TBA0M01 & TBA0M02

Tone Remote and Alarm Interface

Service Manual

February 2004

MBA0M01-00-812

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About This Manual

Scope This manual contains general, technical and servicing information for the separately sold TBA0M01 and TBA0M02 Tone Remote and Alarm Interfaces.

PCB Information PCB information is provided in the separate PCB Information Package. Included in the package is the latest parts list, grid references, PCB layouts and circuit diagrams.

PCBs may change without notice. The latest parts lists are available from your nearest Customer Service Organisation.

Errors If you find an error in this manual, or have a suggestion on how it might be improved, please do not hesitate to contact Customer Support, Tait Electronics Ltd, Christchurch, New Zealand (full contact details are on page 2).

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Publication Information

Publication Date	Product Code
February 2004	MBA0M01-00-812

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1	General Information
2	Circuit Operation
3	Introduction To Servicing
4	Installation and Configuration

1 General Information

This section provides a brief description of the TBA0M0x tone remote, along with detailed specifications and information on system configuration.

The following topics are covered in this section.

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1.1 Description

The TBA0M01 and TBA0M02 are tone-operated remote controller products otherwise known as tone remotes. The TBA0M01 has a single tone remote module while the TBA0M02 has two modules. The TBA0M02 is used for two channel subrack systems with each tone remote module dedicated to a channel. The two modules of the TBA0M02 are completely independent. The TBA0M01 and TBA0M02 are collectively referred to as the TBA0M0x tone remote product.

Features include alarm monitoring, voting tone generation and simple high-site control. The TBA0M0x interfaces either a 2-wire or 4-wire leased circuit to the TB8000 series base station products, in particular the current release TB8100 base station, and so enables a dispatch console (otherwise known as a desktop controller) to control and monitor a remote base station. The TBA0M01 and the TBA0M02 are both 2U subracks designed to fit into a standard 19 inch rack or cabinet, just above or below the TB8100 base station. A simple 25-way cable provides all the connections, including DC power from each TB8100 reciter to each TBA0M0x module. The TBA0M0x is configured using the Tone Remote Programming Application (TRPA) version 1.08 or later, which runs on a PC.

1.1.1 Tone Remote

The TBA0M0x tone remote enables a remotely located user to:

- key a transmitter
- defeat a receiver's CTCSS mute (to monitor a channel)
- change their set channel (up to 256 channels)
- change between base station and repeater modes (repeater knockdown)
- monitor and cancel alarms
- turn repeater site equipment on or off (highsite Control)
- loop back line audio (4 wire line interface only)

This is achieved using three industry-standard tone signalling plans for ease of integration into existing control systems and choice of vendor for office/control room equipment. These plans are:

- **EIA tone remote using a single function tone.**
  In this system when the control room user presses the transmit key, the line control equipment sends a 120ms long burst of high level guard tone (HLGT – usually 2175Hz at +10dBM to line). This is followed by a single 40ms function tone at 0dBm to line. The available tone set is 650Hz to 2050Hz in 100Hz steps. This function tone can instruct the tone remote to change channel, monitor the radio channel (defeat receiver CTCSS) or a variety of other functions. Following these initial tone bursts a low level guard tone (LLGT – usually 2175Hz at –20dBm) is sent to line and speech is gated onto line (at approximately 0dBm peak level). This continues until the user releases the transmit key. This removes speech from the line and the low level guard tone ceases.

- **EIA enhanced tone remote using two function tones.**
  This is a variant of the above system where two function tones are sent one after

the other in the period between the high level guard tone and the low level guard tone. The tone set is also expanded (650Hz to 2050Hz in 100Hz steps) to give 225 possible combinations which can be allocated to various actions. The duration of both high level guard tone and function tones can be varied.

- **Simple Transmitter keying using low level guard tone only.**
  This is used where complex functionality is not required.

1.1.2 Alarm Monitoring and Confirmations

The TBA0M0x monitors a total of eight alarms, six external closure alarms, a low voltage (power supply) alarm and a line alarm (line fail indication). Two of the external closure alarms can be triggered by the TB8100 digital outputs while the other four can be triggered by inputs on the TBA0M0x auxiliary connector. If alarms are triggered the TBA0M0x can be programmed to generate tone sequences (DTMF, Selcall or function tones) and/or enable auxiliary outputs, to alert system users of a problem. The tone sequences can be sent to line and/or radio. The auxiliary outputs can be directed to the TBA0M0x auxiliary connector or to the TB8100 digital inputs where they can be used to initiate actions based on user programmable TB8100 tasks (using the Task Manager in the TB8100 Service Kit).

Additionally the TBA0M0x can be programmed to respond to as many as eight different non-alarm triggers. These can be used as confirmation that an event has occurred. Confirmations can be programmed to occur in the event of power-up, channel change and/or the detection of up to six user defined function tones. In the same way as for alarms, the TBA0M0x can generate tone sequences and/or enable auxiliary outputs in response to a confirmation.

1.1.3 Voting Tones

The TBA0M0x can also generate voting tones where a 4-wire line interface is used. Voting systems are used where several base station receivers are tuned to the same radio channel and located at different sites, sending audio back to a central control where the best quality audio must be selected or “voted upon”. Tone on Idle or Sliding Voting Tones can be generated to interface a TB8000 series sub-rack to a wide variety of industry standard Radio Voting systems.

In Tone on Idle applications, a tone (normally the same frequency as LLGT) is transmitted to line when the base station’s receiver is muted. When the tone disappears, control room equipment can perform signal to noise measurements on incoming audio lines and select the best for feeding to the control room user.

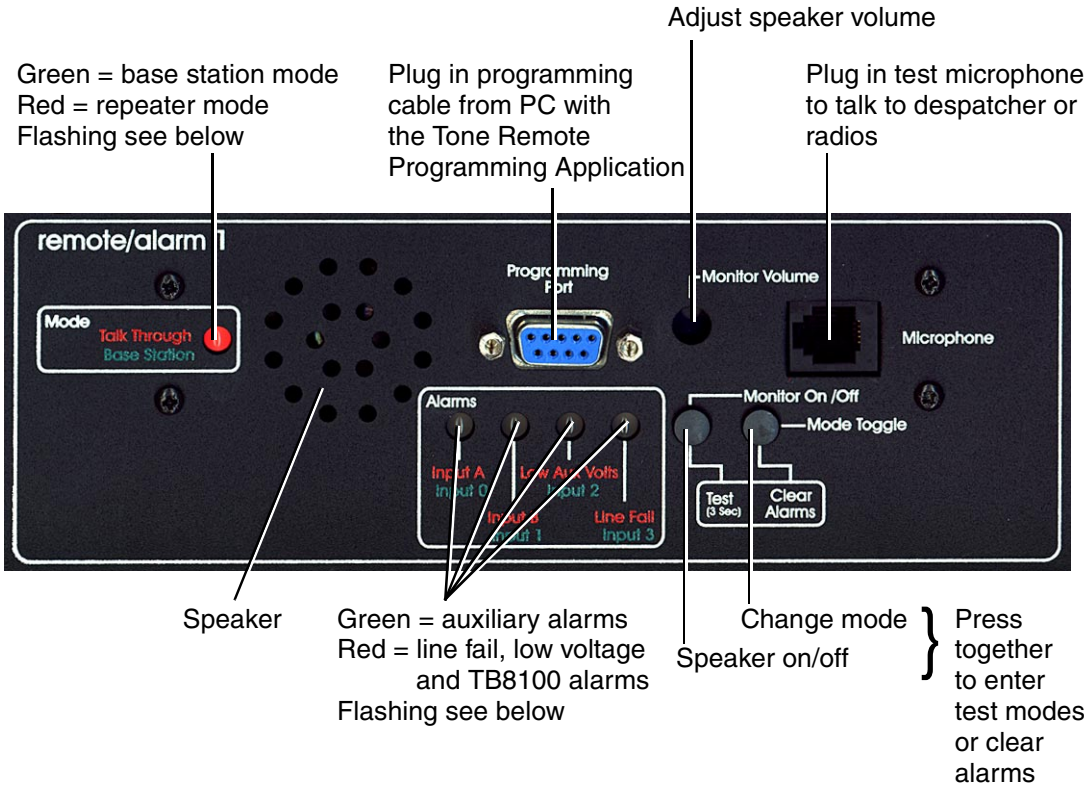
In Sliding Voting Tone systems, a tone is transmitted to line whose frequency is proportional to the base station receiver's RSSI. Control room equipment determines which receiver has the highest RSSI and thus selects which line carries the highest quality incoming audio.

1.1.4 Other Features

- Programmable Morse Code Encoder for automatic station identification (CWID)
- User programmable Line levels
- Programmable Transmit and Receive audio path delays
- Programmable (on/off) notch filtering.

1.1.5 Operating Controls

1.1.5.1 Layout and Controls



1.1.5.2 Mode LED

The colour of the Mode LED on the front panel indicates the TBA0M0x mode of operation:

- Green = Base station mode
- Red = Repeater (talk through) mode

The LED flashes in different ways when particular conditions occur.

Flash Rate		Condition
	equal 0.3s on/ 0.3s off	Module is linked with TBA0M0x Programming Application
	long flash 1 s on/0.3 s off	Microcontroller has detected an internal communications error
	short off 0.3 s on/0.08 s off	Speaker is on.

Where two or more conditions occur at the same time, the precedence is in the order shown above (i.e. module linked has the highest priority, followed by microcontroller error, then speaker on).

1.1.5.3 Alarm LEDs

The alarm LED turns on only when its alarm condition has been latched. The colour of the LED indicates the source of the alarm trigger:

- Green = Assigned to the four external closure alarm triggers, Alarm Input0 to Input3.
- Red = Assigned to line fail, low voltage and the two external closure alarm triggers, Alarm InputA and InputB.

The LED flashes in different ways as indicated below.

Flash Rate and Colour		Alarm
	green very short off 0.32s on/0.01s off	External closure alarm Input0 to Input3.
	red short off 0.32s on/0.1s off	Line fail, low voltage or external closure alarm InputA or InputB
	alternating red and green 0.32s on/0.1s off/ 0.32s on/0.1s off	Combination of above alarm sources.

The factory configuration of the I/O resistor links (see Section 4.1.4) means that by default the green LEDs associated with external closure alarms are triggered by inputs on the TBA0M0x Auxiliary connector while the two (external closure) red LEDs are associated with alarms triggered by the TB8100 digital outputs. These associations may change if the I/O configuration is changed.

Press the Monitor and Mode Toggle buttons together to reset all alarms.

1.2 Specifications

1.2.1 Introduction

The performance figures given are minimum figures, unless otherwise indicated, for equipment operating at standard room temperature (+22°C to +28°C) and standard test voltage ($13.8V_{DC}$).

Details of test methods and the conditions which apply for Type Approval testing in all countries can be obtained from Tait Electronics Ltd.

1.2.2 General

Supply Voltage:

Operating Voltage	… 10.8 to $16V_{DC}$
Standard Test Voltage	… $13.8V_{DC}$
Polarity	… negative earth only

Supply Current … 250mA max.

Operating Temperature Range … –30 to +60°C.

Dimensions – module only

Height	… 56mm
Width	… 160mm
Length	… 280mm

Dimensions – with front panel

Height	… 2U
Width	… Standard 19 inch
Depth	… 288mm
Weight	
TBA0M01	… 2.4kg
TBA0M02	… 3.9kg

1.2.3 Line

1.2.3.1 Input levels

Line-In (Level required to produce a transmitter output at 60% full system deviation):

Programmable	… –27dBm to +3dBm
Maximum input peak	… +7dB relative to programmed level

1.2.3.2 Output levels

Line-Out (Radio receiver level to TBA0M0x must be 230mV$_{rms}$)

Programmable	… –27dBm to –1dBm
Dynamic range	… +7dB relative to programmed level
Maximum output peak	… +5.5dBm

For compliance with TIA/EIA-IS-968, CS-03 (Canada), PTC200 (New Zealand) and HKTA 2023 (Hong Kong):

Programmable Line Output level must be set to ≤ –10dBm.

For compliance with ACA TS002 (Australia):

Programmable Line Output level must be set to ≤ –11dBm.

For compliance with TS PSTN1 (Singapore):

Programmable Line Output level must be set to ≤ –7dBm.

1.2.4 Radio Levels

From Radio Receiver … 230mV$_{rms}$ at input of TBA0M0x
(for 1kHz tone at 60% full system deviation)
(Note: This input of theTBA0M0x is high impedance)

To Radio Transmitter:

From Line-In	… –4.4dBm
From Radio Receiver	… –4.4dBm (With receiver level to TBA0M0x set to 230mV$_{rms}$)

1.2.5 Tone Remote

Keytone Sensitivity … 29dB less than programmed Line-In level

Keytone Accept Bandwidth … ±0.75% typical (±16Hz at 2175Hz) (Speech at –10dBm, keytone at –30dBm)

Talkoff
(Max. difference between speech and keytone)

2-wire mode	… 32dB typical
4-wire mode	… 35dB typical

Programmable Guardtone Frequencies … 1950, 2100, 2175, 2325, 2500, 2600, 2800, 2900, 2970, 3000 and 3100Hz

Programmable High Level Guard Tone Duration … 60 to 200ms

Function Tone Frequencies	… 650Hz to 2050Hz in 100Hz steps
Function Tone Accept Bandwidth	… ±24Hz typical
Maximum Number of Function Tones	… 2
Programmable Function Tone Duration	… 20 to 100ms

1.2.6 Audio Response

Frequency Response	… ±1dB 300Hz to 3kHz except at notch frequency
Notch Filter Bandwidth At –38dB	… ±0.6% typical (±13Hz at 2175Hz)
Notch Filter Bandwidth At –3dB	… ±1.28% typical (±28Hz at 2175Hz)
Notch Filter Attenuation	… 38dB
Audio Distortion:	
From Line	… <2.5%
From Receiver	… <2%
Programmable Audio Delay:	
Minimum	… 0ms
Maximum	… 500ms
Step	… 1ms

1.2.7 Alarms

Low Voltage Alarm Threshold	… 10.7V to 14.1V (±0.05V) programmable in 0.2V steps
Line Fail Alarm Timer	… off or 1 minute to 4 hours
External Closure Alarms	
Input Trigger	… First and subsequent falling edges
Input Threshold	… 1.5V (or to 0V via 3.3KΩ resistor)
Maximum Input Voltage	… 16V
Alarm/Confirmation Sequence	… 0 to 14 tones to radio and/or line (and/or Aux output when enabled)
Programmable Signalling Standards	… Selcall (CCIR, EIA, EEA, ZVEI, & DZVEI) DTMF and EIA Tone Remote function tone format.

Tone Carrier Deviation	… 70% nominal system deviation at 1kHz (for test tone set at 60%)
Alarm Pip Tone Frequency/Duration	… 600Hz/200ms on tail of audio

1.2.8 Morse Code

Sending Speed	… 20 words per minute (PARIS)
Maximum Code Length	… 15.36 seconds
Tone Frequency	… 1200Hz
Valid Station ID	… alphanumeric only
Repetition Rate	… off or 1 to 60 minutes
Carrier Deviation (for test tone set at 60%)	… 20% nominal system deviation

1.2.9 Voting

Programmable Tone-On-Idle Frequencies	… 1950, 2100, 2175, 2325, 2500, 2600, 2800, 2900, 2970, 3000 and 3100Hz
Programmable Sliding Voting Tone Frequencies	… 2700 to 3500Hz
Voting Tone Level To Line	… –40dBr to –1dBr (Adjustable relative to Line-Out setting)

1.2.10 Miscellaneous

Auxiliary Output Rating	… open collector, 50V, 100mA (at 25°C)
Momentary Monitor (CTCSS Defeat) Time	… off or 1 to 20 seconds

1.3 Regulatory Information

1.3.1 Canada

This product meets:

- Industry Canada Telecommunications Apparatus Compliance Specification CS-03. Registration No. 737A-10118A.

- Canadian ICES-003 (Radiated and conducted emissions, and electromagnetic susceptibility specifications) for Class A digital apparatus.

1.3.2 United States Of America

A copy of the Declaration of Conformity is available at www.taitworld.com

This equipment complies with TIA/EIA/IS-968, Part 15 Class A of 47CFR and Part 68 of 47CFR as detailed below.

- **TIA/EIA/IS-968** (Telecommunications – Telephone Terminal Equipment – Technical Requirements). Adopted criteria of the Administrative Council on Terminal Attachments (ACTA).

- **Part 15 Class A of 47CFR** (Radiated and conducted emissions, and electromagnetic susceptibility specifications) of the FCC rules for the United States. Operation is subject to the following conditions:

  1. This device may not cause harmful interference, and
  2. This device must not accept any interference received, including interference that may cause undesired operation.

  Warning:

  This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide a reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with this manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at their own expense.

- **Part 68 of 47CFR** (Connection of terminal equipment to the telephone network) of the Federal Communications Commission (FCC) rules and the requirements adopted by ACTA. On the rear face of this equipment is a label that contains, among other information, the product identifier i.e. US: 6FPNZL-34203-OT-N. If requested this number must be provided to the telephone company.

Warnings:

If this equipment, *TBA0M01 or TBA0M02 Tone remote and Alarm Interface*, causes harm to the telephone network, the telephone company will notify you in advance that temporary discontinuance of service may be required. But if advance notice isn't practical, the telephone company will notify the customer as soon as possible. Also, you will be advised of your right to file a complaint with the FCC if you believe it is necessary.

The telephone company may make changes in its facilities, equipment, operations or procedures that could effect the operation of the equipment. If this happens the telephone company will provide advance notice in order for you to make necessary modifications to maintain uninterrupted service.

Connection to party line service is subject to state tariffs. Contact the state public utility commission, public service commission or corporation commission for information

If trouble is experienced with this equipment, *TBA0M01 or TBA0M02 Tone remote and Alarm Interface*, for repair or warranty information, please contact:

Tait North America Inc
Building 1, Suite 450
15740 Park Row
Houston, Texas, 77084, USA
Phone: 0800 320 4037
Fax: 281 829-3320
Mobile: 713-703-4991

Only approved Tait Dealer or Customer Service Organisations equipped with the necessary facilities should perform any servicing. Repairs attempted with incorrect equipment or untrained personnel may result in permanent damage. If the equipment, *TBA0M01 or TBA0M02 Tone Remote and Alarm Interface*, is causing harm to the telephone network, the telephone company may request that you disconnect the equipment until the problem is resolved.

1.3.2.1 Facility Interface and Service Order Codes

Unit Configuration	Function	USOC Jack type	REN[a]	FIC[b]	SOC[c]
TBA0M01 or TBA0M02 2-wire	2-wire leased line	RJ-11C	—	Metallic	7.0Y
TBA0M01 or TBA0M02 4-wire	4-wire leased line	RJ61X	—	Metallic	7.0Y

a. Ringer Equivalence Number

b. Facility Interface Code

c. Service Order Code

1.3.3 Europe

For Declaration of Conformity refer to www.taitworld.com

According to the requirements of the EC Council Directive:
1999/5/EC Radio Equipment and Telecommunications Terminal Equipment Directive,

The TBA0M01 or TBA0M02 Tone Remote and Alarm Interface complies with;

- EN 301 489-5 Radiated and conducted emissions, and electromagnetic susceptibility specifications.
- EN60950 : 2000 Electrical safety

1.3.4 New Zealand

This product complies with the following standards:

- PTC200 Requirements for analogue telecommunications equipment.
- AS/NZS 3548 Class A Radiated and conducted emissions specifications

Warning:

TBA0M01 or TBA0M02 for use in New Zealand

"The grant of a Telepermit for any item of terminal equipment indicates only that Telecom New Zealand has accepted that the item complies with minimum conditions for connection to its network. It indicates no endorsement of the product by Telecom New Zealand, nor does it provide any sort of warranty. Above all, it provides no assurance that any item will work correctly in all respects with another item of Telepermitted equipment of a different make or model, nor does it imply that any product is compatible with all Telecom New Zealand's Network services."

"This equipment does not fully met Telecom New Zealand's impedance requirements. Performance limitations may occur when used in conjunction with some parts of the

network. Telecom New Zealand will accept no responsibility should difficulties arise in such circumstances."

1.3.5 Australia

This product complies with the following standards:

- AS/ACIF S006 - 2001 Telecommunications technical standard
- AS/ NZS 3260 Electrical safety
- AS/NZS 3548 Class A Radiated and conducted emissions specifications

1.3.6 Hong Kong

This product complies with the Network Connection specification HKTA 2023

1.3.7 Singapore

This product complies with the Type Approval specification IDA TS PSTN1

2 Circuit Operation

This section provides a description of the circuit and operation of the TBA0M0x tone remote.

Note: Unless otherwise specified, the term "Tone Remote Programming Application" used in this and following sections refers to version 1.08 or later.

Refer to the TBA0M01 PCB Information Pack for detailed information on identifying and locating components and test points on the main PCB.

The following topics are covered in this section.

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2.1 Circuit Overview

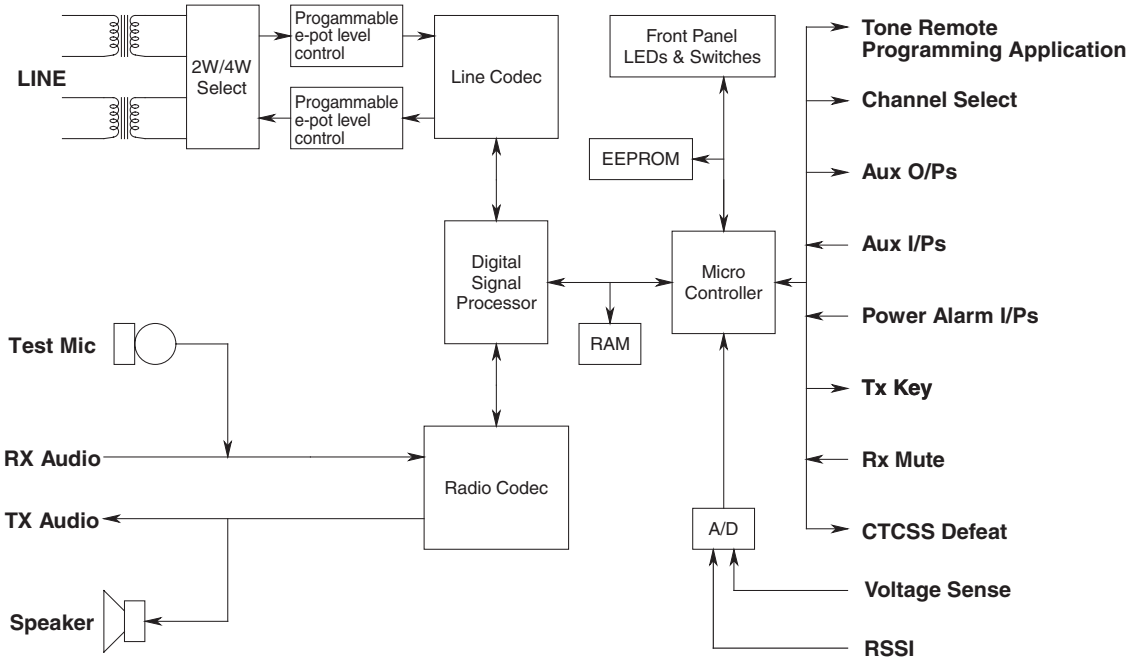

Figure 2.1 High Level Block Diagram

The TBA0M0x is connected to a leased line from control room equipment by means of an RJ45 connector. 600R transformers are used to couple the audio into and out of the TBA0M0x. On the secondary of these line matching transformers are analogue transmission switches which configure the line interface as either 2-wire or 4-wire compatible. Audio from line is passed through a programmable electronic potentiometer (e-pot) level control circuit before entering a CODEC where it is digitised. Audio to line is output from the same line CODEC via a second programmable e-pot level control circuit.

The line CODEC is connected to a digital signal processor (DSP) which is also connected to a similar radio CODEC (the CTCSS CODEC is not used in this application). The radio CODEC receives audio from the receiver and sends audio to the transmitter via a 25-way cable connecting the TBA0M0x to the TB8000 series base station. Receiver audio is low frequency filtered to extend the radio CODEC's effective frequency range.

The DSP processes the digitised audio streams from the CODECs in accord with instructions sent to it by the TBA0M0x's microcontroller. The DSP can:

- detect high level guard tone, low level guard tone and function tones coming from line, notch filter line in and receiver audio (used to eliminate low level guard tone from Line-Out and transmitter audio);
- generate Selcall DTMF/function tone alarms and pip tones to Line-Out and transmitter audio;
- generate voting tones to Line-Out;
- generate morse code to transmitter audio;
- cross connect line and radio audio paths;
- adjusts the Line-In and Line-Out levels;

- mute audio from Line-In and receiver;
- delay the audio.

The microcontroller boot loads the DSP, interfaces with the user via the front panel switches and LEDs, interfaces with the Tone Remote Programming Application and runs the TBA0M0x state machines (alarm monitoring, alarm tone generation, high level guard tone/function tone/low level guard tone timing, RSSI/voting tone conversion etc.).

2.2 Tone Detection

In the quiescent state, audio on the Line-In pair is passed through the DSP (IC300) unfiltered to the TBA0M0x loudspeaker (which is connected to Tx audio – TP203). The audio is bandpass filtered to detect guard tone. In normal operation (keytone and function tone operation) the tone detector threshold is set for high level guard tone (HLGT).

If HLGT is detected, the DSP signals this detection to the micro using the TONE_DETECT line (TP300 is pulled low). The micro instructs the DSP, using the asynchronous serial communications connection (TP306) between them, to switch on the in line guard tone notch filter, lower the threshold of the guard tone detector (so that it can detect low level guard tone – LLGT) and turn on the function tone detectors.

Where the TBA0M0x is operating in 2-wire mode and receiver audio (RX audio) is being gated to line, the micro will soft mute the RX audio first). The micro then starts an internal timer, the duration of which is set by the HLGT and function tone times programmed by the Tone Remote Programming Application.

If a function tone is detected, the DSP signals the micro using the CALL_UP line (TP301 pulled low). The micro then interrogates the DSP via the serial communications connection to find out what frequency was detected.

If no tones are detected and the timer expires, the micro resets the DSP to its quiescent state. If two different frequencies are detected or if only one function tone frequency is decoded and the timer expires, the micro decodes them/it into an action by reading data programmed into the EEPROM (IC312) by the Tone Remote Programming Application. The micro then keys on the transmitter (PTT line) and instructs the DSP to turn off the function tone detectors and the talk-through gate (if it was on). If the function tone sequence decodes into a channel number that is different from the currently set channel, the micro will output the channel number on lines CH0 to CH7. These lines may then be sent to the TB8000 and/or the Aux connector depending on the configuration of I/O link resistors.

Note: If channel selection is required for the base station, the appropriate Digital Inputs on the TB8100 System Interface will need to be configured as such.

As long as the DSP is detecting LLGT (indicated by a low level on TP300) the micro will keep the transmitter keyed on. When the DSP fails to detect LLGT the micro turns off the transmitter key and returns the DSP to the quiescent state.

When the TBA0M0x is programmed for keytone-only operation, the micro keying of the

transmitter follows the state of the TONE_DETECT line from the DSP.

In the quiescent state when the receiver mute line (RX_MUTE) goes low, the micro instructs the DSP to gate audio from the receiver to Line-Out. If the line interface is 2-wire, Line-In and Line-Out are joined and the RX audio will pass through the line internally to the loudspeaker. It will therefore also reach the guard tone detector. RX audio is therefore notch filtered at the guard tone frequency to prevent false guard tone detection. If the line interface is 4-wire this filtering is unnecessary but the talk-through gate must be turned on to send RX audio to the loudspeaker. If the TBA0M0x is in Repeater mode the transmitter is keyed and will remain so until the RX_MUTE line goes high. Note that the TBA0M0x will not key the transmitter if the receiver's CTCSS is defeated (CD_OUT is low) to prevent receiver channel noise being transmitted.

From the description above of the keytone/function tone detection it can be seen that keying from line has priority over repeater mode keying and audio gating.

2.3 Alarm Monitoring

The TBA0M0x microprocessor monitors eight alarm sources:

- Two external closure alarms: Alarm InputA and InputB
- Four external closure alarms: Alarm Input0 to Input3
- Low voltage
- Line fail

When an alarm is triggered it is latched, as indicated by the corresponding LED on the front panel. If the TBA0M0x is keying the transmitter or sending receiver audio to the line the latched alarm is ignored. Once the TBA0M0x re-enters the idle state the latched alarms are actioned. The microprocessor reads the EEPROM to determine what tone sequence the user programmed and instructs the DSP accordingly. If the tone sequence is to be sent to the transmitter, it is keyed 500ms before the tones are generated. Additionally the user may program any of the 4 auxiliary output ports as a response to an alarm event. The micro will activate (pull low) these outputs if enabled. If several alarms are latched together they are actioned in the following order of priority:

1. External closure alarms: Alarm Input0 to Input3
2. External closure alarm: Alarm InputA
3. External closure alarm: Alarm InputB
4. Low voltage
5. Line fail

If the programmed alarm action is a pip tone, the micro will instruct the DSP to append 200ms burst of 600Hz tone to each transmission (to line and/or radio).

Note: Sub-rack alarms (Alarm Input A, Alarm Input B, Low battery or Line fail) cannot be re-triggered until they are cleared. The 4 external closure alarms however will re-send any user programmed tone sequence if re-triggered when already latched.

2.3.1 Alarm Triggers

The alarms are triggered according to their type.

External Closure Alarms

The 8 bit input latch (IC202) is sampled every 50ms. If two successive samples are the same value then the state of the closure alarms is tested (this has the effect of debouncing the alarm inputs). If any alarm is low, it is then latched. Note that Alarm InputA and InputB must be active (low) for two seconds before they are latched.

Low Battery Alarm

The power supply line voltage is measured by the A/D converter (IC208) every 50ms. If the voltage is below the programmed alarm threshold (±0.05V) for more than 25 seconds of a 30 second sampling period, the alarm is latched. The long sampling period allows for load fluctuation effects on the supply.

Line Fail Alarm

If no keying from line occurs within the period programmed by the user from the Tone Remote Programming Application, the microprocessor latches this alarm, saves the mode status and puts the TBA0M0x into Repeater mode. Note that programming zero as the line fail time disables this alarm.

External Closure Alarm (Auxiliary Input Alarms)

The 8 bit input latch (IC202) is sampled every 50ms. If two successive samples are the same value then the state of the closure alarms is tested (This has the effect of debouncing the alarm inputs). If any alarm is low then those alarms are latched.

Alarm Summary Table

Priority	Alarm Name	Trigger type	Re-triggerable when latched	LED colour
1	Alarm Input0 to Input3	External closure. Sampled every 50ms	Yes	Green
2	Alarm InputA	External closure. Sampled every 50ms with a 2s delay.	No	Red
3	Alarm InputB			
4	Low voltage	Voltage must be below the programmed threshold for 25s of a 30s period.	No	Red
5	Line fail	Programmable non-activity time period	No	Red

2.4 Confirmations

Additional to alarms the TBA0M0x microprocessor also monitors eight non-alarm triggers known as Confirmations:

- Power-up
- Channel change
- Up to six user defined function tone inputs

The TBA0M0x micro responds to a confirmation trigger in the same way as it does to an alarm trigger — depending on what has been programmed into the EEPROM, a tone sequence may be sent, an auxiliary output enabled and/or a pip tone enabled. These are all actioned by the micro with the same rules as for alarm triggers. The only difference is that there are no LEDs associated with confirmations.

If several confirmations are triggered together they are actioned in the following order of priority: Power-up, Channel change and then User Confirmation 0 to 5. If several alarms and confirmations are triggered together the Power-up confirmation, if enabled, is always actioned first, followed by any alarms and then any other confirmations, both in their normal priority order.

Note: Confirmations will re-send any user programmed tone sequence if re-triggered.

2.5 Clearing Alarms and Confirmations

The alarms can be cleared by either pressing both front panel switches together or sending the TBA0M0x a correctly programmed ("Clear Alarms") function tone. All alarms are cleared together. Clearing alarms turns off all LEDs, cancels any associated pip tones and resets auxiliary outputs. If an alarm condition is still valid when it is cleared, it will be re-latched and the user-programmed action will be executed. If required, pip tones can be cleared separately (leaving alarms latched) by using a "Clear Alarm/Confirmation Pip tones" function tone.

When the Line fail alarm is cleared, the TBA0M0x will revert to the mode it was in (Basestation or Repeater) before the alarm was triggered. A keying sequence from line can also clear this alarm in the same way except that the pip tone will not be cleared if used by other latched alarms. Line fail is the only alarm that can be cleared individually in this way.

Confirmations can not be cleared by a single command like the Alarms. Confirmation pip tones are cancelled by using a "Clear Alarm/Confirmation Pip tones" programmed function tone and the auxiliary outputs are individually reset by using a "Turn OFF Auxiliary output (x)" function tone.

It is possible to have more than one Alarm or Confirmation using the pip tone. In this situation the clearing behaviour must be carefully considered:

- Line Fail Pip — Cleared by line keying-sequence only if pip tone is not 'active' for other Alarms and/or Confirmations.

- Alarm Pips (including Line Fail) — Cleared by “Clear Alarms” command only if Confirmation pips are not ‘active’. Always cleared by “Clear Alarm/Confirmation Pip tones“ command.
- Confirmation Pips — Cleared by “Clear Alarm/Confirmation Pip tones” command.

Additionally, it is also possible to have a single Auxiliary output assigned to more than one Alarm or Confirmation. However, be aware that any command that resets auxiliary outputs, such as “Clear Alarms” or “Toggle Auxiliary Output (x)”, will not make any check for multiple use — auxiliary outputs will be reset regardless.

2.6 Voting Tone Operation

When the TBA0M0x is programmed to generate a tone on idle, the microprocessor monitors the receiver Mute-In signal. When it is high (receiver muted) the DSP is instructed to generate a voting tone to Line-Out. When receiver Mute-In is low the voting tone is turned off. To prevent false detection of the idle tone at the far end voting equipment, the DSP filters energy at the idle tone frequency from the receiver audio transmitted to Line-Out.

If the TBA0M0x is programmed to generate a Sliding (or Simoco compatible) Voting Tone the microprocessor reads the receiver RSSI level every 6ms using the A/D converter and sends this value to the DSP. The DSP generates a voting tone to Line-Out. The tone frequency is proportional to the RSSI level. To prevent incorrect operation of the far end voting equipment, the DSP low pass filters the receiver audio transmitted to Line-Out.

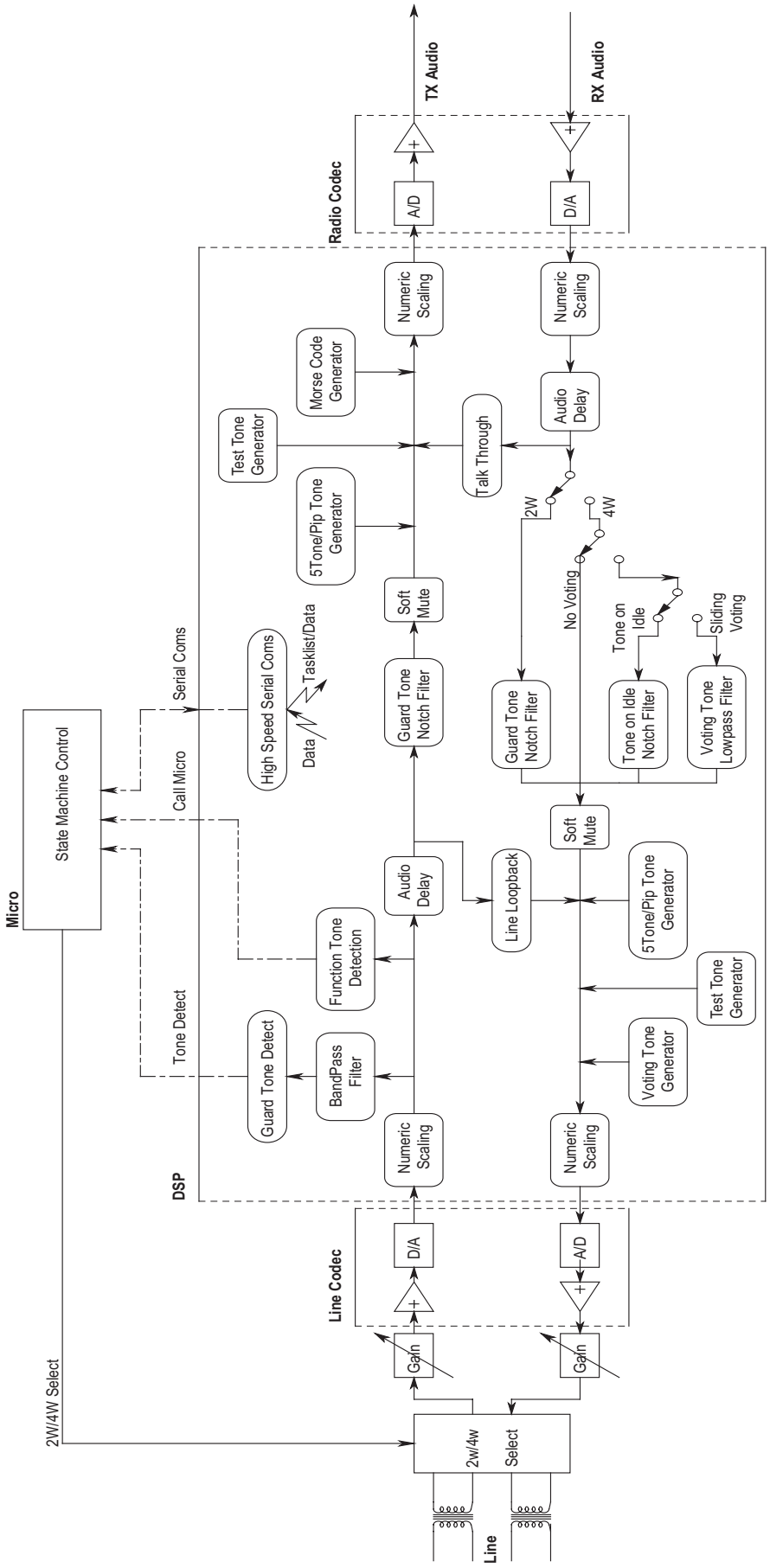

Figure 2.2 Signal Flow

3 Introduction To Servicing

This section of the manual provides some general and advisory information on servicing procedures.

Refer to the TBA0M01/2 Tone Remote and Alarm Interface PCB Information Package for the parts lists, grid reference index and diagrams which provide detailed information on identifying and locating components and test points on the main PCB.

The following topics are covered in this section.

Section	Title	Page
3.1	**Caution: CMOS Devices**	**3.3**
3.2	**Mechanical**	**3.4**
3.2.1	Torx Recess Head Screws	3.4
3.2.2	Pozidriv and Philips Recess Head Screws	3.5
3.3	**Component Replacement**	**3.6**
3.3.1	Leaded Components	3.6
3.3.1.1	Desoldering Iron Method	3.6
3.3.1.2	Component Cutting Method	3.6
3.3.2	Surface Mount Devices	3.7

Figure	Title	Page
3.1	Typical Anti-static Bench Set-up	3.3
3.2	Torx Screw Identification	3.4
3.3	Pozidriv verses Philips Screw and Screwdriver Identification	3.5

3.1 Caution: CMOS Devices

This equipment contains CMOS Devices which are susceptible to damage from static charges. Care when handling these devices is essential. For correct handling procedures refer to the manufacturers' data books, e.g. Philips data books covering CMOS devices, or Motorola CMOS data books, Section 5 'Handling', etc.

An anti-static bench kit (refer to Figure 3.1) is available from Tait Electronics Ltd under the following product codes:

- KS0001 – 1 conductive rubber bench mat
  – 1 earth lead to connect the mat to ground
- KS0004 – 1 wrist strap.

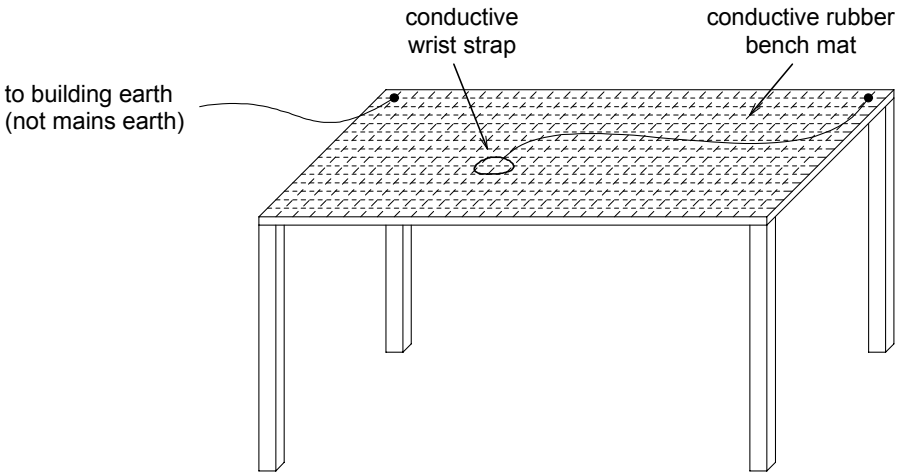

Figure 3.1 Typical Anti-static Bench Set-up

3.2 Mechanical

3.2.1 Torx Recess Head Screws

The Torx recess head has the advantage of improved screwdriver tip location, reducing the chances of screw head damage caused by the driver tip rotating within the recess. In addition, using a ball-tip Torx screwdriver allows you to drive a Torx head screw with the driver on a slight angle, which can be useful in situations where access is restricted.

It is important that you use the correct Torx screwdriver tip:

M3 screws – use T10
M4 screws – use T20

Figure 3.2 below shows a typical Torx recess head screw (actual hardware may differ slightly from this illustration due to variations in manufacturing techniques).

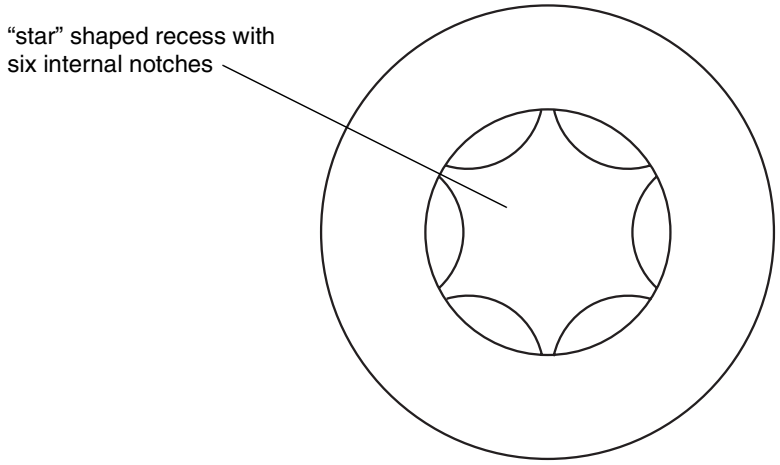

Figure 3.2 Torx Screw Identification

3.2.2 Pozidriv and Philips Recess Head Screws

It is important that you use the correct type and size screwdriver for each screw type 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 and/or size screwdriver.

Figure 3.3 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).

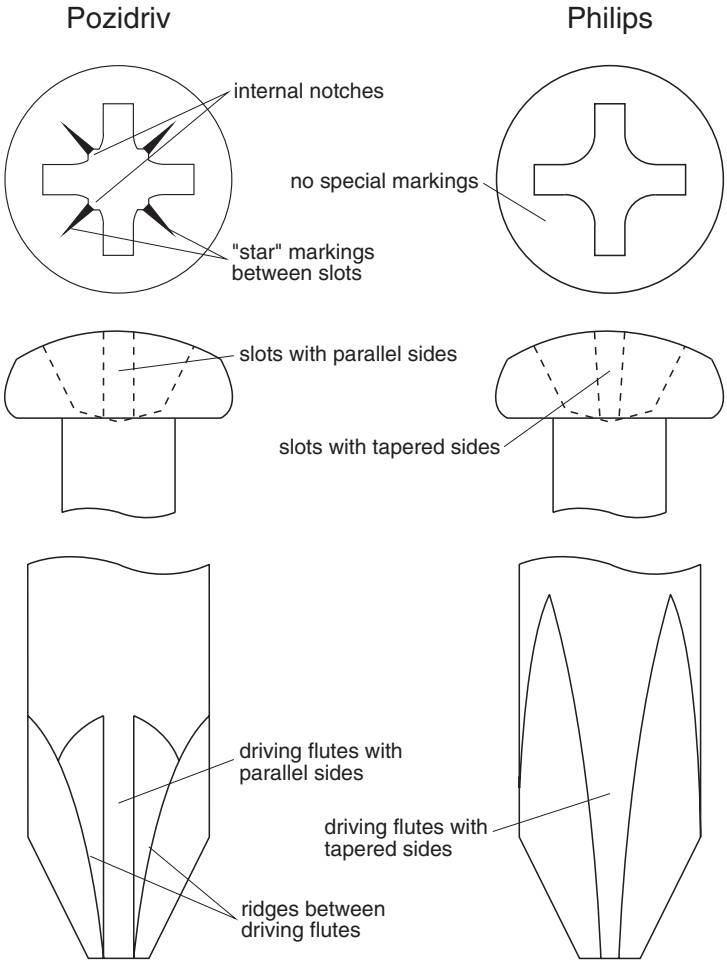

Figure 3.3 Pozidriv verses Philips Screw and Screwdriver Identification

3.3 Component Replacement

3.3.1 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. The two satisfactory methods of removing components from plated-through hole (PTH) PCBs are detailed below.

Note: The first method requires the use of a desoldering station, e.g. Philips SBC 314 or Pace MBT-100E.

3.3.1.1 Desoldering Iron Method

Place the tip over the lead and, as the solder starts to melt, move the tip in a circular motion.

Start the suction and continue the movement until 3 or 4 circles have been completed.

Remove the tip while continuing suction to ensure that all solder is removed from the joint, then stop the suction.

Before pulling the lead out, ensure it is not stuck to the plating.

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).

3.3.1.2 Component Cutting Method

Cut the leads on the component side of the PCB.

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.

Fill the hole with solder and then clear with solderwick.

3.3.2 Surface Mount Devices

Caution: **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.**

4 Installation and Configuration

Caution: **This equipment contains CMOS devices which are susceptible to damage from static charges. Refer to Section 3.1 for anti-static procedures for handling these devices.**

This section of the manual describes how to install and configure the TBA0M0x with a TB8000 series base station, and test that it is functioning correctly.

Note: Unless otherwise specified, the term "Tone Remote Programming Application" used in this and following sections refers to version 1.08 or later.

Refer also to the TBA0M01/2 Tone Remote and Alarm Interface PCB Information Package for the parts lists, grid reference index and circuit diagrams which provide detailed information on identifying and locating components and test points on the main PCB.

The following topics are covered in this section.

Section	Title	Page
4.1	**Installing the TBA0M0x**	**4.3**
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Figure	Title	Page
4.1	TBA0M0x cabinet installation	4.3
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4.6	TBA0M0x setup	4.17
4.7	Rack and test equipment setup	4.18
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4.9	TB8100 Service Kit — Signal Path edit window for the default channel	4.21

4.1 Installing the TBA0M0x

WARNING: This equipment must only be installed and maintained by service personnel.

The TBA0M01 and TBA0M02 are both 2U subracks designed to fit into a standard 19 inch rack or cabinet, just above or below the TB8000 series base station. It is beyond the scope of this manual to provide comprehensive information regarding the installation of the base station. If this is required please refer to the TB8100 base station Installation and Operation Manual.

The TBA0M0x subracks are secured to the rack or cabinet using M6 screws, and require a pozidriv PZ3 screwdriver.

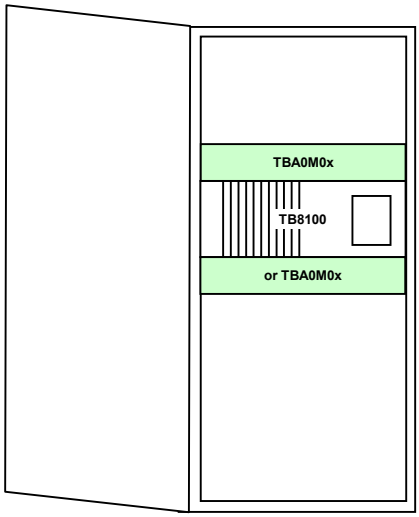


Figure 4.1 TBA0M0x cabinet installation

4.1.1 Connecting to the Base station.

The connection between the TBA0M0x and the TB8100 base station is achieved using the supplied 25-way cable(s). The cable connects a TBA0M0x module to a TB8100 reciter, but only if the reciter has been fitted with a system interface PCB. This is an optional board that provides the links between the reciter's internal circuitry and external equipment.

The TBA0M0x is compatible with two of the system interface PCBs available at the time of publication:

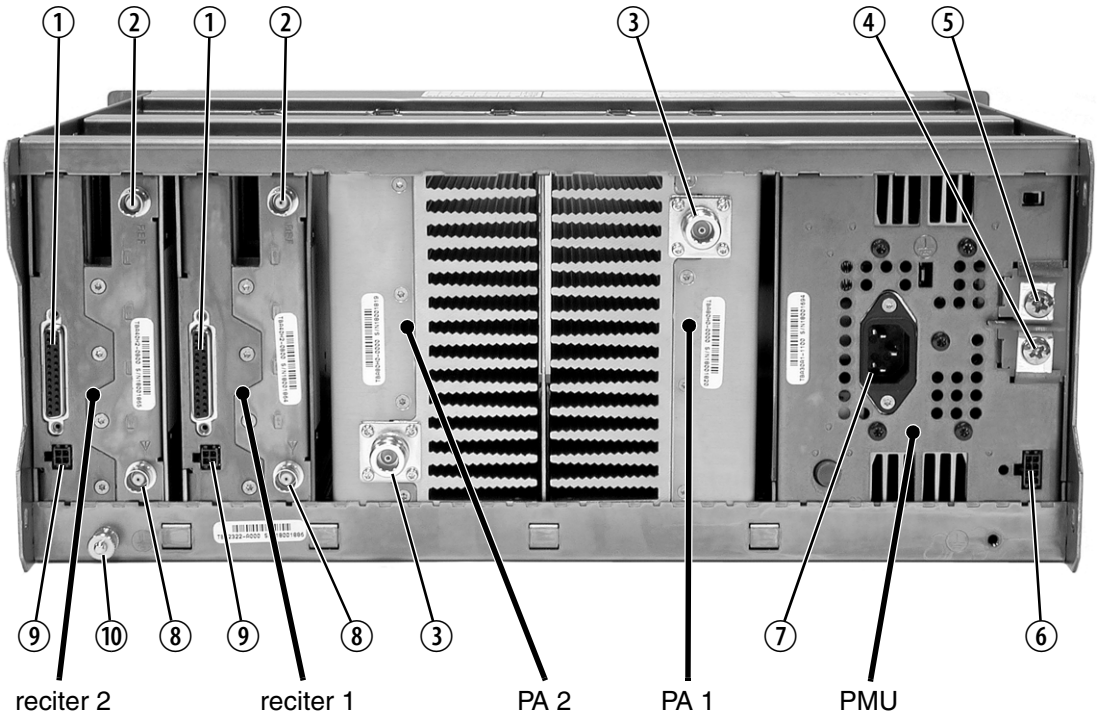
Standard The standard system interface PCB is fitted to reciters bearing the product code TBA4xxx-0A0x or TBA5xxx-0B0x. If purchased separately, it has the product code TBA10A0.

Isolated This system interface PCB is fitted to reciters bearing the product code TBA4xxx-0B0x or TBA5xxx-0A0x. If purchased separately, it has the product

code TBA10B0. It is the same as the standard model, except that the balanced audio interfaces are electrically isolated.

Each of these boards is fitted with a 25-way female D-range connector and an auxiliary DC input connector. The TBA0M0x is supplied with DC power via the +AUX_V pin (pin 13) of the 25-way connection from the system interface PCB (see "Power supply" below).

Figure 4.2 below identifies the connections at the rear of a dual base station



① system interface connector

② external reference frequency input

③ RF output

④ $-V_{DC}$ input

⑤ $+V_{DC}$ input

⑥ auxiliary $12V_{DC}$ output (connects to 9)

⑦ AC mains input

⑧ RF input

⑨ auxiliary $12V_{DC}$ input for system interface

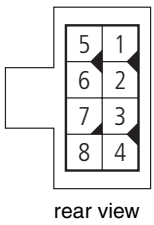
⑩ subrack ground connector

Figure 4.2 Dual 5 or 50W Base station Inputs and Outputs – Rear View.

4.1.2 Power supply

The DC power supply for the TBA0M0x is provided by the 40W Auxiliary Power Supply (13.8V option) which must be fitted to the TB8100 Power Management Unit (PMU). This power supply is current limited to 3A and is available on the auxiliary DC output connector on the rear panel of the PMU (item ⑥ in Figure 4.2). By linking this output to the auxiliary DC input on the system interface PCB (item ⑨ in Figure 4.2), DC is supplied to the +AUX_V pin of the 25-way system interface connector and hence the TBA0M0x.

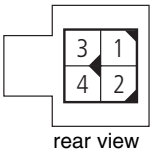
The pin allocations for the auxiliary DC output on the PMU are given in the following table. Note that pins 1 to 4 and pins 5 to 8 on this connector are linked. The DC output is $13.8V_{DC}$. Although this power output is isolated, the negative side of the supply is grounded on the system interface PCB.



Pin	Description	Links	
1	+V output	●	
2	+V output	●	
3	+V output	●	
4	+V output	●	
5	ground		●
6	ground		●
7	ground		●
8	ground		●

Figure 4.3 PMU auxiliary DC output pin allocations

The pin allocations for the auxiliary DC input on the system interface PCB are given in the following table. Note that pins 1 & 3 and pins 2 & 4 on this connector are linked.



Pin	Description	Links	
1	+V input	●	
2	ground		●
3	+V input	●	
4	ground		●

Figure 4.4 Reciter system interface PCB pin allocations

4.1.3 Line Interface

The following table describes the pin configuration for interfacing with the TBA0M0x on 4-wire and 2-wire networks.

RJ45 pins	4-Wire	2-Wire
2	LineOut+	NC
3	LineIn+	Line In / Out
4	LineIn-	Line In / Out
5	LineOut-	NC

The TBA0M0x accommodates an input signal range of 28dB. Normally this is sufficient, however by shorting JP200 (found on the TBA0M0x PCB) an extra 15dB gain is added.

4.1.4 TBA0M0x Input/Output Connections

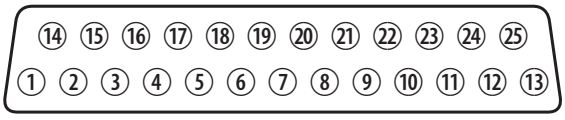
The TBA0M0x has a twin 25-way D-range connector at the rear. The top (female) connector is dedicated to TB8100 I/O while the lower 'Aux' (male) connector ports auxiliary I/O.

The Aux connector not only provides access to the TBA0M0x I/O but also allows through connection to the TB8100 system interface (SIF) so that communication with the base station I/O is still possible even when the TBA0M0x is plugged in. This means that most of the TB8100 I/O normally present on the SIF can be made available on the TBA0M0x Aux connector.

The inter-connection between the TBA0M0x, the basestation (via the TB8000 connector) and external equipment (via the Aux connector) is configurable by use of link resistors and DIP switches inside the TBA0M0x. To access these turn the TBA0M0x upside down and remove the two screws towards the rear edge. The cover can then be removed by sliding towards the rear – take care to avoid sharp edges.

Refer to the TBA0M01/2 Tone Remote and Alarm Interface PCB Information Package for the parts lists, grid reference index and circuit diagrams which provide detailed information on identifying and locating components and test points on the main PCB.

4.1.4.1 The TB8000 Connector



Rear View

The supplied 25-way cable provides all the connections between the TB8000 connector (at the rear of the TBA0M0x) and the TB8100 base station reciter. The default configuration of the TB8100 connection includes all the standard I/O required to operate the TBA0M0x with the base station.

4.1.4.2 Default Signals

TBA0M0x Alarm Input A and Input B have been associated with the TB8100 Digital Outputs (1 and 2). By creating tasks in the Task Manager of the TB8100 Service Kit these digital outputs can be enabled and thus used to trigger the TBA0M0x alarms.

TBA0M0x Channel select 0 to Channel select 6 have been assigned to the TB8100 Digital Inputs 1 to 7 respectively. This allows for selection of up to 128 channels, but the TB8100 SIF needs to be configured accordingly.

From within the TB8100 Service Kit navigate to Configure > Base station > System Interface:

- Enable “Channel selection”
- Choose “7 bit selection”
- Select “Binary format”
- Select “Invert”

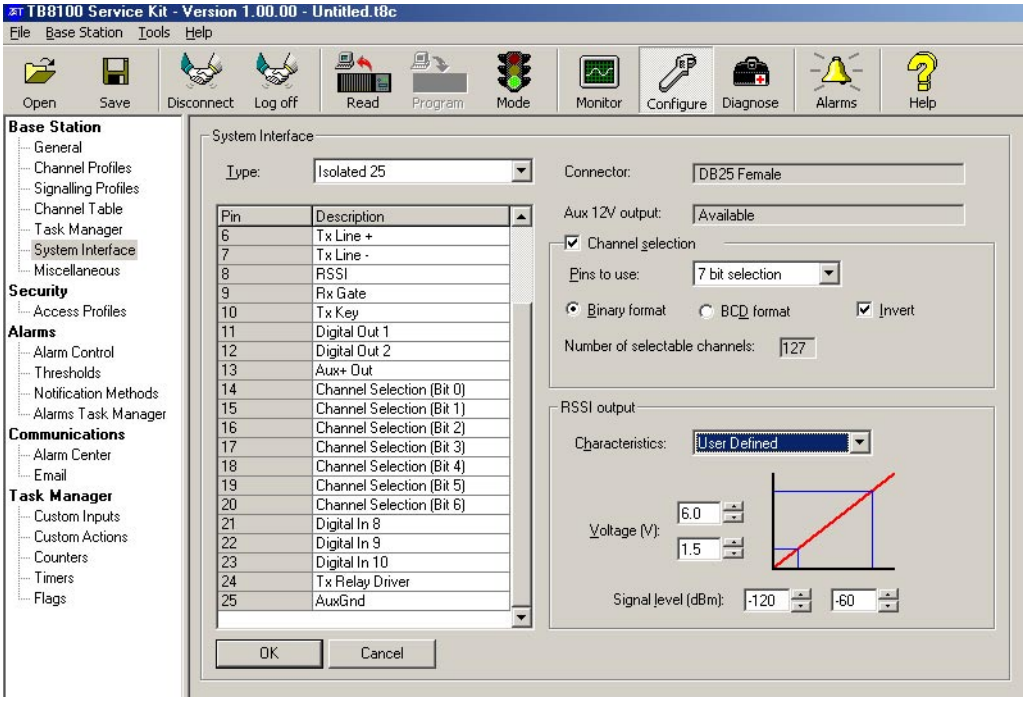


Figure 4.5 TB8100 SIF configuration

TBA0M0x Auxiliary Outputs 1 and 0 have been assigned to the TB8100 Digital Inputs 8 and 9 respectively. By creating tasks in the Task Manager of the TB8100 Service Kit these digital inputs can be used and to trigger some kind of TB8100 action or response. This is very useful if the base station is required to respond to a TBA0M0x alarm or a dispatch console button press (a TBA0M0x confirmation initiated by a function tone).

4.1.4.3 Alternative Signals

Pins 11 and 12: TB8100 Digital Outputs 1 and 2 can also be associated with TBA0M0x Alarm Input 0 and Input 1.

Pins 14 to 21: These pins can be linked directly to pins on the Aux connector thus allowing channel selection to be achieved by external devices. Alternatively by changing the configuration of the TB8100 SIF these lines become simple TB8100 Digital inputs available for use by TB8100 tasks.

Pins 19 and 20: Instead of channel select lines they can also be linked to the TBA0M0x Auxiliary Outputs 3 and 2, respectively. The required TB8100 SIF pins must be re-configured so that they become TB8100 Digital inputs. These are then available for use by TB8100 tasks, in response to a TBA0M0x alarms and/or confirmations.

For full details of default and alternative pin configurations, see the adjacent table (Bold shaded cells indicate default values.).

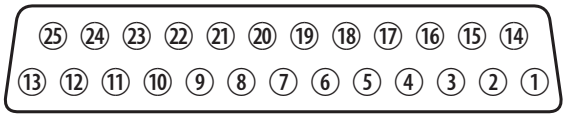
Pin	Signal Type (relative to TBA0M0x)	Name	Required TBA0M0x links and/or switch settings	Notes
1	Audio Input	**Rx in+**[a]		**Balanced 600Ω Not used by the TBA0M0x but routed to Aux connector.**
2		**Rx in-**		
3	Audio Input	**Rx audio**	**DIP SW600 switch 4 ON**	**TB8100 receiver audio to TBA0M0x. High impedance unbalanced.**
4	Ground	**Audio ground**		
5	Audio Output	**Tx audio**		**High impedance unbalanced. Direct connection from Aux connector.**
6	Audio Output	**Tx out+**		**TBA0M0x audio to TB8100 transmitter. Balanced 600Ω**
7		**Tx out-**		
8	DC Signal Input	**RSSI**		
9	Input	**Rx gate**	**DIP SW600 switch 3 ON**	**From TB8100 to TBA0M0x**
			R 619A, R620B and SW600 switch 3 ON	From TB8100 (open collector) to TBA0M0x and Aux connector (P100 pin 37)
			R 619A, R620B and SW600 switch 3 OFF	From TB8100 (open collector) to Aux connector (P100 pin 37) only
10	Output	**Tx key**	**SW600 switch 2 ON**	**TBA0M0x keying of TB8100**
			R616A, R634B and SW600 switch2 ON	TBA0M0x and Aux connector (P100 pin 34) keying of TB8100 (8V logic)
			R616A, R634B and SW600 switch2 OFF	Aux connector (P100 pin 34) keying of TB8100 (8V logic)
11	Input	**Alarm Input A**	**R605A**	**From TB8100 Digital out 1 (open collector) to TBA0M0x Alarm input A**
			R605A and R643	From TB8100 Digital out 1 (open collector) to TBA0M0x and Aux connector (P100 pin32)
		Alarm Input 0	R605B	From TB8100 Digital out 1 (open collector) to TBA0M0x Alarm input 0
			R605B and R615B	From TB8100 Digital out 1 (open collector) to TBA0M0x and Aux connector (P100 pin33)
12	Input	**Alarm Input B**	**R604A**	**From TB8100 Digital out 2 (open collector) to TBA0M0x Alarm input B**
			R605A and R644	From TB8100 Digital out 2 (open collector) to TBA0M0x and Aux connector (P100 pin35)
		Alarm Input 1	R604B	From TB8100 Digital out 1 (open collector) to TBA0M0x Alarm input 1
			R604B and R618B	From TB8100 Digital out 1 (open collector) to TBA0M0x and Aux connector (P100 pin36)
13	Power input	**+13.8V**		
14	Output	**Channel select 0**	**DIP SW600 switch 5 ON**	**TBA0M0x Channel Select 0 to TB8100 Digital In 1**
		Aux Channel select 0	DIP SW600 switch 5 OFF	From Aux connector (P100 pin 40) to TB8100 Digital In 1 (5V logic)
		Digital 1		
15	Output	**Channel select 1**	**DIP SW600 switch 6 ON**	**TBA0M0x Channel Select 1 to TB8100 Digital In 2**
		Aux Channel select 1	DIP SW600 switch 6 OFF	From Aux connector (P100 pin 41) to TB8100 Digital In 2 (5V logic)
		Digital 2		
16	Output	**Channel select 2**	**DIP SW600 switch 7 ON**	**TBA0M0x Channel Select 2 to TB8100 Digital In 3**
		Aux Channel select 2	DIP SW600 switch 7 OFF	From Aux connector (P100 pin 42) to TB8100 Digital In 3 (5V logic)
		Digital 3		
17	Output	**Channel select 3**	**DIP SW600 switch 8 ON**	**TBA0M0x Channel Select 3 to TB8100 Digital In 4**
		Aux Channel select 3	DIP SW600 switch 8 OFF	From Aux connector (P100 pin 43) to TB8100 Digital In 4 (5V logic)
		Digital 4		
18	Output	**Channel select 4**	**DIP SW601 switch 1 ON**	**TBA0M0x Channel Select 4 to TB8100 Digital In 5**
		Aux Channel select 4	DIP SW601 switch 1 OFF	From Aux connector (P100 pin 44) to TB8100 Digital In 5 (5V logic)
		Digital 5		

Pin	Signal Type (relative to TBA0M0x)	Name	Required TBA0M0x links and/or switch settings	Notes
19	Output	**Channel select 5**	**R603A and SW601 switch 3 ON**	**TBA0M0x Channel Select 5 to TB8100 Digital In 6**
		Aux Channel select 5	R603A, R628B and SW601 switch 3 OFF	From Aux connector (P100 pin 45) to TB8100 Digital In 6 (5V logic)
		Digital 6	R603B, R619B and SW601 switch 2 OFF	From Aux connector (P100 pin 37) to TB8100 Digital In 6 (5V logic)
			R603B, R621A and SW601 switch 2 OFF	From Aux connector (P100 pin 38) to TB8100 Digital In 6 (5V logic)
		Auxiliary output 3 and Digital 6	R603B, R619B and SW601 switch 2 ON	TBA0M0x Auxiliary Output 3 and P100 Pin 37 parallel connection to TB8100 Digital In 6 (5V logic)
			R603B, R621A and SW601 switch 2 ON	TBA0M0x Auxiliary Output 3 and P100 Pin 38 parallel connection to TB8100 Digital In 6 (5V logic)
		Auxiliary output 3	R603B and SW601 switch 2 ON	TBA0M0x Auxiliary Output 3 to TB8100 Digital In 6 (5V logic)
20	Output	**Channel select 6**	**R602A and SW601 switch 5 ON**	**TBA0M0x Channel Select 6 to TB8100 Digital In 7**
		Aux Channel select 6	R602A, R629B and SW601 switch 5 OFF	From Aux connector to (P100 pin 46) to TB8100 Digital In 7 (5V logic)
		Digital 7	R602B, R616B and SW601 switch 4 OFF	From Aux connector to (P100 pin 34) to TB8100 Digital In 7 (5V logic)
		Auxiliary output 2 and Digital 7	R602B, R616B and SW601 switch 4 ON	TBA0M0x Auxiliary Output 2 and P100 Pin 34 parallel connection to TB8100 Digital In 7 (5V logic).
		Auxiliary output 2	R602B and SW601 switch 4 ON	TBA0M0x Auxiliary Output 2 to TB8100 Digital In 7 (5V logic)
21	Output	Channel select 7	R601A and SW601 switch 7 ON	TBA0M0x Channel Select 7 to TB8100 Digital In 6
		Aux Channel select 7	R601A, R630B, R631A and SW601 switch 7 OFF	From Aux connector to (P100 pin 47) to TB8100 Digital In 8 (5V logic)
		Digital 8	R601B, R606B, R608A and SW601 switch 6 OFF	From Aux connector to (P100 pin 27) to TB8100 Digital In 8 (5V logic)
		Auxiliary output 1 and Digital 8	R601B, R606B, R608A and SW601 switch 6 ON	TBA0M0x Auxiliary Output 1 and P100 Pin 27 parallel connection to TB8100 Digital In 8 (5V logic).
		Auxiliary output 1	**R601B and SW601 switch 6 ON**	**TBA0M0x Auxiliary Output 1 to TB8100 Digital In 8 (5V logic)**
22	Output	**Auxiliary output 0**		**TBA0M0x Auxiliary Output 0 to TB8100 Digital In 9 (5V logic)**
		Digital 9	R610A	TBA0M0x Auxiliary Output 0 and P100 Pin 29 parallel connection to TB8100 Digital In 9 (5V logic)
23	Output	**CTCSS defeat**	**R600A**	**TBA0M0x CTCSS defeat control line to TB8100 Digital In 10 (5V logic)**
		Auxiliary output 3	R600B and SW601 switch 2 OFF	TBA0M0x Auxiliary Output 3 to TB8100 Digital In 10 (5V logic)
		Digital 10	R600B, R628A and SW601 switch 2 OFF	TBA0M0x Auxiliary Output 3 and P100 Pin 45 parallel connection to TB8100 Digital In 10 (5V logic)
24	Input	**Coax relay driver**	**R606A and R607A**	**From TB8100 Tx relay (open collector) to Aux connector (P100 pin27)**
25	Ground	**Ground**		

a. Bold shaded cells indicate default values.

Table 4.1 TB8000 Connector possible configurations

4.1.4.4 The Aux Connector



Rear View

The Aux connector not only provides access to the TBA0M0x I/O, but also allows connection to the TB8100 system interface (SIF) so that communication with the base station I/O is still possible even when the TBA0M0x is plugged in. The default configuration of the Aux Connector has the most commonly used I/O provided.

4.1.4.5 Default Configuration

- Direct connection to or from theTB8100 base station for:
  - Coax relay driver
  - RSSI
  - Tx Audio (high impedance input, unbalanced)
  - Rx Audio (high impedance output, unbalanced)
  - Digital Outputs 1 and 2
  - +13.8V supplied by the 40W auxiliary power supply fitted to the TB8100 PMU. Current limited to 3A.
- All TBA0M0x Auxiliary outputs
- Tx key output from TBA0M0x
- Rx Gate input to TBA0M0x
- Channel select output from TBA0M0x (128 channel binary format)
- TBA0M0x Alarm Inputs 0 and 1
- A Serial Comms connection. This is a Ping-Pong protocol bus. By linking this connection (and ground) between modules, all the connected modules can be programmed via the RS232 from a single module (which becomes the master). The slave modules must have switch 8 of DIP SW601 switched OFF. The Tone Remote Programming Application will then detect and identify each connected module.

Pin	Name	TBA0M0x links and/or switch settings	Signal Type	Notes
1	+13.8V		Power output	Current limited to 3A by the 40W auxiliary power supply
2	Coax relay driver	R606A and R607A	Output	From TB8100 Tx relay (open collector)
3	RSSI		DC signal output	From TB8100
4	Auxiliary output 0	R610A	Output	From TBA0M0x. Open collector
5	Tx audio in	R611A	Audio input	To TB8100. High impedance unbalanced
6	Rx Audio out	R612B and SW600 switch 4 ON	Audio output	From TB8100. High impedance unbalanced.
7	Digital out 1	R643 and R605A	Output	From TB8100 Digital Out 1 (open collector)
8	Alarm 0 in	R615B (R605B not fitted)	Input	To TBA0M0x Alarm input 0 (5V logic)
9	Auxiliary output 2	R616B and SW601 switch 4 ON	Output	From TBA0M0x. Open collector
10	Digital out 2	R644 and R604A	Output	From TB8100 Digital Out 2 (open collector)
11	Alarm 1 in	R618B (R604B not fitted)	Input	To TBA0M0x Alarm input 1 (5V logic)
12	Auxiliary output 3	R619B and SW601 switch 2 ON	Output	From TBA0M0x. Open collector
13	CTCSS Defeat	R621B	Output	From TBA0M0x. Open collector
14	Tx key out		Output	From TBA0M0x. Open collector
15	Channel select 0	DIP SW600 switch 5 ON	Output	From TBA0M0x. 5V Logic (Active high)
16	Channel select 1	DIP SW600 switch 6 ON		
17	Channel select 2	DIP SW600 switch 7 ON		
18	Channel select 3	DIP SW600 switch 8 ON		
19	Channel select 4	DIP SW601 switch 1 ON		
20	Channel select 5	R628B and SW601 switch 3 ON		
21	Channel select 6	R629B and SW601 switch 5 ON		
22	Auxiliary output 1	R630A	Output	From TBA0M0x. Open collector
23	Rx gate in		Input	To TBA0M0x. 5V logic.
24	Serial Comms	DIP SW601 switch 8 OFF (slave)		Ping-Pong protocol. See note above.
25	Ground		Ground	

Table 4.2 Default Aux connector signal configuration

4.1.4.6 Alternative Configurations

There are more possible inputs and outputs than there are available connector pins. Consequently, in order to help prevent loss of accessibility, many of the inputs and outputs can be linked to more than just one connector pin. This provides a high degree of flexibility.

Pins 15 to 22 are the default TBA0M0x Channel select outputs (128 channel binary format) However, they can also be used as Channel select inputs to the TB8100. Alternatively by programming the required TB8100 SIF pins accordingly these inputs can become TB8100 Digital Inputs (1 to 8). These are then available for use by TB8100 tasks.

Tx Out– and Tx Out+ are parallel connected to the 600Ω balanced Tx Audio path between the TBA0M0x and the TB8100. Consequently if this audio is to be accessed on the Aux connector this must be done using a high impedance load, thereby not upsetting the match or levels between the TBA0M0x and the base station. An example of when this may be required is if the Tx Audio is routed through an external device (connected to the Aux Connector) and processed before being passed to the base station on the unbalanced Tx Audio path (Aux pin 5 or 22).

A Serial Comms connection is available. This is a Ping-Pong protocol bus. By linking this connection (and ground) between modules, all the connected modules can be programmed via the RS232 from a single module (which becomes the master). The slave modules must have switch 8 of DIP SW601 switched OFF. The Tone Remote Programming Application will then detect and identify each connected module.

The adjacent table shows all the TB8100 connector input/output possibilities.

I/O Name	Signal Type	Pin	Required TBA0M0x links and/or switch settings	Notes
+13.8V	Power output	**1**	**Direct Connection**	Current Limited to 3A by the 40W Auxiliary Power supply
Alarm 0 in[a]	Input	**8**	**R615B (R605B not fitted)**	To TBA0M0x Alarm input 0 (5V logic)
		9	R616A and R634A (R605B not fitted)	
Alarm 1 in	Input	**11**	**R618B (R604B not fitted)**	To TBA0M0x Alarm input 1 (5V logic)
		12	R619A and R620A (R604B not fitted)	
Alarm 2 in	Input	7	R614B	To TBA0M0x Alarm input 2 (5V logic)
		8	R615A	
Alarm 3 in	Input	10	R617B	To TBA0M0x Alarm input 3 (5V logic)
		11	R618A	
Alarm A in	Input	7	R643 (R605A not fitted)	To TBA0M0x Alarm input A (5V logic)
Alarm B in	Input	10	R644 (R604A not fitted)	To TBA0M0x Alarm input B (5V logic)
Aux Channel select 0	Input	15	DIP SW600 switch 5 OFF	To TB8100 Digital In 1 (5V logic)
Aux Channel select 1	Input	16	DIP SW600 switch 6 OFF	To TB8100 Digital In 2 (5V logic)
Aux Channel select 2	Input	17	DIP SW600 switch 7 OFF	To TB8100 Digital In 3 (5V logic)
Aux Channel select 3	Input	18	DIP SW600 switch 8 OFF	To TB8100 Digital In 4 (5V logic)
Aux Channel select 4	Input	19	DIP SW601 switch 1 OFF	To TB8100 Digital In 5 (5V logic)
Aux Channel select 5	Input	20	R628B, R603A and SW601 switch 3 OFF	To TB8100 Digital In 6 (5V logic)
Aux Channel select 6	Input	21	R629B, R602A and SW601 switch 5 OFF	To TB8100 Digital In 7 (5V logic)
Aux Channel select 7	Input	22	R630B, R631A, R601A and SW601 switch 7 OFF	To TB8100 Digital In 8 (5V logic)
Auxiliary output 0	Output	**4**	**R610A**	From TBA0M0x. Open collector.
Auxiliary output 1	Output	**22**	**R630A**	
		2	R606B, R608A and Sw601 switch 6 ON	
Auxiliary output 2	Output	**9**	**R616B and SW601 switch 4 ON**	
		21	R629A	
Auxiliary output 3	Output	**12**	**R619B and SW601 switch 2 ON**	
		13	R621A and SW601 switch 2 ON	
		20	R628A	
Channel select 0	Output	**15**	**DIP SW600 switch 5 ON**	From TBA0M0x (5V Logic - active high)
Channel select 1		**16**	**DIP SW600 switch 6 ON**	
Channel select 2		**17**	**DIP SW600 switch 7 ON**	
Channel select 3		**18**	**DIP SW600 switch 8 ON**	
Channel select 4		**19**	**DIP SW601 switch 1 ON**	
Channel select 5		**20**	**R628B and SW601 switch 3 ON**	
Channel select 6		**21**	**R629B and SW601 switch 5 ON**	
Channel select 7		22	R630B, R631A and SW601 switch 7 ON	
Coax relay driver	Output	**2**	**R606A and R607A**	From TB8100 Tx relay. Open collector.
CTCSS Audio	Audio output	2	R606A and R607B	Currently unavailable
CTCSS Defeat	Output	**13**	**R621B**	From TBA0M0x (open collector)
Digital in 1	Input	15	DIP SW600 switch 5 OFF	To TB8100 Digital In 1 (5V logic)
Digital in 2	Input	16	DIP SW600 switch 6 OFF	To TB8100 Digital In 2 (5V logic)
Digital in 3	Input	17	DIP SW600 switch 7 OFF	To TB8100 Digital In 3 (5V logic)
Digital in 4	Input	18	DIP SW600 switch 8 OFF	To TB8100 Digital In 4 (5V logic)
Digital in 5	Input	19	DIP SW601 switch 1 OFF	To TB8100 Digital In 5 (5V logic)

I/O Name	Signal Type	Pin	Required TBA0M0x links and/or switch settings	Notes
Digital in 6	Input	37	R619B, R603B and SW601 switch 2 ON	To TB8100 Digital In 6 (5V logic) with parallel connection from TBA0M0x Auxiliary output 3
			R619B, R603B and SW601 switch 2 OFF	Switch 2 OFF prevents TBA0M0x Auxiliary output 3 connection to TB8100.
		38	R621A, R603B and SW601 switch 2 ON	To TB8100 Digital In 6 (5V logic) with parallel connection from TBA0M0x Auxiliary output 3
			R621A, R603B and SW601 switch 2 OFF	Switch 2 OFF prevents TBA0M0x Auxiliary output 3 connection to TB8100.
		45	R628A, R603B and SW601 switch 2 ON	To TB8100 Digital In 6 (5V logic) with parallel connection from TBA0M0x Auxiliary output 3
			R628B, R603A and SW601 switch 3 OFF	To TB8100 Digital In 6 (5V logic)
Digital in 7	Input	34	R616B, R602B and SW601 switch 4 ON	To TB8100 Digital In 7 (5V logic) with parallel connection from TBA0M0x Auxiliary output 2
			R616B, R602B and SW601 switch 4 OFF	Switch 4 OFF prevents TBA0M0x Auxiliary output 2 connection to TB8100.
		46	R629A, R602B and SW601 switch 4 ON	To TB8100 Digital In 7 (5V logic) with parallel connection from TBA0M0x Auxiliary output 2
			R629B, R602A and SW601 switch 5 OFF	To TB8100 Digital In 7 (5V logic)
Digital in 8	Input	27	R606B, R608A, R601B and SW601 switch 6 OFF	To TB8100 Digital In 8 (5V logic)
		47	R630A, R601B and SW601 switch 6 ON	To TB8100 Digital In 8 (5V logic) with parallel connection from TBA0M0x Auxiliary output 1
			R630B, R631A, R601A and SW601 switch 7 OFF	To TB8100 Digital In 8 (5V logic)
Digital In 10	Input	45	R628A and R600B	To TB8100 Digital In 10 (5V logic) with parallel connection from TBA0M0x Auxiliary output 3
Digital Out 1	Output	**32**	**R643 and R605A**	From TB8100 Digital Out 1. Open collector
		33	R615B and R605B	
		34	R616A, R634A and R605B	
Digital Out 2	Output	**35**	**R644 and R604A**	From TB8100 Digital Out 2. Open collector.
		36	R618B and R604B	
		37	R619A, R620A and R604B	
Ground	Ground	**50**	**Direct Connection**	Ground
RSSI	DC signal output	**28**	**Direct Connection**	From TB8100
RX Audio in	Audio input	**31**	R612B and SW600 switch 4 OFF	To TBA0M0x. High impedance unbalanced.
Rx Audio out	Audio output		**R612B and SW600 switch 4 ON**	From TB8100. High impedance unbalanced.
Rx gate in	Input	**48**	**Direct Connection**	To TBA0M0x (5V logic)
Rx gate out	Output	37	R 619A, R620B and SW600 switch 3 ON	From TB8100. Open collector.
			R 619A, R620B and SW600 switch 3 OFF	Switch 3 OFF disconnects TBA0M0x from TB8100 Rx gate
Rx out-	Audio output	32	R614A	From TB8100. Balanced 600ohm
Rx out+	Audio output	29	R610B	
		31	R612A	
Serial Comms		**49**	**DIP SW601 switch 8 OFF (slave)**	Ping-Pong protocol. See note on the right
Shift mix	Output	27	R606B and R608B	From TBA0M0x. Open collector
Tx audio in	Audio input	**30**	**R611A**	To TB8100. High impedance unbalanced.
		47	R630B and R631B	
Tx key in	Input	34	R616A and R634B and SW600 switch 2 ON	Additional method of keying TB8100 (8V logic)
			R616A and R634B and SW600 switch 2 OFF	SW600 switch 2 OFF prevents the TBA0M0x from keying TB8100 transmitter
Tx key out	Output	**39**	**Direct Connection**	From TBA0M0x. Open collector
Tx out-	Audio output	35	R617A	Transmit audio from TBA0M0x (See Summary on the right).
Tx out+	Audio output	30	R611B	

a. Bold text indicates default values.

Table 4.3 Aux connector possible configurations

4.1.4.7 Aux Connector I/O specifications

The following tables describe the specifications and ratings of the signals available on the TBA0M0x Aux connector.

Caution: **If two different inputs or outputs are used in parallel ensure that the lower rating is used.**
For example, the TB8100 Digital Input (max input = 20V) is driven by the TBA0M0x Auxiliary Output (max input = 50V) and also by an external Digital In on the Aux Connector. The maximum voltage input level of the external Digital In must not exceed the 20V of the TB8100 Digital Input.

Name	Signal path	Logic levels	Logic sense	Ratings
+13.8V	TB8100 output	—	—	Current limited to 3A by the 40W Auxiliary power supply.
Alarm In	TBA0M0x input	5V CMOS	0V = active	Max input voltage = 16V
Aux Channel Select	TB8100 input	5V CMOS	0V = active[a]	Max input voltage = 20V
Auxiliary Output	TBA0M0x output	open collector	0V = active	Max applied voltage = 50V Max sink current = 100mA
Channel Select	TBA0M0x output	5V CMOS	5V = active	Max applied voltage = 20V Max sink current = 20mA
Coax relay driver	TB8100 output	open collector	0V = active	Max applied voltage = 32V Max sink current = 250mA
CTCSS defeat	TBA0M0x output	open collector	0V = active	Max applied voltage = 50V Max sink current = 250mA
Digital In	TB8100 input	5V CMOS	0V = active	Max input voltage = 20V
Digital Out	TB8100 output	open collector	0V = active	Max applied voltage = 32V Max current = 100mA
RSSI	TB8100 output	DC level		800Ω output impedance
Rx Gate In	TBA0M0x input	5V logic	<1.5V = audio	Max input voltage = 50V
Rx Gate Out	TB8100 output	open collector	0V = audio	Max applied voltage = 32V Max current = 100mA
Shift Mix	TBA0M0x output	open collector	0V = active	Max applied voltage = 50V Max sink current = 250mA
Tx Key In	TB8100 input	8V Logic	<0.6V = keyed	Max input voltage = 50V
Tx Key Out	TBA0M0x output	open collector	0V = active	Max applied voltage = 24V Max sink current = 100mA

a. Default is active low, but can be inverted by programming.

Table 4.4 Logic signal and supply voltage specifications

Name	Signal path	Specifications
Rx Audio In	TBA0M0x input	Unbalanced high impedance input (>10kΩ). Level required for correct operation of TBA0M0x = 230mV_{rms}
Rx Audio Out	TB8100 output	Unbalanced output, should only be used with high impedance loads (>10kΩ). The output level is adjustable 0.3V_{pp} to 3.0V_{pp}, for 60% modulation (0.1V resolution). The output is AC coupled. When this output is used by the TBA0M0x the level must be set to 0.6V_{pp}.
Rx Out+ Rx Out-	TB8100 output	Balanced 600Ω audio interface. The output level is adjustable –20dBm to +10dBm for 60% modulation (0.1dB resolution). May be transformer isolated or AC coupled depending on the SIF. Not used by the TBA0M0x.
TX Audio in	TB8100 input	Unbalanced high impedance input (>10kΩ). The input level is adjustable 0.3V_{pp} to 3.0V_{pp}, for 60% modulation (0.1V resolution). The input is AC coupled.
Tx Out- Tx Out+	TBA0M0x output	Parallel connection to the 600ohm balanced Tx Audio path between the TBA0M0x and the TB8100. Consequently if this audio is to be accessed on the Aux connector this must be done using a high impedance load, thereby not upsetting the match/levels between the TBA0M0x and the base station. Output level = –4.4dBm (when the Line-In level is properly set-up or when the TBA0M0x is in Test Mode)

Table 4.5 Audio Signal Specifications

4.2 TBA0M0x Configuration

Before using the TBA0M0x, the audio input and output levels need to be properly configured. This includes line input and output levels, the level from the receiver and the level presented to the base station transmitter. The following sections describe how this is done.

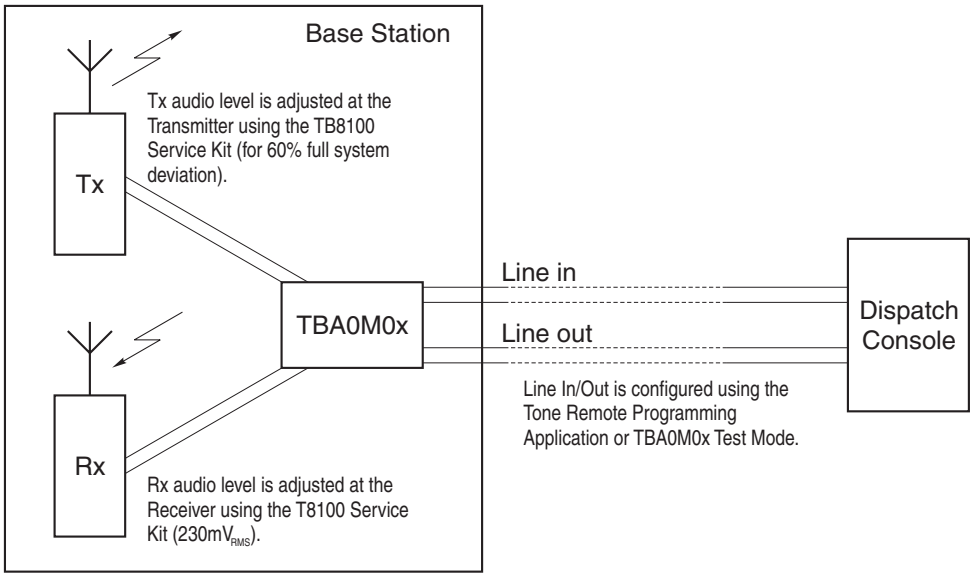


Figure 4.6 TBA0M0x setup

The Line-In and Line-Out levels can be set up using either the Tone Remote Programming Application or the test modes of the TBA0M0x (accessed via the buttons on the front panel. See Section 4.2.3). The advantage of the Test mode method is that it can provide a direct test of the system. The programming method is required when access to the far end dispatch console is difficult.

Using the test modes, the TBA0M0x line levels are set up using actual signals present on the line. For the Line-In level, the test tone and keytone, are generated by the dispatch console and sent to the TBA0M0x via the leased line (or an audio generator could be used with the line loss simulated). For the Line-Out level, the test tone is generated by the TBA0M0x.

Programming the Line-In/Line-Out levels using the Tone Remote Programming Application does not require any connection to the line. However, input and output specifications of the dispatch console and actual line loss must be known so that the TBA0M0x levels can be properly calculated and programmed.

Setting up receiver and transmitter audio levels can only be achieved by programming the basestation using the TB8100 Service Kit. The levels can be checked using the TBA0M0x Test Mode.

4.2.1 Equipment Setup for Level Configuration.

Configuring the TBA0M0x Line levels (using the Tone Remote Programming Application or Test Mode) and radio receiver or transmitter levels requires the sub-rack and test equipment to be set up as shown below.

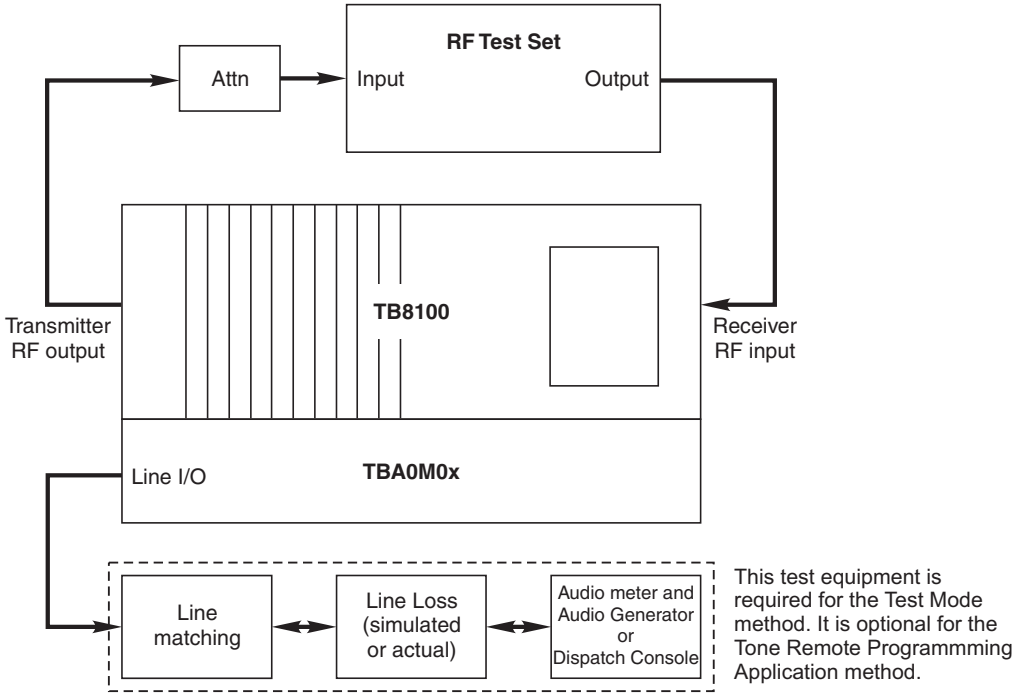


Figure 4.7 Rack and test equipment setup

Remove any coaxial relay or duplexer in the TB8000 modules' RF path and connect them directly to an RF Test Set. Ensure that transmitter or PA RF output is sufficiently attenuated to prevent damage to the test set.

4.2.2 Use of Test Microphone

The TBA0M0x test microphone is used to communicate both on air to radios and down the line to dispatch consoles. It plugs into the RJ11 connector on the front panel. It is electrically connected in parallel with the receiver (microphone with receiver audio and PTT button with receiver mute).

Most dispatch consoles are equipped with an intercom facility whereby speech can be sent to line without a keytone. This enables the dispatcher to talk to service personnel at the repeater site using the TBA0M0x's built in speaker without broadcasting speech to air. The service personnel can talk back to the dispatcher using the TBA0M0x test microphone (the PTT must be pressed to gate microphone speech).

Note: If the TBA0M0x is in repeater mode, PTT on the test microphone will key up the transmitter and thus broadcast test speech to air.

4.2.3 Test Modes

The TBA0M0x has three test modes to assist with setting levels:

- Test Tone mode
- Line-In Level Configuration mode
- Line-Out Level Configuration mode

To enter the test modes, press the Monitor and Mode Toggle buttons on the front of the TBA0M0x simultaneously for three seconds. The alarm LEDs will display flashing colours travelling back and forth to indicate Test Tone mode. The TBA0M0x will key-on the TB8100 transmitter and encode a 1kHz test tone to the transmitter for one minute. The test tone can also be heard on the TBA0M0x speaker.

While still in Test Tone mode, simultaneously pressing the Monitor and Mode Toggle buttons again will change the mode to Line-In Level Configuration mode. All the LEDs will be on — either entirely red or entirely green.

- Green = Keytone present on Line-In. TBA0M0x will key-on the associated transmitter.
- Red = No keytone present

While still in Line-In level configuration mode, simultaneously pressing the Monitor and Mode Toggle buttons again will change the mode to Line-Out Configuration mode. To indicate this, all the LEDs will be orange.

Note: After entering each mode, a one to two second pause is required before attempting the simultaneous press to enter the next mode (or to exit).

While in Line-In or Line-Out Configuration mode, the Monitor and Mode Toggle buttons operate as 'gain' adjust buttons. A press on the Monitor button will increase the Line-In/Line-Out gain and toggle the left alarm LED on or off, indicating a level increase. The LED will no longer toggle (it will stay on) when the top of the range has been reached. Conversely the Mode Toggle button will decrease the gain and toggle the right alarm LED. Likewise, the LED stays on when the bottom of the range has been reached. In both of these modes Line-In audio can be heard on the monitor speaker.

To exit Line-Out Configuration mode, simultaneously press both buttons again. Alternatively, the unit will automatically return to normal operation mode after one minute. (This occurs in all three test modes).

Note: These levels are always preserved on exit. Take care not to change them unintentionally during simultaneous button press.

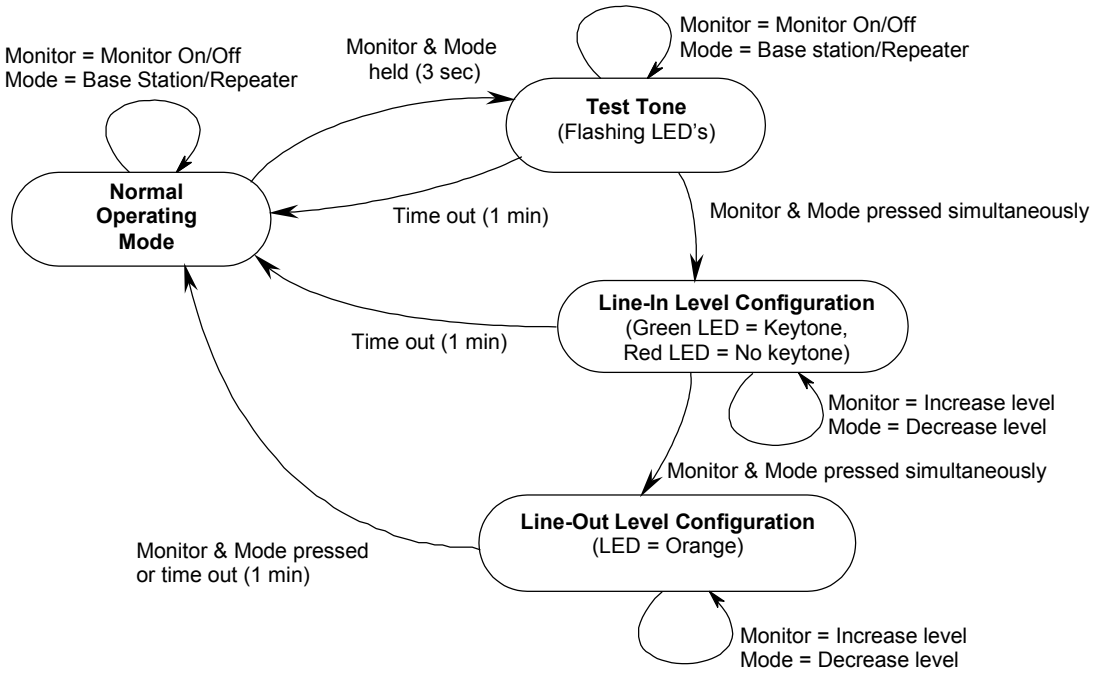


Figure 4.8 Cycle of switching between the modes

4.2.4 Level Configuration

Before proceeding with any level configuration ensure that the equipment has been setup correctly as in Section 4.2.1. It is important that the TB8100 transmitter output is connected to the Test Set (through a load as required) because the TB8100 will often be keyed during these procedures.

The following levels need to be set:

1. Tx Audio — Audio level from the TBA0M0x to the TB8100 transmitter (balanced)
2. Line-In level
3. Rx Audio — Audio level from the TB8100 receiver to the TBA0M0x (unbalanced)
4. Line-Out level

The only consideration of order is that the Tx Audio level (1) needs to be configured before the Line-In level (2) can be done.

The Tx Audio and the Rx Audio are both adjusted within the base station using the TB8100 Service Kit software. These two levels cannot be adjusted on the TBA0M0x. The Tx Audio output from the TBA0M0x is set at –4.4dBm (when the Line-In level is properly set up or when in Test Mode), and the TBA0M0x is designed for a Rx Audio level of 230mV_{rms} from the base station receiver.

Using the TB8100 Service Kit, the Tx Audio and Rx Audio level adjustment is done within the Configuration section as follows.

1. Navigate to Base Station > Channel profiles

2. For a standard TB8100 Base Station, choose the “Default” channel profile and click the “Edit” button. For an advanced TB8100 Base Station (Advanced Profiles and Task Manager enabled) choose the channel profile name required and click the “Edit” button. The “Edit Channel Profile” window is then displayed with five tabs along the top.

3. Select the Signal Path tab (shown below in Figure 4.9). This is where the Rx and Tx Audio paths can be configured as describe in the following sections.

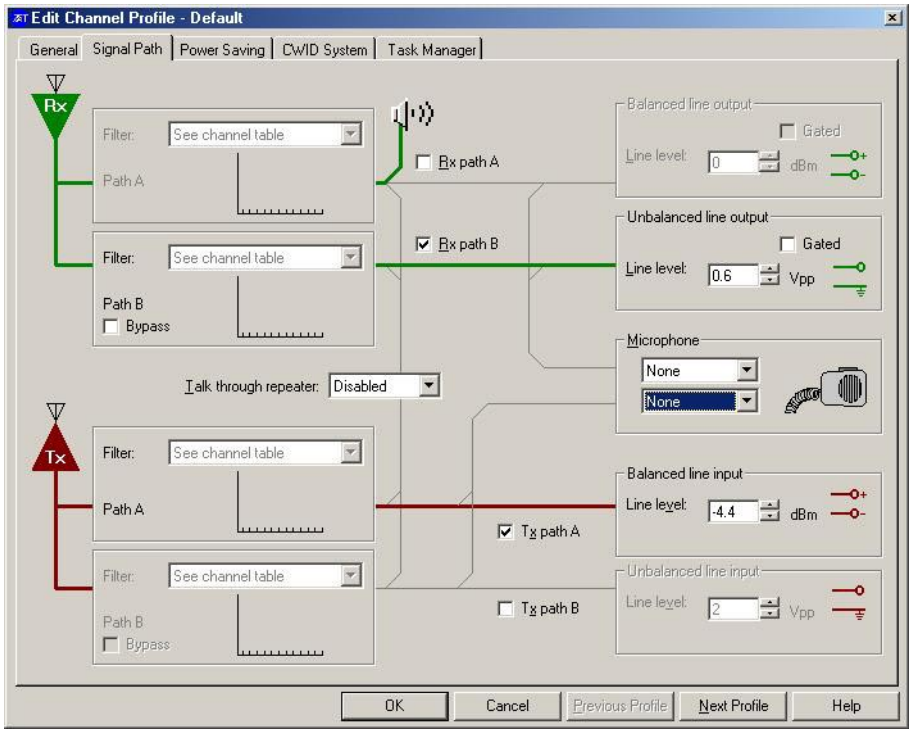


Figure 4.9 TB8100 Service Kit — Signal Path edit window for the default channel

For additional help refer to the TB8100 Service Kit User’s Manual provided on the CD supplied with the base station. Additional information is also available in the TB8100 Installation Guide and TB8100 Operation Manual.

4.2.4.1 Tx Audio — Audio level from the TBA0M0x to the TB8100 transmitter

The Tx Audio level is adjusted on the input of the transmitter using the TB8100 Service Kit.

1. Using the TB8100 Service Kit read the TB8100 base station. This will load the configuration data into the Service Kit.

2. For a standard TB8100 Base Station navigate to Configuration > Base Station > Channel Table. For an advanced Base Station (Advanced Profiles and Task Manager enabled) jump to step 5.

3. Set the “Filter” of the Default channel to “Pre/De-Emph Speech Band”.

4. Click “OK”.

5. Navigate to Configuration > Base Station > Channel Profiles.

6. Select the channel profile required (see Section 4.2.4) and navigate to the Signal Path options tab.

7. Within the Signal Path options window:
   - Select "Tx path A"
   - For advanced Base Stations only, set the Tx path filter to "Pre-Emph Speech Band"
   - Set the Balanced Input level to –4.4dBm
     The Line level adjust boxes on the transmit path define the level of the line input that the Base Station expects. The line level affects the gain across the transmit path. When the base station receives a line input equal to the level programmed, it transmits at 60% of maximum transmit deviation.

8. Program the TB8100.

The above configuration can be checked by putting the TBA0M0x into Test Mode (see Section 4.2.3). Ensure the equipment is correctly setup as in Section 4.2.1. In Test Mode the TBA0M0x keys the base station transmitter and outputs –4.4dBm balanced Tx Audio (equal to average speech level). Using the RF Test Set, with the De-Emphasis filter ON, confirm that the deviation displayed equates to 60% of maximum system deviation. The maximum transmit deviation is determined by the channel spacing, or for the channels using custom profiles, it is defined by the parameter Max Tx deviation. See Table 4.6 below.

Channel Spacing	Equivalent Max Tx Deviation (Hz)	60% of Max Tx Deviation (Hz)
12.5 kHz Narrow Band	2500	1500
20 kHz Mid Band	4000	2400
25 kHz Wide Band	5000	3000

Table 4.6 Maximum Tx deviation

As another check, the TB8100 Service Kit monitoring or diagnostics tool can be used to measure and display (to the nearest 1dBm) the actual audio level input to the base station. Within the Service Kit navigate to Monitor > Monitoring > Reciter (or Diagnose > Reciter > Audio I/O)

With the TBA0M0x in Test Mode the balanced audio input level should be displayed as –4dBm. For more information see the Service Kit online help notes titled "Measuring the Audio Input Level".

4.2.4.2 Line-In Level

The Line-In level can be set up in two ways:

- With the TBA0M0x in Level Configuration mode
- Using the Tone Remote Programming Application.

Using Level Configuration Mode:

Note: The Tx audio level must be set up before starting this procedure (Section 4.2.4.1).

1. Set the TBA0M0x into Line-In Level Configuration mode (See Section 4.2.3).

2. Connect a dispatch console to the far end of the line (or simulate the console and line loss using an audio generator).

3. Press the PTT on the dispatch console. This will send a keytone to the TBA0M0x. Ensure the console also sends a test tone at speech level to line (This audio is required for this method of configuring the Line-In level).

4. The alarm LEDs on the front panel of the TBA0M0x should change to green (for as long as the PTT is pressed), indicating that a keytone has been detected.

5. Adjust the Line-In level by pressing the Monitor button (increases the level) or the Mode Toggle button (decreases the level) until the TB8100 transmitter deviation reading, monitored on the RF Test Set, indicates 60% full system deviation.

6. Press the PTT on the dispatch console again, but this time use speech instead of the test tone. Ensure the LEDs on the TBA0M0x remain constant on green during speech transmission. If not, see Section 4.3.1 (point 6) on how to troubleshoot for Talkoff.

Note: The monitor speaker is forced on in this mode so that the test-microphone may be used as an intercom to communicate to the dispatcher room (See Section 4.2.2).

Using the Tone Remote Programming Application:

1. Determine the output level of the console. This may be a preset or default value specified in the console's manual or a value programmed by the operator.

2. Determine the actual line-loss between the console and the TBA0M0x.

3. Calculate TBA0M0x Line-In Level as follows:
   TBA0M0x Line-In Level = console output level (dBm) – Line-loss (dB)

4. Program the TBA0M0x with the calculated level.

Example case:

Console output level = –13dBm
Measured Line loss = 6.5dBm
TBA0M0x Line-In level = –13 – 6.5 = –19.5dBm

4.2.4.3 Rx Audio — Audio level from TB8100 Receiver to TBA0M0x

The Rx Audio level is adjusted on the output of the receiver using the TB8100 Service Kit.

Caution: **The Rx audio level must not exceed the 230mV_{rms} specified in this procedure. This will ensure that the actual TBA0M0x Line-Out level corresponds to the programmed value and thus ensures levels do not exceed the power level requirements of the Telecommunications leased line.**

1. Using the TB8100 Service Kit read the TB8100 base station. This will load the configuration data into the Service Kit.

2. For a standard TB8100 Base Station navigate to Configuration > Base Station > Channel Table. For an advanced Base Station (Advanced Profiles and Task Manager enabled) jump to step 5.

3. Set the "Filter" of the Default channel to "Pre/De-Emph Speech Band" by selecting it from the drop-down menu shown after clicking in the "Filter" field.

4. Click "OK".

5. Navigate to Configuration > Base Station > Channel Profiles

6. Select the channel profile required (see Section 4.2.4) and navigate to the Signal Path options tab.

7. Within the Signal Path options window:
   - Select "Rx path B"
   - Set the Unbalanced line output level to 0.6V_{pp} (approximately 230mV_{rms})
   - For advanced Base Stations only, set the Rx path filter to "De-Emph Speech Band"

8. Program the TB8100

Three different methods can be used to check that the level is correctly set.

Direct measurement of Rx Audio on the TBA0M0x Aux Connector (P100 Pin 31).

1. Use the RF Test Set to generate an on-channel signal to un-mute the TB8100 receiver. Modulate the RF carrier with a 1020Hz tone[1] at 60% full system deviation (adding a CTCSS tone if necessary).

2. Measure TBA0M0x Aux Connector (P100) Pin 31 with an Oscilloscope or a high impedance multimeter (this assumes the default I/O link configuration of R612B and SW600 switch 4 ON has not been changed). The level should be approximately 600mV_{pp}.

1. 1020Hz tone is used because some Test Sets can produce unstable deviation readings.

Using TB8100 transmitter deviation

This test requires the RF Test Set to be used in Duplex mode with de-emphasis filter OFF on the Test Set receiver.

1. Use the RF Test Set to generate an on-channel signal to un-mute the TB8100 receiver.

2. Modulate the RF carrier with a 1020Hz tone[1] at 60% full system deviation (adding a CTCSS tone if necessary).

3. Put the TBA0M0x into Talk-through mode (Repeater mode) using the mode toggle button[1]. The Mode LED should be red (constant or flashing) and the transmitter should be keyed-up.

4. Check for a 60% full system deviation reading on the RF Test Set. This confirms that both the Rx audio and Tx audio levels are correct as both are tested with this setup.

Using TBA0M0x Line-Out

1. Use the RF Test Set to generate an on-channel signal to un-mute the TB8100 receiver.

2. Modulate the RF carrier with a 1020Hz tone[1] at 60% full system deviation (adding a CTCSS tone if necessary).

3. Put the TBA0M0x into Base station mode using the mode toggle button[1]. The Mode LED should be green (constant or flashing).

4. Measure the TBA0M0x Line-Out level (balanced audio).

5. Using the Tone Remote Programming Application, read the TBA0M0x and note the programmed Line-Out level. The measured level (of step 4) should be the same as this programmed level if the RX Audio has been set-up correctly.

4.2.4.4 Line-Out Level

The Line-Out Level can be set up in two ways:

- With the TBA0M0x in Level Configuration mode
- Using the Tone Remote Programming Application.

Using Level Configuration Mode:

1. Set the TBA0M0x into Line-Out Level Configuration mode (See Section 4.2.3).

2. Use the RF Test Set to generate an on-channel signal to un-mute the TB8100 receiver.

1. The Mode Toggle button may have been disabled by the Tone Remote Programming Application.

3. Modulate the RF carrier with a 1020Hz tone[1] at 60% full system deviation, adding CTCSS tone if necessary.

4. Monitor the TBA0M0x Line-Out level and adjust by pressing the Monitor button (increases the level) or the Mode Toggle button (decreases the level) until the level is acceptable at the dispatch console.

Note: The monitor speaker is forced on in this mode so the test-microphone may be used as an intercom to communicate to the dispatcher room (See Section 4.2.2).

Using the Tone Remote Programming Application software:

1. Determine the input level required at the dispatch console. This may be a preset or default value specified in the console's manual or a value programmed by the operator.

2. Determine the actual line-loss between the console and the TBA0M0x.

3. Calculate TBA0M0x Line-Out Level as follows:
TBA0M0x Line-Out Level = console input level (dBm) + Line-loss (dB)

4. Program the TBA0M0x with the calculated level.

Example case:
Console input level = –13dBm
Measured Line loss = 6.5dBm
TBA0M0x Line-Out level = –13 + 6.5 = –6.5dBm

4.3 Fault Finding

1. Connect the TBA0M0x to its companion dispatch console via the leased line. Check that speech sent from the console can be heard on the TBA0M0x speaker (un-mute speaker if required).

   One possible cause of incorrect operation is that the line connections have become transposed in the wiring network or that the dispatch console uses different Send/Receive pairs.

2. Use the dispatch console to key-on the transmitter. If the transmitter does not key-on, check that the console and TBA0M0x have been compatibly programmed.
   - check 2-wire or 4-wire
   - check the keytone frequency
   - check if function tones are used
   - check high level guard tone and function tone periods (if used) are the same

   Finally check that the console is sending appropriate signal levels and that tone

1. 1020Hz tone is used because some Test Sets can produce unstable deviation readings.

durations are correct (which are often variable), and that the line is not causing unacceptable attenuation or distortion.

3. If the console can key the transmitter but not change repeater/basestation mode, change channel, auxiliary outputs, receiver defeat or cancel alarms, carry out the checks in Step 2 above, but pay particular attention to the function tone programming.

4.3.1 Troubleshooting

1. Sometimes misses function tone command

Set up the Line-In level so that the function tones are about $2V_{pp}$ at TP204.

2. Misses function tone sequence on very fast key repetition

A minimum of 200ms pause is required between pressing buttons on the console. Some consoles do not limit the maximum keying rate.

3. Loop-Line functionality (also known as Loopback)

Loopback can be enabled with the Tone Remote Programming Application. It is then activated by sending the TMA0M0x the programmed function tones.

4. While in Line-In Level Configuration mode, the LEDs flash green only briefly when the dispatch console PTT is pressed

The Line-In level is too low. The TBA0M0x is only detecting the high level guard tone (HLGT).

While still in Line-In Level Configuration mode, activate the console PTT and adjust the Line-In level by pressing the Monitor button (increases the Line-In level) until the LEDs remain constant green. The top alarm LED will toggle on and off, indicating a level increase until the top of the range is reached (this may take up to 65 presses). If this still fails, open up the unit and add JP200, and try again.

5. When the PTT is pressed, a pulsing sound can be heard from the speaker

The Line-In level is too high. The function tones can not be decoded properly hence it keys off.

While still in Line-In Level Configuration mode, activate the console PTT and adjust the Line-In level by pressing the Mode button. The bottom alarm LED will toggle on and off, indicating a level decrease until the bottom of the range is reached. Using an oscilloscope measure the signal on TP204—the function tone level should be about half the level of the high level guard tone.

6. The console keys the transmitter correctly except when speech is present.

This is known as “Talkoff” and occurs when the difference between the keytone level and peak speech level exceeds specification (32dB in 2-wire mode and 35dB in 4-wire mode), causing the keytone detector to fail.

Adjust the relative audio levels (keytone and speech) sent from the dispatch console. For reliable operation the keytone level should be no more the 35dB lower than the ***peak*** speech level.

If it is not possible to adjust the levels at the console, decrease the programmed Line-In level of the TBA0M0x until Talkoff is eliminated. This requires that the Tx Audio level (from the TBA0M0x to the TB8100 transmitter) will also need to be re-adjusted to maintain 60% full system deviation for the test tone sent from the console. See Section 4.2.4.1 for adjusting Tx Audio using the TB8100 Service kit. As a general rule, the TB8100 Tx Audio input level will increase by the same amount as the TBA0M0x programmed Line-In level is decreased.

7. Keytone Falsing in 2-wire mode.

When operating in 2-wire mode with lossy lines (i.e. significant separation required between TBA0M0x Line-In and Line-Out levels) the keytone detector can become desensitised by noise.

1. Check to ensure that the Rx Audio level is setup correctly at 230mV_{rms} (See section 4.2.4.3).

2. Check the TB8100 receiver gating level (squelch). If necessary adjust the receiver gating, using the TB8100 Service Kit, so that the receiver mute opens at a higher SINAD level (12dB or preferably greater). This has the effect of reducing noise on the input of the TBA0M0x in 2-wire mode.

3. If there is still a problem after the receiver gating has been adjusted as much as practicable, it becomes necessary to reduce the separation between the TBA0M0x Line-In and Line-Out levels. This separation may need to be reduced to less than 8dB if the receiver audio SINAD is less than 12dB (or less than 12dB for 14dB receiver audio SINAD). To achieve this, adjust the relative input and output levels of the dispatch console. Again this has the effect of reducing the noise on the input of the TBA0M0x.

If the above solutions do not help resolve the problem, the 2-wire line loss may be too severe and unacceptable for normal 2-wire TBA0M0x operation. In this case a solution involving a Rx Audio path notch filter and an external 2-wire/4-wire hybrid fitted across the line, may be required.

