SRP 9100 Series
FM VHF/UHF Portable
Radio Transceiver

SERVICE MANUAL

TNM-M-E-0012

ISSUE 1.24

January 2006

Quality System

Quality Endorsed Company

TMC Radio

TMC RADIO PTY LTD

TMC Radio
TMC RADIO PTY LTD

SRP9100 Series FM VHF/UHF Portable Transceiver TNM-M-E-0012 ~ Iss 1.24

Table of Contents

Declaration

The performance figures quoted are subject to normal manufacturing and service tolerances. The right is reserved to alter the equipment described in this manual in the light of future technical development.

Copyright

Errors and Omissions

The usefulness of this publication depends upon the accuracy and completeness of the information contained within it. Whilst every endeavour has been made to eliminate any errors, some may still exist. It is requested that any errors or omissions noted should be reported to:

Product Engineering
TMC Radio Pty Ltd.
1270 Ferntree Gully Road
Scoresby Vic
3179 Australia

Ph: +61 3-9730-3800
Fax: +61 3-9730-3968
Mob: +61 408-160-661

e-mail: jkuhrt@tmcradio.com

http://www.tmcradio.com/

Document History

Issue	Date	Comments
Draft A-1	2004-01-10	Initial issue for Review
1.21	2004-05-15	Official Release
1.22	2004-06-24	Replaceable parts BOM corrected
1.23	2005-01-31	Update Mute/Audio offset adjustment
1.24	2005-09-05	Updated for Rev 2.

List of Associated Publications

Document No.	Description	Issue
TNM-U-E-0045	SRP9100 Brief User Guide	1
TNM-U-E-0047	SRP9100 Operating Instructions PMR	1
TNM-U-E-0048	SRP9100 Operating Instructions Trunked	1

Warnings and Cautions

WARNING

The Power Amplifier Module may use semiconductor devices containing Beryllium Oxide. Dust from this oxide is toxic and, if inhaled or skin contact is made, can be hazardous to health.

No danger can arise from normal handling, but no attempt should be made to break open or tamper with these devices in any way.

These items should not be discarded with industrial or domestic waste.

WARNING

SRP9100 radio equipment is to be connected to TMC approved chargers and accessories only.

WARNING

Do not dispose of batteries in a fire or expose them to high temperatures.

WARNING

Do not operate your radio, without a handsfree kit, whilst driving a vehicle.

WARNING

Do not operate your radio in an explosive atmosphere. Obey the "Turn Off Two-way Radios" signs where these are posted, e.g. on a petrol station forecourt.

Caution

Customer configuration files should be saved prior to any alignment adjustments.

Preparing the radio for alignment will erase from the radio all customer PMR and Trunking configuration data (channel, signalling information etc). The only data retained by the Alignment Tool is the factory alignment data for the radio (DAC settings for Tx power, front-end tuning etc).

GLOSSARY OF TERMS

A summary of common radio terms and some other terms used in this document, and their meanings, are given below.

3RP Trunking Signalling Specification relating to trunked networks for shared use. Used primarily for networks in France.

ADC Analogue to Digital Converter.

AFC Automatic Frequency Control.

AGC Automatic Gain Control.

Alarm A Selcall sequence sent from subscriber equipment to indicate an Emergency situation.

When activated the radio will enter a repeating sequence consisting of an Alarm Live Transmit Time and an Alarm Dead Receive Time.

ANN Abbreviation for Algorithmic Network Numbering. This is the numbering system where the numbers presented to the radio user can be mapped directly to the MPT1327 PFIX/IDENTs and vice versa by use of a fixed algorithm in combination with some other customisation parameters. See also FPP and MEP.

ANI Automatic Number Identification.

Auto Interrogate An Acknowledge identity sent as a response to an individual reset call.

Automatic Power Feature whereby the transmit power is automatically set to a level determined by the level of the received signal. This is used to extend the battery life and/or reduce radiated emissions.

Background Hunting The searching for an alternative and 'better' control channel whilst already on a valid control channel.

BCAST MPT1327 broadcast message. Used to transmit information about the trunked radio system to radio units.

Busy The state of a channel such that:

- For a non-signalling channel - if Busy this means that the carrier is above squelch.
- For a channel with CTCSS/DCS - if Busy this means a signal is being received with either no CTCSS tone / DCS code or the correct CTCSS tone /DCS code.
- For a channel with Selcall - if busy this means a closed channel where the signal is above squelch.

A feature that equates to 'Do Not Disturb' such that the radio will reject all non-emergency calls. This feature can be activated using the busy key (if assigned) or from a menu; it is reset to disabled at switch on.

C4FM Compatible 4-Level Frequency Modulation.

Call Back A request, sent by the dispatcher, to a unit requesting that the unit calls the dispatcher back.

CCSC Control Channel System Codeword.

Channel Spacing The distance (in Hz) between the defined frequency channels.

CHEKKER System Interface Specification for Trunked Networks in Germany.

CLIM	Call Limit Time; time limit on calls made. Normally this is defined by the Call Time Limit parameter but can by overridden by the TSC depending upon the setting of TSCLIM.
CLIME	Emergency Call Limit Timer.
Closed	A state where transmit and receive are not allowed until a Selcall message to open the channel has been received. A Closed Channel is one that defaults (when selected or after timed reset) to its closed state. Contrast with Open. Normally a Closed channel would have Selcall Mute and PTT Inhibit would be enabled.
CODEC	COde (Analogue to Digital Converter) / DECode (Digital to Analogue Converter).
Community Repeater	A communications set-up whereby different groups of radios can operate by using only one base station. This is achieved by the use of CTCSS tone signalling such that each group has a different CTCSS tone (encode and decode) and radios can only communicate with other radios in their group. Only one group of radios can use the base station at any one time.
Continuous	A continuous control channel is one that is only used by one site. There are no breaks in the transmission of signalling. Emergency Call Time Limit
Control Channel	A channel used for the transmission of messages that enables the TSC to control radios. Control channels may either Continuous or Timed Shared.
Control Channel Burst	A feature that enables control channel burst transmissions on systems using time-shared control channels. It is unavailable if the control channel acquisition type is not 'Time Shared'. To make available: go to Control Channel Acquisition Type and set to Time-shared.
CRU	Central Repair Unit
CTCSS	CTCSS stands for Continuous Tone Controlled Squelch System. A continuous tone (lower than the audio range of the receiver) is modulated onto the carrier as well as other signalling or voice traffic. Compare with DCS. Only receivers that have been instructed to recognise the same CTCSS tone are able to receive the transmissions, since the squelch of receivers looking for different CTCSS tones prevents the audio from being heard. This provides a simple method of sending messages to selected receivers only and allows several different networks to use the same frequencies. CTCSS is also known as Tone Lock or Tone Squelch.
DAC	Digital to Analogue Converter.
Dash (-) digits	Digits known as 'No Tone' digits used in Selcall Identities.
DCS	Digital Coded Squelch system is based on sending a continuous stream of binary code words using, low deviation, direct frequency shift keying. Only receivers which have been instructed to recognise the same DCS sequence are able to open their squelch and receive the associated speech transmissions. This provides a simple method of sending messages to selected receivers only and allows several different networks to use the same frequencies.
Decode	Reception of signalling. Either Selcall where encoded tone frequencies are decoded and identified as specific tones digits or CTCSS/DCS where tones are analysed to see if the channel should be opened.
Demanded	Demanded Registration; a procedure in which the TSC forces a single radio unit to attempt registration immediately (providing the radio is not already attempting to register).
Disabled	The 'False' state of a parameter. That indicates this parameter is not active. Typically this state is represented by an unmarked check box. Compare with Enabled.

DSP Digital Signal Processor.

DTMF Abbreviation of Dual Tone Multi-Frequency signalling. Used to dial into Telephone networks using tone dialling.

Dual Watch A facility that enables the Radio to periodically monitor another channel for a signal above squelch. Typically applications are checking an emergency channel whilst on another channel.

Economiser A process by which the Receiver is powered down whilst there is no received signal. Periodically the receiver is powered up to check for such a signal. This is used to extend the battery life of a Portable.

Enabled The 'True' state of a parameter. That indicates this parameter is active. Typically this state is represented by a mark (either a tick or a cross) in a check box. Compare with Disabled.

Encode Transmission of signalling. Either Selcall where Selcall tone digits are encoded into tone frequencies or CTCSS/DCS where tones modulated onto the channel's carrier.

ETS European Technical Standard.

Fallback A mode of operation that may be entered when the Network is suffering a malfunction. During this mode certain facilities (e.g. PSTN) may not be available.

FFSK Fast Frequency Shift Keying. This is a signalling system for the transfer of digital information. It works by using one of two audio tones to represent data being transmitted.

Fleet A group of units formed such that only a shortened form of dialling (2 or 3 digits) is required between them. These groups are normally assigned contiguous Idents.

FOACSU Full Off Air Call Set Up. A method of call set-up where the calling party has to manually answer the incoming call before the trunking system will allocate a traffic channel to the call. This reduces the loading on traffic channels as it prevents them being allocated to calls when the called party is not present to deal with the call.

PLA Programmable Logic Array.

FPP Field Personality Programmer.

Hash (#) digits These digits are used for two purposes:

- For Selcall identities (encode and decode) - known as User Id digits. These digits are replaced by the user id entered at switch on (if enabled)
- Use in DTMF dialled strings - their use is network dependent to access special services.

IDENT A 13 bit number used for Identification purposes. Associated with a Prefix (PFIX) this forms a 20 bit address which is used for identification purposes in signalling between the radio and the trunking system.

Identity Name given to a sequence of tones that is used in sequential tone signalling. See Valid Selcall Digits.

Idle State The state of the radio when it is not in a call.

Inaccessible A state of a channel such that it is unavailable to the user through normal methods of channel selection. Therefore inaccessible channels will not appear on the channel menu.

Include Calls These types of calls are used to allow a 3rd party to join into an existing call.

Link Establish Time	A delay incorporated into the start of every selective call or DTMF transmission that allows for the finite delay of the radio equipment in responding to any radio signal. This includes both the commencement time of the originating transmitter and the response time of the receiver.
Locked	A state of a channel whereby it is not possible to change channels using the normal up/down keys on the channel menu until the OK key is pressed. See Auto Channel Selection Lock.
MEP	Miniaturisation Extent Parameter. Used in systems that use ANN numbering.
Modifier	Part of a dialled string that modifies the nature of the call made to a number (e.g. dialling "*9" before the number that is to be dialled will modify the call to be an emergency call).
MPT1327	A signalling standard for Trunked Private Land Mobile Radio Systems. Defined for systems in the UK but also used outside the UK. Issued January 1988.
MPT1343	A System Interface Specification for commercial Trunking networks. Defined for systems in the UK but also used outside the UK. Issued January 1988.
Noise Blanker	A circuit designed to reduce automotive ignition interference.
NDD	Network Dependent Data. This is a field within the CCSC codeword that is used by the trunking system to identify information about the trunking network and, in particular, information specific to the site that is radiating the control channel. It is used by the radio when it is acquiring a control channel to identify valid channels.
Null Id	A Selcall identity that is not defined and whose tones' field is displayed as a blank.
Open	A state where transmit and receive are allowed. The channel is no longer open when reset. Contrast with Closed. Normally an Open channel would not have Selcall Mute and PTT Inhibit would be disabled.
OPID	Network Operator Identity used in Regional Systems. See Roaming.
PABX	Private Automatic Branch Exchange.
Password	An optional password system available on the radio. This feature is only available if the radio does has a display and a keypad. To make available: go to Hardware Components, Terminal Settings and set Product Type to one which has a display and a keypad.
PFIX	The 7 most significant bits of an MPT1327 address number. Normally same fleet units have same prefix. Relates to individual and group address numbers.
PLL	Phased Locked Loop.
PMR	Private Mobile Radio (not normally trunked).
Priority Channel	A channel in a search group that is scanned between every other channel.
PSTN	Public Switched Telephone Network
PTT	Press To Talk. This is the term given to the operator’s key normally used to commence transmitting a message.
PTT Inhibit	A state whereby transmission using the PTT is not allowed. Also know as Tx Lockout.
PWM	Pulse Width Modulation
Queuing	The storing of a Selcall Identity for later transmission.

If inhibited from transmitting a Selcall sequence because the channel is busy then the radio can queue the Send 1 / Send 2 sequence for later transmission. When a radio unit is in Queuing mode all incoming calls are stored automatically in a queue for later examination. The caller is given an indication that the call has been queued by the called party. The queue will contain the identity of the caller and the status value received (if a status call). Up to 20 calls may be queued. The Queuing mode may be selected using the Modes Menu.

Note: Connecting a MAP27 device to a radio that is in queuing mode will disable queuing. All incoming calls will then be routed both to the radio user interface and to the MAP27 device connected to the radio. Also known as Logging Mode

Reference Frequency Normally this is generated from a high stability crystal oscillator reference and is divided digitally in a frequency synthesiser for comparison with other frequency sources, e.g. a VCO.

Registration Registration is a technique used to ensure that the trunking system knows the location of radio units that are using the system. This allows the system to set-up calls quickly without having to search the whole system for the called radio.

Repeat Tone A selcall tone that is used to replace repeated tones. Fixed at tone E.

Example: An identity entered as '12333' would be sent by the radio as '123E3'.

Reset Resetting is caused by Three Tone Reset, a Remote Reset, and an Individual reset or a Group reset (Call Types in Decode Identity). When a radio is reset the effect on the radio will be as follows:

- Any Call Alerts will be stopped
- The Call LED flashing will stop
- If the channel is in Open mode then the channel is closed
- The PTT is optionally inhibited (see PTT Inhibit After Reset Sequence).
- In searching - if paused on a Selcall channel then searching resumes
- If the Acknowledge property of a Decode Identity is set to 'Auto Interrogate' or 'Transpond & Auto Interrogate' then the Auto Interrogate encode identity is transmitted.

Roaming This is a process that allows changing between regional trunking systems which have different Operator Identities (OPID 's). Not allowed on MPT1343 Systems.

RSSI Received Signal Strength Indicator.

Scanning Process of switching between the channels in the nominated search group in cyclic sequence, stopping when the search condition (which may be to look for either a free or a busy channel) is satisfied.

SDM Short Data Message.

Selcall Selective Calling - a system of signalling which allows 'dialling up' of specific mobiles, portables and controllers. Such a system may be used to pass messages as a data message to a specific user or group of users. It can be used to provide remote switching facilities and to provide access control into community repeaters or similar devices.

Selcall Mute A state of the audio gate whereby the loudspeaker is muted (closed).

Selcall System Selective Calling, uses a tone sequence at the start, and end, of a call to control which members of a fleet react to the transmission.

SFM Short Form Memory.

Sidetone Sidetone is the audio which can be (optionally) heard when Selcall, DTMF and toneburst transmissions are made.

Simplex Mode of operation whereby the radio operates as a conventional fixed channel radio outside the Trunking network.

Squelch System used to prevent weak, unintelligible signals and random noise from being heard by a radio operator while still allowing intelligible signals to be received normally. This is accomplished by the use of a threshold below which any received signals are ignored. Only signals whose signal-to-noise ratio is above the squelch level cause the audio circuits of the radio to be enabled, with the result that only satisfactory signals are received. The squelch level is specified in SINAD.

Star (*) digits Digits known as Status or Message digits. These digits are used for three purposes:

- Status Digits for Selcall Identities
- Wildcard digits in Status strings
- Use in DTMF dialled strings - their use is network dependent to access special services.

Status A feature whereby a radio's status (or usually the status of the radio's user) can be transmitted and a status message from other radios can be displayed. This operates through status digits in Selcall identities. Either in Encode Identities or Decode Identities as follows:

Encode Identities: Status digits within the identity are used to transmit the current situation of the radio's user (E.g. "Out To Lunch").

Decode Identities: Status digits are looked up in a table (Status Menu) for possible messages to display.

SW Software.

SYS System Identity Code part of the CCSC.

TCXO Temperature Compensated Crystal Oscillator.

Temporary Temporary Registration; a process carried out by the Dispatcher due to some system failure that prevents it from carrying out normal registration. The radios will recognise this temporary registration mode but will otherwise use the network in the same way as if they were registered. They may be required to re-register when normal registration mode is resumed.

Three Tone Reset This is a system whereby a call to a user automatically reset all other users in a group.

Example: a call to user '12345' would call 12345 and reset all other users on this channel with an identity 123nn where n can be any digit 0-9, A-F.

Timed Reset Facility that causes the Radio, after a certain period of time, to restore current channel to its initial condition e.g. if it was previously searching it will resume searching.

Time Shared A time-shared control channel is one that is used by more than one site. This allows a wide coverage area to be obtained using only one frequency.

The forward channel from the TSC to the radio is divided into timeslots. Each site using the channel is allocated one timeslot in which to transmit and send signalling.

Therefore, when on a timeshared channel, the radio may be able to receive bursts of signalling from different sites at different signal strengths and may receive periods when no signalling is received.

Depending on the type of system, the radio may be able to perform transactions with any site it can receive from or only with a specific site.

TMR	Trunked Mobile Radio.
Tone Burst	An audio tone is transmitted at the start of transmission to inform a relay (repeater) station to switch itself on to relay the transmission.
Transpond	An Acknowledge identity sent as a response to an individual call.
TRAXYS	Air Interface for the PTT Telecom Trunked Radio Network, used in the Netherlands.
TSC	Trunking Site Controller. Central control required for the Trunking System to function. Controls base stations.
Tx Inhibit	A facility which prevents the user from transmitting,(other than alarms), while the channel is Busy.
UMP	User Memory Plug. A special device that contains the customisation data for the radio. If this is removed then this can cause the radio to behave in a number of ways.
User Defined Groups	These groups are set up by the user (contrast with Dynamic User Groups) when the user desires to be included, temporarily, in an existing group. Up to 8 groups may be defined (in addition to the Network group Idents defined by Network Group Numbers). This feature is only available if User Defined Groups parameter is enabled. These temporary groups are lost at switch off unless 'Save Groups at Switch Off' is enabled.
User Identity	This is a sequence of up to four digits entered by the user when the Radio is switched on, if this option is programmed. These digits are then substituted into any transmitted Selcall identity which includes # digits.
VCO	Voltage Controlled Oscillator.
Vote	Method used to compare the signal strength on a current channel with another specified channel and then to choose the channel having the stronger signal.
Voting	Feature used during searching when there is more than one channel that satisfies the required conditions. It involves examining all the channels that satisfy the required conditions, and then selecting the channel with the highest signal strength.
VOX	Voice Operated Transmit.

1. INTRODUCTION

1.1 General

The SRP9100 series of FM portable radio transceivers are designed for conventional PMR and Trunked operation in VHF and UHF radio systems.

The transceiver is available in three functional variants. The variants are as follows:

Description	PMR/Trunked
Portable Transceiver with no Keypad	SRP9120
Portable Transceiver with Keypad	SRP9130
Portable Transceiver with Keypad and Graphic Display	SRP9130-Plus

1.2 Scope

This manual provides technical specifications, description and servicing details for the SRP9100 series of portable radio transceivers together with the related accessories.

Unless specifically stated otherwise, the text and illustrations refer to all versions in the series.

1.3 Description

The design concept utilises wide band analogue techniques for RF transmit and receive circuitry with digital signal processing of analogue or digital modulation and demodulation. Electronic tuning is used throughout the portable to eliminate manual tuning and level adjustment.

A Digital Signal Processor (DSP) and a Programmable Gate Array (PLA) are used with other dedicated devices in the SRP9100 to perform the following functions under software control:

- Frequency Synthesis of all operating frequencies.
- Modulation and demodulation of 10/12.5/20/25kHz FM signals on a per channel basis.
- Modem functionality for specified data modulation schemes.
- Filtering, pre-emphasis, de-emphasis, limiting, compression, muting, CTCSS, Selcall or any other frequency or level dependent signal modification.
- Serial communications with the Control Ancillaries, Field Programmer and Alignment Tool.
- Tuning Control data for Tx and Rx.

The SRP9100 Transceiver comprises a rugged cast internal lightweight alloy chassis that houses two printed circuit board assemblies and provides all heatsink requirements. The battery slides into the chassis where it is securely locked via two high impact clips. Release is achieved by depressing a latch on the battery. The chassis is enclosed in a high impact polycarbonate ABS plastic case that retains the speaker, keypad and display.

The buttons, connectors and antenna are sealed against moisture and dust ingress by gaskets around keys and display or bungs in the case of the external connectors.

The main PCB assembly comprises a multi-layer board containing all the RF and control circuitry. The display or man-machine interface (MMI) board is connected via a miniature connector to the main board. A flex strip connects the speaker and microphone also to the main board. Provision is made for optional plug-in accessories in the radio. (eg. for encryption, P25, etc.)

Several battery capacities and technologies are available to suit the endurance requirements of the portable application.

The antenna is connected to the radio via an SMA plug that is mounted into the radio chassis. The antenna flange provides it with additional rigidity when seated on the radio body.

1.4 PRODUCT VARIANTS AND FACILITIES

Product variants and facilities are detailed in Table 1-1, Table 1-2 and Table 1-3.

Table 1-1 Common Features for All Variants

Feature:	Model:	9120	9130	9130+
Keys		7 Function keys. All keys can be customised.	7 Function keys. All keys can be customised	7 Function keys. All keys can be customised
Keypad		-	12 button numeric keypad	12 button numeric keypad
Display		LCD 12 character with bit mapped section and fixed icons.	LCD 12 character with bit mapped section and fixed icons.	Graphic LCD 102 x 64 pixels.
Volume		Rotary control	Rotary control	Rotary control
Indicators		Tri-colour LED's	Tri-colour LED's	Tri-colour LED's
Facility connector		Yes	Yes	Yes
Frequency Bands		66-88MHz, 136-174MHz, 174-208MHz, 335-375MHz, 400-480MHz, 440-520MHz		
Channel Spacing		10/12.5/20/25kHz		
Menu driven		Yes Limited selections	Yes	Yes
Customisable Menus		Yes	Yes	Yes

Table 1-2 Conventional-PMR Variants

Feature:	Model:	9120	9130/9130+
Channels		200	1000
Signalling		CTCSS / DCS Selcall/FFSK/DTMF	CTCSS / DCS/Selcall/FFSK/DTMF
Text Messaging		FFSK test messaging display Selcall status messaging	FFSK text messaging display Selcall status messaging
Attack Operation		Yes	Yes
DTMF Encode		Pre defined Encodes via function keys	Free form encodes via keypad Pre defined Encodes via function keys
PTT Limit Timer with warning beeps		Yes	Yes
PTT Inhibit on Busy		Yes	Yes
Scanning		100 groups with up to 15 channels per group.	240 groups with up to 15 channels per group. 4 user defined scan groups.
Voting		Up to 50 groups consisting of up to 16 channels per group.	Up to 200 groups consisting of up to 16 channels per group.
Priority Scanning		Yes	Yes
Nuisance Delete		-	Yes
Multiax		Yes	Yes
Phonebook		250 entries	250 entries
P25		Optional	Optional

Table 1-3 Trunked Variants

Feature:	Model:	9120	9130/9130+
Channels		1024 channels in 50 sub-bands	
Frequency Bands		Specifically: 136-174MHz, 400-450MHz (and possible in all other bands)	
Background Hunt and Vote-Now		Yes	Yes
MPT1343 dial strings		Yes	Yes
ANN Numbering		Yes	Yes
Phonebook Memories		250	250
User Phonebook		Recall entries configured by FPP only.	Recall and edit.
Alpha Status List		Yes	Yes
SDM/EDMs		Yes	Yes
NPDs		Yes	Yes
Attack Operation		Yes	Yes

1.5 SOFTWARE VERSIONS AND NAMING

There are various associated items of Software (SW) required for the SRP9100 radio and programmer to operate. This section simply defines the naming rules of the SW files to allow identification and conformity.

This allows different versions of SW to be distributed and co-exist without confusion.

The SRP9100 Transceiver has three items of SW for digital and analogue PMR, Trunking and Alignment.

1.5.1 Filename Structure

- 2 character Application code
- 2 or 3 character SW Type code
- 3 character version number
- File Extension as required.

eg. **91tm533.bin**

91p_533.bin

91s_533.bin

1.5.2 Application Code

This identifies the application the SW was initially designed for:

91 = Standard SRP9100 Software

1.5.3 Software Type Code

This identifies different types of SW within an application.

s_	Start-up code (for alignment and start-up)
p_	Conventional PMR code
p_s	Scrambler
tm	Trunk MPT
ta	Trunk ANN
bo	Transceiver Boot-code
bc	Transceiver Boot-Backup-code
bf	Transceiver PLA-code
ba	Transceiver PLA-Backup-code

Note. The above file names are not stored within the code. As a consequence, when the radio is read by the FPP, the FPP will display version numbers and release dates for the Backup, Startup, PMR, TMR and DMAP codes. The Bootloader, PLA Backup and PLA codes show release dates only.

1.5.4 Version Number

This is a 3-digit number allocated by Engineering to identify the SW version.

eg. 103 = Version 1.03

1.5.5 Exclusions

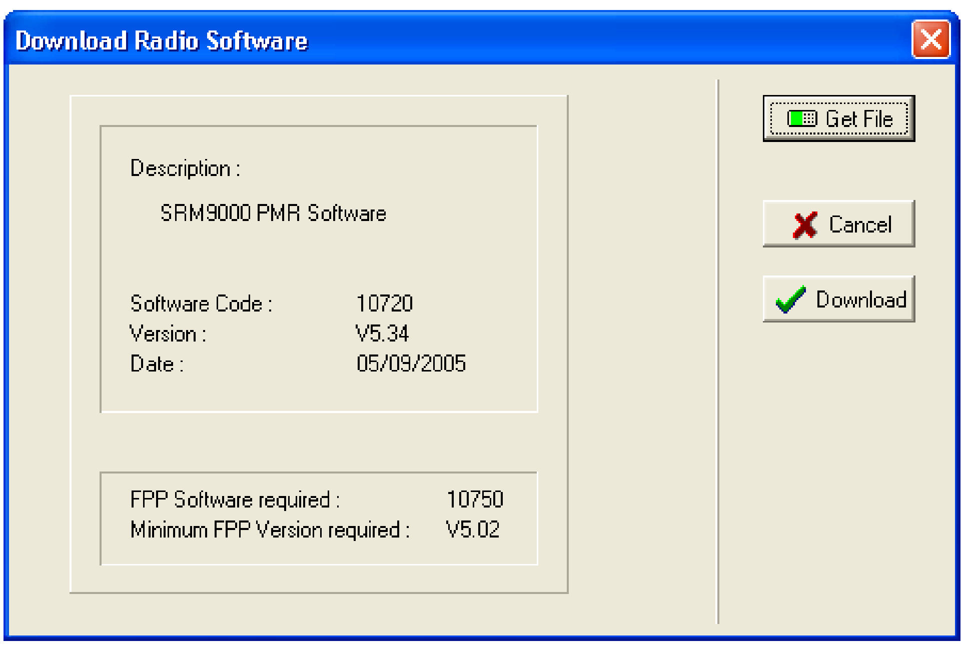
The Programmer SW does not follow the above rules, as it is a PC based Program and its version number can be easily identified by starting the SW. Later releases of SW will be backward compatible, unless deliberately not so, in which case a different directory structure/path may be implemented.

1.5.6 Displaying Software Versions

Each Transceiver SW code file (e.g. 91tm258.bin, etc.) contains version information about itself and possibly compatible Programming SW.

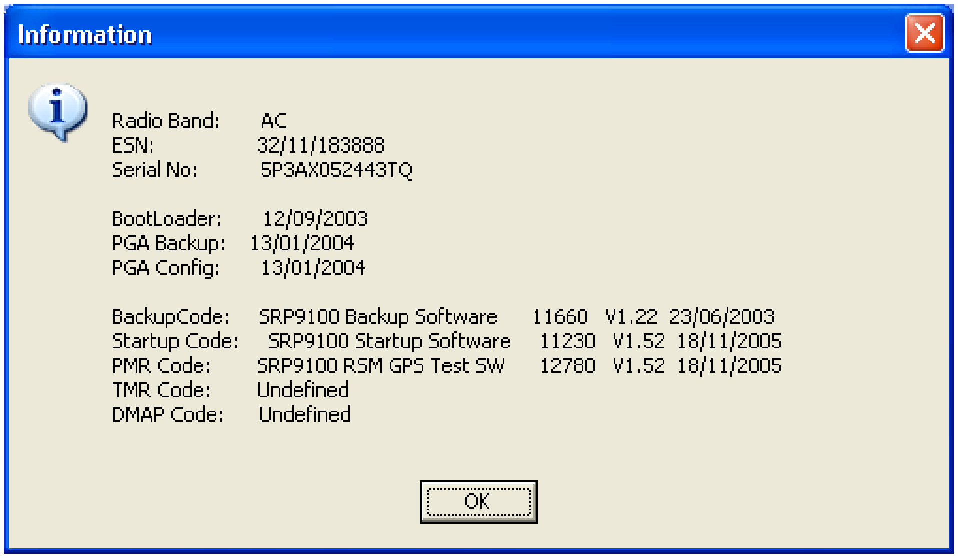
For **Radio SW saved on Disk**, this information can be displayed via the Programmer function:

Options : Upgrade_Software : Get_File



For **Software loaded in the radio**, information can be read from the Transceiver and displayed via the Programmer function:

Options : Radio_Information



The portable software version can be read from the portable display if required by accessing the **Set-up** menu and then choosing **Radio Info** and selecting the software version on the radio.

1.5.7 Automatic Version Upgrade Prompting

When a configuration is downloaded to the Transceiver, the Programmer performs a brief check on the SW currently installed in the radio. If a later version of SW exists (on PC hard disk) then the Programmer will prompt the user with the following message:

NOTE. As early versions of FPP cannot recognise a more recent revision of the radio, it is important that the latest FPP version is downloaded from http://www.tmcradio.com

If **YES** is selected, the Transceiver Radio code is updated before the new configuration is downloaded.

If **NO** is selected, <u>only</u> the configuration is downloaded.

It is strongly recommended to select "Yes" when this message is shown.

This process also updates the Start-up code to ensure it is compatible with the loaded PMR or Trunk code.

Note: If the …\StandardFPP\RadioSW folder contains no files, then the above check will not be performed.

1.5.8 Transceiver SW Description, Start-up and Backup-Software

The SRP9100 Transceiver software is split into the following separate modules:

- Bootloader and Backup Software
- Start-Up Software
- PLA and PLA-Backup Software
- Mainline PMR Software
- Mainline Trunk Software

When the Transceiver starts, it basically performs the following steps:

- Initial execution starts with the Bootloader code, which attempts to load the Start-Up Software (if Start-Up checksum is bad, then the Backup Software is loaded.)
- Start-Up Software then downloads the PLA code (or PLA-Backup code if PLA checksum is bad) to the PLA device. If both PLA and PLA-Backup checksums are bad then the radio is not operational and serial communication is not possible.
- Start-Up Software then reads the On/Off switch line and compares these with saved parameters to determine if the radio should be continue to power-up or switch itself off again.
- Start-Up software then attempts to load either PMR or Trunk Mainline Software (dependent on saved parameter) and switches execution to complete the power-up process and start normal operation.

If the Mainline Software cannot be loaded, or a Job file configuration has not been loaded (e.g. non-existent or checksum fail) then execution switches to Backup Software until the error is corrected (e.g. by FPPing the radio).

There are three states that the radio can end up in after switch-on:

- Mainline Trunk Software or Mainline PMR Software (normal power-up)
  If the radio does not have a valid Job file configuration loaded, then it will display a “No PMR Cfg” or “No TMR Cfg” message.
- Start-Up Software (characterised by “Alignment Mode” shown on the display). This is also the code that is running when the radio is being aligned using the Alignment Tool.
- Backup Software (via various paths from above.)

1.5.9 Wailing Siren (Boot-up Software Corrupted)

A “WAILING SIREN” sound is emitted from the Loudspeaker while the radio is running in Boot Backup Software. In this mode the FPP can be used to re-load a Job file, or re-load Start-Up or Mainline Operating Software.

Simply writing a Job file to the radio should allow the FPP to determine and update the offending software – however there may be instances where the FPP cannot determine this and the Start-Up and Mainline Software should be updated manually. This can be done using the *FPP* : *Upgrade_Software*: *Get_File* … then *Download*. Both Start-Up Software (filename = *91ks_xxx.bin*) and Mainline PMR (91kp_xxx.bin) or Trunk (91ktxxxx.bin) should be loaded if the FPP cannot automatically fix the problem. The wailing siren should stop once the problem is fixed.

Note 1: Holding down the alarm key and PTT key when power is applied to the radio will also force the radio to start-up in Backup Software. This may be useful in some situations.

Note 2: Should these steps fail to restore the set and the Wailing Siren cease, the radio will need to be returned to a Level 3 Service Centre for FLASH replacement.

1.6 Adjustment and Alignment

There are no internal adjustments in the SRP9100. Re-programming and alignment is performed using software tools. For testing, a special test jig is required so that the radio PCB can be powered and input/output accessible. This test jig has a dummy battery and a connector that plugs into the top of the radio so that the jig controls PTT and provides access to audio in and out.

As the radio has no internal adjustments, there is no need to have the radio PCBs powered while out of the chassis. Field repair of the PCBs is not recommended as specialised equipment is required to fault find and repair the boards.

1.7 Specification

1.7.1 General

Operation

Single or two frequency simplex (half-duplex).

Modulation

Frequency modulation (phase) F3E, F1D, F1E.

Battery Voltage

7.2V DC (nominal)

Current Consumption

	All measurements at 7.2 Volts			
Radio off	<120uA			
Standby (squelched):	<120mA			
Rx Audio O/P:				
500mW	<320mA			
Transmit:	66-88MHz	136-174MHz	174-400MHz	400-520MHz
1W	<0.7A	<0.8A	<1.0A	<1.0A
5W	<1.8A	<2.2A	<2.2A	<2.5A

Frequency Bands

Band	Frequency Range	Band	Frequency Range
E0	66 - 88 MHz	R1	335 - 375MHz
AC	136 - 174MHz	TU	400 - 480MHz
K1	174 - 208MHz	UW	440 - 520MHz
KM	208 -245MHz		

Switching Bandwidth

Radio covers the complete band without retuning

Channel Spacing

10/12.5/20/25kHz

Frequency Stability (-30°C to 60°C)

Less than ±2.0ppm

Dimensions (mm)	Height	Width	Depth
Radio excluding antenna	147mm	68mm	43 mm
	Excluding volume control		Including std. battery

Weight

Radio only	210g
Battery NiCad 1600mAH	250g
Battery NIMH 2150mAH	230g
Battery Li 3000mAH	180g
Battery NiMH 2700mAH	280g
Antenna E0	30g
Antenna UW	19g
Battery Endurance	> 10 hours, high transmit power, 2700mAh battery, 90:5:5 duty cycle

Conformance Approvals

***** Pending in some cases

ETS	EN 300 086 *
	EN 300 113 *
	EN 300 489 *
	EN 300 219 *
Australia	AS4295 *

1.7.2 Transmitter

Power Output	Any two levels programmable from High Power: 5W Adjustable down to 0.5W Low Power: 0.5W Adjustable up to 5W
Transmitter Rise Time	Less than 40 ms
Duty Cycle	1 minute transmit: 4 minutes receive
Spurious Emissions	< 0.25uW (9kHz to 1GHz) < 1.0uW (1GHz to 4GHz)
Residual Noise	60% deviation. CCITT Weighted 25kHz Channel Spacing >45dB 12.5kHz Channel Spacing >40dB
Audio Frequency Distortion	≤ 3% (at 60% deviation)
Audio Frequency Response	300 to 3000Hz* +1dB -3dB Figures apply for a flat audio response or a 6dB/octave pre-emphasis curve (*2550Hz for 12.5kHz channel spacing)
Audio Sensitivity **(PMR Mode 1kHz)** **(User programmable via FPP)**	Accessory Connector: 5mV±2dB Internal Mic: 10mV±2dB

1.7.3 Receiver

Receiver	ETS	AS4295
Sensitivity	≤0.5µV PD (-113dBm) for 20dB SINAD	≤0.3µV PD (-117.5dBm) for 12dB SINAD ≤0.5µV PD (-113dBm) for 20 dB Quieting.
Adjacent Channel Selectivity	25kHz Channel Spacing: >73dB 12.5kHz Channel Spacing: >60dB	25kHz Channel Spacing: >73dB 12.5kHz Channel Spacing: >65dB
Intermodulation Rejection	>65dB	>70dB
Spurious Response Rejection	>70dB	>73dB
Blocking	>95dB	>95dB
Conducted Spurious Emissions	<2nW (-57dBm) - 9kHz to 1GHz <20nW (-47dBm) - 1GHz to 4GHz	<20nW (-47dBm) - 9kHz to 4GHz

GENERAL

FM Residual Noise (CCITT weighted)	25kHz Channel Spacing: 12.5kHz Channel Spacing:	>45dB >40dB
Mute Range	Typically 6dB to 25dB SINAD Typical setting 10dB to 12dB SINAD	
Mute Response Time	<30mS (no CTCSS) Add 200mS for CTCSS	
Voting Response Time	Searches at 50ms/channel	
Audio Distortion	500mW into 16Ω at <5% distortion	
Audio Frequency Response	300 to 3000Hz*: +1dB to -3dB Figures apply for a flat audio response or a 6dB/octave de-emphasis curve (*2550Hz for 12.5kHz channel spacing)	
Deviation Sensitivity (For rated audio at 1kHz)	20% MSD±3dB	

1.7.4 Signalling

1.7.4.1 CTCSS

All 38 standard CTCSS Tones are supported as per the table below.

Identifier	Frequency	Identifier	Frequency	Identifier	Frequency
Q	67.0	C	107.2	0	167.9
R	71.9	L	110.9	1	173.8
S	74.4	D	114.8	2	179.9
T	77.0	M	118.8	3	186.2
U	79.7	E	123.0	4	192.8
I	82.5	N	127.3	5	203.5
V	85.4	F	131.8	6	210.7
A	88.5	O	136.5	7	218.1
W	91.5	G	141.3	8	885.7
J	94.8	P	146.2	9	223.6
=	97.4	H	151.4	*	241.8
B	100	X	156.7	#	250.3
K	103.5	Y	162.2	‘ ‘	NONE

Encoder

Tone Deviation:

25kHz channel spacing	500 to 750Hz
20kHz channel spacing	400 to 600Hz
12.5kHz channel spacing	250 to 375Hz
Tone Distortion	Less than 5.0%
Frequency Error	Less than ±0.5%

Decoder

Bandwidth	Not greater than ±3.0%
Deviation Sensitivity	Less than 6.0% of system deviation (for decode with full RF quieting)
Noise Immunity	Less than 500ms dropout per minute at 10dB SINAD (CTCSS tone deviation 10% of system deviation. RF deviation 60% at 1000Hz).
False Decode Rate	Less than 5 false decodes per minute (no carrier input)
Talk-off	For no dropouts in one minute, interfering tone at 90% of system deviation (CTCSS tone at 10% of system deviation).
	Full quieting signal: 310Hz to 3000Hz
	20dB SINAD RF signal: 320Hz to 3000Hz
	12dB SINAD RF signal: 350Hz to 3000Hz
Response Time	Less than 250ms (full quieting/tone >100Hz)
	Less than 350ms (full quieting/tone <100Hz)
De-Response Time	Less than 250ms
Reverse Tone Burst	none

1.7.4.2 FFSK

1200 Baud: 1200 / 1800 Hz MPT1317 based

2400 Baud: 1200 / 2400 Hz MPT1317 based

1.7.4.3 Selcall

The following tone sets are supported as per tables below:

- ST-500: CCIR, EEA, ZVEI, DZVEI, EIA
- ST500/CML: ZVEI_3, DZVEI
- CML: CCIR, EEA, ZVEI
- SIGTEC: CCIR, CCIRH, EEA, ZVEI_1, XVEI_2, ZVEI_3, NATEL, EIA
- SEPAC: CCIR, EEA, ZVEI_1, ZVEI_2, ZVEI_3, EIA

Selcall Tone Frequency Table

Tone	CML CCIR	ST500 CCIR	SIGTEC CCIR	SIGTEC CCIRH	SEPAC CCIR	CML EEA	ST500 EEA	SIGTEC EEA
0	1981	1981	1981	1981	1981	1981	1981	1981
1	1124	1124	1124	1124	1124	1124	1124	1124
2	1197	1197	1197	1197	1197	1197	1197	1197
3	1275	1275	1275	1275	1275	1275	1275	1275
4	1358	1358	1358	1358	1358	1358	1358	1358
5	1446	1446	1446	1446	1446	1446	1446	1446
6	1540	1540	1540	1540	1540	1540	1540	1540
7	1640	1640	1640	1640	1640	1640	1640	1640
8	1747	1747	1747	1747	1747	1747	1747	1747
9	1860	1860	1860	1860	1860	1860	1860	1860
A	2400	1055	2110	2400	2400	1055	1055	2110
B	930	....	2400	930	1055	930	....	1055
C	2247	2400	1055	2247	2247	2247	2400	2400
D	991	....	2247	991	991	991	....	2247
E	2110	2110	930	2110	2110	2110	2110	930
F	....	....	991	1055	....	....	....	991

Tone	SEPAC EEA	CML ZVEI	ST500 ZVEI	SIGTEC ZVEI-1	SEPAC ZVEI-1	SIGTEC ZVEI-2	SEPAC ZVEI-2	SIGTEC ZVEI-3
0	1981	2400	2400	2400	2400	2400	2400	2200
1	1124	1060	1060	1060	1060	1060	1060	970
2	1197	1160	1160	1160	1160	1160	1160	1060
3	1275	1270	1270	1270	1270	1270	1270	1160
4	1358	1400	1400	1400	1400	1400	1400	1270
5	1446	1530	1446	1446	1446	1446	1446	1400
6	1540	1670	1670	1670	1670	1670	1670	1530
7	1640	1830	1830	1830	1830	1830	1830	1670
8	1747	2000	2000	2000	2000	2000	2000	1830
9	1860	2200	2200	2200	2200	2200	2200	2000
A	1055	2800	970	2600	2800	970	885	2400
B	970	810	....	2800	970	885	741	885
C	2247	970	2800	741	885	741	2600	741
D	2400	886	....	970	....	2600	....	2600
E	2110	2600	2600	810	2600	2800	970	2800
F	....	....	....	886	....	600	....	600

Tone	SEPAC	ST500/CML		ST500	SIGTEC	SIGTEC	SEPAC	ST500
	ZVEI-3	ZVEI-3	DZVEI	DZVEI	NATEL	EIA	EIA	EIA
0	2200	2400	2200	2200	1633	600	600	600
1	970	1060	970	970	631	741	741	741
2	1060	1160	1060	1060	697	882	882	882
3	1160	1270	1160	1160	770	1023	1023	1023
4	1270	1400	1270	1270	852	1164	1164	1164
5	1400	1530	1400	1400	941	1305	1305	1305
6	1530	1670	1530	1530	1040	1446	1446	1446
7	1670	1830	1670	1670	1209	1587	1587	1587
8	1830	2000	1830	1830	1336	1728	1728	1728
9	2000	2200	2000	2000	1477	1869	1869	1869
A	885	885	2600	825	1805	459	2151	2151
B	741	....	....	....	1995	2151	1091	....
C	2600	810	886	2600	1300	2600	2400	2010
D	....	....	810	....	1700	2010	....	....
E	2400	970	2400	2400	2175	2433	459	459
F	....	....	....	....	2937	2292	....	....

Selcall Tone Periods

The Selcall tone period:

4 pre-set lengths selectable: 20ms and 30 seconds in 1ms increments.

1.7.4.4 DTMF

DTMF Encode supported via keypad:

TONES	1209Hz	1336Hz	1477Hz
697Hz	1	2	3
770Hz	4	5	6
852Hz	7	8	9
941Hz	*	0	#

Tone Period, programmable: 0 – 2.55ms in 10ms steps.

Inter-Tone Period, programmable: 0 – 2.55s in 10ms steps.

Link Establishment Time, programmable: 0 – 10s in 10ms steps.

Tx Hang Time, programmable: 0 – 9.99s in 10ms steps.

Side-Tone in Loudspeaker: selectable via programmer.

1.7.4.5 DCS

Data rate	134 bits per second, frequency modulated 7.46ms/bit 171.6ms per codeword continuously repeating
Deviation	0.5kHz for 12.5kHz systems 1kHz for 25kHz systems
Codeword size	23 bits comprising: 8 bits - DCS code (3 octal digits 000-777) 3 bits - Fixed octal code 4 11 bits - CRC (error detection) code
Available Codes	104 codes from 512 theoretically possible codes – see below
Turn off code	200ms 134Hz tone at PTT release

DCS Codes can be Transmitted “Normal” or “Inverted” (programmable).

The radio can Receive DCS codes in either Transmitted “Normal” or “Inverted” or both (selectable via programmer).

Valid DCS Codes				
023	132	255	413	612
025	134	261	423	624
026	143	263	431	627
031	145	265	432	631
032	152	266	445	632
036	155	271	446	654
043	156	274	452	662
047	162	306	454	664
051	165	311	455	703
053	172	315	462	712
054	174	325	464	723
065	205	331	465	731
071	212	332	466	732
072	223	343	503	734
073	225	346	506	743
074	226	351	516	754
114	243	356	523	
115	244	364	526	
116	245	365	532	
122	246	371	546	
125	251	411	565	
131	252	412	606	

1.7.4.6 C4FM

Digital speech format in accordance with TIA/ EIA 102 requirements.

1.7.5 Environmental

Note: Operation of the equipment is possible beyond the limits stated but is not guaranteed.

Operational Temperature

-30°C to +60°C

Storage Temperature

-40°C to +80°C

Vibration Specification

IEC 68-2-6 with additional frequency acceleration from 60 – 150Hz

Cold

IEC 68-2-1 Test 5 hours at -30°C

Dry Heat

IEC 68-2-2 Test 5 hours at +60°C

Damp Heat Cycle

IEC 68-2-30 Test 2 cycles at +40°C

Product Sealing

Main Radio Unit:	IEC529 rating IP54
Accessories:	IEC529 rating IP54

MIL STD 810

Low Pressure	500.4 Procedure II
High Temperature Storage	501.4 Procedure I
High Temperature Operation	501.4 Procedure II
Low Temperature Storage	502.4 Procedure I
Low Temperature Operation	502.4 Procedure II
Temperature Shock	503.4 Procedure I
Humidity	507.4 Figure 507.4-1
Sand and Dust	510.4 Procedure I – Blowing Dust
Random Vibration	514.5 Figure 514.5C-1
Transit Drop	516.5 Table 516.5-V1

Functional Shock of severity 25g Acceleration, 6ms pulse duration, 500 shocks in 6 directions.

2. SERVICE PHILOSOPHY

2.1 SERVICE CONCEPT

The SRP9100 series has been designed to provide low cost trunked and non-trunked analogue, portable transceivers, using common core electronics, software and interfacing. It is a requirement that once the customer has purchased equipment, TMC Radio can follow this by providing an ongoing, high level of customer support together with a competitive and professional servicing activity.

There are three levels of service available:

Level	Activity	Recommended Spares	Recommended Test Equipment
1	Replacement of complete transceiver/antenna/fuses Reprogramming	Antennas, Fuses Ancillaries	Multimeter P.C. Radio software Programmer
2	Replacement of PCB or mechanical component replacement, Cosmetic repair	Listed in Level 2 Spares Schedule	As above + service aids and test equipment
3	Repair by PCB or mechanical component replacement, Cosmetic repair. Repair of Radio PCB to component level in CRU.	Listed in Level 2 Spares Schedule Radio PCB components only available to CRU.	As above + service aids and test equipment

2.2 WARRANTY

Initially, the normal 12-month warranty will apply to all radios and ancillaries.

2.2.1 Service Within and Out Of Warranty

The field Service Level for the SRP9100 portable is LEVEL 2, PCB replacement.

LEVEL 2 Service, PCB (only) and case part replacement, will be carried out in field repair workshops, or the Central Repair Unit (CRU) if required.

LEVEL 3 Service (Radio PCB component level repair) will ONLY be carried out in the Central Repair Unit. For this, the complete radio must be returned to the CRU.

A PCB replacement program may be offered by the CRU in some countries.

2.2.2 Ancillary Items

All ancillary items are Level 1 service.

These items should be replaced if faulty; they are non-repairable, and non-returnable to the CRU.

2.3 SOFTWARE POLICY

Software provided by TMC Radio shall remain the Company's property, or that of its licensors and the customer recognises the confidential nature of the rights owned by the Company.

The customer is granted a personal, non-exclusive, non-transferable limited right of use of such software in machine-readable form in direct connection with the equipment for which it was supplied only.

In certain circumstances the customer may be required to enter into a separate licence agreement and pay a licence fee, which will be negotiated at the time of the contract.

The customer undertakes not to disclose any part of the software to third parties without the Company's written consent, nor to copy or modify any software. The Company may, at its discretion, carry out minor modifications to software. Major modifications may be undertaken under a separate agreement, and will be charged separately.

All software is covered by a warranty of 3 months from delivery, and within this warranty period the Company will correct errors or defects, or at its option, arrange free-of-charge replacement against return of defective material.

Other than in the clause above, the Company makes no representations or warranties, expressed or implied such, by way of example, but not of limitation regarding merchantable quality or fitness for any particular purpose, or that the software is error free, the Company does not accept liability with respect to any claims for loss of profits or of contracts, or of any other loss of any kind whatsoever on account of use of software and copies thereof.

3. DISASSEMBLY

Remove the Battery

(1) Depress the spring-loaded battery latch to release the battery.

(2) Slide the battery down the radio to disengage the retaining lugs.

(3) Lift the battery away from the radio.

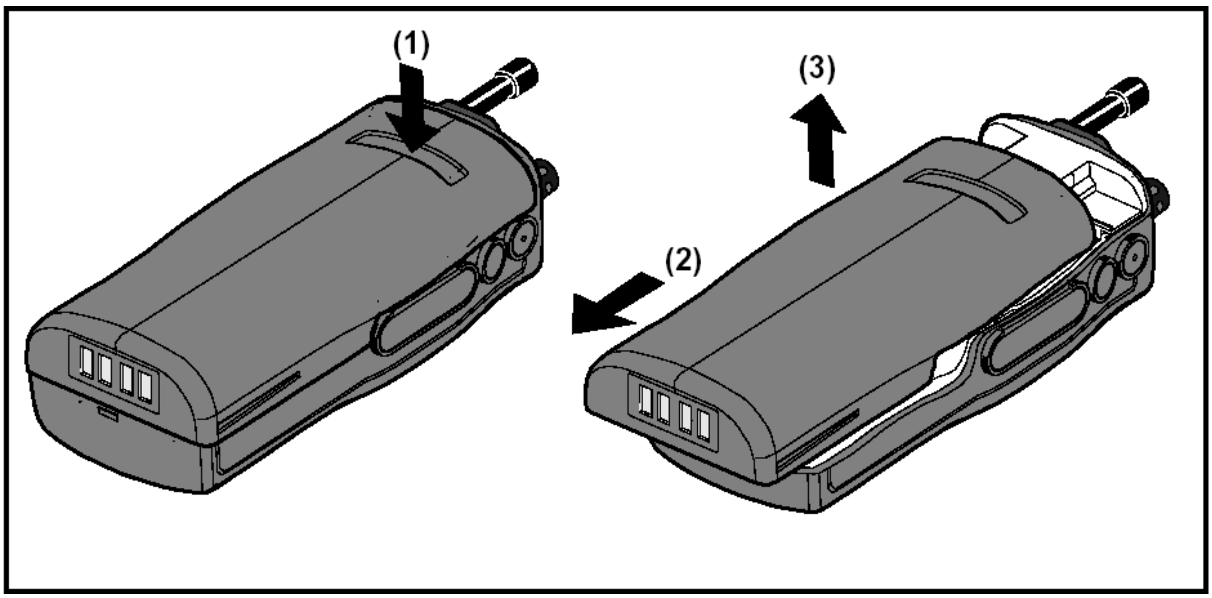


Figure 1 Battery Removal

Remove the Antenna and On/Off/Volume Control Knob

(1) Unscrew and remove the antenna.

(2) Remove the lanyard ring (if fitted).

(3) The On/Off/Volume control knob is a friction fit. Pull the knob from its spindle.

(4) Remove the smart interface cover from the smart interface jacks and the antenna boss.

Remove the Metal Frame Assembly

(1) Use a small, flat bladed screwdriver to release the cast metal frame assembly from the bottom of the front casing. This action releases the radio PCB from the MMI PCB.

(2) Gently ease the frame assembly out of the front casing taking care not to damage the two flexi-circuits. (lift the bottom of the frame so that it just clears the plastic casing, then gently slide the frame away from the top of the casing until it is released from the casing). Caution: The loudspeaker / microphone flexi-circuit connects the radio PCB (attached to the metal frame) and the loudspeaker / microphone assembly (attached to the front casing). The flexi-circuit must be released from the connector on the radio PCB before the frame can be lifted clear of the front casing. Also ensure that the volume control/top connector assembly stay retained within the chassis and does not fall out.

(3) Slide out the locking drawer of connector, S6, (on the radio PCB) to release the flexi-circuit. Use a very small bladed screwdriver.

(4) Remove the flexi-circuit from connector, S6.

(5) Lift the frame away from the front casing. At this stage the radio PCB and metal screen are still attached to the frame.

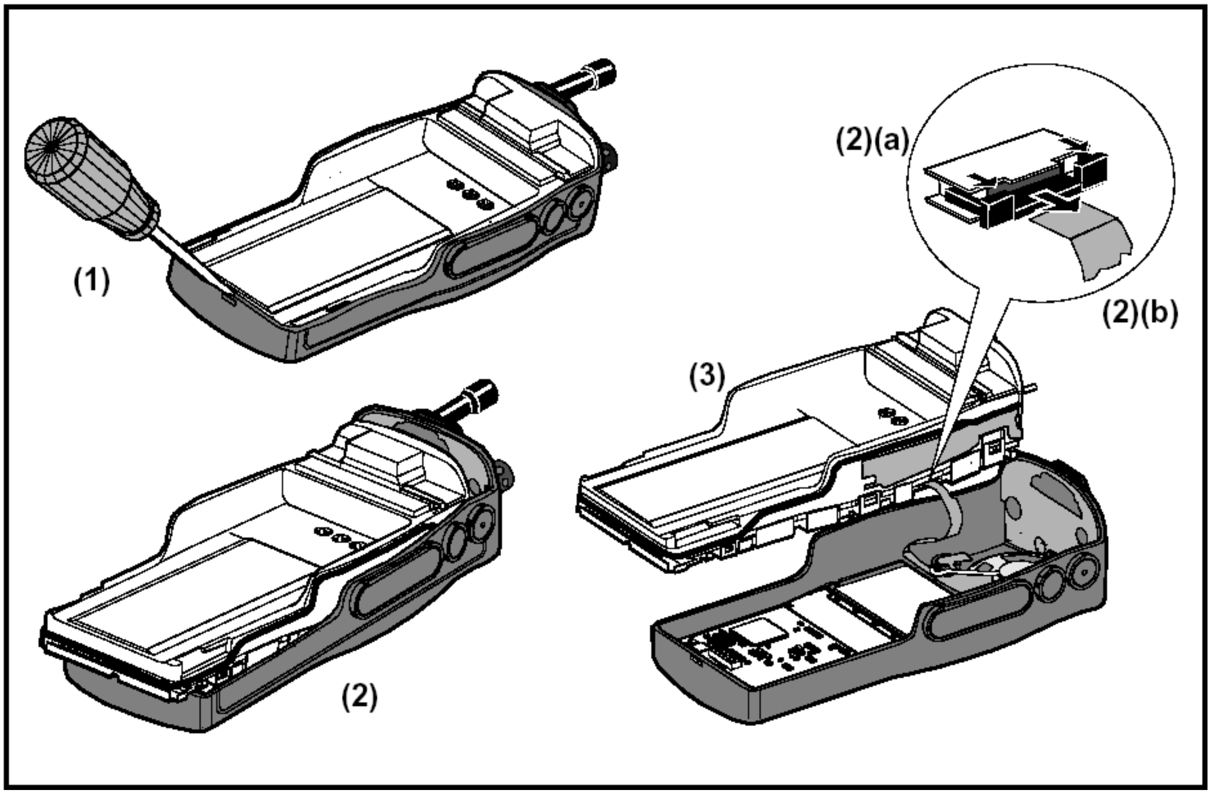


Figure 2 Removal of Chassis

Remove the Metal Screen from the Radio PCB and Frame Assembly

(1) Use a small, flat bladed screwdriver to release the seven spring tabs on the metal screen. Note: Releasing three spring tabs on one side and the one at the top of the metal screen should be sufficient to remove the metal screen.

(2) Lift the metal screen away from the radio PCB and frame assembly.

Remove the Speaker and Microphone

(1) Remove the speaker retaining clip.

(2) Lift the speaker / microphone assembly away from the front casing taking care not to damage the flexi-circuit.

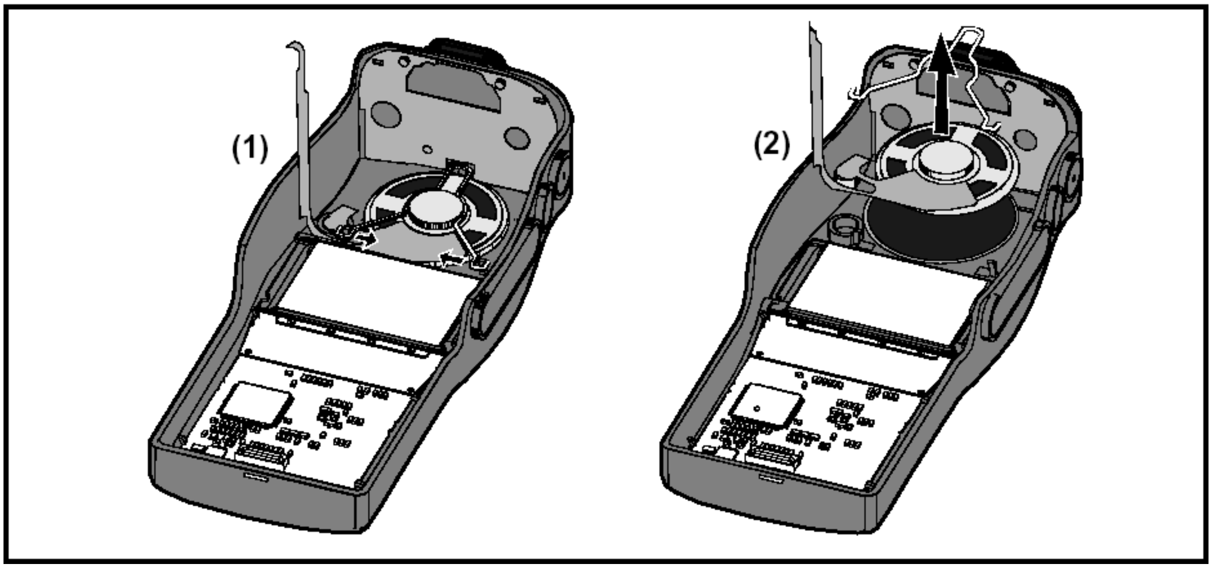


Figure 3 Removal of Speaker and Microphone

Remove the MMI PCB

The MMI PCB is held in place by four plastic lugs on the front casing.

(1) Using a small flat bladed screwdriver, exert slight sideways and upwards pressure on the edge of the PCB (close to one of the top retaining lugs) whilst exerting slight outward deflection of the casing side walls (A). This will release the PCB from the retaining lugs.

(2) Lift the MMI PCB and LCD display assembly away from the front casing.

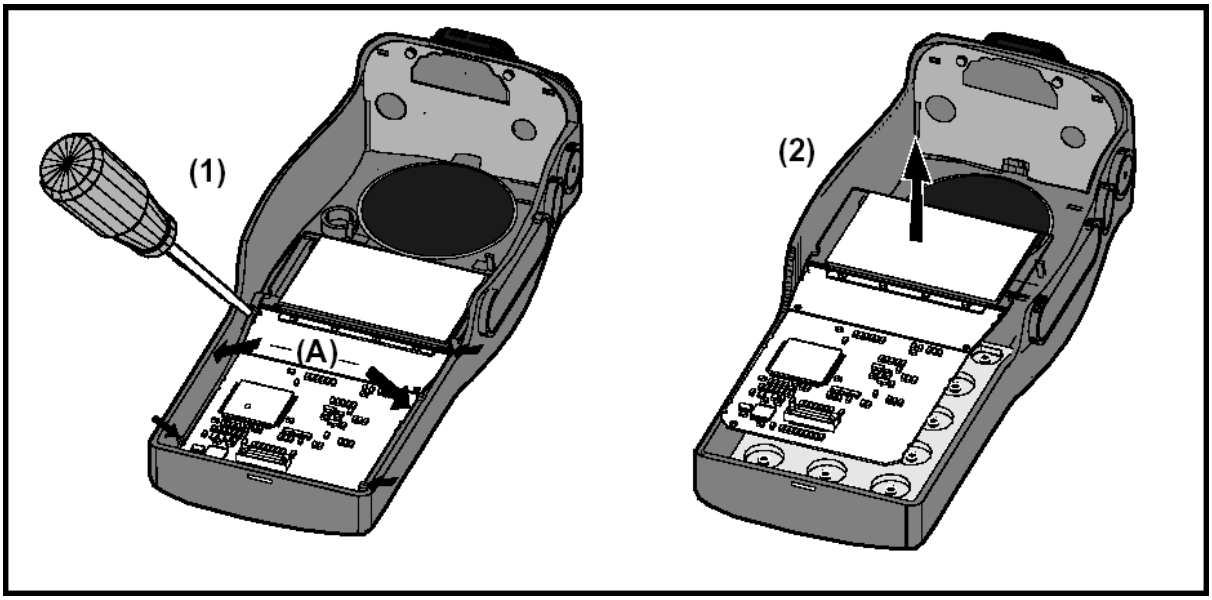


Figure 4 Removal of MMI Assembly

Remove the Switch Mat

The switch mat is held in place by the MMI PCB. Lift the switch mat clear of the casing.

RE-ASSEMBLY

Re-assembly is the reverse of disassembly. However:

(1) Examine the various seals before re-assembly and replace with new items if necessary.

(2) Slight outward deflection of the case walls will ease re-assembly of the MMI PCB behind the retaining lugs.

(3) Care must be taken when reconnecting the flexi-circuits to ensure that they are correctly aligned before pressing home the locking drawers on the connectors.

(4) Ensure that the metal screen is fitted to the PCB / frame assembly before the assembly is fitted to the casing.

(5) To prevent damage to the frame seal, use a thin, flat piece of plastic (or other material) in a ‘shoehorn’ action between the bottom inside of the front case and the frame / PCB assembly as the assembly is pushed home. Carefully remove the piece of plastic (or other material) after the frame / PCB assembly has been fitted to the front case.

4. TECHNICAL DESCRIPTION

4.1 RECEIVER

Refer to Figure 4-1. Description based on UW band

4.1.1 Front-End Filters and RF Amplifier

The receiver input signal from the antenna passes through the harmonic filter and antenna switch. With the portable in receive mode, diodes D580, D540a and D541a in the antenna switch are reverse biased allowing the receiver input signal to be coupled through to the receiver front-end with minimal loss. The overall insertion loss of the harmonic filter and switch is approximately 0.8dB.

A noise blanker is also fitted to E0 band radios. The noise blanker samples the received signal and gates the 45MHz signal in the IF stage in the event that high level noise transients are received. Due to inherent time delays in the bandpass filters prior to the blanking gate, gating synchronisation occurs before the transients can adversely affect the following stages.

Varactor-tuned bandpass filters at the input and output of the RF amplifier provide receiver front-end selectivity. Varactor tuning voltages are derived from the alignment data stored in the radio. The DSP processes this data to optimise front end tuning relative to the programmed channel frequencies, which may be changed at any time without re-aligning the radio.

To achieve the required varactor tuning range an arrangement of positive and negative bias power supplies is used to provide a total bias across the varactors of up to 14.0VDC. A fixed 2.5V positive bias derived from the 5V0 supply using voltage divider R429/R430 is applied to the cathodes of the varactor diodes. The negative bias supply originates at the DSP/PLA as a PWM signal (FE TUNE) for the four front-end tuning voltages TUNE1 to 4, for the particular channel frequency selected. The PWM signal is dependent on channel frequency and tuning and passes through level shifting transistors Q404 to Q411 where it is converted to a negative voltage in the range -0.5V to -11.5V. The -12.0V rail of the level translators is generated by U904D/E with D903 to D906 providing the required voltage multiplication.

The RF amplifier stage comprises a low noise transistor amplifier Q400 that is compensated to maintain good linearity and low noise matching. This provides excellent intermodulation and blocking performance across the full operating range. The overall gain of the front-end is typically 14dB for all bands.

4.1.2 First Mixer and IF Section

The output of the last front-end bandpass filter is coupled into single balanced mixer T400/D415 which converts the RF signal to an IF frequency of 45MHz. The local oscillator injection level is typically +8dBm at T400 pin 1 with low side injection used for UHF bands and high side for VHF bands.

Following the mixer is IF amplifier Q401 that provides approximately 15dB of gain and in association with its output circuitry, presents the required load conditions to the 4 pole 45MHz crystal filters Z401A/Z401B.

The crystal filters provide part the required selectivity for adjacent channel operation with the remaining selectivity provided by a DSP bandpass filter algorithm.

4.1.3 Quadrature Demodulator

Additional IF gain of approximately 45dB occurs at U400 which is a dedicated IF AGC amplifier/Quadrature Demodulator configured for single ended input and output operation. The AGC voltage for U400 is derived from the RSSI function of the DSP. The onset of AGC operation occurs when RF input signal level at the antenna connector exceeds -90dBm and can reduce the gain by approximately 100dB for strong signals.

Conversion of the 45MHz IF signal to I and Q baseband signals is carried out by the demodulator section of U400. The 90MHz local oscillator signal is generated by VCO Q402 which is phase locked by the auxiliary PLL output of U701 via feedback signal AUX_LO2.

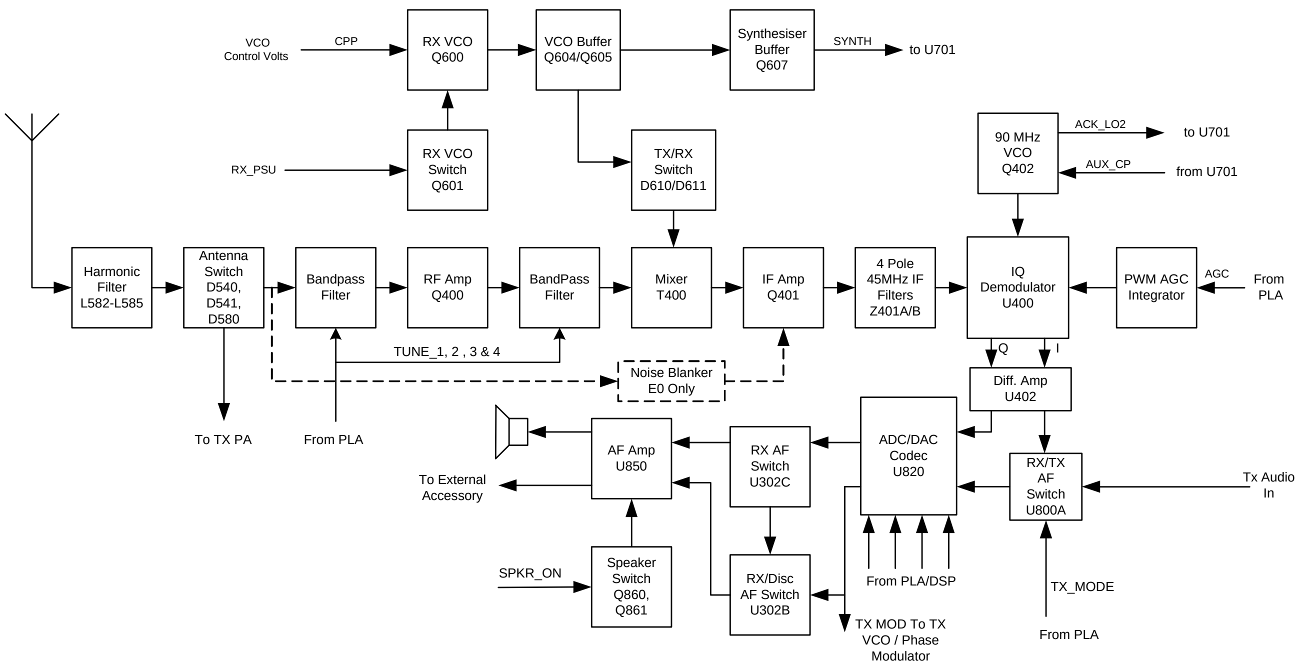


Figure 4-1 VHF/UHF Receiver Block Diagram

4.1.4 Receiver Audio Processing

The base band audio from the IQ Demodulator is applied to a differential amplifier that cancels out DC offsets and converts the balanced demodulator I/Q output signals to unbalanced inputs for the CODEC U820.

All receiver audio processing and filtering functions are performed by the CODEC under the control of the DSP. The receiver I and Q analogue baseband signals are converted to digital signals by the CODEC ADC before being applied to a series of digital filters which provide the final stage of adjacent channel filtering, high pass and low pass filtering, mute noise processing and volume control for narrow and wideband operation. The fully processed signal is then converted to an analogue audio signal by the CODEC DAC and then applied to conventional dual speaker amplifier U850-1.

Dual audio amplifier U850 provides an audio output level of up to 500mW watts into the 16 ohm speaker. The carrier and signalling mute functions are performed by Q860/861 under DSP control. De-emphasis to the audio is performed within the DSP.

In addition, Discriminator Audio is derived from the other CODEC output channel and then amplified by U802A after which it is applied to one of the radio I/O connectors for option purposes. Discriminator Audio is a preset level set by the FPP and is independent of squelch operation. Switch U302B can select either flat or de-emphasised audio from the CODEC DAC U820-24. The selected audio is applied to the other half of the audio amplifier U850-2 that drives the options connector audio after which it is routed to the portable's options connector.

4.2 TRANSMITTER

Refer to Figure 4-2.

4.2.1 Drivers and PA Stages

The RF output level from the VCO T/R switch D611a is typically +8dBm. Tx buffers Q550/Q560 increase this level by approximately 6dB (136-530MHz), 9dB (66-88MHz) and also provide a high degree of VCO isolation from the Tx output.

The PA module U500 requires a drive power of approximately 17dBm (335-520MHz), 13dBm (136~245MHz) and 15dBm (66-88MHz). The module contains power control circuitry and MOSFET stages to provide a maximum output power of +37dBm (5 watts).

Note. Care should be taken during servicing since if for any reason the drive power is lost, while the power control voltage is high, the current into the PA may exceed its specification. Therefore, the power supply current should be monitored at all times and preset to as low as required. The radio has additional inbuilt safeguards, but these should not be relied on.

Power output settings are derived from alignment data stored in flash memory during the initial factory alignment. The DSP processes this data to optimise the power output level relative to the programmed channel frequencies that may be changed at any time without retuning the radio.

PA current is monitored via comparator U520B, the output of which is passed via a temperature compensation network R534 to R537, and analogue gate U800B to ADC U301C. U301C samples the applied voltage after which it is passed to the PLA and then processed by the DSP.

4.2.2 Power Control

Output power is stabilised by a power control feedback loop. A printed circuit transmission line, L590, R580, D510 and associated components comprise the power detector. Comparator U520A and associated components provide the power setting and control functions. Forward power is sampled by the power detector and applied as a DC voltage to the inverting input of the comparator. The TX_PWR set voltage is a DC voltage proportional to the programmed Tx power setting and is applied to the non-inverting input of the comparator.

The TX_PWR voltage originates from the PLA as a PWM signal and is integrated for application to the comparator.

PA module output level changes due to supply voltage, load or temperature variations are detected and applied to the comparator that proportionally adjusts the PA pre-driver supply, and therefore the PA drive level. High temperature protection is provided by thermistor R532 that progressively reduces the power level if the PA module temperature becomes excessive.

4.2.3 Antenna Changeover and Harmonic Filter

The antenna changeover circuit consisting of pin diodes D580/D540a/D541a, is switched by Q541/Q542 and associated circuitry allowing the transmitter output to be coupled to the antenna while providing isolation for the receiver input. With the transmitter switched on, the diodes are forward biased allowing power to be coupled through to the antenna and isolating the receiver by grounding its input at C588. The short circuit at the receiver input is transformed to an effective open circuit at D580 by L583, which minimises transmitter loading. With the transmitter switched off the diodes are reverse biased allowing the receiver input signal to reach the receiver front end with minimal loss. The harmonic rejection low pass filter comprises L582/L584/L585 and associated capacitors.

4.2.4 Transmitter Audio Processing

The internal microphone unit comprising an Electret microphone provides 10mV RMS (nominal) at the microphone input (INT_MIC) to provide approximately 60% of maximum system deviation. U800C is a control gate to switch between the microphone audio signal and EXT_MOD to provide external audio options and data input.

U800A provides CODEC input switching which selects either the receiver I signal or transmitter audio/data signals depending on the Tx/Rx mode. All pre-emphasis, filtering, compression and limiting processes for narrow and wideband operation are carried out in the DSP after A-D conversion by the CODEC (U820). The processed transmitter audio/data from the CODEC output at VOUTL is applied to the VCO as a modulation signal with a level of approximately 200mV P/P.

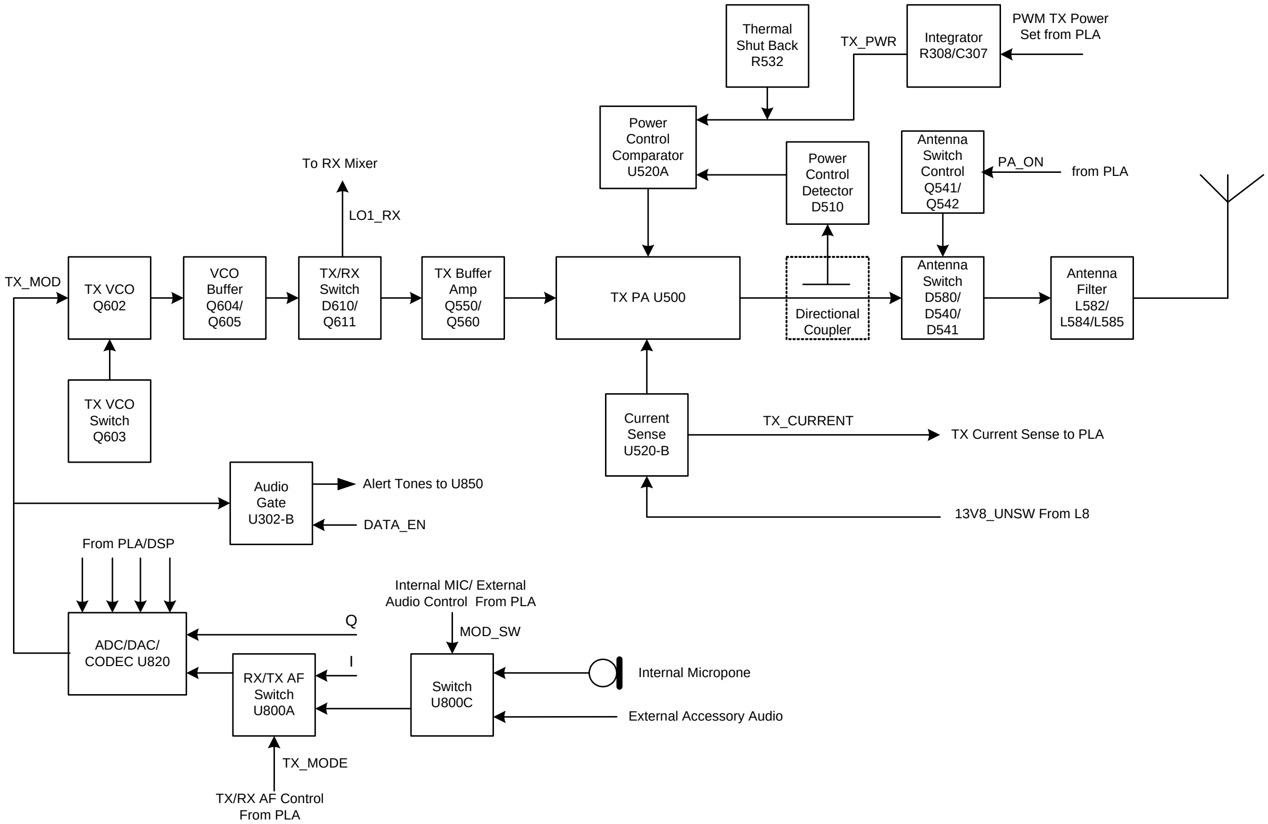


Figure 4-2 VHF/UHF Transmitter Block Diagram

4.3 FREQUENCY SYNTHESISER

4.3.1 General

Refer to Figure 4-3.

The frequency synthesiser consists of one transmitter and two receiver voltage controlled oscillators, loop filters, varactor negative bias generator, reference oscillator and an integrated dual phase locked loop device U701.

4.3.2 PLL

The PLL device contains two prescalers, programmable dividers and phase comparators to provide a main and auxiliary PLL. The main PLL of U701 controls the frequency of the Tx/Rx VCO's via Control Voltage outputs at pins 2 and 3 and VCO feedback to pin 6. The auxiliary PLL is used to control the receiver 90MHz second local oscillator via the Control Voltage output at pin 17 and VCO feedback to pin 15. The PLL operation involves the division of the 14.4MHz reference oscillator frequency to 225kHz (VHF) or 450kHz (UHF) by divider. It is then divided by the internal divider of U701 down to a low frequency that corresponds to a sub-multiple of the radio channel spacing, ie. 6.25kHz for 12.5/25kHz channel spacing, 5kHz for 10/20kHz channel spacing or 7.5kHz if required. The VCO frequency is sampled and divided down to the same frequency after which it is phase compared to the reference. Any error produces an offset to the Control Voltage output that is used to correct the VCO frequency. A valid lock detect output is derived from pin 20 and is sampled by the PLA. During transmit, if an unlocked signal is detected the radio will switch back to receive mode. An unlocked signal in receive mode will cause the radio to beep.

4.3.3 VCO's

The transmitter and receiver VCO's use low noise JFET transistors Q600 (Rx), Q602 (Tx) and associated parts to generate the signals for the required band coverage. Electronic tuning is provided by varactor diodes D600 to D608 with their control voltages derived from the Loop Filter, PLL and Negative Bias Generator. VCO selection and timing is controlled by the DSP/PLA via the Rx and Tx power supplies and applied through switches Q601 (Rx) and Q603 (Tx). VCO buffer Q604/Q605 isolates the VCO from load variations in following circuits and active power supply filter Q615 minimises supply related noise. A PLL feedback signal is sampled from the VCO buffer output via buffer Q607.

The 90MHz receiver VCO comprises Q402 and associated parts. Automatic tuning is achieved by applying a Control Voltage to D408/D409 via Loop Filter R433, R445, R464, C467, C493 and C702.

4.3.4 Negative Bias Generator and Loop Filter

A positive and negative varactor bias supply similar to the front-end varactor arrangement has been used to achieve the required broadband tuning range of the VCO's. PLL device U701 is programmed to deliver a nominal +2.5V output from phase detector/charge pump CPPF or CPP regardless of the channel frequency selected. This voltage is filtered to remove synthesiser noise and reference products by the Loop Filter, comprising C671 to C686 and R683/R684/R685. The resulting low noise voltage is applied to the cathode side of the VCO varactor tuning diodes as a positive bias voltage. The negative bias supply originates as a positive DC voltage (0.1V to 3.0V) at the DAC output of U701 (DOUT) with a level relative to the programmed state of the radio (eg. channel frequency and Tx/Rx state). The voltage is translated to a negative voltage between 0V and –16V by the circuit comprising Q700 to Q703. The -16V rail of this supply is generated by U904E/F with D903 to D906 providing the voltage multiplying effect needed to achieve -16V. The output of the negative supply is applied directly to the VCO varactor anodes as the negative tuning voltage VCAP BIAS.

4.3.5 Phase Modulator

The modulation path for audio, data and higher frequency CTCSS signals is via varactor D609 and its associated components in the Tx VCO. The reference input to the PLL (REF) provides the low frequency modulation path via the Phase Modulator.

The phase modulator comprises the following sections:

- Integrator U760B is a low pass filter providing 6dB per octave attenuation to frequencies above approximately 10Hz.
- Divider U710 divides the 14.4MHz reference frequency down to 225kHz (VHF) or 450kHz (UHF).
  - Ramp generator Q711/Q712 provides a saw tooth output, the slope of which is adjustable via the MOD_BAL line. This adjustment is set via a DAC output controlled from the Alignment

Tool. Adjustment of the ramp slope effectively changes the Phase Modulator gain by modification of the Schmitt Trigger switching points after modulation from the Integrator is combined to the saw tooth ramp.
The divided reference signal is differentiated and discharges C744 via Q711 after which Q711 is turned off allowing C744 to recharge via constant current source Q712/Q713.

- Schmitt Trigger comprising Q714 to Q716 converts the modulation combined with the saw tooth ramp to a square wave output, the duty cycle of which is controlled by the ramp slope and modulation.

Modulation balance adjustment is carried out using a CODEC generated 100Hz square wave applied to the TX_MOD input and set to give an optimum demodulated square wave output.

4.3.6 Reference Oscillator

TCXO U700 determines the overall frequency stability and frequency setting of the radio. The frequency setting is achieved by adjusting its ADJ voltage with the Alignment Tool. In addition, the ADJ input is used in a frequency control loop with the receiver I and Q signals to provide receiver AFC. U700 operates at 14.4MHz and is specified at ±2.0ppm frequency stability over the temperature range -30° to +75°C.

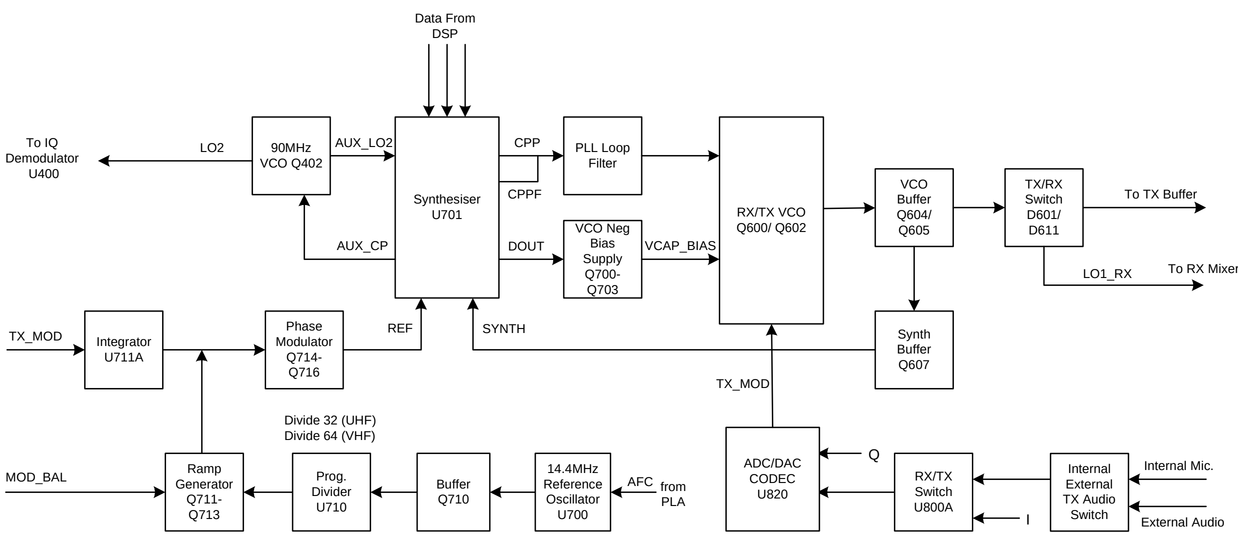


Figure 4-3 VHF/UHF Synthesiser, Block Diagram

4.4 CONTROL

Refer to Figure 4-4.

4.4.1 DSP and PLA

The SRP9100 transceiver operates under the control of a DSP (U201) and PLA (U300) combination that together with a number of other dedicated devices perform all the operational and processing functions required by the radio. The PLA is configured by the DSP under software control to provide the following functions:

- Channel set-up of all operating frequencies
- Modulation processing and filtering
- De-modulation processing and filtering
- Tx power output reference
- Modulation Balance adjustment
- Receiver front-end tuning
- Serial communications with alignment tool, microphone and control head
- Modem functionality for data modulation
- All signalling / CTCSS generation and decoding
- DSP Crystal Oscillator control
- Receiver muting control
- RSSI / AGC control
- AFC
- Tx / Rx switching and PTT control
- PLL lock detect
- Audio switching
- Power On/Off control
- Interface functionality with Option Boards and External Devices
- Battery voltage and Tx current monitor

4.4.2 DSP Clock Oscillator

The DSP is clocked by a 15.360MHz oscillator that consists of crystal X200 and an internal DSP oscillator. Q200 forms a crystal switching circuit with C205 which, when activated by a command from the PLA, steers the oscillator away from potential interfering frequencies.

4.4.3 PLA PWM

The PLA must supply several analogue signals to control radio tuning. It does this with several Pulse Width Modulated (PWM) outputs.

The front-end tune signals (TUNE1-TUNE4) originate from the PLA in the form of PWM signals. The values for these signals are stored in flash memory from radio alignment and selected depending on the channel that the radio is currently tuned to. These signals are integrated by RC networks to provide the analogue tuning voltages that are ultimately applied to the tuning varicap diodes.

Other analogue PWM derived signals used are transmitter power (TX_PWR), receiver AGC voltage (AGC), LED's (RED/GREEN) and modulation balance (MOD_BAL).

Analogue inputs are monitored by comparators and a ramp generator that is derived from a PWM signal at the PLA. Four comparators comprising U301A-D have their non-inverting inputs connected to a ramp voltage generator.

Analogue voltages to be monitored such as PLL Loop Voltage (LOOP_VOLTS), key detect (KEY_DET), battery voltage (BAT_SENSE), transmitter current (TC_CURRENT), volume level (VOLUME) and external sense (EXT_SENSE) are connected to the inverting inputs. The analogue voltages are compared with the ramp voltage as they increase and the comparator switches at the point where the input voltage exceeds the ramp. The PLA compares the time that this occurs with the PWM signal and converts it to a binary value.

4.5 MEMORY

Memory consists of the internal DSP memory and an external 8MB non-volatile Flash Memory U202. When power is off, all program SW and data are retained in Flash Memory. At power-on, a boot program downloads the DSP and PLA SW from Flash Memory to their internal RAM's for faster program execution and access to data. PLA SW is loaded by the factory into the Flash Memory and can be updated via the Alignment Tool. DSP SW comprises Start-up code that is also loaded by the factory. High-level SW comprising Operational Code and Customer Configuration are loaded at distribution centres and are loaded via the FPP Programmer.

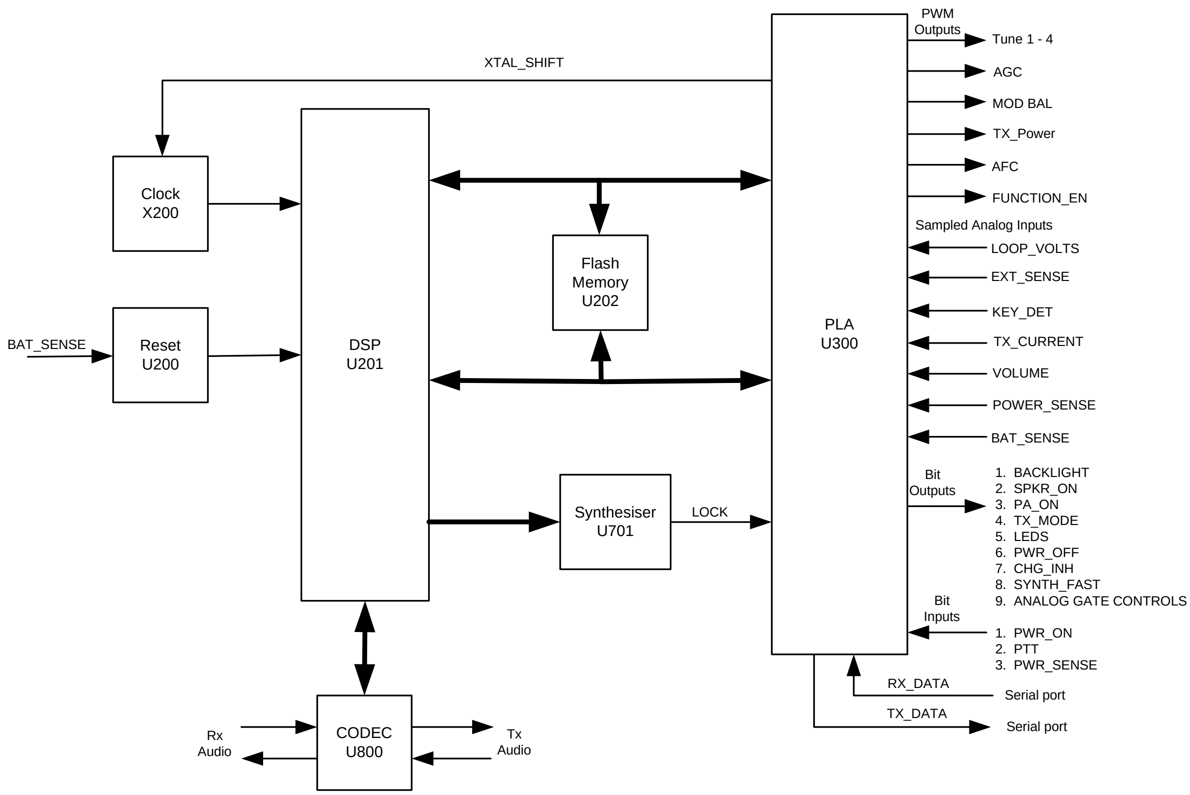


Figure 4-4 Controller Block Diagram

4.6 POWER SUPPLIES

4.6.1 Power On Function

The unregulated battery input (6.4V ~ 9.6V DC) is routed directly to all high current devices after the battery fuse and is then switched via FET Q900 to provide BAT_SW supply for all other circuits. The output from Q900 feeds three low dropout series regulators, switched battery voltage and a switch-mode 3.3V DC supply. These regulated supplies power auxiliary supplies as well as the negative voltage generator. The radio ON/OFF function is achieved through Q908 and Q909. The On-Off switch is connected between unswitched fused battery and PWR_ON. When the switch is turned on, a DC pulse is applied to Q908 that turns on the main FET switch Q900 for approximately 1 sec. In this time, the radio DSP samples the PWR_SENSE line and determines the state of the on-off switch. If the on-off switch is on, the DSP raises the PWR_OFF line and latches the main FET on, which then maintains power to the radio circuitry.

The Power-off operation requires the On-Off switch to be turned off for more than 2 seconds. If the On-Off switch is sensed going low by the DSP via the PWR_SENSE line, the DSP will save radio settings and then lower the PWR_OFF line, thereby turning Q900 off.

4.6.2 Power Supplies

The following is a list of the SRP9100 power supplies and some of the devices and circuits they supply.

4.6.2.1 5V Regulator U900

This regulator can be powered down by a STBY signal from the PLA. Supplies RX_PSU and TX_PSU are switched via Q903 and Q904. Circuits supplied by U900 are as follows.

- Synthesiser reference oscillator, divider and phase modulator
- VCO Varicap driver
- Switched RX PSU to VCO output switch
- Switched TX PSU to TX VCO enable/Rx VCO disable
- Switched TX PSU to Transmit Buffer Amplifiers
- Switched RX PSU to Receive front end and mixer
- 90MHz local oscillator Q402

4.6.2.2 5V Regulator U901

- Transmit and receive VCO's
- PLL U701
- Analogue gates U302, U800
- Op amp U760
- 3.3V sub regulator Q910

4.6.2.3 3.3V Regulator U902/Q918

- PLL Synthesiser IC U701
- DSP U201
- Flash memory U202
- PLA U300
- ADC CODEC U1, U820

4.6.2.4 2.5V Regulator U903

- DSP U201
- PLA U300

4.6.2.5 Negative Power Supply U904E/F

- -16V output (-16V) for VCO Varicap tuning drivers
- -12V Output (-12V) for Front end Varicap tuning drivers

4.6.2.6 Switched Battery

- Transmit Power Amplifier
- Speaker Amplifier

4.7 KEYBOARD AND DISPLAY (MMI)

Keypad Press Detection

Electronically, the keypad keys are arranged in a matrix of 3 rows and 7 columns.

The rows are driven directly by two processor port signals KEY_ROW1 and KEY_ROW2 that are normally in the low state. Transistors TR910-916 generate a unique voltage on KEY_DET3 for each column. Any key in the same column generates the same voltage.

For example, if key "1" (S903) is pressed TR913 turns on and sets up a voltage on KEY_DET3 according to the value of R932, R971 on the MMI board and R15 on the main radio board. This generates a processor interrupt on PTT3. The processor then goes through a process of deactivating the keypad rows selectively until it deduces which row the key press is in. The KEY_DET3 voltage that initiated the interrupt identifies which column the key press is in.

Processor Interface to LCD Display

The LCD display is driven by LCD driver chip IC901. The driver chip interfaces to the processor via an 8-bit data bus with the write cycle being controlled by LCD_CS and the LCD register select line controlled by processor address line A20. The processor is only able to write to the LCD driver.

Signal Name	Use	Signal Type
DATA (0:7)	Eight lines, processor data	0V or 5V
A(20)	Low duty cycle, display address selection	0V or 5V
BLITE	Backlight enable	0V OFF, 5V ON
nLCD_CS	Display enable	0V or 5V, active low
nKEY_ROW 1-2	Local keypad enables	0V or 5V, active low
KEY_DET3	Voltage proportional to key press	0V to 5V
AF_PSU	Supply	5V nominal
0VA	Ground	0V
nWR	Write line(for future use)	0V write, 5V read

Four function keys are located below the display:

Legend	**Function**
M	Activate menu
–	Scroll down through channels (or menu, if active)
+	Scroll up through channels (or menu, if active)
OK	Confirm choice or action (ie. Enter).

The SRP9130 has 12 additional keys (supported by the daughter board) arranged as a DTMF keypad.

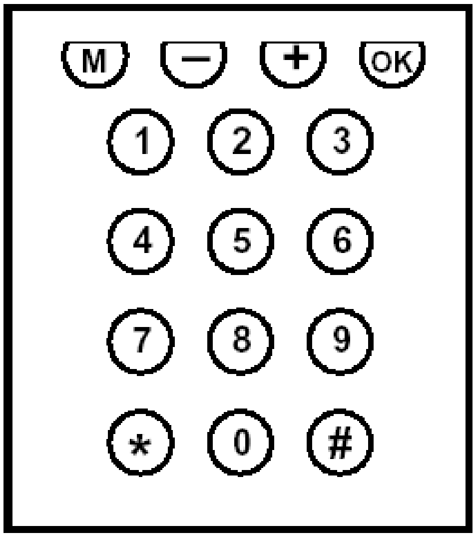


Figure 5 Keypad Layout

Backlighting

The LCD and keypad backlighting LED's, D904 to D918, are turned on by the processor port signal, BLITE, via driver TR909.

5. ALIGNMENT (LEVEL 3 SERVICE ONLY)

This procedure is applicable to all versions of **SRP9100** portable transceivers.

Caution

Preparing the radio for alignment will erase from the radio all customer PMR and Trunking configuration data (channel, signalling information etc). The only data retained by the Alignment Tool is the factory alignment data for the radio (DAC settings for Tx power, front-end tuning etc).

Using the Alignment Tool will allow changes to the original factory alignment and will invalidate all warranties and guarantees unless performed by an authorised level 3 service centre.

If the radio contains customer configuration data that must be retained, you ***must first*** use the SRM/SRP Personality Programmer (FPP) software to read all radio configuration files and save them on to alternative media ***before*** commencing the alignment procedure.

When the Alignment is completed, use the FPP software to retrieve this stored data and write it back to the radio.

It is preferred that the radio remain installed in its cast and ABS case so that appropriate shielding and battery supply are maintained.

Note. Final Tx power adjustments must be performed with the radio board installed in the chassis.

5.1 TEST EQUIPMENT

1.	Radio transceiver test set	CMT, 52/82 or similar. Note. For alternative equipment, the Mod Balance test requires internal DC coupling between the demodulated signal and demodulation output connector.
2.	Variable DC power supply	6.4V to 9.6V at 2.5 amps
3.	Oscilloscope	20 MHz bandwidth minimum
4.	SRP9100 Programming & Alignment Lead	P/N PA-PRLD
5.	SRP9100 Radio Test Interface Unit OR See simple interface circuit in Fig 5.1	P/N PA-RTIU
6.	Personal Computer	486 DX 66 or better. Operating system Windows 95 or later. Minimum RAM - 16MB. 5MB free hard disk space. Floppy drive - 1.44MB. Mouse and serial port required
7.	SRM/SRP Alignment Tool	Computer Software file
8.	SRM/SRP Field Personality Programmer (FPP)	Computer Software file
9.	SRP9100 Simulated Battery	
10.	Antenna Adaptor for Portable	PA-ACON

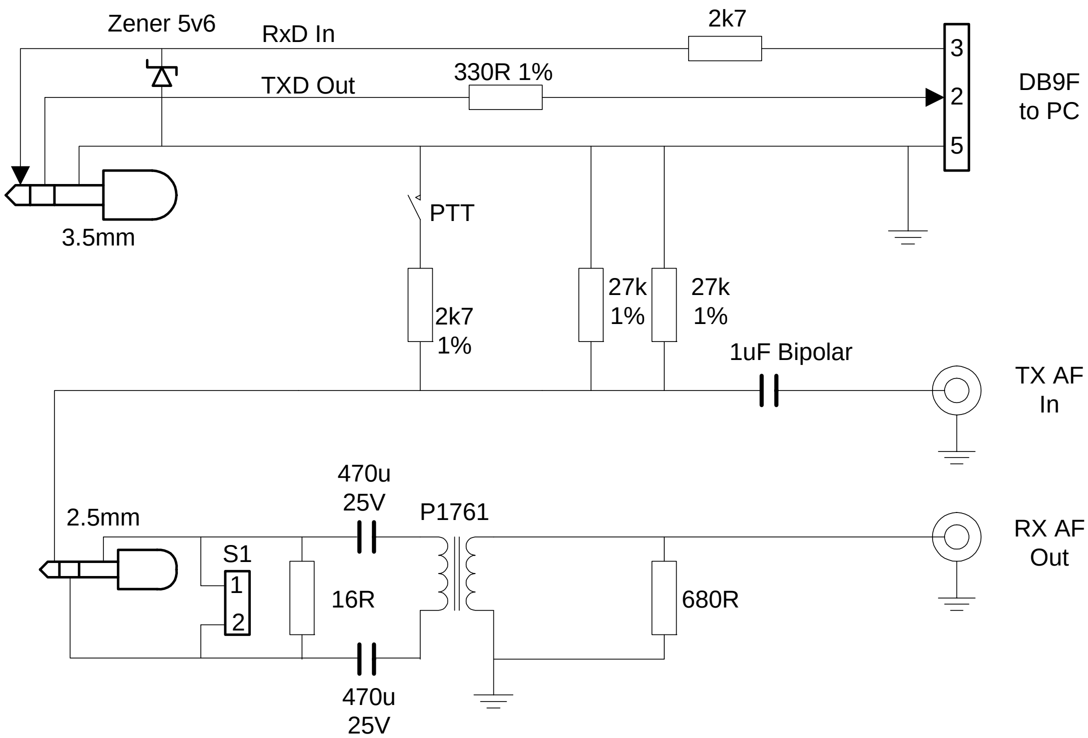


Figure 5-1 SRP9100 Radio Test Interface Unit

Notes for test jig:

1. The PTT switch activates transmit on the portable.
2. Interface data levels are TTL with RS232 polarity, although should work with most personal computers.
3. 16R resistor simulates speaker load.

5.2 TEST SET-UP

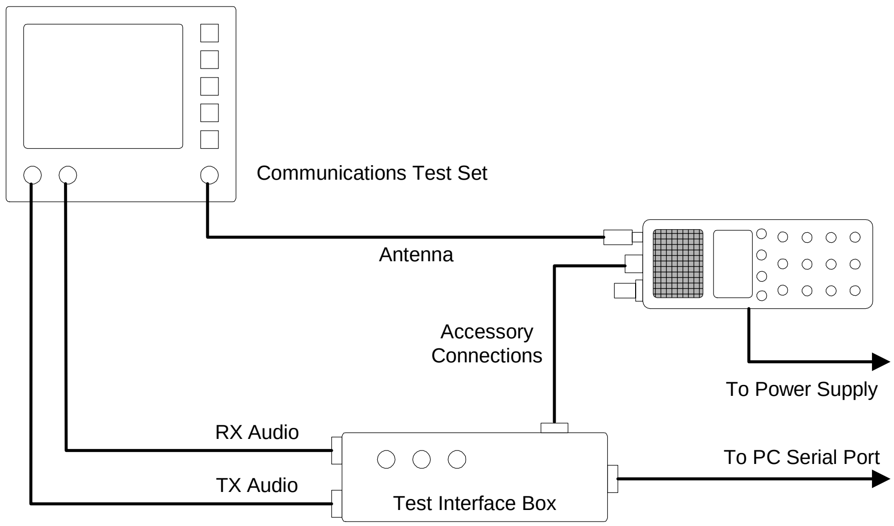


Figure 5-2 Test Set-up

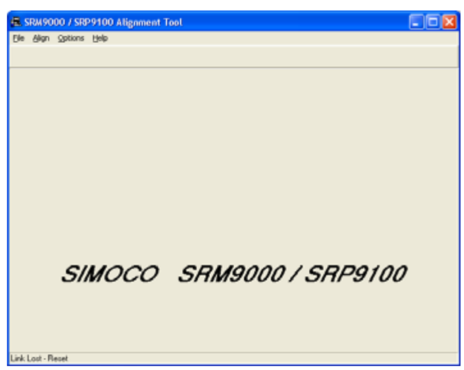
Notes:

1. Connect the radio to the test equipment as shown in Figure above.
2. Use an adaptor (P/N PA-ACON) to provide a coaxial socket termination for the antenna.
3. A battery simulator is used to supply power to the portable. This is an empty battery pack with external DC connections.

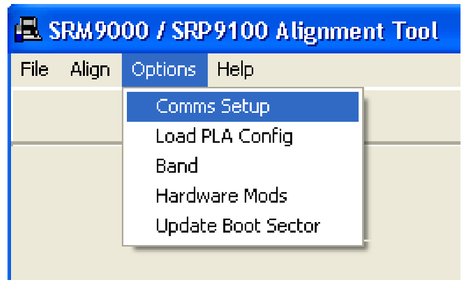
5.2.1 COMMS Set up

1. Copy the SRP9100 Alignment Tool Computer Software file to the PC hard drive and run the program

   The Alignment Tool Opening Menu is displayed.



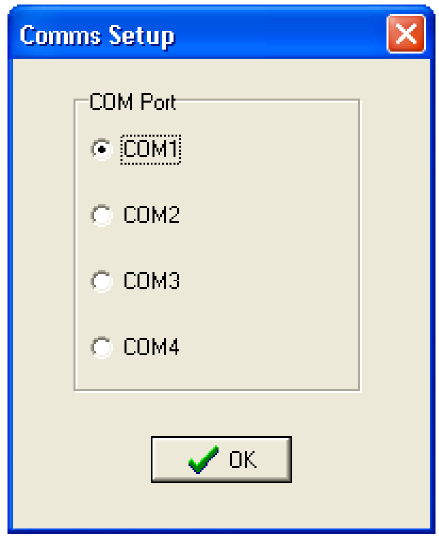
2. Go to the ***Options*** menu and choose ***Comms Setup.***



3. The ***Comms Setup*** dialogue box is displayed.

   Select the Comms Port setting appropriate to the configuration of your PC and choose ✓**OK**.

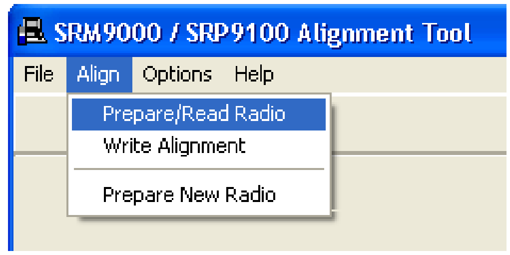
   (Usually COM1)



5.2.2 Radio Preparation

Radio parameters are to be aligned sequentially as detailed in this procedure.

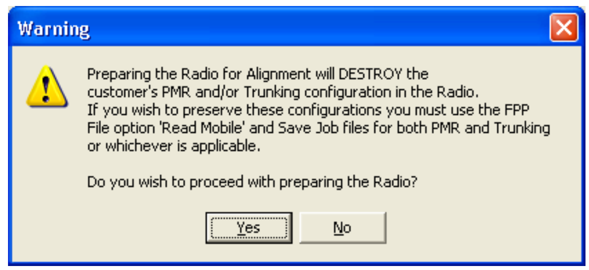
1. At the Opening Menu, select the ***Align Menu*** and choose ***Prepare/Read Radio***.



2. The ***WARNING*** is displayed.

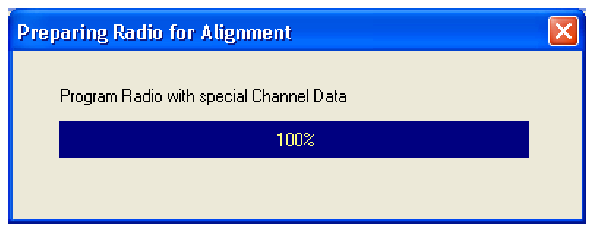
   Choose ***No*** if you want to save the configuration and use the FPP software to read and save the data to a file.

   Choose ***Yes*** if you want to proceed and go to step 3.



3. The radio alignment data is read (indicated by percentage bar) and stored.

   The test alignment data is downloaded into the radio.

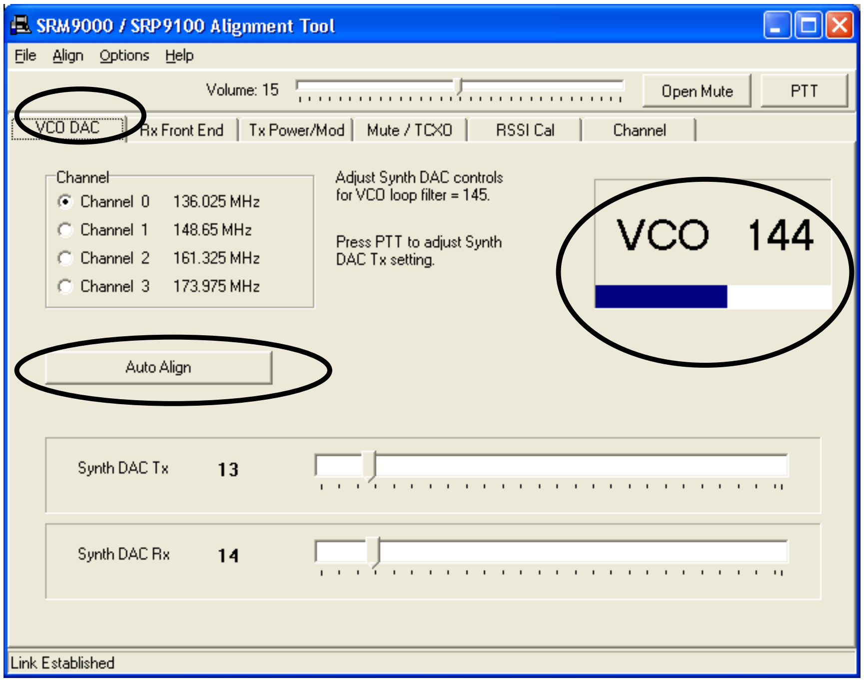


Note: *In test alignment mode the radio is configured only for 12.5 kHz channel spacing, therefore all alignment is carried out at 12.5 kHz settings unless otherwise specified. When the radio is configured with the FPP for other channel spacings, the deviation related levels are calculated on a per channel basis by the radio software.*

5.2.3 Alignment Procedure

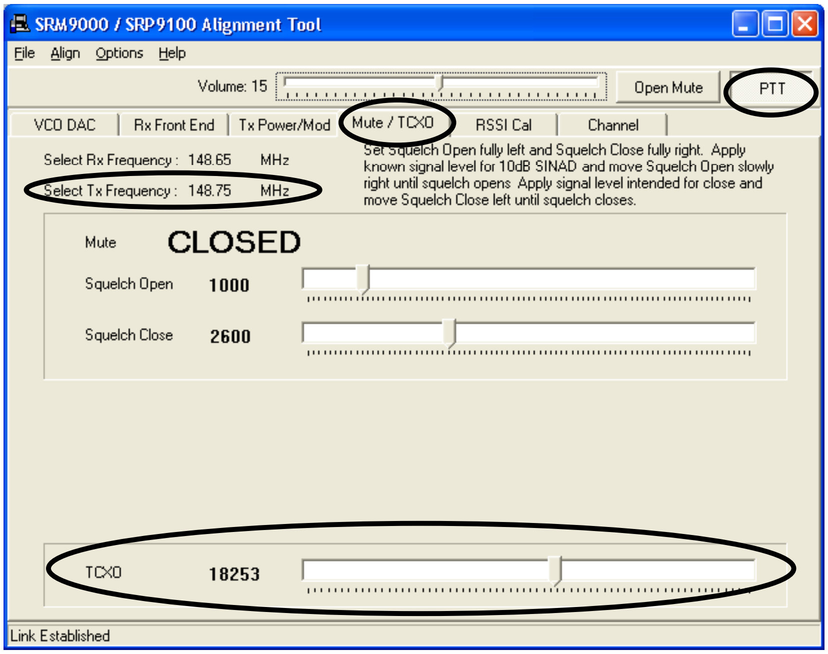
Radio alignment must be done in the sequence detailed in the following paragraphs. This alignment assumes that the radio is functioning normally.

5.2.3.1 VCO DAC Alignment

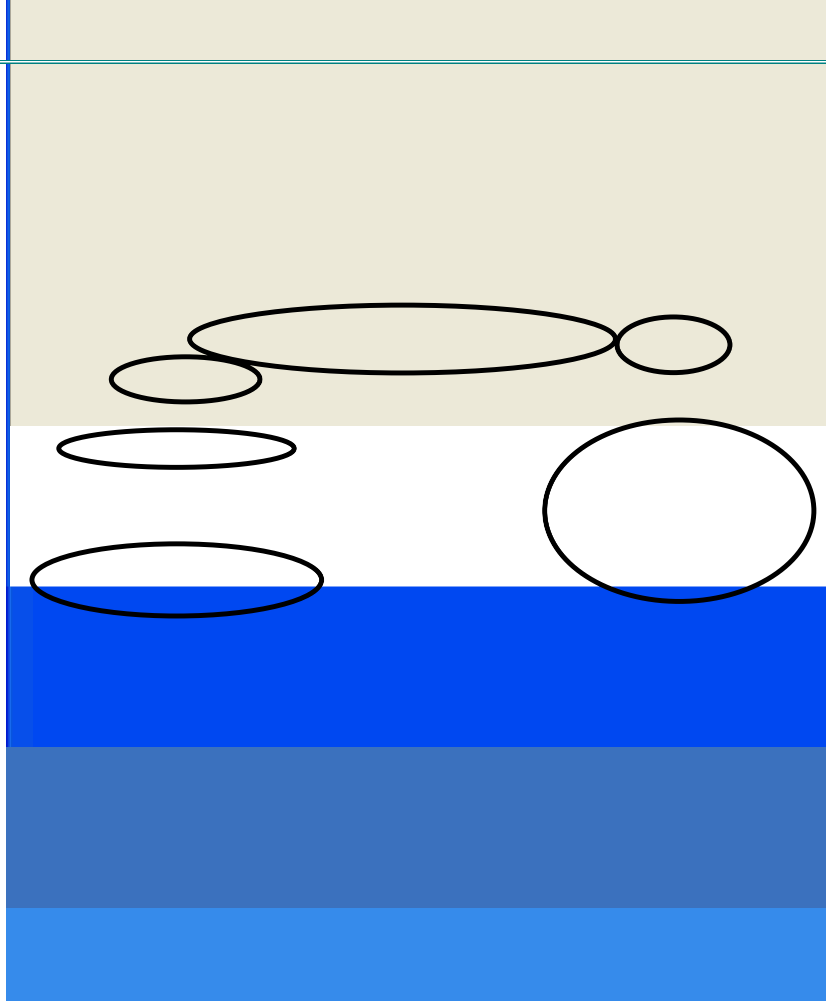


1. Select the ***VCO DAC*** page.
2. Select ***Auto Align.*** The Synth DAC Rx slider will automatically adjust its value for each receiver alignment frequency to set the VCO loop filter value between 140 and 150.
3. Select ***PTT*** and then select ***Auto Align***. The Synth DAC Tx slider will automatically adjust its value for each transmitter alignment frequency to set the VCO loop filter value between 140 and 150.

5.2.3.2 TCXO (Radio Netting Adjustment)



1. Select the ***Mute/TCXO*** page.
2. Select ***PTT***.
3. Adjust the ***TCXO*** slider to ensure that the transmit frequency error is within 50Hz for the selected channel (to be measured on the RF Test Set frequency counter).



1. Ensure that the TCX0 Alignment has been done before proceeding with this section.
2. Select the ***Rx Front End*** Page
3. Select ***Open Mute***.
4. Set the ***Volume*** slider to 15.

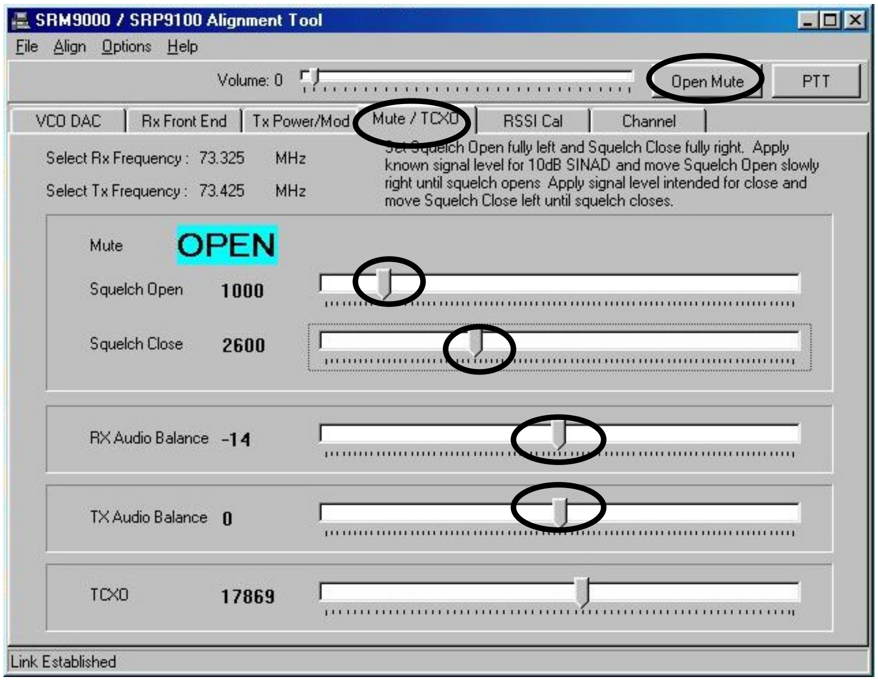
   Speaker audio should now be visible on the Scope. If required readjust the ***Volume*** slider to a suitable level.
5. Set the Signal Generator to the Channel 0 carrier frequency, with a 1000Hz modulation signal, a deviation of ±2 kHz and an RF level of -90dBm.
6. Select ***Channel 0.***
7. Select ***Auto Align***.

   The front end will be tuned automatically and finish with an RSSI reading of typically around 150.
8. Repeat Steps 7 to 8 for the remaining 3 Channels (1, 2, & 3).
9. Change deviation to 1.5kHz.
10. Verify that the receiver sensitivity is better than -117.5dBm for 12dB SINAD on all channels.

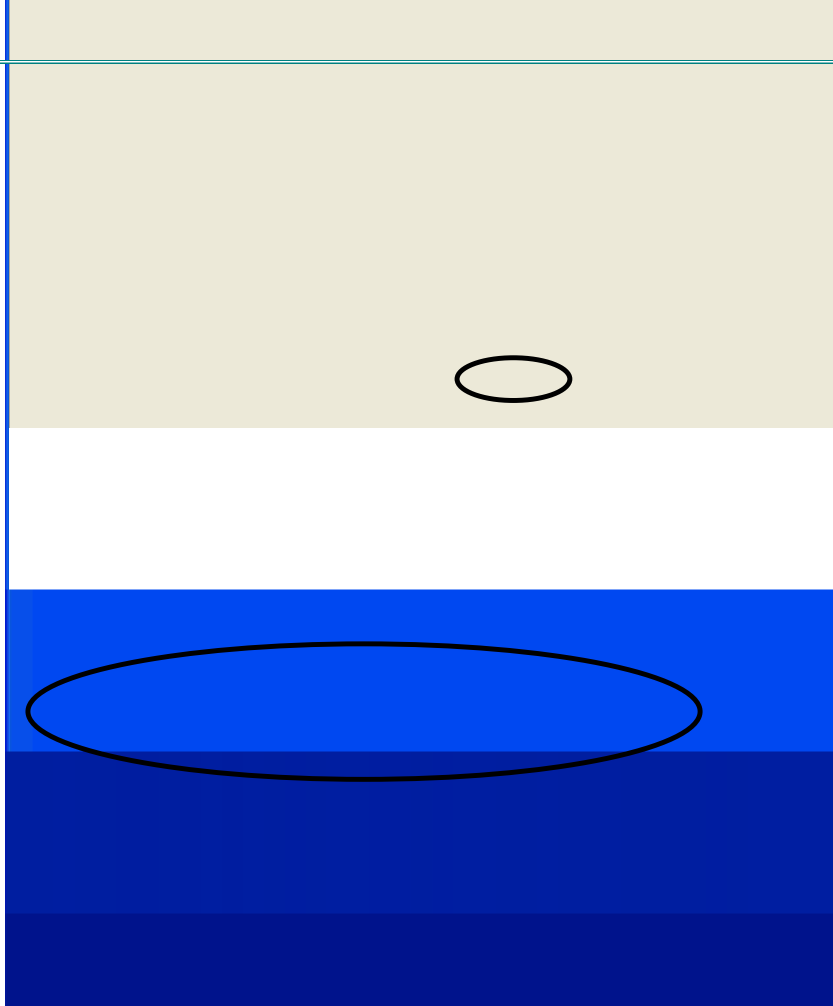
    (Sensitivity is typically -120dBm).

5.2.3.4 Mute/Audio Balance Adjustment

Note. This adjustment has default setting of 1000/2600 and should not need changing except for specific requirements.



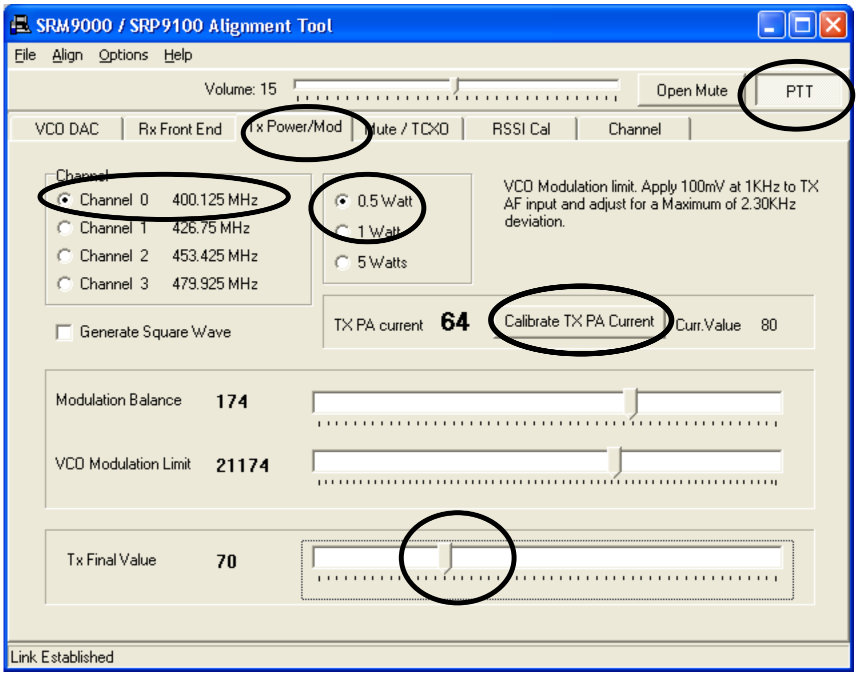
1. Select the ***Mute/TCXO*** page and select ***Open Mute.***
2. Set the RF signal generator to the receiver alignment frequency, and adjust the RF level such that the desired mute opening SINAD (typically 10dB SINAD) is achieved.
3. Select ***Mute Closed*** and remove the RF input from the radio***.***
4. Select the ***Mute/TCXO*** page
5. Set the ***Squelch Open*** and ***Squelch Close*** sliders to the fully left position. This ensures the receiver will be muted.
6. Set the ***Squelch Close*** slider to the fully right position.
7. Reconnect the RF input to the radio.
8. Adjust the ***Squelch Open*** slider to the right until the mute opens.
9. Reduce the Signal Generator output level by approximately 2dB (or by an amount equal to the desired mute hysteresis level).
10. Adjust the ***Squelch Close*** slider to the left until the mute closes.
11. The mute should now open and close at the desired RF levels.
12. Unsquelch the radio and set the radio volume to minimum.
13. Monitor the DC voltage across the speaker or load.
14. Adjust the ***Rx Audio Balance*** DAC to achieve a minimum in the measured DC voltage (within 0V±10mV) and leave at this setting.
15. Note. On revision 2 radios and higher, an additional ***Tx Audio Balance*** DAC is also provided***.*** For these radios, the ***Tx Audio Balance*** DAC is defaulted to zero for normal setting. However, for a more accurate setting, the DC voltage at TP731 needs to be noted during Rx and adjusted by the ***Tx Audio Balance*** DAC to give the same reading (to within 10mV).



1. Select the ***RSSI Cal*** page.
2. Set the Signal Generator for a RF output level of –90dBm and 2kHz deviation at the specified frequency.
3. Activate the ***Store RSSI*** button.

   The receiver RSSI threshold setting is calibrated.
4. Monitor the battery voltage at the simulated battery terminals with an accurate multimeter.
5. Adjust the power supply so that the voltage reads exactly 7.2V ±5mV.
6. Click the ***Battery*** button to store the calibration.

5.2.3.6 Tx Power

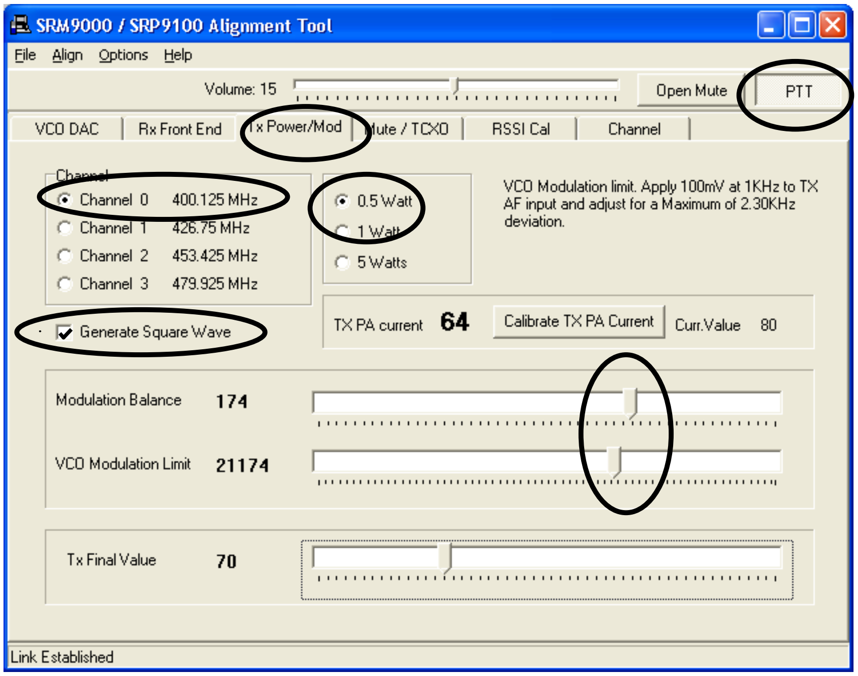


1. Select ***Tx Power/Mod*** page.
2. Select ***Channel 0***.
3. Select the ***0.5W*** power level.
4. Press the ***PTT*** button.
5. Adjust the ***Tx Final Value*** slider for a power output of 0.5W.
6. Repeat step 5 for the remaining 3 Channels (1, 2, & 3).
7. Select the ***1W*** power level.
8. Adjust the ***Tx Final Value*** slider for a power output of 1W.
9. Repeat step 8 for the remaining 3 Channels (2, 1& 0).
10. Select the ***5W*** power level.
11. Adjust the ***Tx Final Value*** slider for a power output of 5W.
    Note that the supply current is less than 2.5A.
12. Repeat step 11 for the remaining 3 Channels (1, 2, & 3).

13 Press “Calibrate TX PA Current” button to automatically set the maximum current limit.

14 Release the ***PTT*** button.

5.2.3.7 Modulation



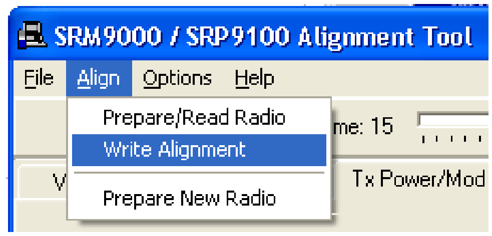
1. Select ***Tx Power/Mod*** page.
2. Select ***Channel 0***.
3. Select the ***0.5W*** power level.
4. Set the microphone input signal from the Audio Generator to 1000Hz at 100mV RMS.
5. Adjust the ***VCO Modulation Limit*** slider for a maximum peak deviation of ±2.3kHz
6. Reduce the microphone input level to 10mV RMS and check that the deviation is within the range ±1.25 kHz to ±1.75 kHz.
7. Repeat steps 2 to 7 inclusive for the remaining 3 Channels (1, 2, & 3).
8. Remove the microphone audio input signal.
9. Select the ***Generate Square Wave*** function.
10. Select ***PTT*** and, while viewing the de-modulated signal on the transceiver test set oscilloscope, adjust the ***Modulation Balance*** slider for the best square wave symmetry.

    Note. DC coupling is required on the scope for optimum setting accuracy.
11. Repeat steps 8 to 11 inclusive for the remaining 3 Channels (1, 2 & 3).

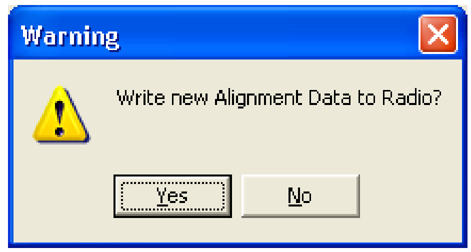
5.2.3.8 Programming

When all channels have been aligned the radio is programmed with the new alignment data:

1. Select ***Align*** and choose ***Write Alignment***.

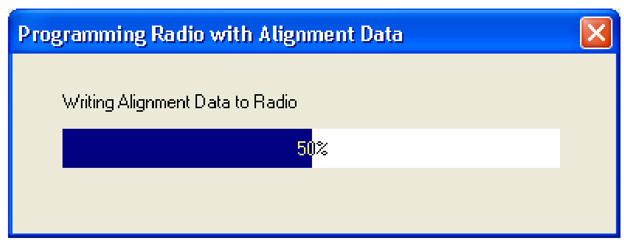


2. A warning message is displayed.



3. Choose ***Yes***.

   New alignment data is written to the radio.



5.2.3.9 Customers Radio Configuration Data

If the Customers Radio Personality Data was saved as a separate file, use the FPP Programmer to write this data to the radio.

6. REPLACEABLE PARTS

The parts listed in this section are considered to those most likely to need replacement due to physical damage to the radio.

Figure 6-1 Replaceable Parts

6.1 COMMON PARTS

Ident	Description	Quantity per Assembly	Part Number
	ACTUATOR PTT BLACK	1	6102 310 00131
	ACTUATOR SIDE KEY B BLACK	1	6102 310 00121
	ACTUATOR SIDE KEY A BLACK	1	6102 310 00111
	CLIP RETN LOUDSPEAKER	1	3513 900 62202
	CLOTH LOUDSPEAKER	1	3513 900 62161
	CLOTH MIC	1	3513 900 62261
	CONTROL VOL/ON-OFF	1	3513 993 51504
	FLEXI-CIRCUIT MIC/SPKR	1	3513 908 02891
	FLEXI-CIRCUIT TOP CTL	1	3513 908 02884
	FRONT CASE ASSY GRAPHIC LCD SRP9100	1	6102 350 00111
	FRONT CASE ASSY COMPLEX SRP9100	1	6102 350 12081
	FRONT CASE ASSY SIMPLE SRP9100	1	6102 350 12091
	GASKET LCD	1	3513 902 10442
	INSULATOR JACK	1	3513 902 50331
	JACK TWIN	1	3513 993 08002
	KEYPAD COMPLEX (keypad 9130)	1	6102 310 00141
	KEYPAD SIMPLE (keypad 9120)	1	6102 310 00151
	KNOB ASSY	1	6102 350 12371
	LABEL FRONT	1	6102 303 00021
	LOUDSPEAKER 16R TO36S23	1	3513 993 55004
	MIC ELECTRET JL-0627B1033-5830	1	6102 640 00011
	MMI ASSY ALPHA/NUMERIC	1	6102 350 12341
	RETAINER TOP ASSY	1	3513 906 40272
	RETAINER MIC	1	3513 905 60541
	SEAL TWIN JACK (for accessory jacks)	1	3513 905 82561
	SEAL ACTUATOR	1	3513 905 81791
	SEAL LOUDSPEAKER	1	3513 905 81801
	SEAL CHASSIS	1	3513 905 81811
	SEAL O-RING KNOB	1	3513 905 60671
	SEAL TOP	1	3513 905 81852
	SRP9100 Brief User Guide	1	TNM-U-E-0046
	SUPPORT SWITCH TOP ASSY	1	3513 905 81783
	WINDOW LCD SRP9100	1	6102 310 00101
	WINDOW GRAPHIC LCD SRP9100	1	6102 310 00111

6.2 ACCESSORIES

Description	Part Number
ACCESSORY CORD STRAIGHT (UNTERMINATED) SRP9100	PA-LDST
ANTENNA HELICAL E0 BAND (66-88 MHz) SRP9100	PA-AHE0
ANTENNA HELICAL HIGH PERFORMANCE E0 BAND (66-88 MHz) SRP9100	PA-AHE0-HIGH
ANTENNA HELICAL AC BAND (136-174 MHz) SRP9100	PA-AHAC
ANTENNA HELICAL K1/KM BAND (174-245 MHz) SRP9100	PA-AHAK
ANTENNA WHIP R1 BAND (335-375 MHz) SRP9100	PA-AWR1
ANTENNA HELICAL TU BAND (400-480 MHz) SRP9100	PA-AHTU
ANTENNA HELICAL UW BAND (440-520 MHz) SRP9100	PA-AHUW
ANTENNA WHIP TU BAND (400-480 MHz) SRP9100	PA-AWTU
ANTENNA WHIP UW BAND (470-520 MHz) SRP9100	PA-AWUW
BATTERY SRP9100 NICAD 1.6AH	PA-BATH
BATTERY SRP9100 NIMH 2.1AH	PA-BATN
BATTERY SRP9100 NIMH 2.7AH	PA-BATB
BATTERY SRP9100 LITHIUM 3.0AH	PA-BATL
EXTERNAL ANTENNA CONNECTOR	PA-CON
LEAD PROGRAMMING SRP9100	PA-PRLD

APPENDIX A - ACCESSORY CONNECTOR

The following table details the connections on the accessory connector.

Connection	Signal Name	Use	Signal type	Direction
2.5mm Tip	MIC1	Multi-function, audio in, ancillary type voltage and key press voltage.	0-5V	To Radio
2.5mm Ring	EXT_LS1A	Balanced Speaker Drive	Nominal Mid Supply	To Accessory
2.5mm Sleeve	EXT_LS1B	Balanced Speaker Drive	Nominal Mid Supply	To Accessory
3.5mm Tip	RXD1_IN	RS232 RxD in or IIC SDA or trickle charge input.	0V to 5V 0V or –12V Space 5V or +12V Mark	Bi-directional
3.5mm Ring	TXD1_OUT	RS232 TxD out or IIC SCL or 5V supply output (50mA maximum.)	0-5V	To Radio
3.5mm Sleeve	0VA	Ground	0V	To Accessory

APPENDIX B - ACCESSORIES

Lapel Speaker Microphone

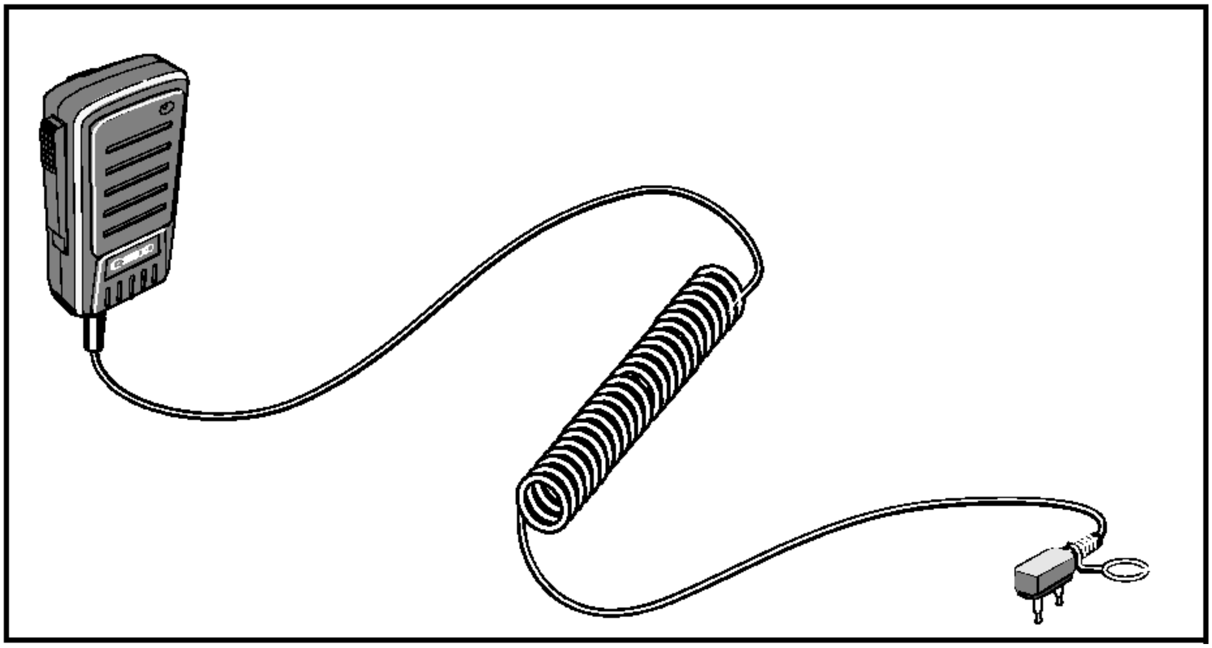


Figure 2 Lapel Speaker Microphone

Introduction

The lapel loudspeaker / microphone is a robust, lightweight, unit with an integral press-to-talk (PTT) switch and a headset socket. The unit connects to the portable radio via a 1.5m ‘curly’ cable with a 2.5mm (J1) and 3.5mm (J2) stereo jack plugs mounted in a single moulding.

Specification

Maximum circuit current	10mA
Type	Electret
Impedance	2kΩ (nominal)
Sensitivity	–64dB ±4dB at 1kHz (0dB = 1V / µbar).
Sensitivity variation relative to 1kHz over frequency range	Less than +10dB, –2dB, 300 Hz to 4kHz
PTT switch	Push to transmit
DC voltage overshoot during switching periods	Within 2% of nominal voltage
PTT ‘click’ suppress circuit:	
DC voltage establishment time for active PTT voltage	Less than 5ms to reach 95% of the nominal PTT
DC voltage established time for PTT release	50ms ±20% to reach 95% of the nominal PTT release voltage

Loudspeaker

Impedance	16Ω ±2Ω
Power rating	0.3W nominal, 0.5W maximum

Headset socket	3.5mm - loudspeaker disconnected when jack inserted
Environmental:	
Operating temperature range	–20°C to +55°C
Storage temperature range	–40°C to +80°C

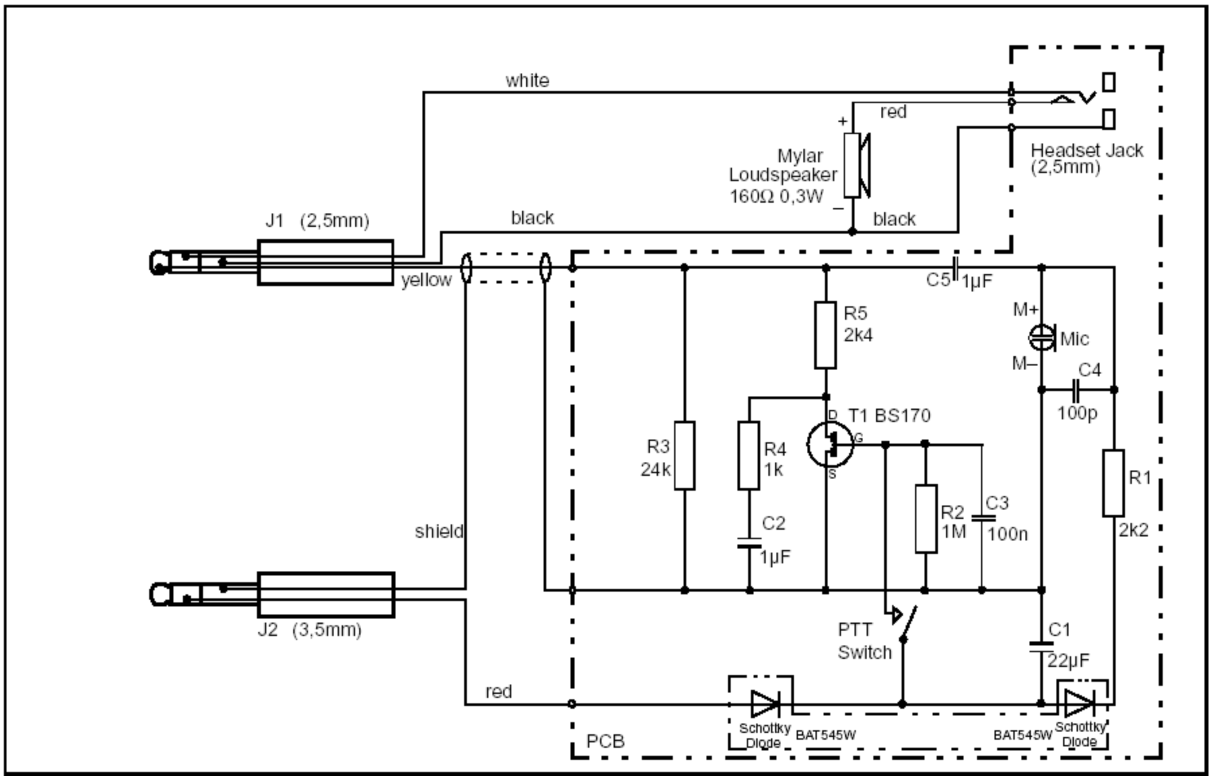


Figure 3 Lapel Speaker Microphone Circuit

OPERATION

Ancillary Type

R3 defines the ancillary as a Lapel Speaker / Microphone.

Microphone

The microphone connects to the radio via the tip of the 2,5mm stereo jack (J1) and is powered via the ring and sleeve of the 3.5mm stereo jack (J2) on the cord assembly.

When the Lapel Speaker / Microphone is connected to the radio, the radio's microphone is switched out of circuit.

Operation of the PTT switch brings into circuit the Electret microphone, which is powered from a rectified and filtered DC supply from the radio. R5 is used to generate a PTT interrupt to the radio.

Speech is superimposed onto this voltage on using the microphone with the PTT switch pressed.

Loudspeaker

The loudspeaker connects to the radio via the ring and sleeve of the 2.5mm stereo jack (J1) on the cord assembly.

When the Lapel Speaker / Microphone is connected to the radio, receive audio is routed to the ancillary loudspeaker and not to the radio's.

The Lapel Speaker / Microphone supports the use of a remote headset.