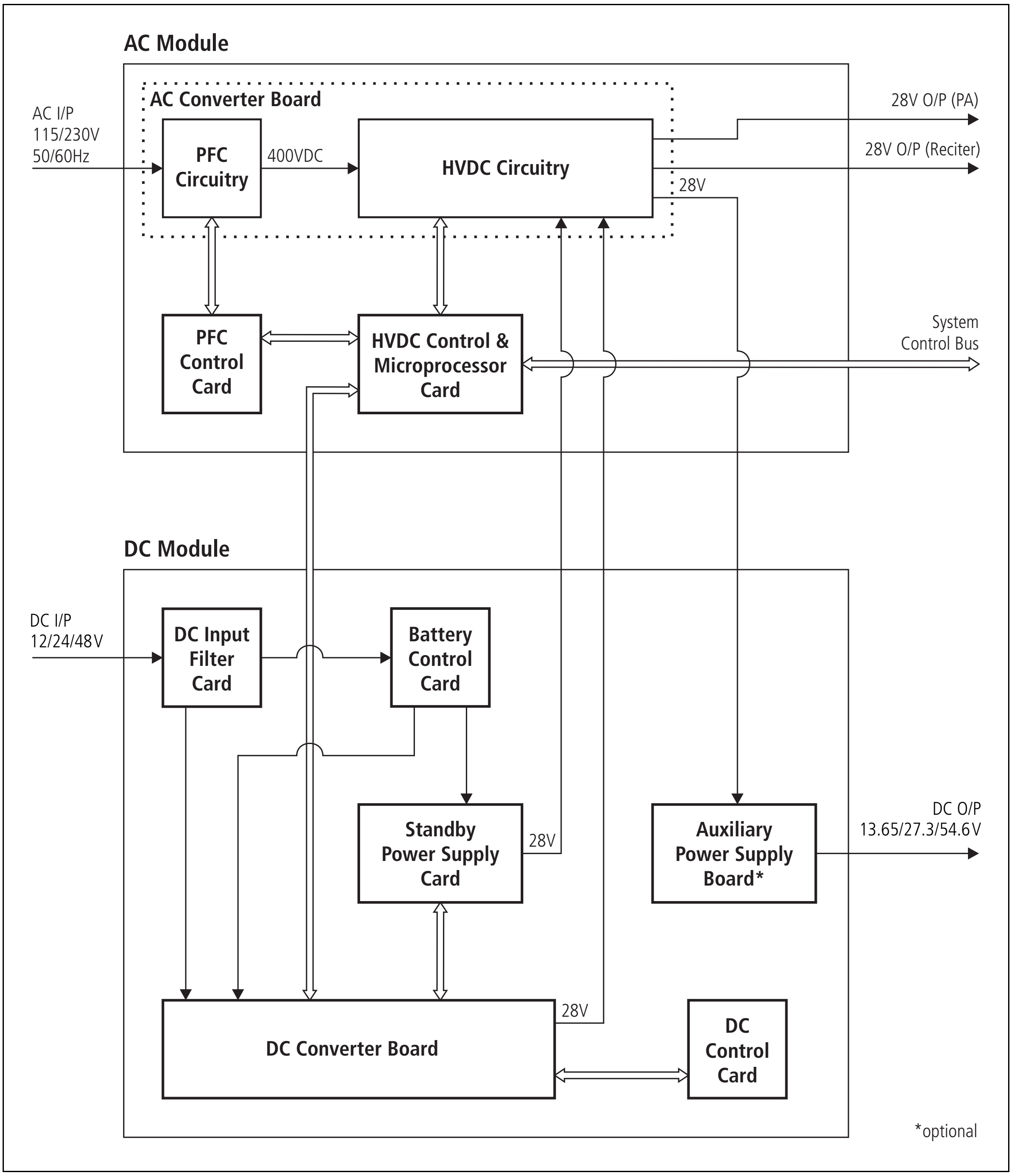
The power supply card allows efficient use of the DC input at low power requirements. The optional auxiliary power supply board provides output voltages which are different from the 28 VDC required by the TB8100 base station.

Figure 12.1 on page 202 shows the configuration for an AC and DC PMU, along with the main inputs and outputs for power and control signals. The table which follows shows which boards and cards are fitted in each module.

The locations of the main circuit blocks on the boards are shown in Figure 12.5 on page 211 and Figure 12.6 on page 213.

1. Because the DC module is designed to run from a battery, there will be a minimum start-up voltage when operating on DC only (refer to the TB8100 Specifications Manual (MBA-00001-xx) for more details).

Figure 12.1 PMU high level block diagram



Board and Card Name	AC PMU	DC PMU	AC and DC PMU
DC converter board		fitted	fitted
DC input filter card		fitted	fitted
DC control card		fitted	fitted
battery control card		fitted	fitted
DC output filter board[a]		fitted	
DC microprocessor card[b]		fitted	
AC converter board	fitted		fitted
HVDC control and microprocessor card	fitted		fitted
PFC control card	fitted		fitted
standby power supply card[c]		fitted	fitted
auxiliary power supply board[d]	optional	optional	optional

a. This is the AC converter board as used in a DC PMU. Only the current sense and output filter circuitry is placed on this board.

b. This is the HVDC control and microprocessor card as used in a DC PMU. Only the feedback and microprocessor circuitry is placed on this card.

c. You must fit the appropriate model card to match the DC input voltage of the PMU (i.e. 12VDC, 24VDC or 48VDC nominal). This card was optional on PMUs manufactured before February 2006.

d. The output voltage is dependent on the model of board - there is a different model board for each output voltage (i.e. 13.65VDC, 27.3VDC or 54.6VDC).

12.1 Microprocessor Control Circuitry

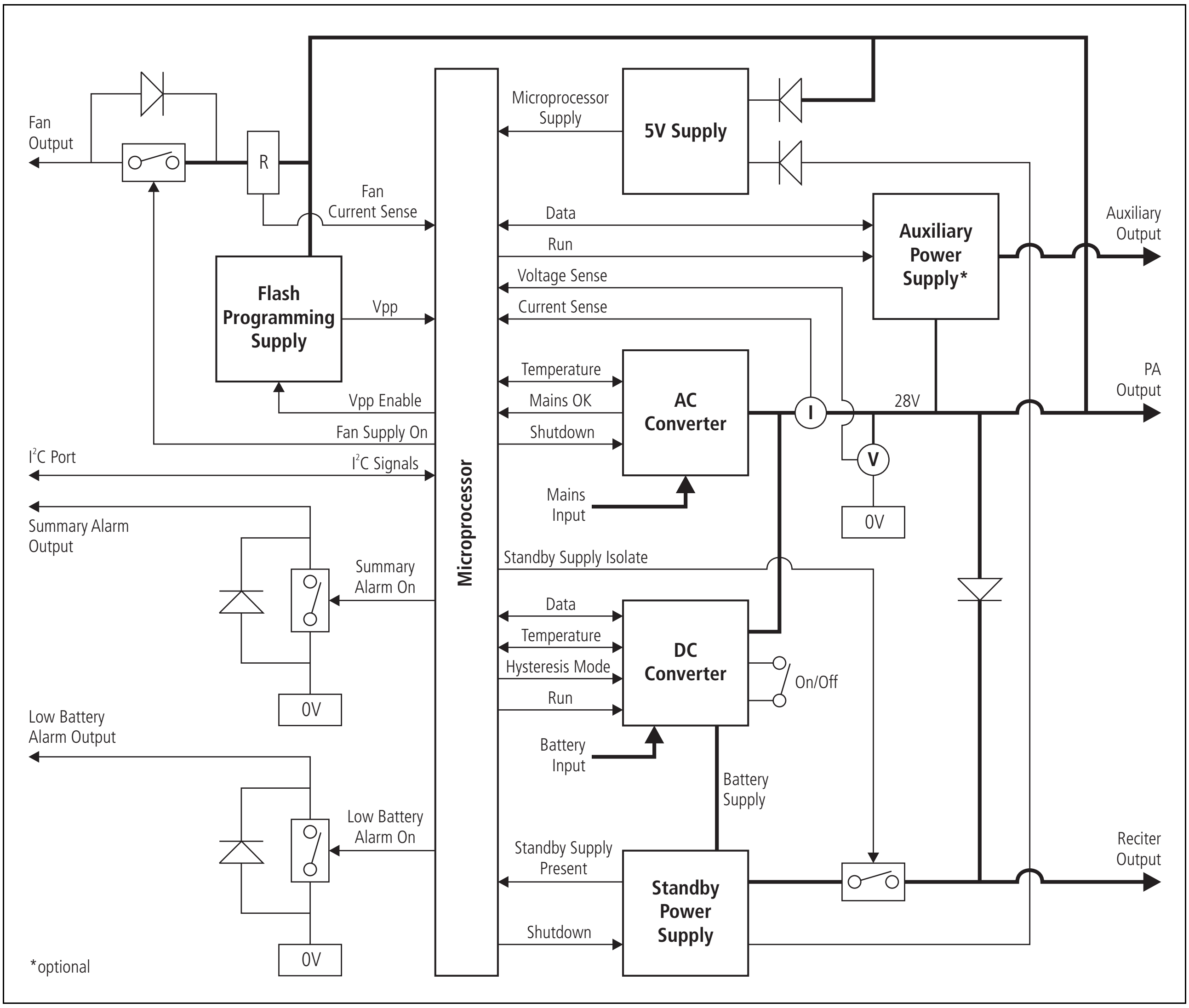
The microprocessor on the HVDC control card monitors and controls the operation of the PMU. If any of the monitored conditions exceeds its normal range of values, the microprocessor will generate an alarm and take appropriate action, depending on the configuration of the PMU. The software also automatically detects the PMU configuration and controls the PMU accordingly.

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

The microprocessor also calibrates the output voltage to the required specification. This information is stored in EEPROM memory during factory run-up. The output voltage of an uncalibrated PMU is 26.5VDC.

Figure 12.2 on page 204 shows the control signal and power connections to and from the microprocessor. These are described in more detail in the paragraphs which follow.

Figure 12.2 PMU microprocessor functional block diagram



AC Converter

The microprocessor can enable or disable the AC converter if the user needs to test the DC module and battery back-up by simulating a failure of the AC mains input.

The microprocessor monitors the output voltage and current, the temperature of the AC module heatsink, and whether the AC mains input is within the specified range.

DC Converter

The microprocessor controls the on/off function of the DC converter. It also controls the mode of operation of the DC converter: normal mode, hysteresis mode[1], or deep sleep mode. Refer to "Hysteresis Mode" on page 209 for details on hysteresis mode, and to "Standby Power Supply" below for details on deep sleep mode.

1. A type of "sleep" mode available when the standby power supply card is not fitted.

The microprocessor monitors the battery input voltage and the temperature of the DC module heatsink. It also identifies the model of DC converter fitted to the DC module (i.e 12V, 24V or 48V nominal input).

Standby Power Supply

The microprocessor detects whether this power supply is fitted, and disables it when the AC mains supply is operating.

The output from this power supply can be isolated from the reciter output to maintain power to the microprocessor when battery capacity is low. The low battery threshold is set with the Service Kit.

This power supply is also used to maintain power to the microprocessor when the PMU is in deep sleep mode and the DC converter is switched off. Deep sleep mode is configured with the Service Kit and can only function if the load on the PMU reciter output is less than 10W.

If the power supply is not fitted, the microprocessor is powered by an internal 5V power supply derived from the main PA output.

Auxiliary Power Supply

The microprocessor controls the on/off function for this power supply. The actual operation of the power supply is set with the Service Kit:

- on only when AC mains is present
- controlled by Task Manager.

The microprocessor detects when the power supply is operating. It also detects which model of power supply is fitted (12V, 24V or 48V), whether the power supply is operating or not.

Front Panel Fan

The microprocessor measures the current drawn by the PMU fan mounted in the front panel. It protects the fan driver circuitry from overload or short circuit by switching the fan off for five seconds, and then switching it on again. The microprocessor will continue to try running the fan indefinitely. If the fan has failed, the reciter sends an alarm to the Service Kit.

I^2C Communications

The microprocessor controls the I^2C communications between the PMU and the other base station modules.

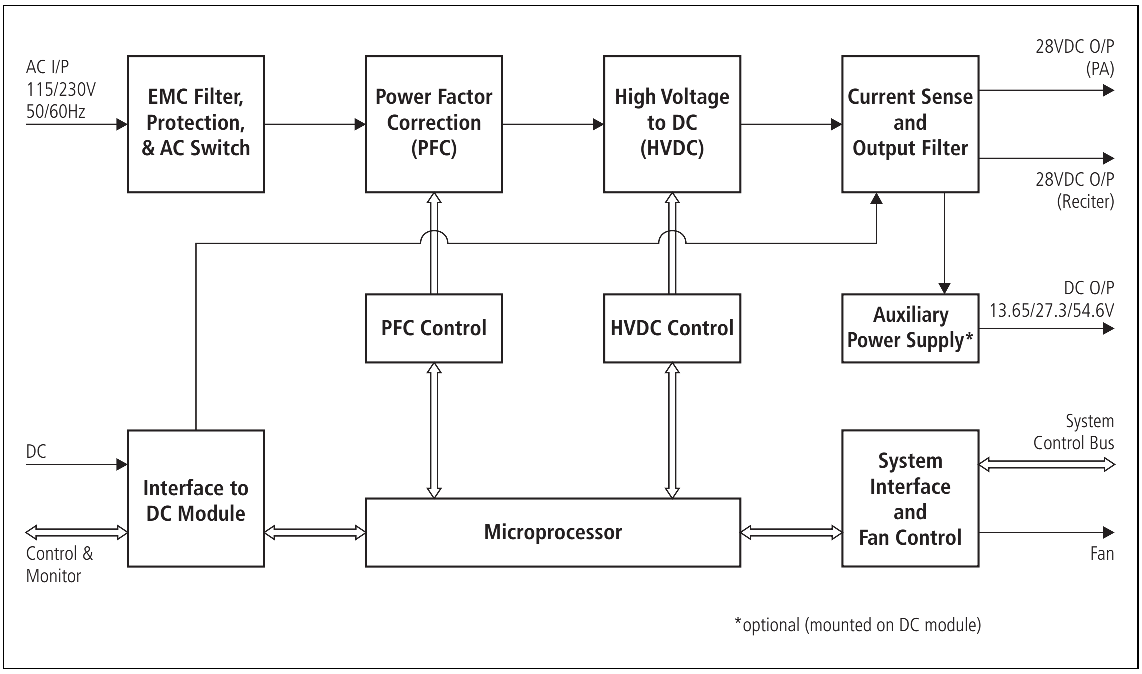
The current source used by the I^2C lines as active pull-up resistors is housed on the microprocessor board.

12.2 AC Module

The AC module accepts an input of 115/230VAC 50/60Hz nominal, and provides two regulated 28VDC outputs: high current for the PA, and low current for the reciter.

The main circuit blocks are shown in Figure 12.3 below, and are described in more detail in the paragraphs which follow.

Figure 12.3 PMU AC module block diagram



EMC Filter, Protection, and AC Switch

The AC input is fed first to an EMC filter consisting of two common-mode and two differential-mode filters. The input voltage is monitored, and if it is within the specified voltage range, a “mains OK” signal is sent to the microprocessor via an opto-coupler. If the mains input voltage is outside the specified range, the power factor stage is inhibited to protect the AC converter from damage.

An MOV is fitted between line and phase to clamp low energy noise on the line. A 10A fuse is also fitted for additional safety. If the fuse blows, it disconnects the PMU from the mains. Inrush current control is provided by a high power resistor, which is bypassed by a relay when the PMU is powered up.

Power Factor Correction (PFC)

The filtered AC input is fed to this boost power supply where the active power factor correction circuit converts it to the regulated 400VDC output. This stage is fully protected from overload and short circuit by the power supply control circuitry.

PFC Control

The control circuitry for the boost power supply is located on the PFC control card which plugs into the AC converter board. This circuitry is designed to achieve a power factor of near unity. The power supply for the PFC control circuitry is derived from the secondary winding on the main boost choke.

High Voltage to DC (HVDC)

The regulated 400VDC from the PFC circuitry is converted to a regulated 28VDC output using a forward converter.

The forward converter transformer provides galvanic isolation between the input and output. The primary is switched between 400V and 0V via two power MOSFETs.

The output from the transformer is rectified and filtered before being fed to a current sense resistor.

HVDC Control

This secondary control circuitry consists of a voltage and current amplifier, which provides a combined error signal. This error signal is fed via an opto-coupler to the PWM (pulse width modulation) controller IC, which is part of the primary control circuitry.

The power supply for the HVDC control circuitry is derived from the secondary winding on the main transformer. The HVDC control circuitry is located on a separate card which plugs into the AC converter board.

Current Sense and Output Filter

The current sense resistor provides the current output level to the microprocessor for monitoring purposes and to supply data to the Service Kit. The current output level is also used by the analogue current control loop to limit the maximum output current.

After the current shunt the regulated 28VDC output is split and filtered to provide two DC outputs: a high current output for the PA, and a low current output for the reciter. The high current output is electronically protected, and the low current output is protected by a 2.5A self-resetting fuse.

The low current output for the reciter is normally supplied by the standby power supply. If this card is not fitted, the high current PA output is also supplied to the low current reciter output via a diode.

The current sense and output filter circuitry is also used by the DC converter to provide a common output stage for the PMU.

Microprocessor Control

The microprocessor is located on the HVDC control card and is referenced to the output (secondary side) of the converter. The microprocessor is used by both the AC and DC modules and is fitted to all PMU models.

The microprocessor controls the output voltage to the fan via a MOSFET and dropping resistor to provide the 24VDC output.

System Interface and Fan Control

The system interface circuitry consists of the I^2C lines, fan power, and alarm outputs, which are fed to the system control bus connector on the front panel. There is high frequency filtering on all lines.

The microprocessor also monitors the current drawn by the PMU fan and protects it from overload or short circuit.

Interface to DC Module

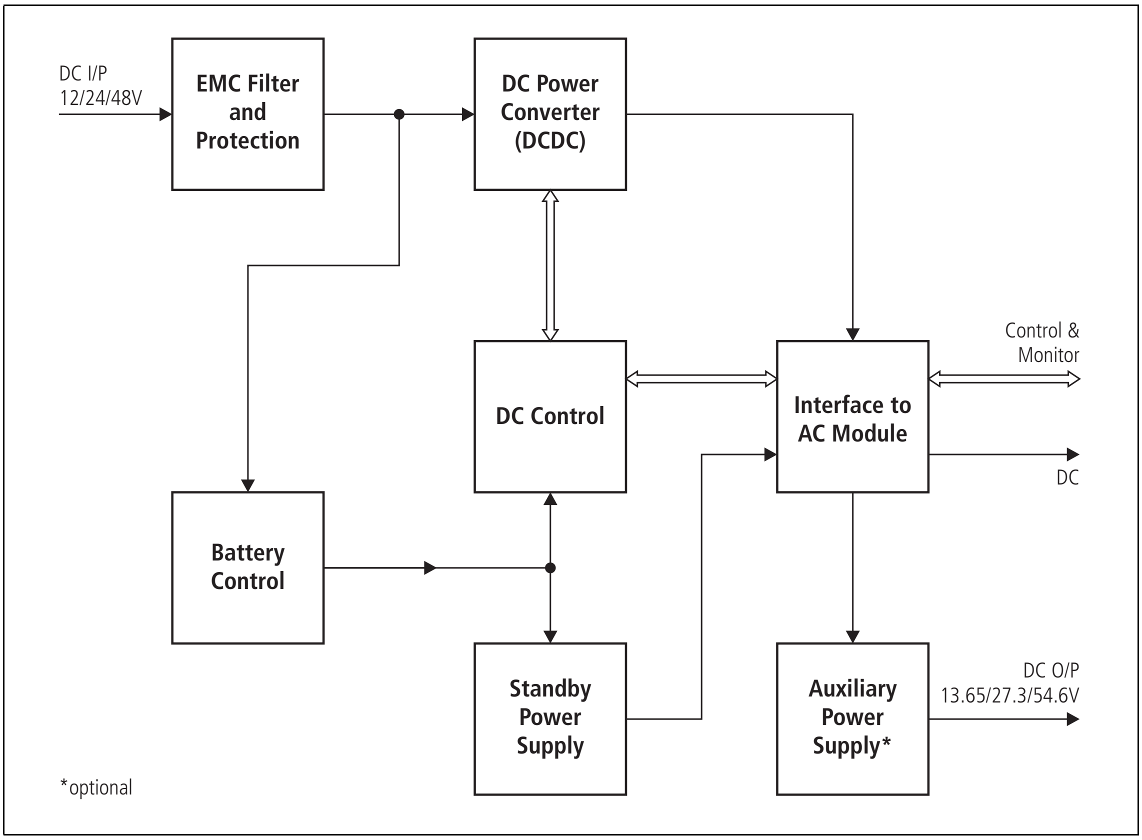
This interface consists of the connectors which connect the AC module to the DC module. Although there is no circuitry involved this interface, it is included in the block diagram to illustrate the interconnection between the AC and DC modules.

12.3 DC Module

The DC module accepts an input of 12 VDC, 24 VDC or 48 VDC nominal, and provides two regulated 28 VDC outputs: high current for the PA, and low current for the reciter.

The main circuit blocks are shown in Figure 12.4 below, and are described in more detail in the paragraphs which follow.

Figure 12.4 PMU DC module block diagram



EMC Filter and Protection

The DC input is fed first to an EMC filter consisting of bus bars, an e-core transformer, and capacitors. These components are located on the DC input filter card, which is connected to the DC converter board via the bus bars and soldered tabs.

The protection is provided by an anti-parallel diode, which prevents damage from reverse polarity input voltage. External series protection (e.g. fuse or circuit breaker) must be provided by the user.

DC Power Converter (DCDC)

In this stage the filtered DC input is fed to a push-pull converter which converts the DC input voltage to a regulated DC output voltage.

The DC voltage is fed to a high frequency transformer which provides galvanic isolation between input and output via two pairs of power MOSFETS on the primary winding.

The output from this transformer is rectified and filtered before being fed to the current sense and output filter circuitry on the AC converter board.

DC Control

This secondary control circuitry consists of a voltage amplifier, which provides a reference voltage and error signal. This error signal is fed via an opto-coupler to the PWM controller IC, which is part of the primary control circuitry.

The power supply for the DC control circuitry is provided by the battery control card. The DC control circuitry is located on a separate card which plugs into the DC converter board.

Hysteresis Mode

When the DC control circuitry receives a “hysteresis enable” signal from the microprocessor, it changes the regulation to a hysteric method (hysteresis mode). Hysteresis mode is used in sleep mode to improve the efficiency of the DC converter under light loads. Sleep mode is configured with the Service Kit and can only function if the load on the PMU is less than 10W.

In hysteresis mode the DC converter is switched off when the output voltage reaches the maximum threshold, and on again when the voltage reaches the minimum threshold. The thresholds are set in hardware at the factory.

While the DC converter is switched on, the output capacitors are charged. When the DC converter is switched off, the output capacitors are discharged by the load connected to the PMU. The discharge time varies in proportion to the load. The longer the discharge time, the greater the efficiency of the PMU, as less power is drawn from the battery.

Battery Control

The battery control circuitry monitors the DC input voltage from the battery. If the voltage is within the specified range, power is supplied to the control circuitry and standby power supply (if fitted). Protection is provided against the wrong input voltage being supplied.

The battery input voltage is also provided as a digital signal to the microprocessor via opto-coupler circuitry. This provides isolation between battery ground and microprocessor ground.

The battery control circuitry also prevents deep discharge of the battery by removing the load from the battery if the voltage falls below a minimum threshold. This threshold is independent of the microprocessor threshold, which is set by the user with the Service Kit.

Another function of the battery control circuitry is to provide the microprocessor with information to identify which DC module is fitted to the PMU (i.e. 12V, 24V or 48V).

The battery control circuitry is located on a separate card which plugs into the DC converter board.

Standby Power Supply

The standby power supply is a high efficiency, low power DC converter which operates in parallel with the main DC converter.

This converter provides a low power output to the reciter, and can also operate when the main DC converter is shut down (i.e. deep sleep mode). It is protected from overload and short circuit.

The circuitry for the standby power supply is located on a separate card which plugs into the DC converter board.

Auxiliary Power Supply

The optional auxiliary power supply uses a high power version of the circuit design used in the standby power supply. It operates from the high current 28VDC output from the AC converter or DC converter (depending on which is operating). The auxiliary power supply converter is voltage and current regulated. The mode of operation is controlled with the Service Kit.

The circuitry for the auxiliary power supply is located on a separate board which is mounted on the heatsink of the DC module. The board is connected to the AC converter board via an 8-way cable.

The main function of this power supply is to provide a controlled 13.65VDC, 27.3VDC or 54.6VDC output (depending on model), as the main output for the TB8100 base station is 28VDC.

Interface to AC Module

This interface consists of the connectors which connect the DC module to the AC module. Although there is no circuitry involved this interface, it is included in the block diagram to illustrate the interconnection between the DC and AC modules.

Figure 12.5 Identifying the circuitry in the AC module

1. EMC filter, protection and AC switch
2. power factor correction (PFC)
3. PFC control
4. high voltage to DC converter
5. 28VDC input from the DC converter board
6. current sense and output filter
7. 28VDC output for PA
8. 28VDC output for reciter
9. 28VDC output to auxiliary power supply board
10. microprocessor control
11. AC and DC voltage and current control
12. HVDC control
13. fuse (10A 250V)
14. AC mains input

Note:
In order to show as much of the circuitry as possible in the photograph, the heatsinks and the components normally attached to them are not fitted, and the plug-in cards are not plugged in.

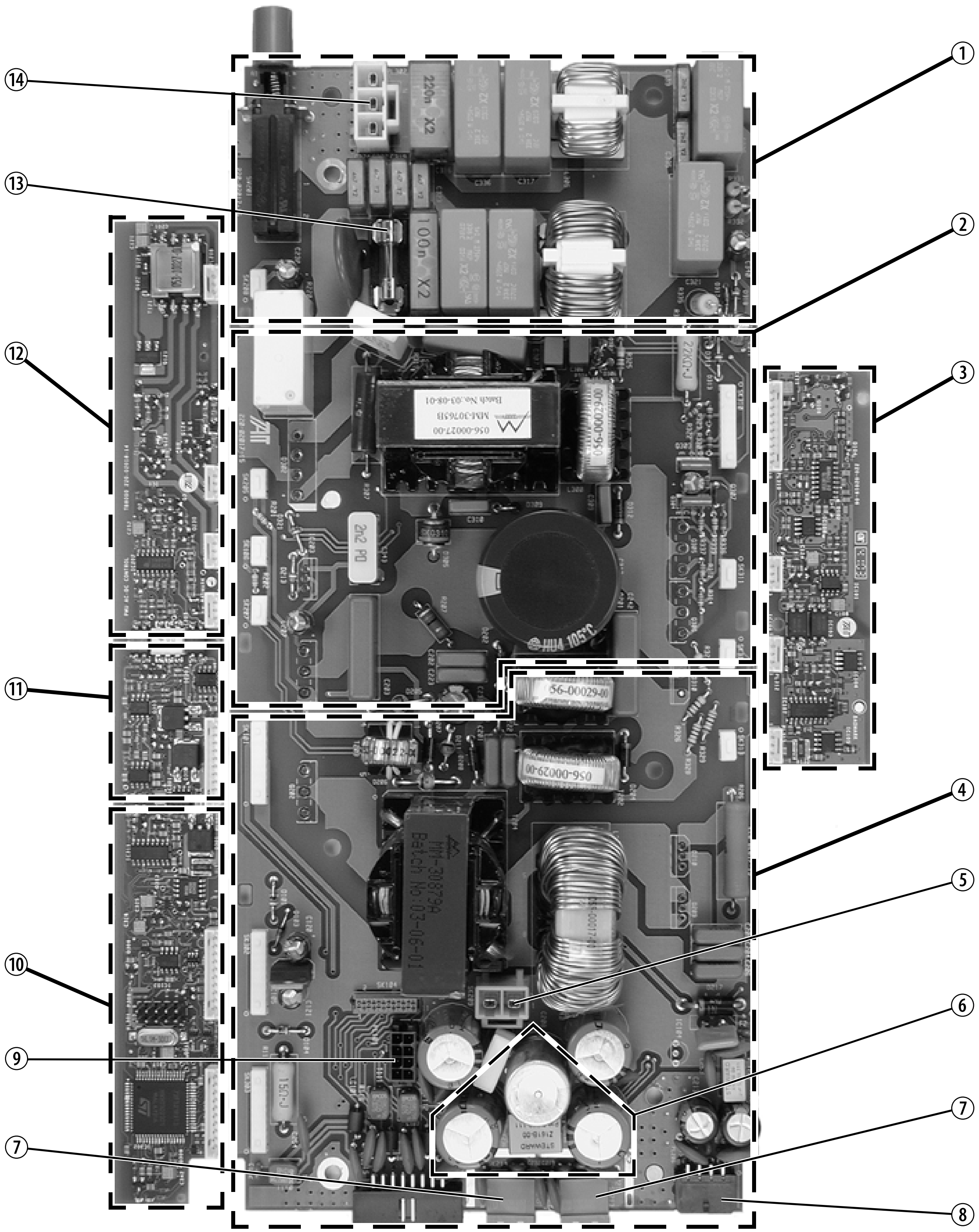
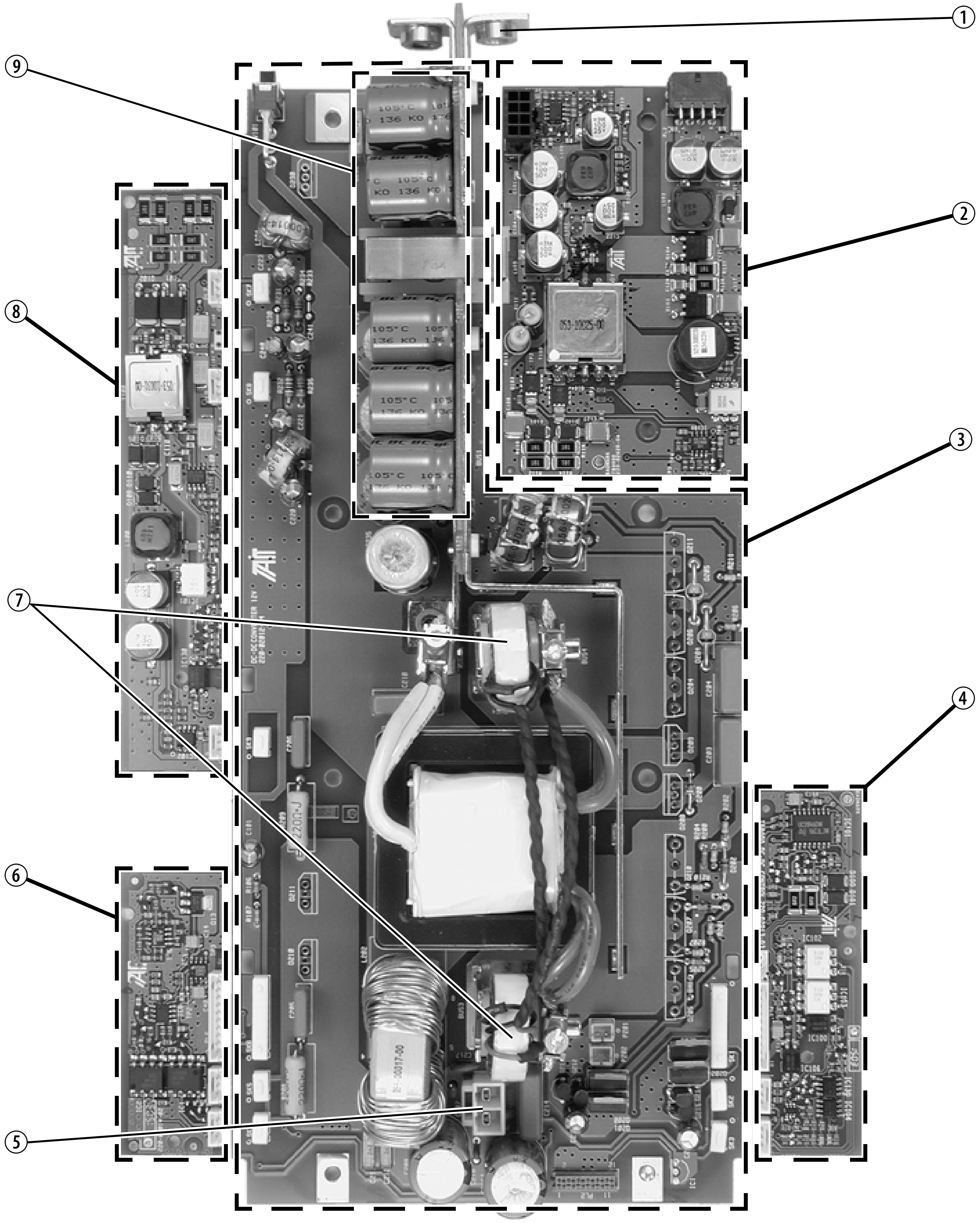


Figure 12.6 Identifying the circuitry in the DC module

1. DC input
2. auxiliary power supply
3. DC power converter
4. DC control
5. output to the current sense and output filter circuitry on the AC converter board
6. battery control
7. current transformer
8. standby power supply
9. EMC filter and protection

Note:
In order to show as much of the circuitry as possible in the photograph, the heatsinks and the components normally attached to them are not fitted, and the plug-in cards are not plugged in.



12 V DC module shown

13 Power Management Unit Fault Finding

This chapter provides enough fault finding information to allow you to trace the fault to an individual board or card in the PMU. It does not provide any information to allow fault finding down to component level. If the fault is traced to the auxiliary power supply board or a plug-in card, the standard procedure is to discard the faulty item and fit a new one. However, if the fault is traced to the DC converter board or AC converter board, you must replace the complete DC or AC module.

The fault finding procedures provided in this chapter assume you are familiar with the operation of the TB8100 Service Kit and Calibration Kit.

Figure 13.1 on page 218 identifies the individual boards and cards, and shows how they are configured in an AC and DC PMU. "Identifying the PMU" on page 217 explains how to identify the model and hardware configuration of a PMU from its product code.

Note For the sake of simplicity and clarity, the instructions and illustrations in this chapter refer to an AC and 12V DC PMU fitted with an auxiliary power supply board. However, the same basic procedures and techniques apply to other models of PMU.

13.1 Safety Precautions

13.1.1 Personal Safety

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

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 DC power on/off 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.**

The PMU should be serviced only by qualified technicians. 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.

Caution **The magnetics and power devices attached to the heatsink in the PMU get hot when they are operating. Take care when working on a PMU that has been in recent use.**

Caution **The PMU can weigh up to 6.4kg (14.1lb). Take care when handling the PMU to avoid personal injury.**

13.1.2 Equipment Safety

Important This equipment contains devices which are susceptible to damage from static charges. Refer to "ESD Precautions" on page 17 for more information on antistatic procedures when handling these devices.

13.2 Identifying the PMU

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

Note This explanation of PMU product codes is not intended to suggest that any combination of features is necessarily available in any one PMU. Consult your nearest Tait Dealer or Customer Service Organisation (CSO) for more information regarding the availability of specific models and options.

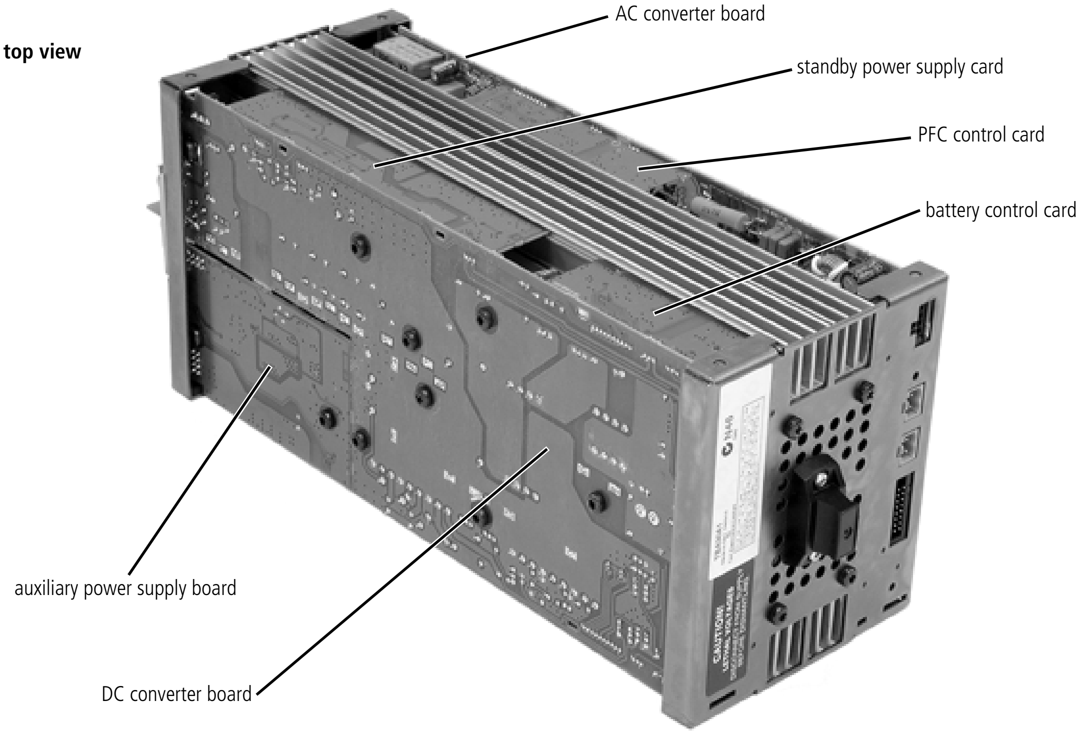
Product Code	Description
TBA**X**XXX-XXXX	3 = PMU
TBA3**X**XX-XXXX	0 = default
TBA3X**X**X-XXXX	0 = AC module not fitted A = AC module fitted
TBA3XX**X**-XXXX	0 = DC module not fitted 1 = 12V DC module fitted 2 = 24V DC module fitted 4 = 48V DC module fitted
TBA3XXX-**X**XXX	0 = standby power supply card not fitted 1 = 12VDC standby power supply card fitted 2 = 24VDC standby power supply card fitted 4 = 48VDC standby power supply card fitted
TBA3XXX-X**X**XX	0 = auxiliary power supply board not fitted 1 = 12VDC auxiliary power supply board fitted 2 = 24VDC auxiliary power supply board fitted 4 = 48VDC auxiliary power supply board fitted
TBA3XXX-XX**X**X	0 = default
TBA3XXX-XXX**X**	0 = default

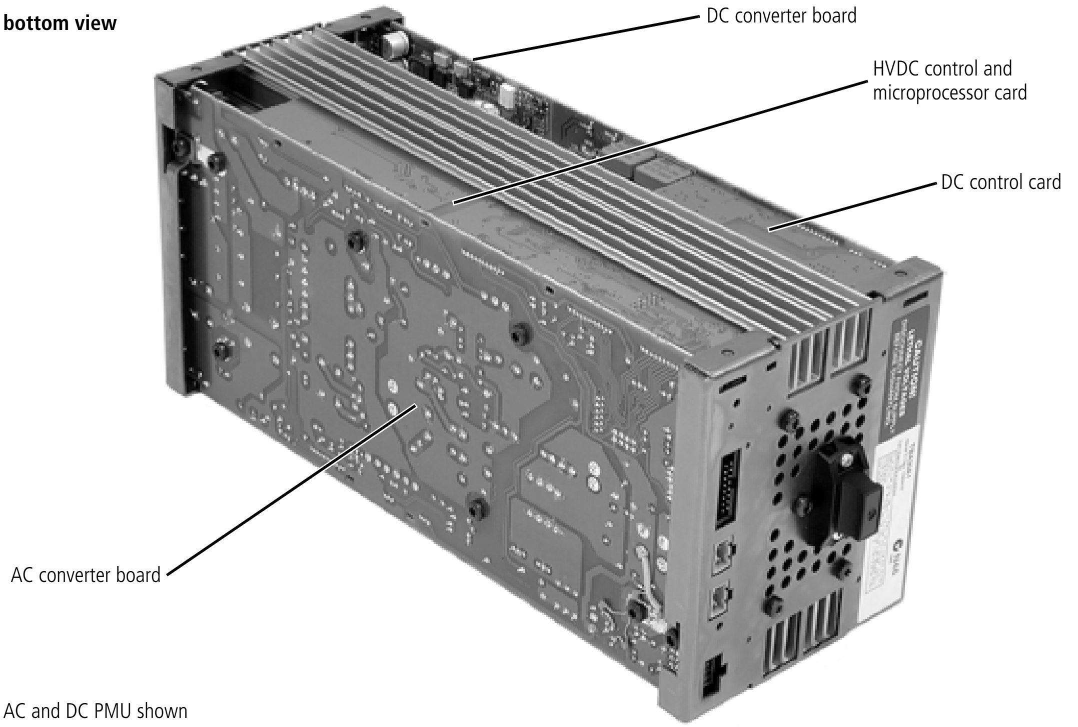
13.2.1 Colour Coding of Circuit Boards and Cards

The DC converter board and standby power supply card are colour-coded according to their nominal input voltage. The auxiliary power supply board is also colour-coded according to its nominal output voltage. The colours used are as follows:

- 12VDC – green
- 24VDC – yellow
- 48VDC – red.

Figure 13.1 Identifying the boards and cards in the PMU





AC and DC PMU shown

13.3 Test Equipment

The following test equipment is required for carrying out the PMU fault finding procedures:

- PC with the latest version of the TB8100 Service Kit (refer to "Software and Firmware Compatibility" on page 220).

Note The Calibration Kit is also installed when you install the Service Kit. If you need to reprogram any factory parameters into the PMU, you will need to use a dongle with the Calibration Kit.

- Operational and calibrated reciter and PA (refer to "Software and Firmware Compatibility" on page 220).
- TB8100 subrack complete with control panel, front panel, and appropriate interconnecting cables.
- Variable voltage DC power supplies:
  - For testing the 12V and 24V DC converters and AC converter, power supplies capable of providing 0V to 30V at 3A. Testing the DC converter requires one power supply, testing the AC converter requires two.
  - For testing the 48V DC converter, a power supply capable of providing 0V to 60V at 3A.
- Isolation transformer or RCD (residual current device).
- Variable load, 2W dissipation minimum (resistive or electronic preferred).
- Multimeter.

The following items of equipment are also specifically required for testing the AC converter (refer to "AC Module" on page 240 for more details):

- Modified PFC control card (refer to "Modifying the PFC Control Card" on page 246).
- Oscilloscope.
- Two 1A rectifying diodes (Tait IPN 001-00106-10).
- One high power resistor (greater than 1W 220Ω).

13.4 Software and Firmware Compatibility

Service Kit

We recommend that you use the latest version of the Service Kit when carrying out these fault finding procedures. The latest version is available from the Tait Technical Support website (http://support.taitworld.com).

Calibration Kit

You must use the version of the Calibration Kit which is compatible with the version of firmware loaded into the PMU.

1. To find out the firmware version, run the Service Kit and connect to the base station. Select Monitor > Module Details > Power Management. The firmware version is displayed in the **Versions** area.

2. To find out which version of the Calibration Kit to use, refer to the Compatibility Table in the TB8100 Base Station Release Notes. These Release Notes are on the TB8100 Product CD, and the latest version is also available from the Tait Technical Support website.

Firmware

If you are testing a PMU separately from the other modules in the customer's base station, we recommend you consult the customer before changing the PMU's firmware version. The new firmware may not be compatible with the other modules in the customer's base station.

Compatibility with TB8100 Modules Used in Testing

Ensure that any TB8100 modules used to test the functionality of the PMU under repair are loaded with compatible firmware. Details of compatible firmware combinations are provided in the Compatibility Table in the TB8100 Base Station Release Notes.

13.5 Board Replacement

Replacing Faulty Boards

At certain stages during the fault finding procedure, you will be instructed to replace a particular circuit board. In these cases, go to the appropriate section in "Power Management Unit Card and Board Replacement" on page 259 and carry out the replacement procedures described there. The full procedure will normally involve:

- removing the faulty board
- fitting a new board
- carrying out the specified reprogramming and recalibration tasks using the Calibration Kit
- carrying out the procedures described in "Final Tasks" on page 247.

Refer to "Power Management Unit Spare Parts" on page 267 for a full description of the spares available for the PMU.

Disposing of Faulty Boards and Modules

We recommend that you dispose of faulty boards and modules according to your local environmental and safety regulations. Otherwise, return them to your nearest CSO for appropriate disposal.

13.6 Initial Checks

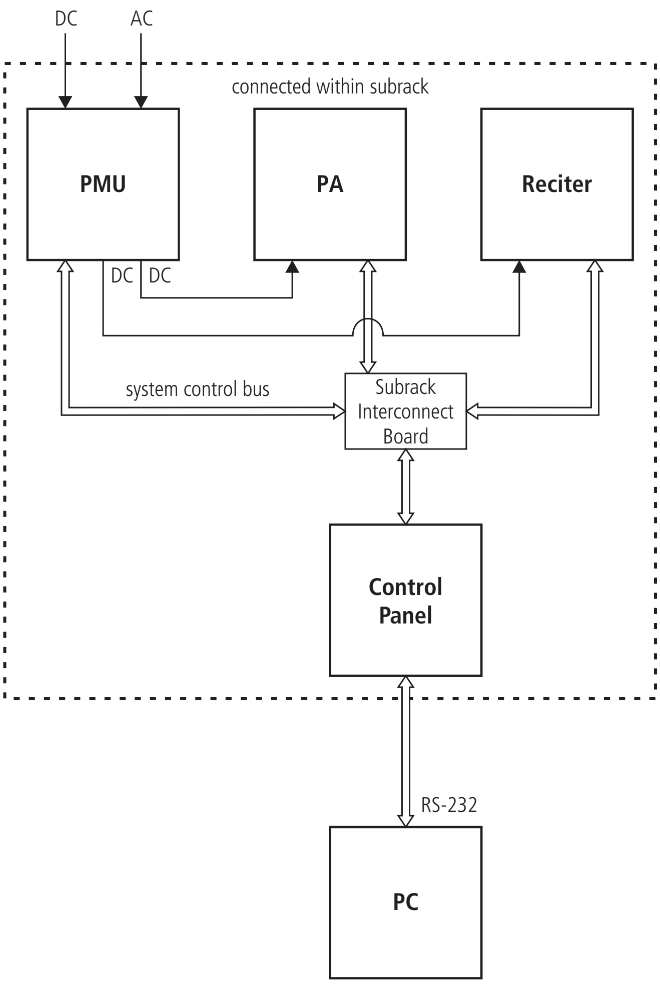
You can use the TB8100 Service Kit to check the basic operation of the PMU without removing the covers.

- To check whether the PMU powers up correctly, produces the correct output power, or generates any alarms, carry out Task 1 to Task 4.
- To carry out additional checks using the Service Kit, go to Task 5.

Note If you are testing an AC and DC PMU, carry out these checks for both supplies.

In this section voltages are given first for a 12V PMU, followed by voltages in brackets for a 24V PMU ( ) and a 48V PMU [ ].

Figure 13.2 Recommended test equipment set-up for initial and DC checks



Task 1 — Check Power-up and Output Voltages

1. Before starting any of these fault finding procedures, you must identify the model and hardware configuration of the PMU under test. "Identifying the PMU" on page 217 explains how to identify a PMU from the product code printed on a label on the rear panel.

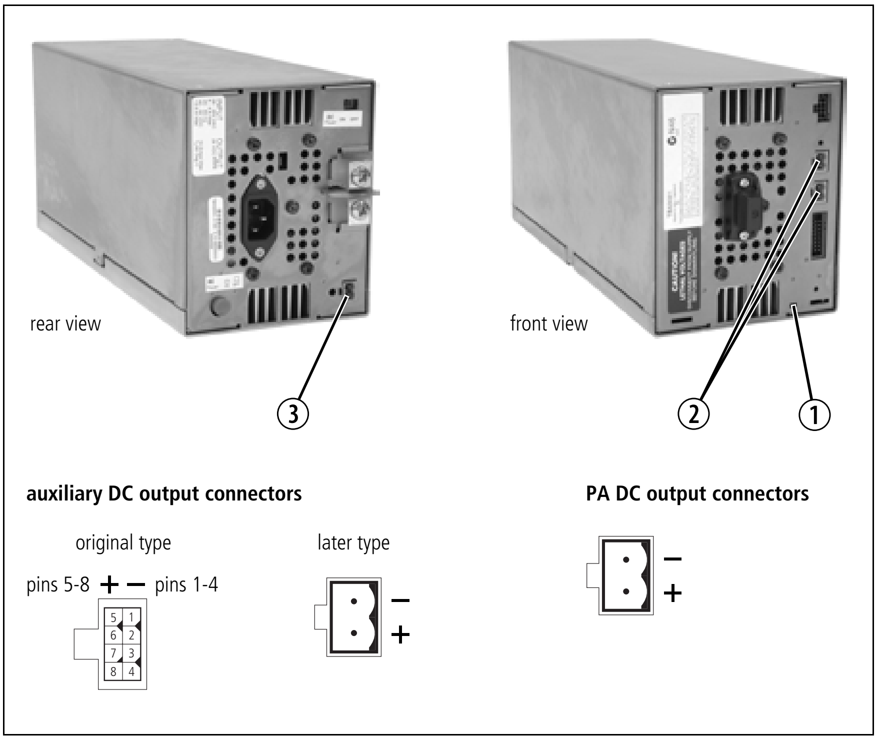
2. Set up the test equipment as shown in Figure 13.2 on page 222. Do not fit the front panel to the subrack.

3. Connect the PMU to the appropriate AC or DC power supply. Switch the PMU on. The recommended DC input voltage for this initial power-up is 16VDC (32VDC) [64VDC].

Note These voltages are above the upper limit of the user-programmable startup voltage (refer to Table 13.4 on page 239). This should ensure that the PMU powers up, even if the startup voltage limit has been set to the maximum value.

4. Check whether the LEDs ① on the front panel are flashing (refer to Figure 13.3). If they are, go to Task 2. If they are not, go to Step 5.

Figure 13.3 Location of indicator LEDs and DC output connectors



5. Check the output voltage at either PA connector ② on the front panel. If the PMU is fitted with an auxiliary power supply board, also check the output voltage at the connector ③ on the rear panel. The voltages should be as listed in Table 13.1.

   If the output voltages are correct, go to Task 3. If the PA output voltage is wrong or not present, go to Step 6. If the auxiliary output voltage is wrong or not present, go to "Auxiliary Power Supply Board" on page 229.

Table 13.1 Output voltages

Output Voltage	Limits
PA	28.0VDC ±0.2V
12V auxiliary 24V auxiliary 48V auxiliary	13.8VDC ±2% 27.6VDC ±2% 54.6VDC ±2%

6. If the output voltages are incorrect, recalibrate the PMU as described in the Calibration Kit documentation and repeat this task. If the output voltages are now correct, go to Task 3. If the output voltages are still incorrect, go to "DC Module" on page 230 or "AC Module" on page 240, depending on which module is faulty. If the PA output voltage is correct, and the auxiliary output voltage is incorrect, go to "Auxiliary Power Supply Board" on page 229.

Task 2 — Check 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 13.2.

Table 13.2 PMU indicator LED states

Green	Red	PMU condition	Procedure
off	off	power off (input above or below safe operating range)	■ check PMU is turned on ■ check power supply/power connectors
flashing (3 Hz)	off	no application firmware loaded	use the Service Kit to download the firmware, then recalibrate the PMU
on	off	the microprocessor is operating; no alarm detected	—
on	flashing (3 Hz)	one or more alarm conditions detected: ■ 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	go to Task 3
flashing (on 300 ms, off 2700 ms)	flashing (on 300 ms, off 2700 ms)	PMU is in battery protection mode	go to "DC Module" on page 230
flashing (on 300 ms, off 4700 ms)	flashing (on 300 ms, off 4700 ms)	PMU is in Deep Sleep mode	go to "DC Module" on page 230
flashing (3 Hz)	flashing (3 Hz)	Service Kit LED test - LEDs flash alternately	—

Task 3 — Check Configuration and Alarms

1. If you are testing a DC module, reset the DC supply to 13.8VDC (27.6VDC) [55.2VDC].
2. Fit the front panel to the subrack.
3. Run the Service Kit and connect to the base station.
4. Once connected to the base station, ensure it is in Standby Mode.
5. Read the base station to load the PMU's configuration information into the Service Kit.
6. Select Monitor > Module Details > Power Management and check that the module details are correct.
7. Select Monitor > Monitoring > Power Management and check that the power management details are correct.
8. Select Configure > Base Station > Miscellaneous and check that the details in the **Power configuration** area are correct.
9. Select Configure > Alarms > Thresholds and check that the limits entered in the **PMU battery voltage** fields are correct.
10. Select Alarms > Current Alarm Status and check for alarms. If there are alarms, go to Task 4. If there are no alarms, go to "DC Module" on page 230, or "AC Module" on page 240 if you are testing an AC PMU.

Task 4 — Check Reported Alarms

Any alarms generated by the PMU under test will appear in the Alarms > Current Alarm Status screen in the Service Kit. The most likely alarms are described in more detail below.

For an explanation of how the operation of the PMU is controlled by fixed hardware limits and user-programmable software limits, refer to "PMU Operation on DC Input" on page 237.

No PMU Detected

1. Check the input voltage is present and correct.
2. If no other alarms are present, check that the system control bus is undamaged and correctly connected.
3. Check the subrack interconnect board for damage.
4. If alarm still present, replace the HVDC control and microprocessor card and retest. If the alarm is still present, replace the AC module, check the DC power ground to the reciter, then retest.
5. If the alarm is still present, return the PMU to your nearest CSO.

Fan Failure

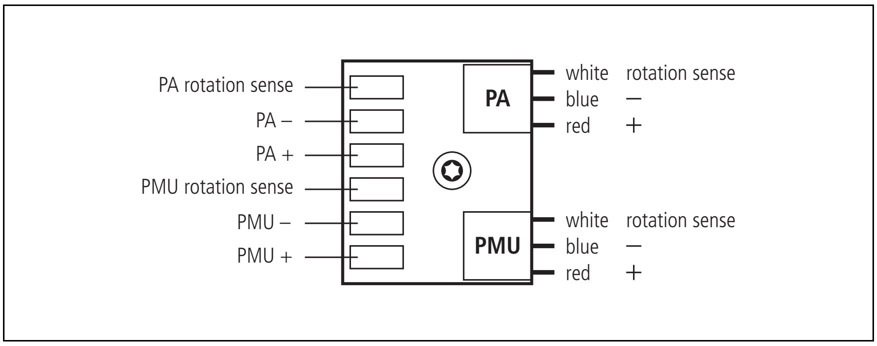
1. Fit the front panel to the subrack (if not already fitted). Run the fan test and check that the fan works (see Task 5). If it does not, go to Step 2. If it does, the control panel may be faulty. Fit another control panel and repeat the test.

2. Check that all cables are connected securely and correctly.

3. Check that the fan itself is in working order. Figure 13.4 identifies the connections on the fan contact board on the front panel.

   If it is not working, replace the fan and repeat the test. If it is working, replace the HVDC control and microprocessor card and repeat the test. If the fan still does not run, replace the AC module.

Figure 13.4 Connections on the fan contact board



Shutdown Imminent

This alarm is generated when the battery voltage falls below the shutdown voltage limit. The PMU will stay in this state for 30 seconds before shutting down, unless the battery voltage rises above the shutdown limit before the 30 second limit is reached (refer to "PMU Operation on DC Input" on page 237 for more information).

If this alarm is generated during testing, make sure that the DC power supply is not current limiting, causing the voltage to drop.

Mains Supply Failed

1. Check that the mains input is present and the voltage is correct. If it is, and the alarm is still present, replace the PFC control card and return to Task 1.

2. If the fault is still present after retesting, replace the AC module.

Battery Voltage High / Battery Voltage Low / Battery Protection Mode

1. Check that all the module details are correct, as described in Task 3.
2. Check that the voltage at the DC input terminals is correct.
3. If the alarm is still present, replace the battery control card and return to Task 1.
4. If the fault is still present after retesting, replace the DC module.

Temperature High / Output Voltage High / Output Current High

1. Replace the HVDC control and microprocessor card and return to Task 1.
2. If the fault is still present after retesting, select Monitor > Module Details > Power Management to determine which module is faulty and replace that module.

Output Voltage Low

1. Check that the PA is powered up, and is being detected by the Service Kit (Monitor > Alarms > Current Alarm Status). If it is, replace the HVDC control and microprocessor card and return to Task 1. If it is not, go to Step 2.
2. Check the **Output Current High** alarm. If it is on, disconnect the PA from the PMU. If the alarm is sill present, go to Step 4. If it is not, go to Step 3.
3. Check the **Battery Protection Mode** alarm. If it is on, refer to action for that alarm above. If it is not, go to Step 4.
4. Select Monitor > Module Details > Power Management to determine which module is faulty and replace that module.

Task 5 — Additional Service Kit Tests

You can also use the Service Kit to perform some additional tests on the PMU. The Control Tests form (Diagnose > Power Management > Control Tests) allows you to carry out the following checks:

- Simulating mains failure.
- Testing the fan.
- Testing the PMU fault (red) LED.
- Testing the auxiliary power output.

The Supply Tests form (Diagnose > Power Management > Supply Tests) provides the following additional information about the PMU:

- Heatsink temperatures for AC and DC modules.
- Battery voltage.
- Output voltage and current.

Refer to the Service Kit documentation for more details.

13.7 Auxiliary Power Supply Board

The optional auxiliary power supply board is a DC–DC converter which takes the 28 VDC output from the DC or AC converter board and converts it to the required 12/24/48 VDC (nominal; depending on the model of board). This board is disabled by default, and only operates when it is switched on by the microprocessor.

1. Set up the test equipment as shown in Figure 13.2 on page 222.
2. Run the Service Kit and select Diagnose > Power Management > Control Tests. Follow the instructions in the online Help to toggle the supply on/off.
3. If necessary, measure the voltage from the auxiliary DC output connector (as shown in Figure 13.8 on page 235) and check that it is as listed in Table 13.3. The toggle function turns the supply on for a few seconds, but this is long enough to give an output which can be measured.

Table 13.3 Auxiliary power supply output voltages

Model	Float Voltage (no load)
12 V	13.65 VDC ±2%
24 V	27.3 VDC ±2%
48 V	54.6 VDC ±2%

4. If the Service Kit test fails, or if the output voltage is wrong or not present, replace the auxiliary power supply board.

13.8 DC Module

Important When removing plug-in cards, we **strongly recommend** that you use the TB8100 card remover[1], as shown in Figure 15.1 on page 263. A flat-blade screwdriver may reach too far through the slot and damage the components or tracks on the card.

For an explanation of how the operation of the PMU is controlled by fixed hardware limits and user-programmable software limits, refer to "PMU Operation on DC Input" on page 237.

13.8.1 DC Converter without Microprocessor Control

These checks will verify the correct operation of the:

- DC converter without microprocessor control
- battery control card
- DC control card.

When testing the DC converter, you will need a variable voltage DC power supply which can provide the correct input voltage for the DC converter under test. The current capability of this power supply will decide how much load you can connect to the converter. Testing at light loads will be enough to verify if the various modules are working. A variable power supply with a 3A capability would be sufficient.

In this section voltages are given first for a 12V PMU, followed by voltages in brackets for a 24V PMU ( ) and a 48V PMU [ ].

Task 1 — Check DC Converter Power Stage

1. Remove the covers and end panels, then disconnect the DC module from the AC module, as described in "Power Management Unit Disassembly and Reassembly" on page 249.

2. Check the DC module boards and cards for any visible signs of damage.

3. Ensure that the DC control card and battery control card are plugged into the DC converter board, as shown in Figure 13.5 on page 231.

4. Connect the correct DC supply to the input of the DC converter and switch the converter on.

Note The supply voltage must be higher than 12.2VDC (24.5VDC) [49VDC] for the DC converter to start.

1. The card remover is included in the TBA0ST2 tool kit, which is available from your nearest Tait Dealer or Customer Service Organisation. It is also available separately as part number 220-02034-01.

5. Measure the voltage at the DC output connector ① shown in Figure 13.5. The voltage should be 28.7VDC±10%.

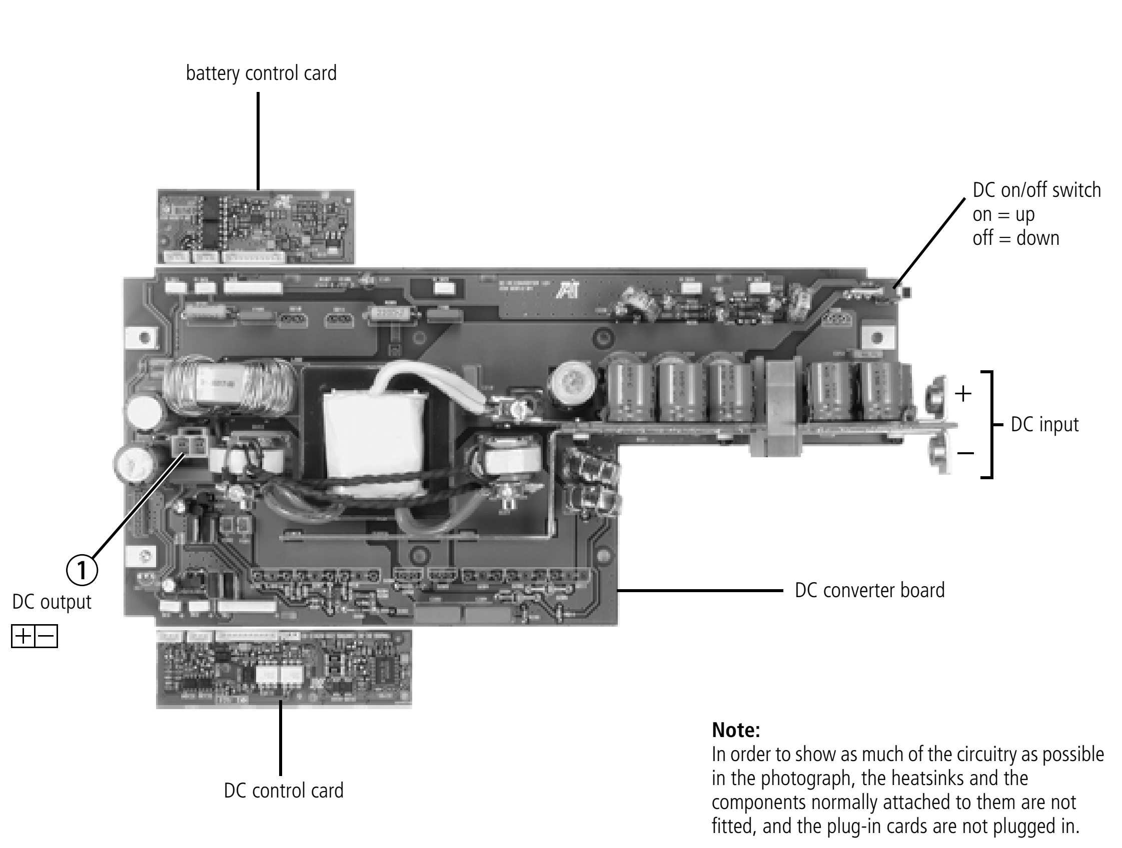
Note The voltage measured may be different from the stated value because it is not under control of the microprocessor, or because of component tolerances.

If the voltage measured is within tolerance, go to Step 6. If the voltage is too low or too high, replace the DC control card and repeat this task. If there is no voltage present, replace both the DC control card and battery control card and repeat this task. If the voltage is still incorrect after replacing the cards, go to Task 4.

6. Connect a load to the DC output connector. This will test the regulation to see if the output remains constant under load. If the output voltage remains steady, go to Task 2. If it does not, replace the DC control card and repeat this step. If the voltage does not remain steady after replacing the card, go to Task 4.

Note The DC input supply must be rated for the load you connect to the output of the DC converter, otherwise the input supply will current limit.

Figure 13.5 Checking the DC converter without microprocessor control



Task 2 — Check Battery Control Card

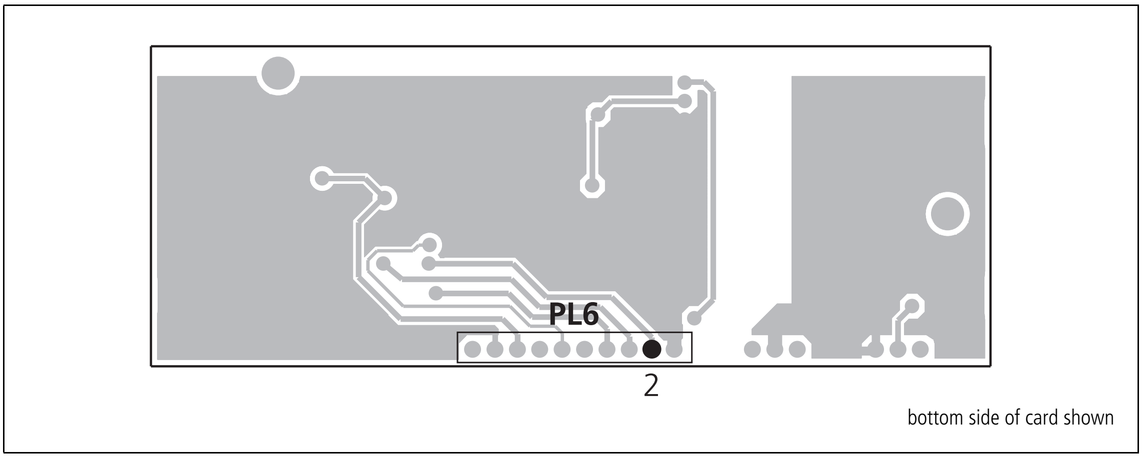
The battery control card monitors the battery voltage and sends the voltage digitally to the microprocessor. When the DC converter is running without a microprocessor, as shown in Figure 13.5, the digital information will have no effect on the operation of the converter. The only analogue circuitry that will be active is the window comparator on the battery control card. This protects the converter from operating on the wrong input voltage.

1. With the DC converter set up as shown in Figure 13.5 and running, decrease the input voltage to the converter and measure the output voltage at the DC output connector.

Note It is a good idea to have some load on the output to indicate quickly when the DC converter stops running, otherwise the output capacitors will slowly decay to zero, and the trip point cannot be determined.

2. Check the behaviour of the DC converter and compare it with the "Hardware Behaviour" described in the graph in Figure 13.9 on page 238. The voltage limits which apply to this graph are given in Table 13.4 on page 239. If the behaviour of the converter matches the graph, go to Task 3. If it does not, go to Step 3.
3. Check that the input voltage is greater than 12VDC (24VDC) [48VDC], but less then 17VDC (34VDC) [68VDC].
4. Check that the DC on/off switch on the rear panel is on (refer to Figure 13.5). The switch is off when down (closest to the PCB).
5. Check that the battery control card output voltage is the same as the voltage provided at the input terminals of the DC converter. Measure this voltage on pin 2 of PL6 (VAUX line), as shown in Figure 13.6. If the voltage is correct, go to Task 3. If there is no voltage present on pin 2 of PL6, replace the battery control card and repeat this task. If the voltage is still incorrect after replacing the card, go to Task 4.

Figure 13.6 Location of test point on the battery control card



Task 3 — Check DC Control Card

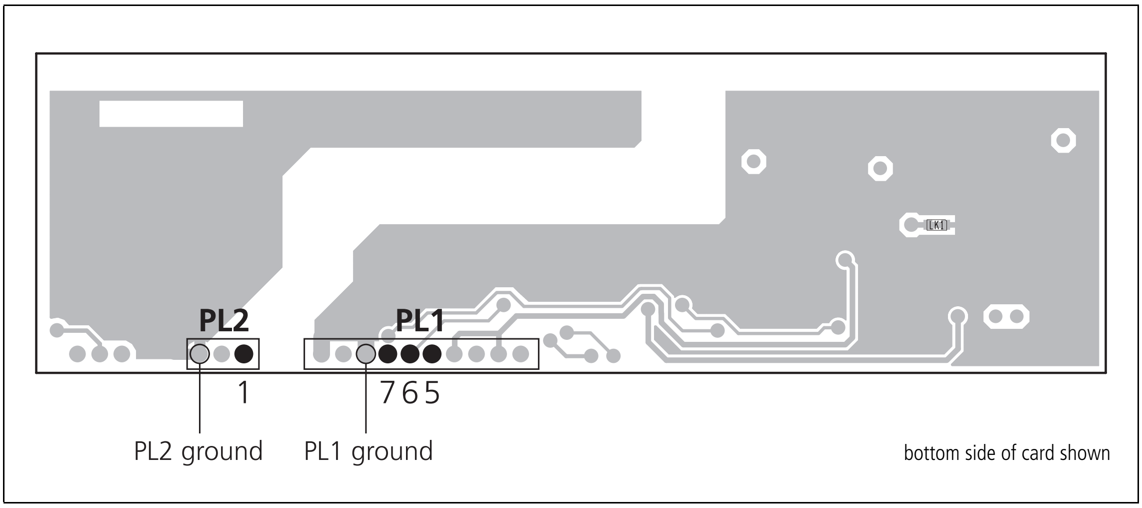
1. Check that VAUX is present on pin 6 of PL1 (VAUX line), as shown in Figure 13.7. If it is, go to Step 2. If it is not, go to Task 4.

2. Check that the DC-Stop line is low on pin 1 of PL2. If it is, go to Step 3. If it is not, check for short circuits around PL2. Carry out any necessary repairs and repeat this step. If the fault is still present, go to Task 4.

3. Check for a PWM signal on pin 5 and pin 7 of PL1. If it is present, go to "DC Converter with Microprocessor Control" on page 234. If it is not, replace the DC control card and repeat this step. If the fault is still present, go to Task 4.

Note There are different grounds (signal return paths) associated with each connector. You must use the correct ground to make meaningful measurements.

Figure 13.7 Location of test points on the DC control card



Task 4 — Check Plug-in Cards with Another DC Converter

If the DC converter still fails to produce an output after testing the control cards as described above, the DC converter board may be faulty.

1. Remove the plug-in cards from the DC converter under test and fit them to another DC converter which is known to work.

2. If this second DC converter works correctly, the DC converter under test is faulty.

3. Fit a new DC module to the PMU under test, reassemble the PMU, and go to "Final Tasks" on page 247.

13.8.2 DC Converter with Microprocessor Control

These checks will verify the correct operation of the:

- DC converter with microprocessor control
- HVDC control and microprocessor card
- standby power supply card.

These procedures check the operation of the DC converter when it is under control of the microprocessor on the HVDC control and microprocessor card which is plugged into the AC converter board. It is assumed that the tests described in Section 13.8.1 have been carried out successfully.

Note The AC converter board fitted to a DC PMU is a sub-populated version of the complete board which is fitted to the AC PMU and AC and DC PMU. Both types of board work in exactly the same way for the purpose of testing the DC converter.

Note Do not connect the standby power supply card at this stage.

In this section voltages are given first for a 12 V PMU, followed by voltages in brackets for a 24 V PMU ( ) and a 48 V PMU [ ].

Task 1 — Check DC Converter Board, and HVDC Control and Microprocessor Card

1. Connect the DC module to the AC module as shown in Figure 13.8.

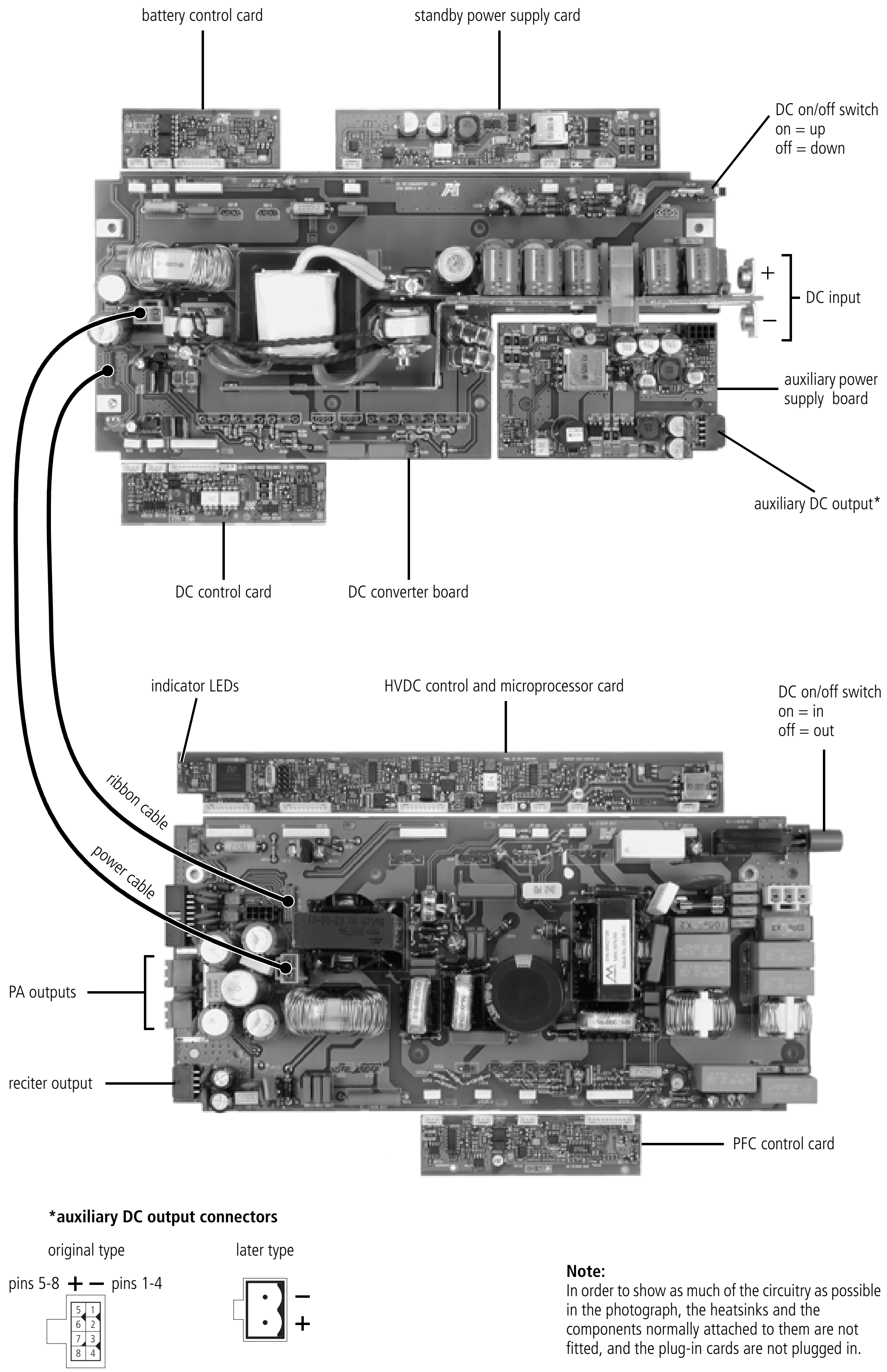
2. Ensure that the DC control card and battery control card are plugged into the DC converter board, and the PFC control card and HVDC control and microprocessor card are plugged into the AC converter board, as shown in Figure 13.8.

3. Connect the correct DC supply to the input of the DC converter and measure the voltage at either PA output connector. The output voltage should be 28 VDC. If it is, go to Task 2. If it is approximately 26.5 VDC, go to Step 4. If it is higher than 28 VDC, go to Step 5.

4. The HVDC control and microprocessor card is probably faulty (because the microprocessor adjusts the output voltage to 28 VDC). Replace the card and recheck the voltage. If it is correct, go to Task 2. If it is not, go to Step 5.

5. Check that the ribbon cable is undamaged, and is connected securely with the correct orientation. There is a hole in the PCB beside pin 1 of the connector. If the ribbon cable is not faulty, go to Task 3.

Figure 13.8 Checking the DC converter with microprocessor control



Note:
In order to show as much of the circuitry as possible in the photograph, the heatsinks and the components normally attached to them are not fitted, and the plug-in cards are not plugged in.

Task 2 — Check Standby Power Supply Card (if fitted)

Once you have established that the DC converter is working correctly (the PA output is 28 VDC and the LEDs are indicating normal operation), you can plug in and test the standby power supply card.

Note The exact voltage levels at which the PMU starts and shuts down (as the input voltage changes) will depend on how the PMU has been configured using the Service Kit (Configure > Base Station > Miscellaneous > Power configuration). Refer to the Service Kit documentation for more details.

1. Set up the PMU as described in Task 1.
2. Plug the standby power supply card into the DC converter board, as shown in Figure 13.8.
3. Connect the correct DC supply to the input of the DC converter. The standby supply now powers the microprocessor, and switches off the DC converter until the microprocessor switches it on again.
4. Measure the voltage at either PA output connector. The output voltage should be 28 VDC. If it is, go to Step 6. If it is not, go to Step 5.
5. Check that the DC converter is not in battery protection mode (red and green LEDs flashing slowly). If this is the case, increase the DC input voltage until it is in the normal operating voltage range.
6. Check that the reciter output is approximately 28.6 VDC. If it is, go to Step 7. If it is not, return to Task 1.
7. Reduce the DC input voltage to approximately 10.5 VDC (21 VDC) [42 VDC] and wait for 30 seconds. Both the reciter and PA outputs should now be disabled, and both indicator LEDs should flash slowly. The DC converter is now in battery protection mode. If it is, go to Task 8. If it is not, replace the standby power supply card and repeat this task. If the fault is still present, go to Task 3.
8. Increase the input voltage to 13 VDC (26 VDC) [52 VDC], and check that the reciter and PA output voltages return to normal. If they do not, go to Task 3. If they do, go to “AC Module” on page 240. If the PMU is not fitted with an AC module, go to “Final Tasks” on page 247.

Task 3 — Check Plug-in Cards with Another DC Converter

If the DC converter still fails to produce an output after testing the cards as described above, the DC converter board may be faulty.

1. Remove the plug-in cards from the DC converter under test and fit them to another DC converter which is known to work.
2. If this second DC converter works correctly, the DC converter under test is faulty.
3. Fit a new DC module to the PMU under test, reassemble the PMU, and go to "Final Tasks" on page 247.

13.8.3 PMU Operation on DC Input

This section is a copy of the section that is published in the TB8100 Installation and Operation Manual. It is reproduced in this manual for your convenience.

Introduction

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 13.4 on page 239. Figure 13.9 on page 238 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.

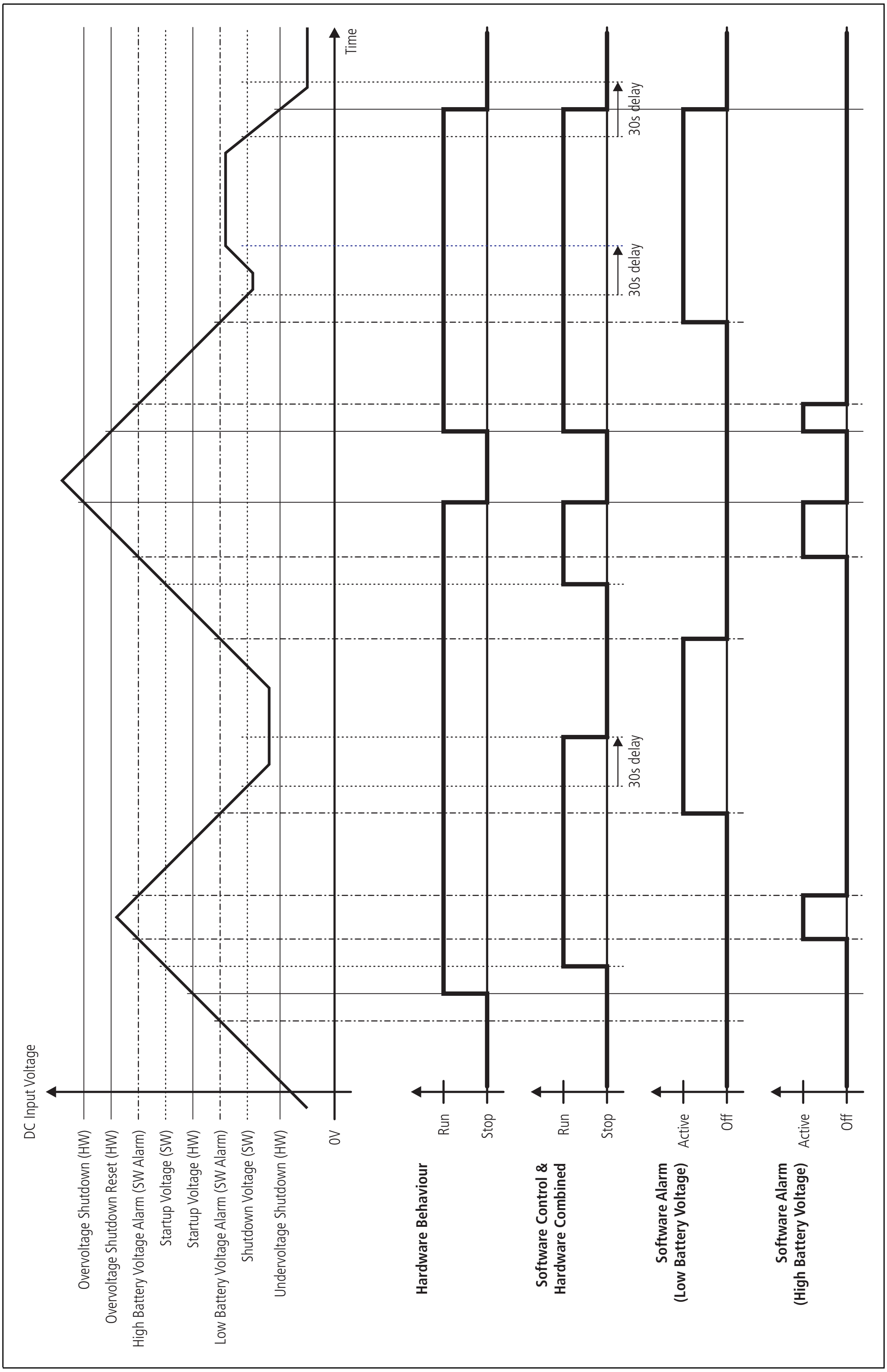
To set the alarms, run the Service Kit and select Configure > Alarms > Thresholds. In the Thresholds form, enter the required minimum and maximum values in the **PMU battery voltage** fields.

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 shutdown.

To set the startup and shutdown limits, run the Service Kit and select Configure > Base Station > Miscellaneous. In the Power Configuration area, enter the required values in the **Power shutdown voltage** and **Power startup voltage** fields.

Figure 13.9 PMU alarm thresholds and voltage limits when operating on DC



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 13.4 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 15.0V	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	12V ±0.2V	24V ±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 TB8100 Specifications Manual. Refer to the latest issue of this manual (MBA-00001-xx) for the most up-to-date and complete PMU specifications.

b. Using the Service Kit.

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

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 13.2 on page 225.

13.9 AC Module

Important When removing plug-in cards, we **strongly recommend** that you use the TB8100 card remover[1], as shown in Figure 15.1 on page 263. A flat-blade screwdriver may reach too far through the slot and damage the components or tracks on the card.

These checks will verify the correct operation of the AC converter. The test procedures require you to power-up the AC converter on approximately 30VDC. Running the AC converter on DC is made possible by carrying out the following modifications to its standard set-up:

- Replacing the standard PFC control card with a spare card which has been modified as described in "Modifying the PFC Control Card" on page 246.
- Connecting two variable voltage DC power supplies as shown in Figure 13.11 on page 243. Note that the control power supply is connected via back-power protection diodes and a high power resistor.

The variable voltage DC power supplies must be able to provide the correct input voltages for the AC converter under test. The current capability of these power supplies will decide how much load you can connect to the converter. Testing at light loads will be enough to verify if the converter is working. Variable power supplies with a 3A capability would be sufficient.

Caution **Even though the AC converter is running on a low DC voltage, there is still 400VDC present on the board.**

If you have been directed to this section from "Initial Checks" and the PMU is still fully assembled, go to Task 1. This allows you to check the operation of the 400VDC bus without disassembling the entire PMU (you only need to remove the top cover). If you have already checked the DC converter and the PMU is disassembled, go to Task 2.

Warning!! **The AC power on/off switch does not isolate the PMU from the mains. It breaks only the phase circuit, not the neutral.**

1. The card remover is included in the TBA0ST2 tool kit, which is available from your nearest Tait Dealer or Customer Service Organisation. It is also available separately as part number 220-02034-01.

Task 1 — Check 400 VDC Bus

1. Remove the top cover, as described in "Power Management Unit Disassembly and Reassembly" on page 249.

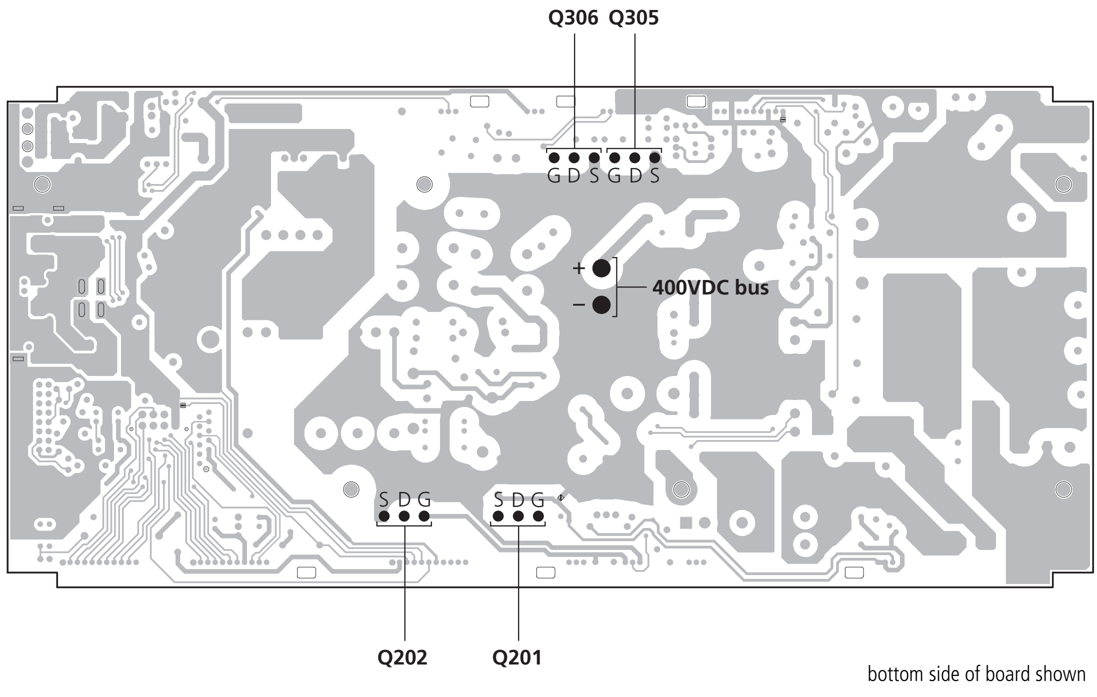
2. Connect the correct AC voltage to the input of the PMU and switch the PMU on.

3. Measure the voltage at the test points on the bottom of the AC converter board, as shown in Figure 13.10. Also measure the voltage at either PA output on the front panel.

   If the test point voltage is 400 VDC, but there is no PA output voltage, replace the HVDC control and microprocessor card and repeat this task. If the test point voltage is not present, replace the PFC control card and repeat this task.

   If, after replacing one or both cards, the test point voltage is 400 VDC and the PA output voltage is 28.5 VDC ±0.2 V, go to "Final Tasks" on page 247. If the voltages are still incorrect or not present, replace the AC module and go to "Final Tasks" on page 247.

Figure 13.10 Location of test points on the AC converter board



Task 2 — Check Resistance of PFC and HVDC FETs

1. If you have not already done so, remove the covers and end panels, then disconnect the AC module from the DC module, as described in "Power Management Unit Disassembly and Reassembly" on page 249.

2. Check the AC module board and cards for any visible signs of damage.

Important Make sure the AC module is disconnected from any power source before testing the FETs. Wait for five minutes for the internal voltages to self-discharge before testing.

3. Check that the in-circuit gate-to-source resistance of the FETs is as follows (refer to Figure 13.10):
   - HVDC FETs (Q201, Q202): approximately 4k6Ω
   - PFC FETs (Q305, Q306): approximately 3M3Ω.

   If the resistance is correct, go to Step 4. If it is not, replace the AC module and go to "Final Tasks" on page 247.

4. Check that the drain-to-source resistance of the HVDC FETs is approximately 300kΩ.

   If the resistance is correct, go to Task 3. If it is not, replace the AC module and go to "Final Tasks" on page 247.

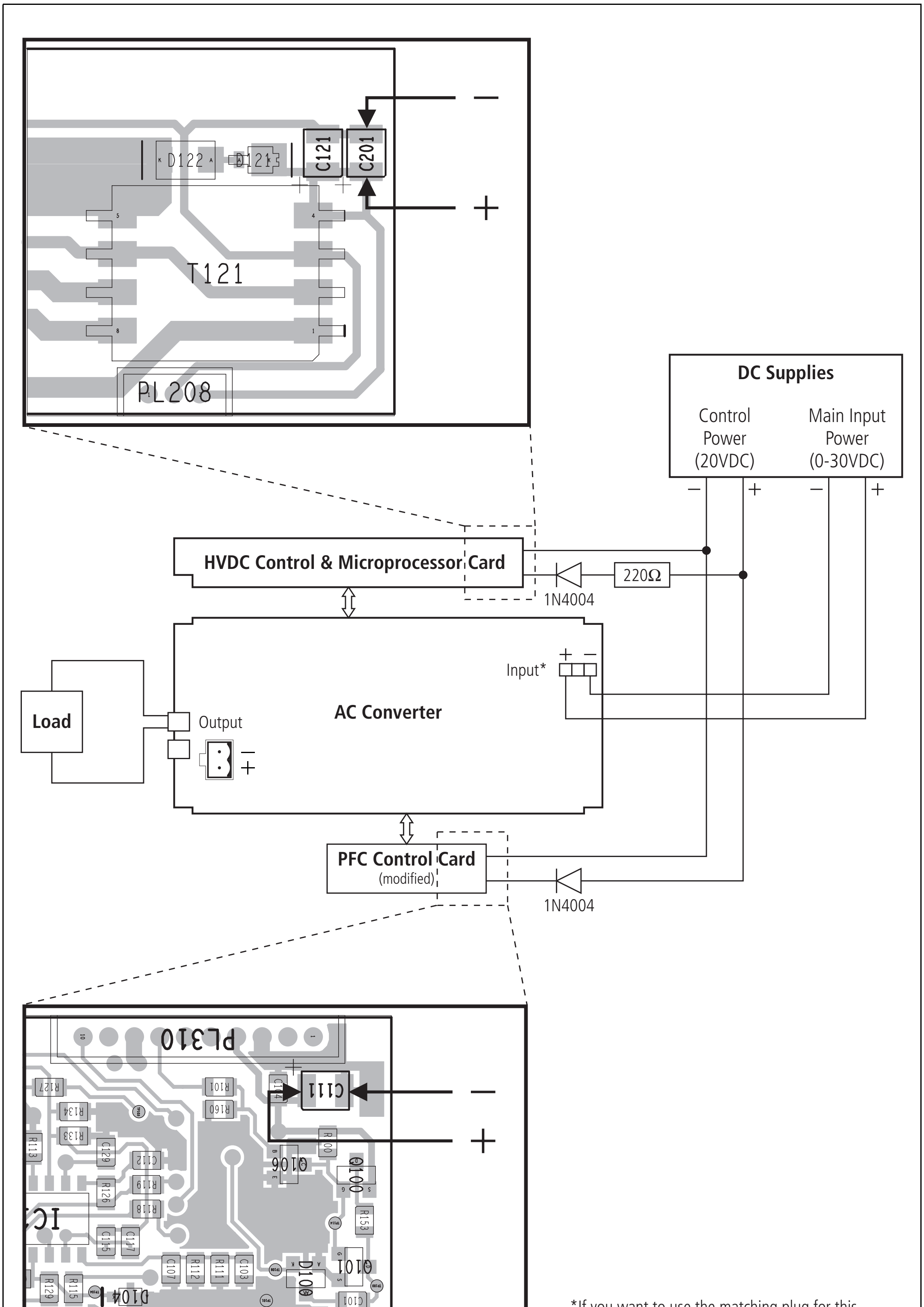
Task 3 — Check Operation of Soft-Start Relay

1. Remove the standard PFC control card and fit the modified card in its place (refer to "Modifying the PFC Control Card" on page 246).

2. Set up the test equipment as shown in Figure 13.11. Set the DC power supplies to 0V (or off), and make sure the load (if used) is disconnected.

3. Slowly increase the control input voltage. You should hear the relay click at approximately 8VDC. PFC gate drive starts at 16.5VDC to 17VDC. If the relay clicks, set the control input voltage to 15VDC and go to Task 4. If it does not, replace the AC module and go to "Final Tasks" on page 247.

Figure 13.11 AC converter test equipment set-up



*If you want to use the matching plug for this connector, the details are as follows:

plug: IPN 240-00022-07 (JST VLP-03V)
crimp socket: IPN 240-00022-00 (JST SVF-61T-P2.0)

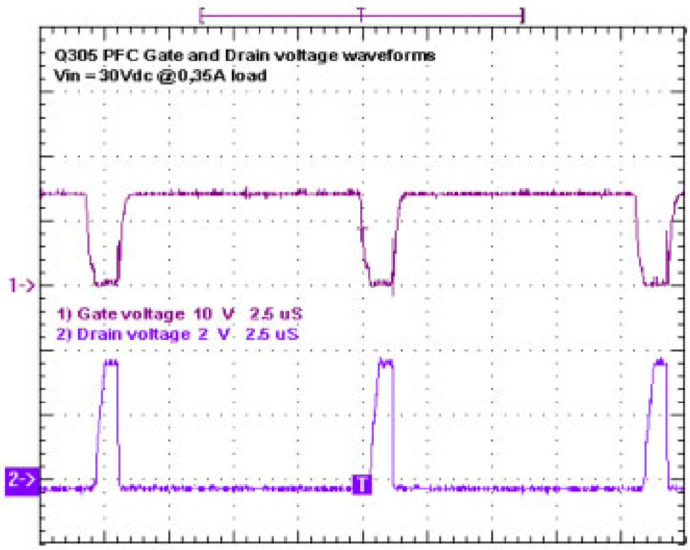
Task 4 — Check Gate Signals of PFC and HVDC FETs

1. Check the gate signals (gate-to-source) of all four FETs (Q201, Q202, Q305, Q306) **individually**. If the signals match the wave forms shown in Figure 13.12, go to Step 2. If they do not, replace the AC module and go to "Final Tasks" on page 247.

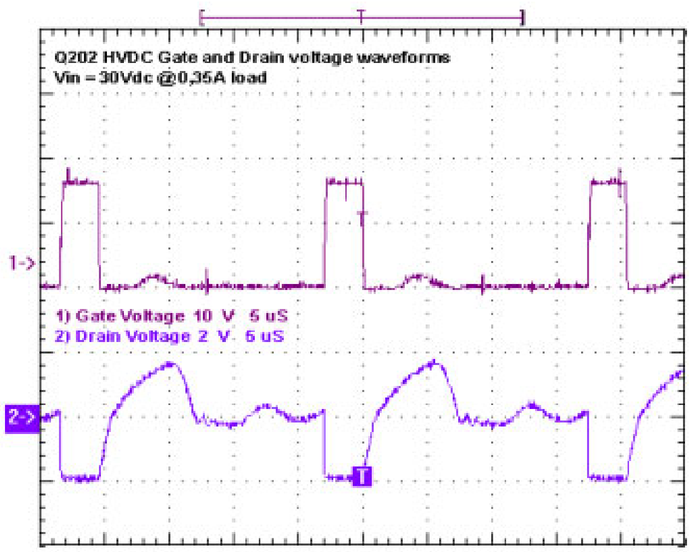
Important Ensure the oscilloscope is floating before earthing the oscilloscope at the source of Q201. **Do not** test the gate-to-source signal of both Q201 and Q202 **simultaneously**. If the oscilloscope is not floating, **do not** test the gate-to-source signal of Q201.

Figure 13.12 Typical gate-source and drain-source waveforms for FETs

Q305 and Q306



Q201 and Q202



2. Set the current limit on the main input power supply to 2.5 A.

3. Slowly increase the main input power supply voltage, taking note of the input current, the output voltage and the gate signal of the PFC FETs (Q305, Q306).

   The input current should increase in proportion to the input voltage until approximately 1 A, where it will drop as the boost converter starts. The output voltage should regulate when the input voltage reaches approximately 11 VDC. If the input current does drop, go to Step 4. If it does not drop before the input voltage reaches 15 VDC, replace the PFC control card and repeat this task. If the fault is still present, replace the AC module and go to "Final Tasks" on page 247.

4. Measure the 400 VDC bus at the test points on the bottom of the AC converter board, as shown in Figure 13.10 on page 241. The voltage should be greater than 300 VDC. If it is, go to Step 5. If it is not, replace the PFC control card and repeat this task. If the fault is still present, replace the AC module and go to "Final Tasks" on page 247.

5. Check the gate signal of the PFC FETs (Q305, Q306). The pulse width should change with input voltage. If it does, go to Task 5. If it does not, replace the PFC control card and repeat this task.

Task 5 — Check Regulation and Efficiency

1. Increase the current limit of the main input power supply to approximately 5–10 W at 28 VDC.

Note The current limit should be relative to the load you are using. Remember also that the converter will be only approximately 34% efficient at this low voltage (having been designed to operate on a minimum of 88 VAC).

2. Connect a load to the PA output. Check that the output voltage does not lose regulation. If it does lose regulation, go to Step 3. If it does not lose regulation, go to Step 4.

3. Measure the 400 VDC bus at the test points on the bottom of the AC converter board. The voltage should be greater than 300 VDC. If it is, replace the HVDC and microprocessor card and repeat this task. If it is not, replace the PFC control card and repeat this task. If the fault is still present, replace the AC module and go to "Final Tasks" on page 247.

4. Measure the input voltage and current and calculate the input power. Measure the output voltage and current and calculate the output power.

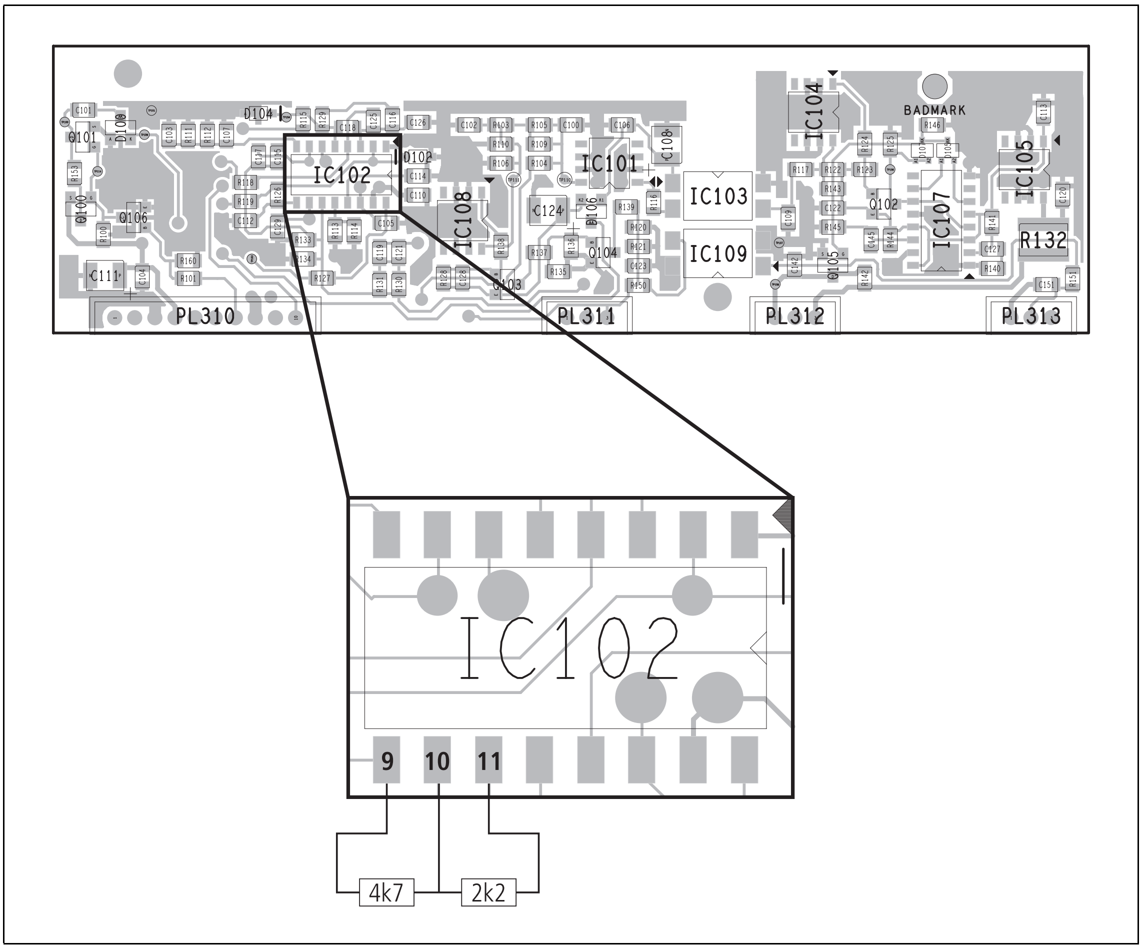
5. Calculate the efficiciency by dividing the input power by the output power. The expected efficiency of the AC converter while operating in test mode is 34% ±10%. If the efficiency is within the limits, go to "Final Tasks" on page 247. If it is outside the limits, replace the AC module and go to "Final Tasks" on page 247.

13.10 Modifying the PFC Control Card

A modified PFC control card is an essential part of the test equipment set-up (shown in Figure 13.11 on page 243) which enables the AC converter to run on DC voltage. The modifications described below will bypass the minimum operating voltage lock-out.

1. Connect a 4k7Ω resistor between pin 9 and pin 10 of IC102.
2. Connect a 2k2Ω resistor between pin 10 and pin 11 of IC102.

Figure 13.13 Modifying the PFC control card for testing the AC converter



13.11 Final Tasks

Once you have completed the testing and repair (if required) of the PMU, carry out the following tasks.

Task 1 — Final Tests

Test the PMU to confirm that it is fully functional again. The recommended tests are listed below:

1. Set up the test equipment as shown in Figure 13.2 on page 222, and apply power. Check that no alarms are generated.
2. Reload the customer's configuration (if required).
3. Check that the output voltages are correct.
4. Run the Service Kit and carry out the control and supply tests (Diagnose > Power Management).

It is good practice to record the test results on a separate test sheet. You can then supply a copy of the test sheet to the customer as confirmation of the repair.

Task 2 — Final Administration

The final administration tasks are the standard workshop procedures for updating the fault database and returning the repaired PMU to the customer with confirmation of the repair.

If the PMU could not be repaired for one of the following reasons:

- fault not located
- repair of fault failed

Level-1 service centres should return the faulty PMU to the nearest Accredited Service Centre, and level-2 service centres should return the PMU to the International Service Centre. Supply details of the customer, the fault and, if applicable, the attempted repair.

14 Power Management Unit Disassembly and Reassembly

This chapter provides information on how to remove and replace the covers and front and rear panels. It also describes how to disconnect and reconnect the AC and DC modules.

14.1 Safety Precautions

14.1.1 Personal Safety

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

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 DC power on/off 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.**

The PMU should be serviced only by qualified technicians. 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.

Caution **The magnetics and power devices attached to the heatsink in the PMU get hot when they are operating. Take care when working on a PMU that has been in recent use.**

Caution **The PMU can weigh up to 6.4kg (14.1lb). Take care when handling the PMU to avoid personal injury.**

14.1.2 Equipment Safety

Important This equipment contains devices which are susceptible to damage from static charges. Refer to "ESD Precautions" on page 17 for more information on antistatic procedures when handling these devices.

Important Insulated gate FET transistors are susceptible to damage from static charges, due to their extremely high input resistance. To avoid possible damage to the device during handling, testing or actual operation, we recommend you follow these procedures: avoid unnecessary handling; when handling the device, pick it up by the cap, not the leads; do not insert or remove the device while the power is on; avoid contact with non-conductive plastic or non-conductive styrofoam.

14.2 Mechanical Overview

The TB8100 PMU is made up of a number of individual boards and cards which comprise two main modules, the AC module and the DC module. The auxiliary power supply board is optional.

The PMU is available in three main hardware configurations:

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

The table below provides an overview of the major mechanical differences between these three configurations.

Part/Assembly	PMU Configuration		
	AC PMU	**DC PMU**	**AC and DC PMU**
AC module	standard module fitted	AC converter board is mounted on special brackets which also cover the holes normally covered by the AC module heatsinks; only the current sense and output filter circuitry is placed on the board	standard module fitted
DC module	not fitted	standard module fitted	standard module fitted
shield	fitted	not fitted	fitted
front and rear panels	fitted with blanking plates to cover the holes normally covered by the DC module heatsinks	fitted	fitted
top and bottom covers	fitted	fitted	fitted

Figure 16.1 on page 269 and Figure 16.2 on page 270 identify the main mechanical parts. Figure 13.1 on page 218 identifies the individual boards and cards, and shows how they are configured in an AC and DC PMU. "Identifying the PMU" on page 217 explains how to identify the model and hardware configuration of a PMU from its product code.

Note For the sake of simplicity and clarity, the instructions and illustrations in this chapter refer to the AC and DC PMU. However, the AC PMU and DC PMU can be disassembled and reassembled using the same basic procedures and techniques.

14.3 Screw Torque Settings

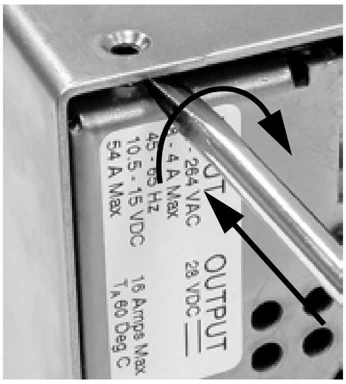
The recommended torque settings for the screws used in the PMU are as follows:

Location / Function	Torque	Driver	Size
■ securing the front and rear panels to the heatsinks ■ securing the AC and DC converter boards to the heatsinks ■ securing the bus bars to the DC converter board	2.0N·m / 18lbf·in	T20	M4
■ securing the top and bottom covers to the front and rear panels ■ securing the handle to the front panel ■ securing the DC input filter card to the bus bars	0.5N·m / 4.5lbf·in	T10	M3
securing the 500W DC transformer primary wires into their terminals	1.8N·m / 16lbf·in	flat blade	

14.4 Removing the Top and Bottom Covers

1. Remove the four M3 Torx screws securing the top cover to the front and rear panels. Lift off the top cover.

Note If the top cover is difficult to move, we suggest you lift one end of the cover away from the end panel with a flat-blade screwdriver. The cover should then be loose enough to lift off.



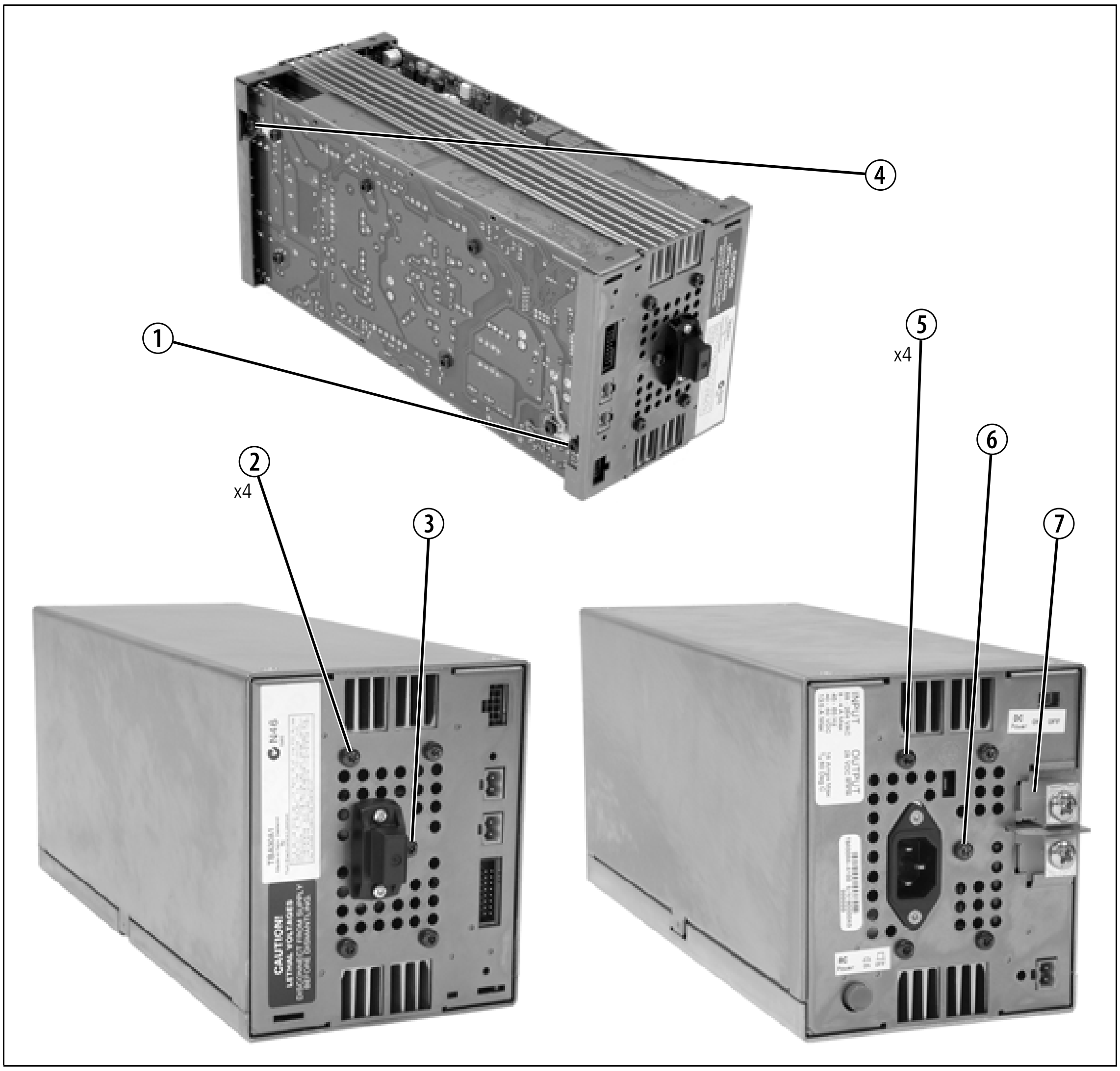
2. Turn the PMU over and remove the four M3 Torx screws securing the bottom cover to the front and rear panels. Lift off the bottom cover.

14.5 Removing the Front and Rear Panels

The circled numbers in the following instructions refer to Figure 14.1.

1. Remove the M4 Torx screw ① grounding the front panel to the AC converter board.
2. Remove the five M4 Torx screws securing the front panel to the heatsinks ② and shield ③. Slide the front panel off the heatsinks.
3. Remove the M4 Torx screw ④ grounding the rear panel to the AC converter board.
4. Remove the five M4 Torx screws securing the rear panel to the heatsinks ⑤ and shield ⑥.
5. Loosen the rear panel slightly and remove the fibreglass DC input insulator ⑦ from behind the DC input terminals. Slide the rear panel off the heatsinks.

Figure 14.1 Removing the front and rear panels



14.6 Disconnecting the AC and DC Modules

Unless otherwise indicated, the circled numbers in the following instructions refer to Figure 14.2 on page 255.

1. As shown in Figure 14.3 on page 256, rotate the PMU so that the DC module ⑤ is on top of the AC module ⑥ and unplug the 12-way ribbon cable ⑦ from the DC converter board.

2. Unfold the DC module from on top of the AC module, and place it end-to-end with the AC module, as shown in Figure 14.2.

3. Unplug the 28VDC cable ① from the DC converter board.

4. If fitted, unplug the 8-way cable ② from the auxiliary power supply board. Remove the cable from the retaining clips ③.

Note These connectors have locking tabs. You must disengage the locking tab before you can remove the plug from the socket.

5. Slide the plastic grommet ④ out of the shield ⑤. Unplug the mains input connector ⑥ from the AC converter board and remove the shield.

14.7 Reconnecting the AC and DC Modules

Unless otherwise indicated, the circled numbers in the following instructions refer to Figure 14.3 on page 256.

1. If previously removed, reconnect the 28VDC cable ①, 12-way ribbon cable ②, and 8-way cable ③ (if fitted) to the AC converter board and feed them through the plastic grommet ④.

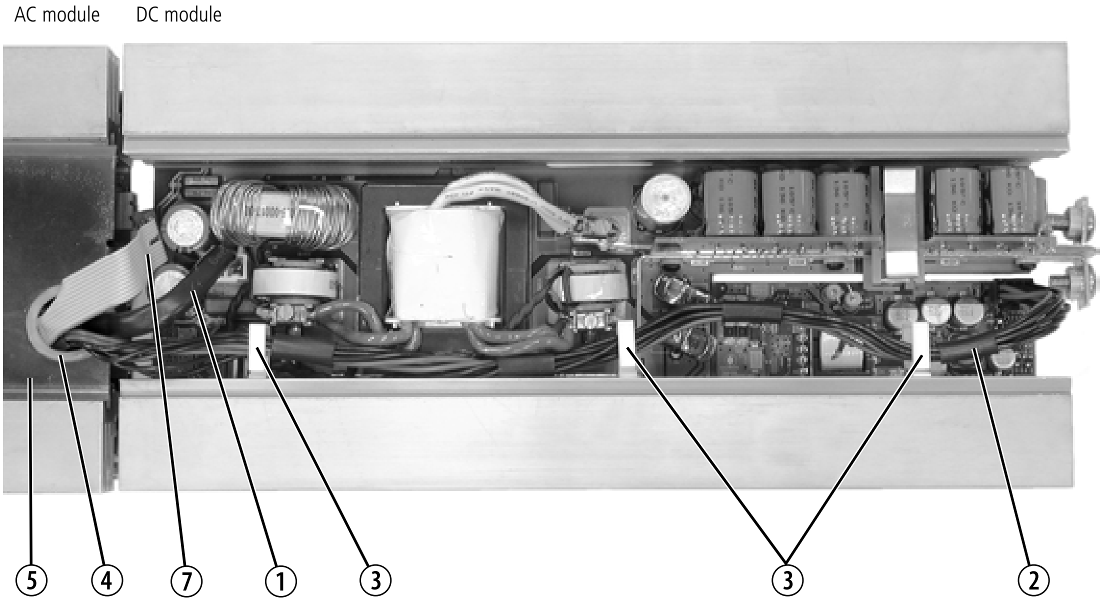
2. Reconnect the mains input connector to the AC converter board (as shown in Figure 14.2 on page 255), then insert the plastic grommet holding the cables into the hole in the shield.

3. As shown in Figure 14.2, place the AC and DC modules end-to-end and reconnect the 28VDC cable ① and 8-way cable ② (if fitted). Position the 12-way ribbon cable ⑦ between the two modules so that it will still be accessible when the AC module is folded on top of the DC module.

4. Fold the AC module ⑤ on top of the DC module ⑥, ensuring that the cables and shield ⑧ are correctly positioned. Make sure that none of the cables is pinched between the modules and/or shield.

5. Reconnect the 12-way ribbon cable ⑦ to the DC converter board.

Figure 14.2 Disconnecting the AC and DC modules



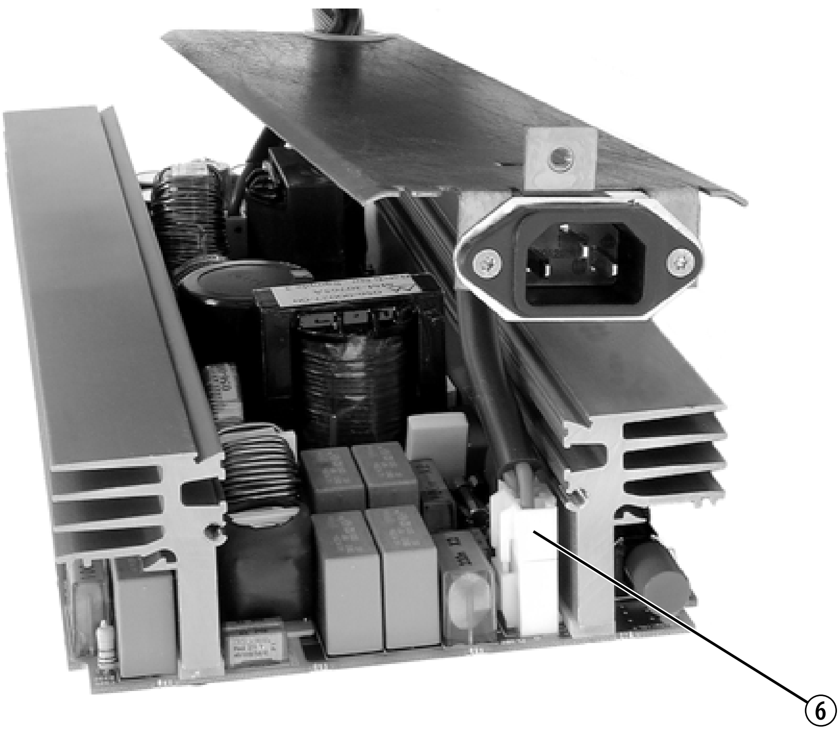
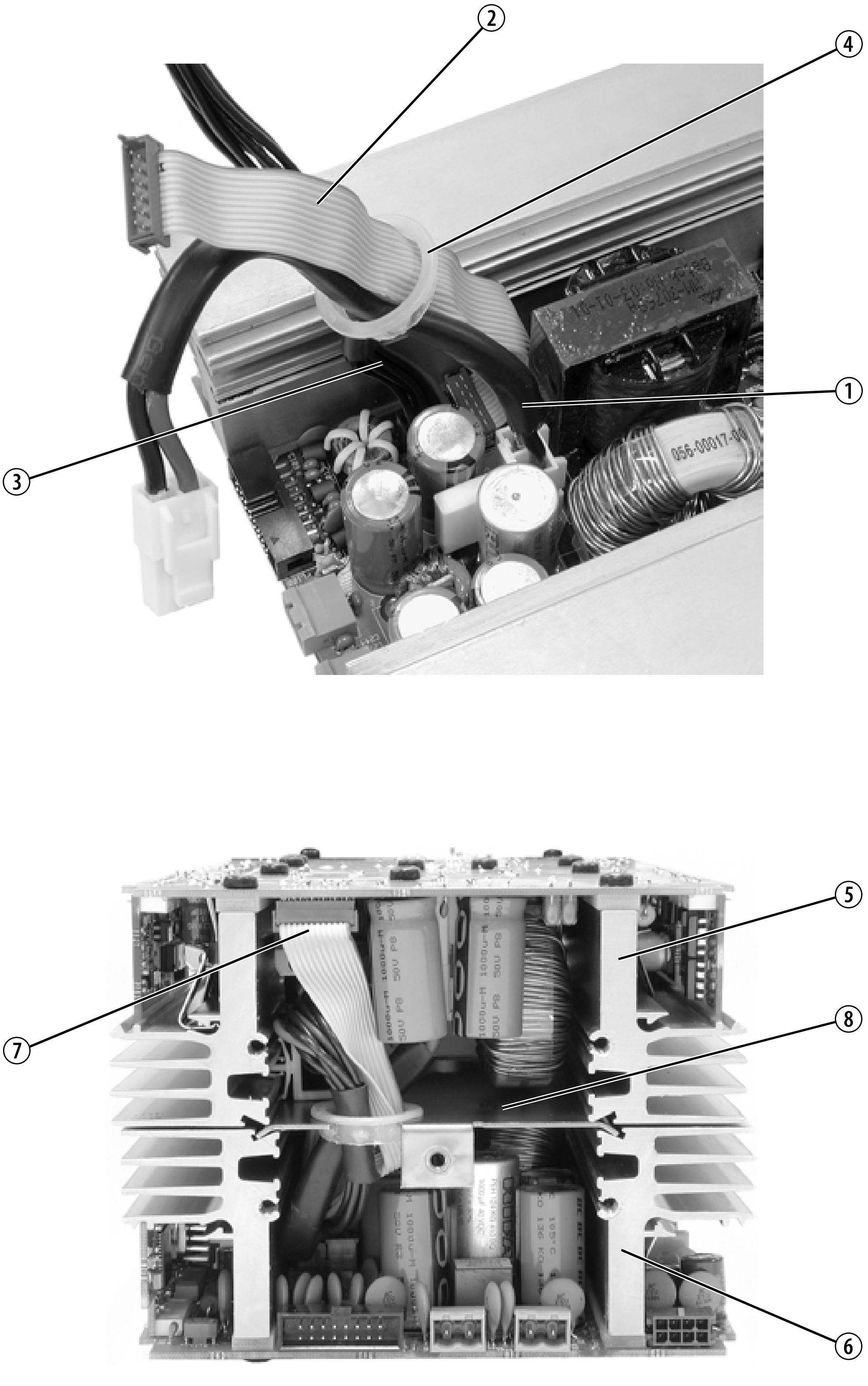


Figure 14.3 Reconnecting the AC and DC modules



14.8 Refitting the Front and Rear Panels

Refer to Figure 14.1 on page 253.

1. Hold the two modules firmly together and fit the front panel over the heatsinks. Ensure that the shield remains in place. You may find it easier to fit the front panel while the PMU is lying on its side. This way the shield is held in place between the heatsinks.

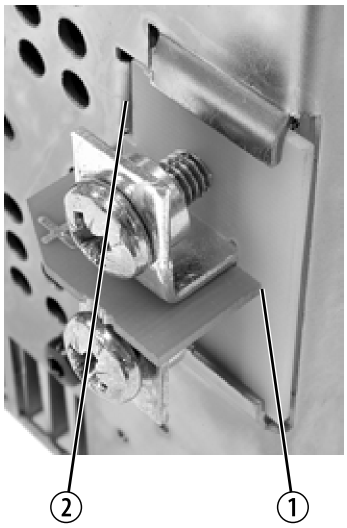
2. Refit and tighten the five M4 Torx screws to secure the front panel to the heatsinks and shield.

Note Make sure that all connectors are correctly located in their respective holes in the panel before fully tightening the screws.

3. Refit and tighten the M4 Torx screw grounding the front panel to the AC converter board.

4. Fit the rear panel over the heatsinks.

5. Slide the fibreglass DC input insulator in behind the DC input terminals. Make sure it fits into the slot in the board ① and is correctly located on its mounting tabs in the rear panel ②.



6. Refit and tighten the five M4 Torx screws to secure the rear panel to the heatsinks and shield.

Note Before fully tightening the screws, make sure that all connectors, switches and the fibreglass insulator are correctly located in their respective holes in the panel.

7. Refit and tighten the M4 Torx screw grounding the rear panel to the AC converter board.

14.9 Refitting the Top and Bottom Covers

1. Refit the bottom cover over the front and rear panels and secure with the four M3 Torx screws.

Note The bottom cover cannot be fitted to the top of the PMU as the mounting holes in the cover will not align with the holes in the front and rear panels.

2. Turn the PMU over and align the top cover over the front and rear panels. Carefully slide the cover down until the locating tabs engage with the bottom cover. Ensure that the fibreglass DC input insulator sits inside the top cover.

3. Push the top cover down firmly and secure with the four M3 Torx screws.

Note Both the top and bottom covers are symmetrical and can be fitted in either orientation.

15 Power Management Unit Card and Board Replacement

This chapter provides information on how to remove and replace the plug-in cards and auxiliary power supply board.

15.1 Safety Precautions

15.1.1 Personal Safety

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

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 DC power on/off 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.**

The PMU should be serviced only by qualified technicians. 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.

Caution **The magnetics and power devices attached to the heatsink in the PMU get hot when they are operating. Take care when working on a PMU that has been in recent use.**

Caution **The PMU can weigh up to 6.4kg (14.1lb). Take care when handling the PMU to avoid personal injury.**

15.1.2 Equipment Safety

Important This equipment contains devices which are susceptible to damage from static charges. Refer to "ESD Precautions" on page 17 for more information on antistatic procedures when handling these devices.

Important Insulated gate FET transistors are susceptible to damage from static charges, due to their extremely high input resistance. To avoid possible damage to the device during handling, testing or actual operation, we recommend you follow these procedures: avoid unnecessary handling; when handling the device, pick it up by the cap, not the leads; do not insert or remove the device while the power is on; avoid contact with non-conductive plastic or non-conductive styrofoam.

15.2 Colour Coding of Circuit Boards and Cards

The DC converter board and standby power supply card are colour-coded according to their nominal input voltage. The auxiliary power supply board is also colour-coded according to its nominal output voltage. The colours used are as follows:

- 12VDC – green
- 24VDC – yellow
- 48VDC – red.

15.3 Replacing the Plug-in Cards

Important You must reprogram the PMU if you fit a replacement HVDC and microprocessor card, or change the configuration of the PMU. Refer to "Reprogramming and Recalibration" on page 264.

Important The HVDC and microprocessor card normally fitted to a DC PMU does not have the HVDC circuitry fitted. **Do not fit this type of card to a PMU with an AC module or the AC module will be damaged.** You can, however, safely fit a card with the HVDC circuitry to any model of PMU.

Important The DC input voltage of a replacement standby power supply card must match the DC input voltage of the DC module (i.e 12 VDC, 24 VDC or 48 VDC nominal). Fitting a card with the wrong input voltage may damage the DC module.

Important We **strongly recommend** that you use the TB8100 card remover[1], as shown in Figure 15.1 on page 263. A flat-blade screwdriver may reach too far through the slot and damage the components or tracks on the card.

Refer to "Power Management Unit Disassembly and Reassembly" on page 249 for details on removing and refitting the top and bottom covers and rear panel. The circled numbers in the following instructions refer to Figure 15.1.

1. The card remover is included in the TBA0ST2 tool kit, which is available from your nearest Tait Dealer or Customer Service Organisation. It is also available separately as part number 220-02034-01.

Removal - Method 1

This procedure applies to the standby power supply and PFC control cards. The procedure for removing the other cards is described in Method 2 below.

1. Remove the top cover.
2. Insert the card remover into the slot in the AC or DC converter board ① and push down ② to lift the nearest plug out of its socket (refer to Figure 15.1).
3. Repeat this procedure at the other end of the card.
4. When all plugs are free of their sockets, slide the card out from the groove in the heatsink.

Removal - Method 2

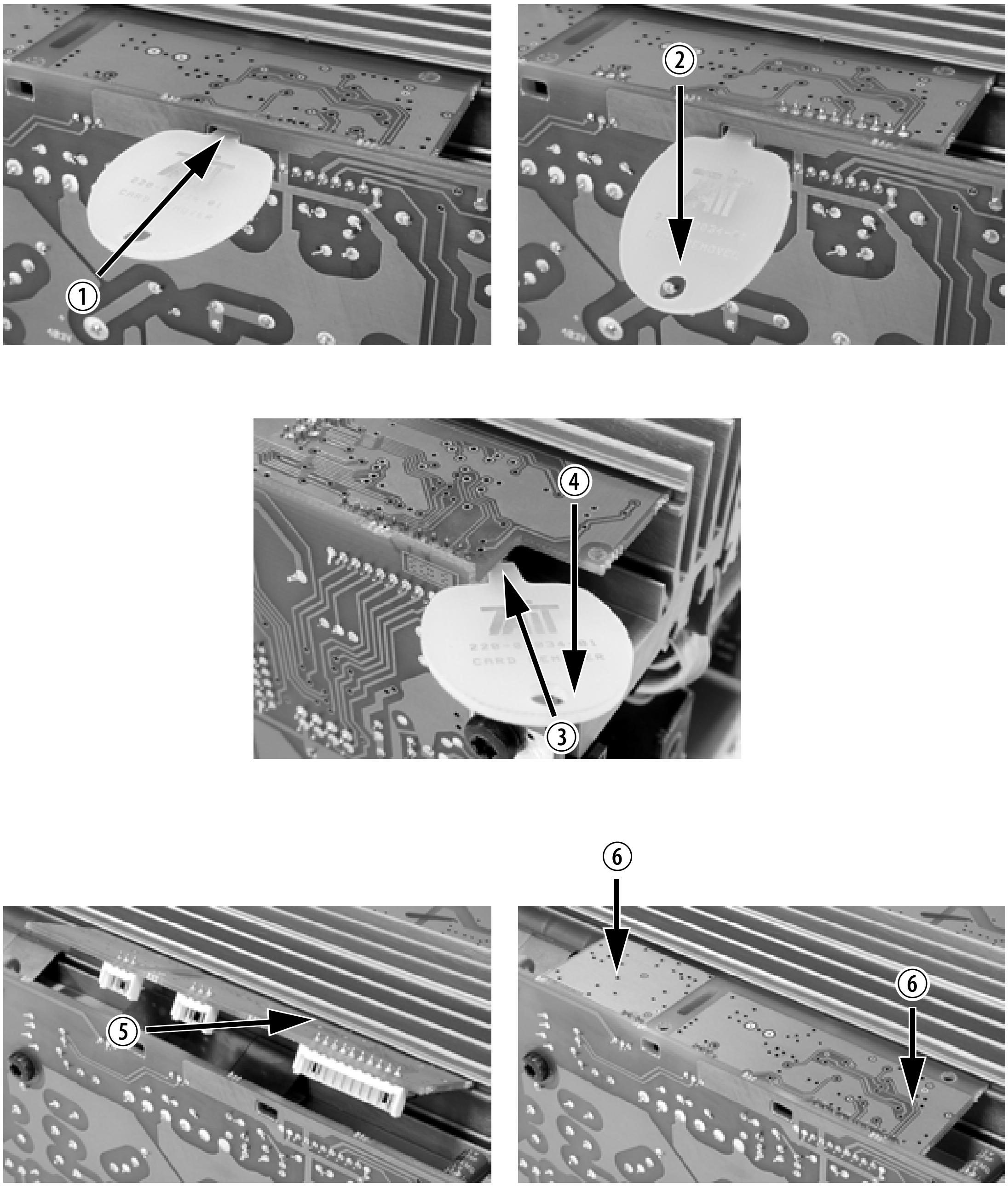
This procedure applies to the DC control, battery control, and HVDC and microprocessor cards.

1. Remove the top and bottom covers and front panel.
2. Insert the card remover between the card and the edge of the AC or DC converter board ③ and push down ④ to lift the nearest plug out of its socket (refer to Figure 15.1).
3. Insert the card remover into the slot near the other end of the card and push down to lift the plug out of its socket. On the longer HVDC and microprocessor card, repeat this procedure for each slot along the length of the card, working from the front to the rear of the PMU.
4. When all plugs are free of their sockets, slide the card out from the groove in the heatsink.

Refitting

1. Insert the top of the card into the groove in the heatsink ⑤.
2. Align the plugs on the card with their matching sockets on the AC or DC converter board.
3. Press the card down firmly at each end ⑥ so that each plug fits correctly into its matching socket. There should be an audible "click" when each plug is fully inserted. On the longer HVDC and microprocessor card, you may need to use both hands to press evenly along its length.
4. Refit the front panel and covers as necessary.

Figure 15.1 Replacing the plug-in cards



Reprogramming and Recalibration

If you have replaced the HVDC and microprocessor card, you will have to reprogram the PMU as described in the table below.

Procedure	Details
■ reprogram the product code ■ reprogram the serial number	reprogram this information into the PMU using the Calibration Kit[a]; refer to the Calibration Kit documentation for more details

a. To reprogram this information into the PMU, you will need to use a dongle with the Calibration Kit.

If you have changed the configuration of the PMU by fitting or removing a standby power supply card, you will have to reprogram the PMU as described in the following table.

Procedure	Details
reprogram the product code	use the Calibration Kit to reprogram the PMU with the product code which corresponds to the new configuration of the PMU[a]; for more details refer to "Identifying the PMU" on page 217, and to the Calibration Kit documentation

a. To reprogram this information into the PMU, you will need to use a dongle with the Calibration Kit.

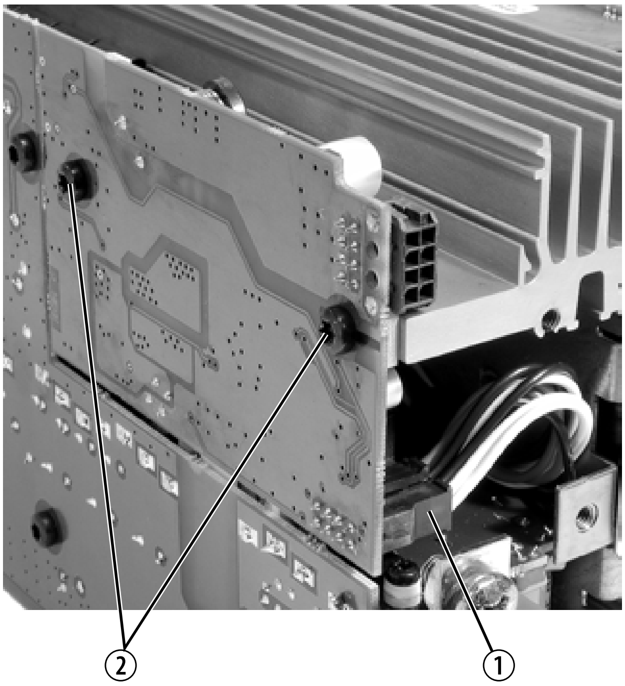
There is no need for any recalibration when any of the plug-in cards is fitted, removed or replaced.

15.4 Replacing the Auxiliary Power Supply Board

Important You must reprogram the PMU if you change its configuration by fitting or removing an auxiliary power supply board. Refer to "Reprogramming and Recalibration" on page 266.

Refer to "Power Management Unit Disassembly and Reassembly" on page 249 for details on removing and refitting the top and bottom covers and rear panel. The circled numbers in the following instructions refer to Figure 15.2.

Figure 15.2 Replacing the auxiliary power supply board



Removal

1. Remove the top and bottom covers and rear panel.
2. Unplug the loom ① from the auxiliary power supply board.
3. Remove the two M4 Torx screws ② securing the board to the heatsink.

Refitting

1. Position the board as shown in Figure 15.2 and secure with the two M4 Torx screws ②.
2. Reconnect the loom ①.
3. Replace the rear panel and top and bottom covers.

Reprogramming and Recalibration

If you have changed the configuration of the PMU by fitting or removing an auxiliary power supply board, you will have to reprogram the PMU as described in the table below.

Procedure	Details
reprogram the product code	use the Calibration Kit to reprogram the PMU with the product code which corresponds to the new configuration of the PMU[a]; for more details refer to "Identifying the PMU" on page 217, and to the Calibration Kit documentation

a. To reprogram this information into the PMU, you will need to use a dongle with the Calibration Kit.

There is no need for any recalibration when this board is fitted, removed or replaced.

16 Power Management Unit Spare Parts

This section lists the spare parts available for the TB8100 PMU at the time this manual was published.

- Spare modules and circuit board assemblies are listed in Table 16.1.
- Mechanical parts are listed in Figure 16.1 on page 269 and Figure 16.2 on page 270.

Other items may become available as spares at a later date. Consult your nearest Tait Dealer or Customer Service Organisation regarding the availability of specific items.

Table 16.1 Spare modules and circuit boards for the PMU

Description		Spares Code
AC module[a]		TBA-SP-WAA0
DC module[b]	12VDC 24VDC 48VDC	TBA-SP-WD10 TBA-SP-WD20 TBA-SP-WD40
standby power supply card	12VDC 24VDC 48VDC	TBA-SP-WDS1 TBA-SP-WDS2 TBA-SP-WDS4
auxiliary power supply board	12VDC 24VDC 48VDC	TBA-SP-WDA1 TBA-SP-WDA2 TBA-SP-WDA4
DC output filter board[c]		TBA-SP-WA00
DC microprocessor card[d]		TBA-SP-WAH0

a. Comes complete with PFC control card and HVDC control and microprocessor card.

b. Comes complete with battery control card and DC control card.

c. This is the AC converter board as used in a DC PMU. Only the current sense and output filter circuitry is placed on this board.

d. This is the HVDC control and microprocessor card as used in a DC PMU. Only the feedback and microprocessor circuitry is placed on this card.

Figure 16.1 PMU mechanical assembly - sheet 1

	Description	IPN
①	current transformer	053-00028-XX
②	E-core choke	069-00010-40
③	clamp for E-core choke	069-00010-41
④	AC mains input connector	219-02843-XX
⑤	E-core choke PCB	220-02023-XX
⑥	4mm bus bar terminal	240-04030-44
⑦	retaining clip (holds device against heatsink)	303-50040-XX
⑧	handle	308-01065-XX
⑨	heatsink	308-13146-XX
⑩	heatsink insulator	309-01051-XX
⑪	DC input insulator	309-01052-XX
⑫	bottom cover	316-06811-XX
⑬	front panel	316-06812-XX
⑭	rear panel	316-06813-XX
⑮	top cover	316-06814-XX
⑯	shield	319-01246-XX
⑰	M6x12mm pan head Pozidriv screw	345-00070-05
⑱	M3x6mm countersunk Torx screw	345-40460-XX
⑲	M3x8mm pan head Torx Taptite screw	349-00020-36
⑳	M4x12mm pan head Torx Taptite screw	349-02058-XX
㉑	M3x10mm pan head Torx Taptite screw	349-02066-XX
㉒	wire retaining clip (if 40W aux. PS board fitted)	357-01051-XX
㉓	plastic grommet	360-02026-XX
㉔	M3 T03 insulator bush	362-00010-11
㉕	10mm ID insulator bush with shoulder	362-00011-XX
㉖	seal (when 40W aux. PS board not fitted)	362-01122-XX
㉗	AC converter board	
㉘	PFC control card	
㉙	HVDC control and microprocessor card	
㉚	DC converter board	
㉛	DC input filter card	
㉜	DC control card	
㉝	battery control card	
	Not Shown in this Drawing	
	12-way ribbon cable between AC and DC modules	219-02629-XX
	8-way cable for auxiliary power supply board	219-02844-XX
	28VDC cable between AC and DC modules	219-02846-XX
	thermally conductive insulator sheet 16x22mm	362-01116-XX
	thermally conductive insulator sheet 130x22mm	362-01117-XX

Note:
The characters XX in an IPN (Tait Internal Part Number) stand for the issue number of the part. Only the latest issue of each part will normally be available for ordering as spare or replacement parts.

Note:
This drawing shows an AC and DC PMU. Those parts fitted only to an AC PMU or a DC PMU are shown in sheet 2.

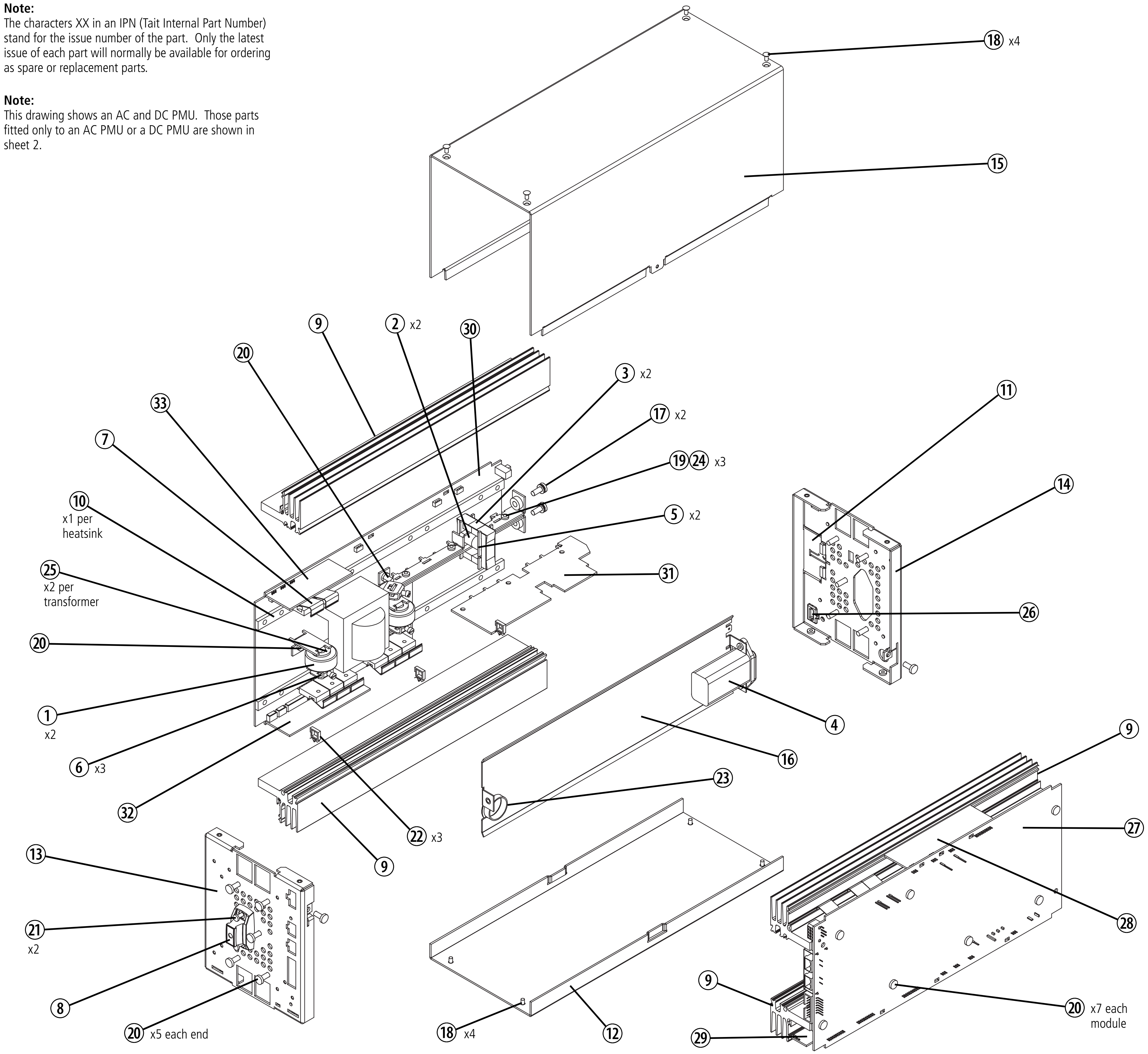
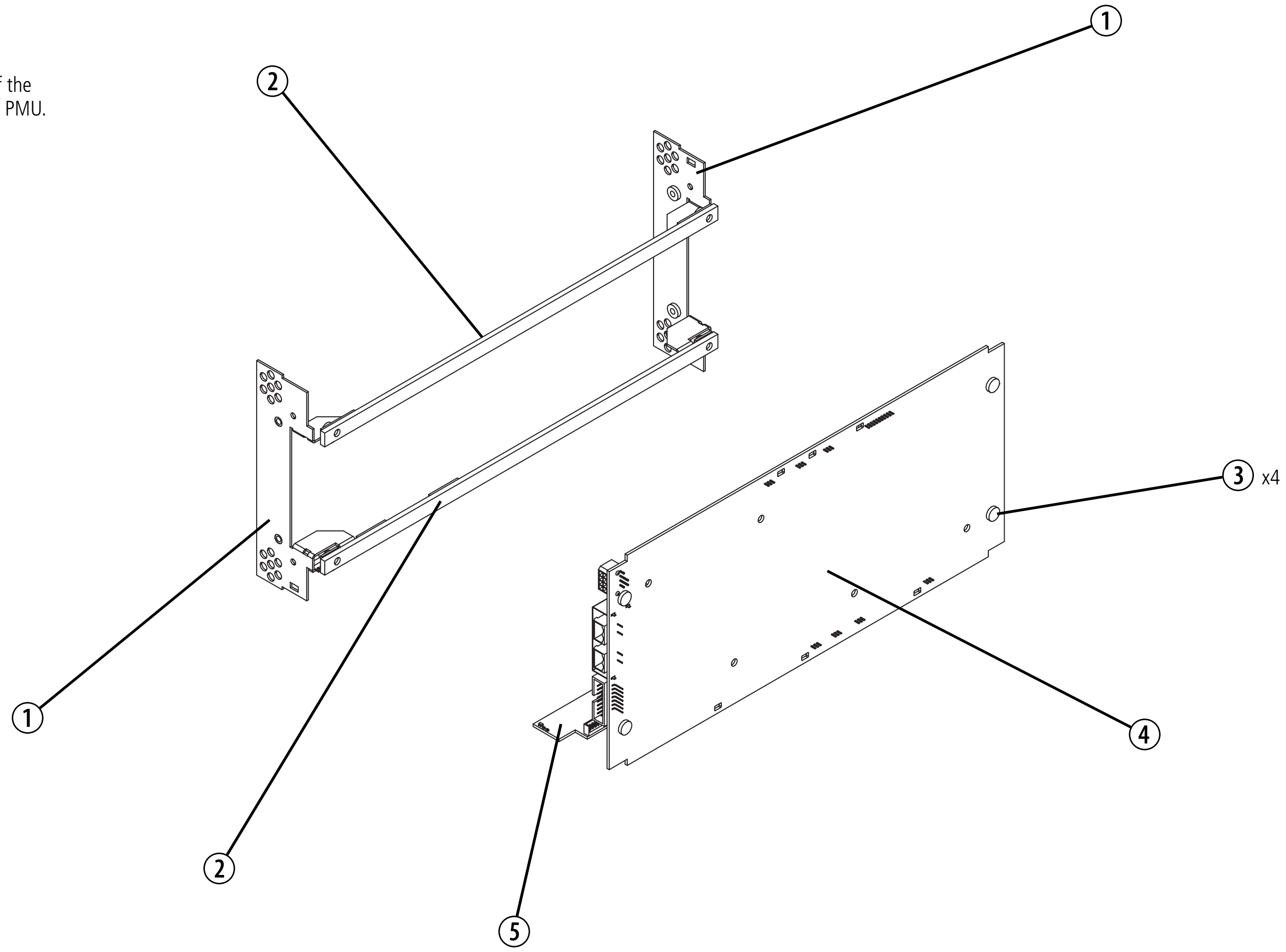


Figure 16.2 PMU mechanical assembly - sheet 2

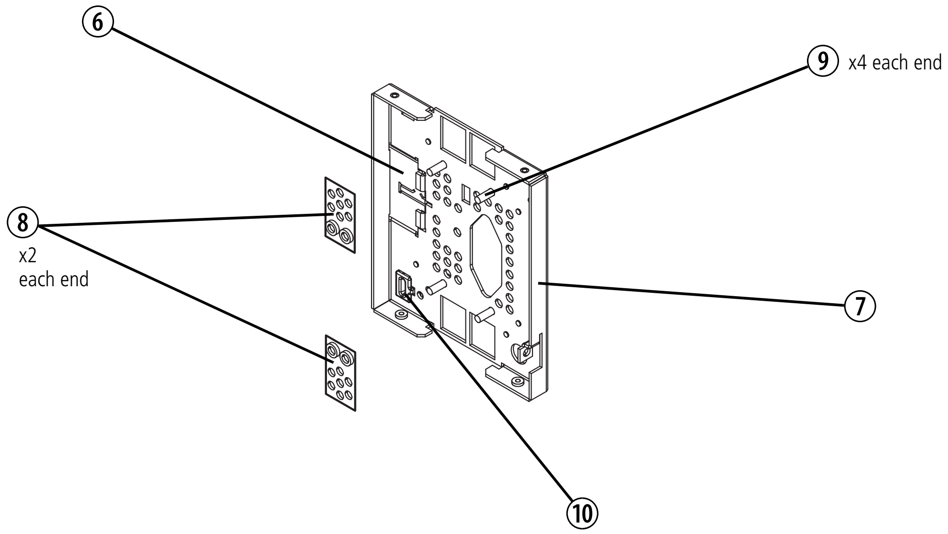
	Description	IPN
DC PMU		
①	AC converter board mounting bracket	302-05268-XX
②	heatsink insulator	309-01051-XX
③	M4x12 mm pan head Torx Taptite screw	349-02058-XX
④	DC output filter board	
⑤	DC microprocessor card	
AC PMU		
⑥	DC input insulator	309-01052-XX
⑦	rear panel	316-06813-XX
⑧	AC blanking plate	316-06836-XX
⑨	M4x12 mm pan head Torx Taptite screw	349-02058-XX
⑩	seal (when 40W aux. PS board not fitted)	362-01122-XX

Note:
The characters XX in an IPN (Tait Internal Part Number) stand for the issue number of the part. Only the latest issue of each part will normally be available for ordering as spare or replacement parts.

DC PMU
This drawing shows the assembly of the AC module when it is fitted to a DC PMU.



AC PMU
This drawing shows the blanking plates fitted to the front and rear panels in an AC PMU. These plates cover the holes normally covered by the DC module heatsinks.



17 Control Panel Circuit Description

The control panel is designed to be the link between the user and the TB8100 base station. The circuitry for the operation of the control panel is located on a board mounted behind its front face. All communication between the base station and the control panel is via the system control bus. Figure 17.1 on page 274 and Figure 17.2 on page 275 show the configuration of the main circuit blocks, and the main inputs and outputs for power, audio and control signals.

This chapter provides an overview of all the control panel circuitry[1]. However, not all the circuitry described here will be fitted to any particular control panel board. The different types of board and their main features are listed in the following table.

	Control Panel Board			
Feature	**Standard**	**Dual Base Station**	**Power Save**	**Multi-reciter**
programming port	✓	✓	✓	✓
microphone socket	✓	✓		✓
volume control knob	✓	✓		✓
0.5W speaker	✓	✓		✓
PTT key from microphone	✓	✓		✓
LED indicators	✓	✓	✓	✓
speaker button	✓	✓		✓
carrier button	✓	✓		✓
microphone channel button	✓			
microphone button				✓
base station select button		✓		
channel button				✓

1. For a description of the controls located on the control panel, refer to "Operating Controls" in the Installation and Operation Manual.

17.1 Control Circuitry

Standard, Dual Base Station, and Power Save

The control panel translates I^2C messages into an appropriate response on the LEDs. It also translates button inputs from the front panel membrane and fan rotation inputs from both fans into appropriate I^2C messages. The type of control panel is also sent with I^2C messages.

The control panel translates RS-232 from the programming port into 0V to 5V open-collector signals which are connected to the reciter (or to the selected reciter in a dual base station).

Multi-reciter

The control panel translates I^2C messages from the reciter into an appropriate response on the LEDs (except the channel LEDs). It also translates control panel button inputs (except the channel button) and fan rotation inputs from the PMU fan (if fitted) into appropriate I^2C messages. The type of control panel is also sent with I^2C messages.

The control panel translates RS-232 communications from the programming port into 0V to 5V open-collector signals which are connected to whichever reciter is selected with the channel button.

17.2 Audio Circuitry

Standard and Dual Base Station

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 167mV pp, the power output into a 16Ω speaker is ≥0.5W at the maximum position of the knob, and 0W at the minimum position of the knob. An LED indicates when the speaker is on.

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

Power Save

The audio circuitry is not fitted to this board.

Multi-reciter

The multi-reciter control panel provides a volume knob to control the volume of the speaker. In addition, the control panel circuitry performs a summation of the audio signals from all reciters and provides a 0.5W drive for the 16Ω speaker. Speaker audio is a shared output from any combination of reciters in the subrack, depending on the speaker mute setting for each reciter.

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

17.3 Power Save

This circuitry is present only on the Power Save control panel board.

When the base station enters Power Save mode, the control panel will shut down after receiving the appropriate I^2C bus message from the reciter. The power LED flashes once every two seconds to indicate the base station is in Power Save mode.

The control panel will power up again when it receives a signal on the RS-232 system control bus or serial port.

17.4 Power Supply

Standard, Dual Base Station, and Power Save

The control panel operates off a 28V (nominal) power supply provided by the reciter. The power supply for the cooling fans mounted on the front panel is fed through the control panel.

Multi-reciter

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

Figure 17.1 Standard, dual base station, and Power Save control panel high level block diagrams

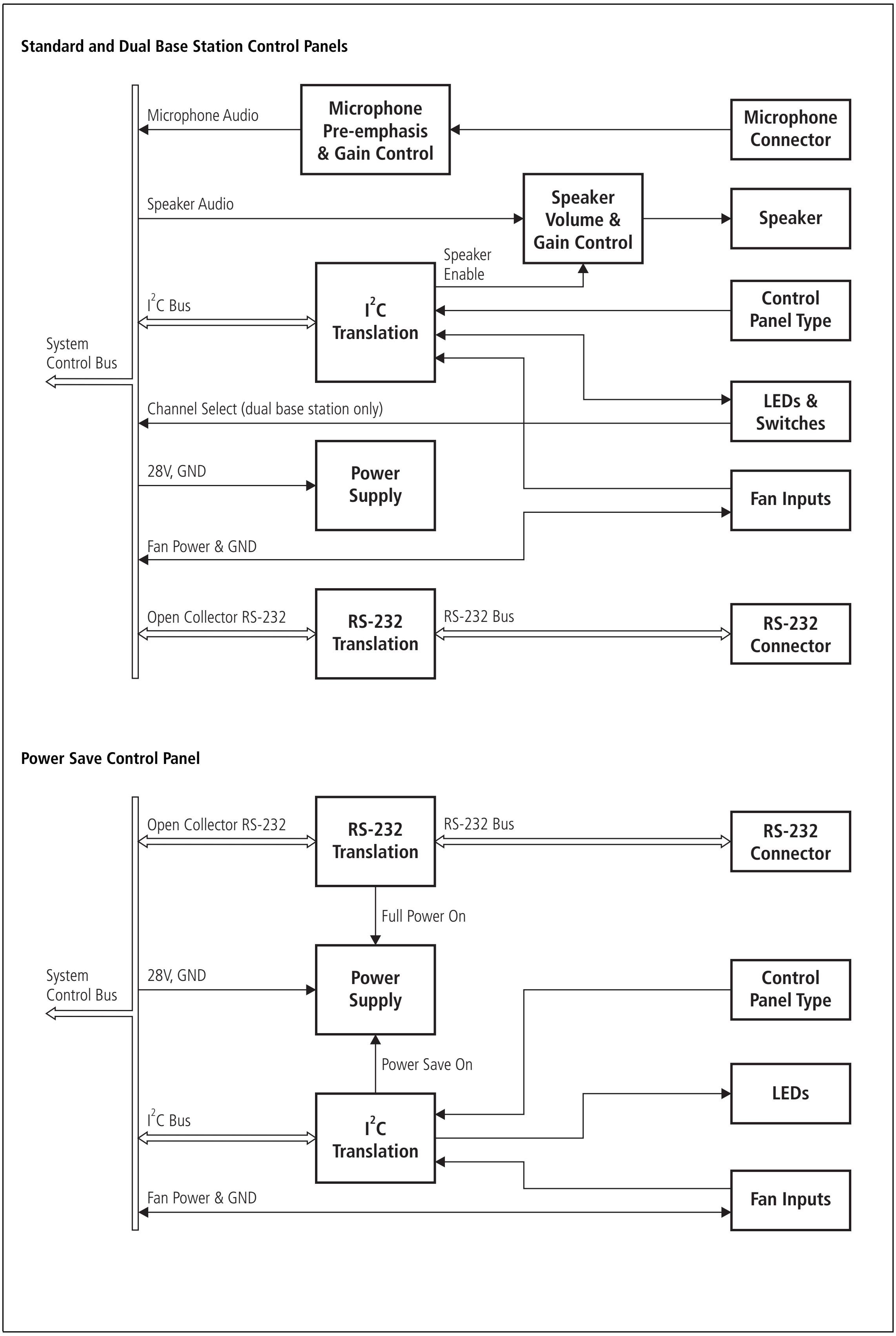
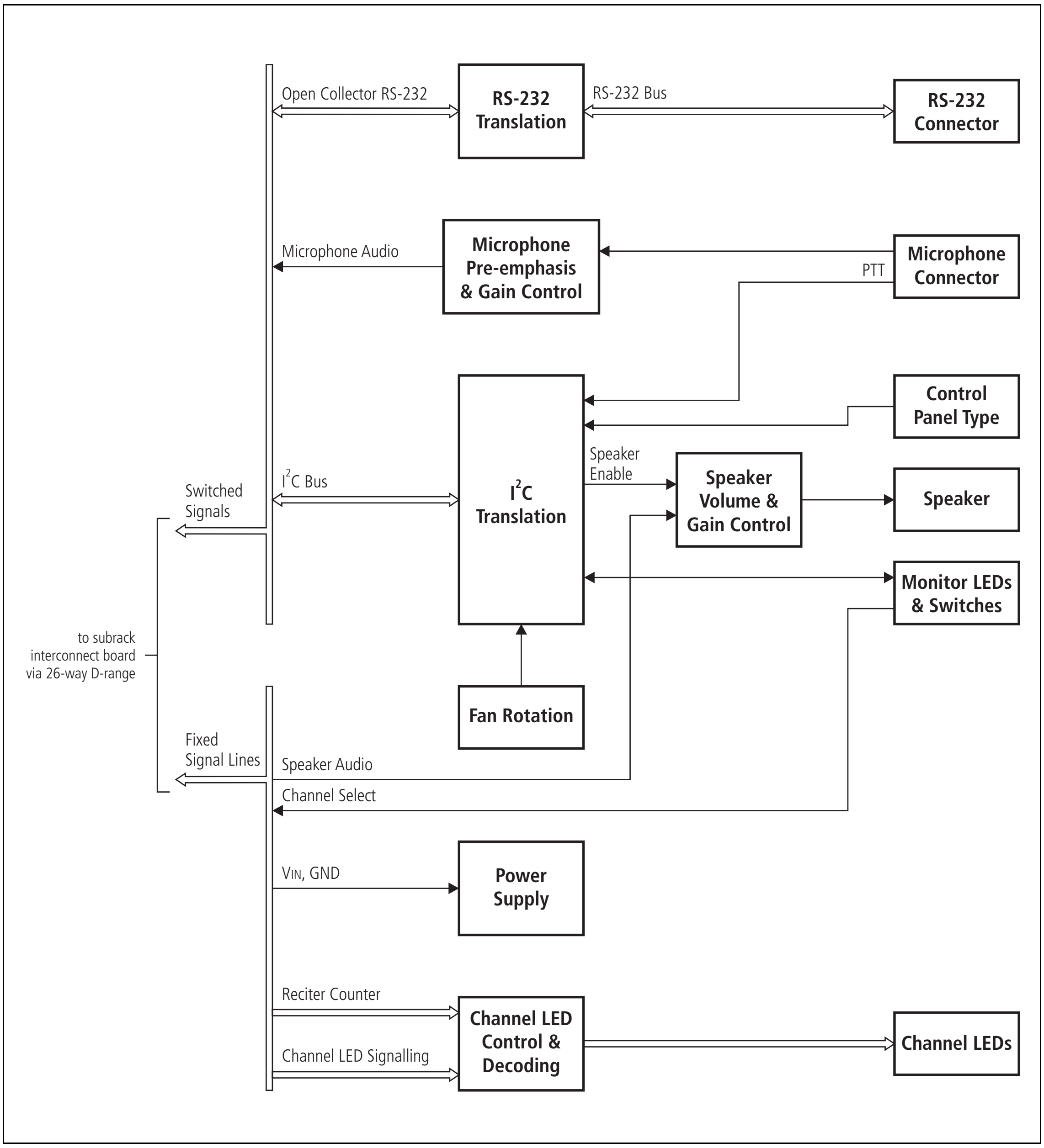


Figure 17.2 Multi-reciter control panel high level block diagram



18 Control Panel Servicing

Important This equipment contains devices which are susceptible to damage from static charges. Refer to "ESD Precautions" on page 17 for more information on antistatic procedures when handling these devices.

This chapter provides information on how to identify, remove and replace the main mechanical parts and circuit board.

Figure 18.4 on page 285 and Figure 18.5 on page 286 identify the main mechanical parts, and "Identifying the Control Panel" on page 278 explains how to identify the model of control panel from its product code.

Note For the sake of simplicity and clarity, the instructions and illustrations in this chapter refer to a standard control panel. However, the same basic procedures and techniques apply to other models.

18.1 Identifying the Control Panel

You can identify the model of control panel by referring to the product code printed on a label on the side of the chassis. The product codes are explained in the table below.

Product Code[a]	Description
TBA2010 XBA2010	power save
TBA2020 XBA2020	standard
TBA2040 XBA2040	dual base station
XBA2060	multi-reciter

a. Some control panels were labelled as "TBA20XX" when sold as separate modules, and "XBA20XX" when sold as part of a base station. This is only a labelling difference. For example, a control panel labelled TBA2020 is the same as one labelled XBA2020.

18.2 Screw Torque Settings

The recommended torque settings for the screws and nuts used in the control panel are as follows:

Location / Function	Torque	Driver/ Spanner	Size
■ securing the circuit board ■ securing the D-range connector	0.5N·m / 4.5lbf·in	T10	M3
securing the speaker clamps	0.5N·m / 4.5lbf·in	5.5mm AF	M3

18.3 Replacing the Circuit Board

The circled numbers in the following instructions refer to Figure 18.1 on page 280.

Removal

1. Gently pull the volume knob off its shaft.
2. Disconnect the speaker plug ① from the socket on the board.
3. Remove the M3 Torx screws ② securing the board and D-range connector.
4. Carefully lift and rotate the board away from the control panel chassis, feeding the shaft of the volume control through the hole in the chassis, until the board is standing upright ③.
5. With the board standing upright, disconnect the flexible connector to the keypad ④.

Refitting

1. Withdraw the flexible connector to the keypad through the hole in the side of the control panel chassis.
2. Refit the board to the chassis, feeding the speaker wire through the hole in the board. Secure the board and D-range connector with the M3 Torx screws.

Note The multi-reciter control board has three washers between the D-range connector and chassis pillars.

3. Reconnect the speaker wire.
4. Insert the flexible connector into its socket on the board through the hole in the side of the chassis.

Important Make sure the flexible connector is correctly positioned and latched in its socket, as shown in Figure 18.2 on page 281.

5. Refit the volume knob.

Figure 18.1 Replacing the control panel board

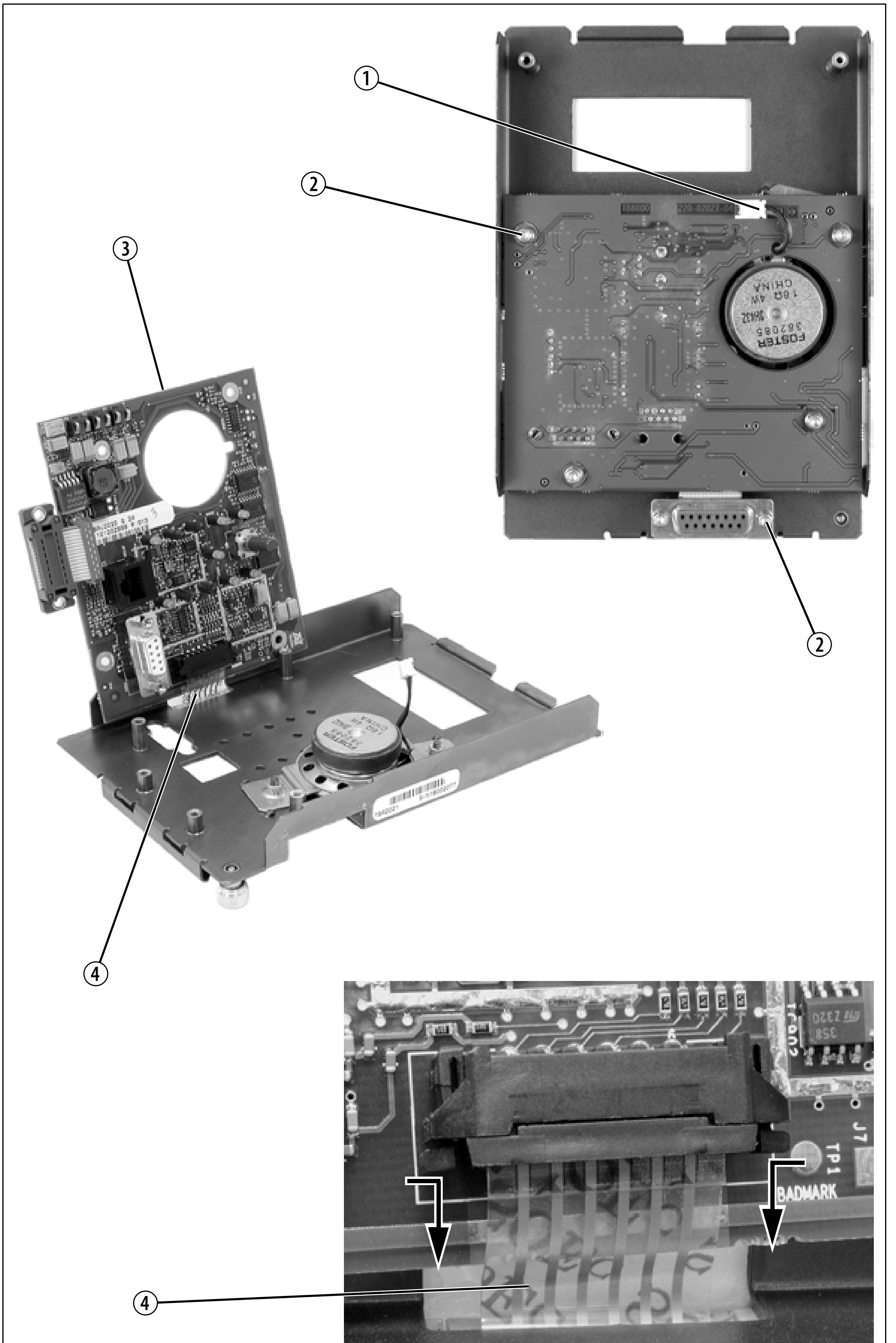
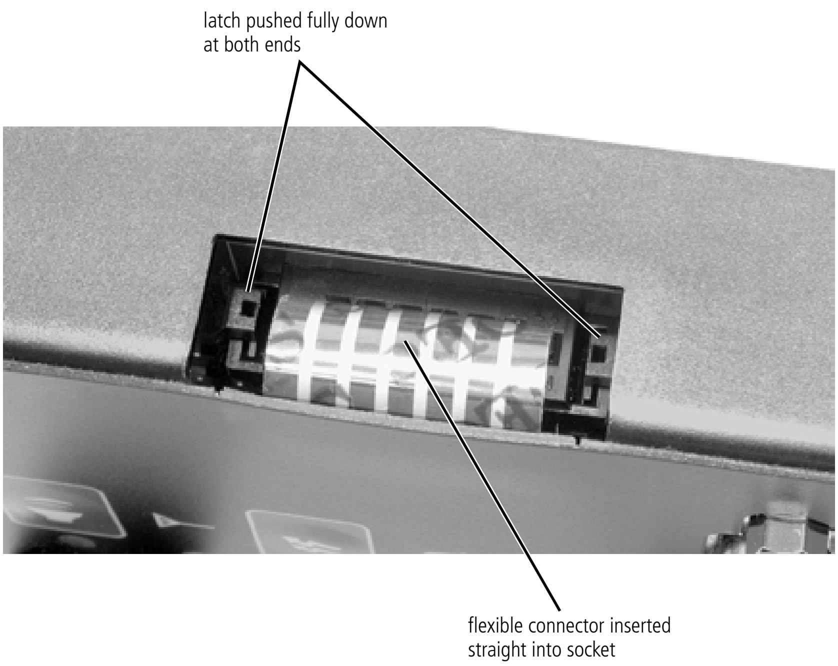


Figure 18.2 Reconnecting the flexible connector



18.4 Replacing the Speaker

The circled numbers in the following instructions refer to Figure 18.3.

Removal

1. Remove the circuit board as described in “Replacing the Circuit Board” on page 279.
2. Remove the M3 nuts and spring washers ① and then remove the brackets ②.
3. Remove the speaker.

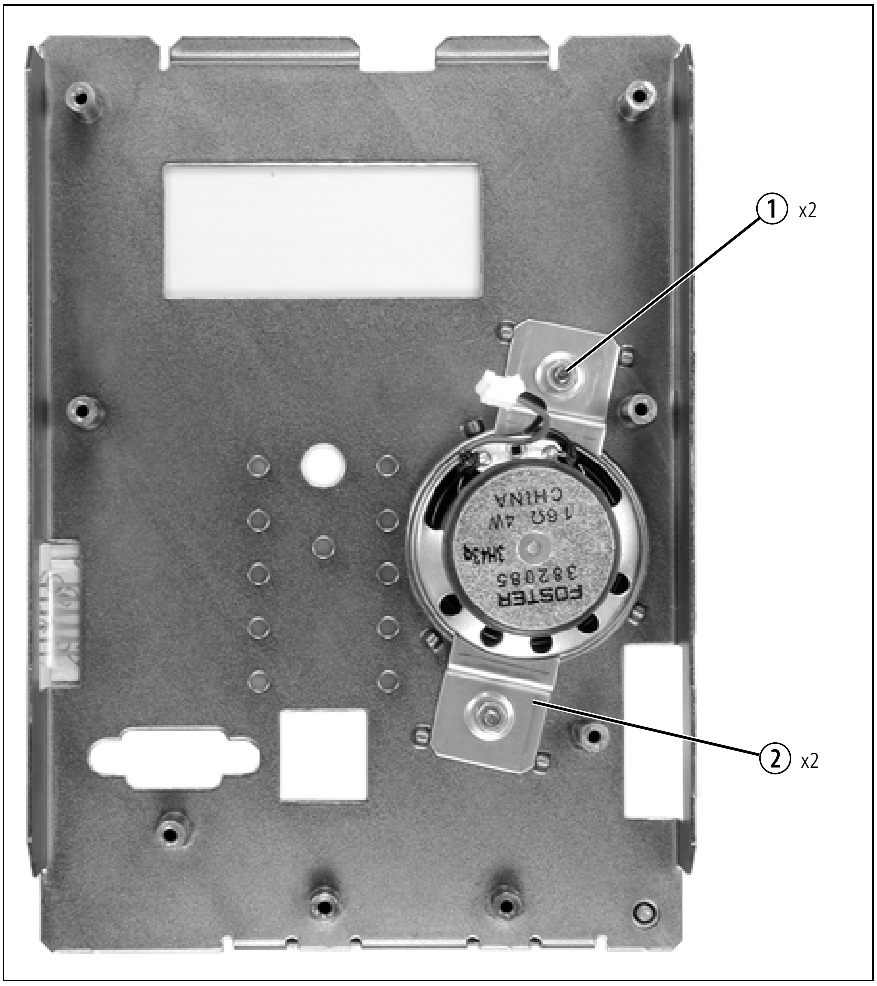
Refitting

1. To refit the speaker, follow the removal instructions in reverse order. Tighten the M3 nuts to the correct torque.

Important Make sure the speaker is correctly aligned as shown in Figure 18.3 so that the wire will fit through the slot in the board (refer to Figure 18.1 on page 280).

2. Refit the board as described in “Replacing the Circuit Board” on page 279.

Figure 18.3 Replacing the speaker



18.5 Spare Parts

This section lists the spare parts available for the TB8100 control panel at the time this manual was published.

- Spare control panels and circuit board assemblies are listed in Table 18.1.
- Mechanical parts are listed in Figure 18.4 on page 285 and Figure 18.5 on page 286.

Other items may become available as spares at a later date. Consult your nearest Tait Dealer or Customer Service Organisation regarding the availability of specific items.

Table 18.1 Spare control panels and circuit boards

Description		Spares Code
power save	complete control panel circuit board only	TBA-SP-2010 TBA-SP-U2010
standard	complete control panel circuit board only	TBA-SP-2020 TBA-SP-U2020
dual base station	complete control panel circuit board only	TBA-SP-2040 TBA-SP-U2040
multi-reciter	complete control panel circuit board only	TBA-SP-2060 TBA-SP-U2060

Figure 18.4 Control panel mechanical assembly - standard, Power Save, and dual base station

	Description	IPN
①	D-range to Micromatch ribbon cable	219-02853-XX
②	speaker*	252-00011-XX
③	speaker mounting bracket*	302-05266-XX
④	speaker grille cloth*	307-01024-XX
⑤	volume knob*	311-01054-XX
⑥	keypad - Power Save keypad - standard keypad - dual base station	311-03115-XX 311-03116-XX 311-03119-XX
⑦	chassis	316-06820-XX
⑧	M3x8mm pan head Torx screw with spring & flat washers	345-40470-XX
⑨	M3 hex nut*	352-00010-08
⑩	M3 spring washer*	353-00010-12
	* not fitted to Power Save control panel	
⑪	control panel board	

Note:
The characters XX in an IPN (Tait Internal Part Number) stand for the issue number of the part. Only the latest issue of each part will normally be available for ordering as spare or replacement parts.

Note:
This drawing shows a standard control panel. Any differences between the standard, Power Save and dual base station control panels are indicated in the description of the parts. The multi-reciter control panel is shown in Figure 18.5 on page 286.

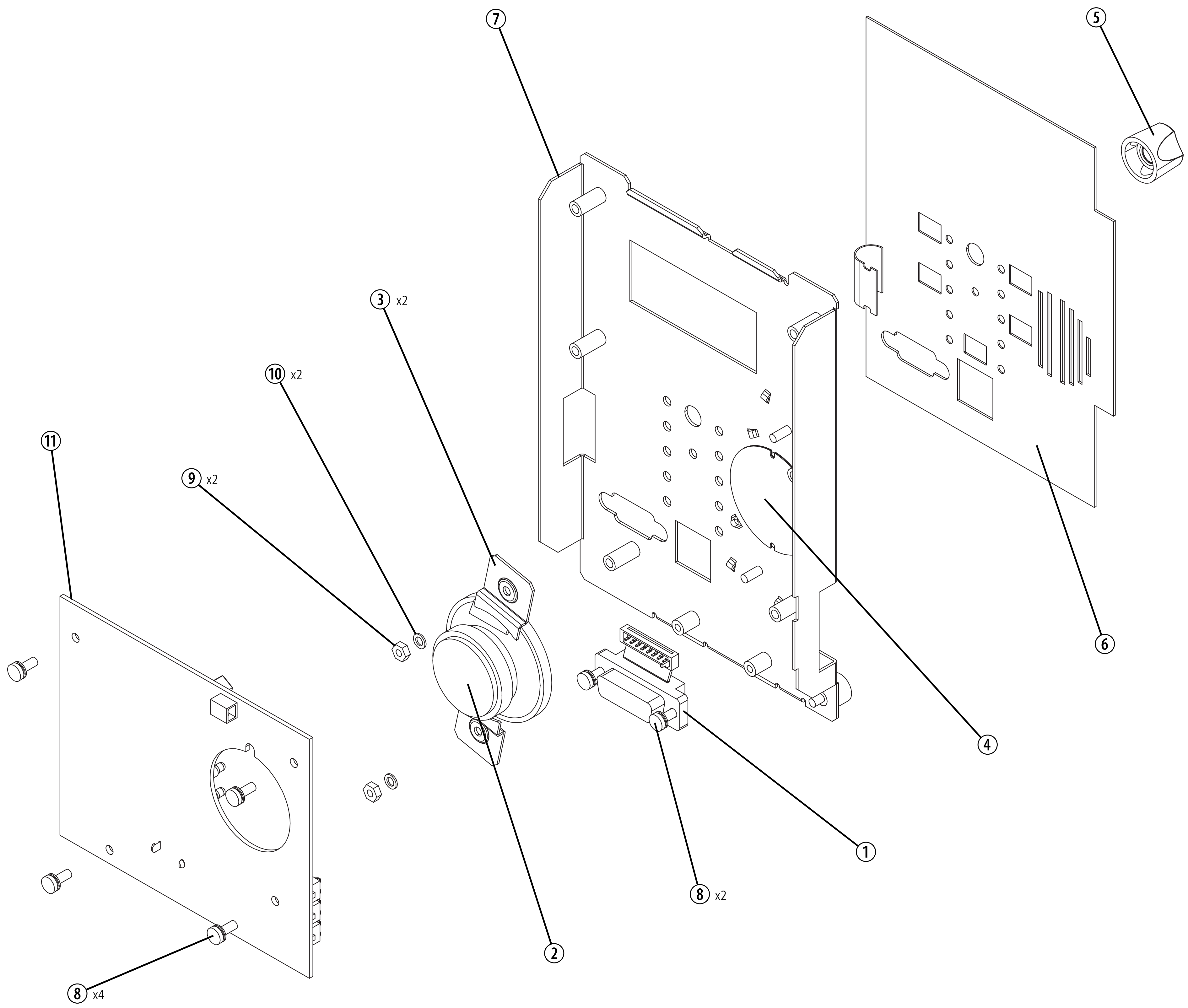
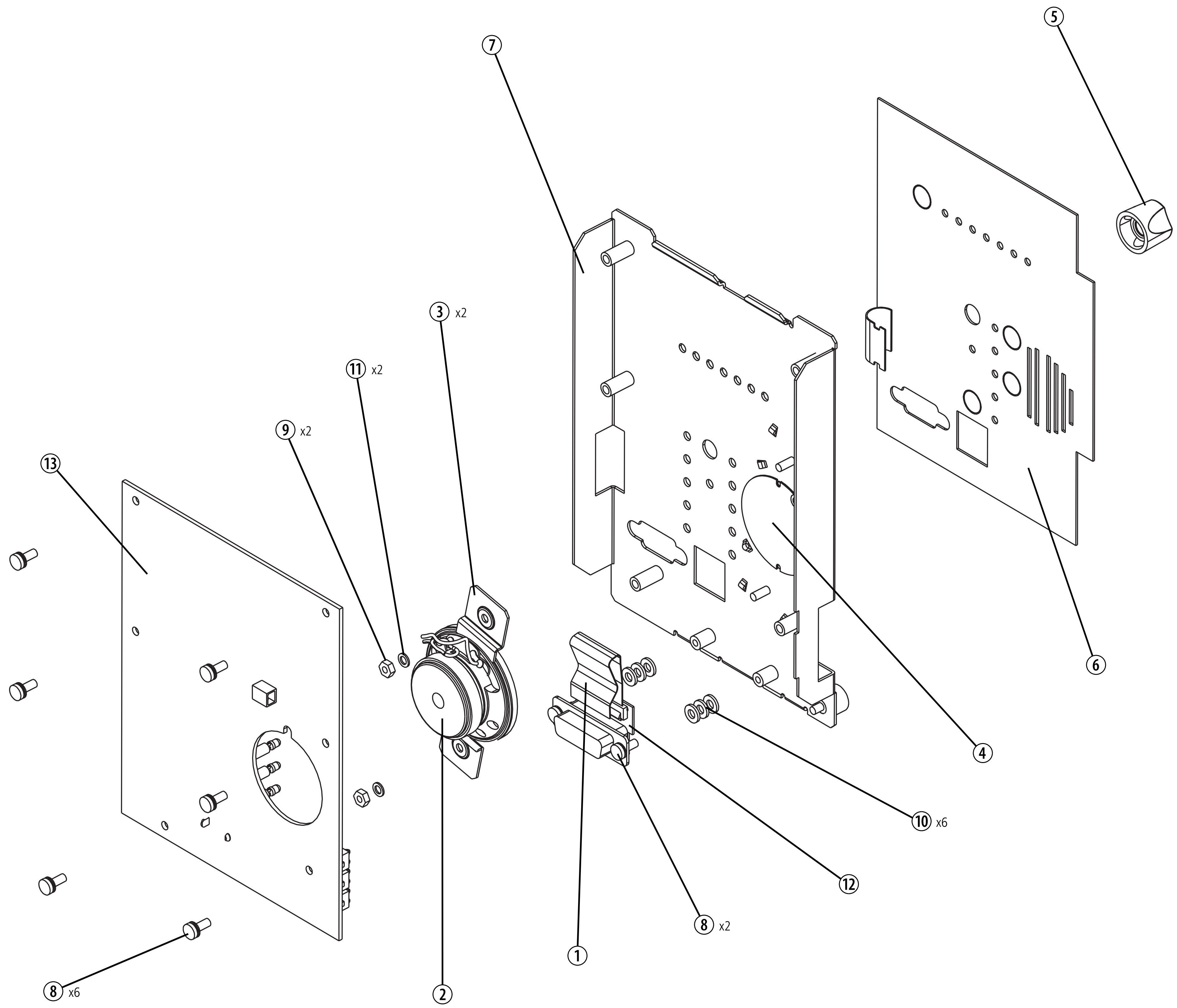


Figure 18.5 Control panel mechanical assembly - multi-reciter

	Description	IPN
①	flexible connector	219-02850-XX
②	speaker	252-00011-XX
③	speaker mounting bracket	302-05266-XX
④	speaker grille cloth	307-01024-XX
⑤	volume knob	311-01054-XX
⑥	keypad	311-03127-XX
⑦	chassis	316-06875-XX
⑧	M3x8mm pan head Torx screw with spring & flat washers	345-40470-XX
⑨	M3 hex nut	352-00010-08
⑩	M3 flat washer	353-00010-10
⑪	M3 spring washer	353-00010-12
⑫	multi-reciter control panel interconnect board assembly	XBAU22C6
⑬	multi-reciter control panel board	

Note:
The characters XX in an IPN (Tait Internal Part Number) stand for the issue number of the part. Only the latest issue of each part will normally be available for ordering as spare or replacement parts.



19 Subrack Servicing

This chapter lists the spare parts available for the TB8100 subrack at the time this manual was published.

- Spare subrack assemblies are listed in Table 19.1.
- Mechanical parts and cables are listed as follows:
  - Figure 19.1 on page 289 identifies the mechanical parts used in the front panel assembly
  - Figure 19.2 on page 290 identifies the mechanical parts used in the subrack assembly
  - Figure 19.3 on page 291 and Figure 19.4 on page 292 identify the cables used in single and dual base stations
  - Figure 19.5 on page 293 identifies the cables and mechanical parts used in the multi-reciter subrack.

Other items may become available as spares at a later date. Consult your nearest Tait Dealer or Customer Service Organisation regarding the availability of specific items.

Table 19.1 Spare subrack assemblies

Description		Spares Code
subrack (complete with guide rails and retaining clamps)		TBA-SP-RACK
front panel (no fans or labels) front panel (complete with fans; no labels) front panel (PA fan only; no labels) front panel (PMU fan only; no labels)		TBA-SP-F2130 TBA-SP-F2132 TBA-SP-F2135 TBA-SP-F2136
subrack interconnect board	single base station dual base station multi-reciter	TBA-SP-K22C0 TBA-SP-K22C2 TBA-SP-K22C6

Figure 19.1 Front panel mechanical assembly

	Description	IPN
①	fan contact board	220-02028-XX
②	fan: no rotation sensor rotation sensor	 258-00011-XX 258-00014-XX
③	PA fan duct	302-05264-XX
④	PMU fan duct	302-05265-XX
⑤	spring clip	303-50106-XX
⑥	front panel	316-06821-XX
⑦	KC30x10mm pan head Torx PT screw	346-10030-10
⑧	M4x40mm pan flange head Torx PT screw	346-10440-XX
⑨	quarter-turn fastener	354-01047-XX
⑩	retaining washer for quarter-turn fastener	354-01048-XX

Note:
The characters XX in an IPN (Tait Internal Part Number) stand for the issue number of the part. Only the latest issue of each part will normally be available for ordering as spare or replacement parts.

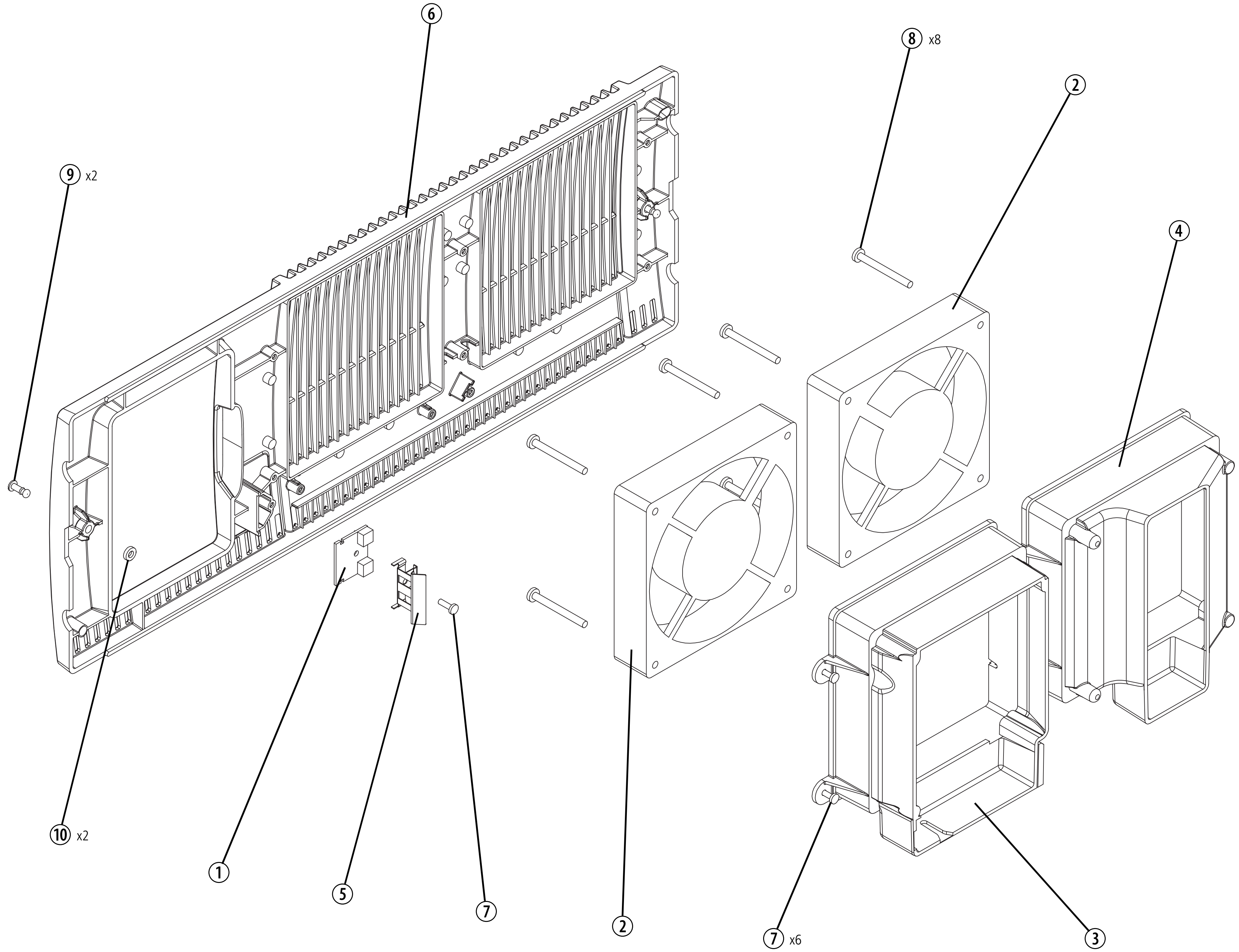


Figure 19.2 Subrack mechanical assembly

	Description	IPN
①	module retaining clamp	303-50102-XX
②	cable retaining clip	303-50104-XX
③	bottom guide rail	307-02052-XX
④	top guide rail (also used in the bottom corners when required)	307-02053-XX
⑤	rear blanking panel	316-06785-XX
⑥	airflow separator	316-06816-XX
⑦	subrack	318-01051-XX
⑧	M4x10mm pan head Pozidriv screw	345-00050-07
⑨	M3 hex nut	352-00010-08
⑩	M3 spring washer	353-00010-12
⑪	receptacle for quarter-turn fastener	354-01049-XX
⑫	subrack ground connector	356-00010-61
⑬	9.5mm P-clip	357-00010-48
⑭	insulating foam	362-01037-XX
⑮	insulator for interconnect board - single base station insulator for interconnect board - dual base station	362-01121-XX 362-01123-XX
⑯	interconnect board	

Note:
The characters XX in an IPN (Tait Internal Part Number) stand for the issue number of the part. Only the latest issue of each part will normally be available for ordering as spare or replacement parts.

Note:
This drawing shows a single base station subrack. Any differences between the single and dual base station subracks are indicated in the description of the parts. Parts which are unique to the multi-reciter subrack are shown in Figure 19.5 on page 293.

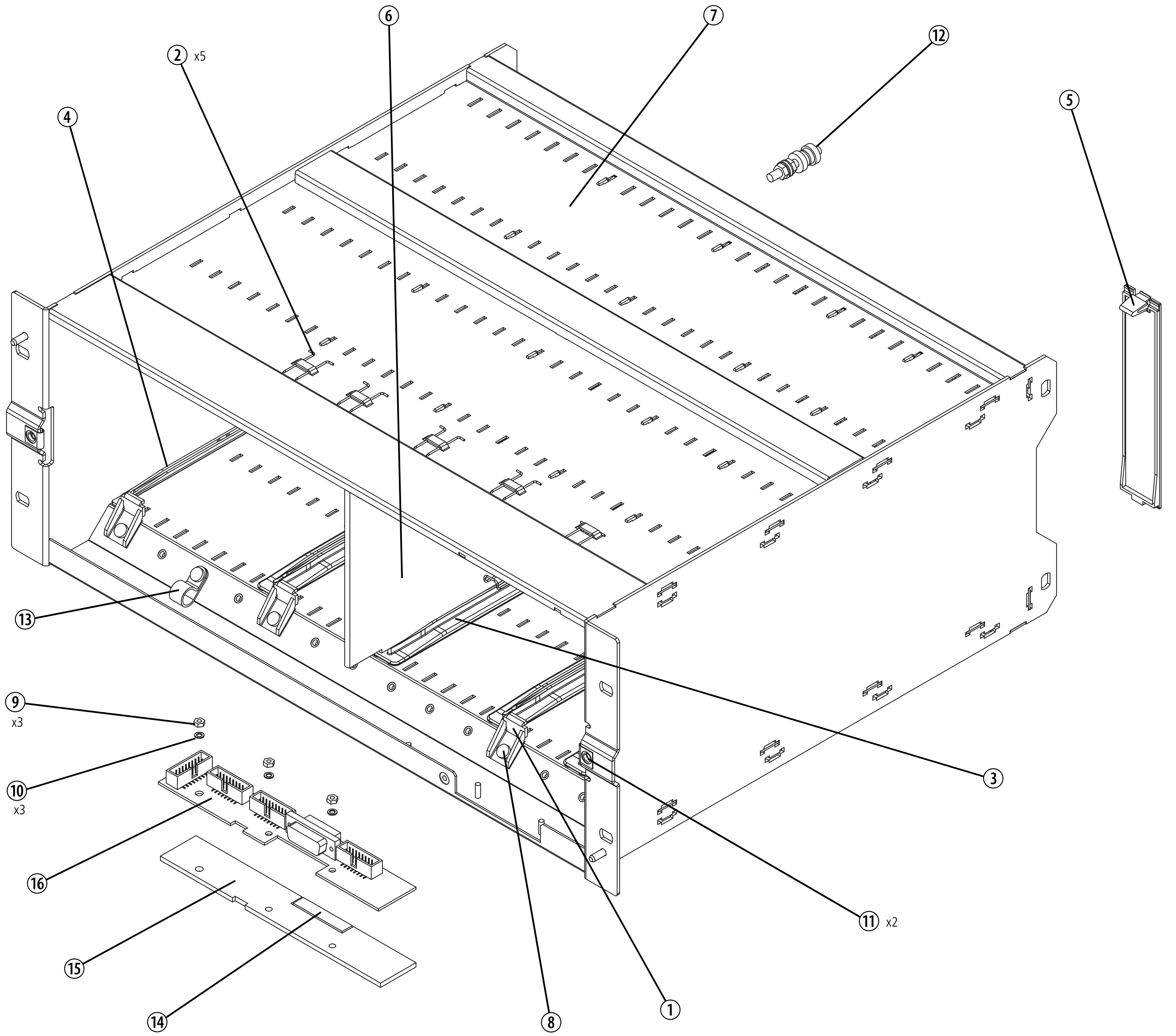
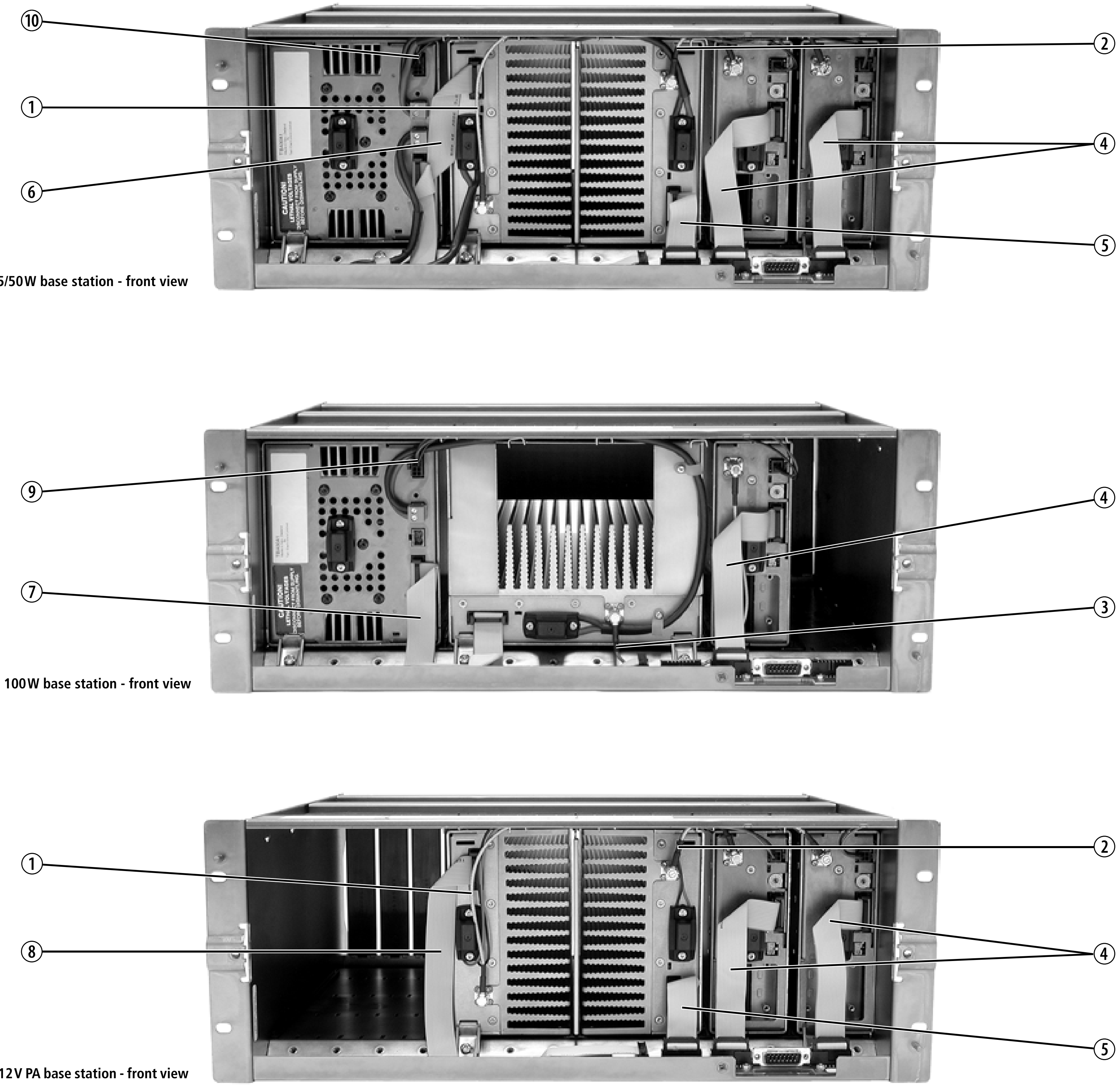


Figure 19.3 Cable identification - sheet 1

	Description	IPN
①	RF coaxial cable - reciter to 5/50W PA (long)	219-02859-XX
②	RF coaxial cable - reciter to 5/50W PA (short)	219-02862-XX
③	RF coaxial cable - reciter to 100W PA (replaced by 219-02859-XX in July 2006)	219-02864-XX
④	system control bus ribbon cable - reciter to subrack interconnect board	219-02858-XX
⑤	system control bus ribbon cable - 5/50W PA to subrack interconnect board	219-02861-XX
⑥	system control bus ribbon cable - PMU and 5/50W PA to subrack interconnect board	219-02857-XX
⑦	system control bus ribbon cable - PMU and 100W PA to subrack interconnect board (replaced by 219-02857-XX in July 2006)	219-02863-XX
⑧	system control bus ribbon cable - 5/50W 12V PA (PA1) to subrack interconnect board	219-02983-XX
⑨	DC power cable - PMU to single reciter (replaced by 219-02860-XX in July 2006)	219-02856-XX
⑩	DC power cable - PMU to dual reciters	219-02860-XX

Note:
The characters XX in an IPN (Tait Internal Part Number) stand for the issue number of the part. Only the latest issue of each part will normally be available for ordering as spare or replacement parts.



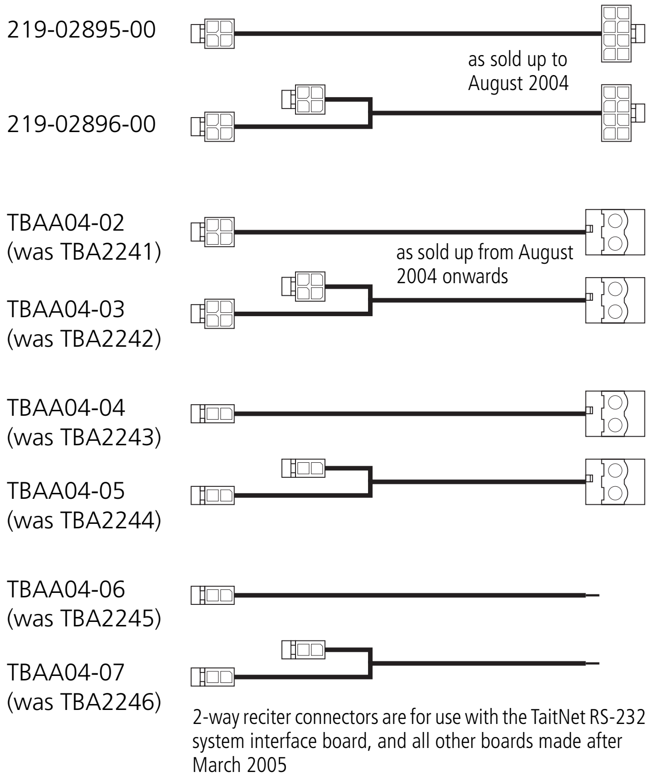
dual 5/50W base station - front view

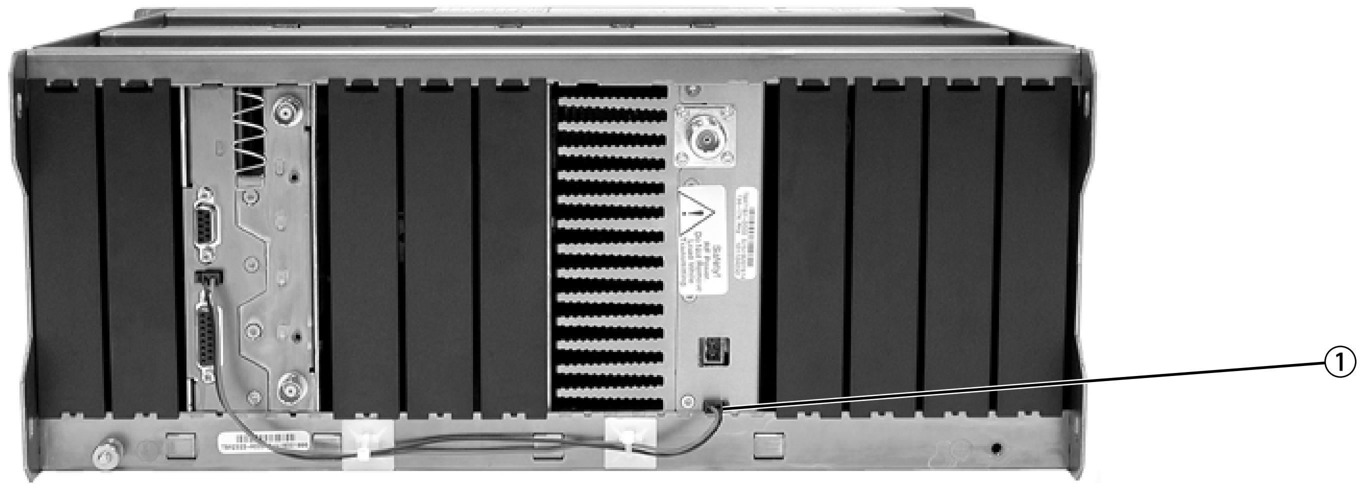
single 100W base station - front view

dual 5/50W 12V PA base station - front view

Figure 19.4 Cable identification - sheet 2

	Description	IPN
①	5/50W 12V PA Power Saving control cable	219-02971-XX
②	DC power cable - PMU aux. output to reciter, as illustrated below:	





single 5/50W 12V PA base station - rear view

dual 5/50W base station - rear view

Note:
The characters XX in an IPN (Tait Internal Part Number) stand for the issue number of the part. Only the latest issue of each part will normally be available for ordering as spare or replacement parts.

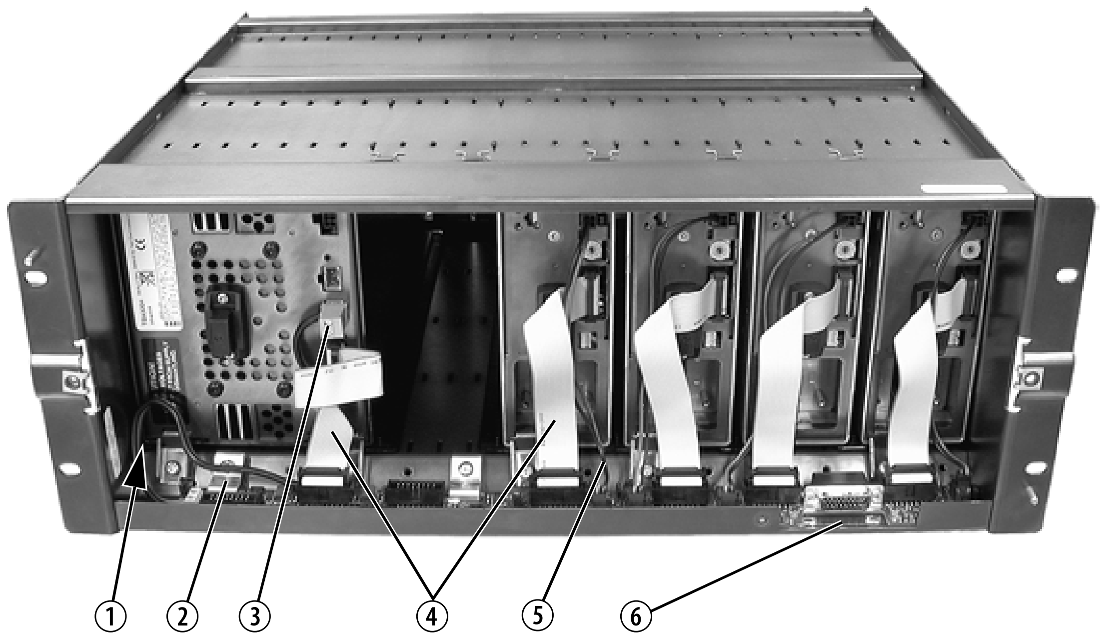
Note:
The PMU connector used in the DC power cables was changed in August 2004 to match the change of connector in the PMU. The old cables are still available under Tait part numbers 219-02895-00 (single) and 219-02896-00 (double). Contact your nearest Tait Dealer or Customer Service Organisation for details on the full range of wiring kits available.

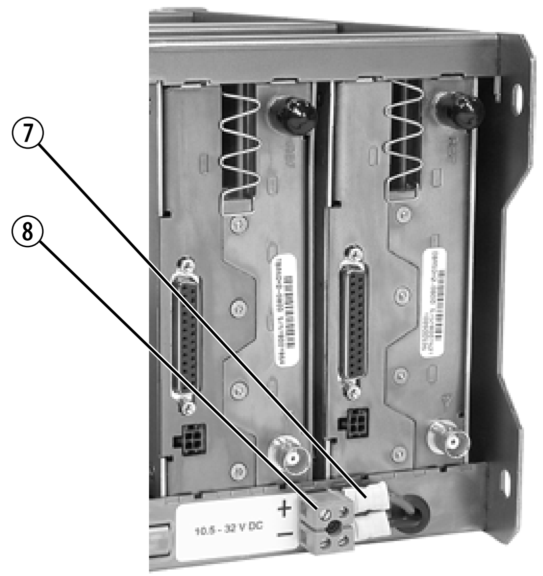
Figure 19.5 Cables and mechanical parts used in the multi-reciter subrack

	Description	IPN
①	bottom guide rail for reciter fitted in subrack position 7	307-02054-XX
②	retaining clamp for securing subrack interconnect board	302-10066-XX
③	DC power cable - PMU to subrack interconnect board	219-03069-XX
④	system control bus ribbon cable - reciter and PMU to subrack interconnect board	219-02858-XX
⑤	DC power cable - subrack interconnect board to reciter	219-03068-XX
⑥	insulator for subrack interconnect board	362-01135-XX
⑦	DC power cable - subrack DC input terminal block to subrack interconnect board (when no PMU fitted)	219-03067-XX
⑧	DC input terminal block (when no PMU fitted)	240-04030-03

Note:
The characters XX in an IPN (Tait Internal Part Number) stand for the issue number of the part. Only the latest issue of each part will normally be available for ordering as spare or replacement parts.

Note:
This drawing shows the cables and mechanical parts which are unique to the multi-reciter subrack. All other mechanical parts are as shown in Figure 19.2 on page 290.





Glossary

This glossary contains an alphabetical list of terms and abbreviations related to the TB8100 base station. For information about trunking, mobile, or portable terms, consult the glossary provided with the relevant documentation.

A B C D E F G H I K L N P R S T U V W

A

access level There are three different levels of access to a base station: Administrator, User, and Read-only. The User access level has a configurable access profile; the Administrator decides which functions that access level can carry out.

action An action is the second part of a Task Manager task. It specifies what the base station must do when the first part (the input) becomes true.

active Digital outputs are active when the base station pulls their voltage low and current is flowing. Digital inputs are active when external equipment is pulling them to ground. All base station digital inputs and outputs are open collector.

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

Alarm log The alarm log is a list of the last 50 alarms that the base station generated. This list is stored in the base station. To view it, select Monitor > Alarms > Reported Alarms.

Alarm Center Alarm Center is a utility provided with the Service Kit that is able to receive, store, and display alarms from any number of base stations with dial-up connections. Participating base stations need an Alarm Reporting license. Alarm Center also routes emailed messages to the email server.

alarm notification Alarm notification is the process by which the base station passes on information about an alarm condition. It can notify alarms over the air, over the line, via email, or to an Alarm Center. It can also activate a digital output. If the Service Kit is logged on to the base station, it is automatically notified of any alarms.

air intake temperature The temperature of the air as measured at the PA's air intake.

anti-kerchunking Anti-kerchunking is a base station configuration that discourages users from kerchunking.

B

balanced line A balanced line has two wires carrying equal and opposite signals. It is typically used in a line-connected base station for connecting to the despatcher console. The system interface identifies the balanced line in as Rx+ and Rx-, and the balanced line out as Tx+ and Tx-.

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

C

Calibration Kit The TB8100 Calibration Kit 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 various parts of the reciter and the PA circuitry.

CCDI2 CCDI2 (computer controlled data interface version 2) is a proprietary Tait command protocol used between computer equipment and a Tait radio.

channel A channel is:

- A frequency pair (or just a single frequency in a simplex system).
- A set of configuration information that defines the frequency pair and other settings. Also referred to as a channel configuration. Generally, 'channel' has this meaning in the Service Kit.

channel profile A channel profile is a named set of configuration items relating to the base station's RF configuration, transmitter power output and power saving modes. Like the signalling profile, it can be applied to any channel. Together, these profiles define most configuration items.

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. To view it, select Configure > Base Station > Channel Table.

CODEC An IC 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, stored as a file in the configurations folder. Configuration files have the extension *.t8c.

connection A connection is a named group of settings that the Service Kit uses when establishing communications with a base station.

control bus The control bus is used for communications between modules in a base station. It is an I^2C bus, a bi-directional two-wire serial bus which is used to connect integrated circuits (ICs). I^2C 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 with buttons, LEDs and other controls that let you interact with the base station.

CTCSS CTCSS (continuous tone controlled squelch system), also known as PL (private line), is a type of signalling 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 combination of pre-defined inputs.

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 signalling used for segregating groups of users. DCS codes are identified by a three-digit octal number, which forms part of the continuously repeating code word. When assigning DCS signalling for a channel, you specify the three-digit code.

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

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

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 operated. The TB8100 PA can be operated continuously.

E

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

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 organisation responsible for producing European telecommunications standards.

F

flag — A flag is a programming term for a "yes/no" indicator used to represent the current status of something. The base station has a set of system flags that are read and set by Task Manager. There is also a separate set of flags that you can use in your own Task Manager tasks.

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

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

G

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

H

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.

hysteresis Hysteresis is the difference between the upper and lower trigger points. For example, the receiver gate opens when the upper trigger point is reached, but will not close until the level falls to the lower trigger point. An adequate hysteresis prevents the receiver gate from repeatedly opening and closing when the level is about that of the trigger point.

Hysteresis mode A mode of PMU operation designed to save power. The PMU is mainly turned off, but switches back on intermittently to maintain output voltage when the output current is low.

I

inactive Digital outputs are inactive if the base station is doing nothing to them. They are floating, open collector outputs. Digital inputs are inactive when they are open circuit.

Intercom mode Intercom mode makes it possible for the operator at the dispatch centre and the servicing technician at the base station to communicate with each other over the line. It connects the base station microphone to line out.

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

kerchunking Kerchunking is transmitting for a second or less without saying anything in order to test the base station. This results in a 'kerchunk' sound.

L

line-controlled base station A TB8100 is a line-controlled base station when it receives audio (sending it out via its system interface), transmits audio received over its system interface, and its transmitter is keyed via the Tx Key line.

logging on Once you have connected to a base station, you can log on. This establishes communications between the Service Kit and the base station.

N

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

O

operating range Operating range is another term for switching range.

P

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

PMU The PMU (power management unit) is a module that provides power to the base station.

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

R

reciter The reciter is a module of a TB8100 base station that acts as receiver and exciter.

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.

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

Run mode Run mode is the normal operating mode of the base station.

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

S

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).

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

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 12dB corresponds to a signal to noise ratio of 4:1. The TB8100 can provide an approximate SINAD value while in service by comparing the in-band audio against out-of-band noise. This value should not be relied upon to make calibrated measurements.

Sleep mode Sleep mode is a power saving state in which a part of the base station is switched off, and then periodically switched on again.

Standby mode Standby mode is a mode of base station operation in which active service is suspended so that special operations can be carried out, such as programming the base station with a new configuration.

status message A status message is a set of information about the base station that can be emailed. It identifies the base station, indicates the current operating channel, lists the status of all alarms, and gives the current values of a number of other monitored parameters. It also contains the alarm log.

subaudible signalling Subaudible signalling is signalling that is at the bottom end of the range of audible frequencies. The TB8100 base station supports CTCSS and DCS subaudible signalling.

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

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

system flag System flags are binary indicators that are read and set by Task Manager. Generally, they are used to disable or enable configured base station functions.

system interface The system interface is the set of inputs to and outputs from the base station (excluding power and RF), provided by a board inside the reciter. A range of different boards are available for different applications.

T

TB8100 Base Station A Tait TB8100 base station consists of the equipment necessary to receive and transmit on one channel. Generally, this means a reciter, a PA, and a PMU. Often abbreviated to TB8100 or base station.

Talk Through Repeater A TB8100 is a talk through repeater when its audio path is configured to pass the audio it receives on to the transmitter.

Task Manager Task Manager is a part of the TB8100 base station firmware that carries out tasks in response to inputs. These tasks are formulated using the Service Kit.

template file A template file contains configuration information that can be used to create a new base station configuration. Template files have the extension *.t8t.

transmit lockout The transmit lockout feature prevents the base station from transmitting for a time once the transmit timer has expired. It is designed to prevent users from monopolising the base station.

U

Unbalanced line An unbalanced line has one wire earthed. It is typically used for short connections, for example, between a base station and a repeater on the same site. The system interface identifies the wires of unbalanced lines with Rx audio, Tx audio, and Audio Ground. Audio Ground is common to line-in and line-out.

V

valid signal A valid signal is a signal that the receiver responds to by opening the receiver gate. A signal is valid for example when it is stronger than a minimum level and when it has the specified subtone.

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 resets the system.

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Directive 1999/5/EC Declaration of Conformity

da **Dansk**

Undertegnede Tait Electronics Limited erklærer herved, at følgende udstyr TBAB1, TBAC0 & TBAH0 overholder de væsentlige krav og øvrige relevante krav i direktiv 1999/5/EF.
Se endvidere: http://eudocs.taitworld.com/

de **Deutsch**

Hiermit erklärt Tait Electronics Limited die Übereinstimmung des Gerätes TBAB1, TBAC0 & TBAH0 mit den grundlegenden Anforderungen und den anderen relevanten Festlegungen der Richtlinie 1999/5/EG.
Siehe auch: http://eudocs.taitworld.com/

el **Ελληνικός**

Με την παρουσα Tait Electronics Limited δηλωνει οτι TBAB1, TBAC0 & TBAH0 συμμορφωνεται προσ τισ ουσιωδεισ απαιτησεισ και τισ λοιπεσ σχετικεσ διαταξεισ τησ οδηγιασ 1999/5/ΕΚ.
βλέπε και: http://eudocs.taitworld.com/

en **English**

Tait Electronics Limited declares that this TBAB1, TBAC0 & TBAH0 complies with the essential requirements and other relevant provisions of Directive 1999/5/EC.
See also: http://eudocs.taitworld.com/

es **Español**

Por medio de la presente Tait Electronics Limited declara que el TBAB1, TBAC0 & TBAH0 cumple con los requisitos esenciales y cualesquiera otras disposiciones aplicables o exigibles de la Directiva 1999/5/CE.
Vea también: http://eudocs.taitworld.com/

fi **Suomi**

Tait Electronics Limited vakuuttaa täten että TBAB1, TBAC0 & TBAH0 tyyppinen laite on direktiivin 1999/5/EY oleellisten vaatimusten ja sitä koskevien direktiivin muiden ehtojen mukainen.
Katso: http://eudocs.taitworld.com/

fr **Français**

Par la présente, Tait Electronics Limited déclare que l'appareil TBAB1, TBAC0 & TBAH0 est conforme aux exigences essentielles et aux autres dispositions pertinentes de la directive 1999/5/CE.
Voir aussi: http://eudocs.taitworld.com/

it **Italiano**

Con la presente Tait Electronics Limited dichiara che questo TBAB1, TBAC0 & TBAH0 è conforme ai requisiti essenziali ed alle altre disposizioni pertinenti stabilite dalla direttiva 1999/5/CE.
Vedi anche: http://eudocs.taitworld.com/

nl **Nederlands**

Hierbij verklaart Tait Electronics Limited dat het toestel TBAB1, TBAC0 & TBAH0 in overeenstemming is met de essentiële eisen en de andere relevante bepalingen van richtlijn 1999/5/ EG.
Zie ook: http://eudocs.taitworld.com/

pt **Português**

Tait Electronics Limited declara que este TBAB1, TBAC0 & TBAH0 está conforme com os requisitos essenciais e outras provisões da Directiva 1999/5/CE.
Veja também: http://eudocs.taitworld.com/

sv **Svensk**

Härmed intygar Tait Electronics Limited att denna TBAB1, TBAC0 & TBAH0 står I överensstämmelse med de väsentliga egenskapskrav och övriga relevanta bestämmelser som framgår av direktiv 1999/5/EG.
Se även: http://eudocs.taitworld.com/