TB8100 base station

Service Manual

radio communications

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Note: For the addresses and phone numbers of the above regional offices refer to the TaitWorld website.

Contents

List of Illustrations

Preface

Scope of Manual

This manual contains information on servicing TB8100 base station system equipment. It also provides circuit descriptions and mechanical assembly drawings for each module.

Enquiries and Comments

If you have any enquiries regarding this manual, or any comments, suggestions and notifications of errors, please contact Technical Support (refer to "Tait Contact Information" on page 2).

Updates of Manual and Equipment

In the interests of improving the performance, reliability or servicing of the equipment, Tait Electronics Ltd reserves the right to update the equipment or this manual or both without prior notice.

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There are no warranties extended or granted by this manual. Tait Electronics Ltd accepts no responsibility for damage arising from use of the information contained in the manual or of the equipment and software it describes. It is the responsibility of the user to ensure that use of such information, equipment and software complies with the laws, rules and regulations of the applicable jurisdictions.

Associated Documentation

TB8100 Installation and Operation Manual.

TB8100 Installation Guide (a subset of the Installation and Operation Manual.).

TB8100 Specifications Manual.

TB8100 Service Kit and Alarm Center User's Manuals and online Help.

TB8100 Calibration Kit User's Manual and online Help.

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 CD supplied with the base station[1]. Updates may also be published on the Tait support website.

Typographical Conventions

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.

1. Technical notes are only available in PDF format from the Tait support website. Consult your nearest Tait Dealer or Customer Service Organisation for more information.

Publication Record

Issue	Publication Date	Description
1	April 2004	first release

1 Safety and Servicing Information

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

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

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

1.1 Personal Safety

Lethal Voltages

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

The TB8100 BSS must be installed so that the rear of the PMU is located in a service access area.

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

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

Explosive Environments

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

Beryllium Oxide

Caution **The termination resistors used in the 100 W 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.**

Proximity to RF Transmissions

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

High Temperatures

Take care when handling a PMU or PA which has been operating recently. Under extreme operating conditions (+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

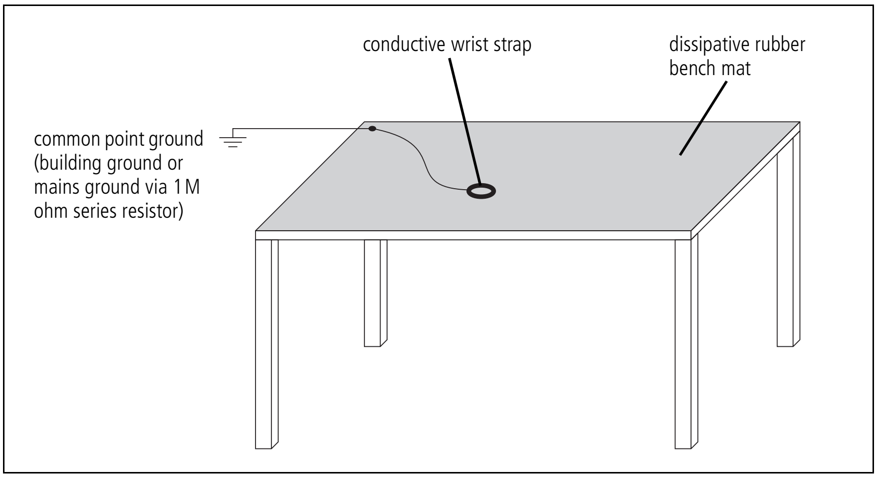
ESD Precautions

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.

Figure 1.1 Typical Antistatic Bench Set-up



Aerial Load

The TB8100 BSS equipment has been designed to operate safely under a wide range of aerial loading conditions. However, we strongly recommend that the transmitter should always be operated with a suitable load to prevent damage to the transmitter output power stage.

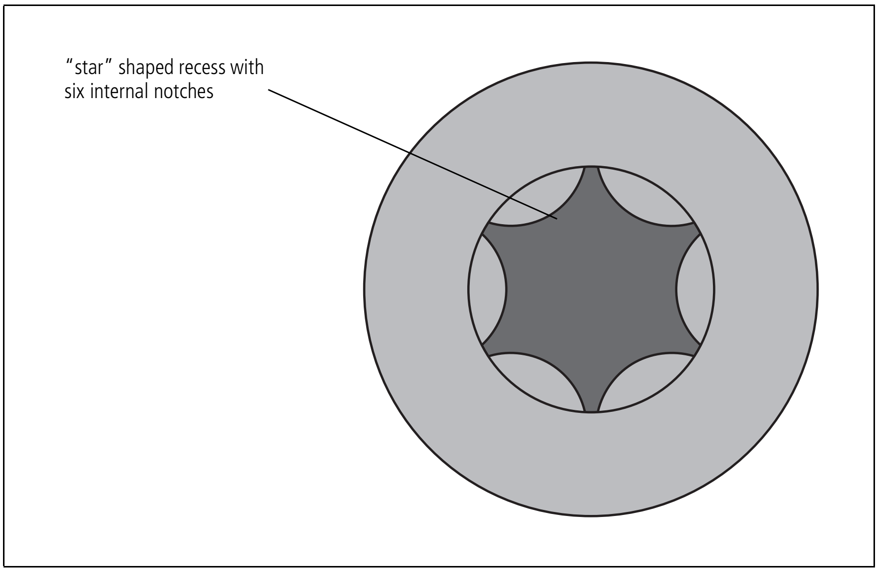
1.3 Identifying Screw Types

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



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 5.10 on page 97).

Pozidriv Recess Head Screws

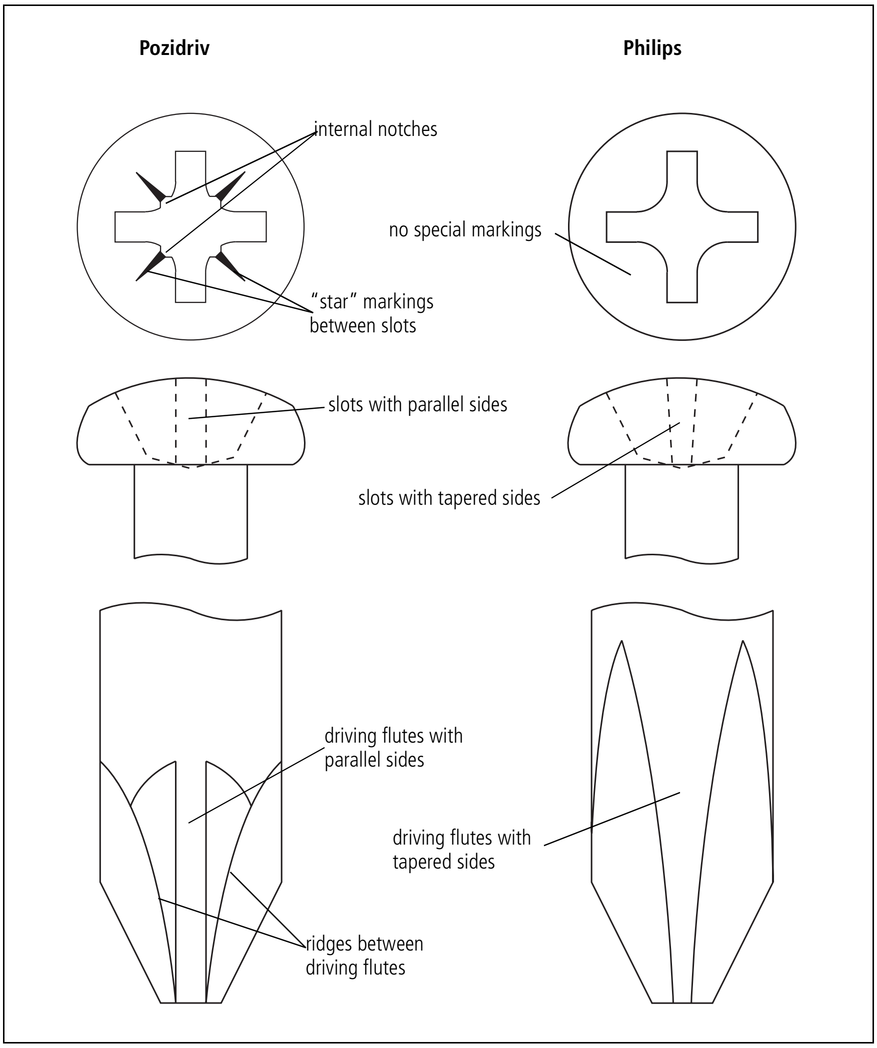
Pozidriv recess head screws are used in TB8100 equipment in a few special applications. It is important that you use the correct type and size screwdriver to avoid damaging the screw head.

It is particularly important that you do not use Philips screwdrivers on Pozidriv screw heads as the tapered driving flutes of the Philips 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 Philips 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 Philips Screws and Screwdrivers



1.4 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 BSS 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 BSS equipment.

Driver/ Spanner	Size	Location / Function
Torx T8[a]	M2.5	securing 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 PZ3	M6	DC input terminals on the PMU
3/32 in Allen key	4-40 UNC	securing the RF power transistors to the PA heatsink
5.5 mm AF[a]	M3	securing the speaker to the control panel chassis
11 mm AF		securing the BNC/TNC connectors to the reciter rear panel

a. Included in the TBA0ST2 tool kit.

1.5 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.

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.

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.
2. Start the suction and continue the movement until three or four circles have been completed.
3. Remove the tip while continuing suction to ensure that all solder is removed from the joint, then stop the suction.
4. **Before** pulling the lead out, ensure it is not stuck to the plating.
5. 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.
2. 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.
3. Fill the hole with solder and then clear with solderwick.

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.

1.6 Regulatory Information

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

1.7 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.

Information on individual PCBs is published in PCB Information Packages. This information consists of:

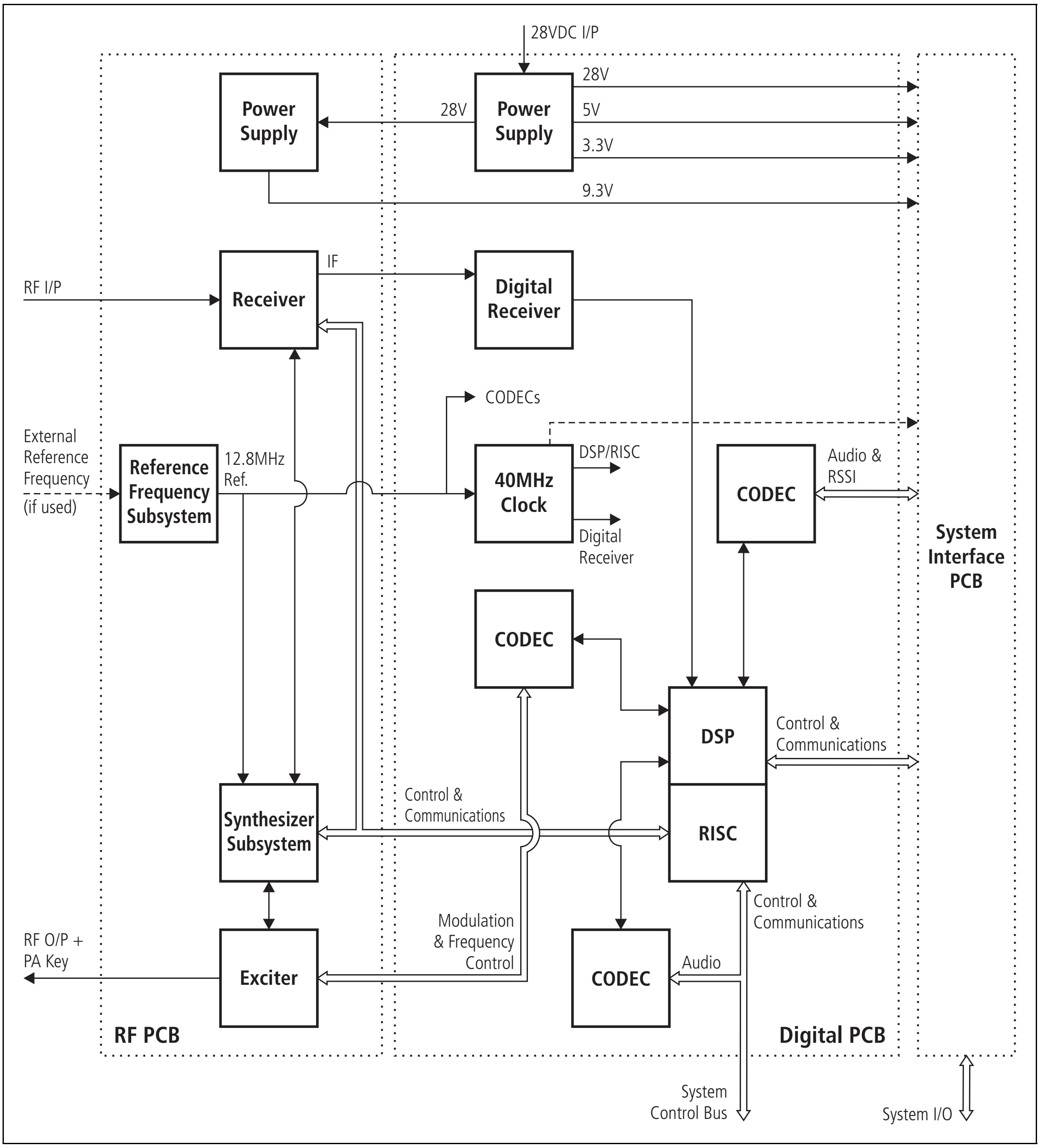
- parts lists
- grid reference indexes
- PCB layouts
- schematics (circuit diagrams).

Contact your nearest Customer Service Organisation for more details on the availability of PCB Information Packages (refer to “Tait Contact Information” on page 2).

2 Reciter Circuit Description

The reciter comprises three PCBs: an RF, a digital, and an optional system interface PCB. These PCBs are mounted on a central chassis/heatsink. Figure 2.1 below 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 PCBs are shown in Figure 2.11 on page 47 and Figure 2.12 on page 49.

Figure 2.1 Reciter High Level Block Diagram



2.1 Digital Circuitry

Refer to Figure 2.2 on page 24.

Digital IF

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.

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.

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 25kSPS and the sampling resolution is 16 bits.

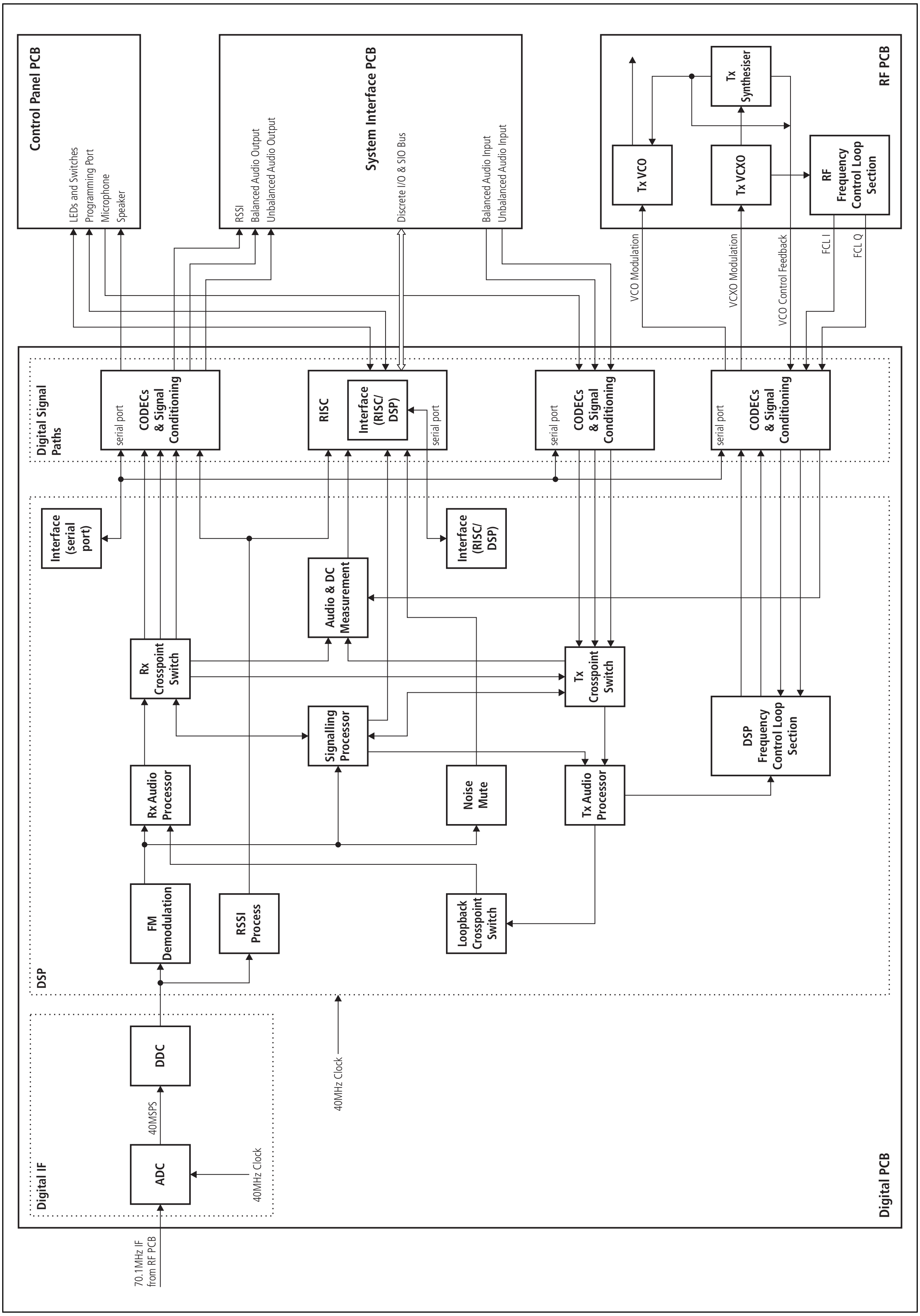
The CODEC inputs are as follows:

- 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.

Figure 2.2 Reciter Digital Circuitry Block Diagram



Reduced Instruction Set Computer (RISC)

Refer to Figure 2.3 on page 27.

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 software and CCTM
- serial peripheral interface (SPI) for programming the synthesizers
- SPI for communication with the system interface PCB
- I^2C for communication with the control panel and other modules in the subrack.

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:

- 12.8 MHz external reference synthesizer
- 40 MHz 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:

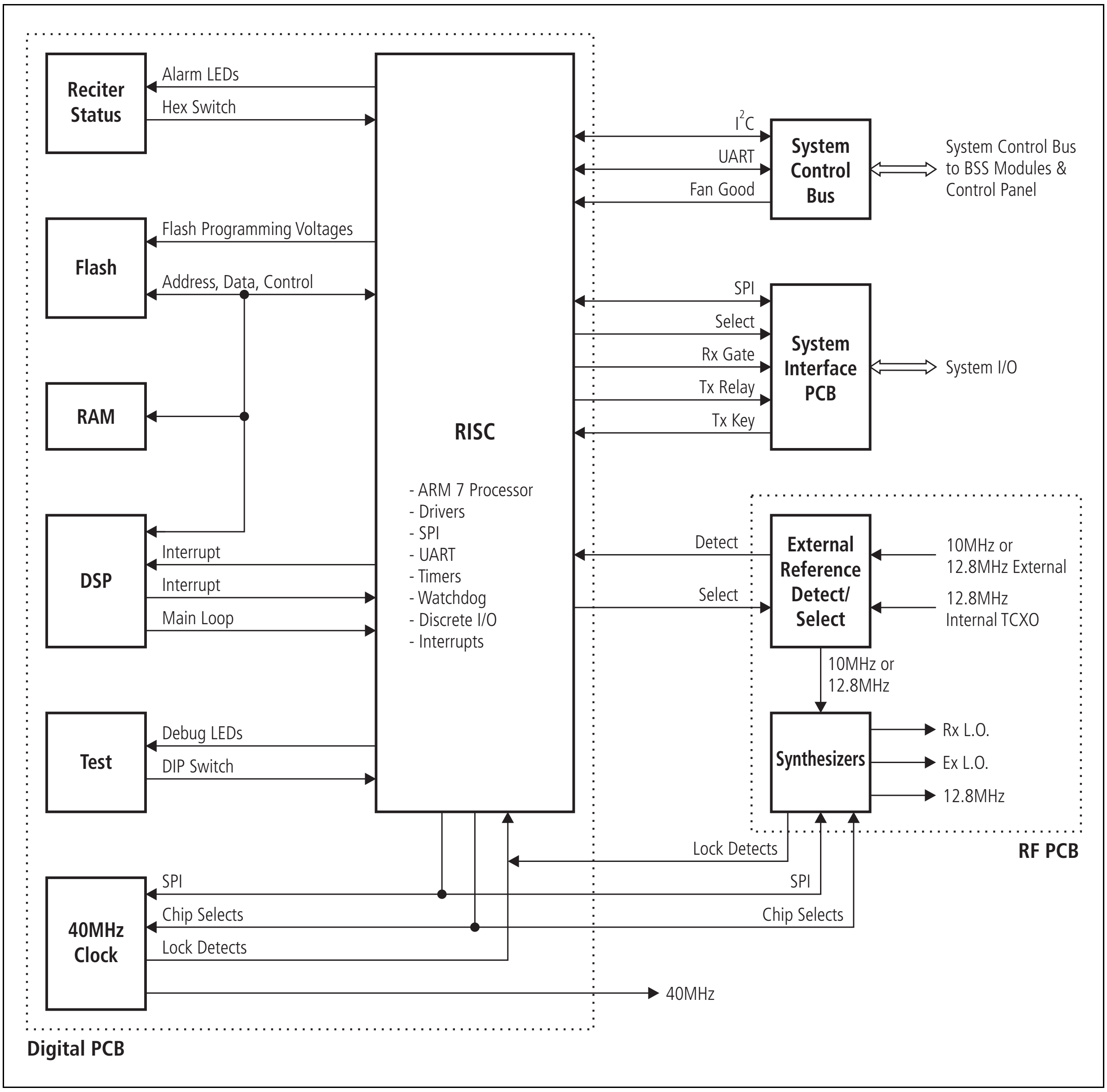
- verify that they are present
- write configuration settings
- read their current status.

The RISC subsystem communicates with the system interface PCB 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 PCB for signal conditioning.

Figure 2.3 Reciter RISC Functional Block Diagram



40 MHz Digital Clock

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

The 40 MHz 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 40 MHz VCXO to a fixed frequency and constant phase relationship with respect to a 12.8 MHz reference. The 40 MHz 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 29.

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.

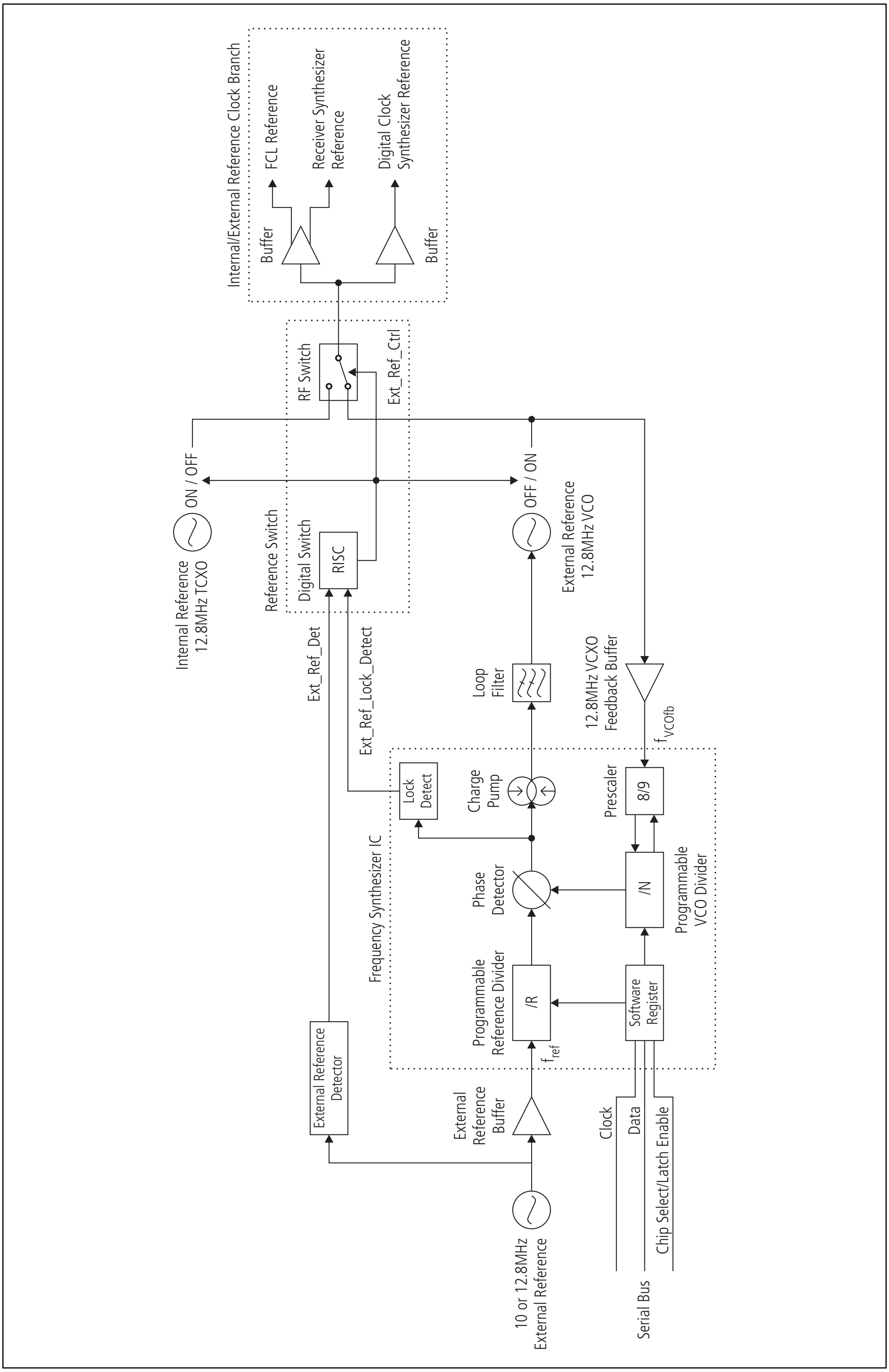
The 10MHz or 12.8MHz externally supplied reference is detected, buffered and divided down to the 100kHz divider reference within the synthesizer IC. The same divider reference is maintained by dividing the 12.8MHz VCXO feedback buffered signal using the programmable dividers of the synthesizer IC. Phase 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.

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.

Figure 2.4 Reciter External Reference Block Diagram



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

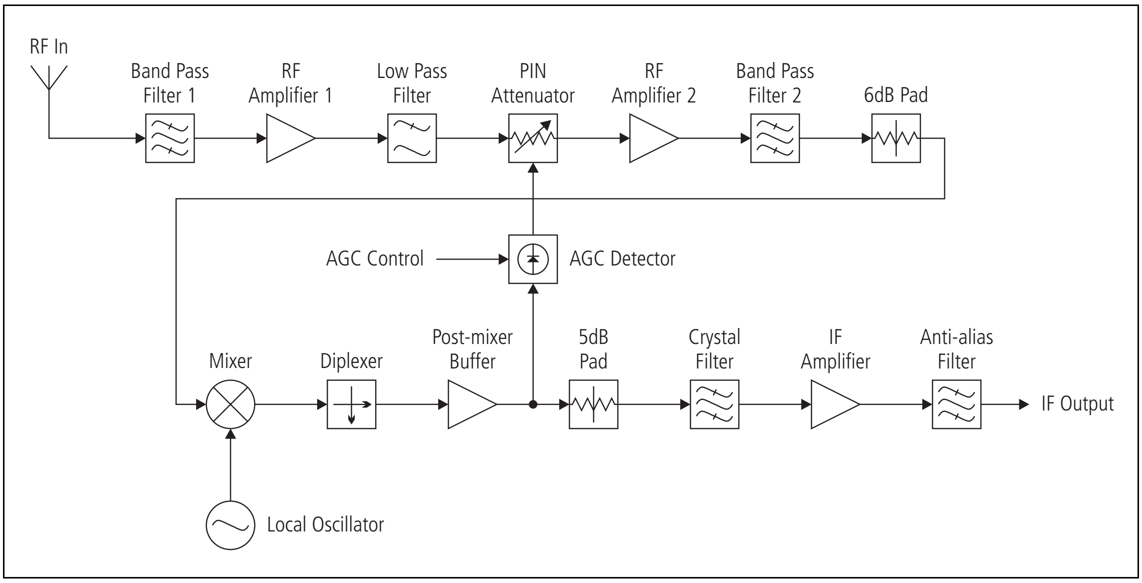
The digital switch is controlled by the RISC, which processes the Syn_Ref_Det and Lock Detect signals from the external reference synthesizer. The RISC controls the hardware switch using the Syn_Ref_Ctrl signal. The hardware switch is on if the Syn_Ref_Det **and** Lock Detect signals have a high logic 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.

2.3 Receiver RF Circuitry

Figure 2.5 Reciter Receiver RF Circuitry Block Diagram



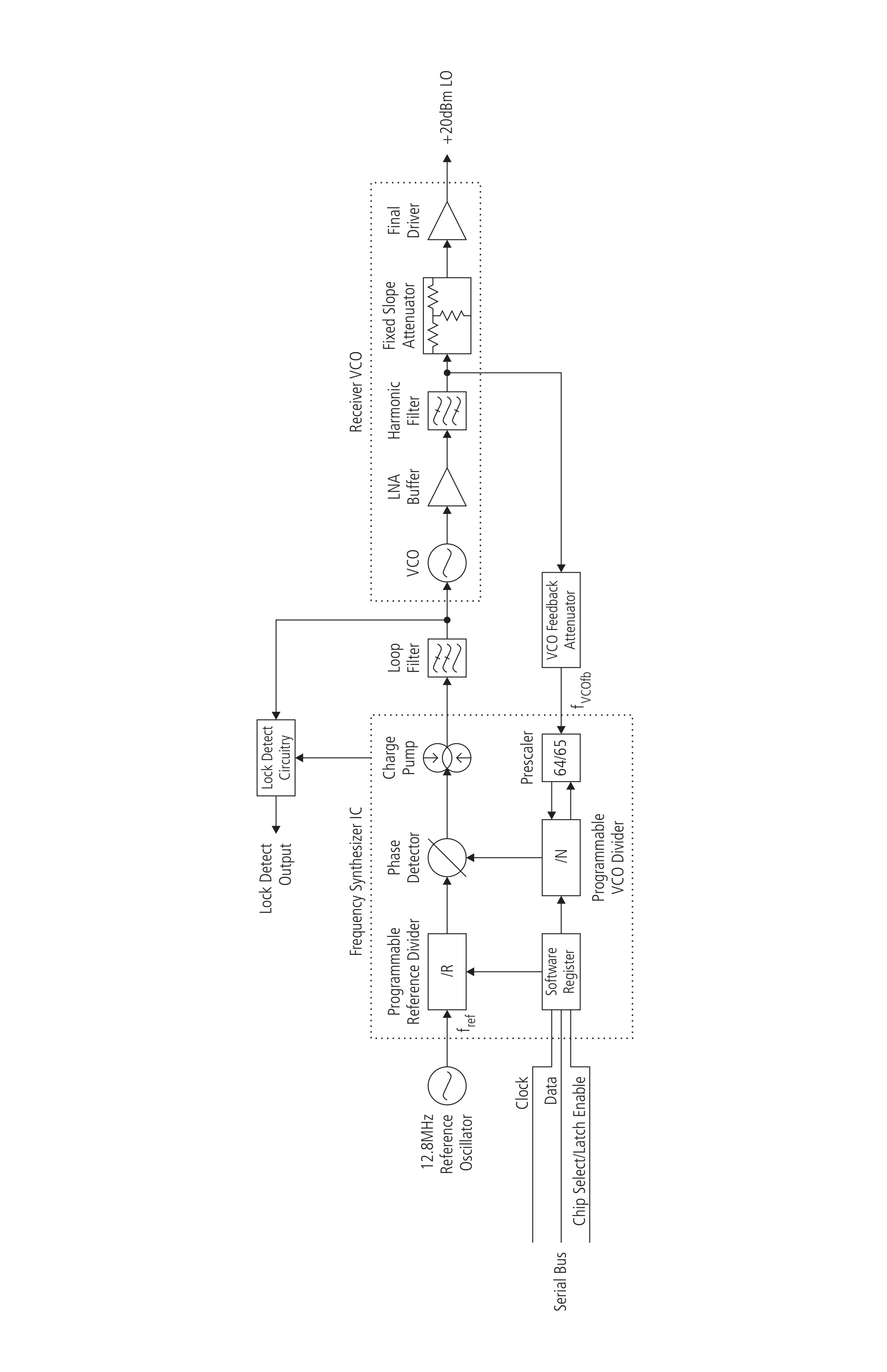
Front End

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 6 dB pad to the mixer.

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 a 3 dB attenuator pad. A diplexer terminates the IF port of the mixer in 50Ω, 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 5 dB attenuator pad.

Figure 2.6 Reciter Receiver Synthesizer Block Diagram



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 70.1MHz 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 70.1MHz, generated in the amplifier, from being sampled by the ADC at other Nyquist zones.

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 28 for details on the phase-locked 12.8MHz external reference oscillator.

The reference oscillators are buffered, branched, and divided down to the 6.25kHz (default) or 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 150Hz and filters the VCO control lines, reference side bands and spurious signals.

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

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 32.

High Q VCO

The VCO BJT transistor operates in a common collector Colpitts oscillator, 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. The oscillator has a drive level of +7dBm ±1dB.

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 delivers an output of +12dBm (nominal) before entering compression.

Harmonic Filter

The VCO has a high second harmonic content. A third order low pass elliptic filter is used to attenuate this content. It has an insertion loss of 0.5dB with 10dB of attenuation at the second harmonics.

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. This circuit delivers 20dB ±1dB of gain for a +3dBm fixed input level. 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 slope attenuator has 8dB of attenuation at the bottom of the band and a slope of $-1\,dB_{attn}$ / 100MHz.

The VCO frequency spans from either 370–410MHz, 400–450MHz or 470–510MHz according to the product type (refer to “Identifying the Reciter” on page 52). 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.

AGC

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 0 dBm. This corresponds to −30 dBm at the antenna connector, and approximately −22 dBm at the AGC pick-off point. The AGC operates over a range of approximately 11 dB.

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

2.4 Exciter RF Circuitry

Refer to Figure 2.8 on page 37.

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:

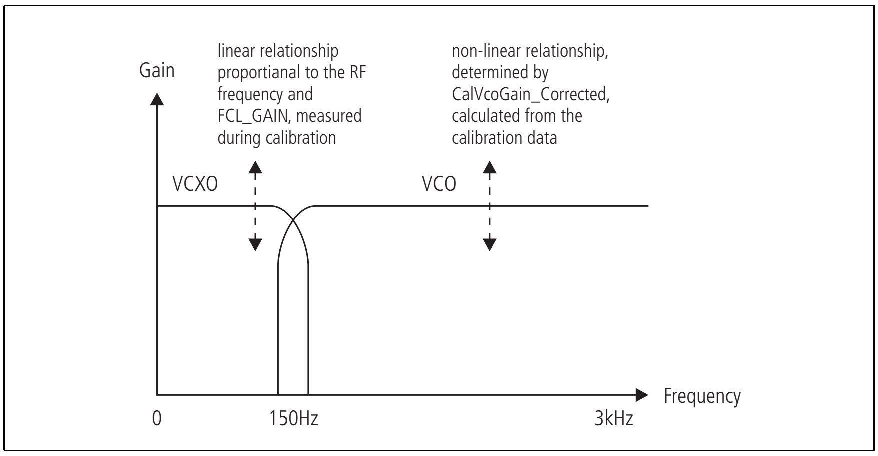
- a constant DC offset to the FCL_VCXO signal until it achieves frequency lock to the internal referenced TCXO;
- frequency modulation to the FCL_VCXO and VCO simultaneously from the transmit audio signal; the transmit audio signal has a range of 0 to 3 kHz.

The modulated signal from the VCXO is attenuated by the bandwidth of the loop filter in the low pass filter (i.e. 150 Hz). To obtain flat modulation across the audio band, the VCO is also modulated simultaneously to obtain a composite high pass filter response. Figure 2.7 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.

Figure 2.7 Comparison of VCXO and VCO Modulation Responses



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".

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.

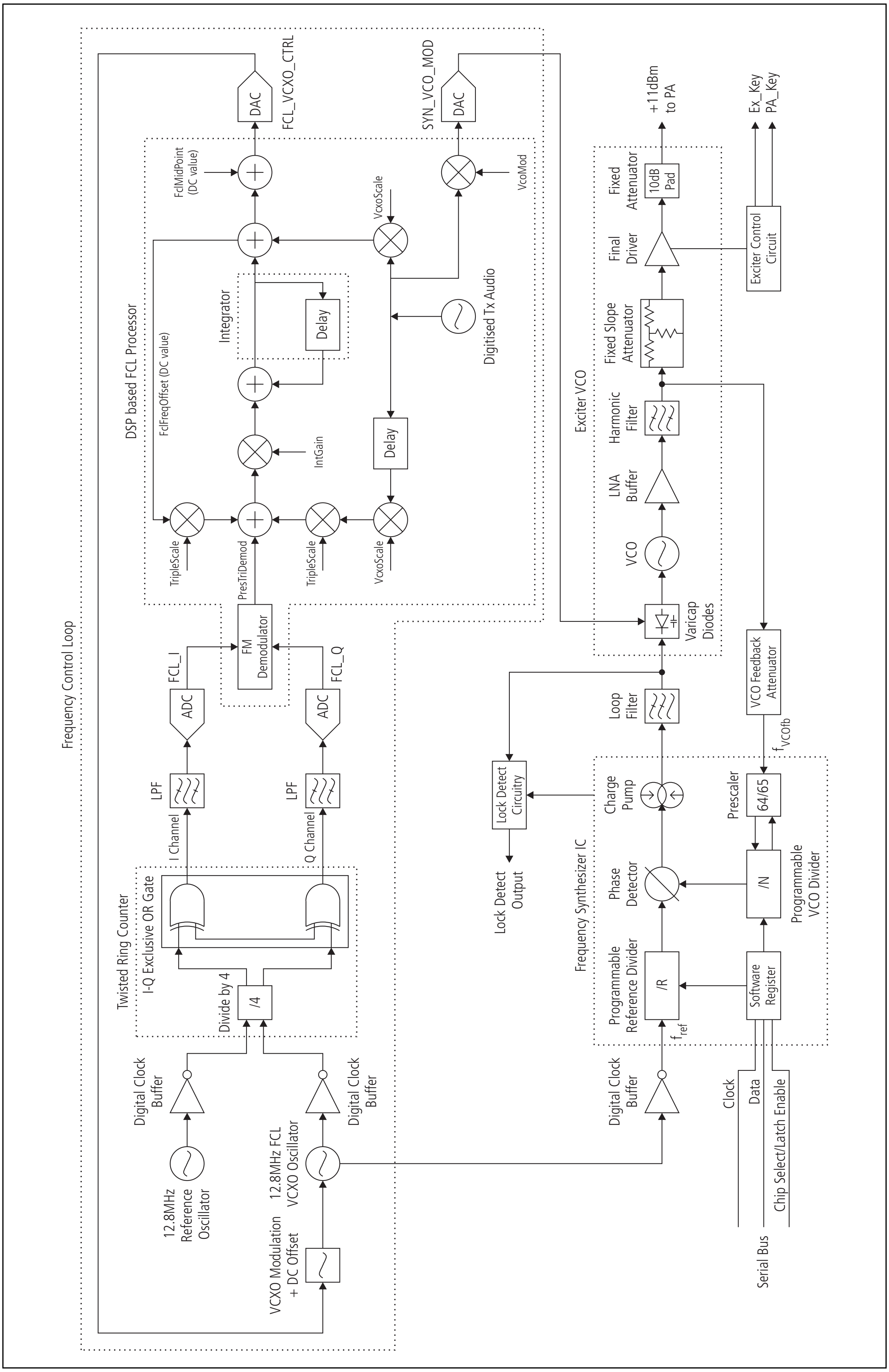
FCL Processor and DAC

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.

Figure 2.8 Reciter Exciter Synthesizer Modulator Block Diagram



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).

The FCL_VCXO reference oscillator is modulated by the FCL. The FCL itself is locked to an internal reference 12.8 MHz 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 12.8 MHz 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 28 for details on the phase-locked 12.8 MHz external reference oscillator.

The FCL_VCXO reference oscillator is buffered 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 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.

VCO

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 10 dB fixed attenuator.

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

High Q VCO

The VCO BJT transistor operates in a common collector Colpitts oscillator, 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. The oscillator has a drive level of +7 dBm ±1 dB.

Modulation Based on Varicap Diodes

Modulation on the VCO is provided by an auxiliary varicap-based control circuit which provides a modulation gain of 5 kHz/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 delivers an output of +12 dBm (nominal) before entering compression.

Harmonic Filter

The VCO has a high second harmonic content. A third order low pass elliptic filter is used to attenuate this content. It has an insertion loss of 0.5 dB with 10 dB of attenuation at the second harmonics.

Fixed Slope Attenuator, Final Driver and 10 dB Fixed Attenuator

To provide a drive of +20 dBm, a silicon-based BJT transistor is used as a broad band matched Class A final driver. This circuit delivers 20 dB ±1 dB of gain for a +3 dBm fixed input level. 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 slope attenuator has 8 dB of attenuation at the bottom of the band and a slope of $-1\,dB_{attn}$ /100 MHz. A 10 dB fixed resistive pad attenuator provides a signal level of +11 dBm ±2 dB to the input port of the PA, providing better reverse isolation.

The VCO frequency spans from either 400–440MHz, 440–480MHz or 470–520MHz according to the product type (refer to "Identifying the Reciter" on page 52).

Exciter Control Circuit

This circuit powers up and shuts down the exciter final driver in a controlled manner. During transient adjacent channel power and cyclic keying, the exciter needs to power up and shut down in a specified time sequence. 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.

2.5 System Interface PCBs

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

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

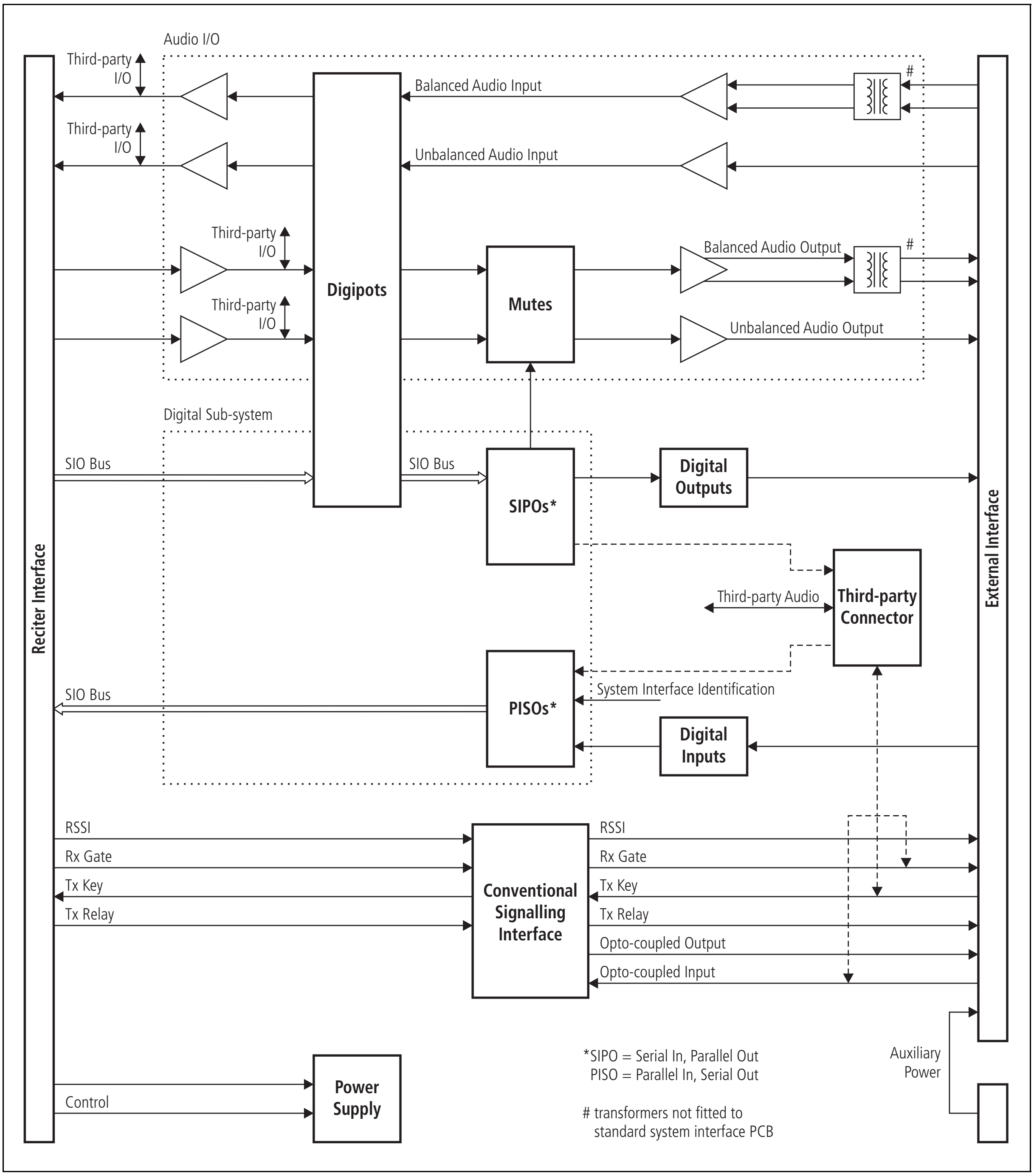
The system interface PCB is removable, which makes it possible to change the application of a reciter by removing one type of PCB and fitting another. Only one system interface PCB can be fitted to a reciter at any one time.

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 PCB. The different types of PCB and their main features are listed in the following table. Refer also to Figure 2.9 on page 41.

	System Interface PCB			
Feature	**Standard**	**Isolated**	**Isolated E & M**	**TaitNet**
balanced audio	non-isolated	isolated	isolated	isolated
unbalanced audio	✓	✓	✓	✓
RSSI	✓	✓	✓	
Rx Gate	✓	✓	✓	✓
Tx Key	✓	✓	✓	✓
digital inputs	10	10	6	1
digital outputs	2	2	2	3
Tx relay output	✓	✓	✓	
auxiliary power	✓	✓	✓	✓
opto-coupled input			✓	
opto-coupled output			✓	
third-party connector	✓	✓	✓	✓

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

Figure 2.9 Reciter System Interface PCB Block Diagram



Connections to the Reciter

The system interface PCB 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 PCB'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 PCBs which require a high rate data connection to the reciter processor.

Balanced Audio Output

The balanced audio output is a 600Ω audio interface. The output level can be set over the range −20dBm to +10dBm, for 60% modulation. The output level can be set with a resolution of 0.1dB. 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 (>10kΩ). The output level can be set over the range 0.3Vpp to 3.0Vpp, for 60% modulation. The output level can be set with a resolution of 0.1Vpp. This output is AC coupled.

Balanced Audio Input

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

Unbalanced Audio Input

The unbalanced audio input is a high impedance input (>10kΩ). The input level can be set over the range 0.3Vpp to 3.0Vpp, for 60% modulation. The input level can be set with a resolution of 0.1Vpp. This input is AC coupled.

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 100mA. The maximum voltage that should be applied to this output is 30V.

Tx Key

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

Digital Inputs

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

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.

Power Supplies

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

2.6 Power Supply

The reciter is designed to operate from the +28V regulated supply provided by the PMU. The nominal +28V supply enters the reciter digital PCB 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 PCB and another on the RF PCB.

RF PCB

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 PCB (via the digital PCB).

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

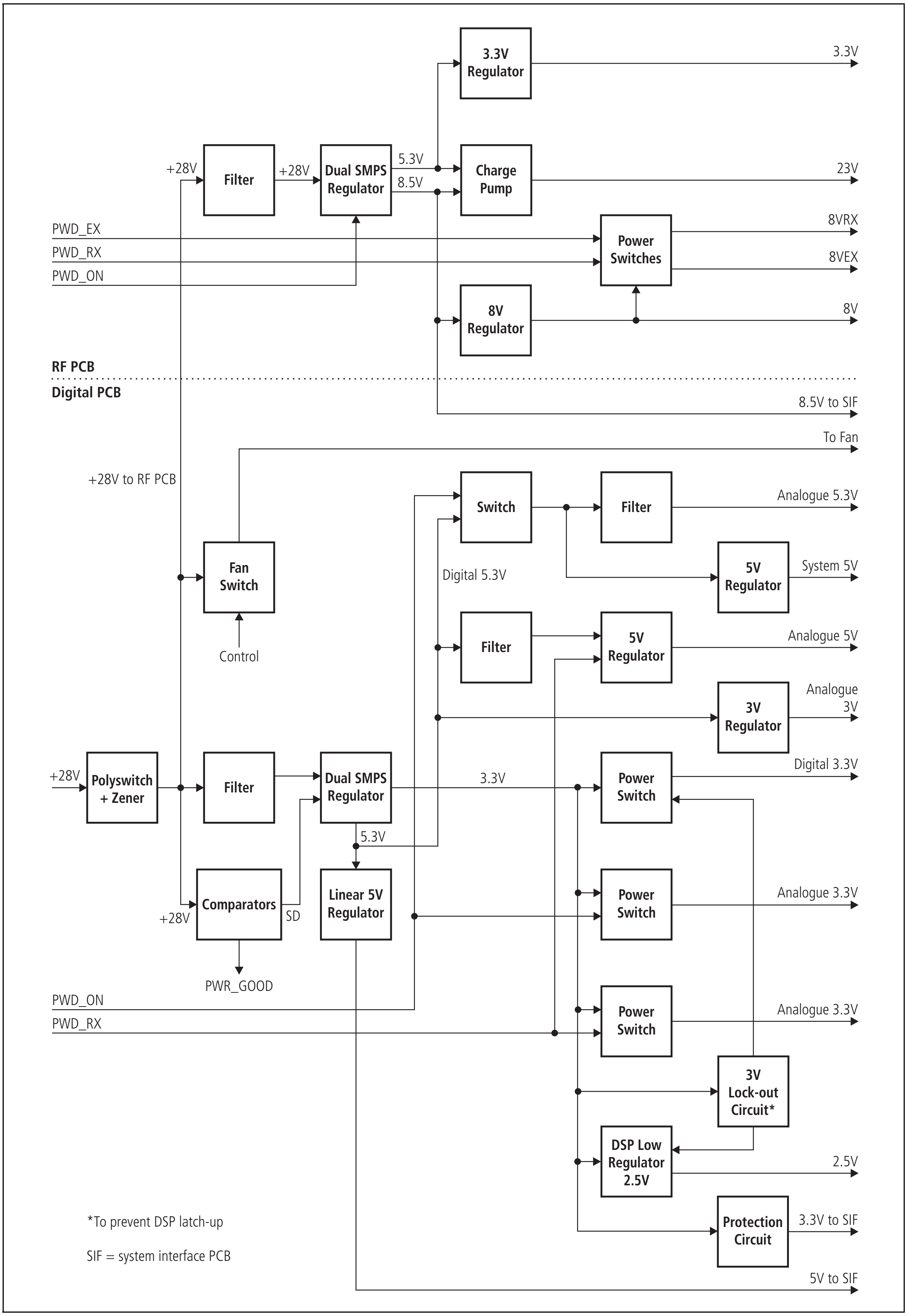
The RF PCB has a charge pump converter that generates +23V from both the +5.3V and +8.5V supplies. This is used to supply the active loop filters of the RF synthesizers. The +8.5V output and the +5.3V supply to the charge pump can be switched as part of the power saving modes.

Digital PCB

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.

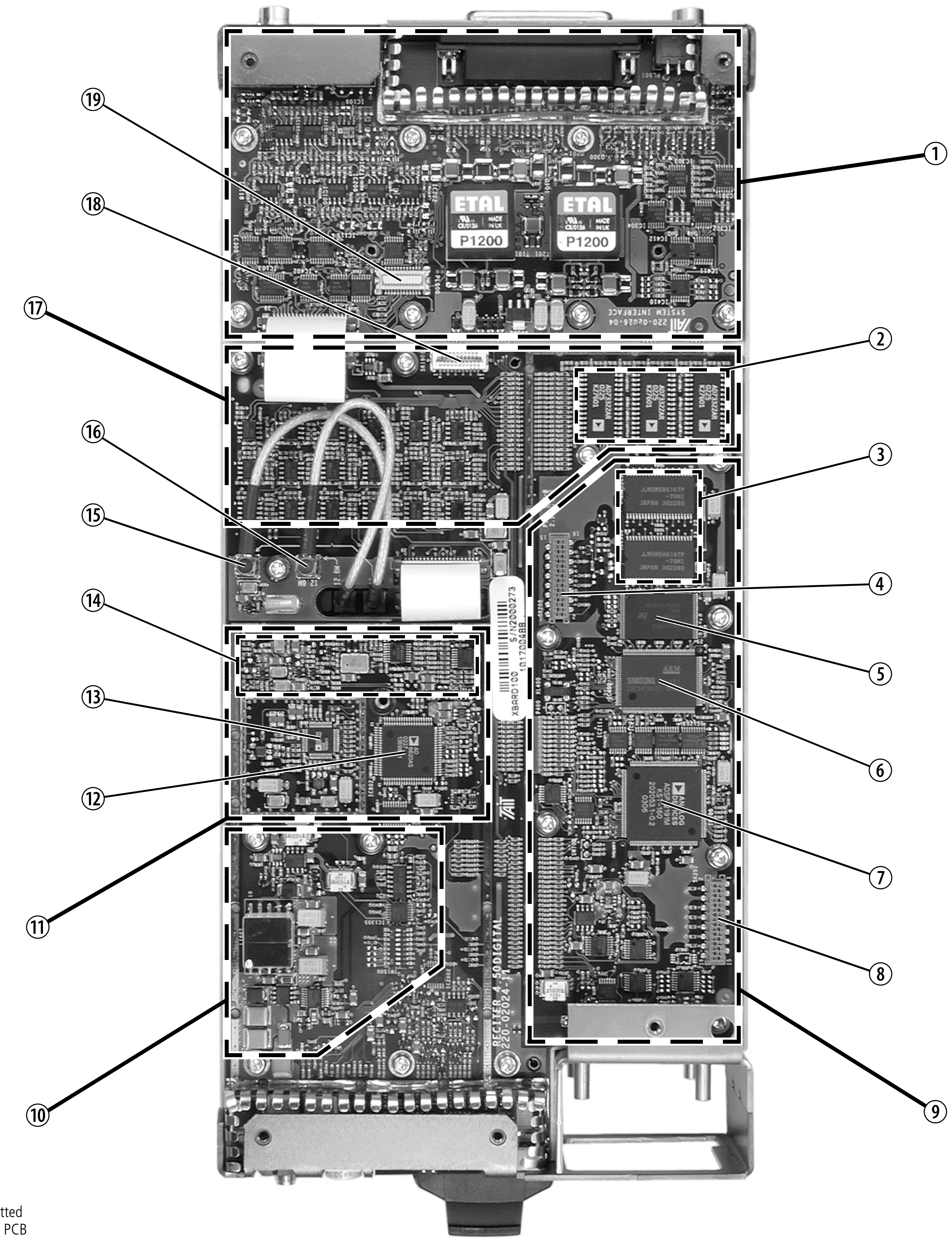
Figure 2.10 Reciter Power Supply Block Diagram



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 PCB via a protection circuit.

Figure 2.11 Identifying the Circuitry on the Digital and System Interface PCBs

1. system interface PCB
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. 70.1MHz IF
16. 12.8MHz reference
17. audio
18. high speed data connector
19. third-party connector

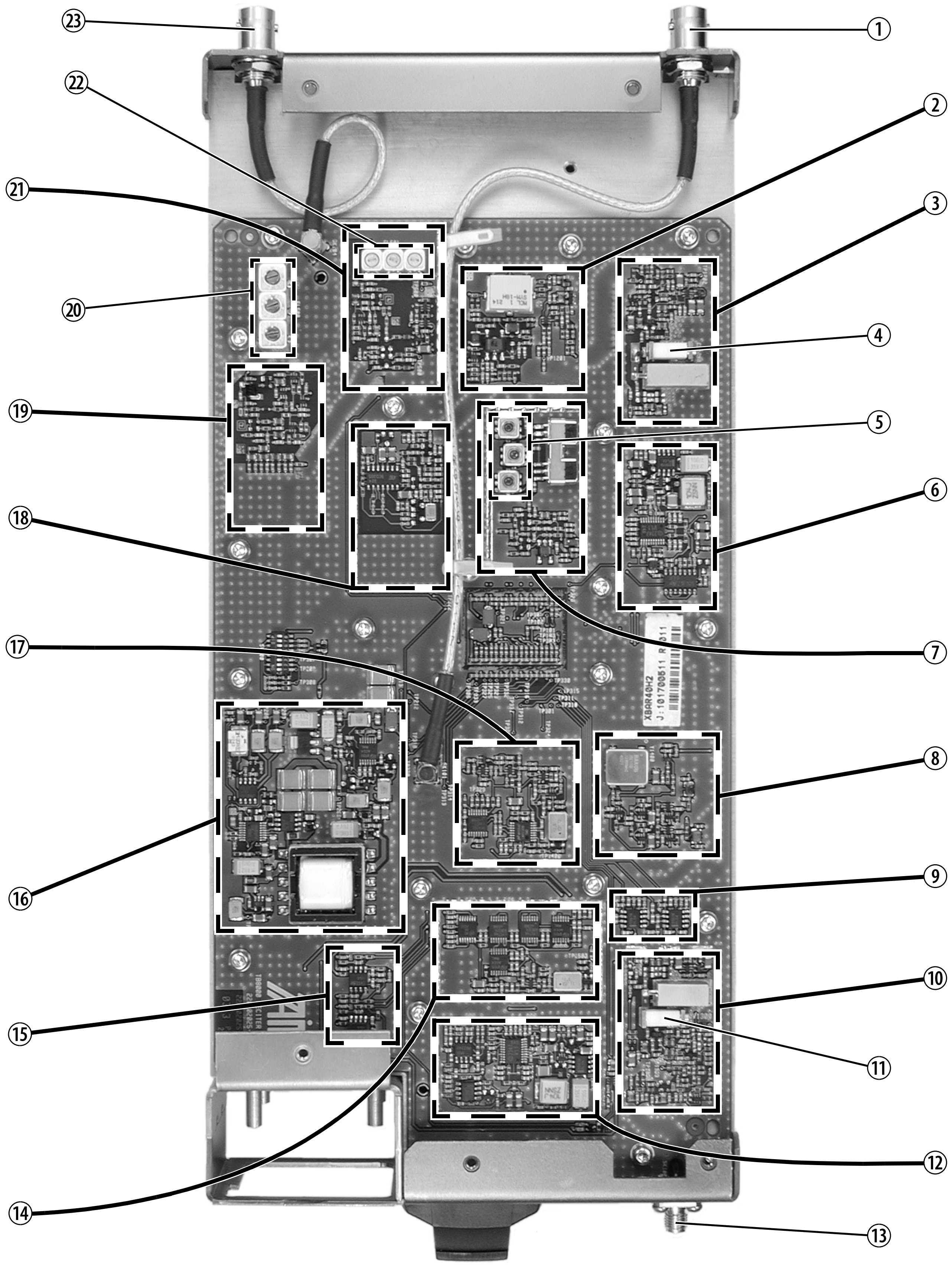


UHF (H band) reciter shown fitted
with isolated system interface PCB

Figure 2.12 Identifying the Circuitry on the RF PCB

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.



UHF (H band) reciter shown

3 Reciter Servicing

Important This equipment contains devices which are susceptible to damage from static charges. Refer to "ESD Precautions" on page 15 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 individual PCBs.

Figure 3.6 on page 65 identifies the main mechanical parts, and Figure 3.1 on page 53 identifies the individual PCBs. "Identifying the Reciter" on page 52 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 PCB. However, the same basic procedures and techniques apply to other models of reciter and system interface PCB.

3.1 Disassembly and Reassembly

Identifying the Reciter

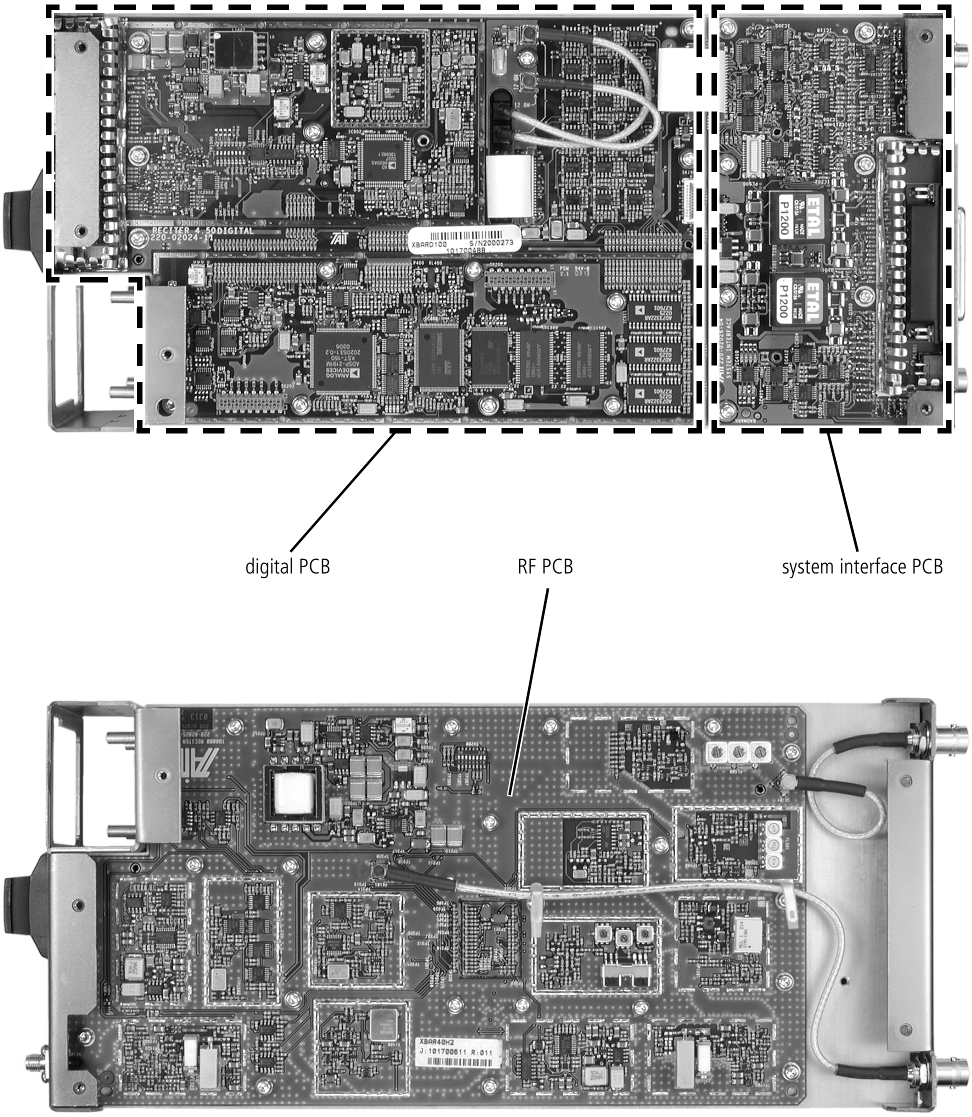
You can identify the model and hardware configuration of a reciter by referring to the product code printed on a label on the rear panel. The meaning of each character in the product code is explained in the table below.

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 for more information regarding the availability of specific models and options.

Product Code	Description
TBA**X**XXX-XXXX	4 = reciter
TBA4**X**XX-XXXX	0 = default
TBA4X**XX**-XXXX	**Frequency Band and Sub-band** B2 = 136 MHz to 156 MHz B3 = 148 MHz to 174 MHz C2 = 174 MHz to 193 MHz C3 = 193 MHz to 225 MHz H1 = 400 MHz to 440 MHz H2 = 440 MHz to 480 MHz H3 = 470 MHz to 520 MHz K2 = 762 MHz to 870 MHz[a]
TBA4XXX-**XXX**X	**System Interface PCB** 000 = no system interface PCB fitted 0A0 = standard 0B0 = isolated 0C0 = isolated E & M 0T1 = TaitNet
TBA4XXX-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 PCBs



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

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 PCBs 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	

Removing the Covers

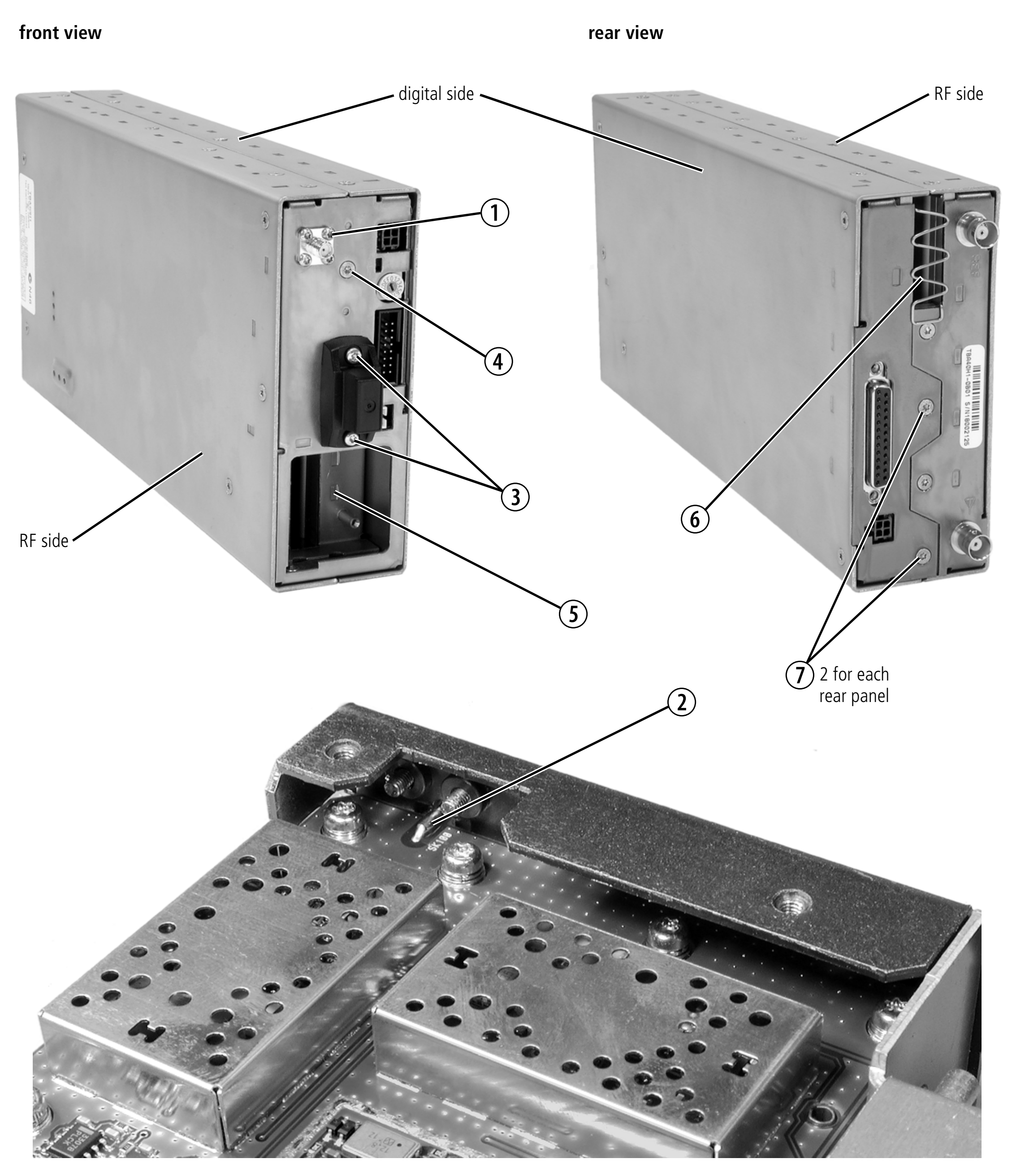
1. Remove the M3 Torx screws securing the covers to the heatsink, and to the front and rear panels. Lift off the covers.

Removing the Front and Rear Panels

The circled numbers in the following instructions refer to Figure 3.2.

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 PCB 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 PCB.

Figure 3.2 Removing the Front and Rear Panels



Refitting the Front and Rear Panels

The circled numbers in the following instructions refer to Figure 3.2.

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 PCB.

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 PCB.

7. Refit the vent guard clip ⑥.

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.

3.2 Replacing the Digital PCB

Important You must reprogram and recalibrate the reciter after replacing the digital PCB. Refer to “Reprogramming and Recalibration” on page 59.

Refer to Section 3.1 “Disassembly and Reassembly” for details on removing and refitting the covers and front and rear panels. The circled numbers in the following instructions refer to Figure 3.3.

Removal

1. Remove the digital side cover and the front panel.

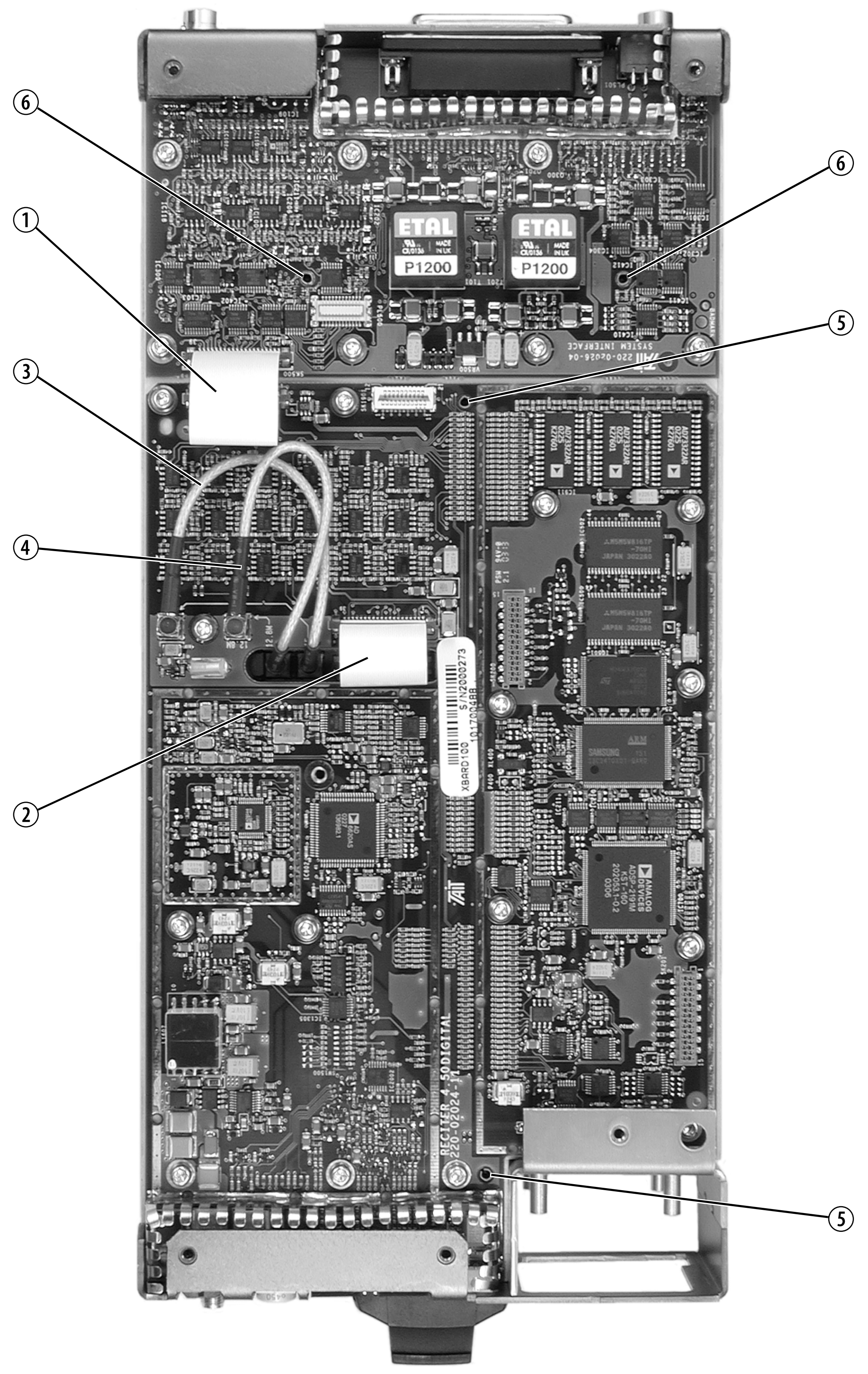
2. Disconnect the flexible connectors to the system interface PCB ① and RF PCB ② from their respective sockets on the digital PCB.

3. Disconnect the 70.1 MHz IF ③ and 12.8 MHz reference ④ coaxial cables.

4. Remove the M3 Torx screws securing the PCB to the heatsink.

5. Carefully lift the PCB upwards off the locating pins ⑤ and remove it from the heatsink, feeding the coaxial cables and flexible connector through the slot in the PCB. Take care not to dislodge the flexible connector from its socket on the RF PCB.

Figure 3.3 Replacing the Digital and System Interface PCBs



Refitting

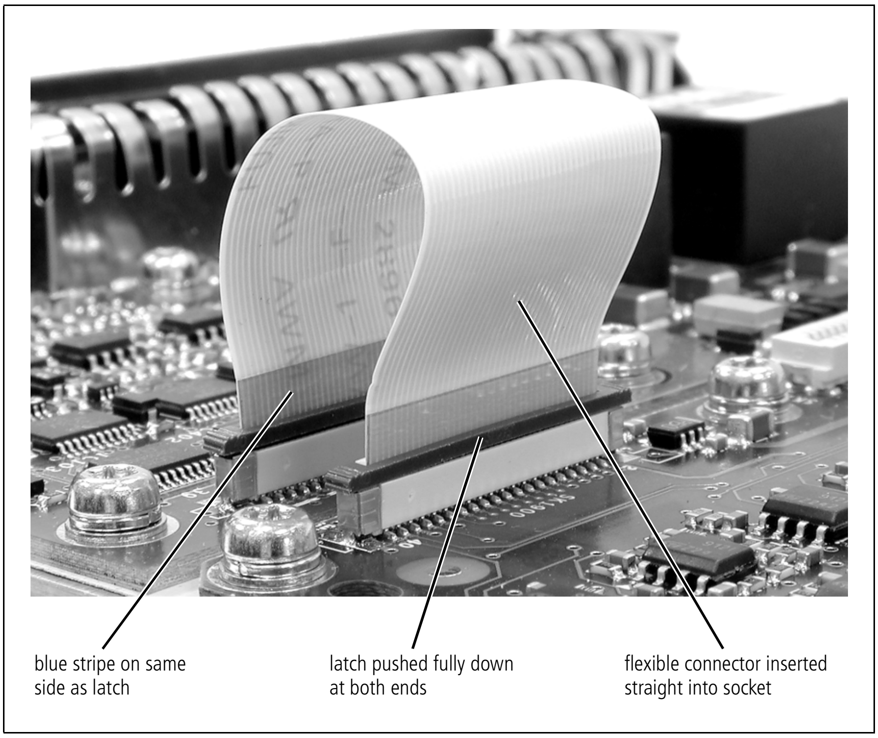
1. To refit the PCB, follow the removal instructions in reverse order.

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 PCB 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 PCBs.**

Important Make sure the flexible connectors are correctly positioned and latched in their sockets, as shown in Figure 3.4.

Note Before tightening the screws, press the PCB 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 PCB to the edges.

Figure 3.4 Reconnecting the Flexible Connectors



Reprogramming and Recalibration

If you have replaced the digital PCB, you will have to reprogram and recalibrate the reciter as described in the table below.

Procedure	Details
■ reprogram the product code ■ reprogram the reciter type	reprogram this information into the reciter using the Calibration Kit software; refer to the Calibration Kit documentation for more details
reprogram the feature licence keys (if necessary)	you will need to reprogram new feature licence keys into the reciter to re-enable any software features that were previously enabled; you will need to use the Service Kit software to do this; contact your nearest Tait Customer Service Organisation for further details about obtaining feature licence keys
replace the serial number label	the serial number of the reciter will change to the number already programmed into the replacement digital PCB; stick the new serial number label onto the rear panel
■ calibrate the exciter ■ calibrate the RSSI ■ calibrate the audio ■ adjust the receiver lock band (switching range) ■ tune the receiver ■ adjust the exciter lock band	carry out these procedures **in the order shown** using the Calibration Kit software; refer to the Calibration Kit documentation for more details

3.3 Replacing the System Interface PCB

Important You must reprogram and recalibrate the reciter after replacing the system interface PCB. Refer to "Reprogramming and Recalibration" on page 60.

Refer to Section 3.1 "Disassembly and Reassembly" for details on removing and refitting the covers and front and rear panels. The circled numbers in the following instructions refer to Figure 3.3 on page 57.

Removal

1. Remove the digital side cover and rear panel.
2. Disconnect the flexible connector to the digital PCB ① from the socket on the system interface PCB.
3. Remove the M3 Torx screws securing the PCB to the heatsink.
4. Carefully lift the PCB upwards off the locating pins ⑥ and remove it from the heatsink.

Refitting

1. To refit the PCB, 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 PCB 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 PCBs.**

Important Make sure the flexible connector is correctly positioned and latched in its socket, as shown in Figure 3.4 on page 58.

Note Before tightening the screws, press the PCB 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 PCB to the edges.

Reprogramming and Recalibration

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

PCB Type	Procedure	Details
when the replacement system interface PCB 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 software; refer to the Calibration Kit documentation for more details
	calibrate the audio	carry out this procedure using the Calibration Kit software; refer to the Calibration Kit documentation for more details
when the replacement system interface PCB is the same type as the original	calibrate the audio	carry out this procedure using the Calibration Kit software; refer to the Calibration Kit documentation for more details

3.4 Replacing the RF PCB

Important You must recalibrate the reciter after replacing the RF PCB. Refer to "Recalibration" on page 63.

Refer to Section 3.1 "Disassembly and Reassembly" for details on removing and refitting the covers and front and rear panels. Unless otherwise indicated, the circled numbers in the following instructions refer to Figure 3.5.

Removal

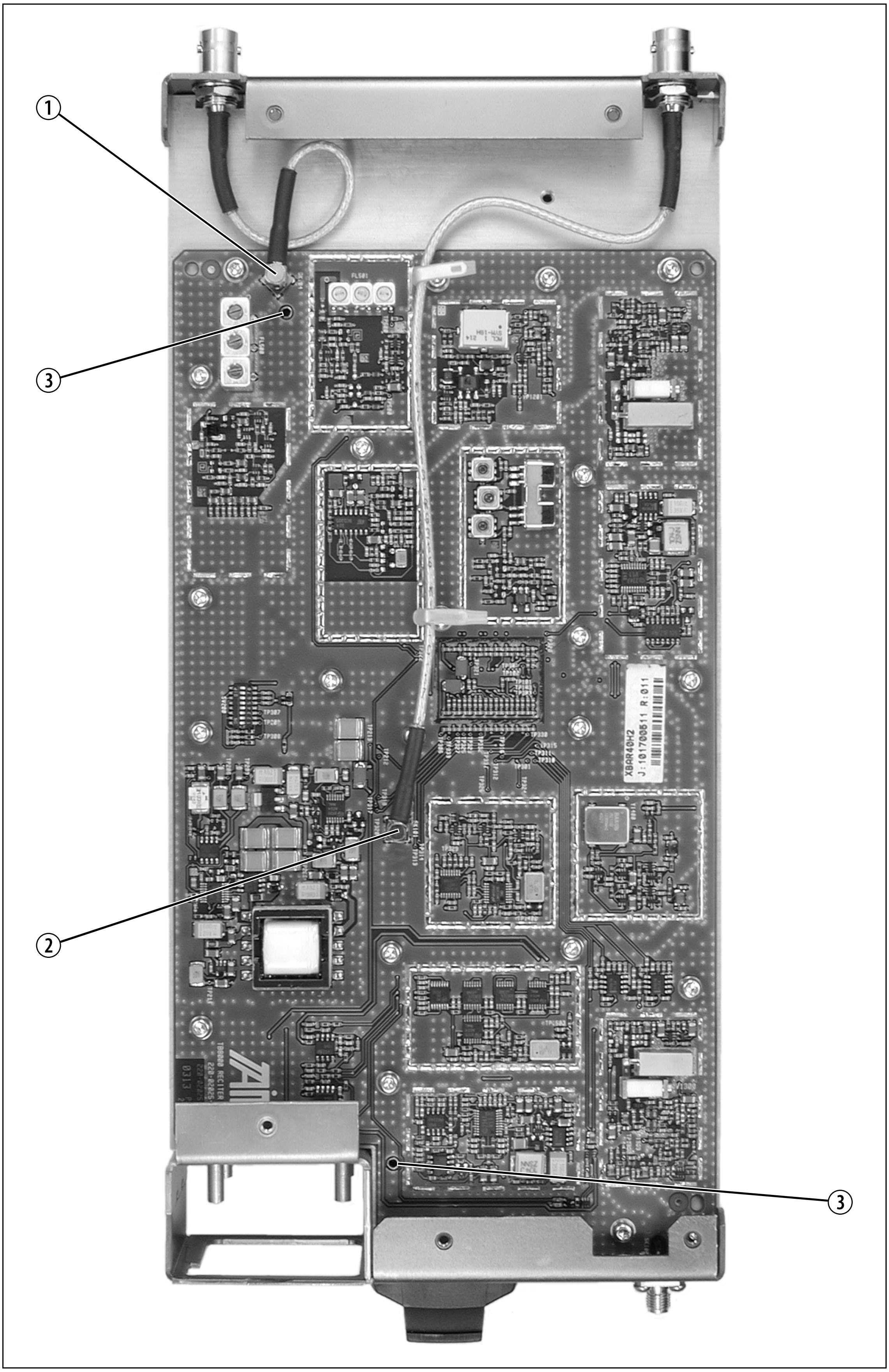
1. Remove both covers and the front panel.
2. Disconnect the flexible connector to the digital PCB ② from its socket on the digital PCB (refer to Figure 3.3 on page 57).
3. Disconnect the 70.1 MHz IF ③ and 12.8 MHz reference ④ coaxial cables from their sockets on the digital PCB (refer to Figure 3.3).
4. Disconnect the RF input ① and external reference ② coaxial cables from their sockets on the RF PCB.
5. Remove the M3 Torx screws securing the PCB to the heatsink.
6. Carefully lift the PCB upwards off the locating pins ③ and remove it from the heatsink, feeding the coaxial cables and flexible connector through the slot in the heatsink.

Refitting

1. Make sure that the 70.1 MHz IF and 12.8 MHz reference coaxial cables are secure in their sockets on the bottom of the RF PCB.
2. Make sure that the flexible connector is correctly positioned and latched in its socket on the bottom of the RF PCB (refer to Figure 3.4 on page 58).
3. Refit the PCB, following the removal instructions in reverse order.

Note Before tightening the screws, press the PCB 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 PCB to the edges.

Figure 3.5 Replacing the RF PCB



Recalibration

If you have replaced the RF PCB, you will have to recalibrate the reciter as described in the table below.

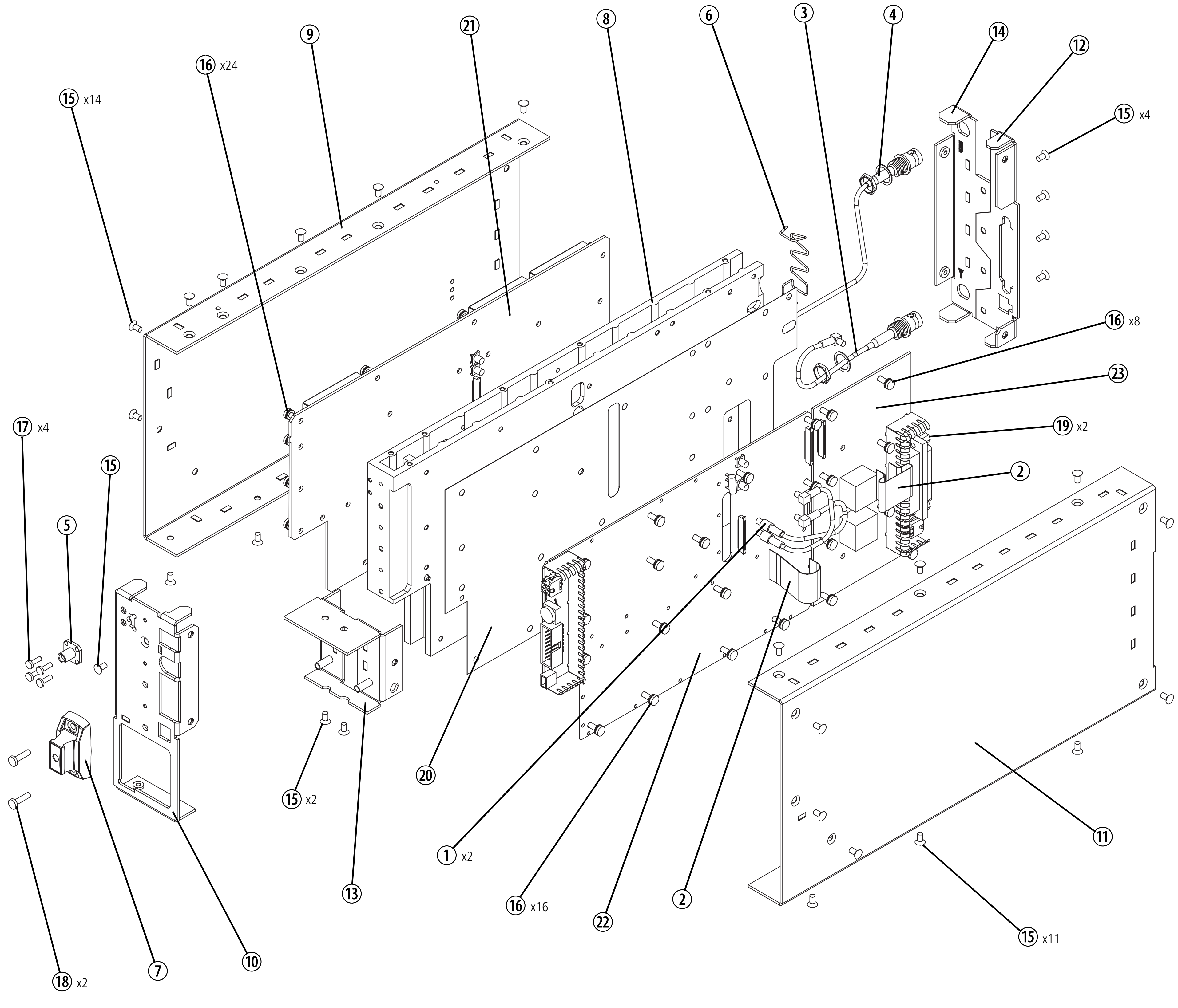
Important Do not adjust the IF.

Procedure	Details
■ calibrate the exciter ■ calibrate the RSSI ■ adjust the receiver lock band (switching range) ■ tune the receiver ■ adjust the exciter lock band	carry out these procedures **in the order shown** using the Calibration Kit software; refer to the Calibration Kit documentation for more details

Figure 3.6 Reciter Mechanical Assembly

	Description	IPN
①	70.1 MHz 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 PCB fitted:	
	standard, isolated, isolated E & M	316-06798-XX
	TaitNet	316-06799-XX
	none	316-06802-XX
⑬	fan duct	316-06804-XX
⑭	rear panel - RF side	316-06805-XX
⑮	M3x6 mm countersunk Torx screw	345-40460-XX
⑯	M3x8 mm pan head Torx screw with spring & flat washers	345-40470-XX
⑰	M2.5x8 mm pan head Torx screw	345-40490-XX
⑱	M3x12 mm 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 PCB	
㉒	digital PCB	
㉓	system interface PCB	

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.



4 Power Amplifier Circuit Description

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

Figure 4.1 below shows the configuration for a 100 W PA, along with the main inputs and outputs for power, RF and control signals. The 100 W PA consists of:

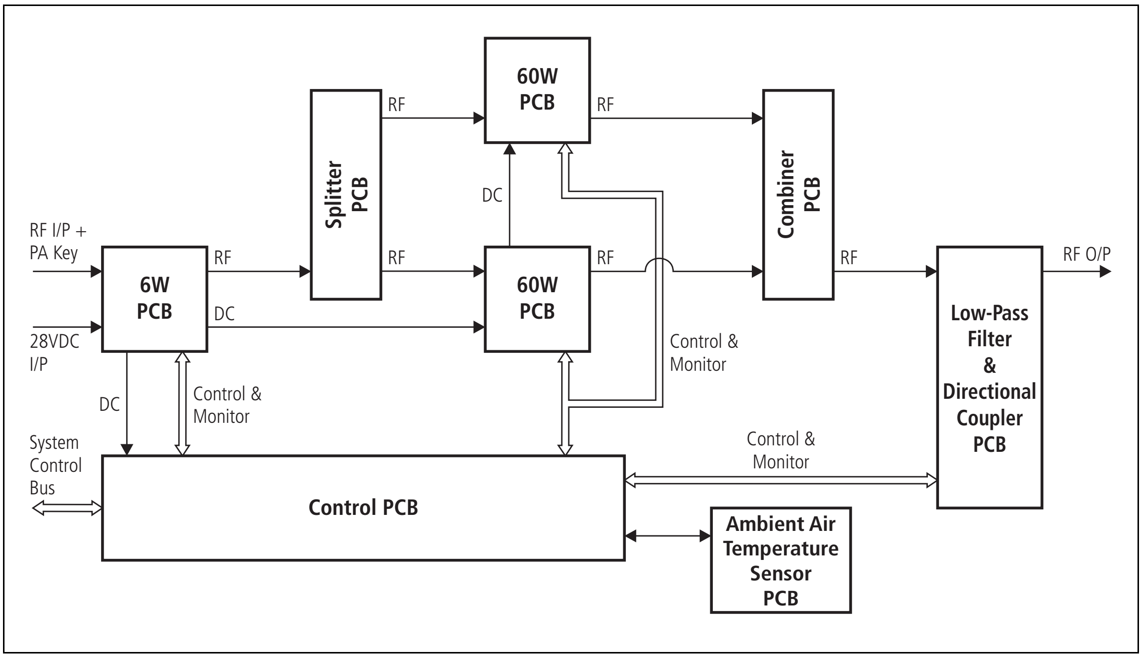
- a 6 W PCB
- two quadrature-combined 60 W PCBs
- a splitter PCB and a combiner PCB
- a low pass filter and directional coupler PCB
- a control PCB.

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

RF interconnect PCBs are also used in some configurations to connect the PCBs together. The type of interconnect PCB used depends on the configuration of the PA. Figure 5.1 on page 79 shows the different configurations for the 5 W, 50 W and 100 W PAs.

The locations of the main circuit blocks on the PCBs are shown in Figure 4.3 on page 75.

Figure 4.1 PA High Level Block Diagram



4.1 Microprocessor Control Circuitry

Refer to Figure 4.2 on page 70.

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 software.

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.

Diagnostics and Alarms

The diagnostic functions and alarms monitored by the PA include:

- the temperature of the 6W PCB
- the temperatures of 60W PCB 1 (50W and 100W PAs) and 60W PCB 2 (100W PA)
- the ambient temperature of the intake air[1]
- forward and reverse power
- load VSWR
- the transmit current of the 6W driver transistor
- the transmit current of the final transistors on 60W PCB 1 (50W and 100W PAs) and 60W PCB 2 (100W PA)
- the current imbalance between the final transistors on 60W PCBs 1 and 2 (100W 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 software. 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.

1. Ambient temperature is defined as the temperature of the air at the intake to the cooling fan.

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.

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.

Foldback

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

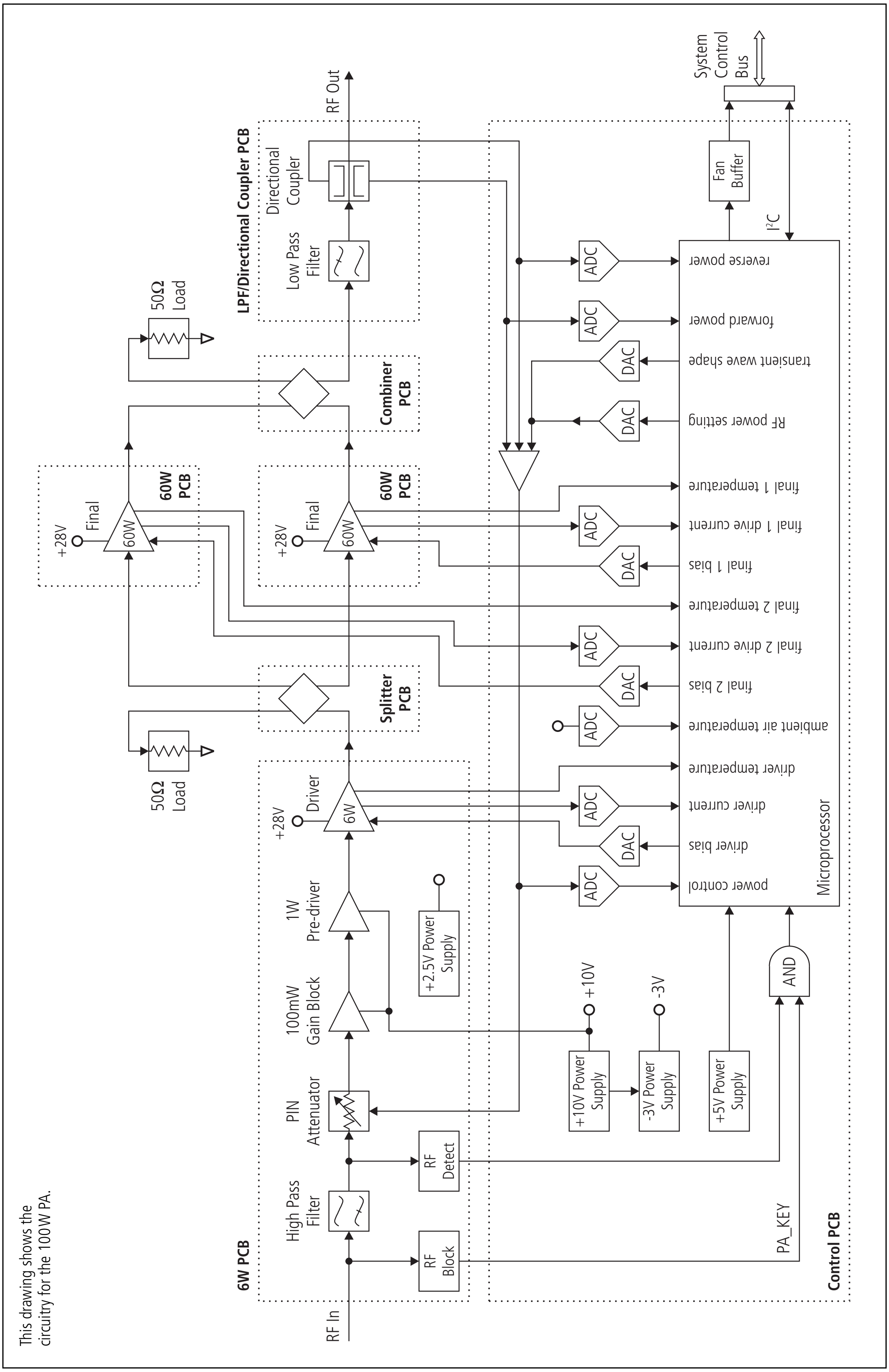
- the temperature of the 6W PCB, 60W PCB 1 or 60W PCB 2 exceeds the maximum allowable temperature
- the supply voltage drops to between 24 and 26VDC or rises to between 30 and 32VDC
- the load VSWR is ≥10:1 (foldback is deactivated when the VSWR <5:1)
- the transmit current of the 6W driver transistor, 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 4.2 PA Control, RF and Power Supply Circuitry Block Diagram



Shutdown

The PA software will prevent transmission under the following conditions:

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

Calibration

You can calibrate the bias currents and output power settings of the 6W driver and 60W final transistors using the Calibration Kit software. However, this calibration is only required if components in the RF signal path have been altered.

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 1W and the range of output power settings is:

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

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.

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 software. The fan remains on until the operating temperature of the PA falls to 5°C below the threshold temperature.

The fan is also turned on for 30 seconds before an ambient temperature measurement is taken. This is necessary as the ambient temperature sensor requires airflow to perform an accurate temperature measurement.

Power is supplied to the fan via the 16-way ribbon cable from the PA to the subrack interconnect PCB. 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.

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.

Temperature Monitoring

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

If any PCB 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 software. In addition to activating alarms, the PCB 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.

Ambient Air Temperature Sensor

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

Note You must fit the sensor PCB in the correct location to ensure that the temperature of the airflow over the sensor is nearest the ambient temperature of the air at the intake to the cooling fan. Figure 5.1 on page 79 shows the correct location of the sensor PCB in each model of PA.

4.2 RF Circuitry

Refer to Figure 4.2 on page 70.

6W PCB

The 11dBm (±2dB) 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 100mW gain block and a 1W gain stage to a 6W transistor where it is amplified to the final output level of 6W. This 6W transistor forms the output stage of the 5W PA and is the driver stage for the 50W and 100W PAs.

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

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

60W PCB

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

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

Low Pass Filter and Directional Coupler PCB

The output from the 60 W PCB 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 output power.

Splitter and Combiner PCBs

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

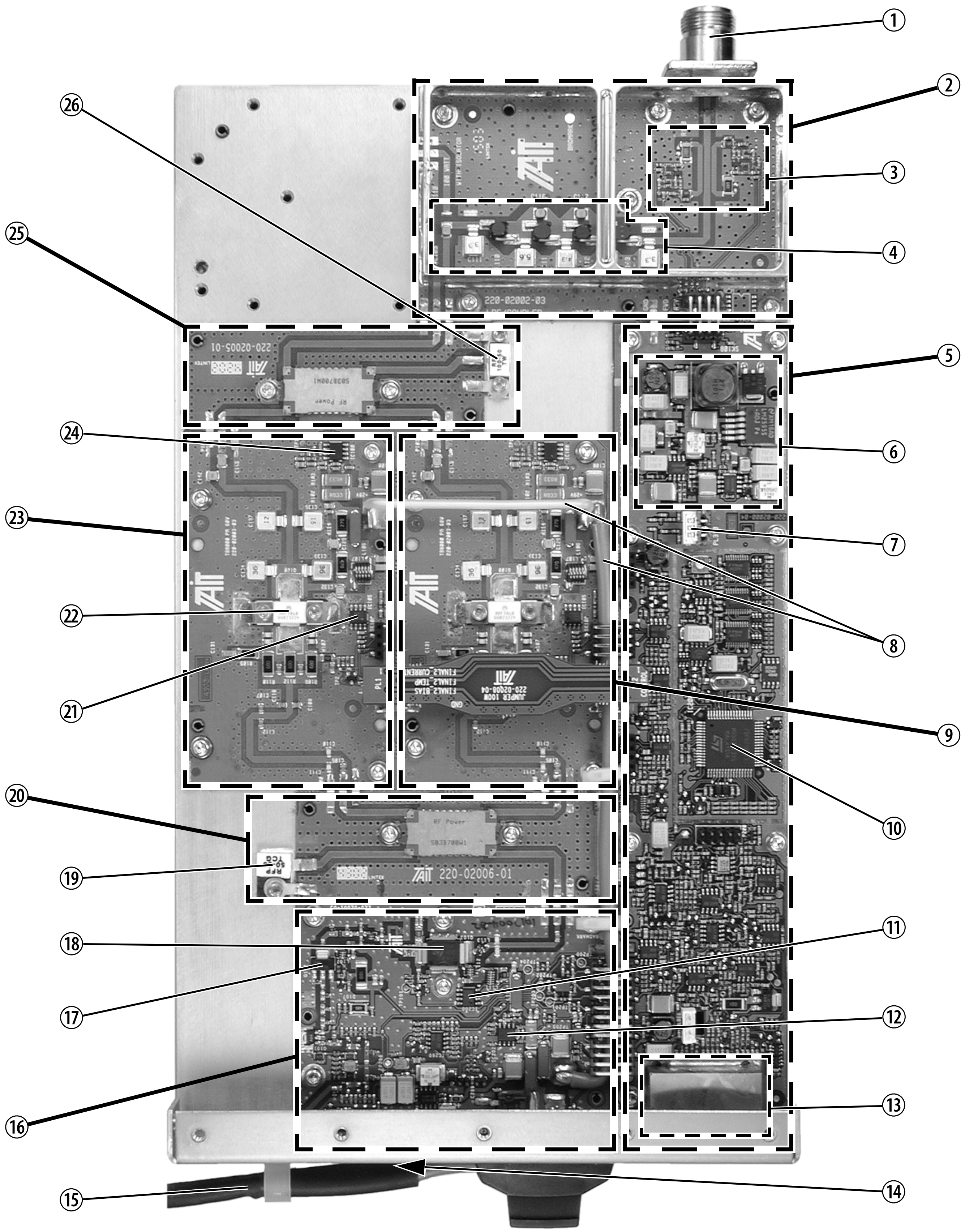
Interconnect PCBs

Because of the modular design of the PA, interconnect PCBs are used in certain models to connect PCBs 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 PCBs are shown in Figure 5.1 on page 79.

Figure 4.3 Identifying the Circuitry on the PA PCBs

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

Note:
This drawing shows a 100W UHF (H band) PA. The configuration of the 5W and 50W PAs is shown in Figure 5.1 on page 79.



5 Power Amplifier Servicing

Caution **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 and 5.8kg. 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 15 for more information on antistatic procedures when handling these devices.

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

This chapter provides information on how to identify, remove and replace the main mechanical parts and individual PCBs.

Figure 5.10 on page 97 and Figure 5.11 on page 98 identify the main mechanical parts, and Figure 5.1 on page 79 identifies the individual PCBs and shows how they are configured in different models. "Identifying the PA" on page 78 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 100W UHF (H band) PA. However, the same basic procedures and techniques apply to other models of PA.

5.1 Disassembly and Reassembly

Identifying the PA

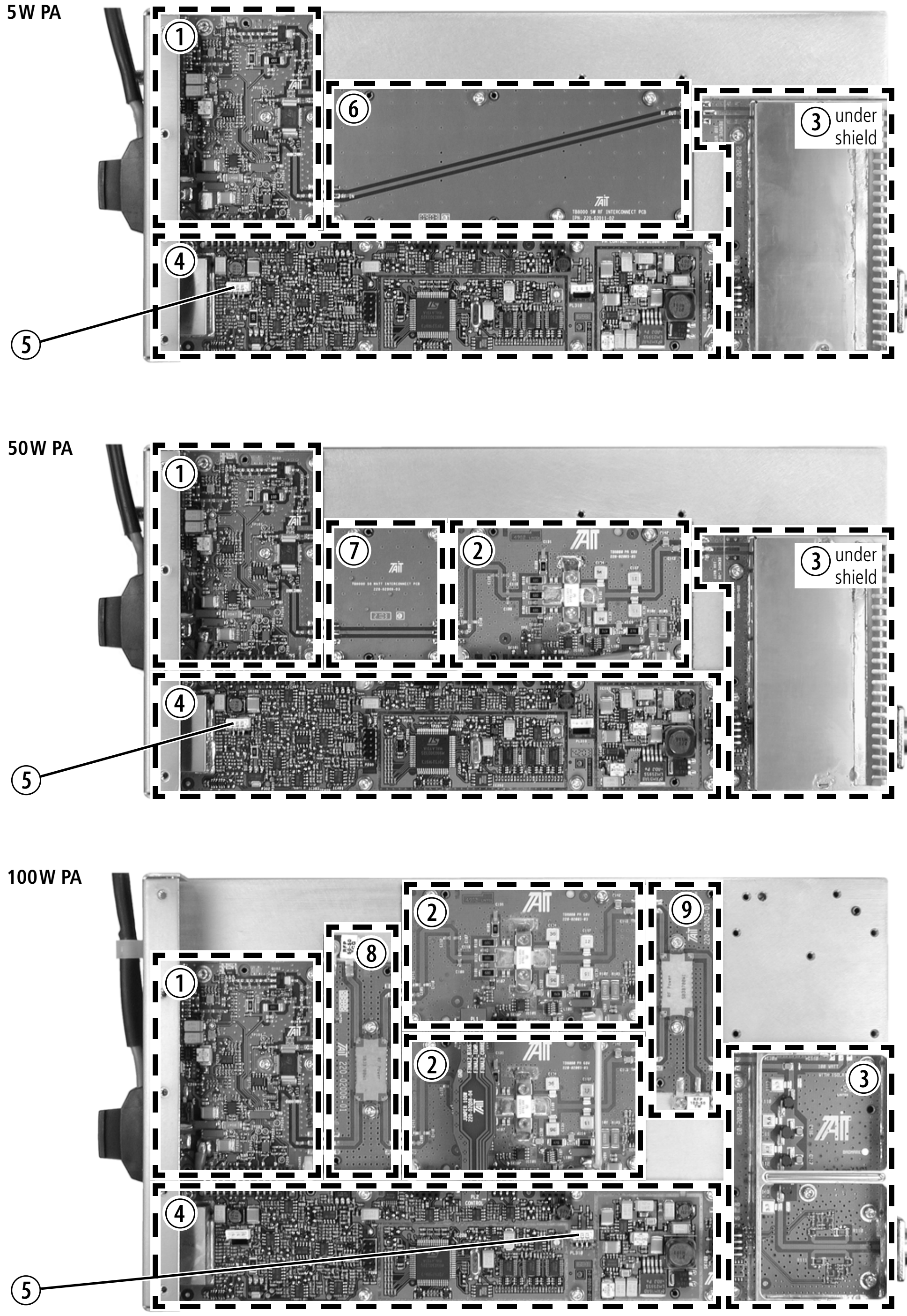
You can identify the model and hardware configuration of a PA by referring to the product code printed on labels on the heatsink and rear of the cover. The meaning of each character in the product code is explained in the table below.

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 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
TBAXX**XX**-XXXX	**Frequency Band and Sub-band** B1 = 136MHz to 174MHz C0 = 174MHz to 225MHz H0 = 400MHz to 520MHz K2 = 762MHz to 870MHz[a]
TBAXXXX-**X**XXX	0 = default
TBAXXXX-X**X**XX	0 = default
TBAXXXX-XX**X**X	0 = default
TBAXXXX-XXX**X**	0 = default

a. The actual frequency coverage in this band is 762MHz to 776MHz, and 850MHz to 870MHz.

Figure 5.1 Identifying the PA PCBs



1. 6W PCB
2. 60W PCB
3. low pass filter/directional coupler PCB
4. control PCB
5. ambient air temperature sensor PCB
6. 5W interconnect PCB
7. 50W interconnect PCB
8. splitter PCB
9. combiner PCB

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	0.6 N·m / 5.0 lbf·in	3/32 in Allen key	4–40 UNC
secure the SMA connector to the front panel	0.3 N·m / 2.5 lbf·in	T8	M2.5
M3 screws are used in all other locations	0.5 N·m / 4.5 lbf·in	T10	M3

Removing the Airflow Duct and Cover

The circled numbers in the following instructions refer to Figure 5.2.

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

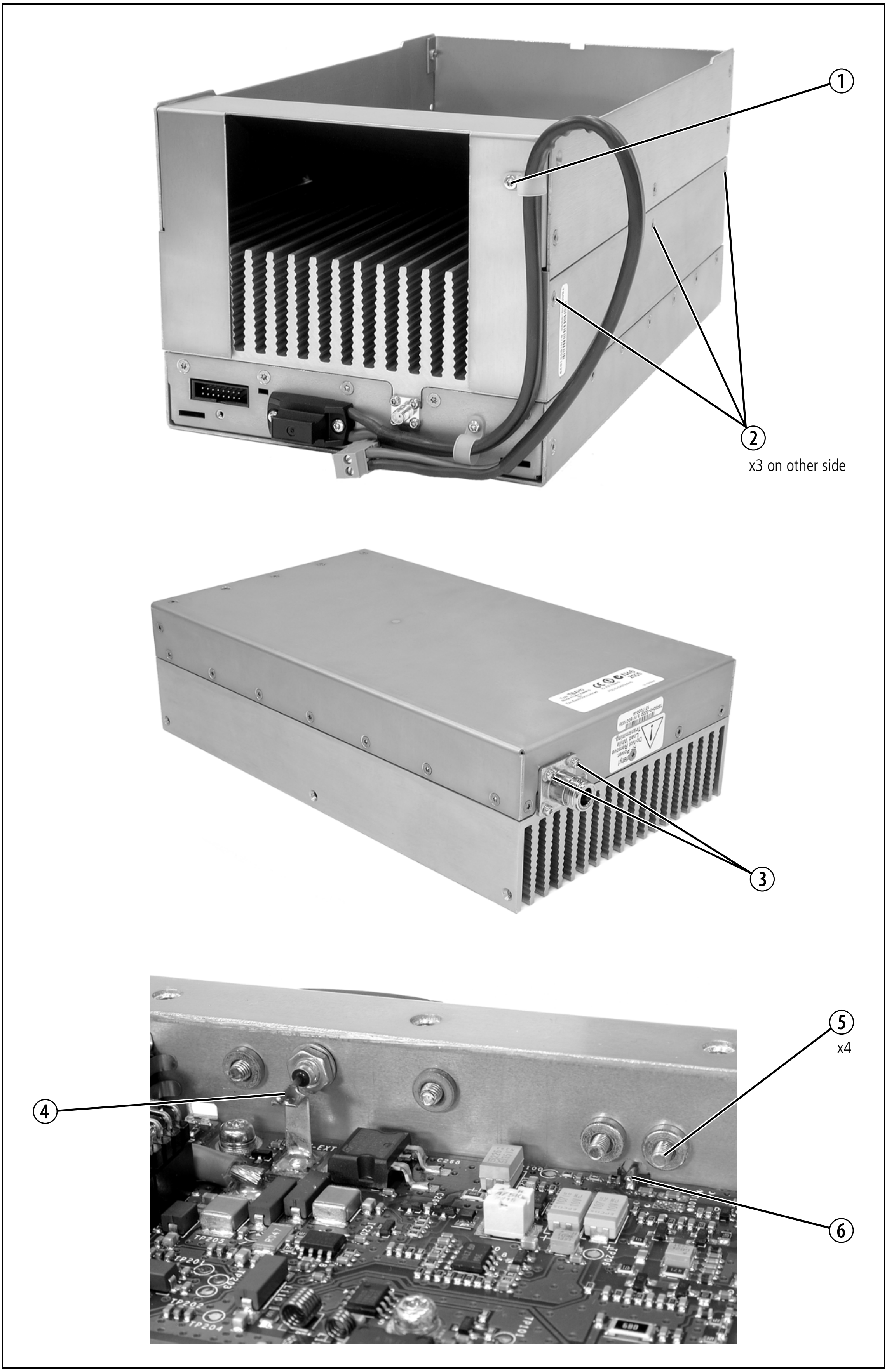
1. Remove the M3 Torx screws securing the cover to the heatsink and to the front panel.
2. Remove the two M3 Torx screws securing the N-type connector to the cover ③.
3. Carefully lift the cover straight up off the heatsink, being careful not to put any strain on the N-type connector.

Removing the Front Panel

The circled numbers in the following instructions refer to Figure 5.2.

1. Disconnect the +28 VDC power feed by desoldering the feedthrough capacitor from the metal strap ④ soldered to the 6 W PCB.
2. Remove the four M2.5 Torx screws ⑤ securing the SMA connector to the heatsink and to the front panel.
3. Desolder the centre pin of the SMA connector ⑥ from the 6 W PCB and remove the connector.
4. Remove the M3 Torx screws securing the front panel to the heatsink and remove the panel.

Figure 5.2 Removing the Airflow Duct, Cover and Front Panel



Refitting the Front Panel

The circled numbers in the following instructions refer to Figure 5.2 on page 81.

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 ⑤.

3. Resolder the centre pin of the SMA connector ⑥ to the 6 W PCB.

4. Resolder the +28 VDC feedthrough capacitor to the metal strap ④ soldered to the 6 W PCB.

Refitting the Cover and Airflow Duct

The circled numbers in the following instructions refer to Figure 5.2 on page 81.

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.

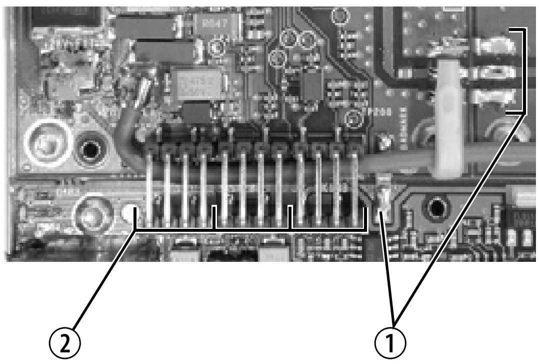
5.2 PCB Connecting Links

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

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

Figure 5.3 shows typical examples of both types of links.

Figure 5.3 PCB Connecting Links



5.3 Replacing the 6W PCB

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

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

Refer to Section 5.1 "Disassembly and Reassembly" for details on removing and refitting the cover and front panel. The circled numbers in the following instructions refer to Figure 5.4 on page 84. Figure 5.4 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 PCB to the control PCB.

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

4. Desolder the RF links ③ connecting the PCB to any adjacent PCBs.

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

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

Refitting

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

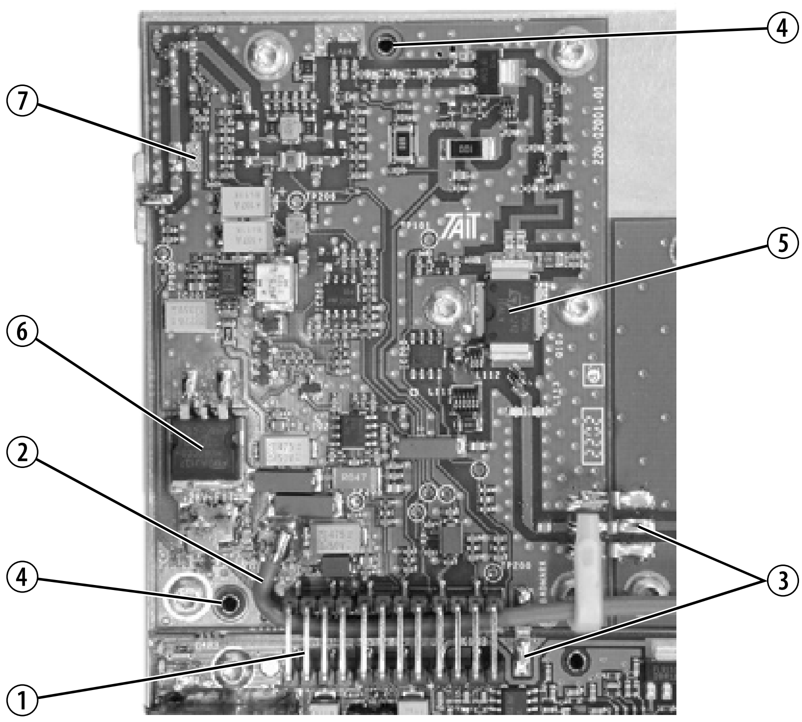
2. Apply a thin layer of fresh heatsink compound to the bottom of the PCB underneath Q103 ⑤, D200 ⑥ and AT100 ⑦ (if fitted). Use as little as possible, while still covering the whole of the mounting area of each component.

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

Note Before tightening the screws, press the PCB 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 5.4 Replacing the 6W PCB



5.4 Replacing the 60 W PCB

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 PCB, you must recalibrate the PA bias using the Calibration Kit software. Refer to the Calibration Kit documentation for more details.

Refer to Section 5.1 “Disassembly and Reassembly” for details on removing and refitting the cover. The circled numbers in the following instructions refer to Figure 5.5 on page 86.

Removal

1. Remove the cover.
2. Remove the bridging links ① connecting the PCB to the control PCB.
3. Desolder the +28 VDC power feed wire ②.
4. Desolder the RF links ③ connecting the PCB to any adjacent PCBs.
5. Remove the 4-40 UNC Allen screws ④ securing the RF power transistor ⑤ to the heatsink.
6. Remove the M3 Torx screws securing the PCB to the heatsink.
7. Carefully lift the PCB directly upwards off the locating pins ⑥ and remove it from the heatsink.

Refitting the Same PCB and Transistor

Use the following instructions if you are fitting the same 60 W PCB 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 PCB, following the removal instructions in reverse order.

Note Before tightening the screws, press the PCB 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 PCB and Transistor

Use the following instructions if you are fitting a new 60W PCB, 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.

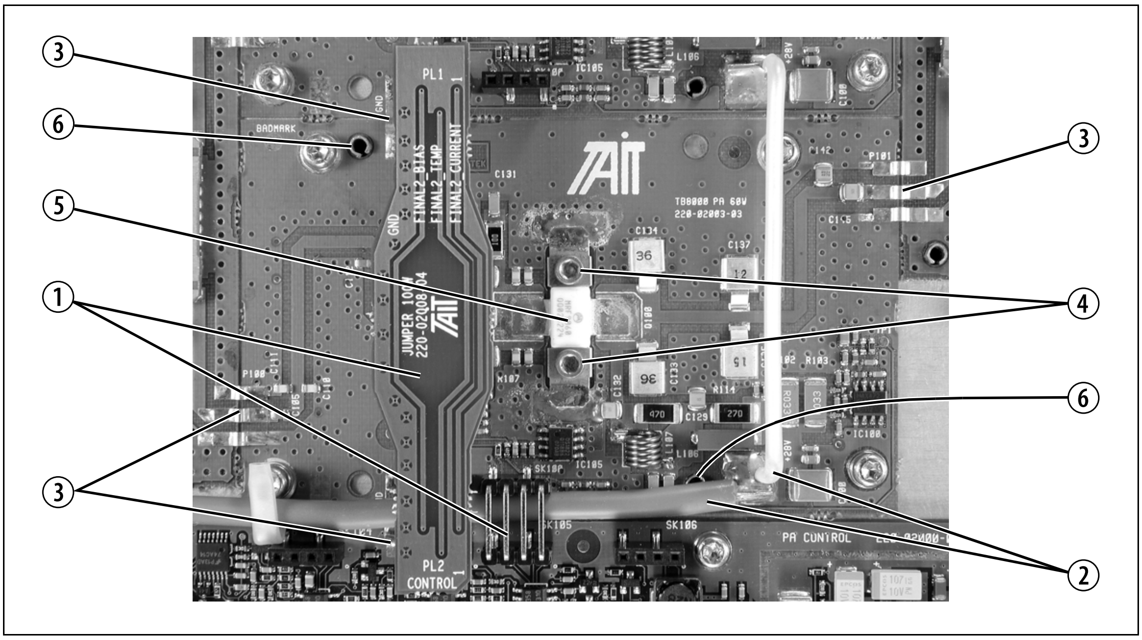
2. Refit the PCB, following the removal instructions in reverse order.

Note Before tightening the screws, press the PCB 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 87.

4. Refit the cover.

Figure 5.5 Replacing the 60W PCB



5.5 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 software. Refer to the Calibration Kit documentation for more details.

Refer to Section 5.1 “Disassembly and Reassembly” for details on removing and refitting the cover. The circled numbers in the following instructions refer to Figure 5.6 on page 88.

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.

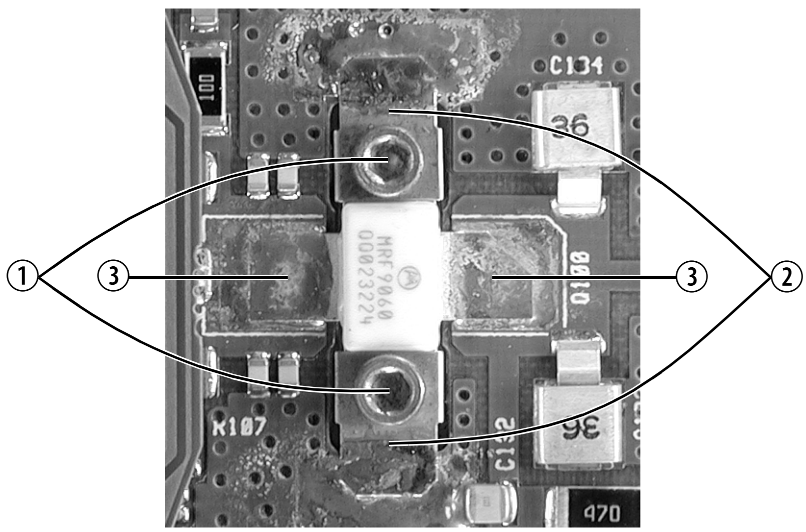
4. Refit the two ground tags and secure the transistor to the heatsink with the two 4–40 UNC screws. Progressively tighten each screw, alternating from side to side, to the correct torque.

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 5.6 Replacing the 60W RF Power Transistor



5.6 Replacing the Control PCB

Important You must reprogram and recalibrate the PA after replacing the control PCB. Refer to “Reprogramming and Recalibration” on page 90.

Refer to Section 5.1 “Disassembly and Reassembly” for details on removing and refitting the cover and front panel. The circled numbers in the following instructions refer to Figure 5.7 on page 90.

Removal

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

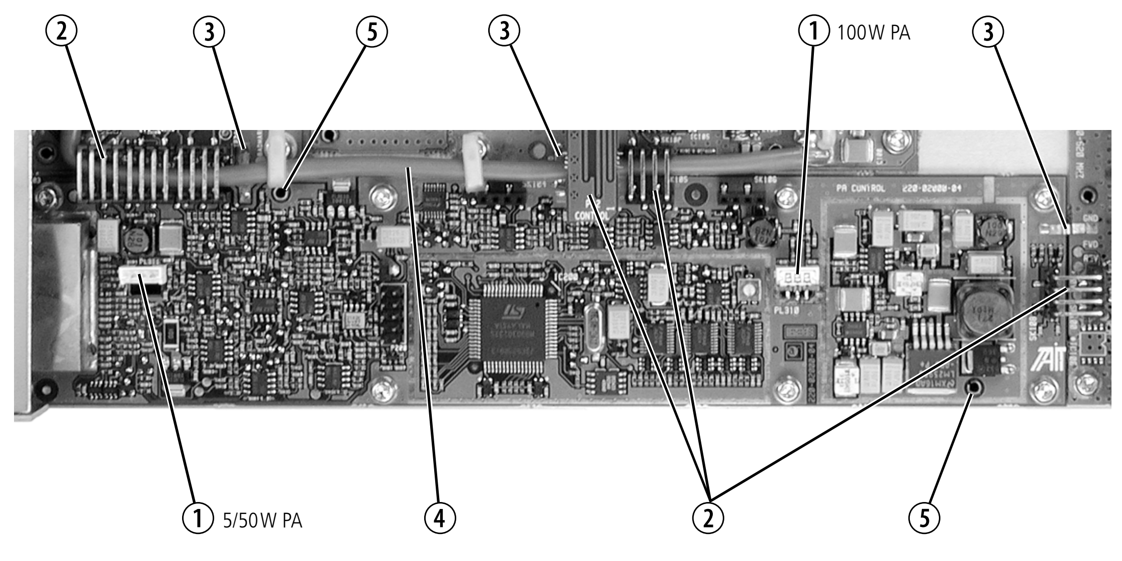
Refitting

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

Important When refitting the ambient air temperature sensor PCB, make sure that it fits properly into the correct hole provided in the heatsink (refer to Figure 5.7). You must fit the sensor PCB in the correct location to ensure that the temperature of the airflow over the sensor is nearest the ambient temperature of the air at the intake to the cooling fan. The sensor PCB must not come into contact with the metal of the heatsink fins. Note that you may feel some resistance as you push the sensor PCB through the slot in the foam dust seal located under the control PCB.

Note Before tightening the screws, press the PCB 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 5.7 Replacing the Control PCB



Reprogramming and Recalibration

If you have replaced the control PCB, 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 this information into the PA using the Calibration Kit software; refer to the Calibration Kit documentation for more details
replace the serial number labels	the serial number of the PA will change to the number already programmed into the replacement control PCB; stick the new serial number labels onto the heatsink and rear panel
■ 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 software; refer to the Calibration Kit documentation for more details

5.7 Replacing the Low Pass Filter/Directional Coupler PCB

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

Refer to Section 5.1 “Disassembly and Reassembly” for details on removing and refitting the cover. The circled numbers in the following instructions refer to Figure 5.8 on page 92.

Removal

1. Remove the cover.
2. Desolder the two tabs and remove the shield lid.
3. Remove the bridging links ① connecting the PCB to the control PCB.
4. Desolder the RF links ② connecting the PCB to any adjacent PCBs.
5. Remove the M3 Torx screws securing the N-type connector to the heatsink.
6. Desolder and remove the N-type connector, leaving the ground plate ③ soldered in place on the shield wall.
7. Remove the M3 Torx screws securing the PCB to the heatsink.
8. Carefully lift the PCB directly upwards off the locating pins ④ and remove it from the heatsink.

Refitting

1. Refit the PCB onto the heatsink, ensuring it is correctly positioned on the locating pins.
2. Secure the PCB 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.

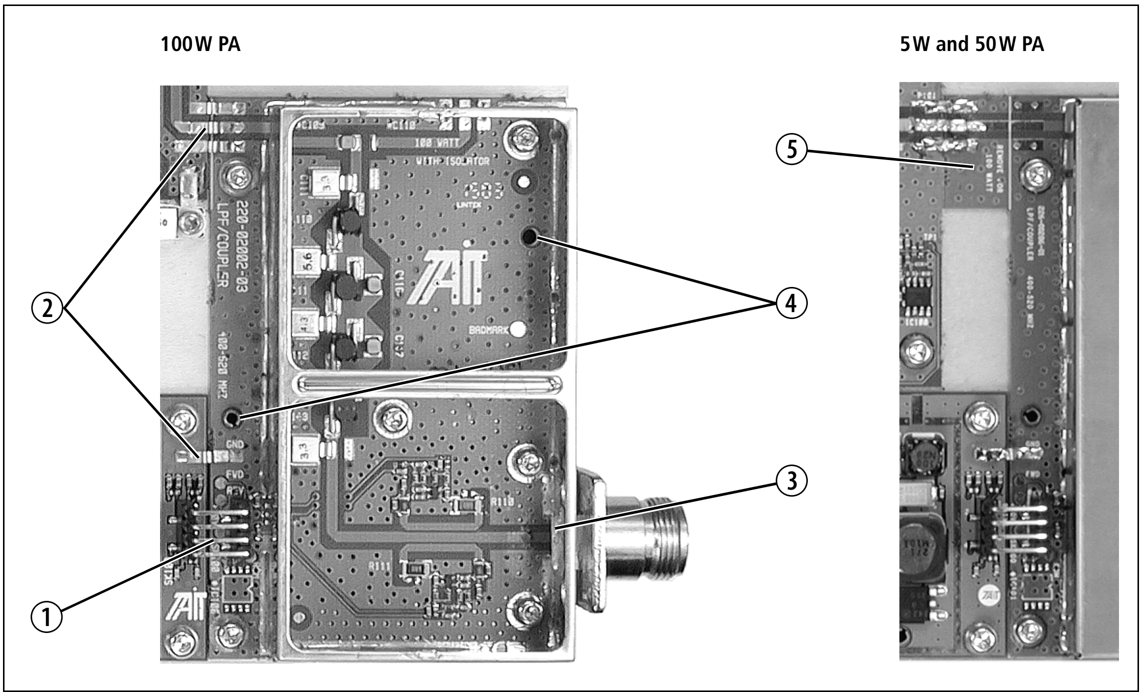
   If the ground plate is not already soldered to the shield wall:
   - fit the ground plate and N-type connector to the heatsink, ensuring that the tab on the ground plate fits through the slot in the shield wall
   - tighten the two M3 Torx screws to the correct torque
   - solder the N-type connector 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. Refit the cover.

Note If you are fitting a new PCB, make sure that the RF input tab ⑤ is left in place for a 5 W or 50 W PA, and removed for a 100 W 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 5.8 Replacing the LPF/Directional Coupler PCB



5.8 Replacing the Interconnect PCBs

Refer to Section 5.1 "Disassembly and Reassembly" for details on removing and refitting the cover.

Removal

1. Remove the cover.
2. Desolder the RF links connecting the PCB to any adjacent PCBs. You may need to move the +28VDC power feed wire out of the way first.
3. Remove the M3 Torx screws securing the PCB to the heatsink.

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

Refitting

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

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

5.9 Replacing the Splitter/Combiner PCBs

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 PCB and the heatsink under the splitter and combiner devices. Any objects caught in the heatsink compound underneath the PCB 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.

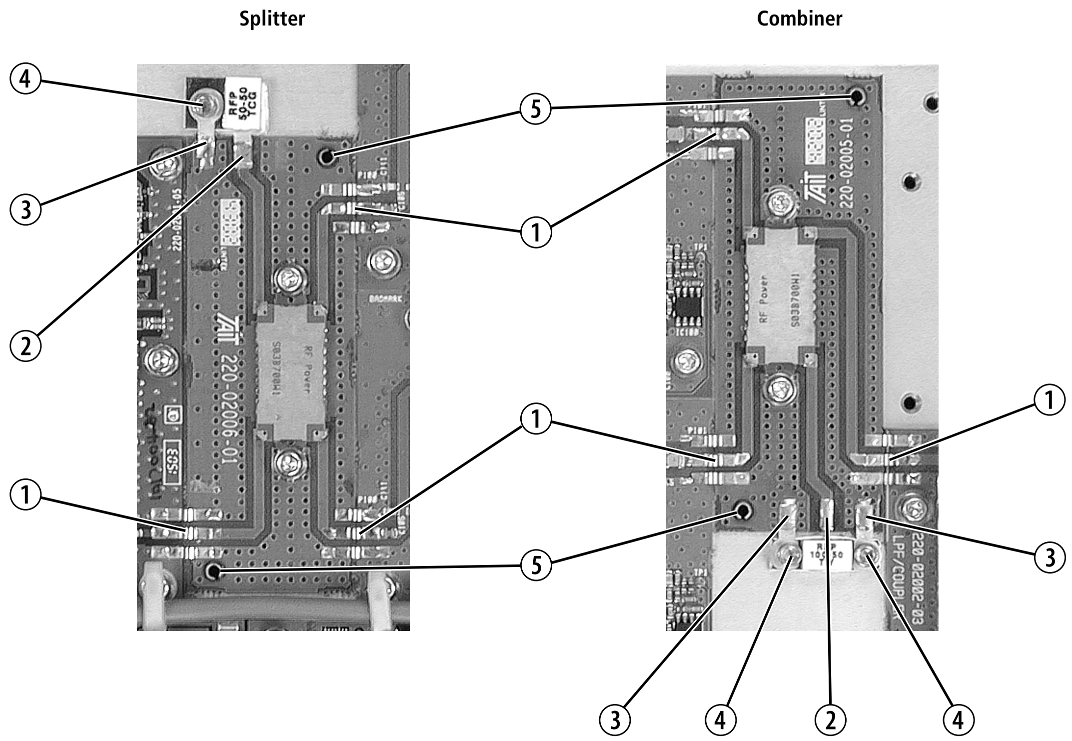
Refer to Section 5.1 “Disassembly and Reassembly” for details on removing and refitting the cover. The circled numbers in the following instructions refer to Figure 5.9 on page 94.

Removal

1. Remove the cover.
2. Desolder the RF links ① connecting the PCB to any adjacent PCBs.
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 securing the PCB to the heatsink.

7. Carefully lift the PCB directly upwards off the locating pins ⑤ and remove it from the heatsink.

Figure 5.9 Replacing the Splitter/Combiner PCBs



Refitting

1. Ensure the heatsink and bottom of the PCB 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 PCB 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 PCB onto the heatsink, ensuring it is correctly positioned on the locating pins.

4. Secure the PCB to the heatsink with the M3 Torx screws and tighten to the correct torque.

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.

Figure 5.10 PA Mechanical Assembly - Sheet 1

	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 PCB	362-01036-XX
㉗	control PCB	
㉘	6W PCB	
㉙	LPF/directional coupler PCB	
㉚	60W PCB	
㉛	ambient air temperature sensor PCB	
㉜	combiner PCB	
㉝	splitter PCB	
㉞	bridging link PCB	
	50W interconnect PCB*	
	5W interconnect PCB*	

*Not shown in this drawing. Refer to Figure 5.1 on page 79.

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 PA. Any differences between the 100W, 5W and 50W PAs are indicated in the description of the parts.

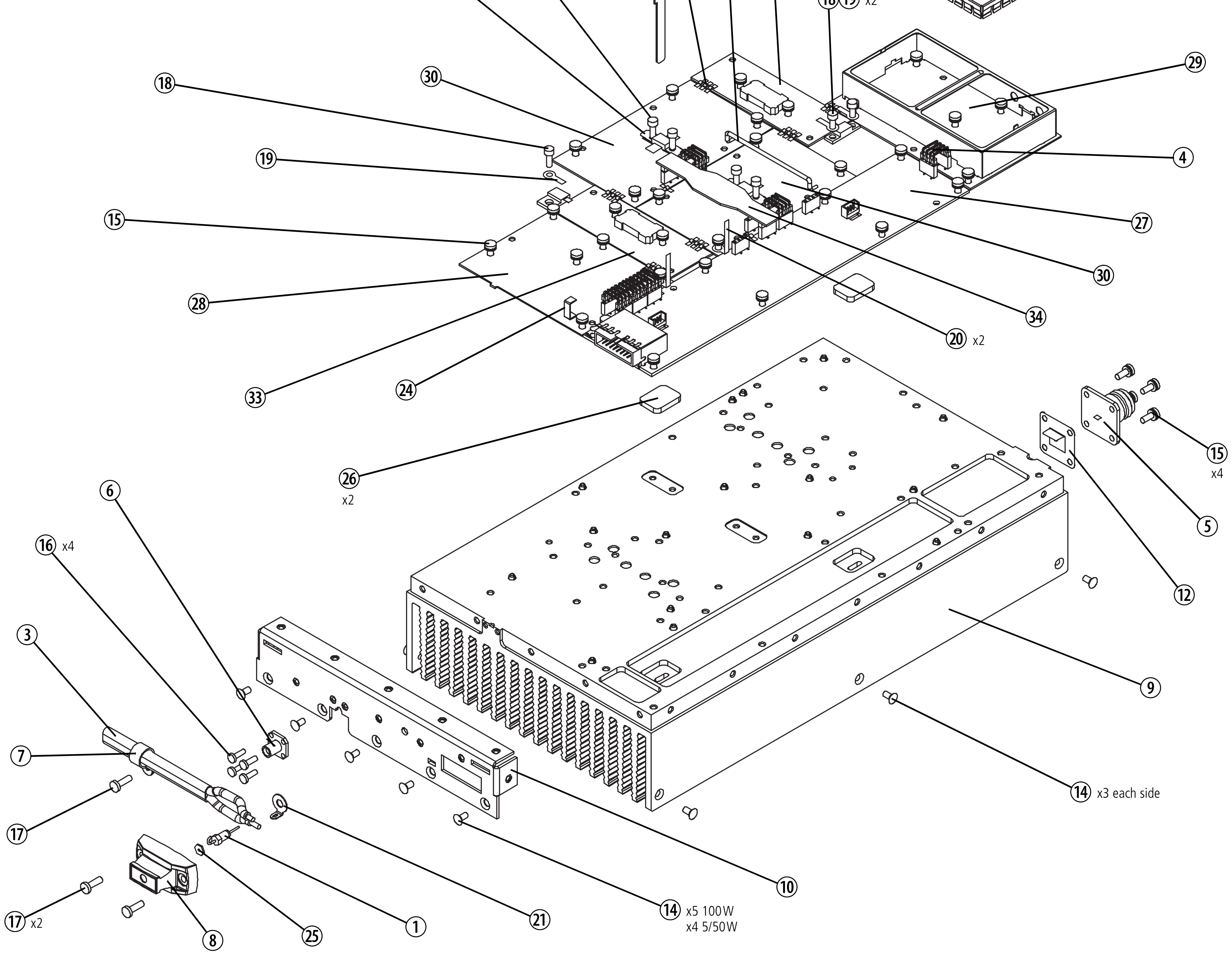
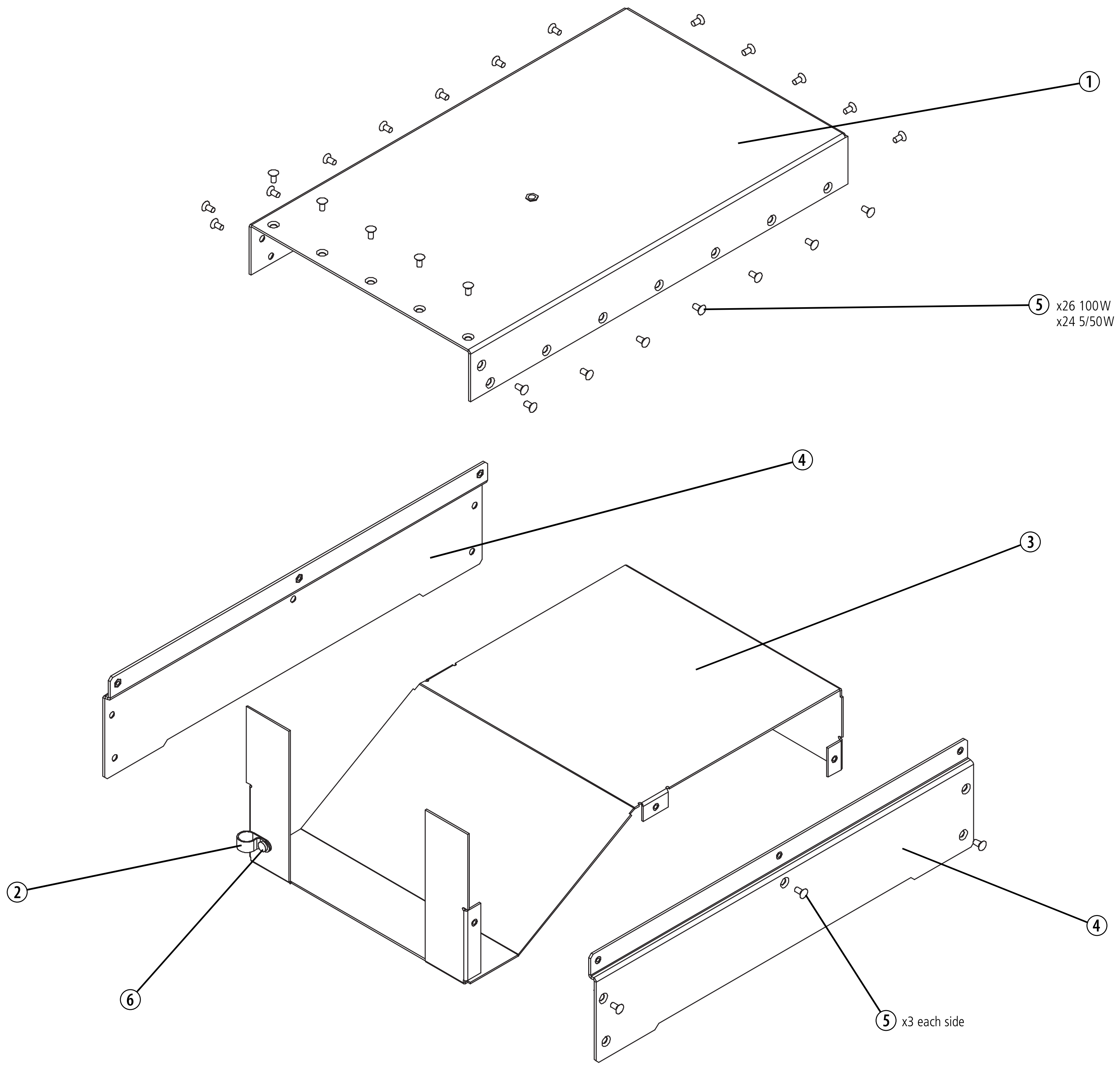


Figure 5.11 PA Mechanical Assembly - Sheet 2

	Description	IPN
1	cover - 5/50W cover - 100W	303-03070-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.



6 Power Management Unit Circuit Description

The TB8100 power management unit (PMU) provides stable, low-noise 28VDC outputs to power the TB8100 BSS. The PMU is made up of a number of individual PCBs and cards which comprise two main modules, the AC module and the DC module. The standby power supply card and auxiliary power supply PCB are optional.

The AC module accepts an input of 115/230VAC 50/60Hz nominal, and the DC module accepts an input of 12, 24 or 48VDC[1] nominal (depending on the model). Both modules provide the following outputs:

- 28VDC high current (PA)
- 28VDC low current (reciter)
- 13.65, 27.3 or 54.6VDC low current (with the optional auxiliary power supply PCB).

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.

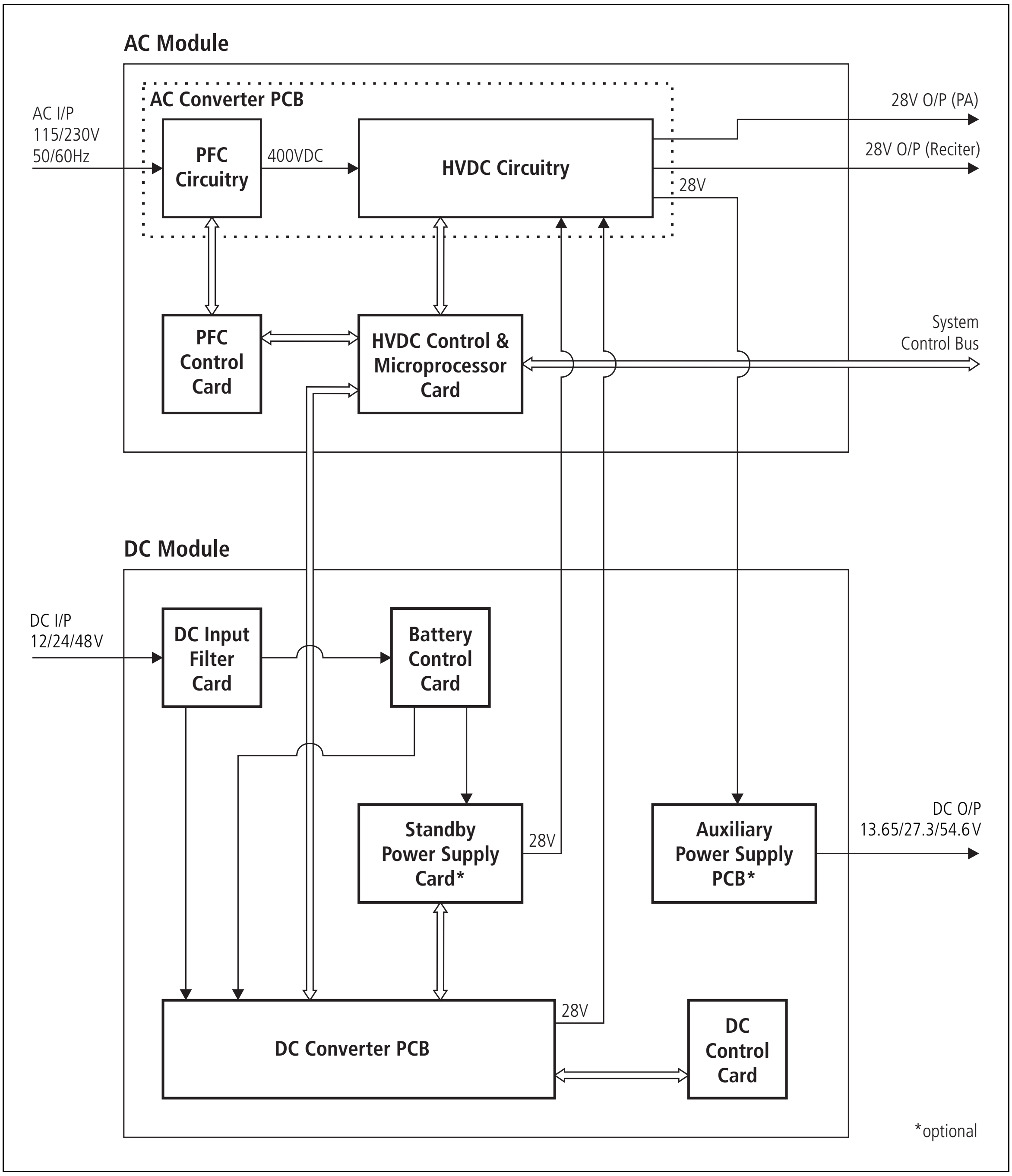
The optional standby power supply card allows efficient use of the DC input at low power requirements. The optional auxiliary power supply PCB provides output voltages which are different from the 28VDC required by the TB8100 BSS. It can also be used to trickle-charge batteries.

Figure 6.1 on page 100 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 PCBs and cards are fitted in each module.

The locations of the main circuit blocks on the PCBs are shown in Figure 6.5 on page 109 and Figure 6.6 on page 111.

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 for more details).

Figure 6.1 PMU High Level Block Diagram



PCB and Card Name	AC PMU	DC PMU	AC and DC PMU
DC converter PCB		fitted	fitted
DC input filter card		fitted	fitted
DC control card		fitted	fitted
battery control card		fitted	fitted
standby power supply card[a]		optional	optional
AC converter PCB	fitted	fitted[b]	fitted
HVDC control and microprocessor card	fitted	fitted[c]	fitted
PFC control card	fitted		fitted
auxiliary power supply PCB[d]	optional	optional	optional

a. You must fit the appropriate model card to match the DC input voltage of the PMU (i.e. 12, 24 or 48 VDC nominal).

b. Only the current sense and output filter circuitry is placed on this PCB when it is fitted to a DC PMU.

c. Only the feedback and microprocessor circuitry is placed on this card when it is fitted to a DC PMU.

d. The output voltage is dependent on the model of PCB - there is a different model PCB for each output voltage (i.e. 13.65, 27.3 or 54.6 VDC).

6.1 Microprocessor Control Circuitry

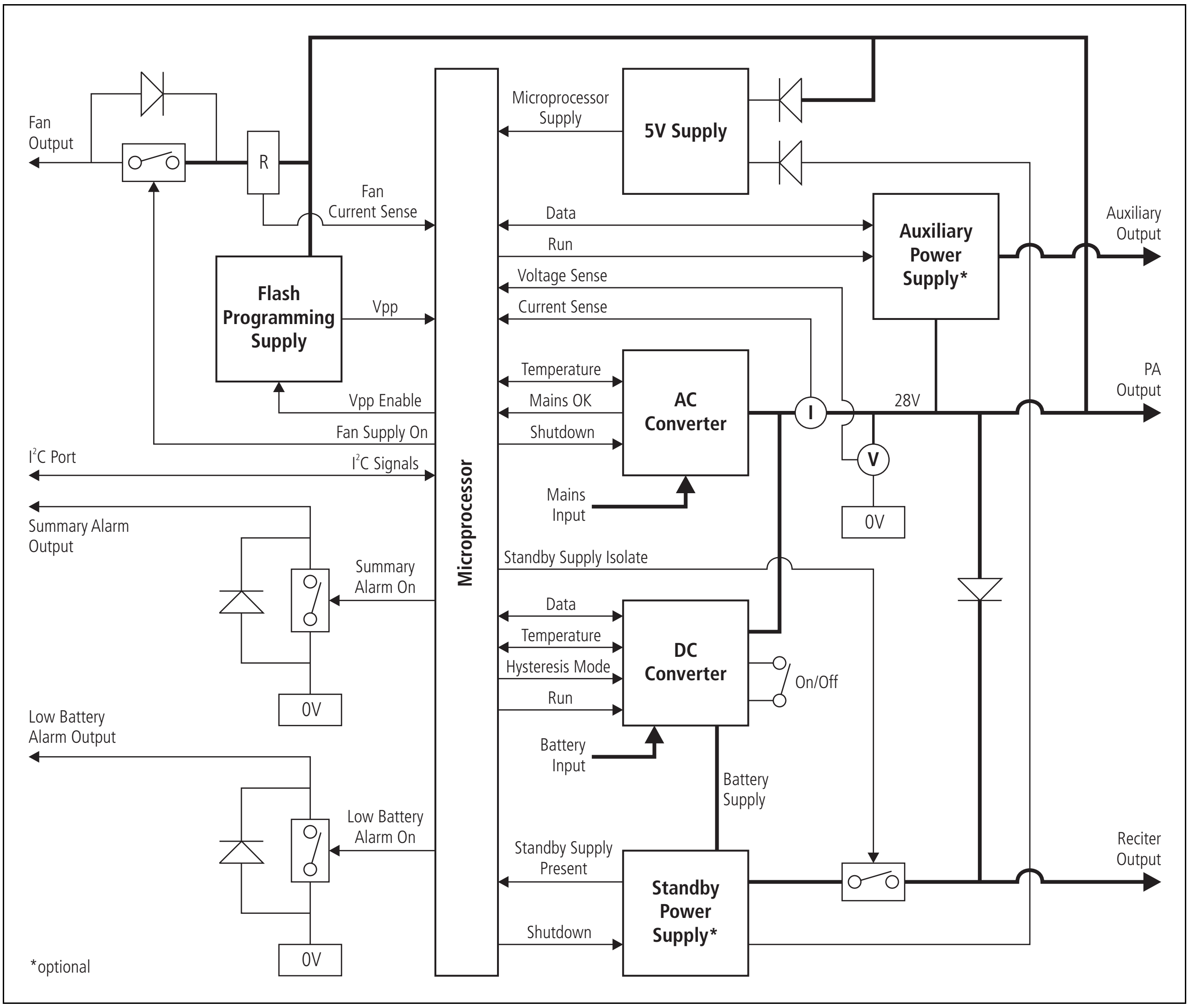
The microprocessor on the HVDC control card monitors and controls the operation of the PMU. If any of the monitored conditions exceeds its normal range of values, the microprocessor will generate an alarm and take appropriate action, depending on the configuration of the PMU. The software also automatically 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 software.

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 26.5 VDC.

Figure 6.2 on page 102 shows the control signal and power connections to and from the microprocessor. These are described in more detail in the paragraphs which follow.

Figure 6.2 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 107 for details on hysteresis mode, and to "Standby Power Supply" below for details on deep sleep mode.

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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 12, 24 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 software.

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 software and can only function if the load on the PMU reciter output is <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 software:

- 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 (12, 24 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 base station system.

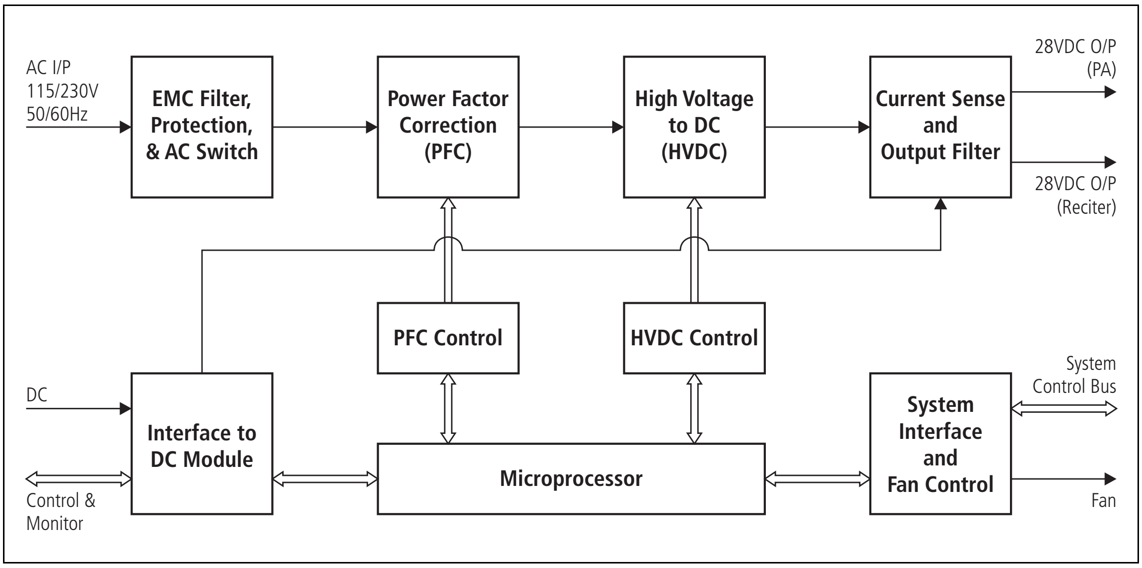
The current source used by the I^2C lines as active pull-up resistors is housed on the microprocessor PCB.

6.2 AC Module

The AC module accepts an input of 115/230 VAC 50/60 Hz 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 6.3 below, and are described in more detail in the paragraphs which follow.

Figure 6.3 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 10 A 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 400 VDC 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 PCB. 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 PCB.

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 software. 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

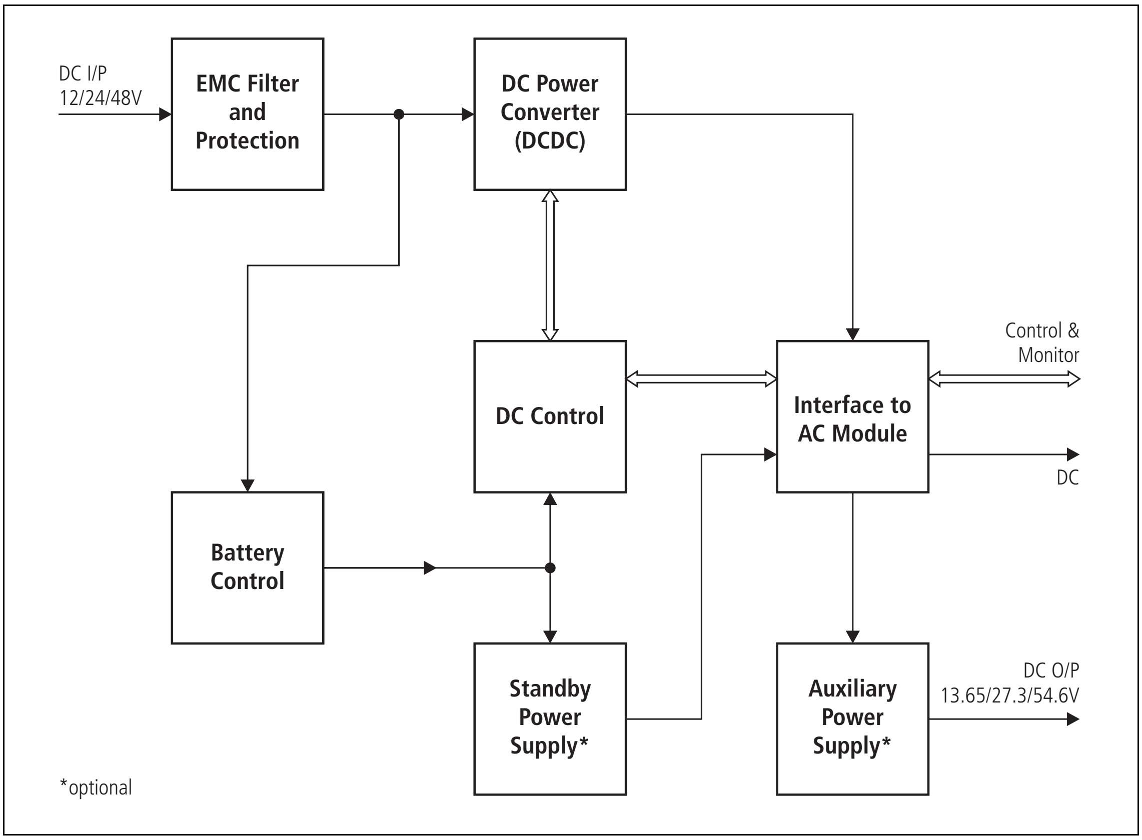
This interface consists of the connectors which connect the AC module to the DC module. Although there is no circuitry involved this interface, it is included in the block diagram to illustrate the interconnection between the AC and DC modules.

6.3 DC Module

The DC module accepts an input of 12, 24 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 6.4 below, and are described in more detail in the paragraphs which follow.

Figure 6.4 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 PCB 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 PCB.

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 PCB.

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 software and can only function if the load on the PMU is <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 optional 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 software.

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. 12, 24 or 48V).

The battery control circuitry is located on a separate card which plugs into the DC converter PCB.

Standby Power Supply

The optional 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 PCB.

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 AC power supplied to the PMU. The mode of operation is controlled with the Service Kit software.

The circuitry for the auxiliary power supply is located on a separate PCB which is mounted on the heatsink of the DC module. The PCB is connected to the AC converter PCB via an 8-way cable.

The main function of this power supply is to provide a controlled 13.65, 27.3 or 54.6VDC output (depending on model), as the main output for the TB8100 base station system is 28VDC. However, because the converter is voltage and current regulated, it can also be used to trickle-charge batteries. The output voltage is set in the factory to the required float voltage, so the batteries can remain connected at all times.

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 6.5 Identifying the Circuitry on the AC Module PCBs

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 PCB
⑥ current sense and output filter
⑦ 28VDC output for PA
⑧ 28VDC output for reciter
⑨ 28VDC output to auxiliary power supply PCB
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.

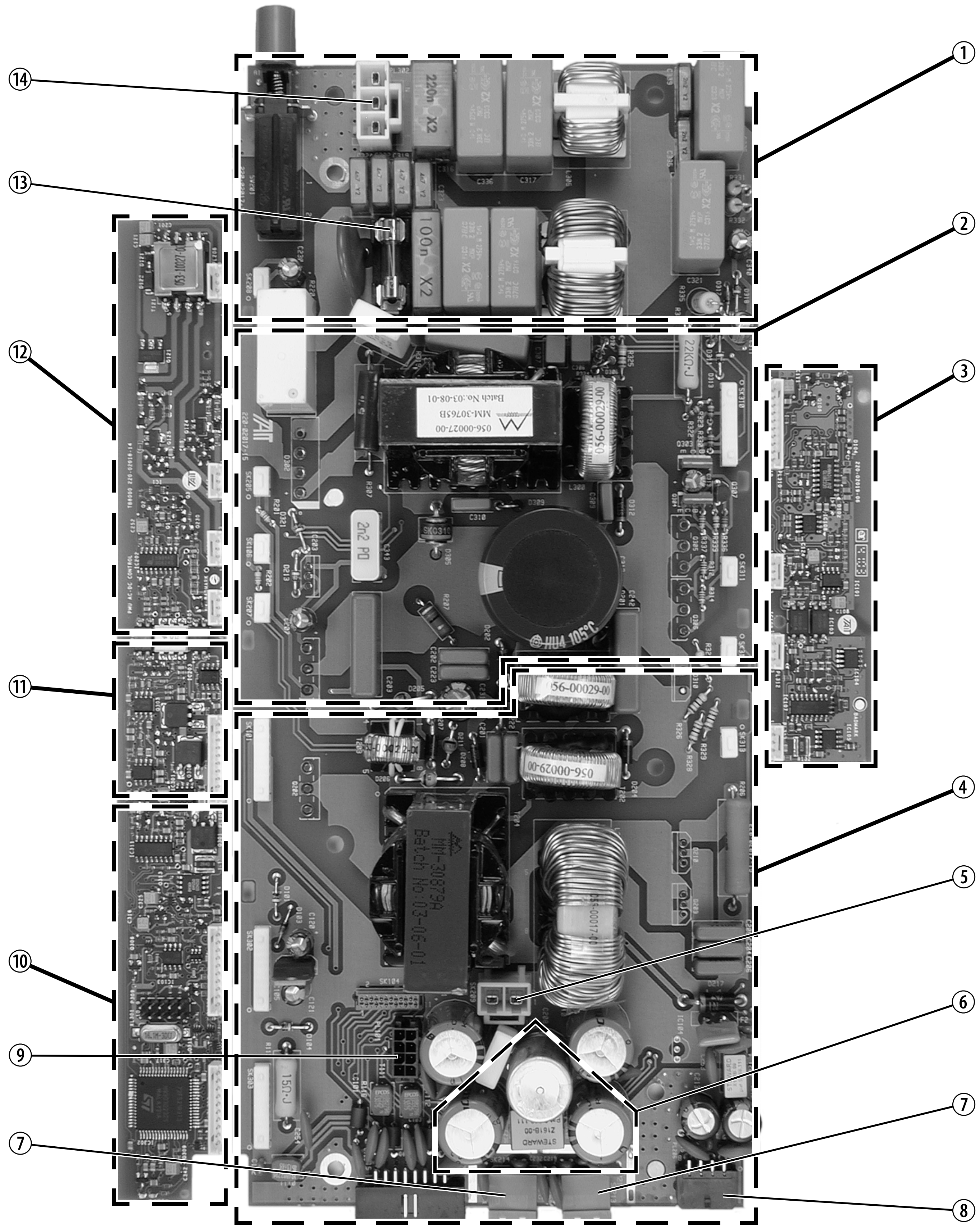
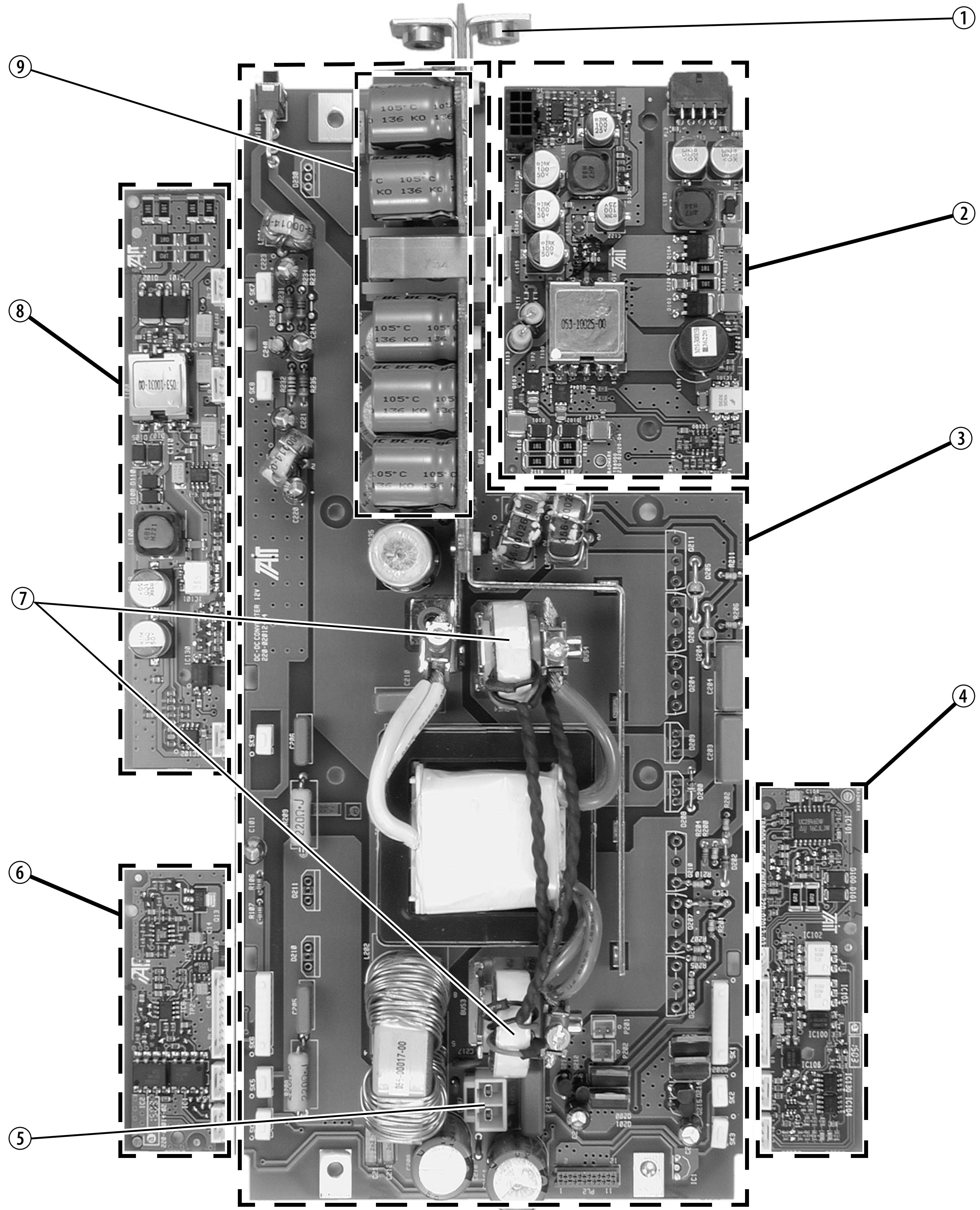


Figure 6.6 Identifying the Circuitry on the DC Module PCBs

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 PCB
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

7 Power Management Unit Servicing

This chapter provides information on how to identify, remove and replace the main mechanical parts, plug-in cards, and auxiliary power supply PCB.

7.1 Safety Precautions

Personal Safety

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

The TB8100 BSS must be installed so that the rear of the PMU is located in a service access area.

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

The PMU should be serviced only by qualified technicians. 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.**

Equipment Safety

Important This equipment contains devices which are susceptible to damage from static charges. Refer to "ESD Precautions" on page 15 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.

Replacing Components Connected To The Mains

To maintain operator safety and protection against fire, you must replace components connected to the mains supply (e.g. fuse [10 A 250 V], X & Y capacitors, filter chokes, etc.) and those that are critical to maintain isolation (optocouplers, transformers, etc.) **only** with their new, original equivalent.

To maintain performance levels we strongly recommend that you apply this policy to every component that is replaced.

7.2 Disassembly and Reassembly

Mechanical Overview

The TB8100 PMU is made up of a number of individual PCBs and cards which comprise two main modules, the AC module and the DC module. The standby power supply card and auxiliary power supply PCB are 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 PCB 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 PCB	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 7.6 on page 129 and Figure 7.7 on page 130 identify the main mechanical parts. Figure 7.1 on page 117 identifies the individual PCBs and cards, and shows how they are configured in an AC and DC PMU. "Identifying the PMU" on page 116 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.

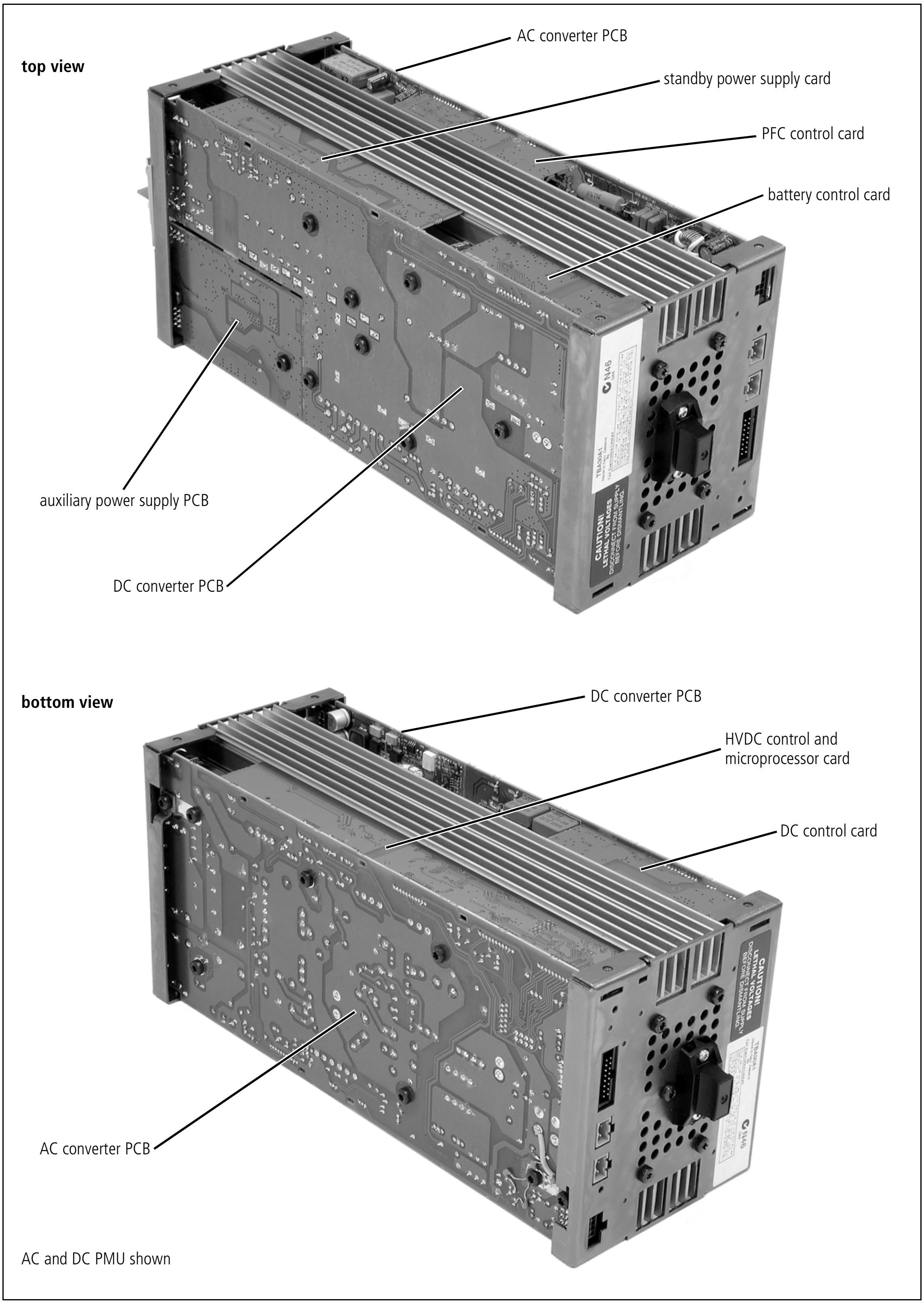
Identifying the PMU

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 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 PCB not fitted 1 = 12VDC auxiliary power supply PCB fitted 2 = 24VDC auxiliary power supply PCB fitted 4 = 48VDC auxiliary power supply PCB fitted
TBA3XXX-XX**X**X	0 = default
TBA3XXX-XXX**X**	0 = default

Figure 7.1 Identifying the PMU PCBs



Screw Torque Settings

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

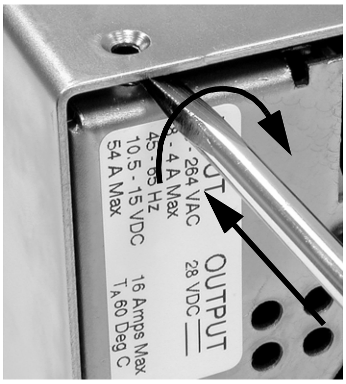
Location / Function	Torque	Driver	Size
■ securing the front and rear panels to the heatsinks ■ securing the AC and DC converter PCBs to the heatsinks ■ securing the bus bars to the DC converter PCB	2.0N·m / 18lbf·in	T20	M4
■ securing the top and bottom covers to the front and rear panels ■ securing the 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	

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.



Removing the Front and Rear Panels

1. Remove the M4 Torx Taptite screw securing the front panel to the AC converter PCB.

2. Remove the five M4 Torx Taptite screws securing the front panel to the heatsinks and shield. Slide the front panel off the heatsinks.

3. Remove the M4 Torx Taptite screw securing the rear panel to the AC converter PCB.

4. Remove the five M4 Torx Taptite screws securing the rear panel to the heatsinks and shield.

5. Loosen the rear panel slightly and remove the fibreglass DC input insulator from behind the DC input terminals. Slide the rear panel off the heatsinks.

Disconnecting the AC and DC Modules

Unless otherwise indicated, the circled numbers in the following instructions refer to Figure 7.2 on page 120.

1. As shown in Figure 7.3 on page 121, 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 PCB.

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 7.2.

3. Unplug the 28VDC cable ① from the DC converter PCB.

4. If fitted, unplug the 8-way cable ② from the auxiliary power supply PCB. 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 PCB and remove the shield.

Reconnecting the AC and DC Modules

Unless otherwise indicated, the circled numbers in the following instructions refer to Figure 7.3 on page 121.

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 PCB and feed them through the plastic grommet ④.

2. Reconnect the mains input connector to the AC converter PCB (as shown in Figure 7.2 on page 120), then insert the plastic grommet holding the cables into the hole in the shield.

3. As shown in Figure 7.2, 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 PCB.

Figure 7.2 Disconnecting the AC and DC Modules

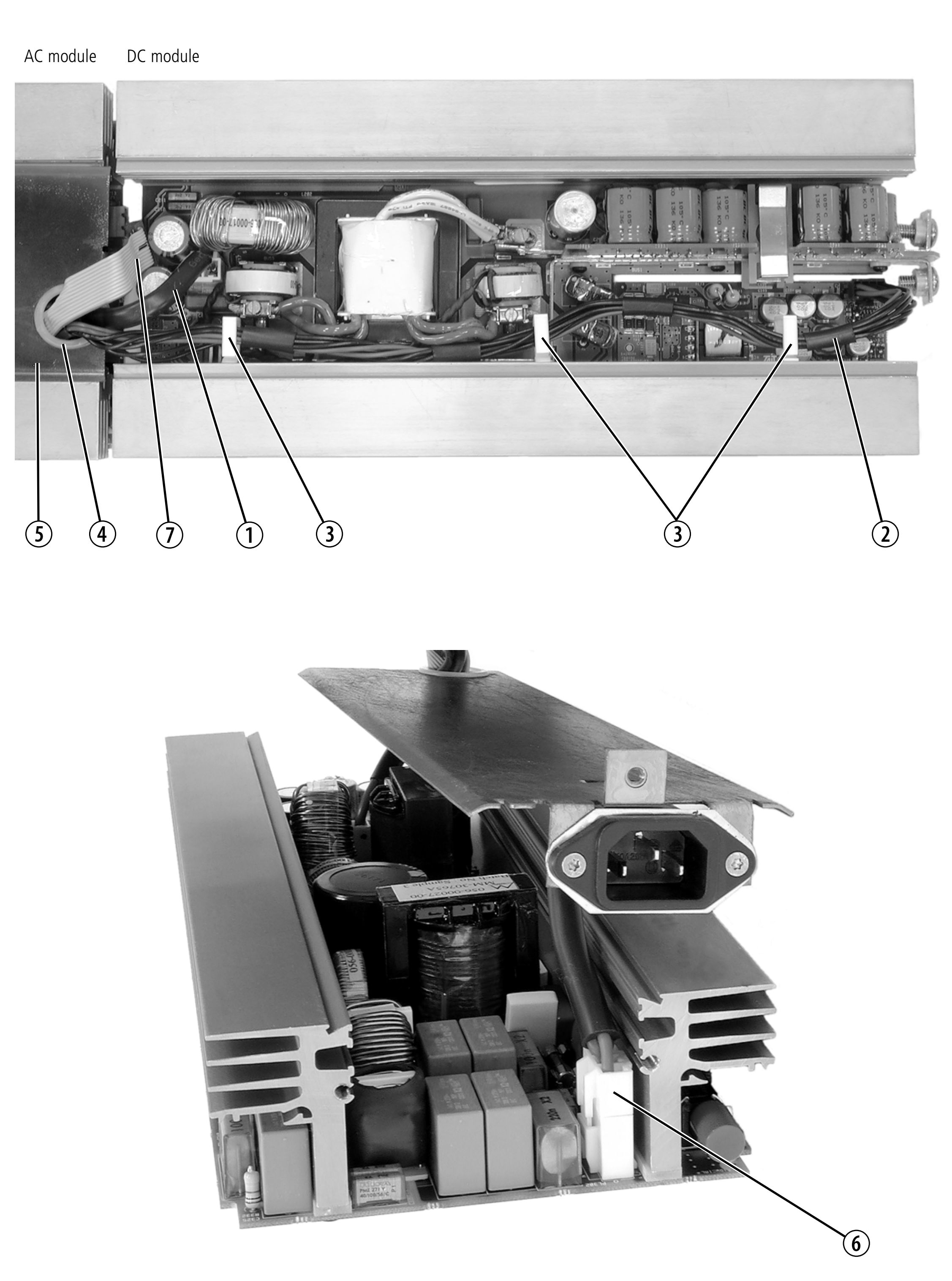
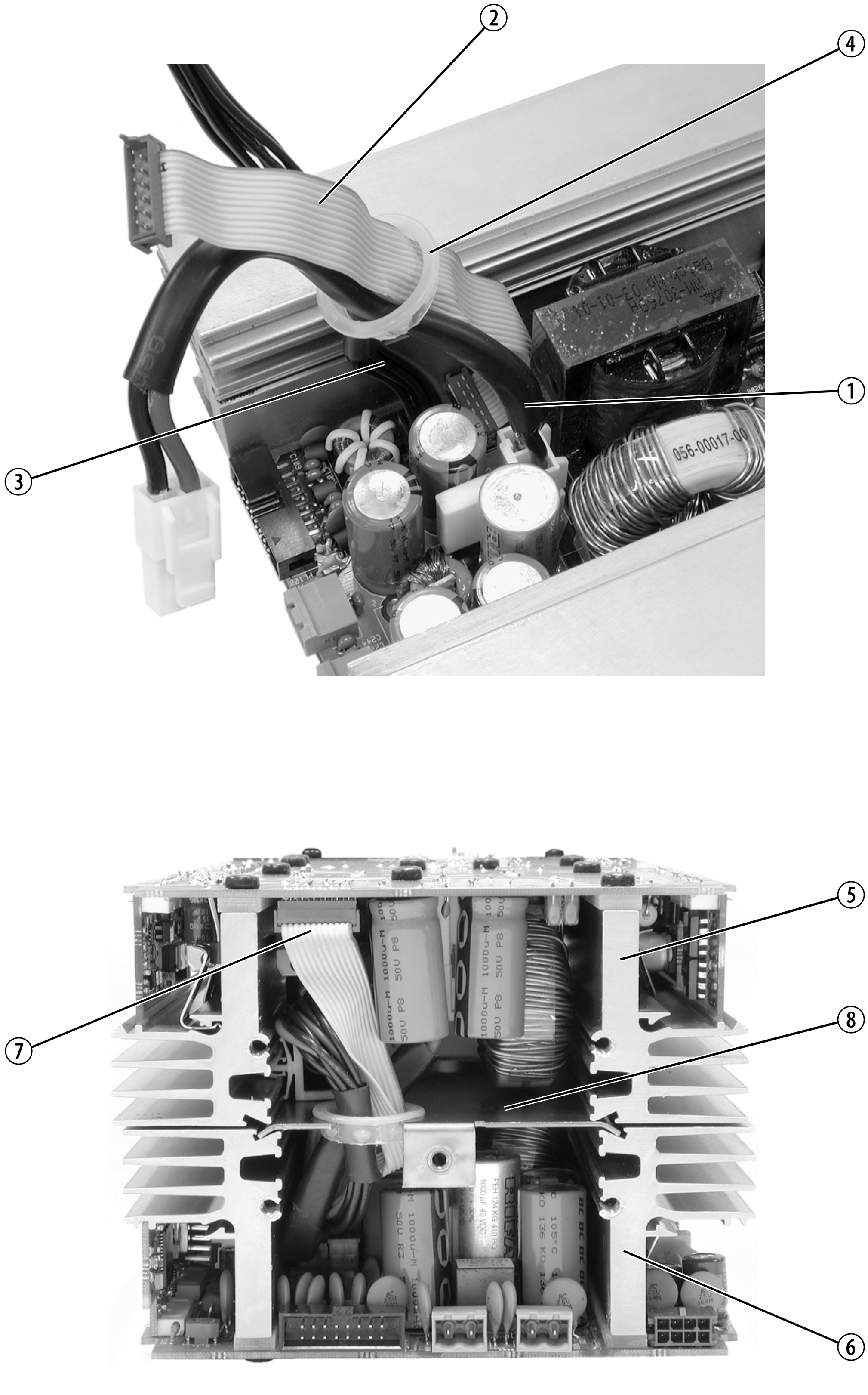


Figure 7.3 Reconnecting the AC and DC Modules



Refitting the Front and Rear Panels

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.

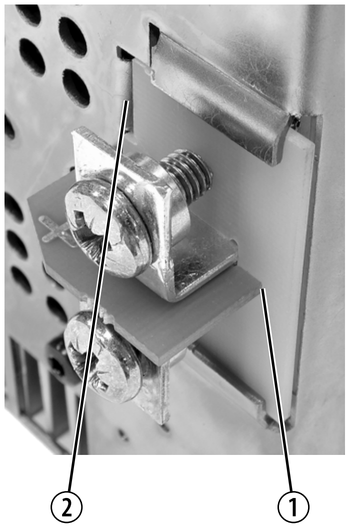
2. Refit and tighten the five M4 Torx Taptite screws to secure the front panel to the heatsinks and shield.

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 Taptite screw securing the front panel to the AC converter PCB.

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 PCB ① and is correctly located on its mounting tabs in the rear panel ②.



6. Refit and tighten the five M4 Torx Taptite 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 Taptite screw securing the rear panel to the AC converter PCB.

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.

7.3 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" on page 125.

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 12VDC, 24VDC or 48VDC 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 7.4 on page 124. A flat-blade screwdriver may reach too far through the slot and damage the components on the card.

Refer to Section 7.2 "Disassembly and Reassembly" for details on removing and refitting the top and bottom covers and front panel.

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.

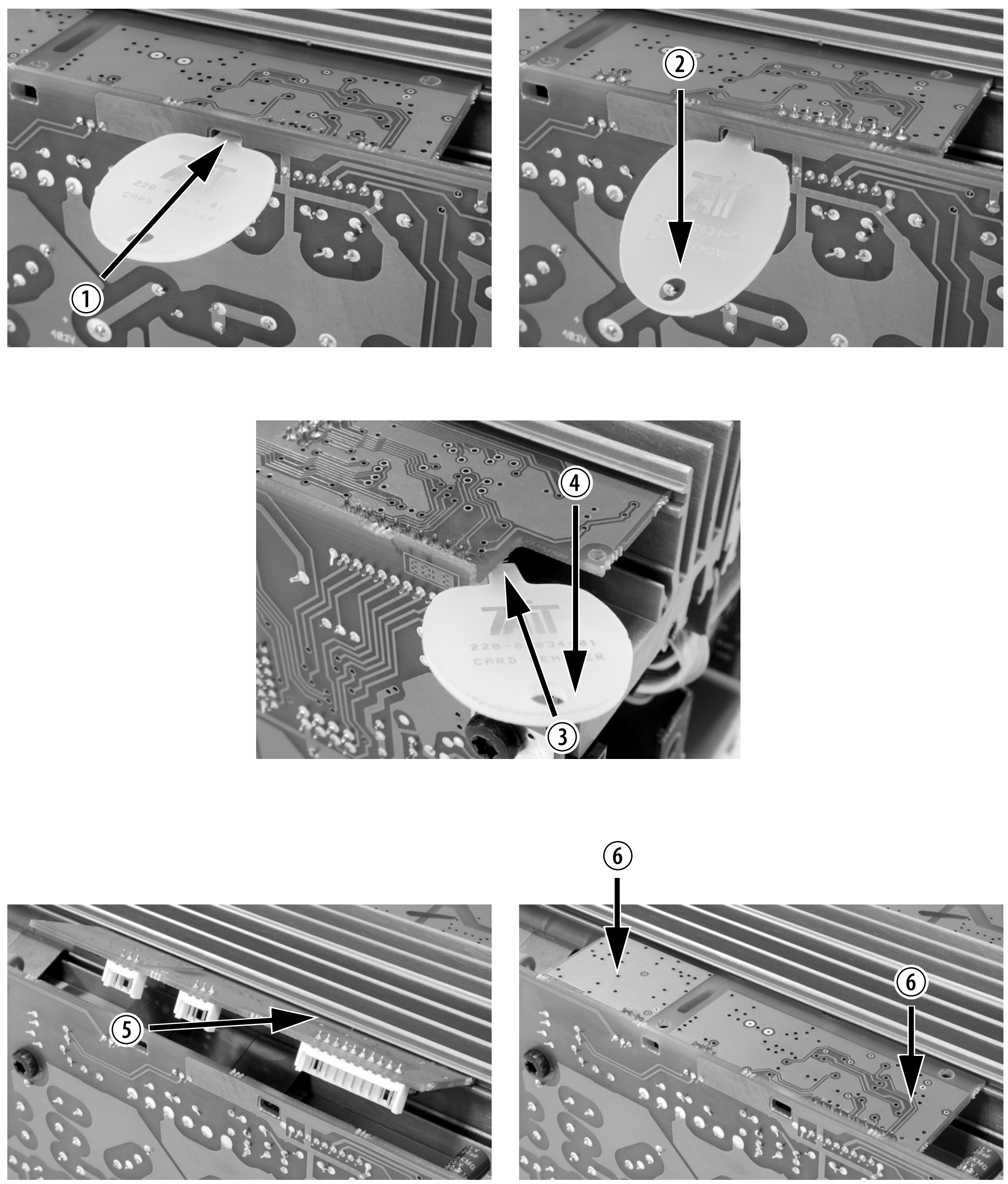
1. Remove the top cover.
2. Insert the card remover into the slot in the AC or DC converter PCB ① and push down ② to lift the nearest plug out of its socket (refer to Figure 7.4).

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.

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.

Figure 7.4 Replacing the Plug-in Cards



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 PCB ③ and push down ④ to lift the nearest plug out of its socket (refer to Figure 7.4).
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 PCB.
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.

Reprogramming

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 this information into the PMU using the Calibration Kit software; refer to the Calibration Kit documentation for more details
replace the serial number label	the serial number of the PMU will change to the number already programmed into the replacement HVDC and microprocessor card; stick the new serial number label onto the rear panel

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 table below.

Procedure	Details
reprogram the product code	use the Calibration Kit software to reprogram the PMU with the product code which corresponds to the new configuration of the PMU; for more details refer to "Identifying the PMU" on page 116, and to the Calibration Kit documentation

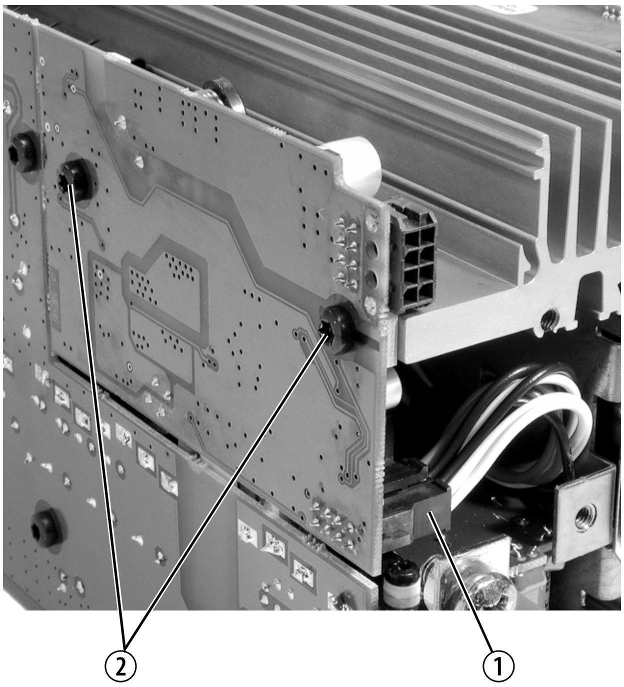
There is no need for any recalibration when any of the plug-in cards is fitted, removed or replaced.

7.4 Replacing the Auxiliary Power Supply PCB

Important You must reprogram the PMU if you change its configuration by fitting or removing an auxiliary power supply PCB. Refer to "Reprogramming" on page 127.

Refer to Section 7.2 "Disassembly and Reassembly" for details on removing and refitting the top and bottom covers and rear panel. The circled numbers in the following instructions refer to Figure 7.5.

Figure 7.5 Replacing the Auxiliary Power Supply PCB



Removal

1. Remove the top and bottom covers and rear panel.
2. Unplug the loom ① from the auxiliary power supply PCB.
3. Remove the two M4 Torx Taptite screws ② securing the PCB to the heatsink.

Refitting

1. Position the PCB as shown in Figure 7.5 and secure with the two M4 Torx Taptite screws ②.
2. Reconnect the loom ①.
3. Replace the rear panel and top and bottom covers.

Reprogramming

If you have changed the configuration of the PMU by fitting or removing an auxiliary power supply PCB, you will have to reprogram the PMU as described in the table below.

Procedure	Details
reprogram the product code	use the Calibration Kit software to reprogram the PMU with the product code which corresponds to the new configuration of the PMU; for more details refer to "Identifying the PMU" on page 116, and to the Calibration Kit documentation

There is no need for any recalibration when this PCB is fitted, removed or replaced.

Figure 7.6 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 PCB 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 PCB not fitted)	362-01122-XX
27	AC converter PCB	
28	PFC control card	
29	HVDC control and microprocessor card	
30	DC converter PCB	
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 PCB	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.

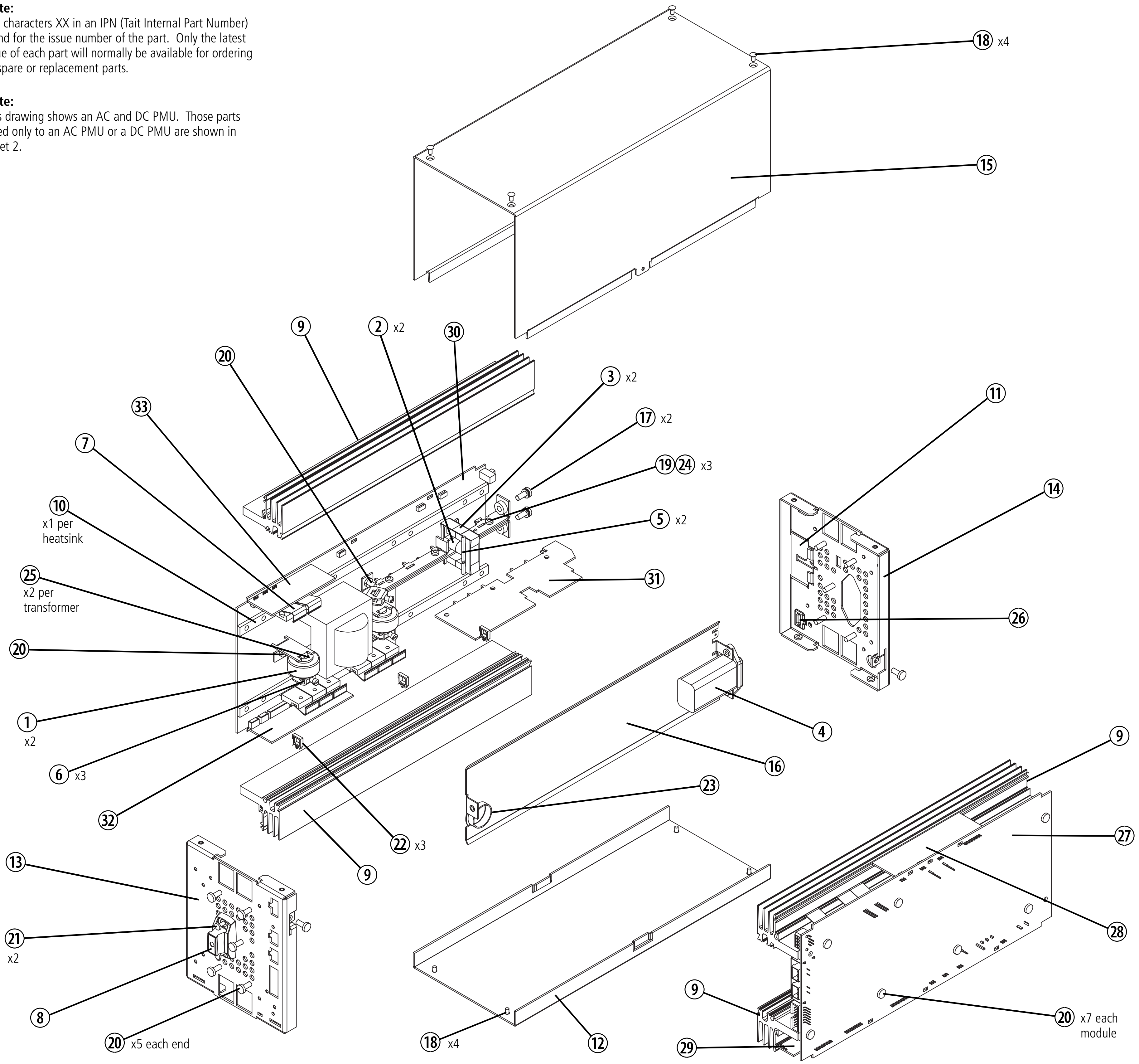
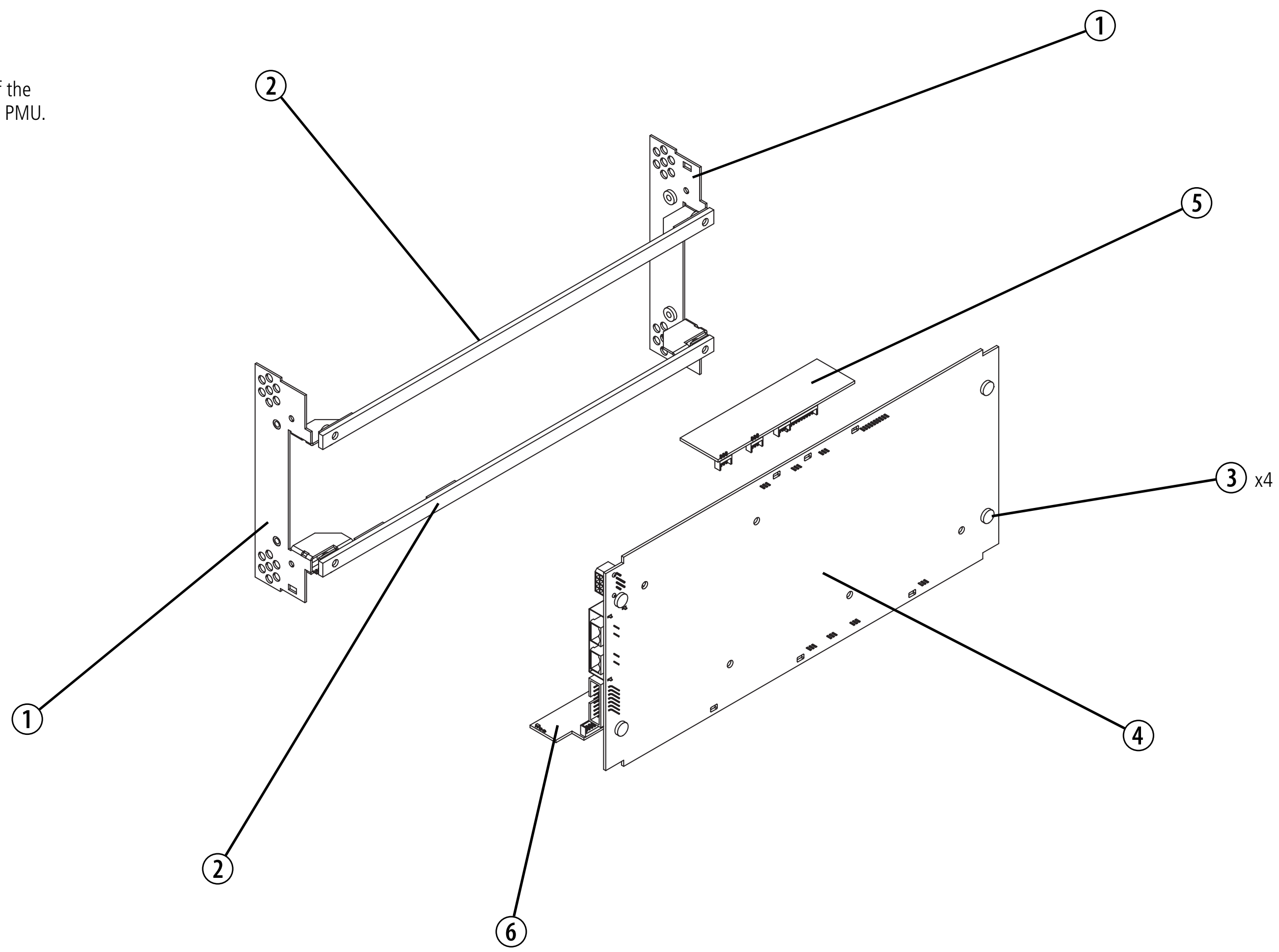


Figure 7.7 PMU Mechanical Assembly - Sheet 2

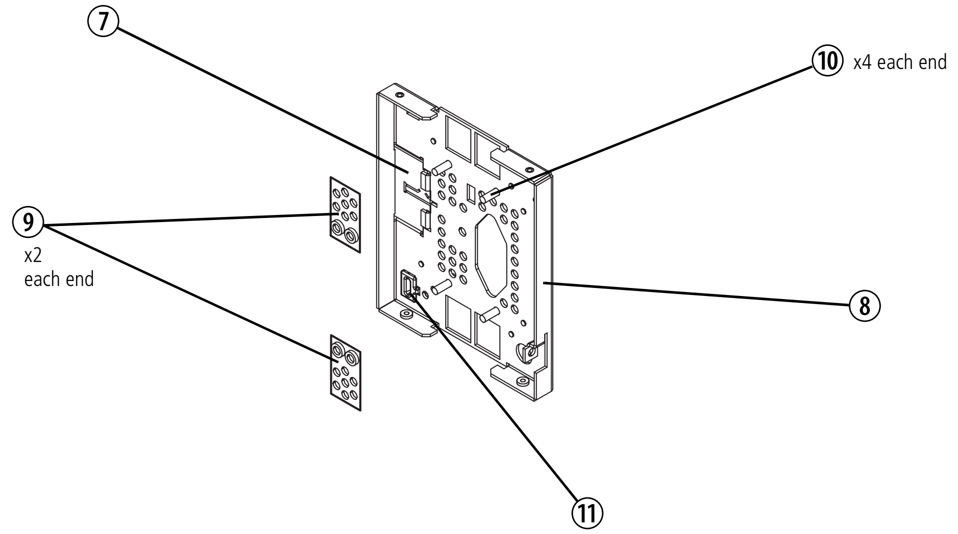
	Description	IPN
	DC PMU	
1	AC converter PCB mounting bracket	302-05268-XX
2	heatsink insulator	309-01051-XX
3	M4x12mm pan head Torx Taptite screw	349-02058-XX
4	AC converter PCB (current sense and output filter circuitry only)	
5	PFC control card	
6	HVDC control and microprocessor card (feedback and microprocessor circuitry only)	
	AC PMU	
7	DC input insulator	309-01052-XX
8	rear panel	316-06813-XX
9	AC blanking plate	316-06836-XX
10	M4x12mm pan head Torx Taptite screw	349-02058-XX
11	seal (when 40W aux. PS PCB 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.



8 Control Panel Circuit Description

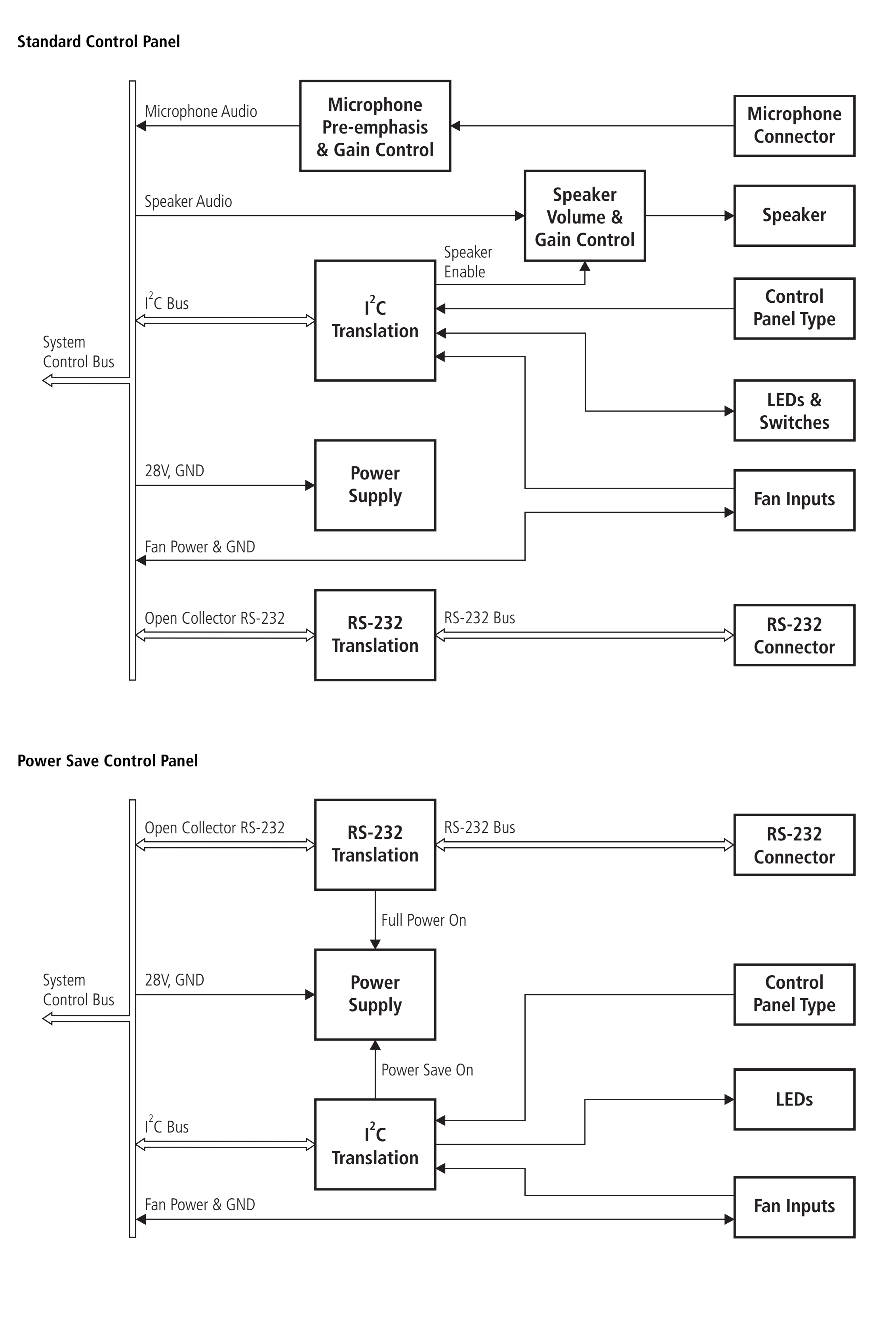
The control panel is designed to be the link between the user and the TB8100 BSS. The circuitry for the operation of the control panel is located on a PCB mounted behind its front face. All communication between the BSS and the control panel is via the system control bus. Figure 8.1 on page 132 shows 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 PCB. The different types of PCB and their main features are listed in the following table.

	Control Panel PCB	
Feature	**Standard**	**Power Save**
programming port	■	■
microphone socket	■	
volume control knob	■	
0.5W speaker	■	
PTT key from microphone	■	
LED indicators	■	■
channel speaker button	■	
channel carrier button	■	
microphone channel select button	■	

1. For a description of the controls located on the control panel, refer to "Operating Controls" in the Installation and Operation Manual.

Figure 8.1 Control Panel High Level Block Diagrams



8.1 Control Circuitry

The control panel translates I^2C messages into an appropriate response on the LEDs. It also translates key inputs from the front panel membrane[1] 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 feed from and drive up to seven reciters.

8.2 Audio Circuitry

This circuitry is present only on the standard control panel PCB.

The audio input level from the reciter is 1V pp for a single reciter. When multiple reciters are connected, this input level will drop by approximately 1/ (number of reciters), to a minimum of 167mV pp for seven reciters.

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.

8.3 Power Save

This circuitry is present only on the power save control panel PCB.

When the BSS 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 BSS 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.

1. Standard control panel only.

8.4 Power Supply

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.

9 Control Panel Servicing

Important This equipment contains devices which are susceptible to damage from static charges. Refer to "ESD Precautions" on page 15 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 PCB.

Figure 9.4 on page 141 identifies the main mechanical parts, and "Identifying the Control Panel" on page 136 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.

9.1 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	Description
TBA201X	power save
TBA202X	standard

9.2 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 PCB ■ 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

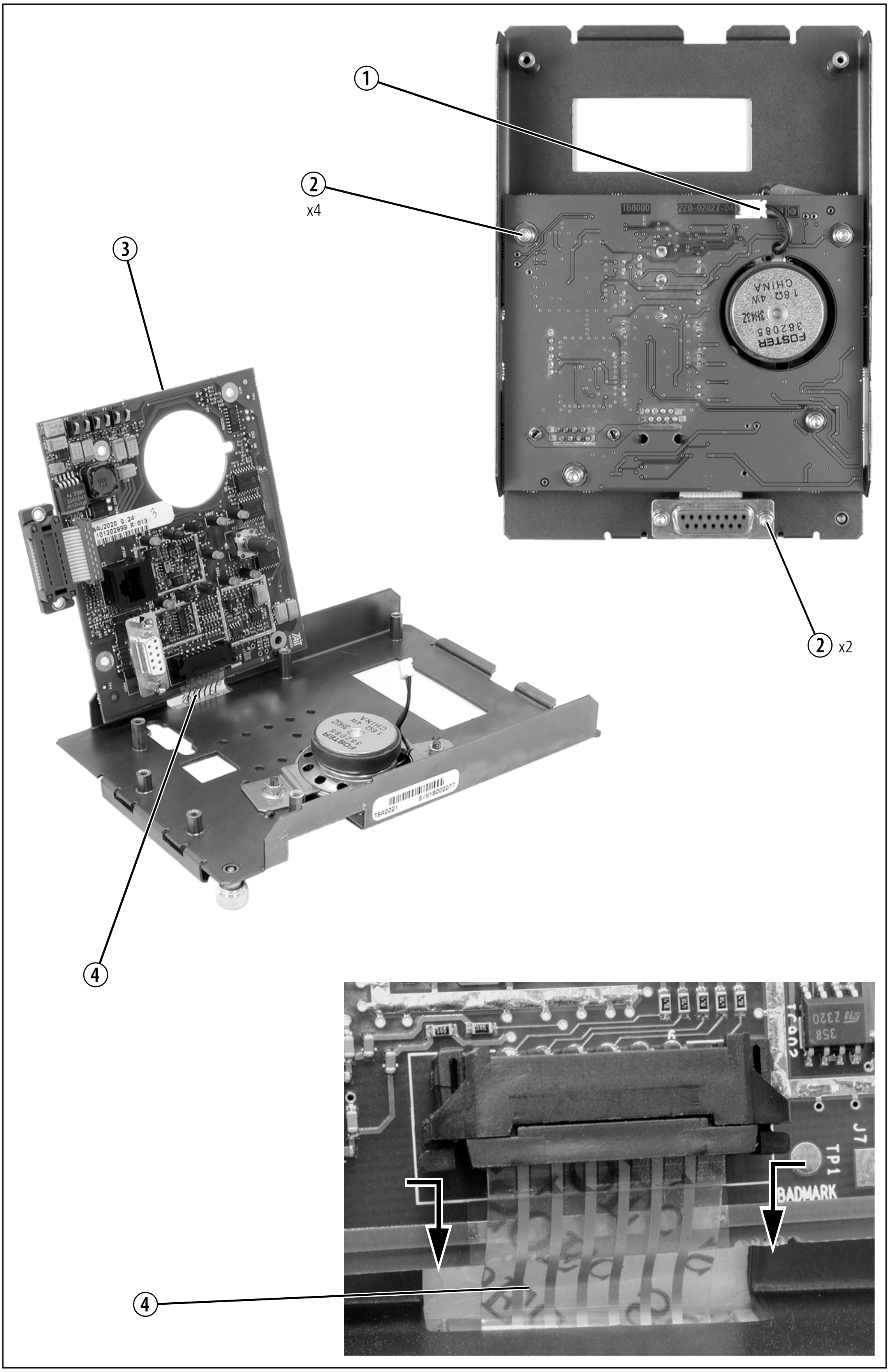
9.3 Replacing the PCB

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

Removal

1. Gently pull the volume knob off its shaft.
2. Disconnect the speaker plug ① from the socket on the PCB.
3. Remove the M3 Torx screws ② securing the PCB and D-range connector.
4. Carefully lift and rotate the PCB away from the control panel chassis, feeding the shaft of the volume control through the hole in the chassis, until the PCB is standing upright ③.
5. With the PCB standing upright, disconnect the flexible connector to the keypad ④.

Figure 9.1 Replacing the Control Panel PCB



Refitting

1. Withdraw the flexible connector to the keypad through the hole in the side of the control panel chassis.

2. Refit the PCB to the chassis, feeding the speaker wire through the hole in the PCB. Secure the PCB and D-range connector with the M3 Torx screws.

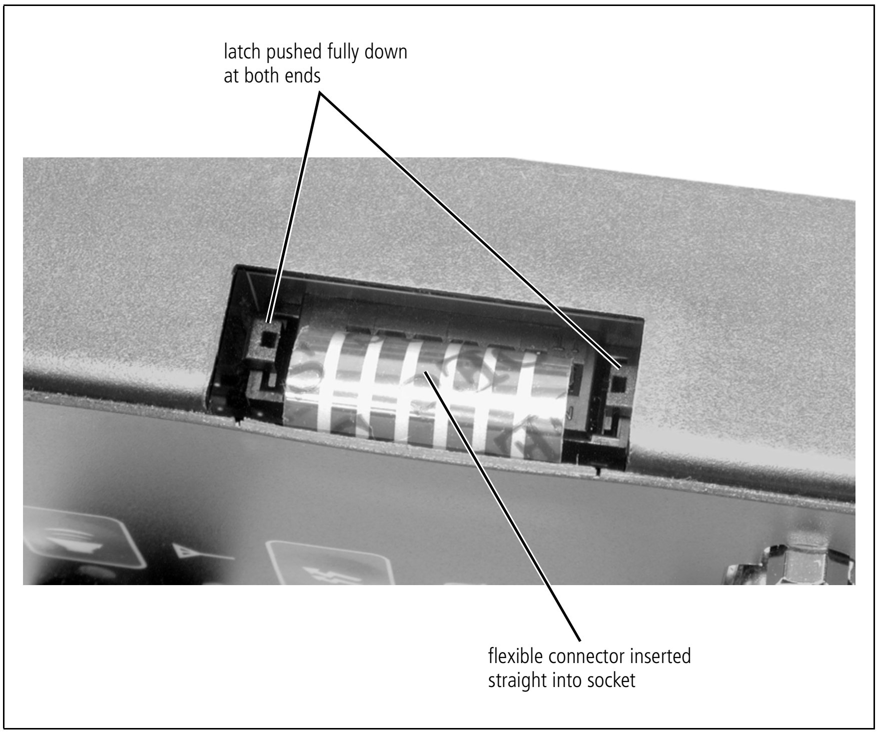
3. Reconnect the speaker wire.

4. Insert the flexible connector into its socket on the PCB 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 9.2.

5. Refit the volume knob.

Figure 9.2 Reconnecting the Flexible Connector



9.4 Replacing the Speaker

The circled numbers in the following instructions refer to Figure 9.3.

Removal

1. Remove the PCB as described in "Replacing the PCB" on page 136.
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 9.3 so that the wire will fit through the slot in the PCB (refer to Figure 9.1 on page 137).

2. Refit the PCB as described in "Replacing the PCB" on page 136.

Figure 9.3 Replacing the Speaker

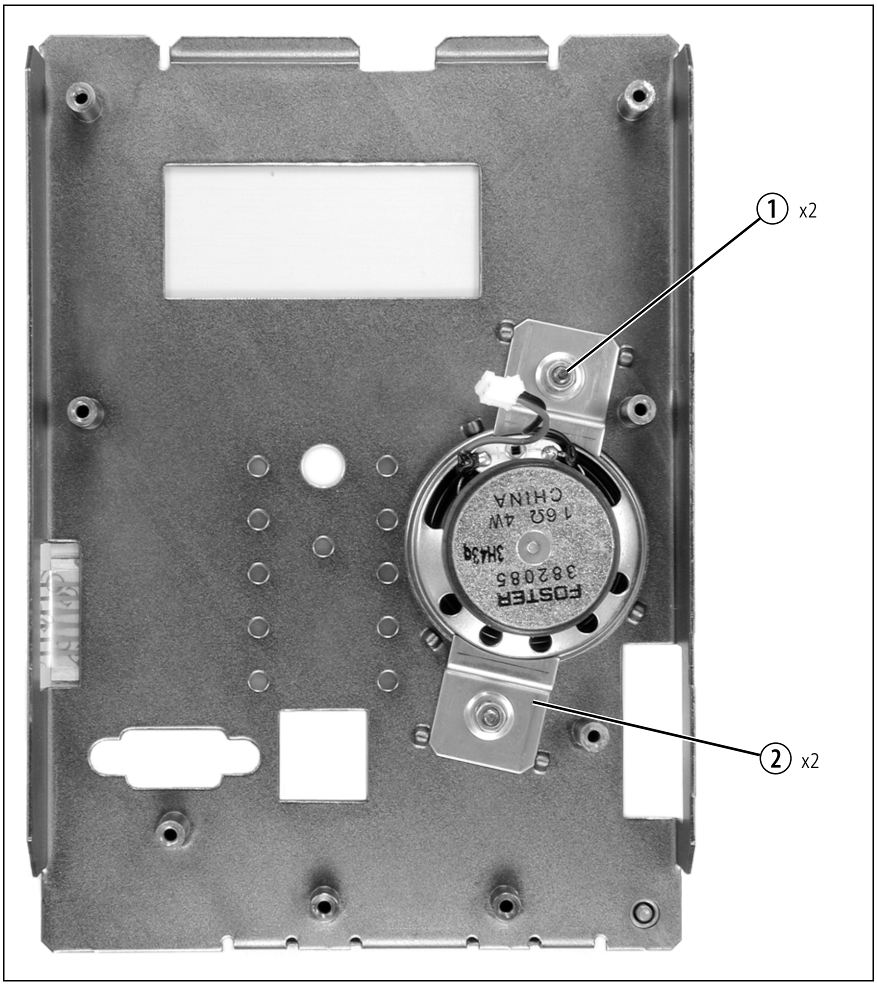


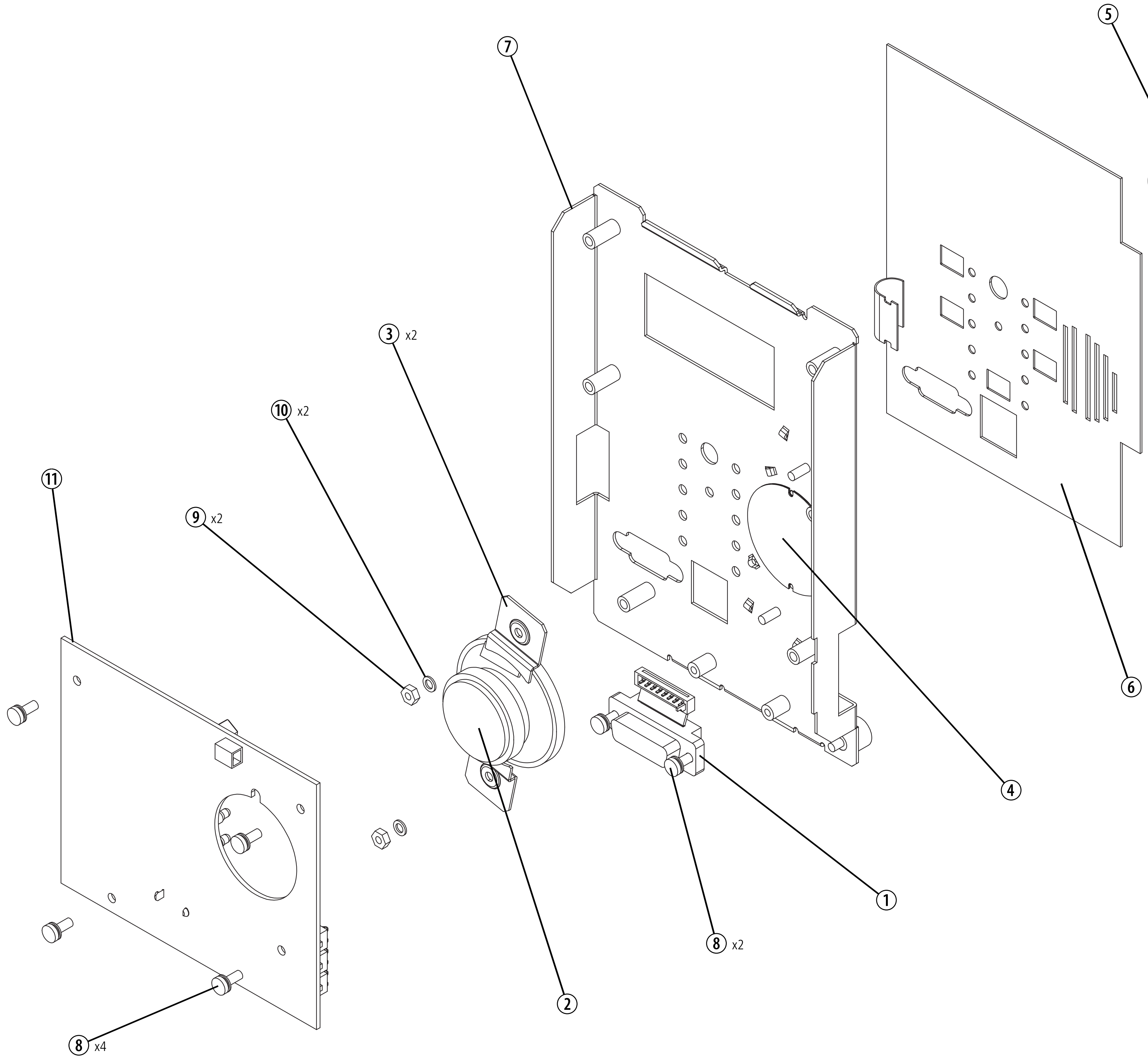
Figure 9.4 Control Panel Mechanical Assembly

	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 - standard keypad - power save	311-03116-XX 311-03115-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
⑪	control panel PCB	

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 and power save control panels are indicated in the description of the parts, or as shown below:

* fitted to standard control panel only



10 Subrack Servicing

This chapter provides information on the standard mechanical parts and cables used in the TB8100 BSS:

- Figure 10.1 on page 145 identifies the mechanical parts used in the front panel assembly
- Figure 10.2 on page 146 identifies the mechanical parts used in the subrack assembly
- Figure 10.3 on page 147 identifies the cables used in single and dual base station systems.

Figure 10.1 Front Panel Mechanical Assembly

	Description	IPN
①	fan contact PCB	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.

Note:
Fully-assembled front panels and replacement fan kits are also available as separate products. Consult your nearest Tait Dealer or Customer Service Organisation for details on the availability of these products.

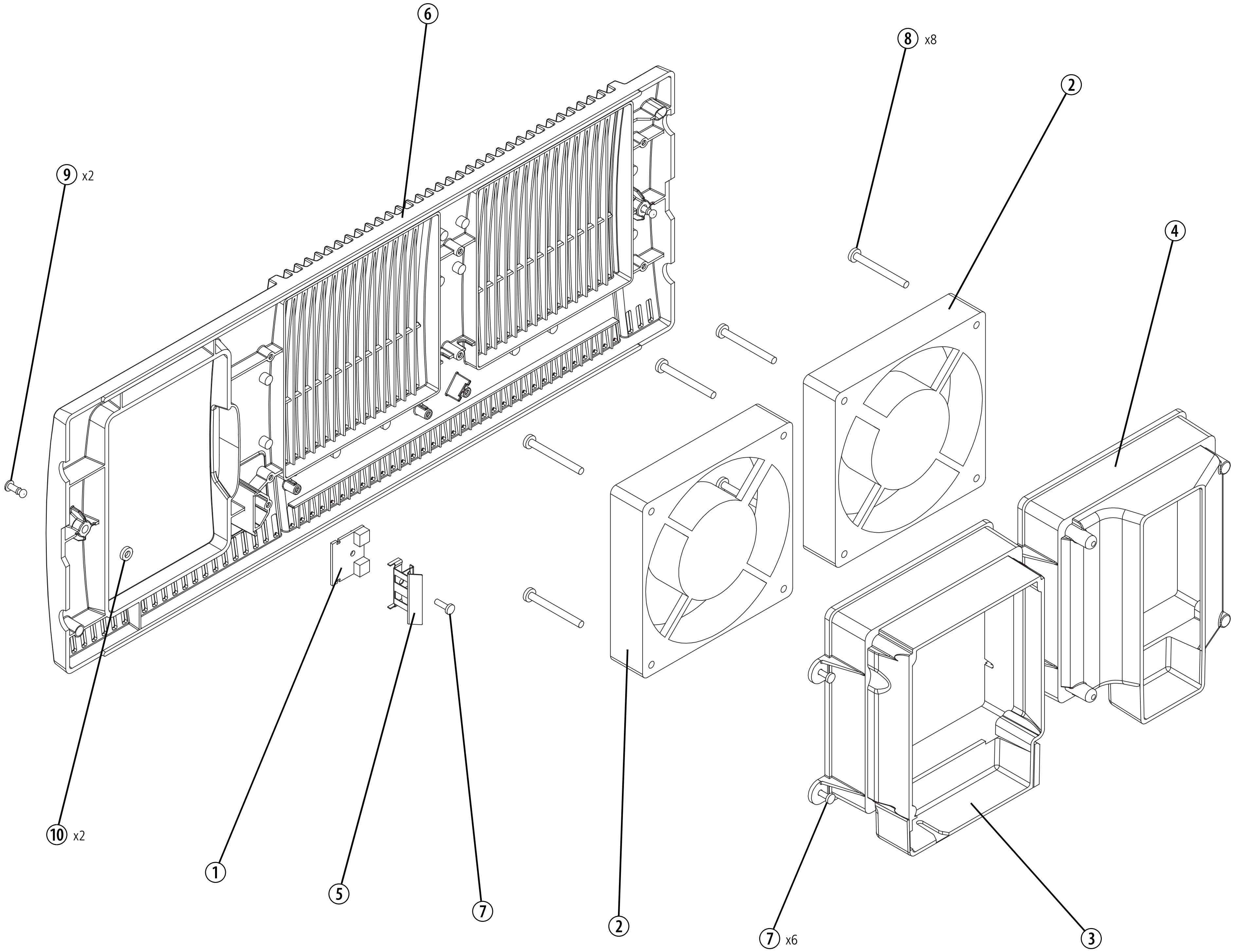


Figure 10.2 Subrack Mechanical Assembly

	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	subrack	318-01051-XX
7	M4x10mm pan head Pozidriv screw	345-00050-07
8	M3 hex nut	352-00010-08
9	M3 spring washer	353-00010-12
10	receptacle for quarter-turn fastener	354-01049-XX
11	subrack ground connector	356-00010-61
12	9.5mm P-clip	357-00010-48
13	insulating foam	362-01037-XX
14	insulator for interconnect PCB	362-01121-XX
15	interconnect PCB	

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:
Some of the parts illustrated in this diagram are also available as part of a kit or set of parts. These kits or sets are available as separate products. Consult your nearest Tait Dealer or Customer Service Organisation for details on the availability of these products.

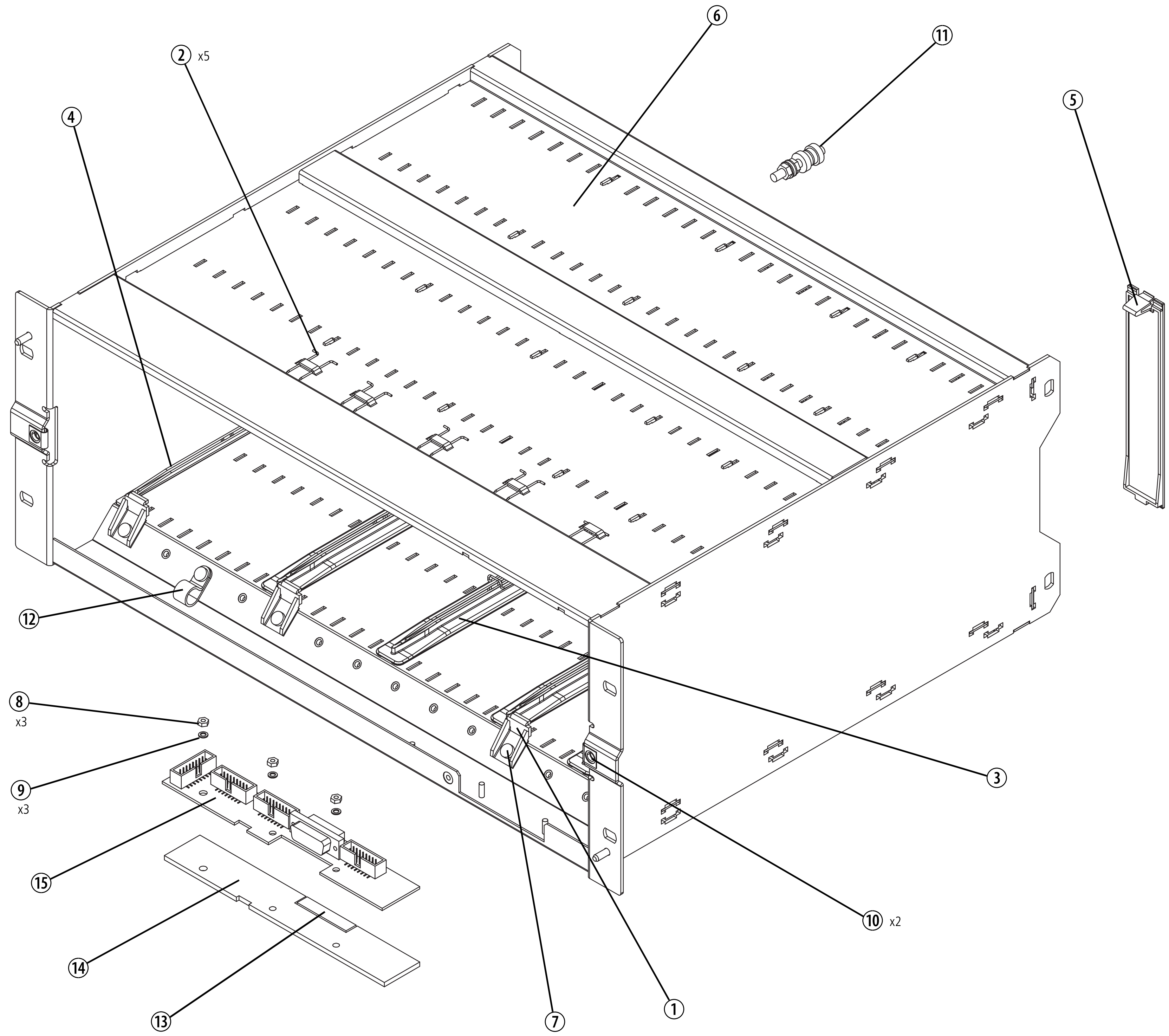
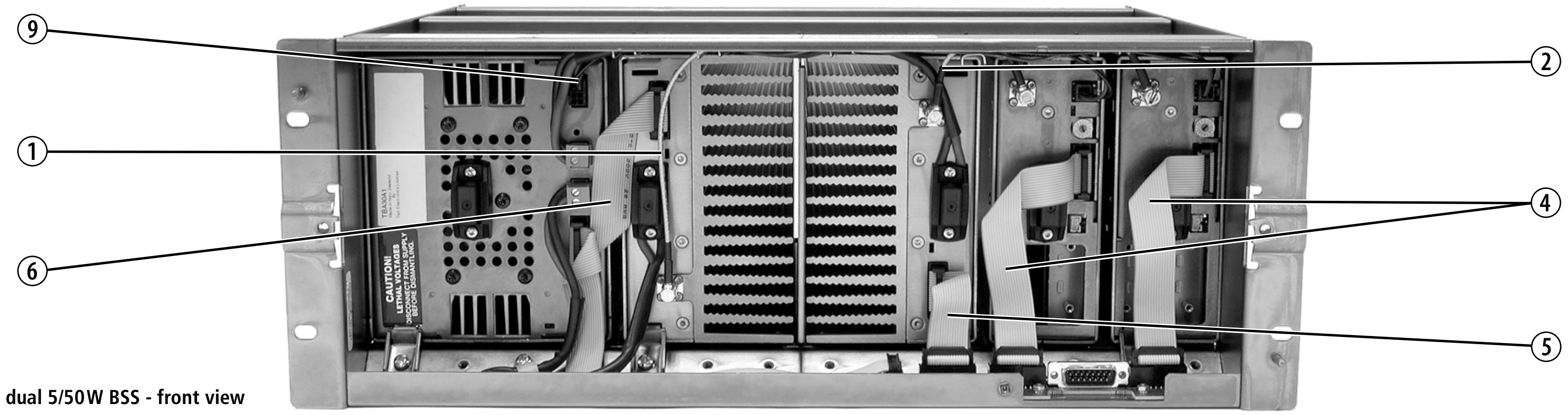


Figure 10.3   Cable Identification

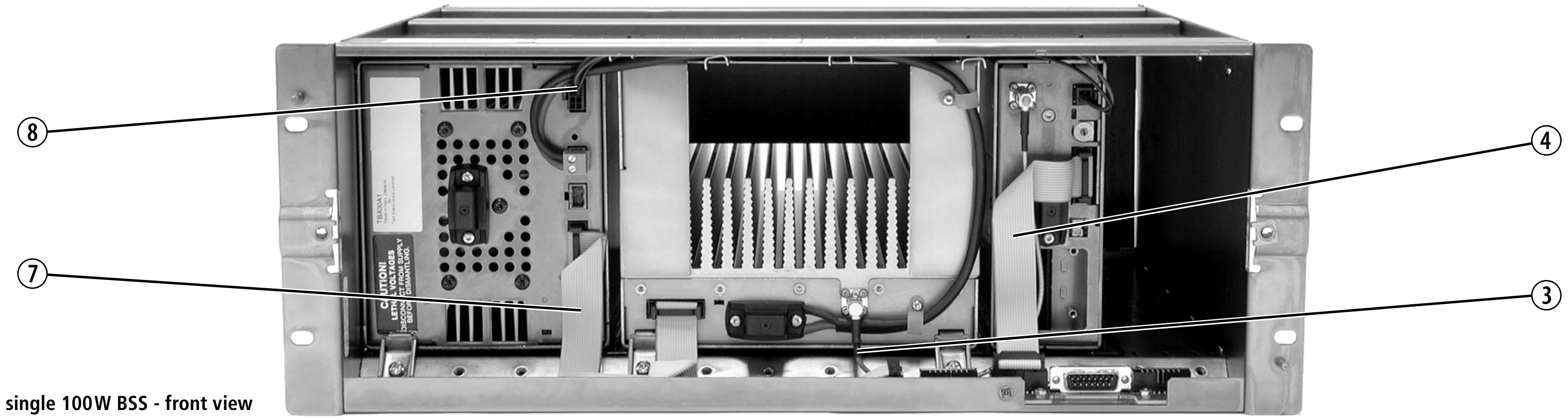
	Description	IPN
①	RF coaxial cable - reciter to 5/50W PA (long)	219-02859-XX
②	RF coaxial cable - reciter to 5/50W PA (short)	219-02862-XX
③	RF coaxial cable - reciter to 100W PA	219-02864-XX
④	system control bus ribbon cable - reciter to subrack interconnect PCB	219-02858-XX
⑤	system control bus ribbon cable - 5/50W PA to subrack interconnect PCB	219-02861-XX
⑥	system control bus ribbon cable - PMU and 5/50W PA to subrack interconnect PCB	219-02857-XX
⑦	system control bus ribbon cable - PMU and 100W PA to subrack interconnect PCB	219-02863-XX
⑧	DC power cable - PMU to single reciter	219-02856-XX
⑨	DC power cable - PMU to dual reciters	219-02860-XX
⑩	DC power cable - PMU aux. output to single reciter DC power cable - PMU aux. output to dual reciters	219-02895-XX 219-02896-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.

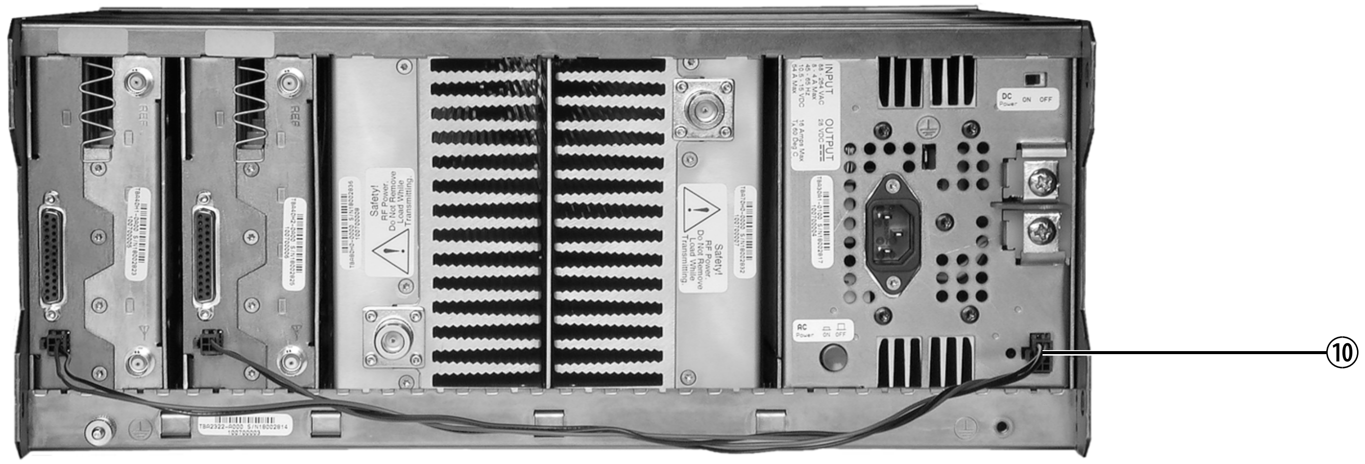
Note:
The cables illustrated in this diagram are also available as part of a wiring kit. These kits are available as separate products. Consult your nearest Tait Dealer or Customer Service Organisation for details on the availability of these products.



dual 5/50W BSS - front view



single 100W BSS - front view



dual 5/50W BSS - rear view

Glossary

This glossary contains an alphabetical list of terms and abbreviations related to the TB8100 base station system. 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.

BSS A BSS (base station system) is a subrack containing at least one TB8100 base station.

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 BSS.

control bus — The control bus is used for communications between modules in a base station system. 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 BSS with buttons, LEDs and other controls that let you interact with the BSS.

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.

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 BSS 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 systems interface), transmits audio received over its systems interface, and its transmitter is keyed via the Tx Key line.

logging on Once you are connected to a BSS, you log on to a base station. This establishes communications between the Service Kit and a particular 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 BSS.

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

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

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 12 dB 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 line to the minimum value anywhere on the 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.