

**T850 Series II**  
**Base Station Equipment**  
**Service Manual**

**Preliminary Issue**

**November 1997**

**(Not For Resale)**



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# About This Manual

## Scope

This manual contains preliminary servicing information on T850 Series II 25W, 50W and 100W base stations which comprise the following equipment:

25W base station	✓	T855 receiver T856 25W transmitter
50W base station	✓	T855 receiver T857 exciter T858 50W power amplifier
100W base station	✓	T855 receiver T857 exciter T859 100W power amplifier

## Contents

Part A contains information on the following procedures:

- changing the operating frequency
- re-tuning the module after changing frequency
- configuring the audio processor

Parts B to G contain the following PCB information:

- parts lists
- grid reference indexes
- PCB layout diagrams
- test points & options diagrams (T857 only)
- circuit diagrams

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

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

Part I contains the following information:

- T850 Series I /II compatibility

## **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**

T850 Series II Preliminary Service Manual published November 1997

# Table Of Contents

Part	Title
A	Changing The Operating Frequency Of The T800 Series II
B	T855 Receiver Preliminary PCB Information
C	T856 Transmitter Preliminary PCB Information
D	T857 Exciter Preliminary PCB Information
E	T858 Power Amplifier Preliminary PCB Information
F	T859 Power Amplifier Preliminary PCB Information
G	T850 VCO Preliminary PCB Information
H	T800-22-0000 Rack Frame
I	T850 Series I/II Compatibility

# Using The Parts Lists

In this manual there are separate parts lists for each product type. The table below shows which lists to use for each product type.

To refer to the parts list for a . . .	use the following sections . . .
T85X-10	D85X-10-0000 X85X-10-0000
T85X-13	D85X-13-0000 X85X-13-0000
T85X-15	D85X-15-0000 X85X-15-0000
T85X-20	D85X-20-0000 X85X-20-0000
T85X-23	D85X-23-0000 X85X-23-0000
T85X-25	D85X-25-0000 X85X-25-0000
To refer to the parts list for a . . .	use the following sections . . .
T858	E
T859	F
T850 VCO	G



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# Overview

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## 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.

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## Purpose of this document

It is the purpose of this document to familiarise you with the steps involved in changing the operating frequency, checking the radio is still operating correctly, and how to re-tune the radio when this is not the case.

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## In this document

This document covers the following topics:

Topic	See page
Selecting a new operating frequency	2
How to determine if the T855/856/857 is still operating	3
How to re-tune the T855	4
Configuring the T855 Audio Processor	8
How to re-tune the T856/857	11
Configuring the T856/857 Audio Processor	15



## Selecting a new operating frequency

### Description

There are two possible ways of changing the operating frequency:

<b>Method 1</b>	<p>By using a computer running PGM800Win and</p> <ul style="list-style-type: none"> <li>• Changing the default channel in the existing setup</li> </ul> <p>or</p> <ul style="list-style-type: none"> <li>• Reprogramming the radio channel frequencies and then selecting a default channel</li> </ul> <p><b>NOTE:</b> Please refer to the T850 service manual and the PGM800WIN programming manual for further instruction.</p>
<b>Method 2</b>	<p>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.</p>

### After changing the operating frequency

Having changed the operating frequency of the T850 there are two different scenarios you will be faced with:

- You will change the frequency and the T850 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 T850 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 “How to re-tune the T855” and “How to re-tune the T856/857” sections).

### 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 T850 Rx can switch up to 5MHz.
- The T850 Tx can switch up to 8MHz.





## Changing the Operating Frequency of the T850 SeriesII

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So if the T850 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.

### Example

A T850 receiver has been tuned optimally for 460MHz. Therefore, its switching range is 460-1.5MHz to 460+1.5MHz. i.e. 458.5MHz to 461.5MHz.

## How to determine if the T855/856/857 is still operating

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### 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.

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### 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 3 & 16V.

**Note:** If the T855 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.



## How to re-tune the T855

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### Introduction

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 select an operating frequency outside the switching band, then the steps below should be followed:

- Change the operating frequency (refer to page 2).
- Lock the VCO.
- Align the front end.
- Set the noise mute.
- Set the line output level.

The procedure is described on the next page.

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### Equipment required

You will need:

- Computer with PGM800Win installed.
- T800 programming kit.
- T800 test & calibration unit.
- Digital multimeter.
- Audio signal generator.
- RF signal generator.
- Audio voltmeter.
- Sinad meter.

or

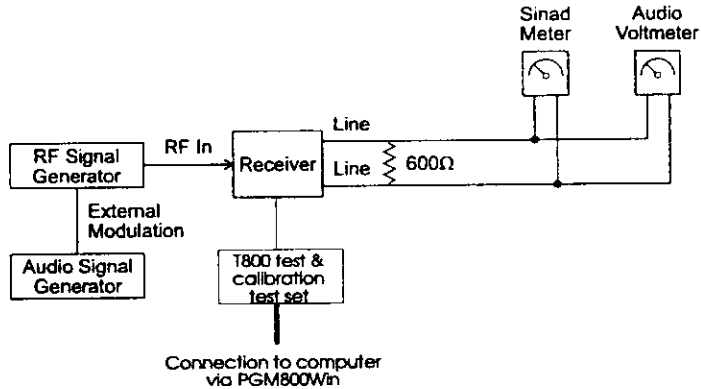
- Computer with PGM800Win installed.
- T800 programming kit.
- T800 test & calibration unit.
- RF test set.



# How to re-tune the T855 cont

### 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 “Configuring the T855 Audio Processor” section).
- Connect the computer to the module using the PGM800Win programming kit.

### Procedure

Follow the steps below to re-tune the T855 if the frequency has been changed and the radio stops operating.

Step	Action
<b>Lock the VCO</b>	
<b>1</b>	Connect a high impedance voltmeter to the long lead of L1 in the VCO (this measures the synthesiser loop voltage).
<i>Continued on next page</i>	



2	<p><b>Single channel</b> Tune VCO trimmer C6 for a synthesiser loop voltage of 10V.</p> <p><b>Multichannel</b> Tune VCO trimmer C6 for a synthesiser loop voltage of 10V on the middle channel.</p> <p>If there is no middle channel, tune C6 so that the channels are symmetrically placed around a loop voltage of 10V.</p> <p>All channels should lie within the upper and lower limits of 16V and 3V respectively.</p> <p>Do not attempt to programme channels with a greater frequency separation than the specified switching range (Rx 5MHz, Tx 8 MHz).</p>
<p><b>Align the front end</b> Settings are first given for wide band sets, followed in brackets by settings for narrow band [ ]. For multichannel operation the receiver should be aligned on a middle frequency.</p>	
1	Inject a strong on-channel RF signal with 3kHz deviation [1.5kHz] at 1kHz into the antenna socket and adjust FL410 & FL420 to give best sinad.
2	Continually decrease the RF level to maintain 12dB SINAD.
3	Readjust the front end helicals FL410 & FL420 to give best sinad.
4	With PL210 and PL220 connected for de-emphaised response (see page 7), the receiver sensitivity should be better than -117dBm, assuming that the audio levels are not being overdriven (refer to line output level on the next page).
<p><b>Set the noise mute</b></p>	
1	Connect pins 1&2 of PL250 to enable the noise mute.
2	Set the RF level to -105dBm with 3kHz deviation [1.5kHz] at 1kHz.
3	Set RV230 (gate sensitivity) fully anticlockwise.
4	Adjust RV330 to close the mute (if necessary turn off the RF signal and then turn it on again).
5	Rotate RV330 anticlockwise until the mute just opens.
6	Adjust RV230 (gate sensitivity) on the front panel for the required opening sinad.
<p><i>Continued on next page</i></p>	



## Changing the Operating Frequency of the T850 SeriesII

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### Set the line output level

1	Apply an on-channel signal from the RF generator at a level of -70dBm with 3kHz deviation [1.5kHz] at 1kHz.
2	Adjust the front panel line level pot. (RV210) to give an output of +10dBm on the 600 ohm line.
3	Set the line level to the required output level.



# Configuring the T855 Audio Processor

## Introduction

There are a number of links in the T855 that can be changed to configure the audio processor in various ways. The linking options are given below followed by a block diagram of the audio processor and link configurations.

## T855 audio processor links

Use the table below to set up the audio processor as you require it.

### General

Plug	Link	Function
PL210	1 - 2	de-emphasised response
	2 - 3	flat response
PL220	1 - 2	flat response
	2 - 3	de-emphasised response
PL230	1 - 2	audio input via audio 2 pad
	2 - 3	audio from internal CTCSS speech filter
	3 - 4	audio input via I/O pad P250
PL240	1 - 2	bypass high pass filter
	2 - 3	300Hz high pass filter in circuit
	or	
	3 - 4	
PL250	4 - 5	audio input via PL230 or I/O pad P250
	1 - 2	noise mute
PL260	2 - 3	carrier mute
	1 - 2	Rx disable link
PL270	2 - 3	not connected
	1 - 2	relay link
		not connected
Options should be selected before alignment of the receiver is attempted.		



## Configuring the T855 Audio Processor cont..

### For CTCSS

The audio processor links must be appropriately connected for the CTCSS option used as shown in the table below.

CTCSS Option	PL230	PL240
Standard, no CTCSS	2 - 3	2 - 3
Received CTCSS tone + speech to line output	3 - 4	1 - 2
High pass filtered speech + internal CTCSS detection	2 - 3	4 - 5
External CTCSS detection	1 - 2	4 - 5

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 + 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:

- Decoding performed in receiver.
- Audio bandwidth 400Hz to 3kHz.
- Hum & noise -30dB with 250.3Hz tone present.

#### External CTCSS:

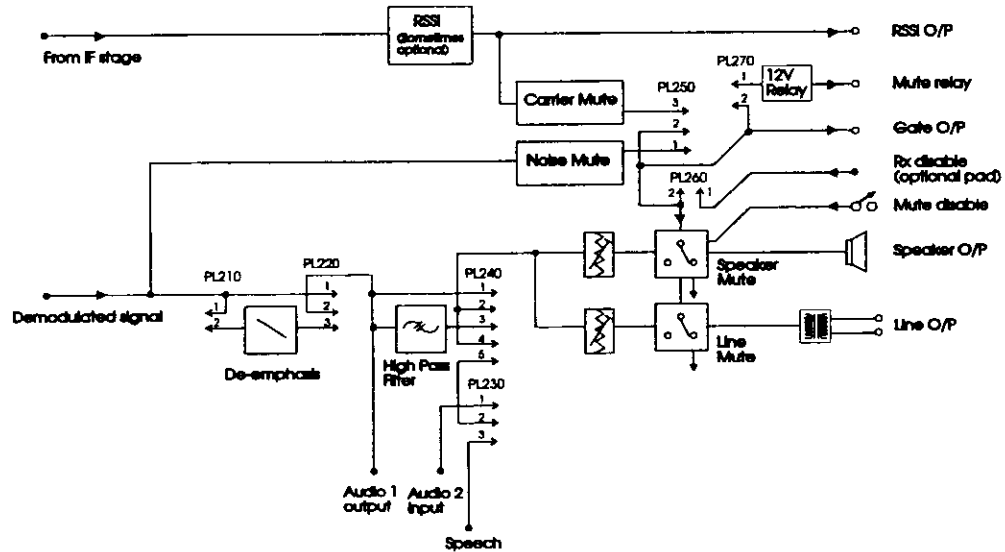
- Decoding performed through the receiver (but externally) by T310-05 or similar.
- Speech injected back into receiver via "audio 2" and sent down 600 ohm line.



# Configuring the T855 Audio Processor cont..

**Note:**

- 1) Audio 2 is available via D-range connector PL100 Pin 7 via the link resistor R160. PL100 Pin 7 is already assigned to serial com. but this can be disabled by removing R808.
- 2) External CTCSS units can be connected in series with audio via Audio 1 and Audio 2.



T855 Audio processor block diagram showing link options





## How to re-tune the T856/857

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### Introduction

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 select an operating frequency outside the switching band, then the steps below should be followed:

- Change the operating frequency (refer to page 2).
- Lock the VCO.
- Align the front end.
- Set the noise mute.
- Set the line output level.

The procedure is described on the next page.

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### 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

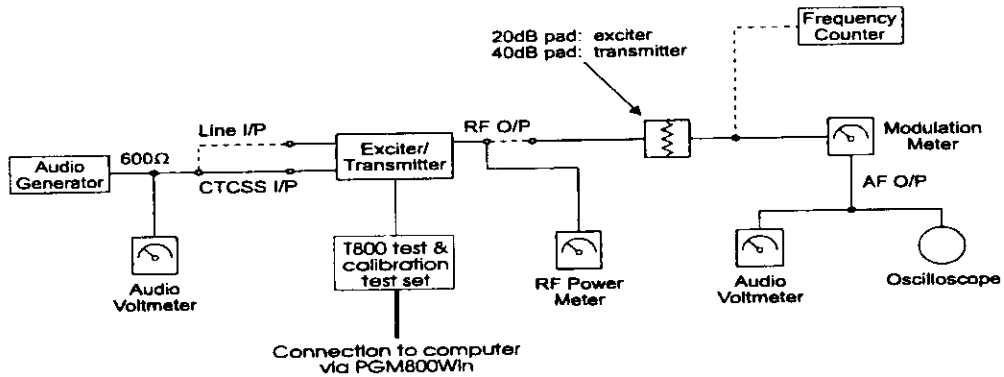
- Computer with PGM800Win installed.
- T800 programming kit.
- T800 test & calibration unit.
- RF test set.



# How to re-tune the T856/857 cont

## 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 “Configuring the T856/857 Audio Processor”).
- Connect the computer to the module using the PGM800Win programming kit.

## Procedure

Follow the steps below to retune the T856 or T857 if the frequency has been changed and the radio stops operating.

Step	Action
<b>Lock the VCO to produce the output frequency</b>	
1	Connect a high impedance voltmeter to the long lead of L1 in the VCO (this measures the synthesiser loop voltage).
<i>Continued on next page</i>	



<b>2</b>	<p><b>Single channel</b> Tune VCO trimmer C6 for a synthesiser loop voltage of 10V.</p> <p><b>Multichannel</b> Tune VCO trimmer C6 for a synthesiser loop voltage of 10V on the middle channel.</p> <p>If there is no middle channel, tune C6 so that the channels are symmetrically placed around a loop voltage of 10V.</p> <p>All channels should lie within the upper and lower limits of 16V and 3V respectively.</p> <p>Do not attempt to programme channels with a greater frequency separation than the specified switching range (8MHz).</p>
<b>Adjust the Output power (T856 only)</b>	
<b>1</b>	Connect an RF power meter to the output socket and key the transmitter.
<b>2</b>	Set power control RV310 fully clockwise.
<b>3</b>	Adjust CV475 for maximum output power and check that this exceeds 30W.
<b>4</b>	Adjust power control RV310 for required power output.
<b>5</b>	Readjust CV475 to reduce the supply current by up to 0.5A.
<p><b>Set the dual point modulation (to maximise the modulation response).</b> Settings are first given for wide band sets, followed in brackets by settings for narrow band [ ].</p>	
<b>Multiple channels</b>	<ul style="list-style-type: none"> <li>• To optimise the modulation response across the switching band repeat steps 1-4 below, for each channel that will be used (usually only needed for data applications).</li> <li>• For usage where the modulation response is less critical (e.g. voice use only) follow steps 1-4 below, on the middle channel and then cut and paste the value for all other channels.</li> </ul>
<b>1</b>	Inject an audio signal of 250Hz 1.5Vrms (+5dBm) into the CTCSS input (D-range pin 8). Key the transmitter.
<b>2</b>	Adjust the output from the audio generator to obtain +/-3kHz [ +/-1.5kHz] deviation at 250Hz.
<b>3</b>	Change the input frequency to 100Hz and using PGM800Win, adjust the "Reference modulation" (by using the mouse or up and down arrow keys) to obtain +/-3kHz [ +/-1.5kHz] deviation.
<i>Continued on next page</i>	



## Changing the Operating Frequency of the T850 Series II

4	<p>Change the input frequency back to 250Hz.</p> <p>Repeat steps 2 and 3 above until the deviations achieved at the two input frequencies are within 0.2dB of each other. This will need to be done at least four times.</p>
5	<p>Sweep the audio between 50 and 300Hz for peaks. A peak indicates a fault condition (incorrect setup or modulation circuitry fault).</p> <p>The specification window is +/-1dB relative to 150Hz from 65 to 260Hz.</p>
<b>Set the FM deviation (limiter adjustment)</b>	
1	<p>Inject 1kHz at -10dBm into the line input (D-range pins 1 &amp; 4; pins 2 &amp; 3 shorted).</p>
2	<p>Adjust RV210 (line sensitivity) fully clockwise and earth the key line. Using PGM800Win, adjust the "Deviation" (by using the mouse or up and down arrow keys) to set the peak deviation to +/-4.7kHz [ +/-2.3kHz].</p>
3	<p>Sweep the audio frequency from 100Hz to 4kHz and ensure that the maximum deviation does not exceed 4.7kHz [2.3kHz]. Re-adjust "Deviation" if necessary.</p> <p>Note:</p> <ul style="list-style-type: none"> <li>• If the radio is to be used over the whole switching bandwidth (8MHz) the deviation should be set for each channel.</li> <li>• If the frequencies to be switched over are less than 1MHz then the deviation can be set on the middle channel and this value used for all other channels using the "fill" option in PGM800Win.</li> </ul>
<b>Reset the line-in level</b>	
1	<p>Set the injected signal at the line input to the required line level (typically -10 to -20dBm).</p>
2	<p>Adjust RV210 (line sensitivity) to provide +/-3kHz [ +/-1.5kHz] deviation.</p>



# Configuring the T856/857 Audio Processor

## Introduction

There are a number of links in the T856/T857 that can be changed to configure the audio processor in various ways. The linking options are given below followed by a block diagram of the audio processor and link configurations.

## T856/T857 audio processor links

Use the table below to set up the audio processor as you require it.

### General

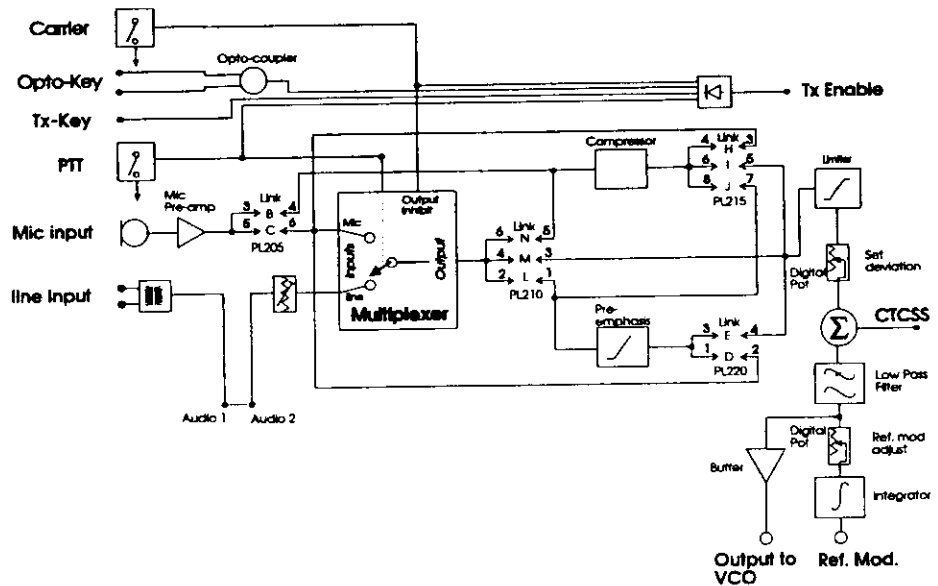
Plug	Link	Function
PL205	(A) 1 - 2 (B) 3 - 4 (C) 5 - 6	not connected microphone pre-amp. output to compressor input microphone pre-amp. output to multiplexer input
PL210	(L) 1 - 2 (M) 3 - 4 (N) 5 - 6	multiplexer output to pre-emphasis input multiplexer output to limiter input multiplexer output to compressor input
PL215	(G) 1 - 2 (H) 3 - 4 (I) 5 - 6 (J) 7 - 8 (K) 9 - 10	not connected compressor output to multiplexer input compressor output to limiter input compressor output to pre-emphasis input not connected
PL220	(D) 1 - 2 (E) 3 - 4 (F) 5 - 6	pre-emphasis output to multiplexer input pre-emphasis output to limiter input not connected



# Changing the Operating Frequency of the T850 Series II

## Typical options

	PL205	PL210	PL215	PL220
microphone pre-amp. compressed and pre-emphasised;	(B) 3 - 4	(L) 1 - 2	(H) 3 - 4	(E) 3 - 4
line input pre-emphasised (standard set-up)				
microphone pre-amp. compressed and pre-emphasised;	(B) 3 - 4	(M) 3 - 4	(J) 7 - 8	(D) 1 - 2
line input unprocessed				
<i>Continued on next page</i>				
line and microphone compressed and pre-emphasised	(C) 5 - 6	(N) 5 - 6	(J) 7 - 8	(E) 3 - 4
microphone pre-amp compressed;	(B) 3 - 4	(M) 3 - 4	(H) 3 - 4	(F) 5 - 6
line and microphone flat response;				



T856/857 Audio processor block diagram showing link options