

T830 Series II
Base Station Equipment
Service Manual

Preliminary Issue

August 1997

(Not For Resale)

About This Manual

Scope

This manual contains preliminary servicing information on T830 Series II 25W, 50W and 100W base stations which comprise the following equipment:

25W base station	T835 receiver T836 25W transmitter
50W base station	T835 receiver T837 exciter T838 50W power amplifier
100W base station	T835 receiver T837 exciter T839 100W power amplifier

Contents

Part A contains information on the following procedures:

- changing the operating frequency
- retuning the module after changing frequency
- configuring the audio processor
- T838/839 user information

Parts B to G contain the following PCB information:

- parts lists
- grid reference indexes
- PCB layout diagrams
- test points & options diagrams
- circuit diagrams

Part H contains the following information on the T800-22-0000 rack frame:

- general information
- circuit operation
- parts lists
- PCB layout diagrams

Technical Information

Any enquiries regarding this manual or the equipment it describes should be addressed in the first instance to your nearest approved Tait Dealer or Service Centre. Further technical assistance and copies of this manual may be obtained from the Customer Support Group, Radio Infrastructure Division, Tait Electronics Ltd, Christchurch, New Zealand.

Date Of Issue

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Overview

Introduction

When you receive the T800 module it will be run up and working on a particular frequency. Sometimes you may want to change the operating frequency. In some cases, when you change the operating frequency, it will also be necessary to re-tune the radio to ensure correct operation.

Purpose of this document

It is the purpose of this document to familiarise you with the procedures that must be carried out to check that the radio is still operating correctly, and how to re-tune the radio when this is not the case.

In this section

This section covers the following topics:

Topic	See page
How to change the operating frequency	2
How to re-tune the T835	4
How to re-tune the T836/837	7
Configuring the Audio Processor	11
How to determine if the T835/836/837 is still operating	16



How to change the operating frequency

Description

There are two possible ways of changing the operating frequency:

Method 1	By using a computer running PGM800Win and • Changing the default channel in the existing setup or • Reprogramming the radio channel frequencies and then selecting a default channel NOTE: Please refer to the T830 service manual and the PGM800WIN programming manual for further instruction.
Method 2	By selecting a new channel using the DIP switch on the rear of the PCB Backplane or some other form of installed channel change switch i.e. BCD, Internal DIP switch.

After changing the operating frequency

Having changed the operating frequency of the T830 there are two different scenarios you will be faced with:

- You will change the frequency and the T830 will continue to operate correctly. In this case you have changed to a frequency within the switching band of the radio.
- You will change the frequency and the T830 will not operate or will not operate correctly. In this case you have changed to a frequency outside of the switching band.

Note: The radio must now be re-tuned (see next section “How to re-tune the T835” & “How to re-tune the T836/837”).

What is the switching band

Because of the high RF performance of the T800 series there is a limit to the amount of frequencies that the radio can switch to before re-tuning must occur. The limit is referred to as the switching bandwidth.

- The T830 Rx can switch up to 3MHz.
- The T830 Tx can switch up to 8MHz.

So if the T830 is optimally tuned to a centre frequency (which is often the case when sent from the factory) then the Rx or Tx will be able to switch half the switching band either side of that frequency.



How to re-tune the T836/837 cont..

Steps involved

The service manual has a section which describes a full Initial Tuning and Adjustment procedure. This must be used if a repair has been made or some other major characteristic has been changed. If the only adjustment made has been to switch to a channel outside the switching band, then the following steps should be followed.

- Change the operating frequency
- Lock the VCO to produce the output frequency
- Adjust the output power
- Set the dual point modulation
- Set the FM deviation
- Reset the line-in level

The procedure is described below.

Procedure

Follow the steps below to retune the T836 or T837 if the frequency has been changed and the radio stops operating.

Step	Action
Lock the VCO to produce the output frequency	
1	Connect a high impedance voltmeter to the long lead of L1 in the VCO (this measures the synthesiser loop voltage).
2	Single channel Tune VCO trimmer C6 for a synthesiser loop voltage of 10V. Multichannel Tune VCO trimmer C6 for a synthesiser loop voltage of 10V on the middle channel. If there is no middle channel, tune C6 so that the channels are symmetrically placed around a loop voltage of 10V. All channels should lie within the upper and lower limits of 16V and 3V respectively. Do not attempt to programme channels with a greater frequency separation than the specified switching range.



How to re-tune the T836/837

Equipment required

You will need:

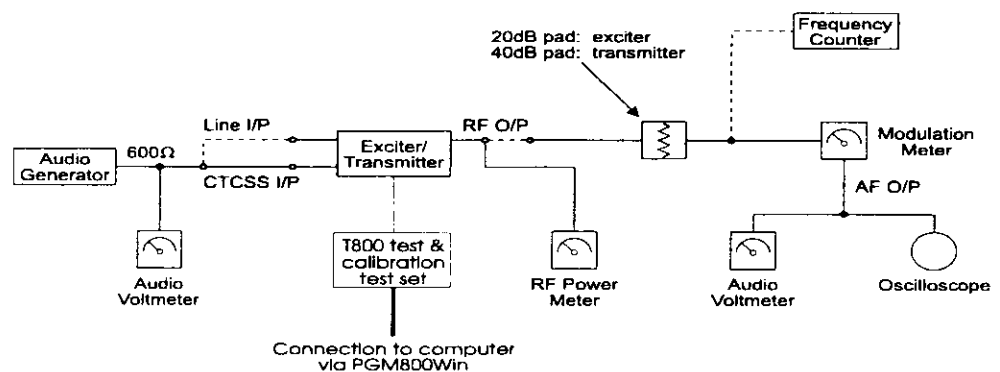
Computer with PGM800Win installed
T800 programming kit
T800 test & calibration unit
Digital multimeter
Oscilloscope (digital preferred)
Audio signal generator
Audio voltmeter x 2
RF power meter
Modulation meter
20dB pad

or

Computer with PGM800Win installed
T800 programming kit
T800 test & calibration unit
RF test set

Before you start

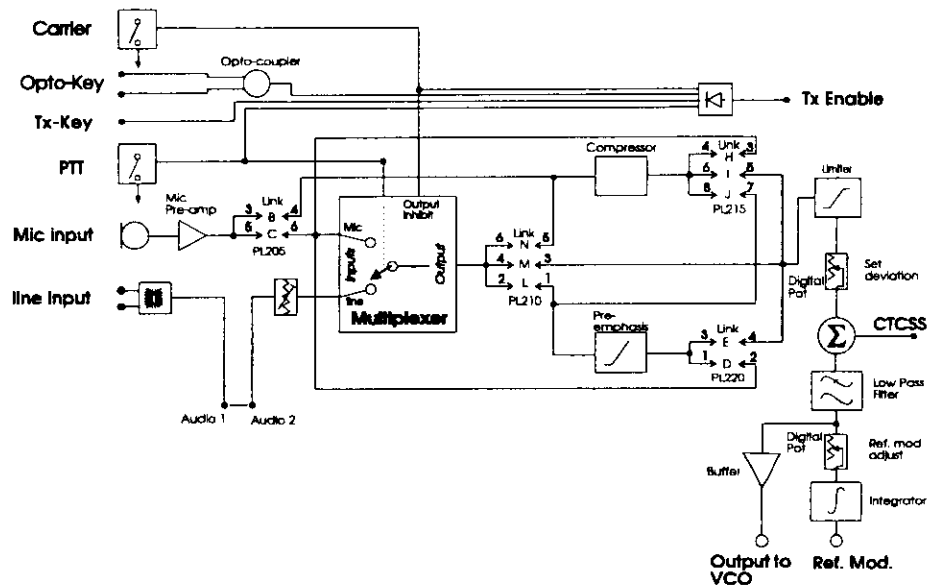
- Remove the top cover of the module (the side closest to the handle).
- Set up the test equipment as shown below.



- Set the jumpers in the audio section of the module as required (see section "Configuring the Audio Processor").
- Connect the computer to the module using the PGM800Win programming kit.

Configuring the Audio Processor cont..

T836/T837 audio processor links cont..



T836/837 Audio processor block diagram showing link options



How to determine if the T835/836/837 is still operating

Introduction

If the radio was working fine and you want to check that it is still operating correctly, after changing the operating frequency, follow the steps listed below.

Procedure

Follow the steps below to perform a quick check of correct operation.

Step	Action
1	Remove the top cover of the module (the side closest to the handle).
2	Connect a high impedance voltmeter to the long lead of L1 in the VCO (this measures the synthesiser loop voltage).
3	Ensure the measured DC voltage is between 5 & 15V

Note: If the T835 Receiver is not operating this will be indicated by a slow flashing of the Green Supply light. This should be used as a visual check followed by the more definitive check given above.

3.4 Short Tuning Procedure

ID: CASTEL0004
2.983 (d)(9) TUNE UP

Use this procedure only if you want to reprogram the T836/837 to a frequency outside the 8MHz switching range and do not intend to carry out any other major adjustments or repairs.

3.4.1 Introduction

Reprogram the operating frequency as described in the PGM800Win programming kit (refer to Section 3.2).

Remove the top cover (nearest the handle).

Set up the test equipment as described in Section 3.3.

Set the links in the audio processor section as required (refer to Section 3.5).

3.4.2 Synthesiser Alignment

- Connect a high impedance voltmeter to PL4-1 or the junction of L1 & R1 in the VCO (this measures the synthesiser loop voltage).
- Key the transmitter by earthing the Tx-Key line.
- **Single Channel** Tune VCO trimmer CV1 for a synthesiser loop voltage of 9V.
- **Multichannel** Tune VCO trimmer CV1 for a synthesiser loop voltage of 9V on the middle channel.
If there is no middle channel, tune CV1 so that the channels are symmetrically placed around a loop voltage of 9V.
All channels should lie within the upper and lower limits of 13V and 5V respectively.
Do not attempt to program channels with a greater frequency separation than the specified switching range of 8MHz.

3.4.3 Output Power Adjustment (T836 Only)

Connect an RF power meter to the output socket and key the transmitter.

Turn RV320 (power adjust) fully clockwise.

Tune CV451 (output power trim) for maximum output power and check that this is >30W.

Adjust RV320 for the required output power (between 5 and 25W).

Readjust CV451 to reduce the supply current by up to 0.5A.

C3.6 T836/837 Initial Tuning & Adjustment

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3.4.4 Two Point Modulation Adjustment

Note 1: In this and following sections deviation settings are given first for wide bandwidth sets, followed by settings in brackets for mid bandwidth sets () and narrow bandwidth sets [].

Note 2: Reference modulation and limiter adjustment are controlled by PGM800Win. Electronic potentiometers (256 step) are used to allow channel-by-channel adjustment of deviation and two point modulation.

Note 3: To optimise the modulation response across the switching range, repeat steps 1-4 below for each channel that will be used (usually needed only for data applications). In applications where the modulation response is less critical (e.g. voice use only), carry out steps 1-4 below on the middle channel and cut and paste the value to all other channels.

1. Inject an audio signal of 600Hz 1.5V rms (+5dBm) into the CTCSS input (D-range 1 (PL100) pin 8).

Key the transmitter by earthing the Tx-Key line.

2. Adjust the output from the audio generator to obtain $\pm 3\text{kHz}$ ($\pm 2.4\text{kHz}$) [$\pm 1.5\text{kHz}$] deviation at 600Hz.

3. Change the input frequency to 120Hz and adjust "reference modulation" via PGM800Win to obtain $\pm 3\text{kHz}$ ($\pm 2.4\text{kHz}$) [$\pm 1.5\text{kHz}$] deviation (you can use either the mouse or up and down arrow keys).

4. Change the input frequency back to 600Hz.

Repeat steps 2 and 3 above until the deviations achieved at the two input frequencies are within 0.2dB of each other. You will need to do this at least four times.

5. Sweep the audio between 50 and 300Hz for peaks.

Note: A peak between 50 and 300Hz will indicate a fault condition, i.e:

- incorrect set-up
- or - modulation circuitry fault.

The specification window is $\pm 1\text{dB}$ relative to 150Hz from 65 to 260Hz.

3.4.5 FM Deviation (Limiter) Adjustment

Note: If the T836/837 will be used over the whole 8MHz switching range, you must set the deviation for each channel. However, if the module will be used on frequencies that cover only a 1MHz (or less) switching range, you can set the deviation on the middle channel and use this value for all other channels with the "fill" option in PGM800Win.

Inject 1kHz at -10dBm into the line input (D-range 1 (PL100) pins 1 & 4; pins 2 & 3 shorted; refer to Section 2.2 of Part F).

Adjust RV210 (line sensitivity) fully clockwise and key the transmitter by earthing the Tx-Key line. Adjust "deviation" via PGM800Win to set the peak deviation to $\pm 4.7\text{kHz}$ ($\pm 3.8\text{kHz}$) [$\pm 2.3\text{kHz}$] (you can use either the mouse or up and down arrow keys).

Sweep the audio frequency from 100Hz to 4kHz and ensure that the maximum deviation does not exceed 4.7kHz ($\pm 3.8\text{kHz}$) [$\pm 2.3\text{kHz}$]. Readjust "deviation" if necessary via PGM800Win.

3.4.6 Line-in Level Adjustment

Set the injected signal at the line input to the required line level (typically -10 to -20dBm).

Adjust RV210 (line sensitivity) to provide $\pm 3\text{kHz}$ ($\pm 2.4\text{kHz}$) [$\pm 1.5\text{kHz}$] deviation.

C2.12 T836/837 Circuit Operation

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2.8 T836 Drive Amplifier & PA

ID: CASTEL0004

2.983 (d)(10) CIRCUIT DESC.

(Refer to Figure 2.1 and the exciter and PA circuit diagrams (sheets 3 & 4) in Section 6.2.)

The output power of the PA is maintained at a constant level via a power control loop applied to the two-stage, wide band exciter amplifier (Q365, Q370). The forward and reverse RF power levels are sensed via a dual directional coupler and detector diodes (D410, D420 in the PA cavity). The detected DC signals are summed with the 'power adjust' level and fed to the control integrator (IC330 pins 1, 2 & 3). The output control voltage is buffered by Q310 and Q315, and applied to the collectors of the wide band exciter amplifier.

Note: Forward and reflected power signals are summed so that, under high VSWR, the power control will turn the output RF level down.

To reduce the spurious output level when the synthesiser is out-of-lock, the Tx-Reg. and Lock-Detect signals are gated to inhibit the PA control circuit and to switch off the RF signal at the input to the drive amplifier. This is achieved by a PIN switch attenuator (D340, D350, D360).

Cyclic keying control is provided by additional circuitry consisting of several time delay, ramp and gate stages:

- Q350, Q355, Q360, IC330 pins 1, 2 & 3 power ramping
- Q340, Q345 Tx-Reg. and Lock-Detect gate
- Q320, Q325, Q330, Q335 delay and PIN switch drive.

This is to allow the RF power circuits (both exciter and PA) to ramp up and down in a controlled manner so that minimal adjacent channel interference is generated during the transition.

The output of the wide band amplifier is approximately 500mW (+27dBm) for an input of 170mW (+22dBm) when the power control is set to maximum.

The zener diode (D330) limits the upper range of the controlled voltage to the exciter transistors.

A temperature sensor (R460) is provided so that the RF output power can be reduced to a preset level when a set temperature is exceeded. This is a protection circuit (IC330 pins 5, 6 & 7, Q305) to prevent overheating, as the unit is *not* rated for continuous operation at high temperatures (refer to Section 1.2.3 for duty cycle specifications). RV330 sets the PA output power while under high temperature fold-back conditions.

R359, R360 and R362 form a 6dB attenuator to provide good VCO/exciter isolation.

The output attenuator (R392, R390, R394 and R396) aids in reducing exciter/PA interaction while also ensuring a reasonable match for Q350.

The RF output from the exciter is fed to the driver stage (Q415) and then to the final (Q425). DC is fed to the final via a low pass filter with special low frequency decoupling. CV451 tunes the output matching across the entire band.