SRP9170/80 Series

FM VHF/UHF Portable

Radio Transceiver

SERVICE MANUAL

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SRP9170/80 Series FM VHF/UHF Portable Transceiver TNM-M-E-0023 ~ Issue 1.00

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.

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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:

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Document History

Issue	Date	Comments
Draft 1.00	2009-03-31	Initial issue.

List of Associated Publications

Document No.	Description	Issue
TNM-U-E-0088	SRP9180 PMR Brief User Guide.	1
TNM-U-E-0089	SRP9180 PMR Operating Instructions.	1
TNM-U-E-0090	SRP9180 TMR Operating Instructions.	1
TNM-U-E-0091	SRP9180 P25 Operating Instructions.	1

Warnings and Cautions

WARNING

SRP9170/80 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, eg 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).

WARNING

Servicing and upgrades of IECEx approved Intrinsically Safe radios and accessories must only be carried out by TMC Radio Pty Ltd IECEx Intrinsically Safe trained staff, at locations that have been IECEx approved. Please contact TMC Radio Pty Ltd for your nearest Service Department.

IECEx Intrinsic Safety

Radio models approved for use in hazardous environments according to the IECEx scheme are marked with the approval number <mark>XXXXXXXXX</mark>, or <mark>XXXXXXXXX</mark>.

The Intrinsically Safe protection rating for these models are either:

- (Gas) Ex iC IIB T4; and,
- (Dust) Ex tD A 22 IP67 T135 ^{o}C; or,

- (Gas) Ex iC IIA T4; and,
- (Dust) Ex tD A 22 IP67 T135 ^{o}C.

The following MUST be observed to maintain the IECEx protection rating:

a) use only approved Simoco battery (PAR-9180BATL2 or PAR-9180BATL3);

b) battery charging must only be carried out in non-hazardous areas, using an approved battery charger;

c) metal belt clips must **NOT** be used in hazardous areas;

d) it is a requirement that when the radio is used in a hazardous area that either the SRP9180 Accessory Connector Cover (6102 350 1446) or an approved Simoco IECEx accessory is fitted;

e) approved accessories may only be connected and disconnected outside the hazardous areas;

f) prior to use in a hazardous area, inspect the radio and accessories for signs of damage. Any visible signs of damage to the radio or accessories may compromise the integrity and safety of the radio. A damaged radio or accessories must be repaired or replaced prior to use in a hazardous area;

g) incorrect storage, handling or operation of the radio and accessories, as specified in TMC Radio Pty Ltd published User Guides and Service Manuals, may compromise the safety and integrity of the radio or accessories;

h) approved labels stating the IECEx rating level must be affixed to the radio and accessories, and must be legible, before their use in a hazardous area;

i) servicing and upgrades of IECEx approved Intrinsically Safe radios and accessories must only be carried out by TMC Radio Pty Ltd IECEx Intrinsically Safe trained staff, at locations that have been IECEx approved. Please contact TMC Radio Pty Ltd for your nearest approved Service Department; and,

j) substitution of parts or accessories will void the equipments' IECEx Intrinsic Safety rating.

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.

Attack Operation

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.

BPF   Band-Pass Filter.

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; and,
- 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 Control Channel	
	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. Only receivers that have been programmed 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 and allows several different networks to use the same frequency. 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 programmed 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 frequency. DCS is also known as CDCSS.
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.
EDM	Extended Data Message (MPT1327).
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.
Encode	Transmission of signalling, either Selcall where Selcall tone digits are encoded into tone frequencies, or CTCSS/DCS where sub-audible signals modulated onto the carrier.
ETSI	European Technical Standard Institute.
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, 1 or 0 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); and, • 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.

IS	Intrinsically Safe.
LCD	Liquid Crystal Display.
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.
MAP27	Mobile Access Protocol for MPT1327 equipment.
MEP	Miniaturisation Extent Parameter. Used in systems that use ANN numbering.
MMI	Man-Machine Interface.
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.
Multiax	CTCSS based multi channel sharing system.
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.
Nuisance Delete	
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.
	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.
PiN Diode	P-type intrinsic N-type diode. Type of diode used for RF switching.
PLL	Phase-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; and,
- 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 (OPIDs). 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) until a valid Selcall is received.
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 tone burst transmissions are made.
Simplex	Mode of operation whereby the radio operates as a conventional fixed channel radio outside the Trunking network.
SINAD	Ratio of SIgnal plus Noise And Distortion to noise and distortion expressed in dB.
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; and, • 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"); and, 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 SRP9170/80 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 four functional variants. The variants are as follows:

Description	PMR/Trunked
Portable Transceiver with no Keypad and Graphic Display.	SRP9170
Portable Transceiver with no Keypad and Graphic Display, Intrinsically Safe.	SRP9170*is*
Portable Transceiver with Keypad and Graphic Display.	SRP9180
Portable Transceiver with Keypad and Graphic Display, Intrinsically Safe.	SRP9180*is*

1.2 SCOPE

This manual provides technical specifications, description and servicing details for the SRP9170/80 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 Logic Array (PLA) are used with other dedicated devices in the SRP9170/80 to perform the following functions under software control:

- frequency synthesis of all operating frequencies;
- modulation and demodulation of 10 / 12.5 / 20 / 25 kHz 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; and,
- tuning control data for Tx and Rx.

The SRP9170/80 Transceiver comprises a rugged cast internal lightweight alloy chassis that houses two printed circuit board assemblies and provides all heatsink requirements. The battery clips into the chassis where it is securely locked via a tensioned clip. Release is achieved by sliding the latch towards the bottom of the transceiver. The chassis is enclosed in a high impact polycarbonate ABS plastic case that retains the speaker, keypad and display.

Gaskets fitted around keys, the display, buttons, connectors, switches, and the antenna socket provide a seal against moisture and dust ingress.

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. Flexible PCBs connect the speaker and microphone, accessories connector, volume control and channel / zone switch to the main PCB. Provision is made in the radio for optional plug-in accessories (i.e. for encryption, P25, etc).

The standard battery capacity is 2200 mAh and utilises lithium-ion technology to suit the endurance requirement of the portable application.

The antenna is connected to the radio via an SMA plug that is mounted in 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

	Model	
Feature	**9170 / 9170*is***	**9180 / 9180*is***
Keys	7 Function keys. All keys can be customised.	7 Function keys. All keys can be customised.
Keypad	Non keypad.	12 button numeric keypad.
Display	LCD 12 character with bit mapped section and fixed icons.	Graphic LCD 102 x 64 pixels.
Volume	Rotary control.	Rotary control.
Zone	Rotary control – 3 position.	Rotary control – 3 position.
Channel	Rotary control – 16 position.	Rotary control – 16 position.
Indicators	Tri-colour LEDs.	Tri-colour LEDs.
Facility connector	Yes.	Yes.
Frequency Bands*	66 to 88 MHz, 136 to 174 MHz, 335 to 400 MHz, 400 to 480 MHz, 440 to 520 MHz.	
Channel Spacing*	$10^{\#}$ / 12.5 / 20 / 25 kHz.	
Menu driven	Yes (limited selections).	Yes.
Customisable Menus	Yes.	Yes.

* Not all combinations are valid or currently available.

 # Requires special hardware build (narrow band filters).

Table 1-2 Conventional-PMR Variants

	Model	
Feature	**9170 / 9170*is* **	**9180 / 9180*is* **
Channels	200 (nominal).	1000.
Signalling	CTCSS / DCS Selcall / FFSK / DTMF.	CTCSS / DCS / Selcall / FFSK / DTMF.
Text Messaging	FFSK text messaging display. Selcall status messaging.	FFSK text messaging display. Selcall status messaging.
Attack Operation:	Yes.	Yes.
DTMF Encode	Pre-defined Encodes via function keys.	Pre-defined Encodes via function keys. Free form encodes via keypad.
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 Analogue Trunked Variants

Feature	9170 / 9170*is*	9180 / 9180*is*
Channels	1024 channels in 50 sub-bands.	
Frequency Bands	136 to 174 MHz, 400 to 480 MHz.	
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 CONVENTION

There are various associated items of software (SW) required for the SRP9170/80 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 SRP9170/80 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   **b1tm182.bin**   (trunking).

    b1p_182.bin   (PMR).

    b1s_182.bin   **(**startup).

1.5.2   Application Code

This identifies the application the SW was initially designed for:

    b1   Standard SRP9170/80 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; and,

    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, and TMR 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   182   = Version 1.82.

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 (eg b1tm182.bin, etc) contains version information about itself and possibly compatible Programming SW.
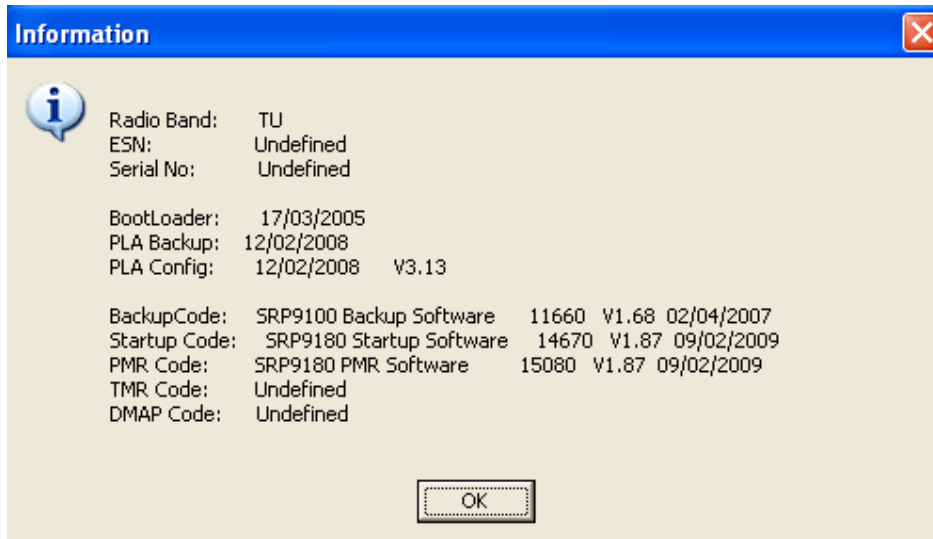
For **Radio SW saved on Disk**, this information can be displayed via the Programmer function:

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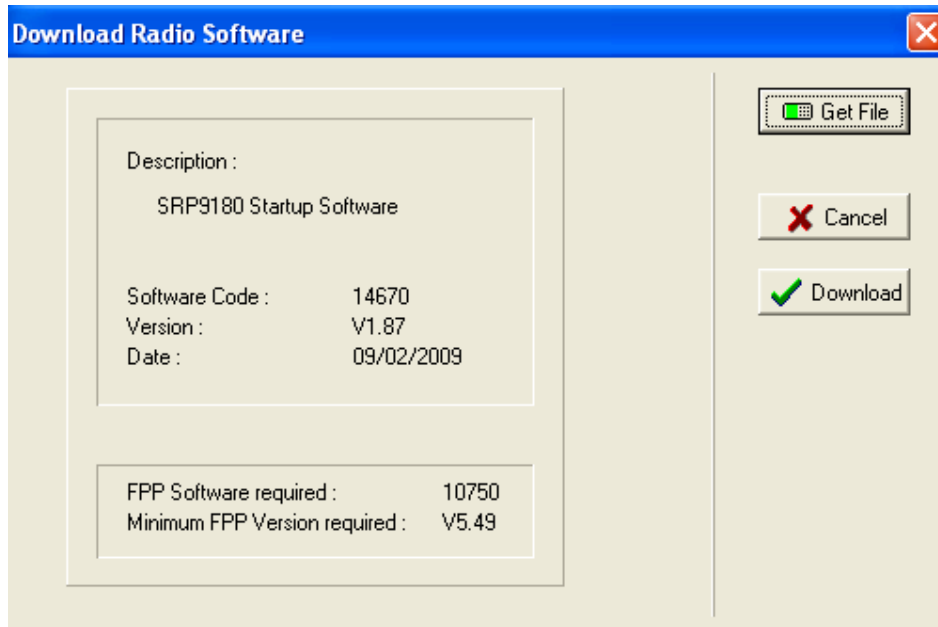
For **Software loaded in the radio**, information can be read from the Transceiver and displayed via the Programmer function:

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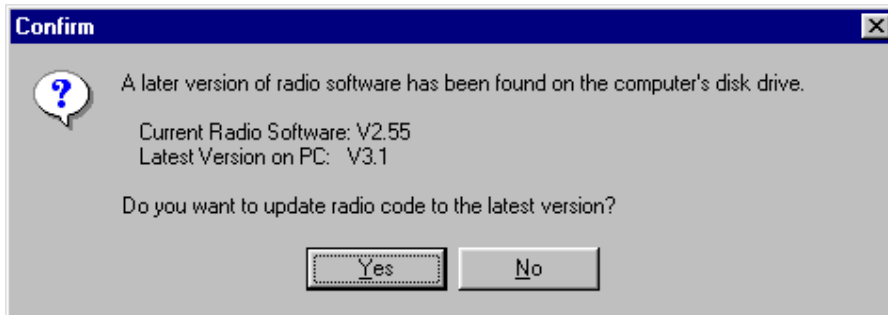
Note: as early versions of FPP cannot recognise a more recent revision of the radio, it is important that the latest FPP version is downloaded from: http://www.tmcradio.com.

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

If **NO** is selected, only 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.

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

The SRP9170/80 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 Analogue Trunk Software; and,

- P25 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 this with saved parameters to determine if the radio should continue to power-up or switch itself off again; and,

- Start-Up Software then attempts to load either Mainline PMR or Analogue Trunk 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 (eg non-existent or checksum fail) then execution switches to Backup Software until the error is corrected (eg by FPPing the radio).

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

- Mainline Analogue 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; and,

- Backup Software (via various paths from above).

1.5.8 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 = *b1s_xxx.bin*) and Mainline PMR (*b1p_xxx.bin*) or Trunk (*b1txxxx.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 (F7) 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 radio and stop the Wailing Siren, 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 SRP9170/80. Re-programming and alignment are performed using software tools. For testing, a special test jig is required so to provide power and control lines.

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:

7.2 V DC (nominal).

Current Consumption:

	All measurements at 7.2 V
Radio off:	< 120 uA
Standby (squelched):	< 120 mA
Rx Audio O/P = 500 mW:	< 340 mA

Transmit:

Freq Range (MHz)	Tx Power 1 W (A)	Tx Power 5 W (A)
66 to 88	< 0.7	< 1.8
136 to 174	< 0.8	< 2.2
174 to 400	< 1.0	< 2.2
400 to 520	< 1.0	< 2.5

Frequency Bands:

Band	Freq Range (MHz)
E0	66 to 88
AC	136 to 174
R3	335 to 400
TU	400 to 480
UW	440 to 520

Switching Bandwidth:

Radio covers the complete band without retuning.

Channel Spacing:

10$^{\#}$ / 12.5 / 20 / 25 kHz

$^{\#}$ *Requires special hardware build (narrow band filters).*

Frequency Stability (-30 °C to 60 °C)

Less than ± 1.5 ppm

Dimensions (radio excluding antenna):	**Height**	**Width**	**Depth**
	150 mm	63 mm	37 mm
	Excluding volume and channel/zone control.		Including 2200 mAh battery.

Weight:

Radio only	210 g
Battery Li-ion 2200 mAh	250 g
Antenna E0	30 g
Antenna UW	19 g

Battery Endurance:	> 10 hours, high transmit power, 2200 mAh battery, 90:5:5 duty cycle.

Conformance Approvals:	ETSI	EN 300 086*
		EN 300 113*
		EN 300 489*
		EN 300 219*
	Australia	AS/NZS4295*

* Pending in some cases.

1.7.2   Transmitter

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

1.7.3 Receiver

	ETSI	AS/NZS4295
Sensitivity:	≤ 0.5 μV PD (- 113 dBm) for 20 dB SINAD	≤ 0.3 μV PD (- 117.5 dBm) for 12dB SINAD
Adjacent Channel Selectivity:	25 kHz Channel Spacing: > 73 dB 12.5 kHz Channel Spacing: > 60 dB	25 kHz Channel Spacing: > 73 dB 12.5 kHz Channel Spacing: > 65 dB
Intermodulation Rejection:	> 65 dB	> 70 dB
Spurious Response Rejection:	> 70 dB	> 70 dB
Blocking:	> 95 dB	> 95 dB
Conducted Spurious Emissions:	< 2 nW (- 57 dBm) 9 kHz to 1 GHz < 20 nW (- 47 dBm) 1 GHz to 4 GHz	< 22 nW (- 57 dBm) 9 kHz to 1 GHz < 20 nW (- 47 dBm) 1 GHz to 4 GHz

GENERAL

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

1.7.4   Signalling

1.7.4.1   CTCSS

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

Identifier	Frequency (Hz)	Identifier	Frequency (Hz)	Identifier	Frequency (Hz)
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	225.7
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
	150.0		171.3		199.5
	206.5		177.3		229.1
	69.3		183.5		254.1
	159.8		189.9		
	165.5		196.6		

Encoder

Tone Deviation:

25 kHz channel spacing:	500 to 750 Hz
20 kHz channel spacing:	400 to 600 Hz
12.5 kHz channel spacing:	250 to 375 Hz
Tone Distortion:	Less than 5.0 %
Frequency Error:	Less than $\pm$ 0.3 %

Decoder

Bandwidth: Not greater than $\pm$ 3.0 %

Deviation Sensitivity: Less than 6.0 % of system deviation (for decode with full RF quieting).

Noise Immunity: Less than 500 ms dropout per minute at 10 dB SINAD.
(CTCSS tone deviation 10 % of system deviation. RF deviation 60 % at 1000 Hz).

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: 310 Hz to 3000 Hz

20 dB SINAD RF signal: 320 Hz to 3000 Hz

12 dB SINAD RF signal: 350 Hz to 3000 Hz

Response Time: Less than 250 ms (full quieting/tone > 100 Hz).

Less than 350 ms (full quieting/tone < 100 Hz).

De-Response Time: Less than 250 ms.

Reverse Tone Burst: Programmable.

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

(Frequency in Hz).

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 ZVEI-3	ST500/CML ZVEI-3	DZVEI	ST500 DZVEI	SIGTEC NATEL	SIGTEC EIA	SEPAC EIA	ST500 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: 20 ms and 30 seconds in 1 ms increments.

1.7.4.4 DTMF

DTMF Encode supported via keypad:

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

Tone Period, programmable:	0 – 2.55 ms in 10 ms steps.
Inter-Tone Period, programmable:	0 – 2.55 s in 10 ms steps.
Link Establishment Time, programmable:	0 – 10 s in 10 ms steps.
Tx Hang Time, programmable:	0 – 9.99 s in 10 ms steps.
Side-Tone in Loudspeaker:	selectable via programmer.

1.7.4.5   DCS

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

Product Sealing

Main Radio Unit: IEC60529 rating IP67
Accessories: IEC60529 rating IP65

MIL-STD-810F

Low Pressure Storage:	500.4 Procedure I
Low Pressure Operational:	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
Solar Radiation:	505.4 Procedure I
Blowing Rain:	505.4 Procedure I
Rain Drip:	505.4 Procedure III
Cyclic Humidity:	507.4 Figure 507.4-1
Salt Fog:	509.4
Blowing Dust:	510.4 Procedure I
Blowing Sand:	510.4 Procedure II
Immersion:	512.4 Procedure I
Basic Transport Vibration:	514.5 Procedure I, Category 4
Minimum Integrity Vibration:	514.5 Procedure I, Category 24
Loose Cargo Vibration:	514.5 Procedure II, Category 5
Functional Basic Shock:	516.5 Procedure I
Crash Hazard:	516.5 Procedure IV
Bench Handling:	516.5 Procedure VI

US Forest Service   TIA / EIA – 603 Section 2.3.4

Vibration Stability: 10 – 30 Hz, 2.54 mm (p-p) excursion

        10 – 60 Hz, 0.635 mm (p-p) excursion

TIA / EIA – 603-C

High Humidity: TIA / EIA – 603-C Section 3.3.3
Vibration Stability: TIA / EIA – 603-C Section 3.3.4
Shock Stability: TIA / EIA – 603-C Section 3.3.5

2.   SERVICE PHILOSOPHY

2.1   SERVICE CONCEPT

The SRP9170/80 series has been designed to operate in PMR, analogue trunked, and P25 digital modes using common core electronics, software and interfacing.

There are three levels of service available:

Level	Activity	Recommended Spares	Recommended Test Equipment
1	Replacement of complete transceiver / antenna. Reprogramming.	Antennas, ancillaries.	Multimeter, PC, radio software.
2	Replacement of PCB or mechanical component replacement. Cosmetic repair.	Listed in Level 2 Spares Schedule.	As above plus service aids and test equipment.
3	Repair by PCB or mechanical component replacement. Cosmetic repair. Repair of PCB to component level in CRU.	Listed in Level 2 Spares Schedule PCB components only available to CRU.	As above plus 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 SRP9170/80 portable is Level 1, PCB replacement.

Level 2 Service, PCB (only) and case part replacement, will be carried out at the Central Repair Unit (CRU).

Level 3 Service (PCB component level repair) will be carried out in the CRU.

A PCB replacement program may be offered by the CRU in some countries, however where the service is performed at a non CRU facility, the IS rating and IP rating of the radio is void.

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

Refer Figure 3-1.

(1) Slide the battery release button towards the bottom of the transceiver to release the battery.

(2) Lift the battery away from the radio.
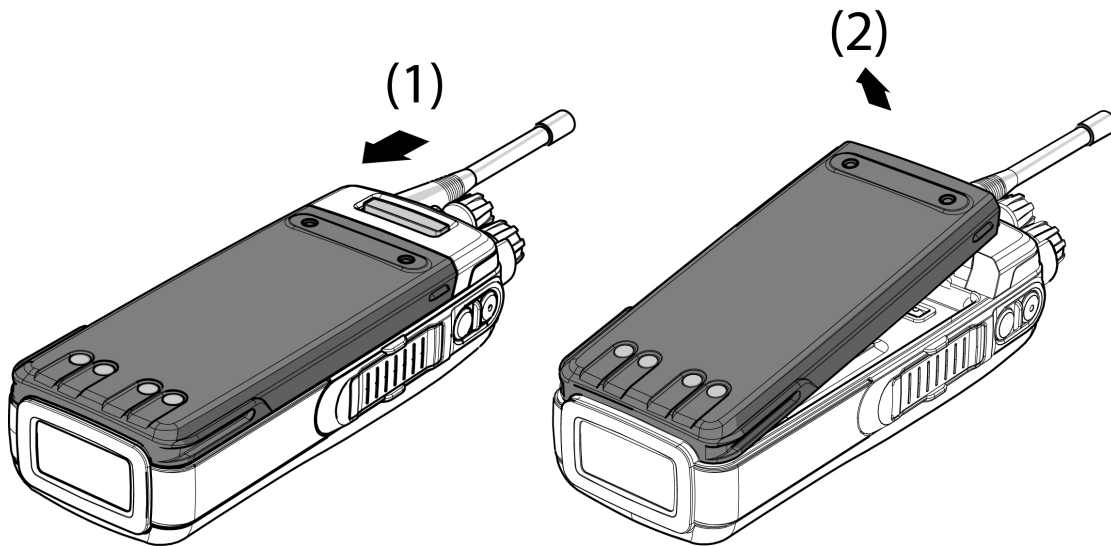
Figure 3-1   Battery Removal

Remove the Antenna, On / Off / Volume Control Knob, Channel Control Knob, and Zone Control Lever

Refer Figure 3-2.

(1) Unscrew and remove the antenna.

(2) The On / Off / Volume Control knob is a friction-fit part. Pull the knob from the shaft.

(3) The Channel Control knob is a friction fit part. Pull the knob from its shaft.

(4) The Zone Control lever is a friction-fit part and can be removed from the switch shaft.
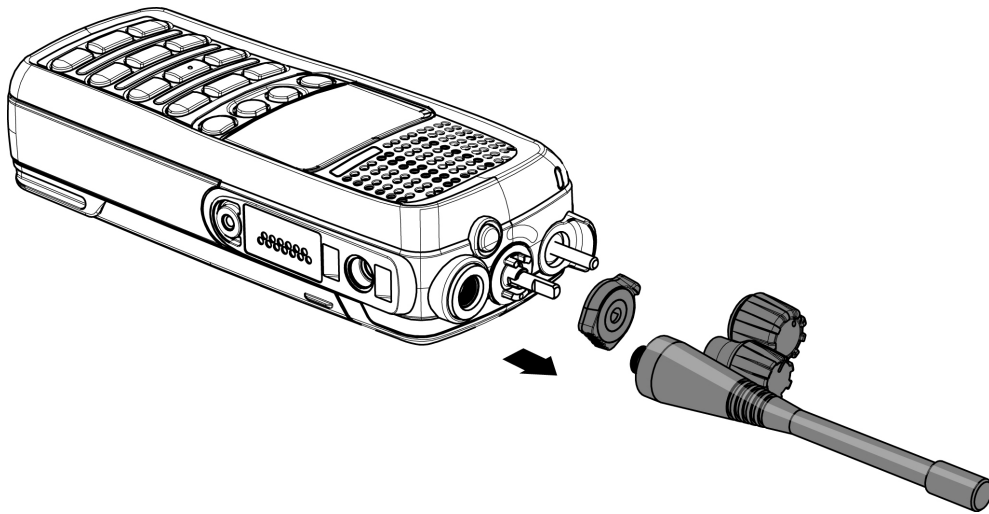
Figure 3-2   Antenna and Knob Removal

Remove the Side RF Connector

Refer Figure 3-3.

Unscrew the RF connector (or dummy insert if fitted) from the side accessory connector with the removal tool (6102 790 0016) using a counter-clockwise motion.
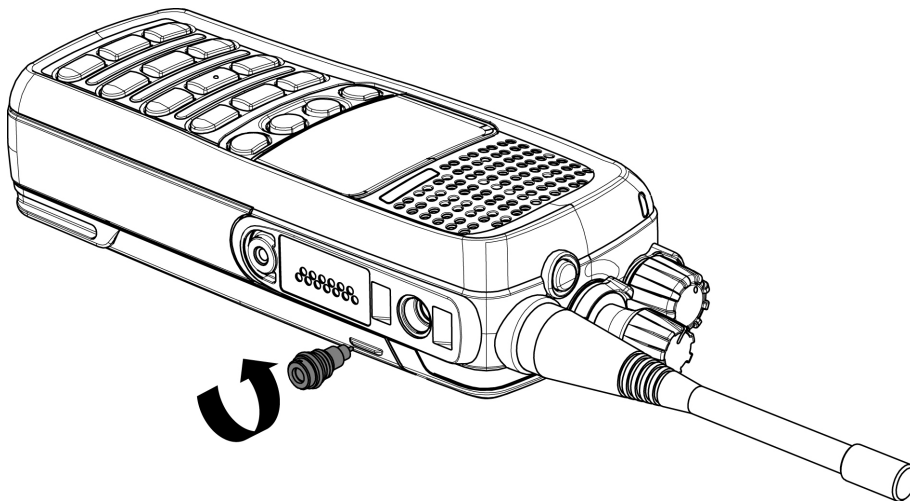
Figure 3-3   Side RF Connector Removal

Remove the Frame Assembly

Refer Figure 3-4.

(1) Use a small, flat-blade screwdriver to carefully 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 three flex 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.

(3) Slide out the locking tab of connector S4 (on the radio PCB) to release the Accessory Flex circuit. Use a very small flat-blade screwdriver.

(4) Slide out the locking tab of connector S6 (on the radio PCB) to release the Speaker Flex circuit. Use a very small flat-blade screwdriver.
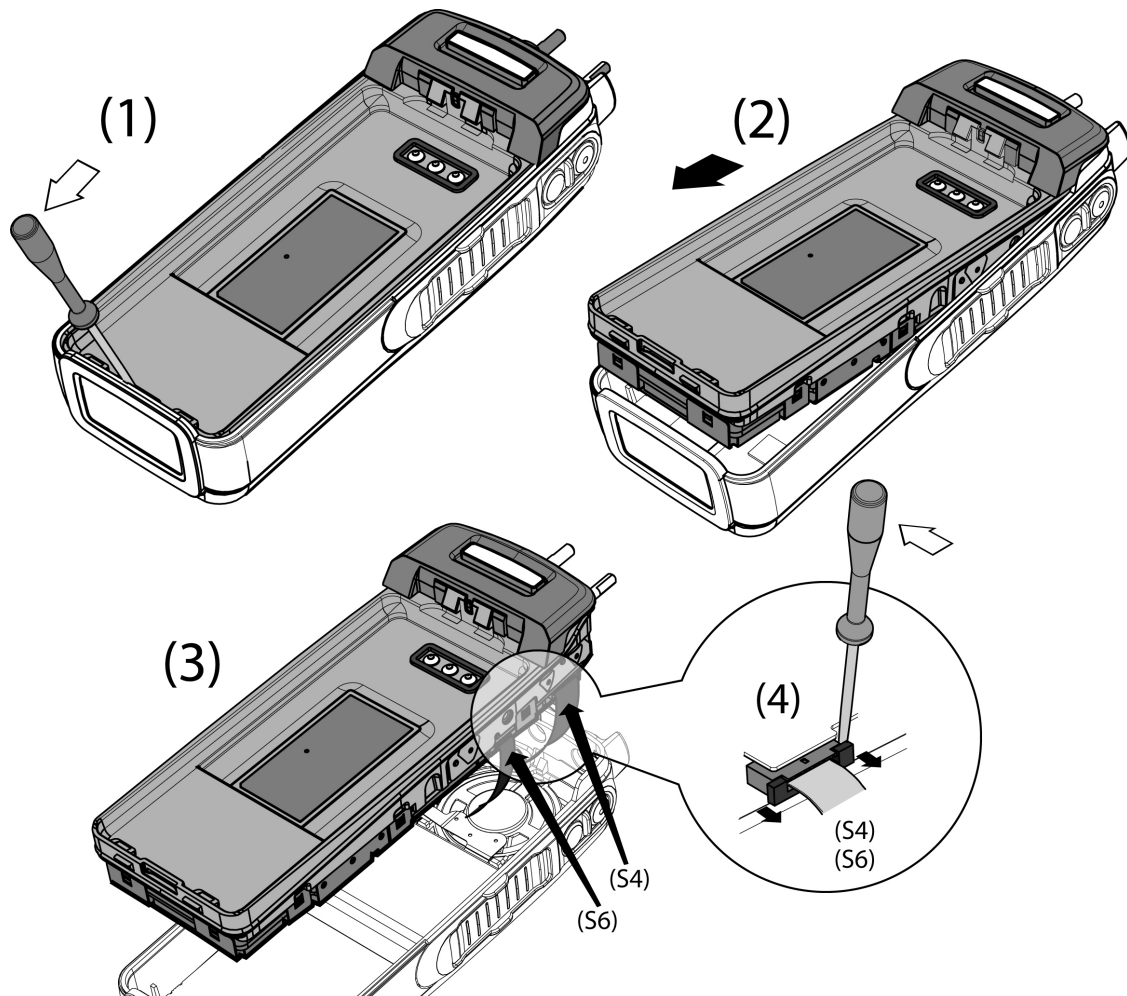
Figure 3-4   Removal of Frame Assembly

Remove the Metal Screen from the Radio PCB and Frame Assembly

Refer Figure 3-5.

(1) Use a small, flat-blade screwdriver to release the nine 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.
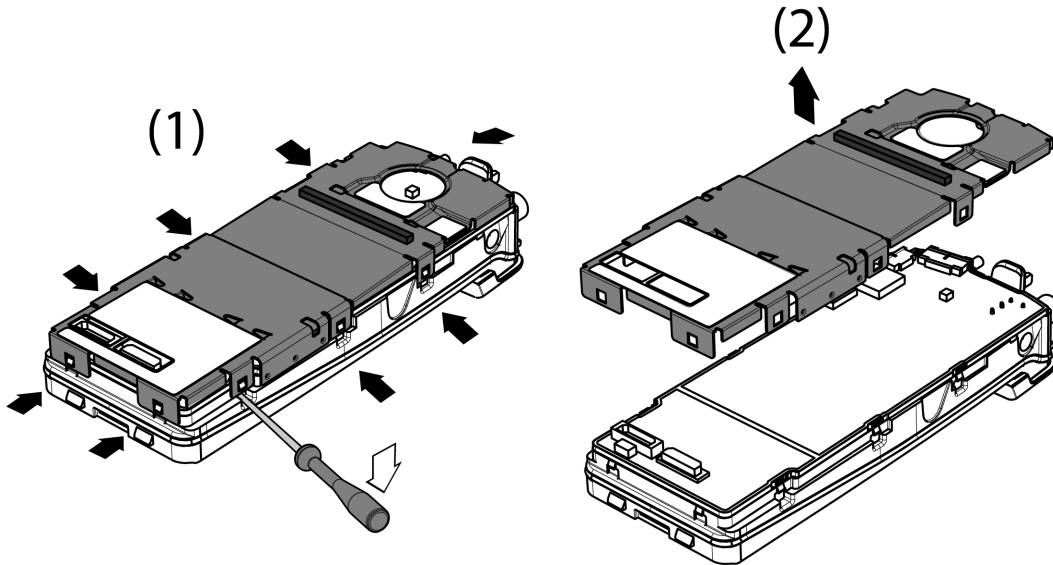
Figure 3-5   Removal of Metal Screen

Remove the MMI Assembly

Refer Figure 3-6.

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

(1) Using a small flat-blade 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. This will release the PCB from the retaining lugs.

(2) Lift the MMI PCB and LCD display assembly away from the front casing.
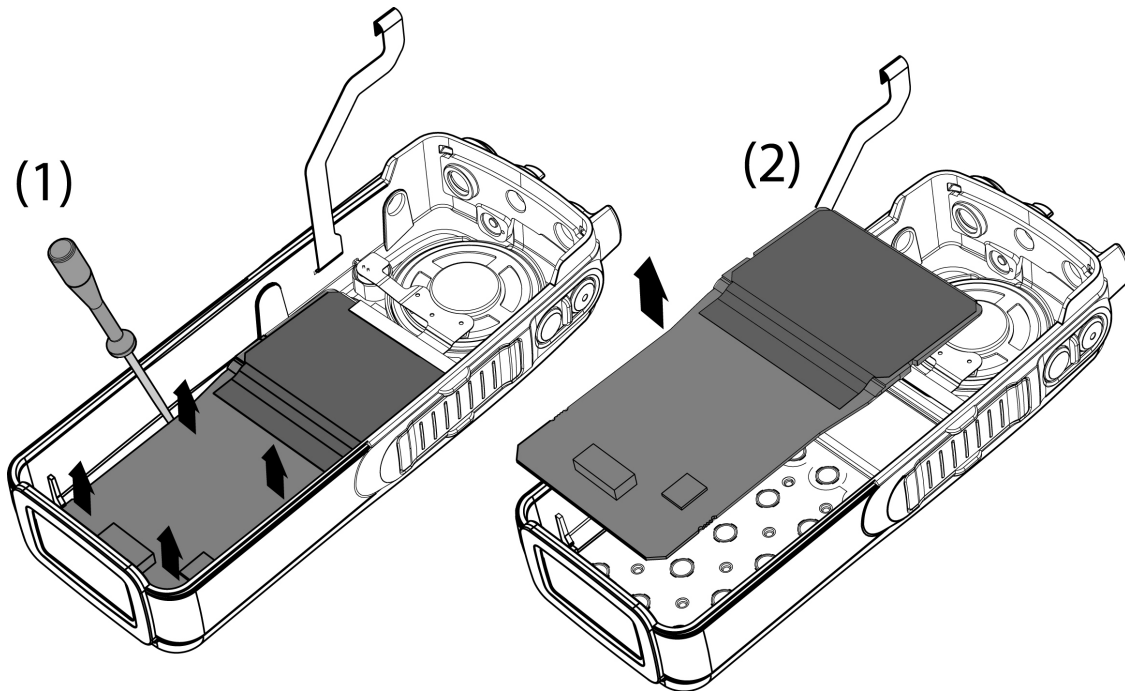
Figure 3-6   Removal of MMI Assembly

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 flex circuits to ensure that they are correctly aligned before pressing home the locking tabs on the connectors; and,

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

For radios requiring IP integrity before release back into the field, the radio must pass a calibrated Air Leak test, subjecting the radio to a pressure equivalent to 1 m H_2O for 60 seconds. This test can only be performed at the CRU, and is an essential requirement for the IS rating of a radio.

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4. TECHNICAL DESCRIPTION

4.1 RECEIVER

Refer to Figure 4-1. Description based on TU-band radios.
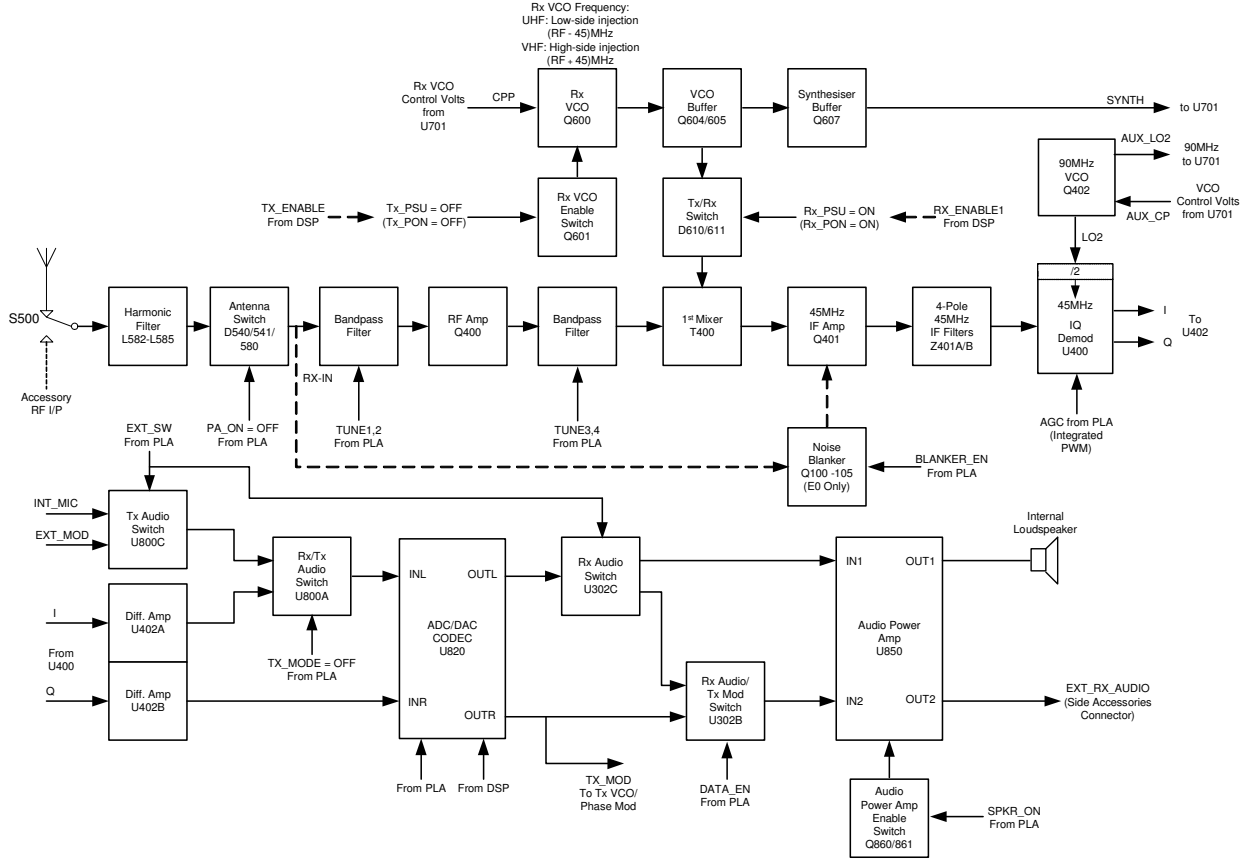
Figure 4-1   VHF/UHF Receiver

4.1.1 Front-End Filters and RF Amplifier

The receiver input signal from the main antenna or accessory RF input (S500) passes through the harmonic filter and antenna switch. With the portable in receive mode, diodes D580, D540, and D541 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 0.8 dB.

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

Varactor-tuned band-pass 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 reverse bias across the varactors of up to 14.0 V DC. A fixed 2.5 V positive bias, derived from the 5V0 supply using voltage divider R429 / R430, is applied to the cathodes of the varactor diodes. The control voltages, TUNE1 to 4, for the four variable negative bias supply voltages, originate at the PLA as PWM signals. The

control voltages vary from 0 to 3.3 V after integration of each PWM signal. The value of each of the four control voltages is dependent on channel frequency and tuning. Each control voltage is applied to level shifting transistors, Q404 to Q411, where they are converted to negative voltages in the range - 0.5 V to - 11.5 V. The - 12.0 V 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 matching for low noise. This provides excellent intermodulation and blocking performance across the full operating range. The overall gain of the front-end is typically 14 dB for all bands.

4.1.2   First Mixer and IF Section

The output of the last front-end band-pass filter is coupled into single balanced mixer T400 / D415 which converts the RF signal to an IF frequency of 45 MHz. The local oscillator injection level is typically + 8 dBm 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 15 dB of gain and in association with its output circuitry, presents the required load conditions to the 4-pole 45 MHz crystal filters Z401A / Z401B.

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

4.1.3   IQ Demodulator

Additional IF gain of approximately 45 dB occurs at U400 which is a dedicated IF AGC amplifier / IQ Demodulator configured for single-ended input and differential-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 – 90 dBm and can reduce the gain by approximately 100 dB for strong signals.

Conversion of the 45 MHz IF signal to I and Q baseband signals is carried out by the demodulator section of U400. The 90 MHz local oscillator signal is generated by VCO Q402 which is phase locked by the auxiliary PLL output of U701 via feedback signal AUX_LO2. The 90 MHz LO2 signal is divided down to 45 MHz internally in U400.

4.1.4   Receiver Audio Processing

The baseband audio from the IQ Demodulator (U400) is applied to a differential amplifier that cancels out DC offsets and converts the balanced demodulator IQ 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 a conventional dual audio amplifier, U850.

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

Discriminator audio is derived from the other CODEC output channel, OUTR. 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. The selected audio is applied to the other half of the audio amplifier, U850, which drives the Accessories Connector audio after which it is routed to the portable's Side Accessories connector.

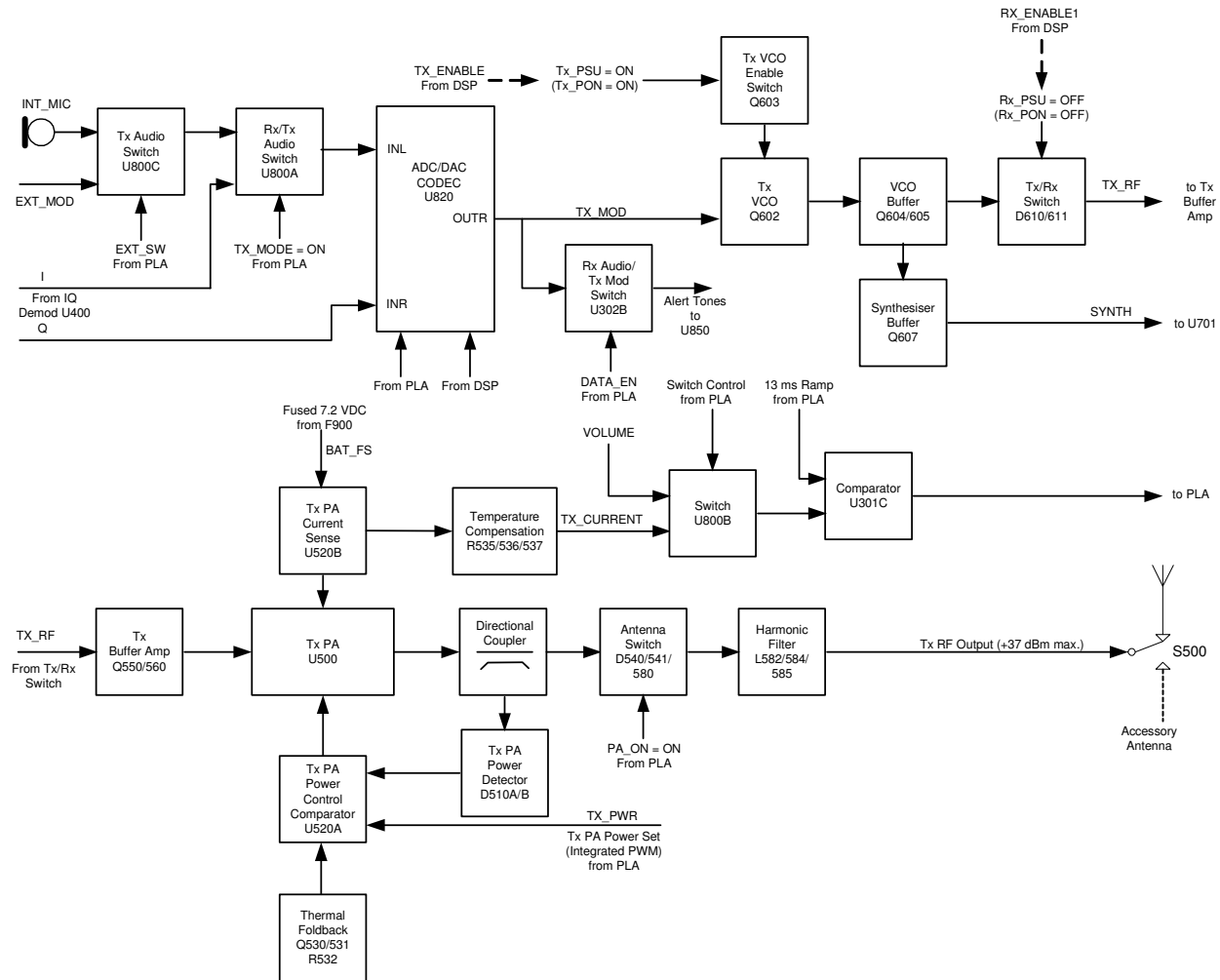## 4.2   TRANSMITTER

Refer Figure 4-2.

Figure 4-2   VHF/UHF Transmitter

4.2.1   Drivers and PA Stages

The RF output level from D611 in the VCO Tx / Rx switch is typically + 8 dBm. Tx buffer Q550/560 increases this level by approximately 6 dB (136 to 530 MHz), 9 dB (66 to 88 MHz) and also provides a high degree of VCO isolation from the Tx output.

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

Caution: During servicing, if drive power is lost while the power control voltage is high, the current into the PA may exceed its specified maximum rating. Therefore, the bench power supply current must be set to as low a value as necessary. The radio has additional in-built 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 output power level relative to the programmed channel frequencies.

Comparator U520B monitors the Tx PA current through L571.The output of U520B is temperature compensated by R535/536/537, and then passed to analogue switch U800B. Comparator U301C is used to compare the output of U800B with a 13 ms ramp signal. The output of U301C is passed to the PLA and then processed by the DSP.

4.2.2   Power Control

Transmitter output power is stabilised by a feedback control loop. A printed-circuit directional coupler, L590, R580, D510, and associated components form a 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 transmitter 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 before applying to the comparator.

Changes in the Tx PA module output level due to supply voltage, load, or temperature variations are detected and applied to the comparator, U520A. The comparator output proportionally adjusts the Tx PA module gate voltage, and therefore the Tx PA output level. High temperature protection is provided by thermistor R532 that progressively reduces the power level if the Tx PA module temperature becomes excessive.

4.2.3   Antenna Switch and Harmonic Filter

The antenna switch, consisting of PiN diodes D580/540/541, is switched by Q541/542 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 L582/584/585 and associated capacitors.

A mechanical changeover switch, S500, is provided to allow connection of an external antenna.

4.2.4   Transmitter Audio Processing

The internal electret microphone provides 10 mV RMS (nominal), to give approximately 60% of maximum system deviation. Analogue switch, U800C, switches between the internal microphone audio signal and external audio options and data input.

U800A provides CODEC (U820) 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 to D conversion by the CODEC. The processed transmitter audio/data from the CODEC output at VOUTR is applied to the VCO as a modulation signal with a level of approximately 200 mV p-p.

4.3 PHASE-LOCKED LOOP (PLL) FREQUENCY SYNTHESISER

4.3.1 General

Refer to Figure 4-3.

The PLL frequency synthesiser consists of one transmitter VCO, two receiver VCOs, loop filters, varactor negative-voltage bias generator, reference oscillator, and an integrated, fractional-N and integer-N synthesiser device U701. When combined, these components form the main and auxiliary PLL frequency synthesisers.
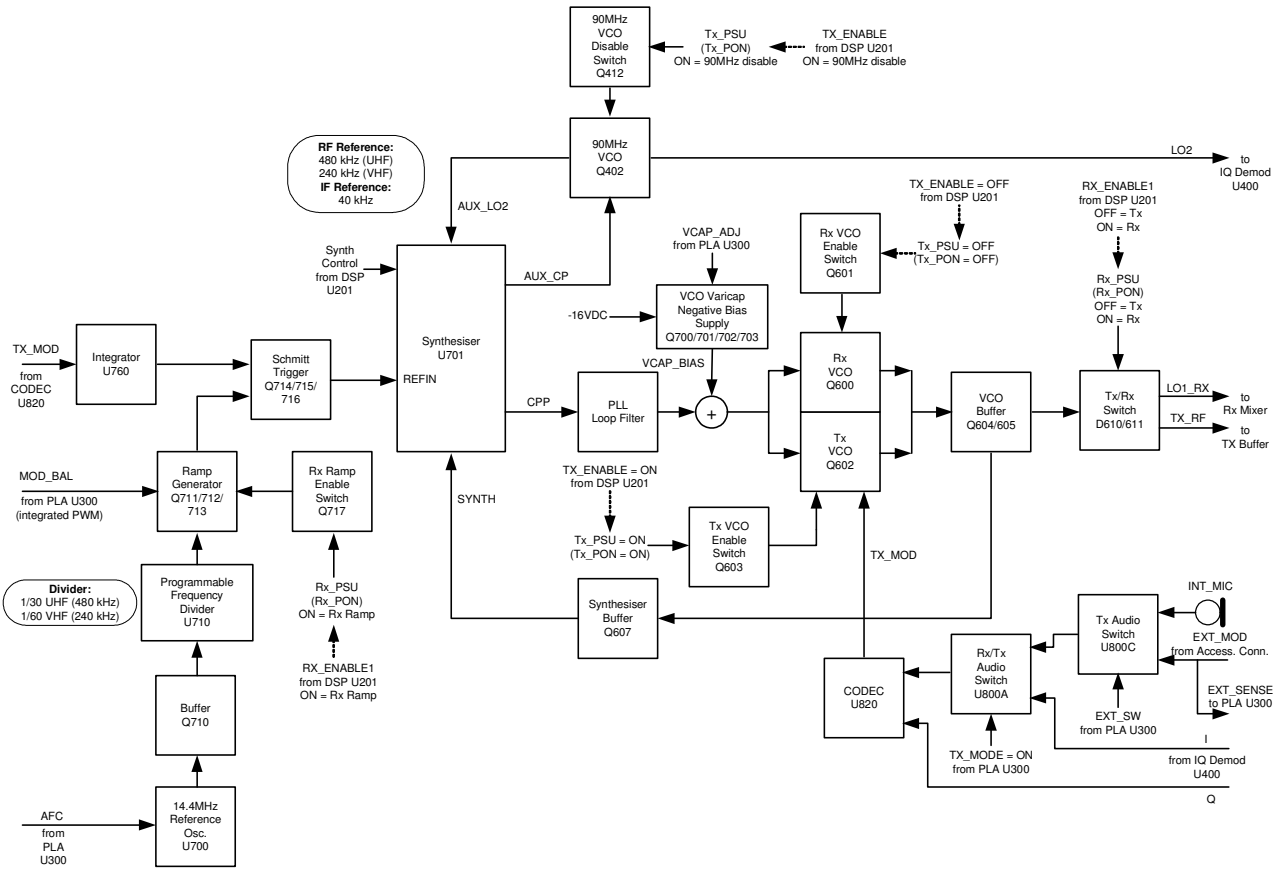

Figure 4-3   VHF/UHF Frequency Synthesiser

4.3.2 Integrated Synthesiser

The synthesiser device, U701, contains two prescalers, two programmable dividers, and two phase comparators, to provide a main and an auxiliary synthesiser. The main synthesiser controls the frequency of the Tx / Rx VCOs via the control voltage output at pin 1 and VCO feedback to pin 4. The auxiliary synthesiser is used to control the receiver 90 MHz second local oscillator via the control voltage output at pin 16 and VCO feedback to pin 13. The main synthesiser is a fractional-N device, and the auxiliary synthesiser is an integer-N device.

4.3.2.1 Main Synthesiser

The main fractional-N synthesiser divides the output of the Tx or Rx VCO down to the value of the comparison frequency. The comparison frequency is either 480 kHz (UHF) or 240 kHz (VHF). Programmable frequency divider, U710, divides the 14.4 MHz reference oscillator, U700, down to 480 kHz (UHF) or 240 kHz (VHF). The divided-down frequency is then compared by the main synthesiser phase comparator. If the two signals differ in phase or

frequency, an error signal is generated by the phase comparator. This error signal forces the VCO to change frequency in a direction to minimise the error signal.

A valid lock detect output is derived from pin 12 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.

4.3.2.2 Auxilliary Synthesiser

The auxiliary integer-N synthesiser is used to generate the second LO frequency, 90 MHz. The comparison frequency for this synthesiser is 40 kHz.

4.3.3 VCOs

The transmitter and receiver VCOs 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 (C636, C640, C671, C675, C681, C682, C686, C691, R683, R684, R685), 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 90 MHz 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 C467a.

4.3.4 Negative Bias Generator and Loop Filter

A positive and negative varactor bias supply, similar to the front-end varactor arrangement, is used to achieve the required broadband tuning range of the VCOs. PLL device U701 is programmed to deliver a nominal + 1.6 V output from phase detector/charge pump CPP regardless of the channel frequency selected. This voltage is filtered by the loop filter to remove synthesiser noise and reference frequency products. 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 an integrated PWM voltage (0.1 V to 3.3 V) at the VCAP_ADJ output of the PLA, with a level relative to the programmed state of the radio (e.g. channel frequency and Tx or Rx mode). The voltage is translated to a negative voltage between 0 V and – 16 V by the circuit comprising Q700 to Q703. The – 16 V rail of this supply is generated by U904E/D with D903 to D906 providing the voltage multiplying effect needed to achieve – 16 V. 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 synthesiser (U701 - REFIN) 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 6 dB per octave attenuation to frequencies above approximately 1 Hz;
- divider U710 divides the 14.4 MHz reference frequency down to 240 kHz (VHF) or 480 kHz (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; and,
- 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.

The modulation balance setting is carried out during alignment using a 100 Hz square wave (generated by the CODEC, U820) applied to the TX_MOD input and adjusted to give an optimum demodulated square wave output.

4.3.6   Reference Oscillator

The TCXO, U700, determines the overall frequency stability and frequency accuracy 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 14.4 MHz and is specified at ± 1.5 ppm frequency stability over the temperature range – 30 °C to + 80 °C.

4.4   SYSTEM CONTROLLER

Refer to Figure 4-4.
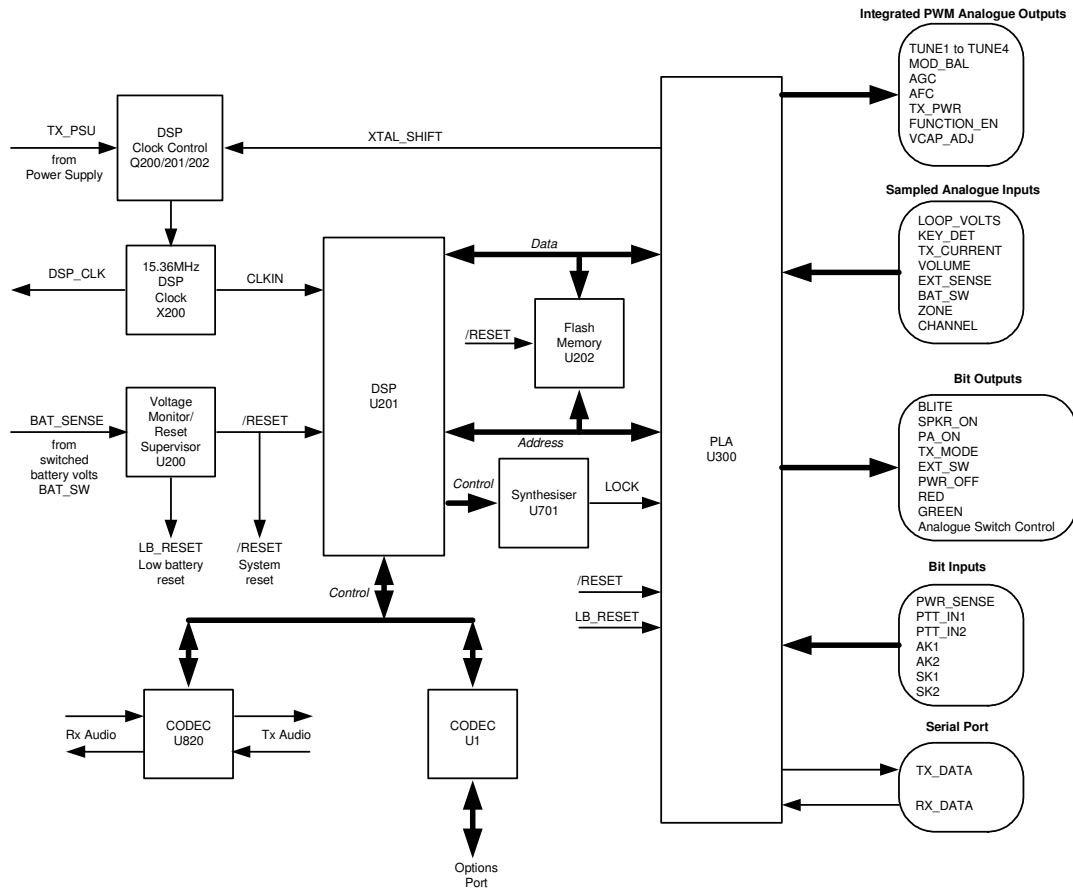
Figure 4-4   System Controller Block Diagram

4.4.1   DSP and PLA

The SRP9170/80 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 operating frequencies;
- modulation processing and filtering;
- demodulation 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; and,

- battery voltage and Tx current monitor.

4.4.2   DSP Clock Oscillator

The DSP is clocked by a 15.360 MHz oscillator that consists of crystal X200 and an internal DSP oscillator circuit. Q200, Q201, Q202 form a crystal switching circuit with C205 which, when activated by a command (XTAL_SHIFT) from the PLA, steers the oscillator away from potential interfering frequencies.

4.4.3   PLA PWM

4.4.3.1   Analogue Outputs

The PLA generates several analogue signals to control radio tuning. These outputs are derived from PWM signals.

The front-end analogue tune values (TUNE1 to TUNE4) originate from the PLA in the form of integrated 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 varactor tuning diodes.

Other analogue PWM derived signals used are:

- transmitter power (TX_PWR);

- receiver AGC voltage (AGC);

- receiver AFC voltage (AFC);

- function enable (FUNCTION_EN);

- varactor VCO tuning diode bias adjustment (VCAP_ADJ); and,

- modulation balance (MOD_BAL).

4.4.3.2   Analogue Inputs

Analogue inputs are monitored by comparators. Comparators U301A, B, C, D and U303A, B have their non-inverting inputs connected to a periodic ramp voltage generator, derived from a PWM signal from the PLA. Analogue voltages to be monitored are connected to the comparator inverting inputs. The analogue voltages are compared with the increasing ramp voltage. The comparator switches at the point where the ramp voltage exceeds the monitored voltage. The PLA determines the ramp signal time that this occurs, and converts it to a binary value.

The monitored analogue voltages are:

- Tx/Rx frequency synthesiser loop volts (LOOP_VOLTS);
- MMI key detection (KEY_DET);
- Tx PA current (TX_CURRENT);
- Transceiver audio volume (VOLUME);
- type of external device detection (EXT_SENSE);
- battery voltage (BAT_SW);
- Zone Switch value (ZONE); and,
- Channel Switch value (CHANNEL).

4.4.4   Digital I/O

4.4.4.1 Bit Outputs

Several ON / OFF digital outputs are used to control various sections of the transceiver:

- enable/disable transceiver audio output (SPKR_ON);
- control Tx / Rx PiN diode switch for Tx or Rx mode (PA_ON);
- control Tx / Rx audio switch, U800A (TX_MODE);
- control Tx audio source switch, U800C (EXT_SW);
- switch off transceiver DC supply (PWR_OFF);
- control Tx LED (RED);
- control Rx LED (GREEN);
- control MMI backlight (BLITE); and,
- various analogue switch on / off control.

4.4.4.2   Bit Inputs

The system controller scans various digital inputs to determine the state of the transceiver:

- battery voltage (PWR_SENS);
- Press-to-Talk switch status (PTT_IN1, PTT_IN2);
- Accessory Key status (AK1, AK2); and,
- Side Key status (SK1, SK2).

4.4.5   System Memory

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

4.4.6 Serial Data Interface

A serial data port is provided on the side accessories connector, S4. The serial data interface supports the following signals:

4.4.6.1 Receive Data (RxD1_In)

Transistors Q90 and 91 form an inverting buffer that translates the incoming data stream to 0 to 3 V logic. The following serial data voltage levels are supported when the appropriate accessory cable is used:

- RS232
- TTL
- USB

Transceiver software detects the type of peripheral connected to the accessories connector and inverts the incoming data if required. A pull-up resistor to + 5 V, R88a, is provide for external devices with open-collector (drain) outputs.

4.4.6.2 Transmit Data (TxD1_Out)

Serial data out is 0 to + 5 V levels. The serial driver, Q80, 81, 82, 83 can also be used as a + 5 V / 100 mA DC source.

4.5 POWER SUPPLIES

Refer to Figure 4-5.
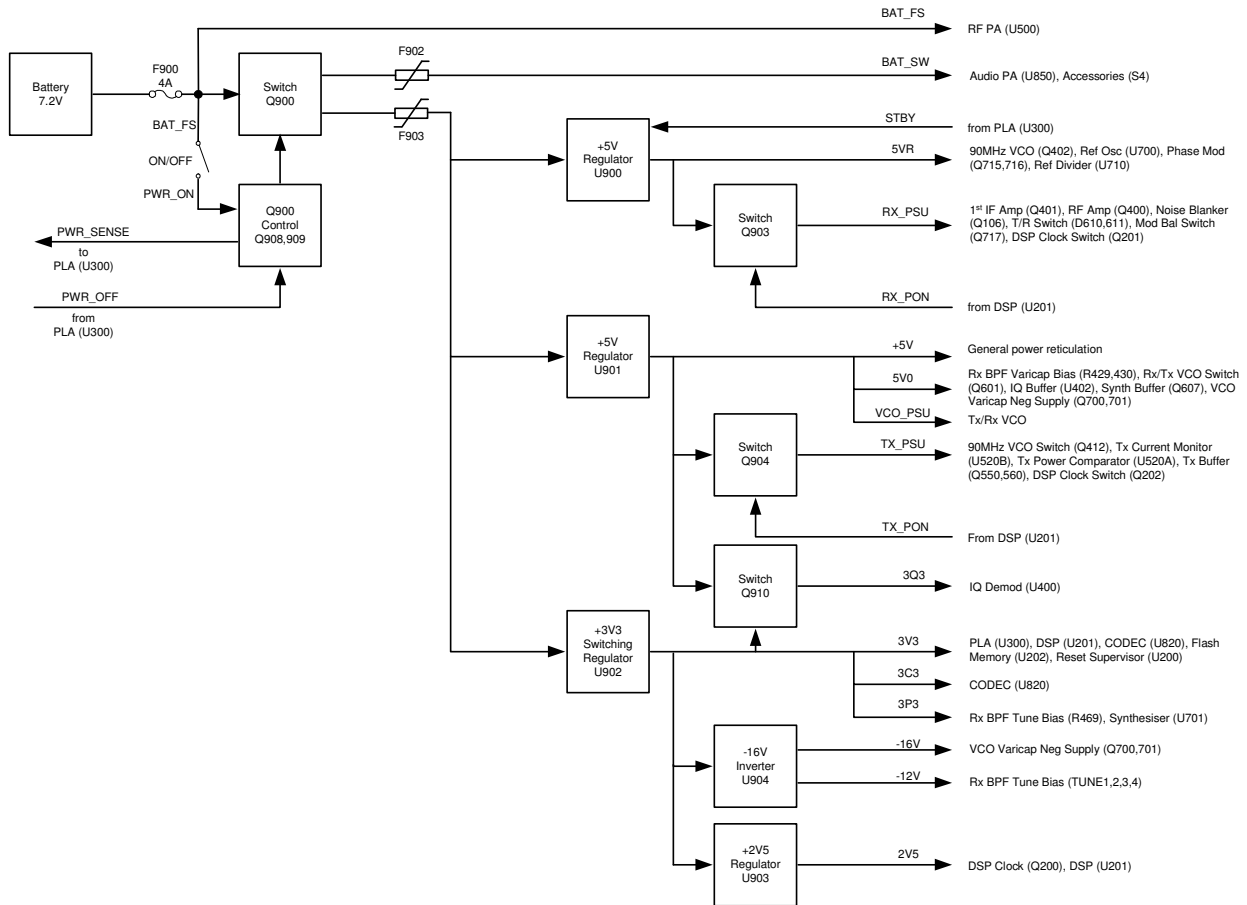
Figure 4-5 Power Supply

4.5.1 Power On Function

The unregulated battery input (6.4 V ~ 9.6 V DC) is routed directly to all high current devices after the battery fuse and is also switched via FET Q900 to provide power for all other circuits. The output from Q900 feeds three low dropout series regulators (U905 not fitted), switched battery voltage and a switch-mode 3.3 V 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, BAT_FS, 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 PLA samples the PWR_SENSE line and determines the state of the On/Off switch. If the On / Off switch is on, the PLA 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.

4.5.2 Power Supply Detail

The following is a list of the SRP91X0 power supplies and some of the devices and circuits they supply.

4.5.2.1 5V Regulator U900

This regulator can be powered down by a STBY signal from the PLA. The RX_PSU supply is switched via Q903. Circuits supplied by U900 are:

- 5VR to synthesiser reference oscillator (U700), divider (U710), and phase modulator;
- 5VR to 90 MHz VCO (Q402);
- switched RX_PSU to VCO output switch (D610, 611);
- switched RX_PSU to noise blanker (Q106);
- switched RX_PSU to phase modulator mod balance switch (Q717);
- switched RX_PSU to DSP clock switch (Q201); and,
- switched RX_PSU to receive front end (Q400) and 1st IF amp (Q401).

4.5.2.2 5V Regulator U901

The TX_PSU supply is switched via Q904. Circuits supplied by U901 are:

- + 5 V is general power reticulation to the transceiver;
- 5V0 to Rx BPF varactor bias (R429, 430);
- 5V0 to Rx / Tx VCO switch (Q601);
- 5V0 to IQ buffer (U402);
- 5V0 to synth buffer (Q607);
- 5V0 to Tx / Rx VCO varactor negative supply (Q700, 701);
- VCO_PSU to Tx / Rx VCO;
- switched TX_PSU to 90 MHz VCO switch (Q412);
- switched TX_PSU to Tx current monitor (U520B);
- switched TX_PSU to Tx power comparator (U520A);
- switched TX_PSU to Tx buffer (Q550, 560); and,
- switched TX_PSU to DSP clock switch (Q202).

U901 also supplies the 3Q3 switch (Q910). The 3Q3 supplies the IQ demodulator (U400).

4.5.2.3 3.3V Regulator U902/Q918

U902/Q918 forms a 3.3 V switching regulator. Circuits supplied by this regulator are:

- 3V3 to PLA (U300);
- 3V3 to DSP (U201);
- 3V3 to CODEC (U820);
- 3V3 to flash memory (U202);
- 3V3 to reset supervisor (U200);
- 3V3 to + 2.5 V regulator (U903) which supplies the DSP clock (Q200) and the DSP (U201);
- 3V3 to – 16 V inverter (U904) which supplies – 16 V to Tx / Rx VCO negative supply (Q700, 701), and – 12 V to Rx BPF tune bias (TUNE 1, 2, 3, 4);
- 3C3 to CODEC (U820);

4 - TECHNICAL DESCRIPTION

- 3P3 to Rx BPF tune bias (R469); and,

- 3P3 to synthesiser (U701).

4.5.2.4   Un-Switched Fused Battery

- BAT_FS supplies the RF PA (U500).

- BAT_FS supplies the transceiver On / Off switch.

4.5.2.5   Switched Battery

- BAT_SW supplies the audio PA (U850).

- BAT_SW supplies the Accessories Connector (S4).

4.6   KEYBOARD AND GRAPHIC DISPLAY MMI

The transceiver interfaces to the MMI assembly via connector S5 (transceiver) and J1 (MMI).
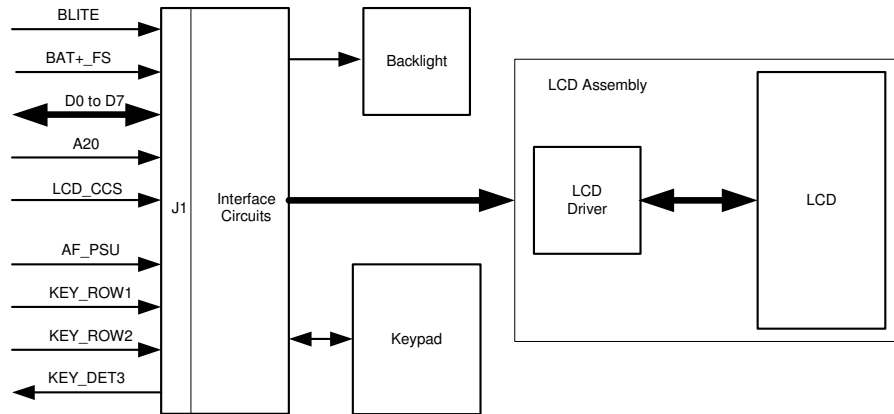
Refer Figure 4-6.

Figure 4-6   Keyboard and Graphic Display MMI

4.6.1   Keypad

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

The rows are driven directly by two signals KEYROW1 and KEYROW2 that are normally in the low state. Transistors Q910 to 916 generate a unique voltage on KEYDET3 for each column (COL1 to COL7). Any key in the same column generates the same voltage.

For example, if key "1" (SW1) is pressed Q913 turns on and sets up a voltage on KEYDET3 according to the value of R932, R971 on the MMI board and R343 on the main radio board. The activated key value is determined using the analogue-to-digital conversion scheme discussed in para. 4.4.3.2.

The MMI is backlit by a matrix of white LEDs, controlled by the BLIGHT (On or Off) line from the main transceiver PCB.

4.6.2   LCD Assembly Interface

The LCD assembly incorporates the LCD driver. The LCD is a 102 (H) x 64 (V) dot graphic display. The display assembly interfaces to the transceiver PCB via connector D100 using an 8-bit data bus (D0 to D7), write data control (WR*), read data control (RD*), and register select (A20) lines.

4.6.3 MMI Interface Signals

S5 Signal Name	J1 Signal Name	Function	Signal Type
0VA (1)	LCDRW (1)	Not used	0 V
D3 (2)	D3 (2)	Data bit 3	0 V or 5 V
D5 (3)	D5 (3)	Data bit 5	0 V or 5 V
D2 (4)	D2 (4)	Data bit 2	0 V or 5 V
D6 (5)	D6 (5)	Data bit 6	0 V or 5 V
D0 (6)	D0 (6)	Data bit 0	0 V or 5 V
D7 (7)	D7 (7)	Data bit 7	0 V or 5 V
D1 (8)	D1 (8)	Data bit 1	0 V or 5 V
D4 (9)	D4 (9)	Data bit 4	0 V or 5 V
LCD_CCS (10)	WR* (10)	Write data to MMI	0 V or 5 V, active low
0VA (11)	GND (11)	Ground	0 V
KEY_ROW1 (12)	KEYROW1 (12)	Keypad row 1 enable	0 V or 5 V, active low
AF_PSU (13)	AF_PSU (13)	Power supply	5 V nominal (from + 5V)
KEY_ROW2 (14)	KEYROW2 (14)	Keypad row 2 enable	0 V or 5 V, active low
N/C (15)	N/C (15)	TP1	Test point
BLITE (16)	BLIGHT (16)	Backlight enable	0 V OFF, 5 V ON
BAT+_FS (17)	BAT+FS (17)	Backlight power supply	7.2 V DC (nominal)
KEY_DET3 (18)	KEYDET3 (18)	Voltage proportional to key value	0 V to 5 V
A20 (19)	A20 (19)	Register select	0 V or 5 V

4.6.4   Function Keys

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 (i.e. Enter).

The SRP9180 has 12 additional keys arranged as a DTMF keypad.
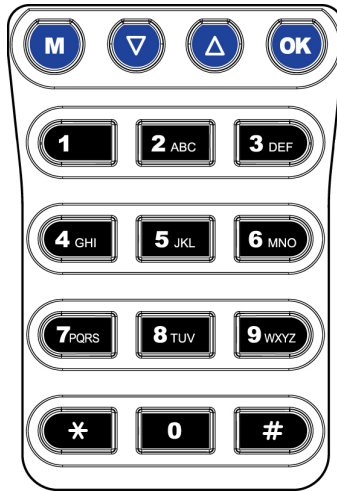
Figure 4-7   Keypad Layout

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5. ALIGNMENT (LEVEL 3 SERVICE ONLY)

This procedure is applicable to all versions of SRP9170/80 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 Field 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 remains installed in its chassis 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.	6.4 V to 9.6 V at 2.5 A
3.	Oscilloscope.	20 MHz bandwidth (minimum).
4.	SRP9170/80 Programming & Alignment Lead.	PAR-9180PRLDU
5.	SRP9170/80 Radio Test Interface Unit, or simple interface circuit in Fig 5.2.	PAR-9180RTIU
6.	PC.	486 DX 66 or better.
		Operating system Windows 95 or later. Minimum RAM – 16 MB. 5 MB free hard disk space. Floppy drive - 1.44 MB. Mouse and serial port required.
7.	SRM / SRP Alignment Tool.	Computer Software file.
8.	SRM/SRP Field Personality Programmer (FPP).	Computer Software file.
9.	SRP9170/80 Battery Eliminator.	
10.	Antenna Adaptor for Portable.	PA-ACON

5.2   TEST SET-UP

Refer Figure 5-1.

Notes for test setup:

1. The PTT switch on the Radio Test Interface Unit (refer Figure 5-2) activates transmit on the transceiver.

2. Interface data levels are TTL with RS232 polarity (i.e. 0 V = MARK, + 5 V = SPACE), and will work with most personal computers.

3. The 16 R resistor in the Radio Test Interface Unit simulates the speaker load.
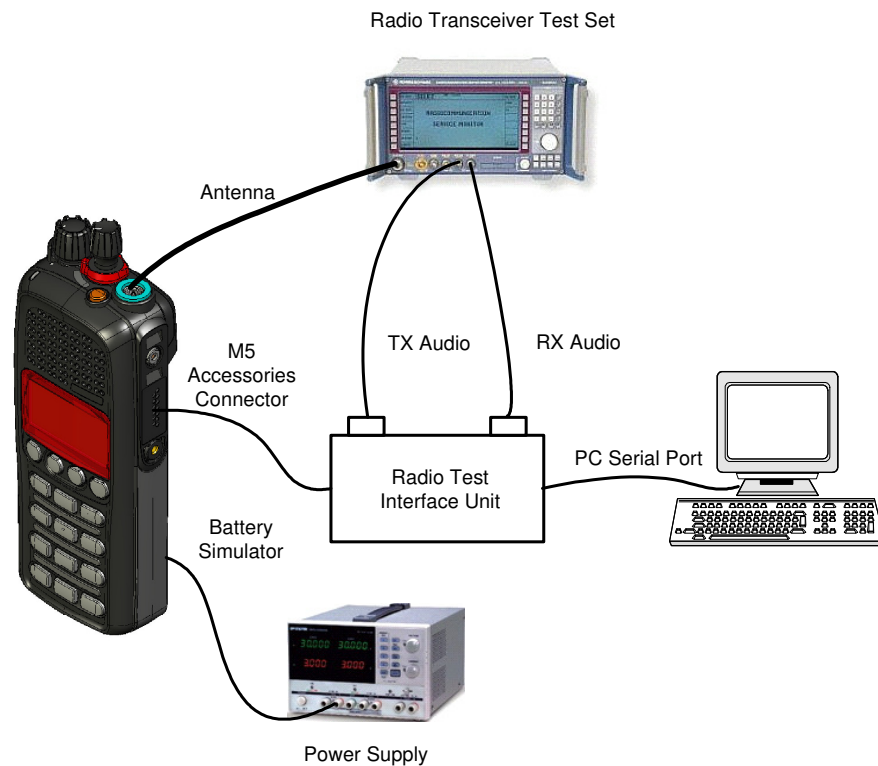

Radio Transceiver Test Set

Antenna

M5 Accessories Connector

TX Audio   RX Audio

PC Serial Port

Radio Test Interface Unit

Battery Simulator

Power Supply

Figure 5-1   Test Set-Up

Notes:

1.   Connect the radio to the test equipment as shown in Figure 5-1.

2.   Use an adaptor (P/N PA-ACON) to provide a coaxial antenna socket termination on the radio.

3.   A battery eliminator is used to supply power to the portable. This is an empty battery pack with external DC connections.
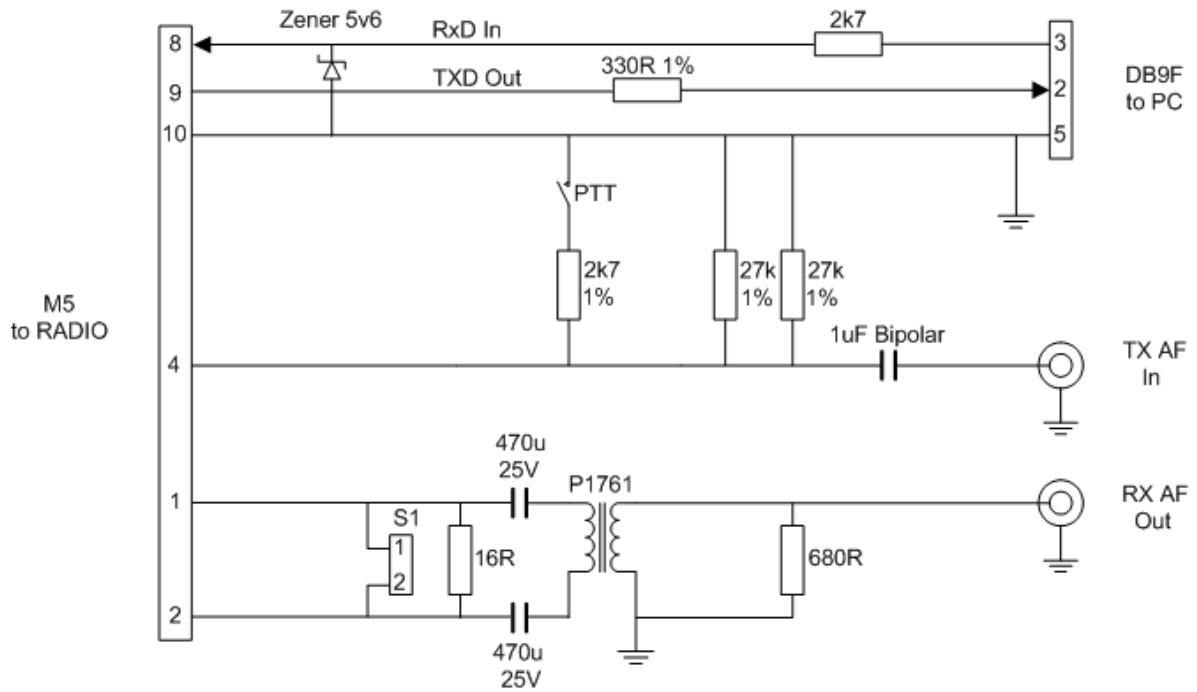
Figure 5-2 SRP9170/80 Radio Test Interface Unit

5.2.1 COMMS Set up

1. Copy the SRP9170/80 Alignment Tool Computer Software file to the PC hard drive and run the program.

   The Alignment Tool Opening Menu is displayed.
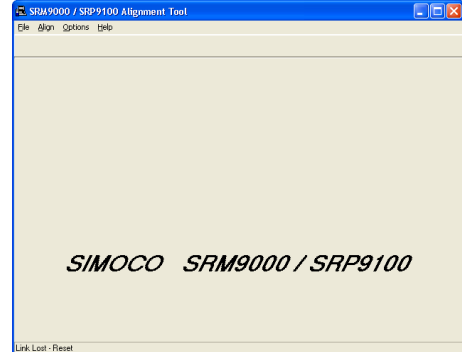
2. Go to the **Options** menu and choose **Comms Setup.**
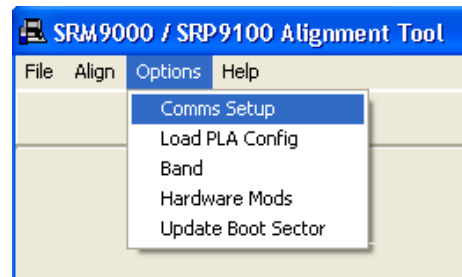
3. The **Comms Setup** dialogue box is displayed.

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

   (Usually COM1).
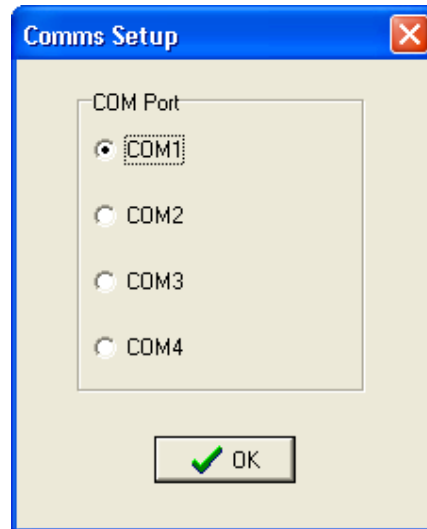
5.2.2 Radio Preparation

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

1. At the Opening Menu, select the **Align Menu** and choose **Prepare/Read Radio**.
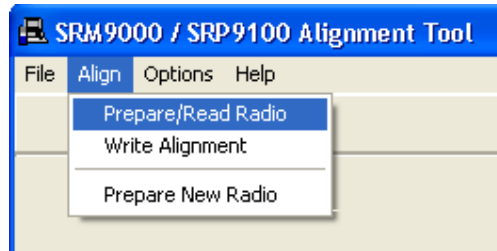
2. The **WARNING** is displayed.

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

    Choose <u>**Yes**</u> if you want to proceed and go to step 3.
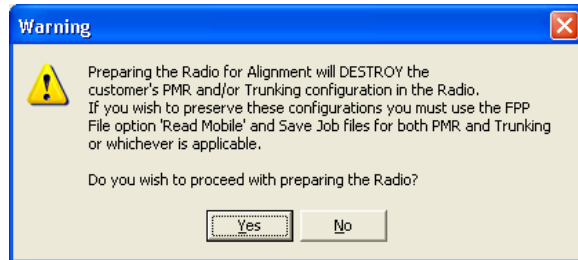
3. The radio alignment data is read (indicated by percentage bar) and stored.

    The test alignment data is downloaded into the radio.
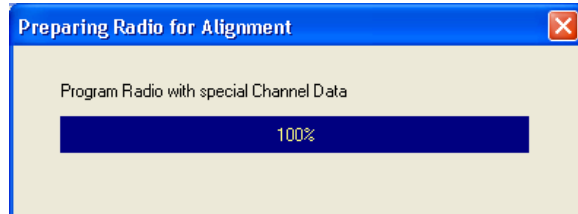
Note: In test alignment mode the radio is configured only for 12.5 kHz channel spacing, therefore all alignment is carried out at 12.5 kHz settings unless otherwise specified. When the radio is configured with the FPP for other channel spacings, the deviation related levels are calculated on a per channel 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
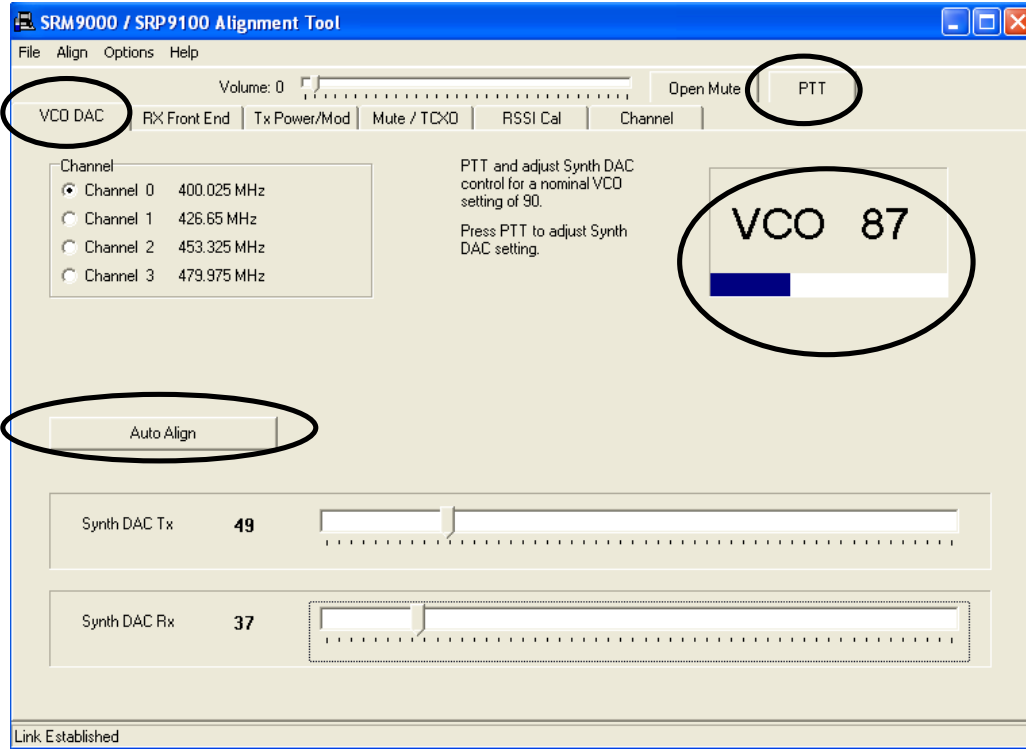
1. Select the **VCO DAC** page.

2. Select **Auto Align.** The Synth DAC Rx slider will automatically adjust its value for each receiver alignment frequency to set the VCO value between 85 and 95.

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 value between 85 and 95.

5.2.3.2 TCXO Frequency Adjust
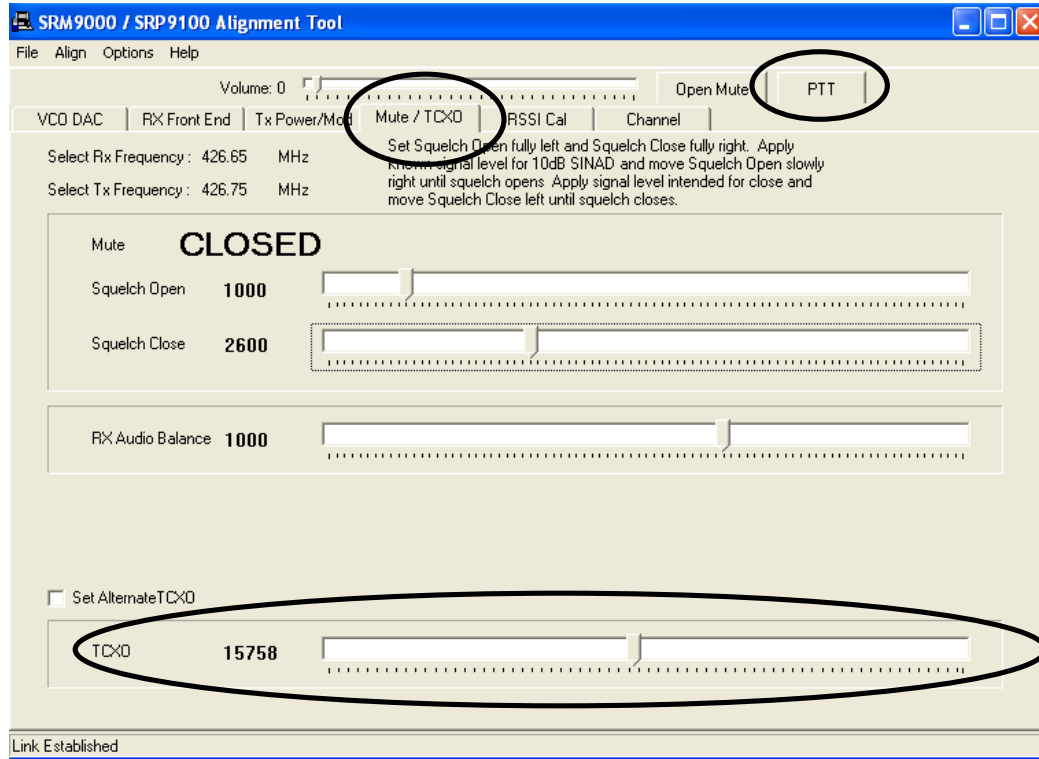
1. Select the **Mute/TCXO** page.

2. Select **PTT**.

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

5.2.3.3 Rx Front End
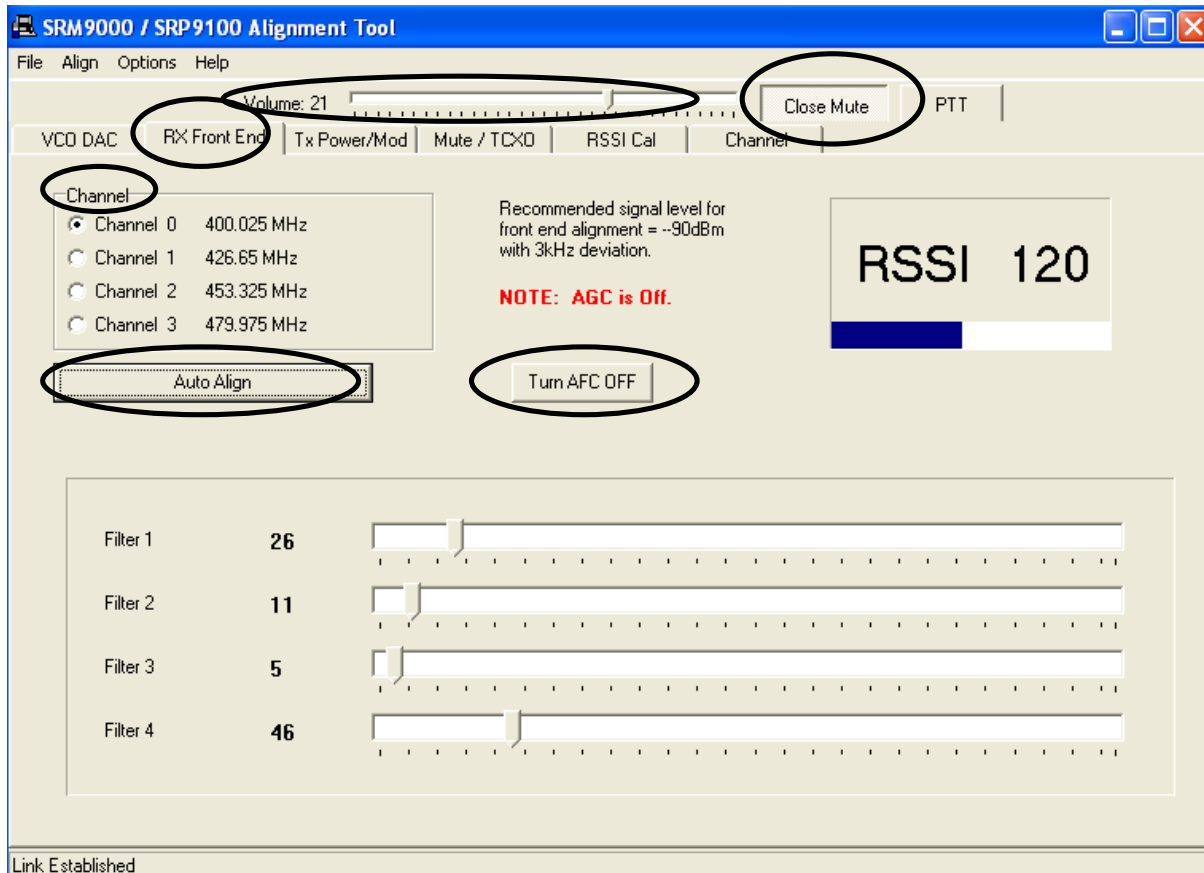
1. Ensure that the TCX0 Alignment has been done before proceeding with this section.

2. Select the **RX Front End** page.

3. Select **Open Mute**.

4. Set the **Volume** slider to 21. Speaker audio should now be visible on the CRO. If required readjust the **Volume** slider to a suitable level.

5. Select **Turn AFC ON**.

6. Set the Signal Generator to the Channel 0 carrier frequency, with a 1000 Hz modulation signal, a deviation of ± 3 kHz and an RF level of – 90 dBm.

7. Select **Channel 0**.

8. Select **Auto Align**. The front end will be tuned automatically and finish with an RSSI reading of typically around 120.

9. Repeat Steps 6 to 8 for the three remaining Channels (1, 2, & 3).

10. Change deviation to 1.5 kHz.

11. Verify that the receiver sensitivity is better than - 117.5 dBm for 12 dB SINAD on all channels. (Sensitivity is typically better than – 119 dBm).

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.
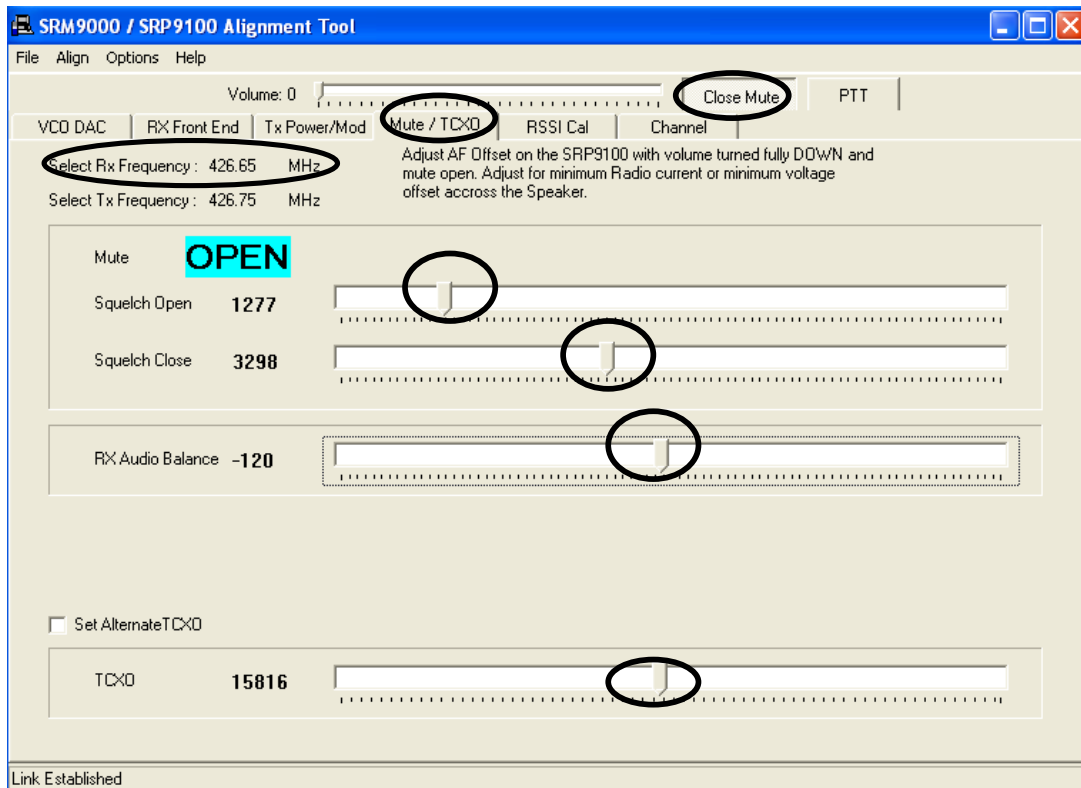

Squelch Adjustment

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 10 dB SINAD) is achieved.

3. Select **Mute Closed** and remove the RF input from the radio.

4. Set the **Squelch Open** and **Squelch Close** sliders to the fully left position. This ensures the receiver will be muted.

5. Set the **Squelch Close** slider to the fully right position.

6. Reconnect the RF input to the radio.

7. Adjust the **Squelch Open** slider to the right until the mute opens.

8. Reduce the Signal Generator output level by approximately 2 dB (or by an amount equal to the desired mute hysteresis level).

9. Adjust the **Squelch Close** slider to the left until the mute closes.

10. The mute should now open and close at the desired RF levels.

**RX Audio Balance Adjustment**

1. Unsquelch the radio and set the radio volume to minimum.

2. Monitor the DC voltage across the speaker or load. Adjust the **Rx Audio Balance** DAC to achieve a minimum in the measured DC voltage (within 0 V ± 10 mV) and leave at this setting.

5 - ALIGNMENT

5.2.3.5   RSSI
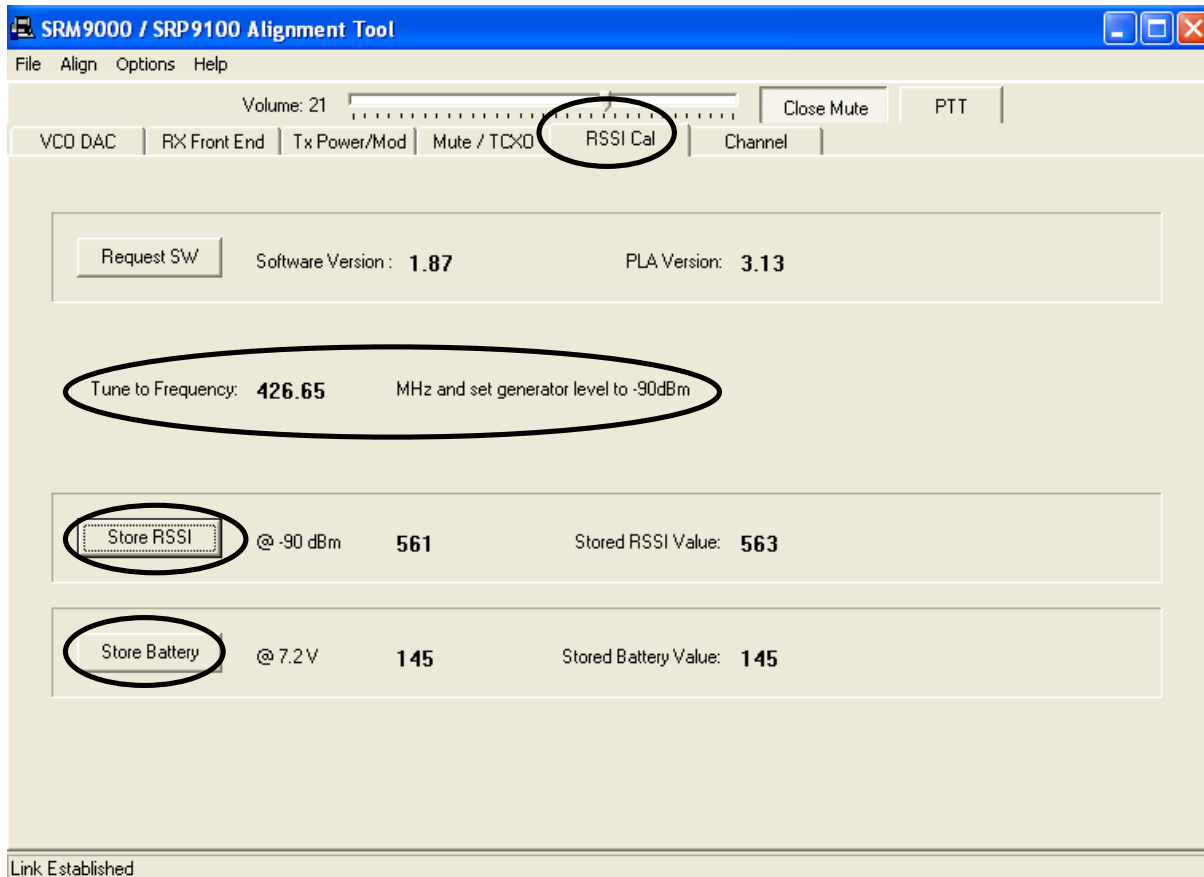
1.   Select the **RSSI Cal** page.

2.   Set the Signal Generator for a RF output level of – 90 dBm and 2 kHz 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 7.2 V ± 5 mV.

6.   Click the **Store Battery** button to store the calibration.

5.2.3.6 Tx Power
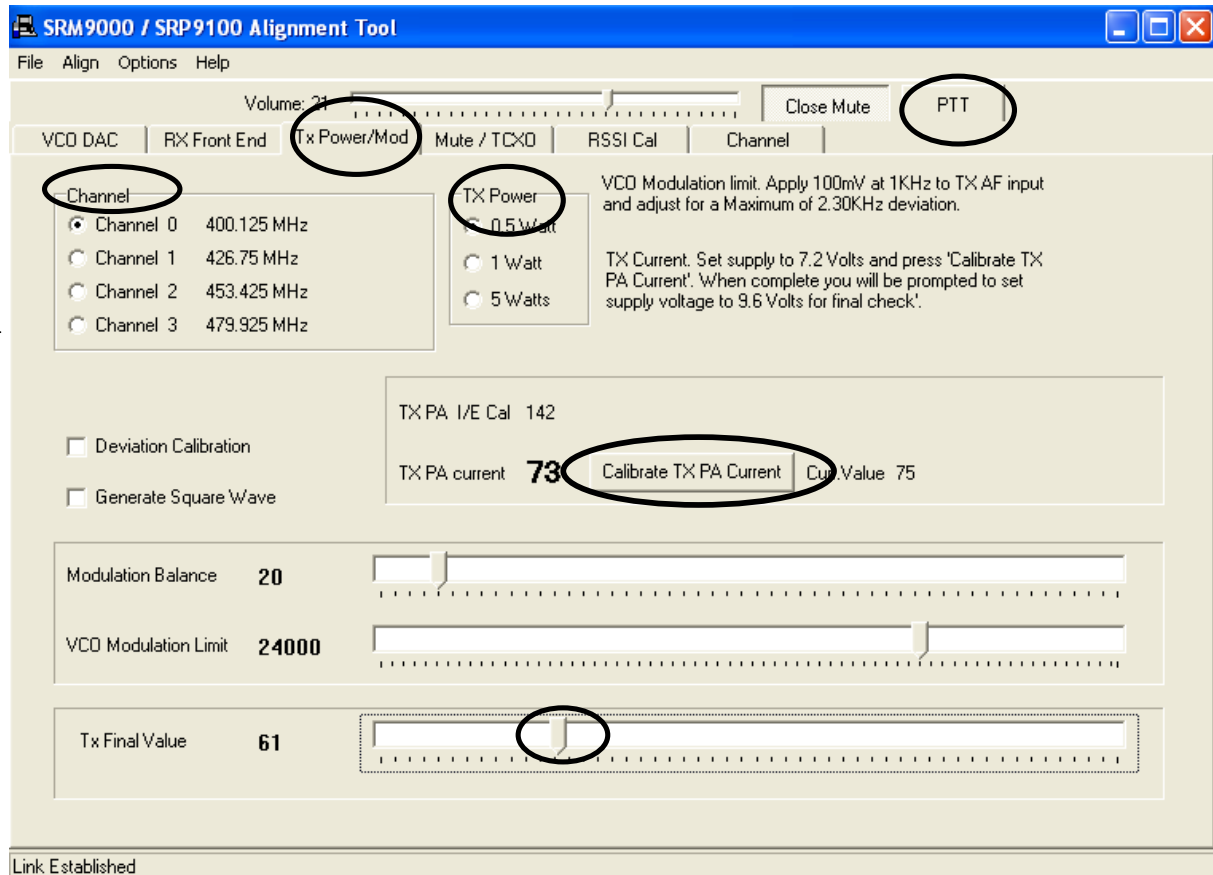
1. Select **Tx Power/Mod** page.
2. Select **Channel 0**.
3. Select the **0.5 Watt** power level.
4. Press the **PTT** button.
5. Adjust the **Tx Final Value** slider for a power output of 0.5 W.
6. Deselect **PTT**.
7. Repeat steps 3 to 6 for the three remaining channels (1, 2, and 3).
8. Select **Channel 0**.
9. Select the **1 Watt** power level.
10. Press the **PTT** button.
11. Adjust the **Tx Final Value** slider for a power output of 1 W.
12. Deselect **PTT**.
13. Repeat steps 9 to 12 for the three remaining channels (1, 2, and 3).
14. Select **Channel 0**.
15. Select the **5 Watt** power level.
16. Press the **PTT** button.

17. Adjust the **Tx Final Value** slider for a power output of 5 W. Note that the supply current is less than 2.5 A.

18. Deselect **PTT**.

19. Repeat steps 15 to 18 for the remaining 3 Channels (1, 2, and 3).

20. Press **Calibrate TX PA Current** button and follow the instructions to automatically set the maximum current limit.

5.2.3.7 Modulation
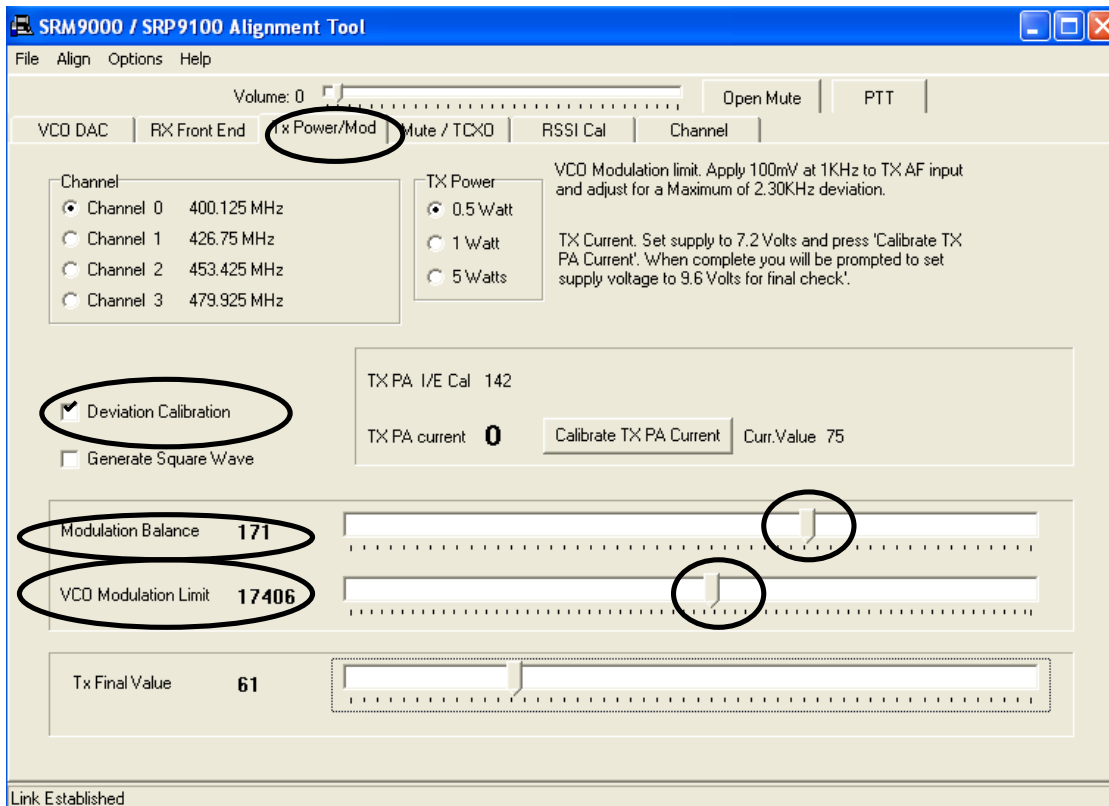
1. Select **Tx Power/Mod** page.

2. Select **Deviation Calibration**.

3. Select **Channel 0**.

4. Select the **0.5 Watt** power level.

5. 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.

6. Repeat steps 4 and 5 for the three remaining channels (1, 2, and 3).

7. Deselect **Deviation Calibration**.

8. Set the Tx Audio input signal from the audio generator to 1 kHz at 100 mV RMS.

9. Adjust the **VCO Modulation Limit** slider for a maximum peak deviation of $\pm$ 2.3 kHz.

10. Repeat step 9 for the three remaining channels (1, 2 and 3).

11. Reduce the Tx Audio input level to 10 mV RMS and check that the deviation is within the range ± 1.25 kHz to ± 1.75 kHz for all channels.
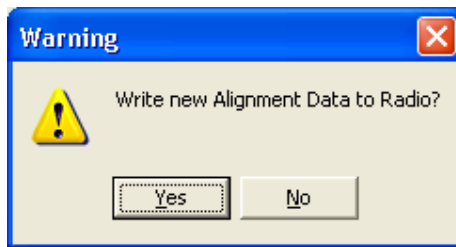
5.2.3.8 Programming

When all channels have been aligned the radio is programmed with the new alignment data:
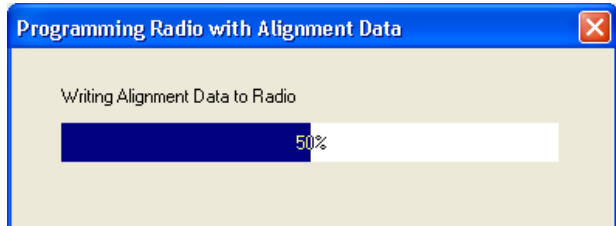
1. Select **Align** and choose **Write Alignment**.
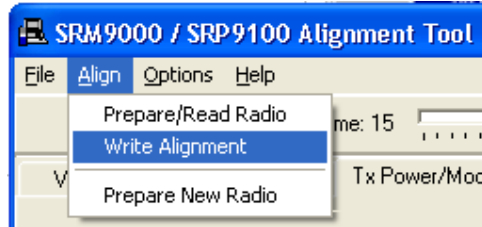
2. A warning message is displayed.

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.

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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.

6.1 COMMON PARTS

Ident	Description	Quantity per Assembly	Part Number
	SRP9180 PTT Button.	1	6102 310 0249
	SRP9180 Function Button – A.	1	6102 310 0250
	SRP9180 Function Button – B.	1	6102 310 0250
	SRP9180 Speaker Clip.	1	6102 310 0242
	SRP9180 Speaker Cloth.	1	6102 310 0279
	SRP9180 Microphone Seal.	1	6102 310 0278
	SRP9180 Volume Pot.	1	6102 141 0000
	SRP9180 Channel Pot 16 Position.	1	6102 141 0001
	SRP9180 Speaker Flex PCB.	1	6102 309 6245
	SRP9180 Control Flex PCB.	1	6102 309 6242
	SRP9180 Accessory Flex PCB.	1	6102 309 6244
	SRP9180 Front Case Black Assy.	1	6102 350 1372
	SRP9170 Front Case Black Assy.	1	6102 350 1371
	SRP9180 LCD Dust Gasket.	1	6102 310 0261
	SRP9180 Keymat.	1	6102 310 0253
	SRP9170 Keymat.	1	6102 310 0319
	SRP9180 Volume Knob Assy.	1	6102 350 1445
	SRP9180 Front Case Label.	1	6102 310 026
	SRP9170 Front Case Label.	1	6102 310 0320
	SRP9180 Speaker.	1	6102 640 0007
	MIC ELECTRET.	1	6102 640 0001
	SRP9180 Graphics MMI Assy.	1	6102 350 1401
	RETAINER MIC.	1	3513 905 6054
	SEAL ACTUATOR.	5	3513 905 8179
	SEAL LOUDSPEAKER.	1	3513 905 8180
	SRP9180 LCD Lens.	1	6102 310 0252

6.2 ACCESSORIES

Description	Part Number
ACCESSORY CORD STRAIGHT (UNTERMINATED) SRP91X0.	E-CAB-M5-S5. OP13-50
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 SRP9180 Li-ion 2200 mAh.	PAR-9180BATL2x
EXTERNAL ANTENNA CONNECTOR.	PA-CON
LEAD PROGRAMMING SRP9180.	PAR-9180PRLDU

APPENDIX A - ACCESSORY CONNECTOR

The following table details the pin-out on the accessory connector.

Pin	Signal Name	Use	Signal type	Direction
1	Ext_Rx2	Balanced Audio Out (+).	10 Vp-p into 16 ohm	To Accessory.
2	Ext_Rx1	Balanced Audio Out (-).	10 Vp-p into 16 ohm	To Accessory.
3	B+	Battery Supply Voltage.	6.5 V to 8.4 V (68 ohm resistor in series)	To Accessory.
4	Ext_Mod	Multi-function. Ext audio mod in: Accessory sense voltage:	External modulation. 5 mV RMS nominal. 0 to 5 V DC sense.	To Radio.
5	Acc_Key2	PTT.	Active low (ground).	To Radio.
6	Acc_Key1	Accessory enabled.	Active low (ground).	To Radio.
7	0VA	Ground.	0 V	Ground.
8	RxD1_In	Serial receive data.	RS232 (- 12 V Mark, + 12 V Space) USB (2.8 V High, 0.8 V Low) TTL (+ 5 V High, 0 V Low)	To Radio.
9	TxD1_Out	Serial transmit data 5 V supply output (100 mA max.).	RS232/USB 5 V (continuous TTL space).	To Accessory.
10	N/C	Not used.		NA
11	N/C	Not used.		NA
12	N/C	Not used.		NA
13	0VA	Ground.		Ground.

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APPENDIX B - ACCESSORIES

Lapel Speaker Microphone
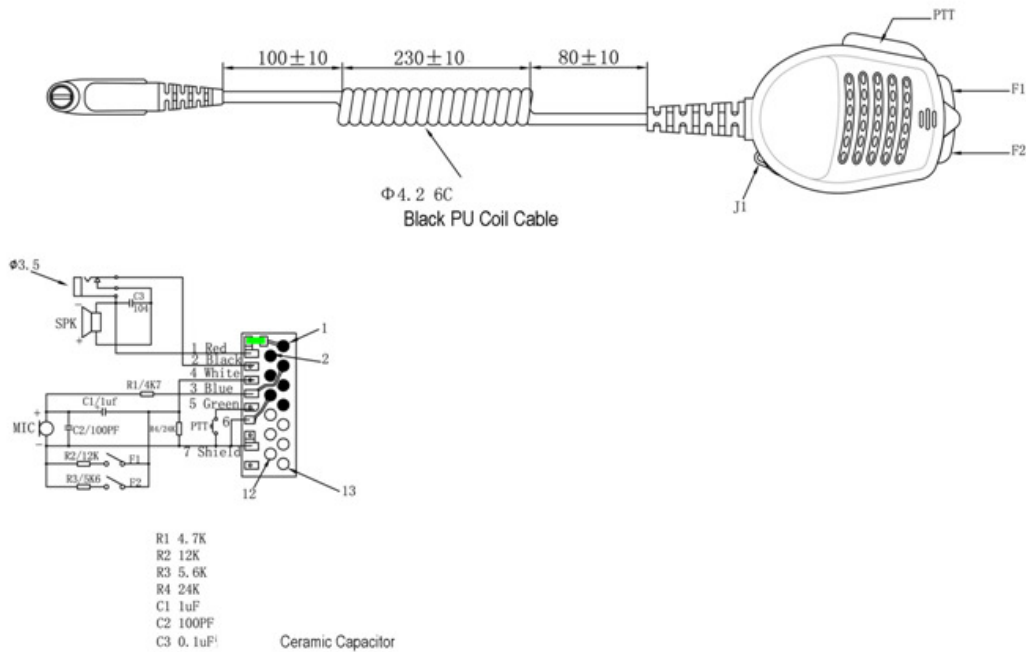
PAR-9180LMS2

Figure B-1   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 450 mm curly cable (un-stretched) fitted with a M5 type plug.

Specification

Microphone

Maximum circuit current:	10 mA
Type:	Electret.
Impedance:	2 kΩ (nominal)
Sensitivity:	– 64 dB ± 4 dB at 1 kHz (0 dB = 1 V/µbar)
Sensitivity variation relative to 1 kHz over frequency range:	Less than + 10 dB, – 2 dB, 300 Hz to 4 kHz
PTT switch:	Push-to-Talk.

DC voltage overshoot during switching periods: Within 2% of nominal voltage.

Loudspeaker

Impedance: $16 \ \Omega \pm 2 \ \Omega$

Power rating: 0.3 W nominal, 0.5 W maximum.

Headset socket: 3.5 mm - loudspeaker disconnected when jack inserted.

Environmental

Operating temperature range: $- 20 \ °C$ to $+ 55 \ °C$

Storage temperature range: $- 40 \ °C$ to $+ 80 \ °C$

OPERATION

Ancillary Type

R4 identifies to the radio that the accessory is a Lapel Speaker/Microphone.

Microphone

The microphone connects to the radio via pin 4 and is powered via pin 3 on the M5 plug.

When the Lapel Speaker/Microphone is connected to the radio, the radio's internal microphone is disabled.

Loudspeaker

The loudspeaker connects to the radio via pin 1 and pin 2 of the M5 plug.

When the Lapel Speaker/Microphone is connected to the radio, receive audio is routed to the accessory loudspeaker, the radio's loudspeaker is disabled.

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