

## 3 T855 Initial Tuning & Adjustment



**Caution:** This equipment contains CMOS devices which are susceptible to damage from static charges. Refer to [Section 1.2](#) in Part A for more information on anti-static procedures when handling these devices.

The following section describes both short and full tuning and adjustment procedures and provides information on:

- channel programming
- selecting the required audio links
- synthesiser alignment
- receiver front end and IF alignment
- noise and carrier level mute adjustment
- setting the line and monitor output levels
- setting up the RSSI.

**Note:** Unless otherwise specified, the term "PGM800Win" used in this and following sections refers to version 2.00 and later of the software.

Refer to [Figure 4.3](#) which shows the location of the main tuning and adjustment controls. Refer also to Section 6 where the parts lists, grid reference index and diagrams will provide detailed information on identifying and locating components and test points on the main PCB. The parts list and diagrams for the VCO PCB are in Part E.

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## 3.1 Introduction

When you receive your T855 receiver it will be run up and working on a particular frequency (the "default channel")<sup>1</sup>. If you want to switch to a frequency that is within the 5MHz switching range (i.e.  $\pm 2.5$ MHz from the factory programmed frequency), you should only need to reprogram the receiver with the PGM800Win software (refer to the PGM800Win programming kit and [Section 3.2](#) below).

However, if you want to switch to a frequency outside the 5MHz switching range, you will have to reprogram and re-tune the receiver to ensure correct operation. In this case you should carry out the short tuning procedure described in [Section 3.4](#).

If you have carried out repairs or other major adjustments, you must carry out the full tuning and adjustment procedure described in this section (except for [Section 3.4](#)).

## 3.2 Channel Programming

You can program up to 128 channel frequencies into the receiver's EEPROM memory (IC820) by using the PGM800Win software package and an IBM™ PC. You can also use PGM800Win to select the receiver's current operating frequency (or "default channel").

If the receiver is installed in a rack frame, you can program it via the programming port in the speaker panel. However, you can also program the receiver before it is installed in a rack frame as follows:

- by using a T800-01-0010 calibration test unit;
- via D-range 1;
- via D-range 2 (standard T800-03-0000 auxiliary D-range only);
- via SK805 (internal Micromatch connector).

If you do not use the T800-01-0010, you will have to connect the PC to the receiver via a module programming interface (such as the T800-01-0004).

For a full description of the channel programming procedure, refer to the PGM800Win programming software user's manual.

**Note:** When an auxiliary D-range kit (D-range 2 - T800-03-0000) is fitted, you can also select a channel with an external switch, such as the DIP switch on the rack frame backplane PCB. Refer to Part C in the T800 Series Ancillary Equipment Service Manual (M800-00-101 or later issue) or consult your nearest Tait Dealer or Customer Service Organisation for further details.

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1. Use the "Read Module" function in PGM800Win to find out what the default channel is.

### 3.3 Test Equipment Required

You will need the following test equipment:

- computer with PGM800Win installed
  - T800 programming kit
  - module programming interface (e.g. T800-01-0004 - optional)
  - 13.8V power supply
  - digital multimeter
  - audio signal generator
  - RF signal generator
  - audio voltmeter
  - sinad meter
- } or RF test set (optional)
- oscilloscope
  - distortion meter
- } not needed for short tuning procedure
- T800-01-0010 calibration test unit (optional)
  - 4Ω speaker (not needed if the calibration test unit is used)

Figure 3.1 and Figure 3.2 show typical test equipment set-ups (with and without a T800-01-0010 calibration test unit).

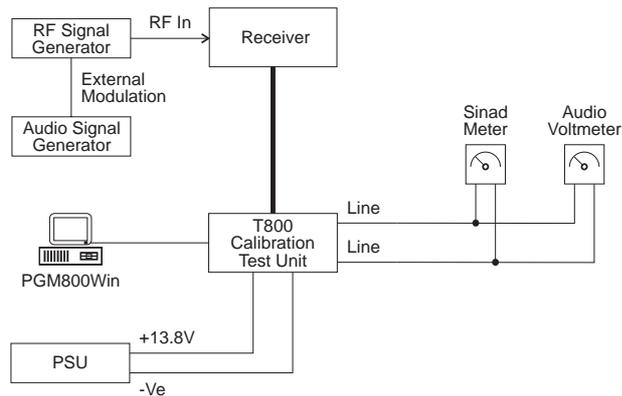


Figure 3.1 T855 Test Equipment Set-up For Short Tuning Procedure

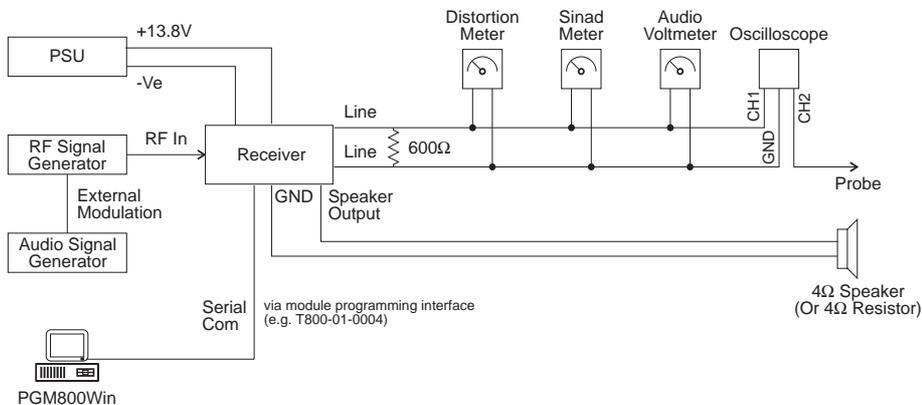


Figure 3.2 T855 Test Equipment Set-up For Full Tuning & Adjustment Procedure

## 3.4 Short Tuning Procedure

Use this procedure only if you want to reprogram the receiver to a frequency outside the 5MHz 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 the long lead of L1 in the VCO (this measures the synthesiser loop voltage).
- **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 program channels with a greater frequency separation than the specified switching range of 5MHz.

### 3.4.3 Front End Alignment

**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:** For multichannel operation align the receiver on a frequency in the middle of the required band.

Set RV230 (front panel gating sensitivity) fully clockwise.

Inject a strong on-channel RF signal with  $\pm 3\text{kHz}$  deviation ( $\pm 2.4\text{kHz}$ ) [ $\pm 1.5\text{kHz}$ ] at

1kHz into the antenna socket and adjust the helical resonators #FL410 & #FL420 to give best sinad.

Continually decrease the RF level to maintain 12dB sinad.

Readjust FL410 and FL420 to give best sinad.

With PL210 and PL220 connected for de-emphasised audio response, the receiver sensitivity should be better than -117dBm, assuming that the audio levels are not being overdriven (refer to [Section 3.4.5](#)).

### 3.4.4 Mute Adjustment

#### 3.4.4.1 Noise Mute

Connect pins 1 & 2 of PL250 to enable the noise mute.

Set the RF level to -105dBm with  $\pm 3$ kHz deviation ( $\pm 2.4$ kHz) [ $\pm 1.5$ kHz] at 1kHz.

Set RV230 (front panel gating sensitivity) fully anticlockwise.

Adjust RV310 (noise mute gain) fully clockwise to close the mute (if necessary turn off the RF signal and then turn it on again).

Rotate RV310 anticlockwise until the mute just opens.

Reset the signal generator for the required opening sinad and adjust RV230 clockwise until the mute just opens.

#### 3.4.4.2 Carrier Level Mute

Connect pins 2 & 3 of PL250 to enable the carrier mute and disable the noise mute.

Apply an on-channel signal from the RF generator at the required mute opening level with  $\pm 3$ kHz deviation ( $\pm 2.4$ kHz) [ $\pm 1.5$ kHz] at  $\pm 1$ kHz.

Adjust RV235 (carrier mute) anticlockwise to close the mute (if necessary, momentarily turn off the RF), then slowly adjust it clockwise until the mute just opens. The mute should now open at this preset level.

### 3.4.5 Line Amplifier Output

Apply an on-channel signal from the RF generator at a level of -70dBm with  $\pm 3$ kHz deviation ( $\pm 2.4$ kHz) [ $\pm 1.5$ kHz] at 1kHz.

Adjust RV210 (front panel line level) to set the line level to the required output level.

### 3.4.6 CTCSS

#### 3.4.6.1 Decoder Operation

Program a CTCSS tone on the default channel using PGM800Win.

Set the RF signal generator output to -70dBm.

Modulate the generator with both:

- a 1kHz tone at  $\pm 3$ kHz deviation ( $\pm 2.4$ kHz) [ $\pm 1.5$ kHz]
- and a CTCSS tone at the programmed frequency at  $\pm 500$ Hz deviation ( $\pm 400$ Hz) [ $\pm 300$ Hz].

Check that the receiver gate opens and the front panel "Gate" LED is on.

#### 3.4.6.2 Opening Sinad

Adjust RV230 (front panel gating sensitivity) fully clockwise.

Reduce the RF signal level to -110dBm.

Observe the sinad meter and reduce the RF level until the receiver mute closes.

Slowly increase the signal level until the receiver mute just opens and stays open.

With PL240 pins 1 & 2 linked (G - H; high pass filter bypassed), check that the sinad is less than 6dB.

Reset the signal generator for the required opening sinad, adjust RV230 fully anti-clockwise, then clockwise until the mute just opens.

#### 3.4.6.3 High Pass Filter

Set the audio processor links as follows:

Plug	Link		Function
PL210	1 - 2	A - B	de-emphasised response
PL230	2 - 3	N - P	audio from internal CTCSS speech filter
PL240	4 - 5	K - L	audio input via PL230 or I/O pad

Reset the RF signal generator output to -70dBm and note the line level (measurement A).

Reduce the 1kHz generator to zero output and measure the line level again (measurement B).

Check that measurement B is at least 30dB below measurement A.

### 3.4.7 RSSI (If Fitted)

The T800-04-0000 RSSI is an optional PCB which adds signal strength monitoring and high level mute facilities to the basic receiver.

Ensure the T800-04-0000 PCB is fitted in SK320 and SK330 in the IF compartment.

Apply an on-channel signal from the RF generator at a level of -110dBm with  $\pm 3$ kHz deviation ( $\pm 2.4$ kHz) [ $\pm 1.5$ kHz] at 1kHz.

Adjust RV320 (RSSI level) to give 2.0V RSSI output on pin 5 of D-range 1 (PL100) when measured with a high impedance DMM.

## 3.5 Audio Processor Links

### 3.5.1 General

Use the following table to set up the audio processor to the configuration you require. You should set the audio processor links before carrying out the receiver alignment. The factory settings are shown in brackets [ ].

Plug	Link <sup>a</sup>		Function
PL210	[1 - 2] 2 - 3	[A - B] B - C	de-emphasised response flat response
PL220	1 - 2 [2 - 3]	D - E [E - F]	flat response de-emphasised response
PL230 <sup>b</sup>	1 - 2 [2 - 3] 3 - 4	M - N [N - P] P - Q	audio input via AUDIO-2 pad audio from internal CTCSS speech filter audio input via I/O pad P250
PL240 <sup>b</sup>	1 - 2 [2 - 3] or 3 - 4 4 - 5	G - H [H - J] or J - K K - L	bypass high pass filter  300Hz high pass filter in circuit  audio input via PL230 or I/O pad
PL250	[1 - 2] 2 - 3	[R - S] S - T	noise mute carrier mute
PL260 <sup>c</sup>	1 - 2 [2 - 3]	U - V [V - W]	RX-DISABLE link not connected
PL270	[1 - 2] 2 - 3	[X - Y] Y - Z	relay link not connected

- The letters in this column and in the table in [Section 3.5.2](#) below refer to the identification letters screen printed onto the PCB beside each set of pins.
- Refer to [Section 3.5.2](#) for further details.
- Refer to [Section 1.4](#) in Part G for further details.

### 3.5.2 Audio Processor Linking Details For CTCSS

You must connect the audio processor links correctly according to the CTCSS option used, as shown in the table below.

CTCSS Option	PL230		PL240	
standard, no CTCSS	2 - 3	N - P	2 - 3	H - J
received CTCSS + speech passed to line output	3 - 4	P - Q	1 - 2	G - H
high pass filtered speech, internal CTCSS detection	2 - 3	N - P	4 - 5	K - L
external CTCSS detection	1 - 2	M - N	4 - 5	K - L

The conditions stated in the above table are defined as follows:

- standard, no CTCSS
  - no CTCSS or other sub-audio signalling used
  - audio bandwidth 300Hz to 3kHz
  - hum & noise -55dB
- received CTCSS tone + speech to line output
  - tone and speech transmitted down 600 ohm line
  - audio bandwidth 10Hz to 3kHz
  - hum & noise -45dB
- high pass filtered speech + internal CTCSS detection
  - 400Hz to 3kHz
  - hum & noise -30dB with 250.3Hz tone present
- external CTCSS detection
  - decoding performed through the receiver (but externally)
  - speech injected back into receiver via "AUDIO-2" and sent down 600 ohm line

**Note 1:** AUDIO-2 is available on D-range 1 (PL100) pin 7 via the link resistor R160. Although PL100 pin 7 is already assigned to SERIAL-COM, this can be disabled by removing R808.

**Note 2:** External CTCSS units can connect in series with the audio chain via AUDIO-1 and AUDIO-2.

## 3.6 Synthesiser Alignment

- Ensure that the receiver has been programmed with the required frequencies using the PGM800Win software.
- Connect a high impedance voltmeter to the long lead of L1 in the VCO (this measures the synthesiser loop voltage).
- **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 of 5MHz.
- The TCXO (=IC700) output frequency should be trimmed when the IF is tuned - refer to [Section 3.7](#).

## 3.7 Alignment Of Receiver Front End And IF

**Note:** 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 [ ].

Align the synthesiser as instructed in [Section 3.6](#). For multichannel operation align the receiver on a frequency in the middle of the required band.

Set RV230 (front panel gating sensitivity) fully clockwise.

Inject a strong on-channel RF signal with  $\pm 3\text{kHz}$  deviation ( $\pm 2.4\text{kHz}$ ) [ $\pm 1.5\text{kHz}$ ] at 1kHz into the antenna socket and adjust the helicals (#FL410 and #FL420) to give the best sinad.

Continually decrease the RF level to maintain 12dB sinad.

Roughly tune IF coils L310, L320, L330, L340, L350, L360, L370, L380, L385 and L390 for best sinad.

While maintaining a low level unmodulated RF input to the receiver, loosely couple into the first IF an additional high level signal at 45MHz - you will hear a beat note.

Trim the synthesiser TCXO (=IC710) for zero beat.

While maintaining the low level RF input to the receiver, loosely couple into the second IF an additional high level signal at 455kHz - you will hear a beat note.

Tune L385 for zero beat.

**Note:** If a second oscillator is not available, you can connect a frequency counter to IC710 pin 8 (i.e. after the TCXO buffer) via an oscilloscope probe to measure the TCXO frequency directly (12.8MHz). At this point the voltage level is approximately 4V p-p.

Readjust the front end helicals (#FL410 and #FL420) to give the best sinad.

Change the RF signal level to -75dBm and modulate with  $\pm 3$ kHz deviation ( $\pm 2.4$ kHz) [ $\pm 1.5$ kHz] at 1kHz.

Connect an oscilloscope probe to SK320 pin 3 (RSSI 455kHz input) and connect plugs PL210 and PL220 to give a flat audio response (refer to [Section 3.5](#)).

Readjust L310, L320, L330, L340, L350, L360, L370 and L380 to give a maximum amplitude response on the oscilloscope with minimal amplitude modulation.

**Note:** If you would like a more accurate method of tuning the IF, refer to the sweep tuning method described in [Section 5.5.5](#).

Further adjust these coils, along with L390, for minimum audio distortion, ensuring that the 455kHz level (on the oscilloscope) does not fall significantly.

Check that the distortion reading is:

wide bandwidth	$\leq 2\%$
mid and narrow bandwidth	$\leq 4\%$

If required, reconnect plugs PL210 and PL220 to give a de-emphasised audio response and check that the distortion reading is  $\leq 2\%$  (all bandwidths).

Reduce the RF level until 12dB sinad is reached. The receiver sensitivity should be better than -117dBm (de-emphasised) or -111dBm (flat), assuming that the audio levels are not being overdriven (refer to [Section 3.11](#)).

## 3.8 Gating Delay

Two solder links (SL210 & SL220) are provided on the bottom of the PCB to allow three gate delay time options, as shown in the table below.

SL210	SL220	Closing Delay
linked	not linked	<50ms*
not linked	linked	<25ms
not linked	not linked	<20ms

\*Factory setting.

## 3.9 Noise Mute Adjustment

Connect pins 1 & 2 of PL250 to enable the noise mute.

Align the receiver as instructed in [Section 3.6](#) and [Section 3.7](#).

Set the RF level to -105dBm with  $\pm 3$ kHz deviation ( $\pm 2.4$ kHz) [ $\pm 1.5$ kHz] at 1kHz.

Set RV230 (front panel gating sensitivity) fully anticlockwise.

Adjust RV310 (noise mute gain) fully clockwise to close the mute (if necessary turn off the RF signal and then turn it on again).

Rotate RV310 anticlockwise until the mute just opens.

Reset the signal generator for the required opening sinad and adjust RV230 clockwise until the mute just opens.

## 3.10 Carrier Level Mute

Connect pins 2 & 3 of PL250 to enable the carrier mute and disable the noise mute.

Apply an on-channel signal from the RF generator at the required mute opening level with  $\pm 3$ kHz deviation ( $\pm 2.4$ kHz) [ $\pm 1.5$ kHz] at  $\pm 1$ kHz.

Adjust RV235 (carrier mute) anticlockwise to close the mute (if necessary, momentarily turn off the RF), then slowly adjust it clockwise until the mute just opens. The mute should now open at this preset level.

## 3.11 Audio Processor

### 3.11.1 Line Amplifier Output

Apply an on-channel signal from the RF generator at a level of -70dBm with  $\pm 3$ kHz deviation ( $\pm 2.4$ kHz) [ $\pm 1.5$ kHz] at 1kHz.

Adjust RV210 (front panel line level) to give an output of +10dBm on the 600 ohm line.

Check for any clipping or distortion on the oscilloscope.

Set the line level to the required output level.

### 3.11.2 Monitor Amplifier Output (Speaker Output)

Adjust RV205 (front panel monitor volume) to give an output of 2V rms into a 4 ohm resistive load.

Check for any clipping or distortion on the oscilloscope.

Switch to a 4 ohm speaker and adjust RV205 to the required level.

## 3.12 CTCSS

### 3.12.1 Decoder Operation

Program a CTCSS tone on the default channel using PGM800Win. |

Set the RF signal generator output to -70dBm.

Modulate the generator with both: |

- a 1kHz tone at  $\pm 3$ kHz deviation ( $\pm 2.4$ kHz) [ $\pm 1.5$ kHz]
- and a CTCSS tone at the programmed frequency at  $\pm 500$ Hz deviation ( $\pm 400$ Hz) [ $\pm 300$ Hz]. |

Check that the receiver gate opens and the front panel "Gate" LED is on.

### 3.12.2 Opening Sinad

Adjust RV230 (front panel gating sensitivity) fully clockwise.

Reduce the RF signal level to -110dBm.

Observe the sinad meter and reduce the RF level until the receiver mute closes.

Slowly increase the signal level until the receiver mute just opens and stays open.

With PL240 pins 1 & 2 linked (G - H; high pass filter bypassed), check that the sinad is less than 6dB.

Reset the signal generator for the required opening sinad, adjust RV230 fully anti-clockwise, then clockwise until the mute just opens.

### 3.12.3 High Pass Filter

Set the audio processor links as follows:

Plug	Link		Function
PL210	1 - 2	A - B	de-emphasised response
PL230	2 - 3	N - P	audio from internal CTCSS speech filter
PL240	4 - 5	K - L	audio input via PL230 or I/O pad

Reset the RF signal generator output to -70dBm and note the line level (measurement A).

Reduce the 1kHz generator to zero output and measure the line level again (measurement B).

Check that measurement B is at least 30dB below measurement A.

## 3.13 RSSI

The T800-04-0000 RSSI is an optional PCB which adds signal strength monitoring and high level mute facilities to the basic receiver.

Ensure the T800-04-0000 PCB is fitted in SK320 and SK330 in the IF compartment.

Align the receiver as instructed in [Section 3.6](#) and [Section 3.7](#).

Apply an on-channel signal from the RF generator at a level of -110dBm with  $\pm 3$ kHz deviation ( $\pm 2.4$ kHz) [ $\pm 1.5$ kHz] at 1kHz.

Adjust RV320 (RSSI level) to give 2.0V RSSI output on pin 5 of D-range 1 (PL100) when measured with a high impedance DMM.