SRM 9000 Series
FM VHF/UHF Mobile
Radio Transceiver

SERVICE MANUAL

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SRM9000 Series FM VHF/UHF Mobile Radio Transceiver TNM-M-E-0001 ~ Iss 3

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

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Document History

Issue	Date	Comments
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2	August 2002	Re-branded to TMC Radio.
3	November 2004	Rev 9 information

List of Associated Publications

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Warnings and Cautions

WARNING

Compliance with RF Energy Exposure Standards: To minimise exposure to RF fields during equipment service and repair, the antenna terminal of the SRM9000 radio should be connected to a suitable non-radiating RF load when the transmitter is in use.

WARNING

SRM9000 radio equipment is to be connected *only* to 12-volt negative earth systems. In vehicles with a 24-volt supply, an approved 24V/12V converter must be used. The supply must not be taken from a 12V tap on the battery.

WARNING

To avoid RF injury, do not touch the Antenna when the Transmitter is in use.

WARNING

Double-fused 12V Supply Leads, Antenna cables and Speaker wiring is to be routed as far away as possible from gas or fuel lines or any electronic control device. The radio transceiver and antenna are to be mounted as far away as possible from these devices and their cabling.

Equipment is to be installed, by a competent person, in accordance with the requirements of local radio communications authorities and/or Health and Safety regulations.

Post installation checks should be performed to ensure that there is no effect on the operation of the vehicle's electronics.

WARNING

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

WARNING

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

Caution

During disassembly and assembly, refer to Torque Settings in Section 1.7

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).

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 a 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.

Certain special conditions for the radio may also occur during the alarm - see Conditions during Alarm.

A dedicated SFM (trunked system) that is sent by pressing the Alarm Key.

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.

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 of a Portable.

Automatic Volume Feature whereby the background audio level is monitored and if this is found to be noisy then the volume level is increased to compensate, allowing the user to hear better.

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

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

Busy The state of a channel such that:

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

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

C4FM Compatible 4-Level Frequency Modulation.

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

CCSC Control Channel System Codeword.

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

Disabled	The 'False' state of a parameter. That indicates this parameter is not active. Typically this state is represented by an unmarked check box. Compare with Enabled.
DSP	Digital Signal Processor.
DTMF	Abbreviation of Dual Tone Multi-Frequency signalling. Used to dial into Telephone networks using tone dialling.
Dual Watch	A facility that enables the Radio to periodically monitor another channel for a signal above squelch. Typically applications are checking an emergency channel whilst on another channel.
Dynamic User Groups	These groups use a temporary user Ident to group a number of units together who would not normally make up a group. These groups are formed by the TSC (contrast with User Defined Groups) sending a special message to units instructing them to add a new group Ident to their list of groups. Up to 8 groups can be defined. These temporary groups are lost at switch off unless 'Save Groups at Switch Off' is enabled.
Economiser	A process by which the Receiver is powered down whilst there is no received signal. Periodically the receiver is powered up to check for such a signal. This is used to extend the battery life of a Portable.
Enabled	The 'True' state of a parameter. That indicates this parameter is active. Typically this state is represented by a mark (either a tick or a cross) in a check box. Compare with Disabled.
Encode	Transmission of signalling. Either Selcall where selcall tone digits are encoded into tone frequencies or CTCSS/DCS where tones modulated onto the channel's carrier.
ETS	European Technical Standard.
External Alert	A facility for switching on various ancillary devices to meet customer's individual requirements (e.g. car horn, flashing lamp etc.) when 'called'. Only available on a mobile radio. To make available: go to Hardware Components, Terminal Settings and set Product Type to a Mobile type.
Fallback	A mode of operation that may be entered when the Network is suffering a malfunction. During this mode certain facilities (e.g. PSTN) may not be available.
FFSK	Fast Frequency Shift Keying. This is a signalling system for the transfer of digital information. It works by using one of two audio tones to represent data being transmitted.
Fleet	A group of units formed such that only a shortened form of dialling (2 or 3 digits) is required between them. These groups are normally assigned contiguous ident's.
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.
FPGA	Field Programmable Gate Array.
FPP	Field Personality Programmer.

Hash (#) digits	These digits are used for two purposes: • For Selcall identities (encode and decode) - known as User Id digits. These digits are replaced by the user id entered at switch on (if enabled) • Use in DTMF dialled strings - their use is network dependent to access special services.
IDENT	A 13 bit number used for Identification purposes. Associated with a Prefix (PFIX) this forms a 20 bit address which is used for identification purposes in signalling between the radio and the trunking system.
Identity	Name given to a sequence of tones which 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 type of calls are used to allow a 3rd party to join into an existing call.
Link Establishment Time	A delay incorporated into the start of every selective call or DTMF transmission which allows for the finite delay of the radio equipment in responding to any radio signal. This includes both the commencement time of the originating transmitter and the response time of the receiver.
Locked	A state of a channel whereby it is not possible to change channels using the normal up/down keys on the channel menu until the OK key is pressed. See Auto Channel Selection Lock.
MEP	Miniaturisation Extent Parameter. Used in systems that use ANN numbering.
Modifier	Part of a dialled string that modifies the nature of the call made to a number (e.g. dialling "*9" before the number that is to be dialled will modify the call to be an emergency call).
MPT1327	A signalling standard for Trunked Private Land Mobile Radio Systems. Defined for systems in the UK but also used outside the UK. Issued January 1988.
MPT1343	A System Interface Specification for commercial Trunking networks. Defined for systems in the UK but also used outside the UK. Issued January 1988.
NDD	Network Dependent Data. This is a field within the CCSC codeword that is used by the trunking system to identify information about the trunking network and, in particular, information specific to the site that is radiating the control channel. It is used by the radio when it is acquiring a control channel to identify valid channels.
Null Id	A selcall identity that is not defined and whose tones' field is displayed as a blank.
Open	A state where transmit and receive are allowed. The channel is no longer open when reset. Contrast with Closed. Normally an Open channel would not have Selcall Mute and PTT Inhibit would be disabled.
OPID	Network Operator Identity used in Regional Systems. See Roaming.
PABX	Private Automatic Branch Exchange.

Password An optional password system available on the radio. This feature is only available if the radio does has a display and a keypad. To make available: go to Hardware Components, Terminal Settings and set Product Type to one which has a display and a keypad.

PFIX The 7 most significant bits of an MPT1327 address number. Normally same fleet units have same prefix. Relates to individual and group address numbers.

PLL Phased Locked Loop.

PMR Private Mobile Radio (not normally trunked).

Priority Channel A channel in a search group that is scanned between every other channel.

PSD Peak System Deviation.

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.

Queuing The storing of an 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 setup 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, an Individual reset or a Group reset (Call Types in Decode Identity). When a radio is reset the effect on the radio will be as follows:

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

Roaming	This is a process that allows changing between regional trunking systems which have different Operator Identities (OPID 's). Not allowed on MPT1343 Systems.
RSSI	Received Signal Strength Indicator.
Scanning	Process of switching between the channels in the nominated search group in cyclic sequence, stopping when the search condition (which may be to look for either a free or a busy channel) is satisfied.
SDM	Short Data Message.
Search Group	A group of channels that are either scanned for a signal above the search threshold or are compared and voted for the strongest signal
Selcall	Selective Calling - a system of signalling which allows 'dialling up' of specific mobiles, portables and controllers. Such a system may be used to pass messages as a data message to a specific user or group of users. It can be used to provide remote switching facilities and to provide access control into community repeaters or similar devices.
Selcall Mute	A state of the audio gate whereby the loudspeaker is muted (closed).
Selcall System	Selective Calling, uses a tone sequence at the start, and end, of a call to control which members of a fleet react to the transmission.
SFM	Short Form Memory.
Sidetone	Sidetone is the audio which can be (optionally) heard when Selcall, DTMF and toneburst transmissions are made.
Simplex	Mode of operation whereby the radio operates as a conventional fixed channel radio outside the Trunking network.
Squelch	System used to prevent weak, unintelligible signals and random noise from being heard by a radio operator while still allowing intelligible signals to be received normally. This is accomplished by the use of a threshold below which any received signals are ignored. Only signals whose signal-to-noise ratio is above the squelch level cause the audio circuits of the radio to be enabled, with the result that only satisfactory signals are received. The squelch level is specified in SINAD.
Star (*) digits	Digits known as Status or Message digits. These digits are used for three purposes: • Status Digits for Selcall Identities • Wildcard digits in Status strings • Use in DTMF dialled strings - their use is network dependent to access special services.
Status	A feature whereby a radio's status (or usually the status of the radio's user) can be transmitted and a status message from other radios can be displayed. This operates through status digits in selcall identities. Either in Encode Identities or Decode Identities as follows: Encode Identities: Status digits within the identity are used to transmit the current situation of the radio's user (E.g. "Out To Lunch"). Decode Identities: Status digits are looked up in a table (Status Menu) for possible messages to display.
SW	Software.
SYS	System Identity Code part of the CCSC.
TCXO	Temperature Compensated Crystal Oscillator.

Temporary	Temporary Registration; a process carried out by the Dispatcher due to some system failure that prevents it from carrying out normal registration. The radios will recognise this temporary registration mode but will otherwise use the network in the same way as if they were registered. They may be required to re-register when normal registration mode is resumed.
Three Tone Reset	This is a system whereby a call to a user automatically reset all other users in a group. Example: a call to user '12345' would call 12345 and reset all other users on this channel with an identity 123nn where n can be any digit 0-9, A-F.
Timed Reset	Facility that causes the Radio, after a certain period of time, to restore current channel to it's initial condition e.g. if it was previously searching it will resume searching.
Time Shared	A time-shared control channel is one which 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 which 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 which satisfies the required conditions. It involves examining all the channels which satisfy the required conditions, and then selecting the channel with the highest signal strength.
VOX	Voice Operated Transmit.

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APPENDICES

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1. INTRODUCTION

1.1 GENERAL

The SRM9000 series of FM mobile radio transceivers is designed for PMR and Trunked operation in VHF and UHF radio systems.

The system is available in a number of functional variants. Each variant uses the standard SRM9000 mobile transceiver, which is software configured for different control ancillaries. The software configuration together with the type of controller (Basic or Enhanced microphone, Handset, or Alphanumeric Control Head) determines the radio features for the different variants as follows.

	PMR/Trunked
Basic Telemetry Transceiver No Display or Control Head.	SRM9005
Low Range Version with Basic Fist Microphone.	SRM9010
Mid Range Version with Enhanced Alphanumeric Fist Microphone.	SRM9020
High-end Version with Alpha Display Handset.	SRM9025
System Level Remote Control Head with Alpha capability and Handset / Fist Microphone / Desk Microphone options.	SRM9030

1.2 SCOPE

This manual provides technical specifications, description and servicing details for the SRM9000 series of mobile radio transceivers together with the related microphones and control heads.

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 analog or digital modulation and demodulation. Electronic tuning is used throughout the mobile to eliminate manual tuning and level adjustment.

A Digital Signal Processor (DSP) and a Field Programmable Gate Array (FPGA) are used with other dedicated devices in the SRM9000 to perform the following functions under software control:

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

The SRM9000 Transceiver comprises a rugged extruded aluminium sleeve, which houses a single printed circuit board assembly and provides all heatsink requirements. The sleeve housing is closed at each end by high-impact plastic end caps; all cable ports and mechanical interfaces are sealed against moisture and dust ingress.

The PCB assembly comprises a single, multi-layer PCB containing all the RF and control circuitry. The PCB seats on an extruded aluminium tray that slides into the outer aluminium sleeve where it is secured with screws accessed from the outside of the case. Provision is made under the main PCB tray assembly for additional hardware options.

There are two installation methods available for the SRM9000. The outer aluminium extrusion has side flanges that allow the mobile to be bolted directly to any flat surface in the vehicle. A quick release cradle is also available.

1.4 PRODUCT VARIANTS AND FACILITIES

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

Table 1-1 Common Features for All Variants

Feature: Model:	9005	9010	9020	9025	9030
Control	None or Serial or Parallel if Option Board	Display Microphone	Display Microphone	Display Handset	Control Unit with Microphone
Display	-	1 digit LED	6 char LCD	2x12 char LCD	8x14 char graphic LCD
Adjustable Display Illumination	-	-	Yes	Yes	Yes
Buttons and Keys	-	Vol Up/Down Select 1 Function	Vol Up/Down 4 Function Scroll Up/Down	Vol Up/Down 6 Function 12 Keypad Send/End Menu + Scroll	6 Function 12 Keypad Send/End Menu + Scroll
Speaker	-	Yes	Yes	Yes*	Yes*
Frequency Bands	66-88MHz, 136-174MHz, 174-208MHz, 208-245MHz, 335-375MHz, 400-450MHz, 440-512MHz, 470-530MHz				
Channel Spacing	10/12.5/20/25kHz				
Menu driven	-	-	Yes	Yes	Yes
Customisable Menus	-	-	Yes	Yes	Yes

* Note: Handsets have a built-in earpiece therefore an external speaker is optional.

Table 1-2 Conventional-PMR Variants

Feature: Model:	9005	9010	9020	9025	9030
Channels	1000	10	100 +	1000	1000
Signalling	CTCSS / DCS	CTCSS / DCS ANI	CTCSS / DCS Selcall	CTCSS / DCS Selcall	CTCSS / DCS Selcall
Attack Operation	-	Yes	Yes	Yes	Yes
DTMF Encode	-	Fixed Seq	Fixed Seq	Yes	Yes
PTT Limit Timer with warning beeps	Yes				
PTT Inhibit on Busy	Yes				
Voting	Yes				
Scanning	Yes	10 fixed groups	124 fixed, 4 user	124 fixed, 4 user	124 fixed, 4 user
Priority Scanning	Yes				
Nuisance Delete	-	-	Yes	Yes	Yes
Multiax	Yes				
Mod/Demod Fctn	Option	-	-	-	-
Ignition Sense Input	Yes				
VOX Handsfree	Option	Option	Option	Yes	Option
General External IO	Option	Option	Option	Option	Option
600 Ohm Interface	Option	Option	Option	Option	Option
Internal GPS	Option	Option	Option	Option	Option

Table 1-3 Trunked Variants

Feature: Model:	9005	9010	9020	9025	9030
Channels	1024 channels in 50 sub-bands				
Frequency Bands	Specifically : 136-174MHz, 400-450MHz (and possible in all other bands)				
Background Hunt and Vote-Now	Yes	Yes	Yes	Yes	Yes
MPT1343 dialstrings	Yes	Yes	Yes	Yes	Yes
ANN Numbering	-	-	-	Yes	Yes
Memories	250	10	100+	250	250
User Phonebook	-	-	Yes	Yes	Yes
Alpha Status List	-	-	Yes	Yes	Yes
SDM/EDMs	Yes	-	-	Yes	Yes
NPDs	Yes	-	-	TBA	TBA
Mod/Demod Fctn	Option	-	-	-	-
Attack Operation	Yes	Yes	Yes	Yes	Yes
Ignition Sense Input	Yes	Yes	Yes	Yes	Yes
VOX Handsfree	Option	Option	Option	Yes*	Yes*
General External IO	Option	Option	Option	Option	Option
600 Ohm Interface	Option	Option	Option	Option	Option

* Note: Requires external microphone for optimum performance.

1.5 SOFTWARE VERSIONS AND NAMING

There are various associated items of Software (SW) required for the SRM9000 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 SRM9000 Transceiver has three items of SW for digital and analog PMR, Trunking and Alignment.

The 9030 Control Head has two SW files for its Flash and EEPROM.

1.5.1 Filename Structure

Basically the Filename Structure is defined as follows:

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

eg. **9kTm103.BIN**

9kP_105.BIN

9kS_103.BIN

9kCf101.HEX

9kCe101.HEX

1.5.2 Application Code

This identifies the application the SW was initially designed for:

9k	=	Standard SRM9000 Software
Rw	=	Specific SW for Raywood Taxi Applications

1.5.3 Software Type Code

This identifies different types of SW within an application.

Td	=	Trunk Data	=	9005 Transceiver-only code
Tb	=	Trunk Basic	=	9010/20 Basic Mic code
Tm	=	Trunk MPT	=	9025/30 MPT-Numbering code
Ta	=	Trunk ANN	=	9025/30 ANN-Numbering code
P_	=	Conventional PMR code		
S_	=	Startup code (for alignment and startup)		
Bo	=	Transceiver Boot-code		
Bc	=	Transceiver Boot-Backup-code		
Bf	=	Transceiver FPGA-code		
Ba	=	Transceiver FPGA-Backup-code		
Cf	=	9030 Control Head FLASH code		
Ce	=	9030 Control Head EEPROM code		
Cp	=	9030 Control Head PIC code		

1.5.4 Version Number

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

e.g. 103 = Version 1.03

1.5.5 Exclusions

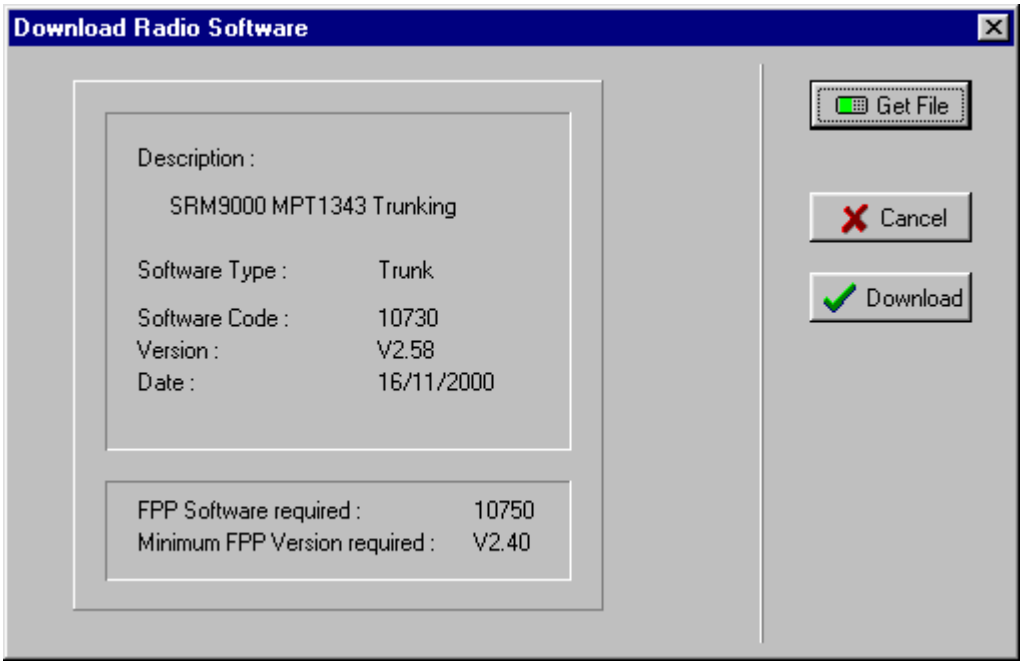
The Programmer SW does not follow the above rules as it is a PC based Program and its version number can be easily identified by starting the SW. Later releases of SW will be backward compatible, unless deliberately not so, in which case a different directory structure/path may be implemented.

1.5.6 Displaying Software Versions

Each Transceiver SW code file (e.g. 9kTm258.BIN, etc.) contains version information about itself and possibly compatible Programming SW.

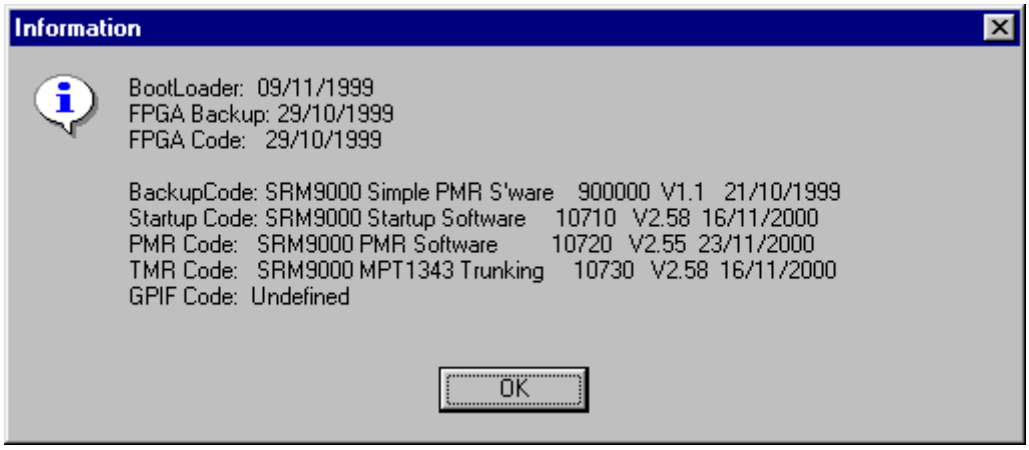
For **Radio SW saved on Disk**, this information can be displayed via the Programmer function:

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



SRM9030 Control Head SW can be displayed on the Control Head by holding the '3' button down when the radio is switched on. This is only implemented in CH V1.06 SW (Oct/2000) and later.

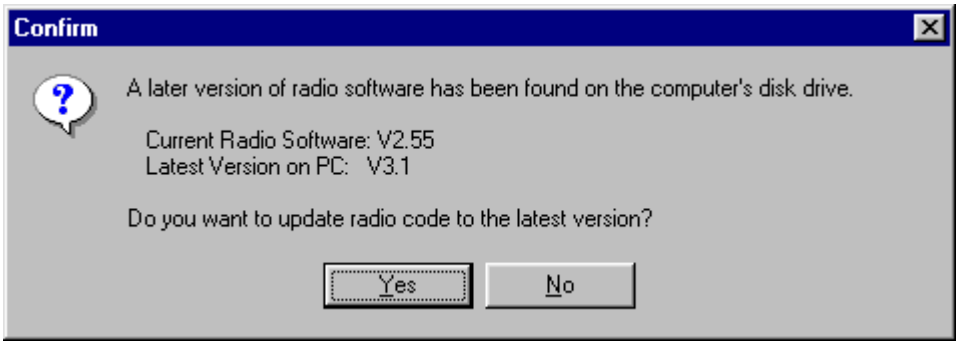
SRM9025 Handset SW has a similar method of Version identification.

SRM9020 Microphone SW has a similar method of Version identification.

SRM9010 Microphone does not have any method of determining loaded SW. There is only one version of this SW in the field.

1.5.7 Automatic Version Upgrade Prompting

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



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.

This only applies for standard SRM9000 SW - i.e. for Startup-Code (9kS_….BIN), Trunking-Code (9kTa…, 9kTm…, 9kTb…, 9kTd….BIN) and PMR-Code (9kP_….BIN).

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

Note : If the …\SRM9000\FPP\RadioSW folder contains no files, then the above check will not be performed.

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

The SRM9000 Transceiver software is split into the following separate modules:

- Bootloader and Backup Software
- Start-Up Software
- FPGA and FPGA-Backup Software (FPGA = Field Programmable Gate Array)
- Mainline PMR Software
- Mainline Trunk Software

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

- Initial execution starts with the Bootloader code, which attempts to load the Start-Up Software (if Start-Up checksum is bad, then the Backup Software is loaded.)
- Start-Up Software then downloads the FPGA code (or FPGA-Backup code if FPGA checksum is bad) to the FPGA device. If both FPGA and FPGA-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 plus Ignition-Sense lines and compares these with saved parameters to determine if the radio should be continue to power-up or switch itself off again.
- Start-Up software then attempts to load either PMR or Trunk Mainline Software (dependent on saved parameter) and switches execution to complete the power-up process and start normal operation.

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

There are three states that the radio can configure after switch-on:

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

1.5.9 Wailing Siren (Boot-up Software Corrupted)

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

Simply writing a Jobfile 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 = *9kS_xxx.BIN*) and Mainline PMR (9kP_xxx.BIN) or Trunk (9kTxxxx.BIN) should be loaded if the FPP cannot automatically fix the problem. The wailing siren should stop once the problem is fixed.

Note 1: Backup Software prior to V1.05 (~Apr 2000) does not enable the +13.8V power line to the Control Unit / FPP-Cable. This means that when the wailing Siren tone is present, power needs to be externally supplied to the FPP Cable in order to re-load any Software.

Note 2: Backup Software V2.10 (~Oct 2000) improved operation protecting the radio FLASH from irrecoverable corruption if a download was inadvertently terminated prior to completion. Care should be exercised when programming radios operating in Backup Software (i.e. with wailing siren sounding) prior to V2.10, so that downloads are not aborted accidentally.

Note 3: Shorting pin-2 (to ground) of the main FLASH Memory IC, when power is applied to the radio, will also force the radio to startup in Backup Software. This may be useful in some situations.

Note 4: Should these steps fail to restore the set and the Wailing Siren cease, the radio will need to be returned to a Level 3 Service Centre for FLASH replacement.

1.6 ADJUSTMENT AND ALIGNMENT

There are no manual internal adjustments in the SRM9000. Re-programming and alignment is done with the unit installed using software tools. For servicing, the radio PCB can be operated as a stand alone unit provided a temporary heatsink is fitted under the transmitter PA module for transmitter servicing and that the receiver audio output be kept below 100mW for receiver servicing. Radio performance is not adversely affected by operating without the outer sleeve but there will be some change to performance when the metal cans are removed from the RF sections of the board.

On re-assembly, the PA module should be checked for a thin layer of heat-conducting paste. If this is missing or dried-out, it should be replaced prior to re-assembly.

1.7 TORQUE SETTINGS

Assembly of 'Chassis' (Inner Extrusion) to 'Outer Extrusion' 8-10 Lb/In (0.90 - 1.13 Nm).

Assembly of 'Front' and 'Rear' end-caps to 'Outer Extrusion' 13-14 Lb/In (1.47 - 1.58 Nm).

1.8 SPECIFICATION

1.8.1 General

Operation

Single or two frequency simplex (half-duplex).

Modulation

Frequency modulation (phase) F3E, F1D, F1E.

Supply Voltage Requirements

10.8 to 16.2V DC negative earth (13.8V nom.)

Current Consumption

	Mobile With Control Mic	**Mobile With Alpha Mic**	**Mobile With Alpha Head**
Radio off	≤ 5mA	≤ 5mA	≤ 5mA
Standby(squelched):	≤ 200mA	≤ 210mA	≤ 210mA*
RX Audio O/P:			
300mW (not bridged)	≤ 450mA	≤ 470mA	≤ 500mA *
4.0W	≤ 1200mA	≤ 1220mA	≤ 1250mA*
Transmit:	**VHF**	**UHF**	
25W	≤ 7.5A	≤ 7.5A	
1W	≤ 2.5A	≤ 2.5A	

*Add 250mA to current consumption for Control Head with backlight on.

Frequency Bands	Frequency Range	Band	Frequency Range
E0	66 - 88 MHz	R1	335 - 375MHz
AC	136 - 174MHz	TK	400 - 450MHz
K1	174 - 208MHz	UW	440 - 512MHz
KM	208 -245MHz	WR	470 - 530MHz

Switching Bandwidth

Radio covers the complete band without retuning

Channel Spacing

10/ 12.5 / 20 / 25kHz

Frequency Stability

Better than ±2.0ppm

Dimensions (mm)	Height	Width	Depth
Transceiver	56	170	165
9030 Alpha Control Head	65	188	45
9025 Alpha Display Handset	165	52	30
9020 Alpha Mic	96	68	44
9010/30 Microphone	82	57	38
9030 Desk Microphone	300	120	130
9030 Handset	200	50	40

Weight

Transceiver 1.8kg

1.8.2 Transmitter

Power Output

High Power:	25W	Adjustable down to 1W
Low Power:	1W	Adjustable up to 25W

Transmitter Rise Time

Less than 40 ms

Duty Cycle

1 minute transmit : 4 minutes receive

Spurious Emissions

< 0.25uW (9kHz to 1GHz)

< 1.0uW (1GHz to 4GHz))

Residual Noise

60% deviation. CCITT Weighted

25kHz Channel Spacing	>45dB
12.5kHz Channel Spacing	>40dB

Audio Frequency Distortion

≤ 3% (at 60% deviation)

Audio Frequency Response

300 to 3000Hz* +1dB -3dB

Figures apply for a flat audio signal or a 6dB/octave pre-emphasis curve

(*2550Hz 12.5kHz channel spacing)

1.8.3 Receiver

Sensitivity

≤ 0.3μV PD (-117.5dBm) for 12dB SINAD

≤0.4μV PD for 20 dB Quieting.

Adjacent Channel Selectivity

25kHz Channel Spacing	> 73dB
12.5kHz Channel Spacing	> 65dB

Intermodulation Rejection

ETS Method	> 65dB
AS4295 Method	> 70dB

Spurious Response Rejection

> 75dB

Blocking

> 95dB (±1MHz)

Conducted Spurious Emissions

< 2nW (-57dBm)	9kHz to 4GHz

FM Residual Noise (CCITT weighted)

25kHz :	> 45dB
12.5kHz :	> 40dB

Mute Range

Typically 6 to 25dB SINAD

Typical setting 10 to 12dB SINAD

Mute Response Time

<30mS (no CTCSS)

add 200mS for CTCSS

Voting Response Time

Searches at 50ms/channel

Audio Distortion

< 3% (1W / 4ohm, 60% modulation)

<5% (4W / 4ohm, 60% modulation)

Audio Frequency Response

300 to 3000Hz*, +1dB to -3dB

Figures apply for a flat audio response or a 6dB/octave de-emphasis curve

(*2550Hz for 12.5kHz channel spacing)

1.8.4 Signalling

1.8.4.1 CTCSS

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

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

Encoder

Tone Deviation:

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

Decoder

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

1.8.4.2 FFSK

1200 Baud : 1200 / 1800 Hz MPT1317 based

2400 Baud : 1200 / 2400 Hz MPT1317 based

1.8.4.3 Selcall

The following tone sets are supported as per tables below:

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

Selcall Tone Frequency Table

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

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

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

Selcall Tone Periods

The Selcall tone period :

4 preset lengths selectable : 20ms and 30 seconds in 1ms increments.

1.8.4.4 DTMF

DTMF Encode supported via keypad:

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

Tone Period, programmable : 0 - 2550 mSec in 10mS steps

Inter-Tone Period, programmable : 0 - 2550 mSec in 10mS steps

Link Establishment Time, programmable : 0 - 10000 mSec in 10mS steps.

Tx Hang Time, programmable : 0 - 9999 mSec in 10mS steps.

Side-Tone in Loudspeaker : selectable via programmer

1.8.4.5 DCS

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

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

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

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

1.8.4.6 C4FM

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

1.8.5 Environmental

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

Operational Temperature

-30°C to +60°C

Storage Temperature

-40°C to +80°C

Vibration Specification

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

Cold

IEC 68-2-1 Test 5 hours at -10°C

Dry Heat

IEC 68-2-2 Test 5 hours at +55°C

Damp Heat Cycle

IEC 68-2-30 Test 2 cycles at +40°C

Product Sealing

Main Radio Unit:	IEC529 rating IP54
Microphones:	IEC529 rating IP54
Remote Control Head	IEC529 rating IP54

MIL STD810

Low Pressure	500.4 Procedure II
High Temperature Storage	501.4 Procedure I
High Temperature Operation	501.4 Procedure II
Low Temperature Storage	502.4 Procedure I
Low Temperature Operation	502.4 Procedure II
Temperature Shock	503.4 Procedure I
Humidity	507.4 Figure 507.4-1
Sand and Dust	510.4 Procedure I – Blowing Dust
Random Vibration	514.5 Figure 514.5C-1
Transit Drop	516.5 Table 516.5-V1
Functional Shock of severity 25g Acceleration, 6ms pulse duration, 500 shocks in 6 directions.	

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2. SERVICE PHILOSOPHY

2.1 SERVICE CONCEPT

The SRM9000 series has been designed to provide low cost trunked, non-trunked analogue and digital speech mobile transceivers, using common core electronics, software and interfacing. It is a requirement that once the customer has purchased equipment, TMC Radio can follow this by providing an ongoing, high level of customer support together with a competitive and professional servicing activity.

There are three levels of service available:

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

2.2 WARRANTY

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

2.2.1 Service Within and Out Of Warranty

The field Service Level for the SRM9000 mobile is LEVEL 2, PCB replacement.

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

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

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

2.2.2 Ancillary Items

All ancillary items (except remote alphanumeric control head) 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. TECHNICAL DESCRIPTION

3.1 RECEIVER

Refer to Figure 3-1.

3.1.1 Front End Filters and RF Amplifier

The receiver input signal from the antenna passes through the antenna filter comprising L582, L584, L585 and associated tuning capacitors. With the mobile in receive mode, diodes D580, D540a and D541a in the antenna switch are reverse biased allowing the receiver input signal to be coupled through to the front end with minimal loss. The overall insertion loss of the antenna filter and switch is approximately 0.8dB. Front end selectivity is provided by varactor-tuned bandpass filters at the input and output of the RF amplifier.

Front end tuning voltages are derived from the alignment data stored in the radio. The DSP processes these data to optimise front end tuning relative to the programmed channel frequencies, which may be changed at any time without re-aligning the radio.

To achieve the required varactor tuning range an arrangement of positive and negative bias power supplies is used to provide a total bias across the varactors of up to 14.0VDC. A fixed 2.5V positive bias derived from the 5.0V supply and voltage divider R425/426 is applied to the cathodes of the varactor diodes. The negative bias supply originates at the DSP/FPGA as a PWM signal (FE TUNE) for the four front end tuning values, TUNE 1 to 4, for the particular channel frequency selected. The PWM signal is dependent on channel frequency and tuning. The PWM signal passes through level shifting transistors Q405, Q407, Q409 and Q411 where it is converted to a high level negative voltage (-0.5 to -11.5V). The -12.0V rail of the level translators is generated by U904E/F with D903 to D906 providing the required voltage multiplier effect.

The RF amplifier stage comprises a low noise transistor amplifier (Q400) that is compensated to maintain good linearity across the required frequency bands and temperature range. This provides excellent intermodulation and blocking performance across the full operating range. The gain of this stage is typically 17dB for both UHF and VHF versions.

3.1.2 First Mixer and IF Section

The output of the last front end bandpass filter is coupled into single balanced mixer T400/D413 which converts the RF signal to an IF frequency of 45MHz. The local oscillator injection level is typically +8dBm at T400 pin 1 with low side injection used for UHF and high side for VHF.

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

3.1.3 Quadrature Demodulator

Additional IF gain of approximately 30dB occurs at U401, which is a dedicated IF AGC amplifier/Quadrature Demodulator. The AGC voltage for U401 is derived from the RSSI function of the DSP. The onset of AGC operation occurs when RF input signal levels at the antenna exceed -90dBm.

Conversion of the 45MHz IF signal to I and Q baseband signals is carried out by the demodulator section of U401. The 90MHz local oscillator signal is generated by VCO Q402 which is phase locked by the auxiliary PLL output of U701 via feedback signal AUX LO2.

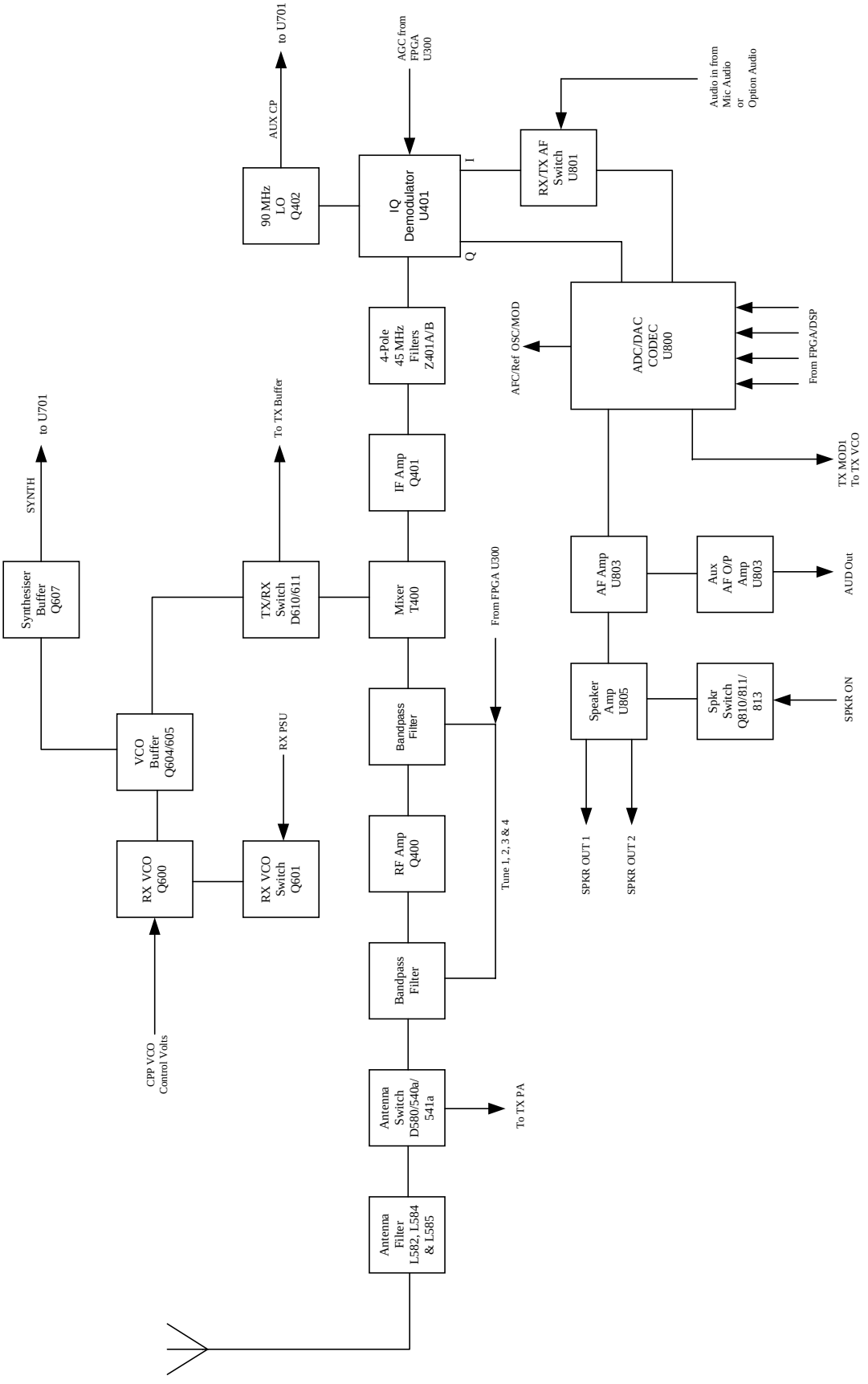


Figure 3-1 VHF/UHF Receiver Block Diagram

3.1.4 Receiver Audio Processing

All receiver audio processing and filtering functions are performed by the CODEC U800 under the control of the DSP. The receiver I and Q analog 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 and mute noise processing for narrow and wideband operation. The processed signals are then converted to analog audio signals by the CODEC DAC and are applied to conventional audio amplifiers U803A/B and the speaker amplifier U805.

There are two speaker options available. A half bridged configuration using a speaker across balanced output SPKR OUT1 and 2, which provides an audio, output level of up to 4 watts into 4 ohms. The other option is a full bridge configuration using a high power speaker across SPKR OUT1 and 2 and providing an audio output level of up to 10 watts into 8 ohms. The carrier and signalling mute functions are performed by Q810/811/813 under DSP control. De-emphasis to the audio PA U805 is performed by R861 and capacitors C866 to C871. Flat audio is provided to S1-6 via amplifier U803A.

3.2 TRANSMITTER

Refer to Figure 3-2.

3.2.1 Drivers and PA Stages

The RF output level from the VCO buffer Q604 is typically +5dBm (UHF) and +8dBm (VHF). TX buffer Q606 increases this level by approximately 3dB (UHF) and 11dB (VHF) and also provides additional VCO isolation. The following section of the TX buffer Q612 is controlled by the transmitter power control loop and Q609. Q609 is normally saturated in transmit mode so there is no minimum gain control applied to this stage. The gain of Q612 is typically 10dB (UHF) and 15dB (VHF) but the output level is reduced by input and output resistive attenuators to limit the PA driver input level to typically +20dBm. The gain of PA driver Q571 is controlled by the power control loop to ensure that transmitter output power remains within defined limits. The PA driver output level is typically +16dBm. PA module U500 utilises three stages (UHF) and two stages (VHF) to achieve the required final RF output power level of +44dBm (25 watts). Power output settings are derived from alignment data stored in flash memory during the initial factory alignment. The DSP processes this data to optimise the power output level relative to the programmed channel frequencies.

3.2.2 Power Control

Output power is stabilised by a power control feedback loop. L580, R580, a printed circuit transmission line, D510 and associated components comprise the power detector, and U520A/B and associated components providing the power setting and control sections. Forward and reverse power is sampled by the power detector and applied as a DC voltage to the inverting input of comparator U520A. The TX PWR SET voltage is a DC voltage proportional to the programmed TX power setting and is applied to the non-inverting input of the comparator. PA module output level changes due to supply voltage, load or temperature variations are detected and applied to the comparator which proportionally adjusts the PA module bias supply and the PA driver (Q571) supply, and therefore the PA drive level. High temperature protection is provided by thermistor R552 that progressively reduces the power level if the PA module temperature becomes excessive.

3.2.3 Antenna Changeover and Harmonic Filter

The antenna changeover circuit consisting of pin diodes D580/D540a/D541a, is switched by Q541/Q542/Q543 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 C558. 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 loading and loss. The harmonic rejection low pass filter comprises L582/L584/L585 and associated capacitors.

3.2.4 Transmitter Audio Processing

Microphone audio input signals of 40mV RMS with a source impedance of 470 ohms are provided at the microphone input (AUDIO IN1) by an external microphone unit comprising an electret microphone insert and a preamplifier with a gain of 18dB. U801 is a control gate for the microphone audio signals.

OPTION AUDIO1 is the external audio options and data input, which is controlled by gate U801A.

U801C provides CODEC input switching which selects either the receiver I signal or transmitter audio/data signals depending on the TX/RX mode. All pre-emphasis, filtering, compression and limiting processes for narrow and wideband operation are carried out in the CODEC (U800) under the control of the DSP. 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 200mV P/P.

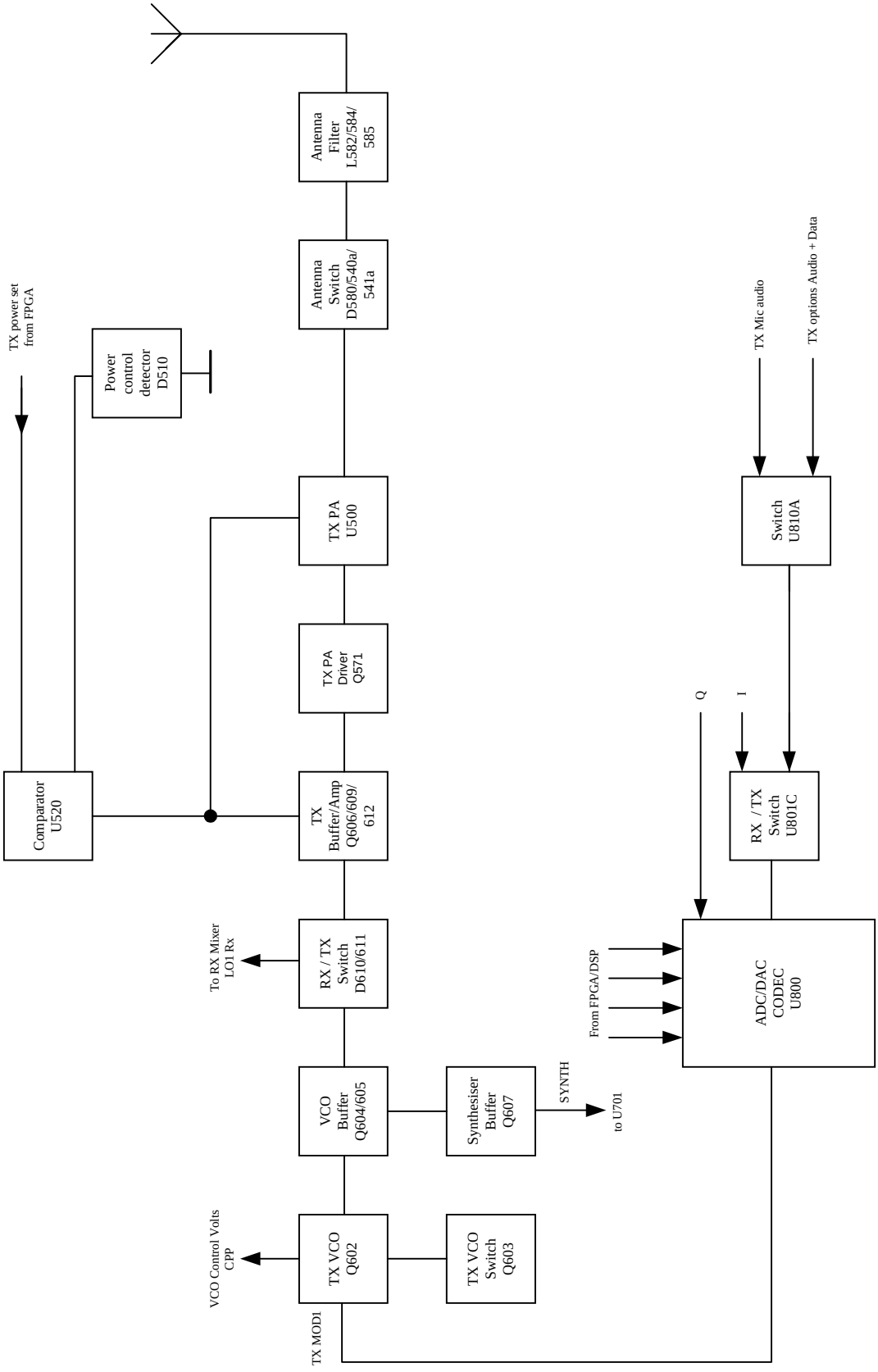


Figure 3-2 VHF/UHF Transmitter Block Diagram

FREQUENCY SYNTHESISER

3.2.5 General

The SRM9000 frequency synthesiser consists of individual transmitter and receiver (local oscillator) voltage controlled oscillators, loop filter, varactor negative bias generator, reference oscillator and an integrated, dual phase locked loop device U702.

3.2.6 PLL

The PLL device contains two prescalers, programmable dividers and phase comparators to provide a main and auxiliary PLL. The main PLL of U702 controls the frequency of the TX/RX VCOs via Control Voltage outputs at pins 2 and 3 and VCO Feedback to pin 6. The auxiliary PLL is used to control the receiver 90MHz second local oscillator via the Control Voltage output at pin 17 and VCO Feedback to pin 15. The PLL operation involves the division of the 14.4MHz reference oscillator frequency by divider U710 and the internal divider of U702, down to a lower frequency that corresponds to a sub-multiple of the radio channel spacing ie. 6.25kHz for 12.5/25kHz channel spacing, 5kHz for 10/20kHz channel spacing or 7.5kHz if required. The VCO frequency is sampled and divided down to the same frequency after which it is phase compared to the reference. Any error produces an offset to the Control Voltage output that is used to correct the VCO frequency. A valid lock detect output is derived from pin 20 and is sampled by the FPGA during transmit. If an unlocked signal is detected the radio will switch back to receive mode.

3.2.7 VCO

The transmitter and receiver VCOs use low noise JFET transistors (Q600 RX, Q602 TX) and inductors L602 (RX), L608 (TX) to generate the signals for the required band coverage. Electronic tuning is provided by varactor diodes D600 to D608 with their control voltages derived from the Loop Filter, PLL and Negative Bias Generator. VCO selection and timing is controlled by the DSP via the RX and TX power supplies and applied through switches Q601 (RX) and Q603 (TX). VCO buffer Q604/605 isolates the VCO from load variations and active power supply filter Q615 minimises supply related noise. A PLL feedback signal is sampled from the VCO buffer output via buffer Q607.

3.2.8 Negative Bias Generator and Loop Filter

A positive and negative varactor bias supply similar to the front-end varactor arrangement has been used to achieve the required broadband tuning range of the VCOs. PLL device U702 is programmed to deliver a fixed nominal +2.5V output from phase detector/charge pump CPPF or CPP (selection depends on radio setup) regardless of the channel frequency selected. This voltage is filtered to remove synthesiser noise and reference products by loop filter C676/678/681 and R653/654/655. The resulting low noise voltage is applied to the cathode side of the VCO varactor tuning diodes as a positive bias voltage. The negative bias supply originates as a positive DC voltage (0.1V to 3.0V) at the DAC output of U702 (DOUT) with a level relative to the programmed state of the radio (eg. channel frequency, TX/RX state). The voltage is converted to a high level negative supply by VCO Varicap Negative Supply Q700 to Q703. The -17V rail of this supply is generated by U904E/F with D903 to D906 providing the voltage multiplying effect needed to achieve -17V. The output of the negative supply is applied directly to the VCO varactor anodes as the negative tuning voltage VCAP BIAS.

3.2.9 Phase Modulator

The modulation path for audio, data and higher frequency CTCSS signals is via varactor D609 and its associated components in the TX VCO. The reference input to the PLL (FXTAL) provides the low frequency modulation path in conjunction with phase modulator Q714 to Q716. U711A is a low pass filter that provides 6dB per octave attenuation to frequencies above approximately 180Hz. Modulation balance adjustment is carried out using a CODEC generated 100Hz square wave applied to TX MOD. A DAC output from the Alignment Tool is applied to buffer U711B and ramp generator Q711 to Q713 via the MOD BAL line to adjust the low frequency modulation level.

3.2.10 Reference Oscillator

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

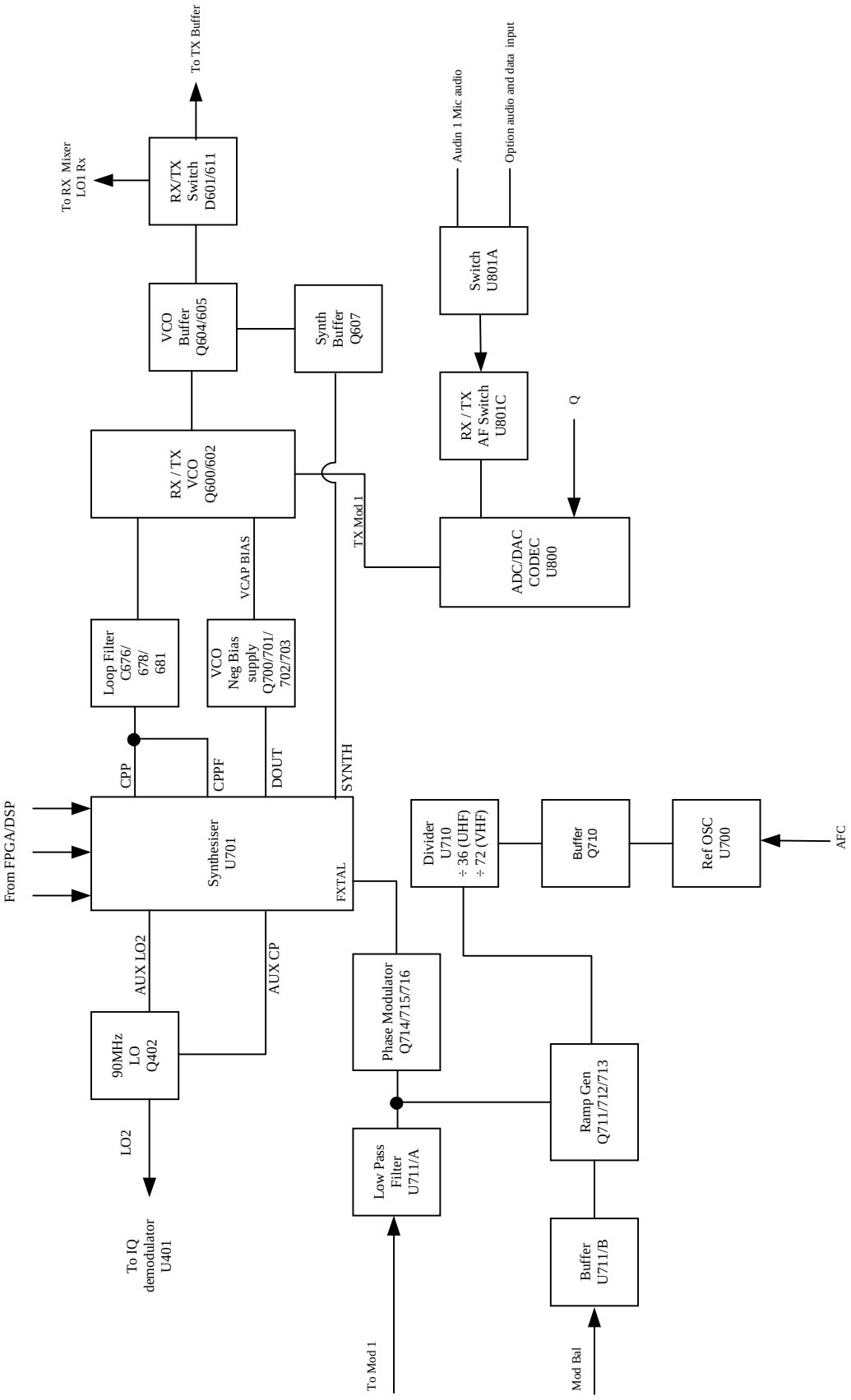


Figure 3-3 VHF/UHF Synthesiser, Block Diagram

3.3 CONTROL

Refer to Figure 3-4.

3.3.1 DSP and FPGA

The SRM9000 transceiver operates under the control of a DSP (U201) and FPGA (U300) combination that together with a number of other dedicated devices perform all the operational and processing functions required by the radio. The FPGA is configured by the DSP under software control to provide the following functions:

- Channel set-up of all operating frequencies
- Modulation processing and filtering
- De-modulation processing and filtering
- TX power output reference
- Receiver front end tuning
- Serial communications with alignment tool, microphone and control head
- Modem functionality for data modulation
- All signalling / CTCSS generation and decoding
- Crystal Oscillator control
- Receiver muting control
- TX / RX switching
- PLL detect

3.3.2 DSP Clock Oscillator

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

3.4 MEMORY

Memory consists of the internal DSP memory and an external 8MB non-volatile Flash Memory U202. When power is off, program and data are retained in Flash Memory. At power-on, a boot program downloads the DSP's program from Flash Memory to its internal RAM for faster program execution and access to data.

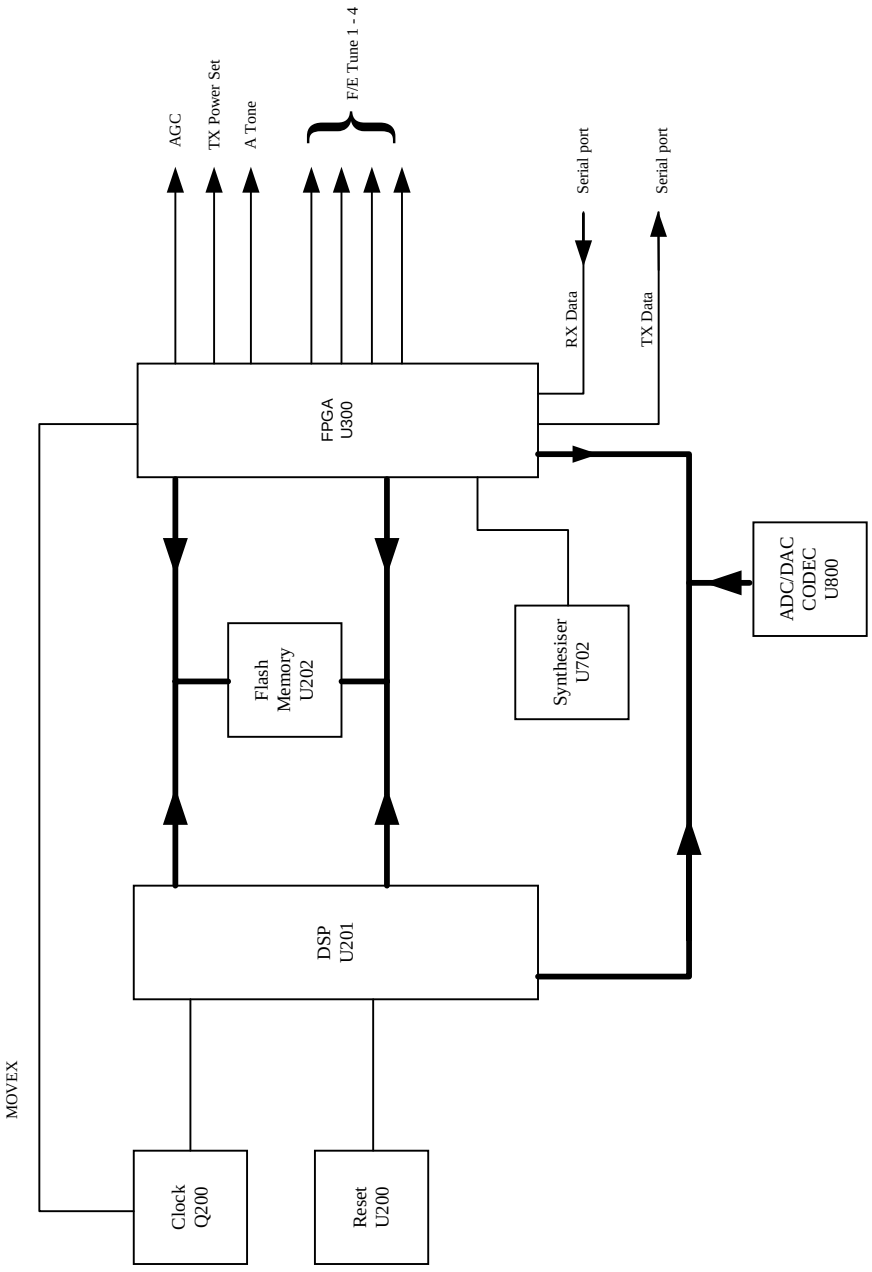


Figure 3-4 VHF/UHF Control Block Diagram

3.5 POWER SUPPLIES

3.5.1 Power On Function

The unregulated 13.8V DC input (13V8_UNSW_F) is routed directly to all high current devices and is then switched via FET Q900 to provide BAT_SW supply for all other circuits. The output from Q900 feeds four, low drop out series regulators and associated switched and auxiliary supplies that along with a negative voltage generator, provides all the switched power requirements of the transceiver. Radio ON/OFF function is achieved through Q902, 908 and 909. A low voltage pulse from the control unit or microphone handset PWR ON or PWR OFF momentarily turns on Q900, which supplies input voltage to the four regulators. Q909 is then kept switched on by the PWR OFF line that is set to high by the DSP and FPGA and so maintains the BAT_SW supply.

PWR OFF operation requires the PWR ON/ OFF button of the control unit to be held down for more than 2 seconds. This is sensed by the FPGA via the PWR SENSE line and so turns the radio off by placing a low voltage to Q909 base. Supply lines are held on for a short period at switch off while the DSP stores critical data.

3.5.2 Power Supplies

The following is a list of the SRM9000 power supplies and some of the devices and circuits they supply.

3.5.2.1 +8V Regulator U900

Regulated +8.0V supply (8V0 and +8V)

- TX buffer Q571
- VCOs and VCO buffers via active filter Q615
- RX second local oscillator via Q403

Regulated +8.0V switched supply (RX PSU)

- RX front end
- IF Amplifier
- Various switching functions

3.5.2.2 +5V Regulator U901

Regulated +5.0V supply (5V0 and +5V)

- RX front end varactor positive bias
- Synth. buffer Q607
- VCO varactor negative supply Q700 to Q703
- TCXO U700
- RX audio amplifiers U803A/B
- RX mute switch Q810/813
- FE TUNE level translators, Q404/411

Regulated +5.0V switched supply (TX PSU and TX PSU+)

- TX power control U520
- TX buffer Q606
- Various switching functions

3.5.2.3 +3.3V Regulator U912

Regulated +3.3V supply (3V3)

- Digital supply for CODEC U800
- FPGA U300

Regulated +3.3V supply (3Q3)

- I Q demodulator U401

Regulated +3.3V supply (3C3)

- Analog supply for CODEC U800

Regulated +3.3V supply (3P3)

- PLL U702
- TCXO divider U710

Unregulated 13.8V (13V8_UNSW_F)

- TX PA module U500
- Antenna changeover switch Q541/542/543
- RX mute switch Q811
- RX speaker amplifier U805

3.5.2.4 +2.5V Regulator U903

- DSP core U201

3.5.2.5 Negative Power Supply U904E/F

Provides -17.0V output (-17V0)

- Negative rail for VCO Varicap Negative Supply Q700, 701, 702 and Q703

-12.0V Output (-12V0)

- Negative rail for FE TUNE level translator Q404-Q411.

4. ALIGNMENT (LEVEL 3 SERVICE ONLY)

This procedure is applicable to all versions of **SRM9000** mobile 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 SRM9000 Configuration Programmer (FPP) software to read the radio and save the data on an FPP file ***before*** commencing with the alignment procedure.

When the Alignment is completed, use the SRM9000 Field Personality Programmer (FPP) software to retrieve this stored data from the FPP file and write it back to the radio.

It is preferred that the radio remain installed in its aluminium extruded case throughout this alignment procedure. If the radio is to be aligned when removed from the case, a temporary heat sink must be fitted under the Transmitter PA module and the receiver output must be kept below 100mW.

4.1 TEST EQUIPMENT

1.	Radio transceiver test set	CMT, 52/82 or similar.
2.	Variable DC power supply	10.8V to 16.2V at 10 amps
3.	Oscilloscope	20 MHz bandwidth minimum
4.	SRM9000 Programming & Alignment Breakout Box	As detailed in Figure 4-1
5.	SRM9000 Speaker O/P Breakout Box	As detailed in Figure 4-2
6.	Personal Computer	486 DX 66 or better. Operating system Windows 95 or later. Minimum RAM - 16MB. 5MB free hard disk space. Floppy drive - 1.44MB. Mouse and serial port required
7.	SRM9000 Alignment Tool	Computer Software file
8.	SRM9000 Configuration Programmer (FPP)	Computer Software file

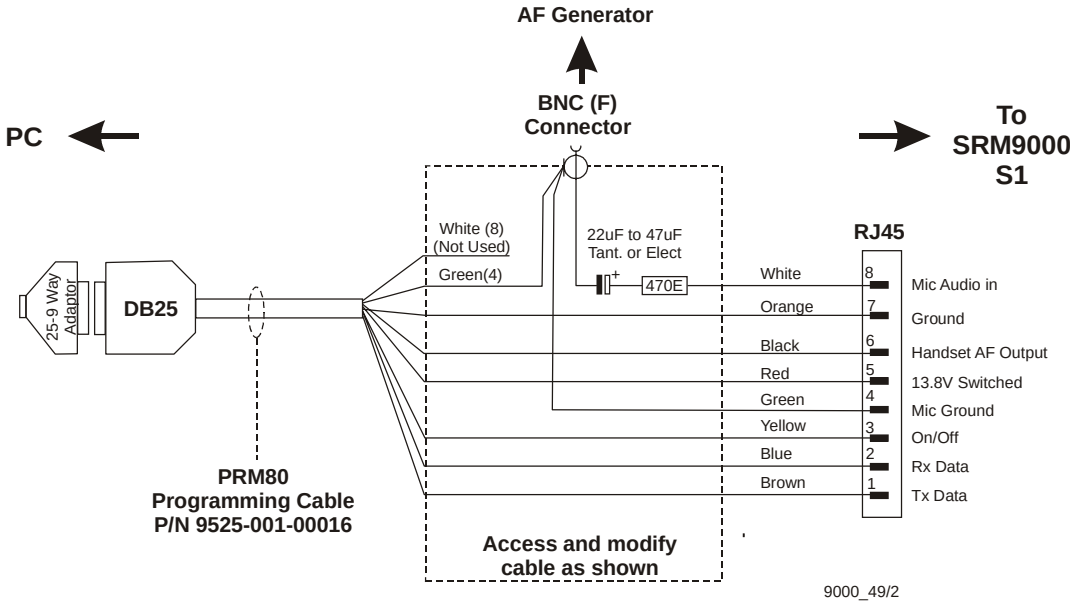


Figure 4-1 SRM9000 Programming & Alignment Breakout Box

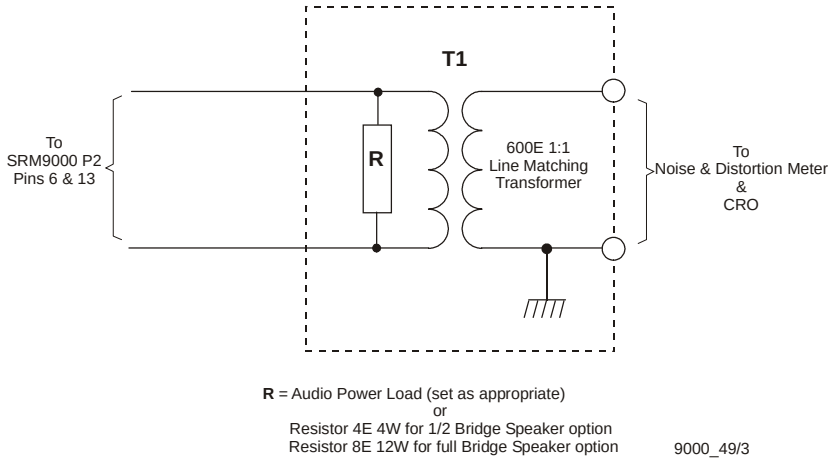


Figure 4-2 SRM9000 Speaker Output Breakout Box

4.2 TEST SET-UP

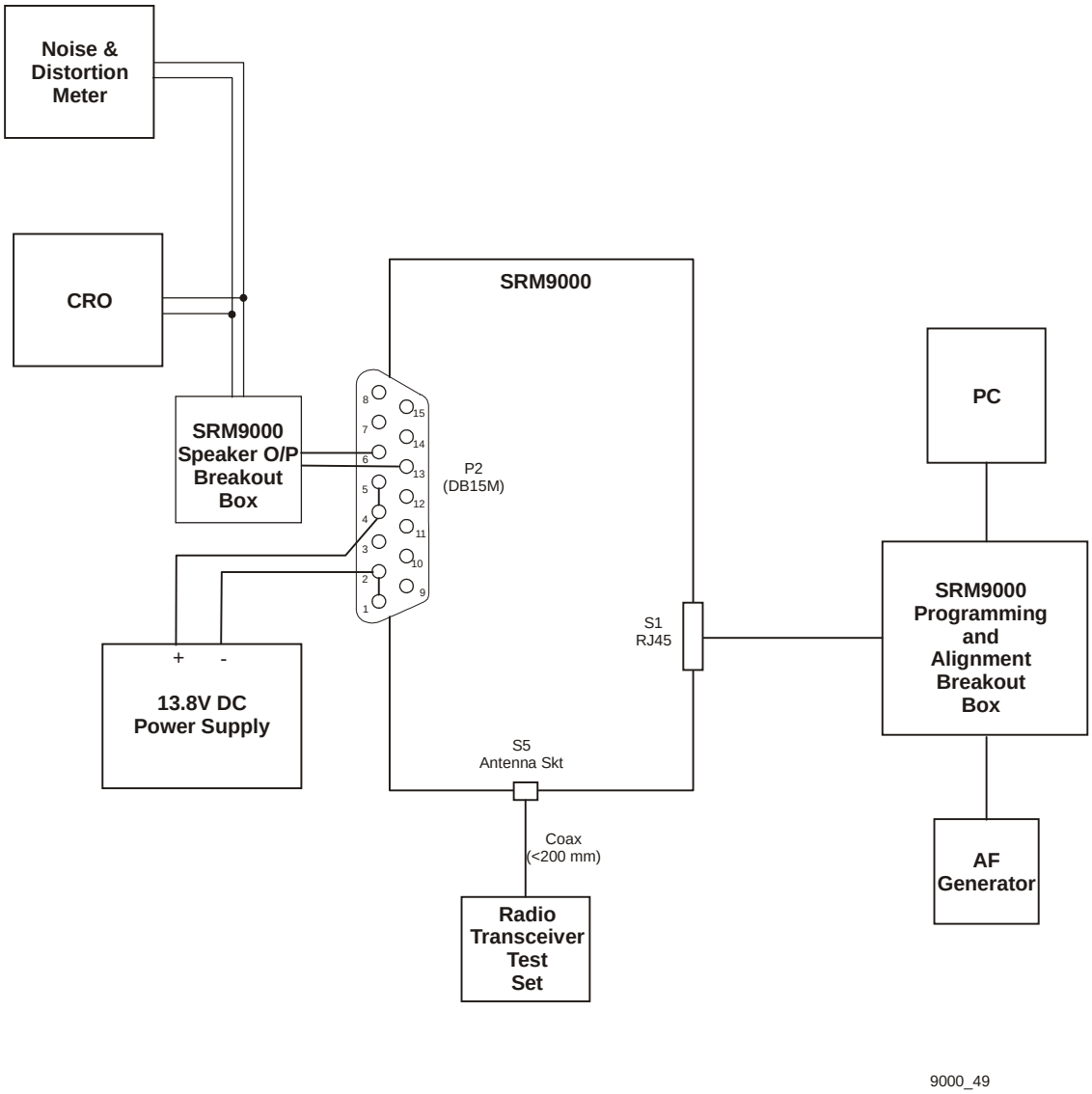


Figure 4-3 Test Set-up

1. Connect the radio to the test equipment as shown in Figure 4-3.
2. Switch on the DC Power Supply.

4.2.1 COMMS Set up

1. Copy the SRM9000 Alignment Tool Computer Software file to the PC hard drive and run the program

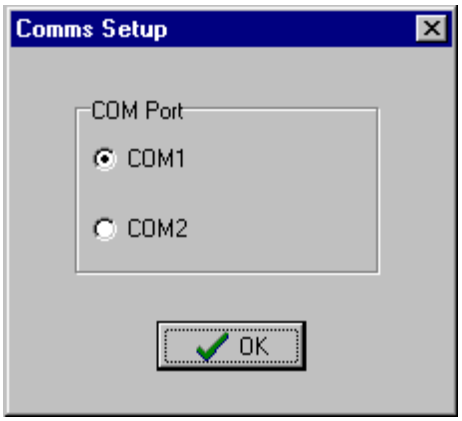
   The Alignment Tool Opening Menu is displayed.

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**.

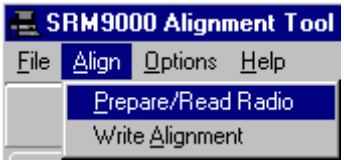
   (Usually COM1)



4.2.2 Radio Preparation

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

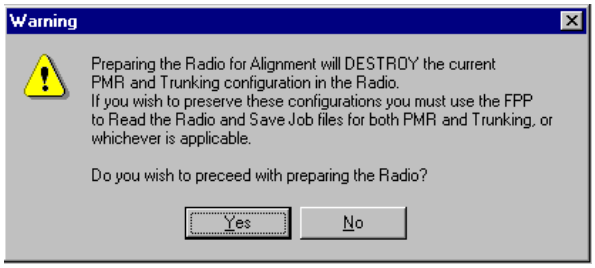
1. At the Opening Menu, select the ***Align Menu*** and choose ***Prepare/Read Radio***.



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

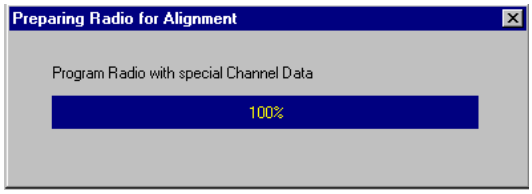
   Choose ***No*** if you want to save the configuration and use the FPP software to read and save the data to a file.

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



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

   The test alignment data is downloaded into the radio.

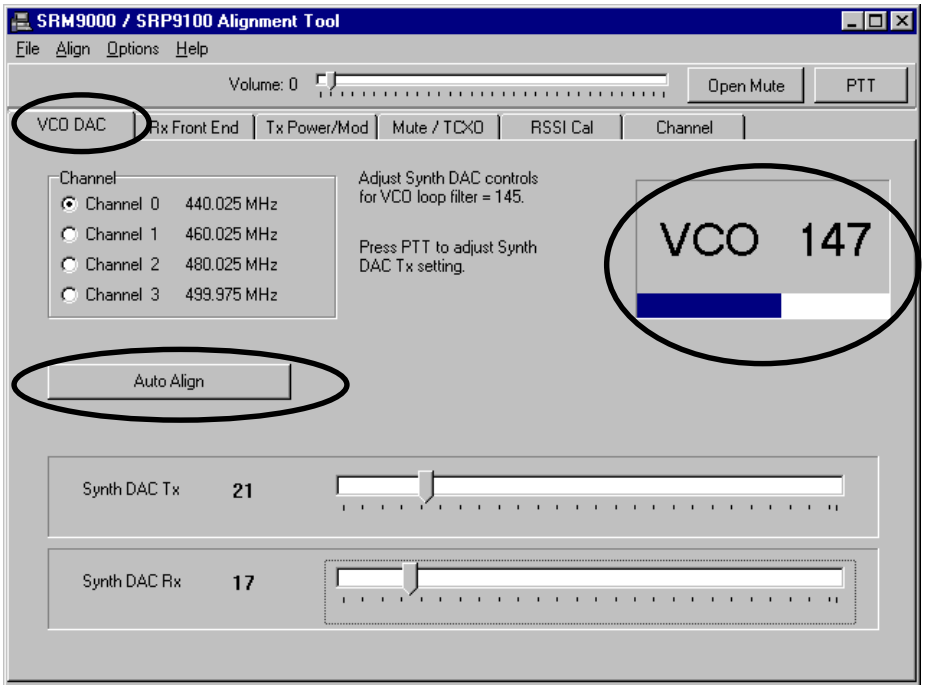


Note: In test alignment mode the radio is configured only for 12.5 kHz channel spacing, therefore all alignment is carried out at 12.5 kHz levels. When the radio is configured with the FPP for other channel spacings, the deviation related levels are calculated on a per channel basis by the radio software.

4.2.3 Alignment Procedure

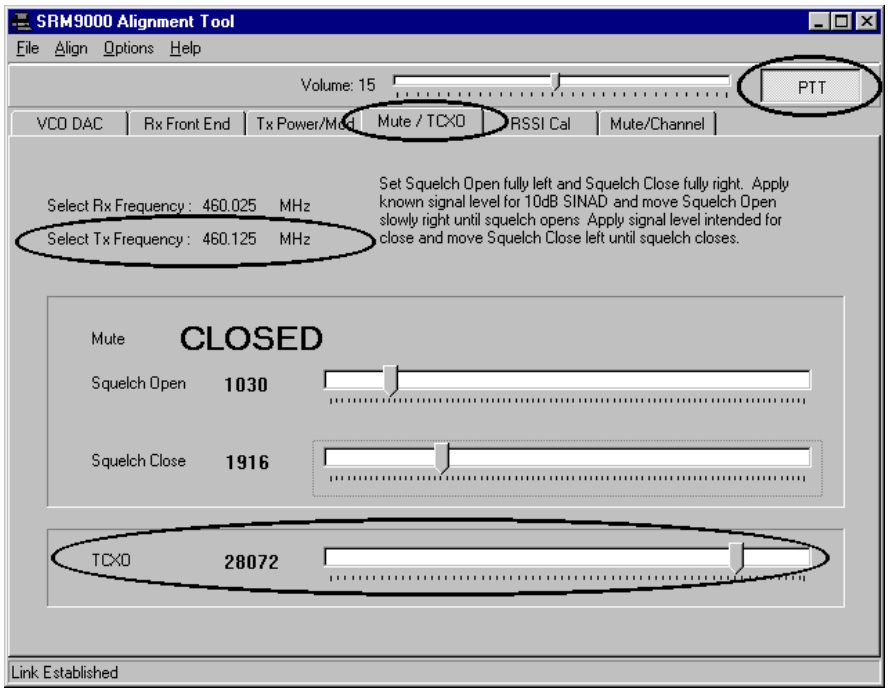
Radio alignment must be done in the sequence detailed in the following paragraphs. This alignment assumes that the radio is functioning normally.

4.2.3.1 VCO DAC Alignment



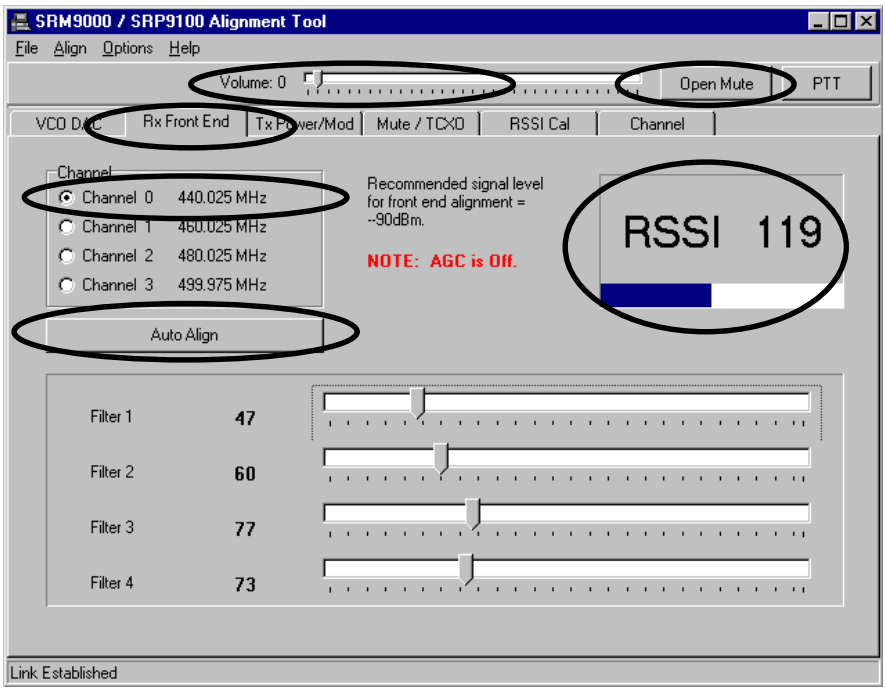
1. Select the ***VCO DAC*** page.
2. Select ***Auto Align.*** The Synth DAC Rx slider will automatically adjust its value for each receiver alignment frequency to set the VCO loop filter value between 140 and 150.
3. Select ***PTT*** and then select ***Auto Align***. The Synth DAC Tx slider will automatically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

4.2.3.2 TCXO (Radio Netting Adjustment)



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

4.2.3.3 RX Front End



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

   Speaker audio should now be visible on the CRO, if required readjust the ***Volume*** slider to a suitable level.
5. Select ***Channel 0***
6. Set the Signal Generator to the Channel 0 carrier frequency, with a 1000Hz modulation signal, a deviation of ±1.5 kHz and a RF level of -90dBm.

   The RSSI barchart display should now be (typically) well above a reading of 20 - if so, jump to step 9.
7. If the RSSI is not visible or is very low, Manual Tuning may be required. To do this, adjust the four Filter sliders (1-4) in combination for the maximum RSSI reading or for the best sinad reading. Proceed to step 9 when an RSSI of better than 20 is achieved.

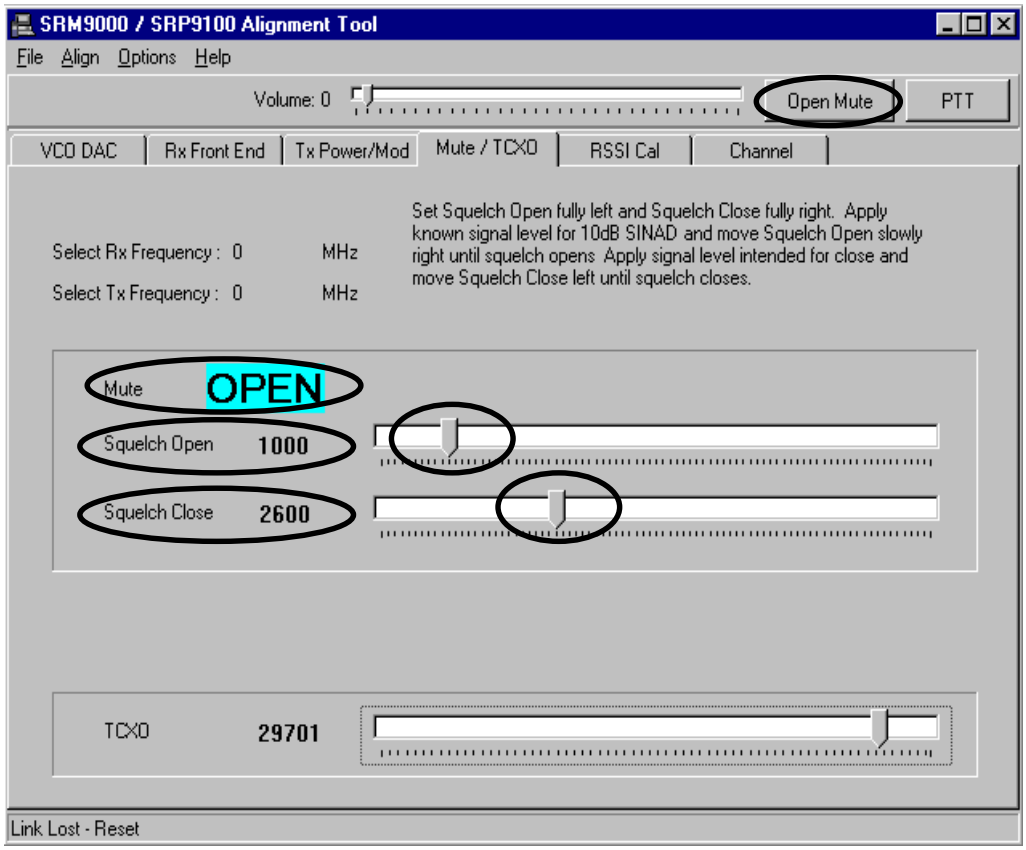
   Note: For optimum results, the sliders should be adjusted to be approximately in line.
8. Select ***Auto Align***.

   The front end will be tuned automatically.
9. Verify that the receiver sensitivity is better than -117.5dBm for 12dB sinad.

   (Sensitivity is typically -120dBm).

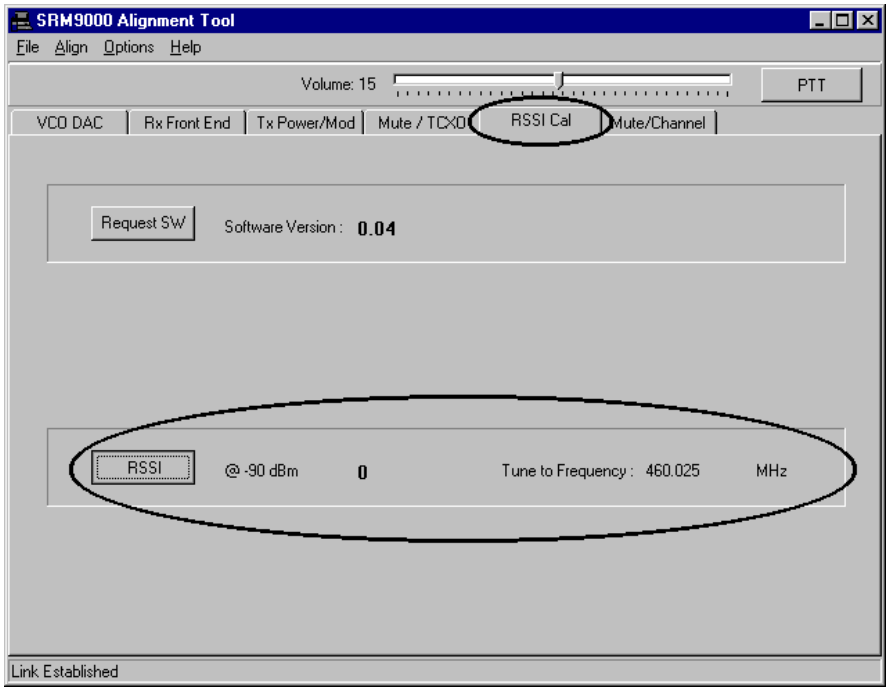
10 Repeat Steps 6 to 10 for the remaining 3 Channels (1, 2, & 3).
.

4.2.3.4 Mute 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 10dB sinad) is achieved.
3. Select ***Close Mute*** 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 2dB (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 closes at the desired RF levels.

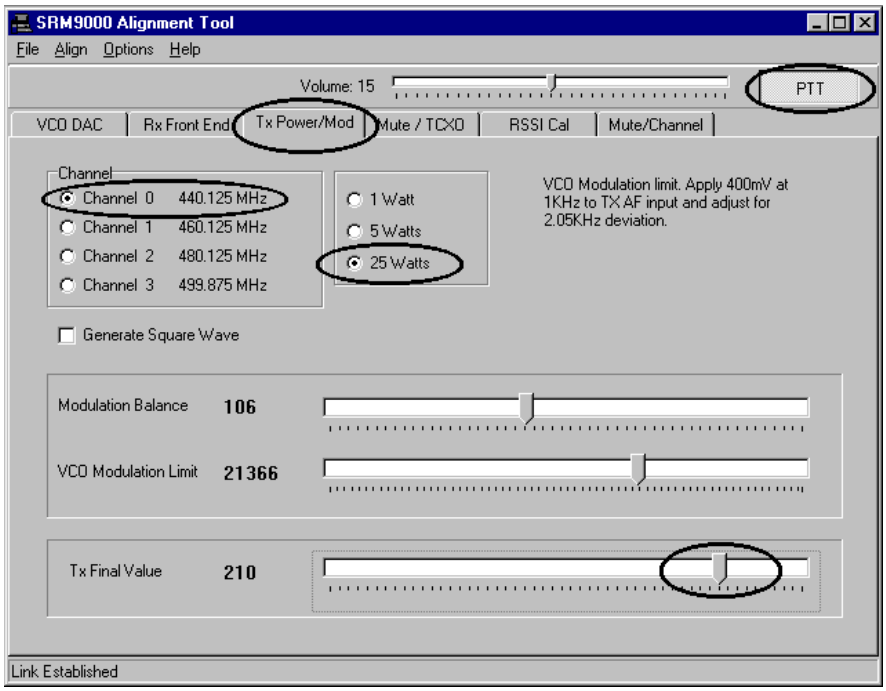
4.2.3.5 RSSI



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

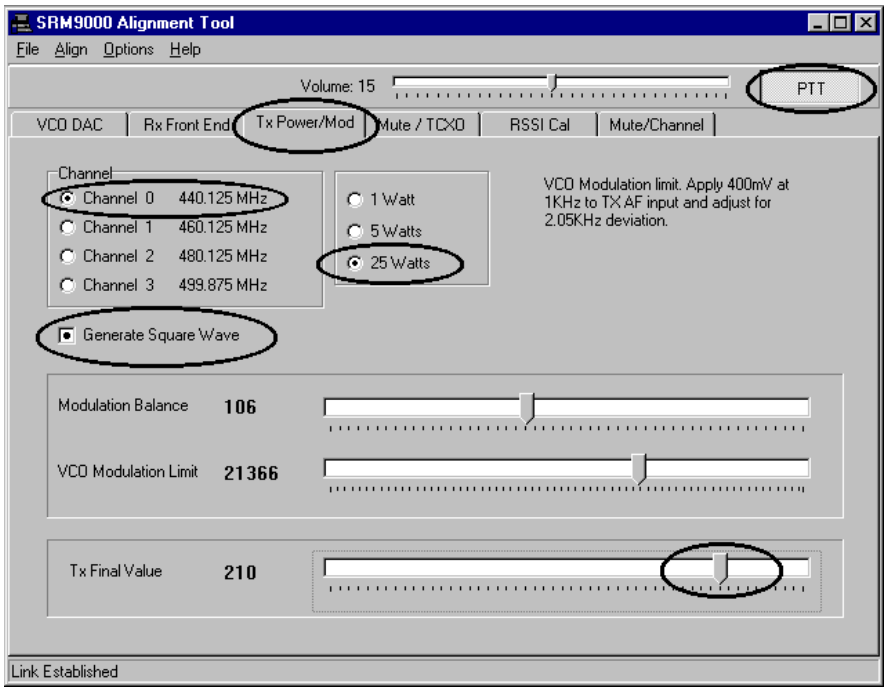
   The receiver RSSI threshold setting is calibrated.

4.2.3.6 TX Power



1. Select ***Tx Power/Mod*** page.
2. Select ***Channel 0***.
3. Select the ***25W***-power level.
4. Press the ***PTT*** button.
5. Adjust the ***Tx Final Value*** slider for a power output of 25W.
   The supply current shall be less than 7.5A.
6. Select the ***5W***-power level.
7. Adjust the ***Tx Final Value*** slider for a power output of 5W.
8. Select the ***1W*** power level.
9. Adjust the ***Tx Final Value*** slider for a power output of 1W.
10. Release the ***PTT*** button.
11. Repeat steps 2 to 10 inclusive for the remaining 3 Channels (1, 2, & 3).

4.2.3.7 Modulation



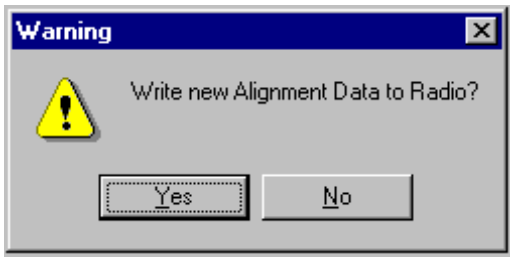
1. Select ***Tx Power/Mod*** page.
2. Select ***Channel 0***.
3. Select the ***1W*** power level.
4. Set the microphone input signal from the Audio Generator to 1000Hz at 400 mV RMS.
5. Adjust the ***VCO Modulation Limit*** slider for a deviation of ±2.05kHz
6. Reduce the microphone input level to 40mV RMS and check that the deviation is within the range ±1.25 kHz to ±1.75 kHz.
7. Repeat steps 2 to 7 inclusive for the remaining 3 Channels (1, 2, & 3).
8. Remove the microphone audio input signal
9. Select the ***Generate Square Wave*** function.
10. Select ***PTT*** and, while viewing the de-modulated signal on the transceiver test set oscilloscope, adjust the ***Modulation Balance*** slider for the best square wave symmetry.
11. Repeat steps 8 to 11 inclusive for the remaining 3 Channels (1, 2, & 3).

4.2.3.8 Programming

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

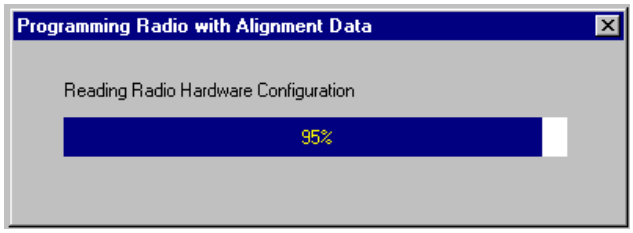
1. Select ***Align*** and choose ***Write Alignment***.

2. A warning message is displayed.



3. Choose ***Yes***.

   New alignment data is written to the radio.



4.2.3.9 Customers Radio Configuration Data

If the Customers Radio Configuration Data was stored in an FPP file, use the SRM9000 Configuration Programmer to write this data to the radio.

5. REPLACEABLE PARTS

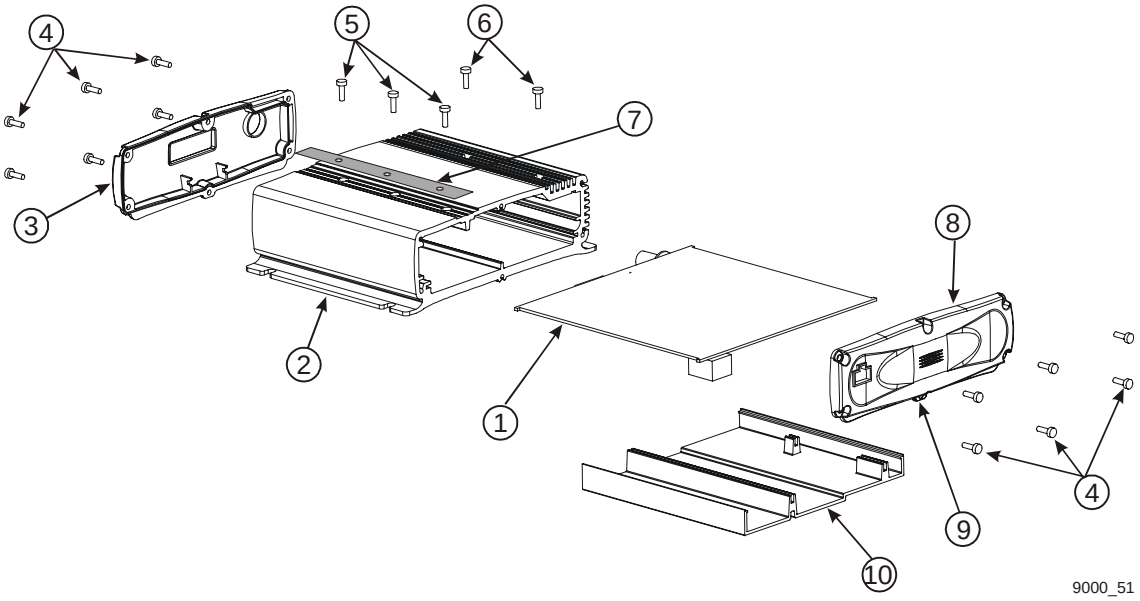


Figure 5-1 Replaceable Parts

5.1 COMMON PARTS

Ident	Description	Quantity per Assembly	Part Number
2	Case	1	3513-901-70071
3	End Cap, Rear	1	3513-903-91082
4	Screw End Cap	12	3513 993 85009
5	Screw Tray Retention M3 x 16	3	3513 993 57117
6	Screw Tray Retention M3 x 12	2	3513 993 57116
7	Label Transceiver Top	1	6102 303 00051
8	End Cap, Front	1	3513-903-91072
9	Label Front End Cap	1	6102 303 00041
10	Inner Tray	1	3513 901 70082
	DC power installation kit	1	MA-DCPOWER
	TX PA Shield cover	1	3502 310 63223
	RJ45 Connector	1	3513 993 05529
	DB15 Connector	1	3513 993 02063
	Antenna BNC connector	1	3513 505 05991
	Audio PA Module U805	1	3513 999 52036
	Voltage Regulator U900, U901, U912	1	3513 999 42084
	Voltage Regulator U903	1	6102 822 00011-0
	Temperature Controlled Crystal Oscillator U700	1	3513 999 99200
	Transient Suppressor Diode D900	1	3513 999 42083
	Transmit Receive Switch Q541	1	3513-999-00006
	ON/OFF FET Q7, Q900	1	3513 999 05046

5.2 BAND-SPECIFIC PARTS

Ident	Description	Quantity per Assembly	Part Number
	Tx PA Module U500 (E0 Band)	1	6102 861 00111
	Tx PA Module U500 (AC Band)	1	6102 861 00011
	Tx PA Module U500 (TK Band)	1	6102 861 00031
	Tx PA Module U500 (R1 & R2 Band)	1	6102 861 00021
	Tx PA Module U500 (UW & WR Band)	1	6102 861 00041
	Tx PA Module U500 (K1 Band)	1	6102 861 00121
	Tx PA Module U500 (KM Band)	1	6102 861 00131