SM5102 Radio

SM5102 (146MHz~174MHz)

MOBILE RADIO SERVICE MANUAL

maxon CIC Corp.

1.INTRODUCTION

About Your SM5102 Radio

Maxon's SM5102 mobile radio are Compatible. Conventional radio system operation. the SM5102 is capable of up to 208 channels 13 Groups per system in conventional operation.
The operation and functions for the SM5102 radios are described in this manual.

We urge you to thoroughly read this manual before operating the radio.

Application of some functions described in this manual is determined by the system you use. Your Maxon Dealer will program your radio so that you have the greatest number of functions possible relative to your needs.

Should you have questions regarding the operation of the radio, please consult your Maxon Dealer.

About Maxon

Maxon is a world-respected name in professional FM two-way radio equipment operating in the UHF, VHF and 800 MHz frequencies; personal two-way communication devices, including the popular FRS (Family Radio Service) and GMRS radios; and a variety of wireless communication products (two-way voice messaging handsets, Wireless Local Loop terminals, etc.).

Safety Information

The Federal Communications Commission (FCC), with its action in General Docket 93-62, November 7, 1997, has adopted a safety standard for human exposure to Radio Frequency (RF) electromagnetic energy emitted by FCC regulated equipment. Maxon subscribes to the same safety standard for the use of its products. Proper operation of this radio will result in user exposure far below the Occupational Safety and Health Act and Federal Communications Commission limits.

Safety Information, Continued

WARNING - It is mandatory that radio installations in vehicles fueled by liquefied petroleum gas conform to the following standard: National Fire Protection Association standard NFPA 58 applies to radio installations in vehicles fueled by liquefied petroleum (LP) gas with LP gas container in the trunk or other sealed-off space within the interior of the vehicle. This standard requires that:

1 Any space containing radio equipment shall be isolated by a seal from the space in which the LP gas container and its fittings are located.
2 Remote (outside) filling connections shall be vented to the outside.

WARNING - DO NOT operate the transmitter of a mobile radio when someone outside the vehicle is within two feet (0.6 meter) of the antenna.

WARNING - DO NOT allow children to operate transmitter - equipped radio equipment.

CAUTION - DO NOT operate the radio near electrical blasting caps or in an explosive atmosphere.

CAUTION - DO NOT operate the transmitter of any radio unless all RF connectors are secure and any open connectors are properly terminated.

All equipment must be properly grounded for safe operation.

All equipment should be serviced by a qualified technician.

NOTE: This radio operates in FCC regulated frequency bands. All radios must be licensed by the FCC before use. Because this radio contains a transmitter, Federal law prohibits unauthorized use or adjustments of this radio.

This device complies with Part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.

Unpacking Inforamtion
Remove and carefully inspect the contents of your package(s) for the following items:

Radio

Microphone

DC Power Supply Cord

Radio Mounting Bracket and Hardware

Microphone Bracket and Hardware

Operating Instructions

WARNINGS

1. **Components containing beryllium oxide are used in the equipment. Dust from this material is a health hazard if inhaled or allowed to come into contact with the skin. Great care must be taken when handling these components. They must not be broken or subjected to excessive heat.**

2. **Never operate the radio transmitter without the correct Maxon antenna, or a suitable artificial load, connected.**

3. **Never modify a radio, or accessory, except as instructed in the Service Manual, Engineering Bulletins or formal communication as this may invalidate any warranty, guarantee or type approval.**

4. **Do not operate this equipment in environments containing explosive materials or vapour.**

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1.1 General

Performance Specifications	FTZ 17TR2049 July 88 TIA-603 IEC 68 Series EC 529 IP54 MIL STD 810 C
Band (Tx & Rx)	(Switching range without retuning) VHF (V2) 146 – 174MHz
Channel Spacing	12.5kHz, / 25kHz (programmable) (12.5, /25kHz switchable by CPU control)
RF Output Power	High Power 50W nominal (+/-10%) Low Power 5W nominal (+/-10%)
Modulation Type	F3E
Audio Power	4W (Internal 16 Ω speaker)
Intermediate Frequencies	45.1MHz First I.F., 455kHz Second I.F.
Number of Channels	208
Frequency Source	PLL Synthesiser
Frequency Stability	+/- 2.5ppm
Power Supply	13.8Vdc nominal 10.8Vdc minimum (extreme**)** 15.6Vdc maximum (extreme**)**
Current Consumption	OFF <10µA Standby (muted) <140mA Unmuted with 25% AF power <350mA Unmuted with 50% AF power <450mA Unmuted with 100% AF power <570mA Transmit @ 5W RF Low output <5.0A Transmit @ 40W RF Normal output <10.0A Transmit @ 45W RF High output <11.0A

Environmental

Temperature Range	
Operating	+15 to +35℃ (nominal) -30 to +60℃ (extreme),
Storage Temperature Range	-40 to +80℃ (storage)
Humidity	EIA/TIA 603 (95%)
Protection against ingress of dust and water	IEC 529 IP54

Vibration	BS2011 : Part 2.1Fc IEC 68-2-6 Part 2.1Fd IEC 68-2-34
Robustness	Mil Std 810 C
ESD	20kV (C-MIC = 15kV)
EMC	EMC Directive 89/336/EEC May 89 ETS 300.279
Physical Dimensions	175(W) x 158(D) x 48(H) mm
Weight	1.44kgs
Programmer	SMP 6001
Reliability Analysis	
MTBF	15,000 Hours MIL-HDBK-217F. Ground benign. Parts stress method.
MTTR	30 minutes average time to rework any SMD component and reassemble.

1.2 Transmitter

Test Method is ETS 300.086 2001 unless stated.
Performance without Sub-Audio Modulation

Power Output

High Power	50W nominal
Low Power	5W nominal

Audio Freq. Deviation

	Nominal	Peak
12.5kHz	+/-1.5kHz	+/-2.5kHz
20kHz	+/-2.4kHz	+/-4.0kHz
25kHz	+/-3.0kHz	+/-5.0kHz

With or without audio sub-modulation (10% peak deviation)

Audio Characteristic
(Method as FTZ17 TR 2049 July 1988)

Modulation Type F3

Within +1/-3dB of limit at 1kHz:
300Hz to 2.55kHz for 12.5kHz channel spacing
300Hz to 3.0kHz for 20 / 25kHz channel spacing

Modulation Type G3

Within +1/-3dB of 6dB/octave limit wrt 1kHz:
300Hz to 2.55kHz for 12.5kHz channel spacing
300Hz to 3.0kHz for 20 / 25kHz channel spacing

Tx Spurious Emission (conducted and radiated)

Below 1GHz	Better than –36dBm
1 – 4GHz	Better than –30dBm

Mic Sensitivity
At Accessory/Mic connector
15mV +/- 3.5mV
Values for 60% peak dev.

Transmitter Audio Distortion (Without CTCSS)

1kHz	< 5% (nominal)

Transmitter Audio Distortion (With CTCSS)

1kHz	< 8% (nominal)

Audio frequency = 1kHz, with any CTCSS freq. combined.

Hum and Noise (Residual Modulation)
Method as FTZ 17 TR 2049 July 1988

Better than 40dB (with PSOPH)

Sub Audio Tones - CTCSS

Tone Range	67 to 250.3Hz @ 0.3% accuracy
Tone Standard	RS-220A EIA
Non-Standard Tones	50 to 260Hz @ 0.3% accuracy
Nominal Tone Deviation	10% (8-15%) Pk Sys Dev.

Sub Audio Tones - DCS

Tone Standard	Normal and Inverted
Tone Deviation	10% (3% Pk System Dev. (UK)

1.3 Receiver

Test Method is ETS 300.086 2001 unless stated.
Performance without Sub-Audio Modulation

Sensitivity
12dB SINAD UHF: Better than –117dBm
12dB SINAD VHF: Better than –118dBm

Amplitude Characteristic Within +/- 3dB

Adjacent Channel Selectivity

	Nominal
12.5kHz	Better than 60dB
25kHz	Better than 70dB

Spurious Response Rejection
Better than 70dB (100kHz – 4GHz)

Intermodulation Response Rejection

+/- 25 / 50kHz	Better than 65dB
+/- 50 / 100kHz	Better than 65dB

Rx Spurious Emissions (radiated) - nominal

9kHz – 1GHz	Better than –57dBm
1GHz – 4GHz	Better than –47dBm

AF Power 6W max.

AF Distortion – Method as FTZ 17 TR 2049

1kHz	< 5% (nominal)

Rx Hum and Noise
Method as TIA / EIA-603

12.5kHz	<40dB No PSOPH
25kHz	<40dB No PSOPH

Sub Audio Tones - CTCSS

Tone Range	67 to 250.3Hz @ 0.3% accuracy
Tone Standard	I-ETS 300.219
Non-Standard Tones	50 to 260Hz @ 0.3% accuracy

Decode Sensitivity
Method (Decrease Signal Level, @ 10% peak dev. with no audio tone)

All Tones	<=9dB SINAD

2 MAINTENANCE & REPAIR

2.1 Introduction

This section covers the tests which should be undertaken prior to handover of the radio to the end user. All of the following tests can be carried out without having to gain access to the interior of the radio.

Recommended Test Equipment

The alignment and performance test procedures assume the use of the following equipment. The functions of most of the equipment may be found in a “Communications Test Set”. This type of equipment is available from a number of test equipment manufacturers.

Throughout this book reference will be made to the use of the Communications Test Set. Where applicable, the equivalent discrete item of test equipment may be used. For example, if measuring power, a stand-alone power meter and a dummy load could be used instead of the Test Set

Discrete Test Equipment

RF Signal Generator
RF Power Meter
RF Frequency Counter
Spectrum Analyser and notch filter (optional)
Audio Signal Generator
Audio Power Meter
SINAD Meter
Modulation Meter
Oscilloscope
Voltmeter
DC Power Supply, 0 - 15V 2A min.

Combined Equipment

Communications Test Set (e.g. Marconi TF2955, Stabilock 4015 or similar).

Accessories

PM200V2 Microphone.

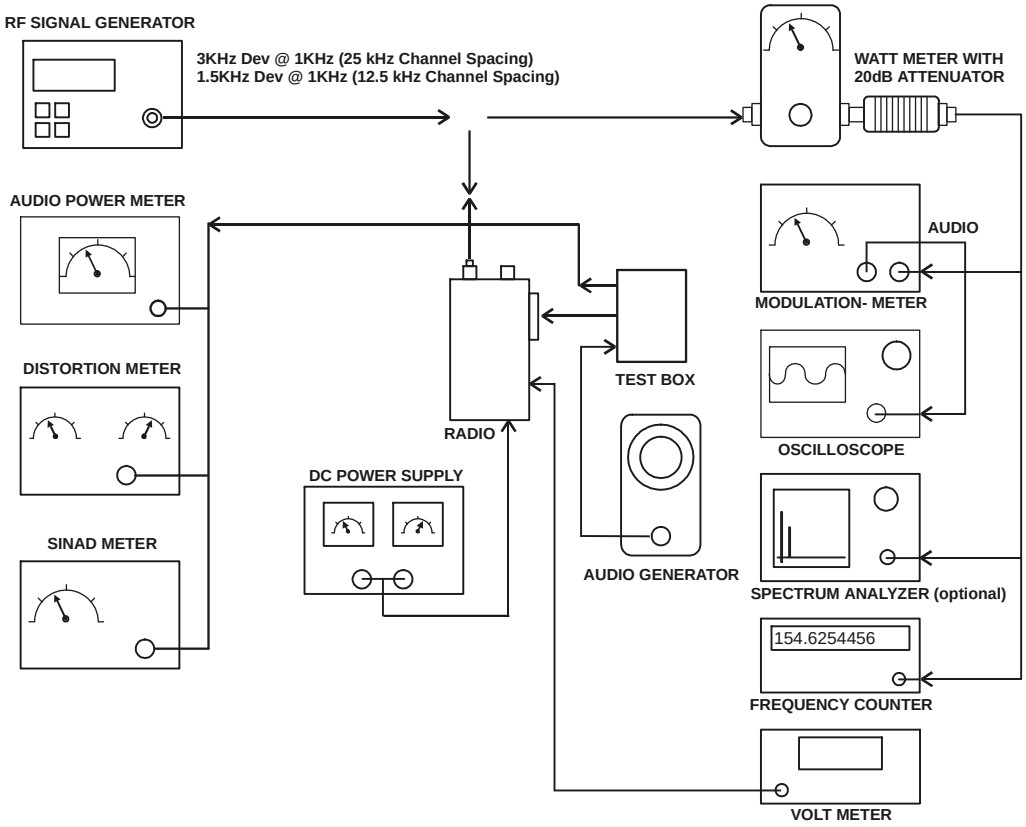


Figure 3-1 - Test Equipment Configuration

Prerequisites

For the following tests, signal generator modulation level should be set to Average System Deviation, i.e. 60% of maximum system deviation.

The level should therefore be set to:

1.5 kHz for 12.5 kHz channel spacing
2.4 kHz for 20 kHz channel spacing
3.0 kHz for 25 kHz channel spacing

If the radio has had components installed to change the channel spacing and/or operating band from those installed at the factory, ensure that the correct components are installed in the receiver and transmitter stages prior to testing.

Refer to the appropriate Electrical Parts List if necessary.

EEPROM programming

Ensure that the EEPROM has the required customer parameters programmed, otherwise ensure that a test EEPROM is programmed with at least the lowest, middle and highest Rx/Tx frequencies prior to aligning the VHF and UHF scanning handheld series radio.

When CTCSS and DCS performance checks are also required, ensure that the lowest, middle and highest Rx/Tx frequencies include:

Lowest Rx/Tx freq. ch. 67.0 Hz CTCSS
Middle Rx/Tx freq. ch. DCS Code 072
Highest Rx/Tx freq. ch. 250.3 Hz CTCSS

The middle Rx/Tx frequencies should be halfway between the lowest and the highest frequencies.

Programming details are given in Section 7.

2.1.1 Test Equipment Connection

Connect the power supply leads from the battery eliminator to the power supply. The red, positive, lead connects to +13.8Vdc. The black, negative, lead connects to the negative, terminal of the power supply.

2.1.2 Transmitter Performance Tests

Power Output

a. Connect the transmitter to the Communications Test Set (CTS) with the power meter set to read 50W.

b. Set the power supply to 13.8Vdc and connect a dc voltmeter across the power supply to monitor the supply voltage.

c. Set the CTS to the same frequency as the radio and PTT. Check and record the power output. The nominal power output is 5W for low power and 50W for high power.

d. Reduce the power supply voltage to 11Vdc and PTT. The output power should be greater than 65% of the level measured above.

Frequency Error

a. Using the frequency counter check that the transmit frequency is within +/- 500Hz (VHF) or +/- 750Hz (UHF) of the frequency which is programmed into the radio.

Spot Deviation and Distortion

a. Set the radio to the middle Tx frequency. Connect the oscilloscope to the output of the modulation meter.

b. Set the audio signal generator to 1kHz tone, low output impedance and adjust its level for 60% system deviation:

12.5kHz channel spacing 1.5kHz dev.
20kHz channel spacing 2.4kHz dev.
25kHz channel spacing 3kHz dev.

c. Press PTT.

d. Measure the audio distortion. This should be less than 5%.

e. Increase the audio signal generator level by 20dB (10x voltage). The peak deviation should be:

12.5kHz channel spacing <= 2.25kHz dev.
20kHz channel spacing <= 3.6kHz dev.
25kHz channel spacing <= 4.5kHz dev.

f. Release PTT.

When CTCSS and DCS performance checks are also required, ensure that the lowest, middle and highest Rx/Tx frequencies include:

Lowest Rx/Tx freq. ch. 67.0 Hz CTCSS
Middle Rx/Tx freq. ch. DCS Code 072
Highest Rx/Tx freq. ch. 250.3 Hz CTCSS

The middle Rx/Tx frequencies should be halfway between the lowest and the highest frequencies.

2.1.3 Receiver Performance Tests

Sensitivity

The SINAD performance test may be used to test the sensitivity of the receiver.

a. Connect the RF signal generator, modulated with a 1kHz tone, to the radio.

b. Set the frequency to correspond to the Rx frequency of one of the channels programmed into the radio.

c. Connect the SINAD voltmeter to the external speaker socket on the radio.

d. Press the monitor button and set the volume control to mid-range.

e. Set the RF signal generator deviation to:

12.5kHz channel spacing 1.5kHz dev.
20kHz channel spacing 2.4kHz dev.
25kHz channel spacing 3kHz dev.

f. Adjust the RF signal generator level until the SINAD meter reads 12dB.

g. Check that the signal generator RF level is < -117dBm (0.31µVpd).

Squelch

a. Ensure that both the radio and the signal generator are set to the appropriate channel spacing.

b. With the above setting, reduce the RF level to –130dBm. The radio should be mute. It may be necessary to press the monitor button to achieve mute.

c. Adjust the RF level until the SINAD meter reads 10dB. The radio should unmute.

Audio Output

a. Set the RF signal generator to 1mV pd (-47.0dBm) and the tone and deviation as above.

b. Connect the audio power meter to the external speaker socket on the radio.

c. Adjust the volume control on the radio under test to maximum (fully clockwise). The voltmeter should indicate >= 3.5V. The audio power meter should read >= 3W.

Note: The audio power meter should be set to 16Ω.

This concludes the Performance Tests.

If the Radio should fail any of these tests it will be necessary to turn to the next section on Alignment.

2.2 Alignment

WARNINGS

Any repairs or adjustments should only be made by, or under the supervision of, a qualified radio-telephone service technician.

CAUTION

This radio contains static sensitive devices. Static safe precautions should be observed, in particular we would recommend the use of a suitable floor mat, table mat, bonding cords and a wrist strap. The soldering iron should have an earthed tip.

Care should be exercised in the handling of static sensitive components and they should always be transported in the correct containers.

Never remove, or insert, static sensitive devices with the power applied.

2.2.1 Disassembly and Re-assembly of the Radio

In order to carry out the following Test and Alignment procedures it will be necessary to gain access to the inside of the radio.

Care should be exercised when opening up the radio for maintenance or repair.

Removing and replacing the main cover

Turn the radio over, so that the radio is upside down.

Remove the four chrome screws.

Lift the cover off.

Replace the main cover by reversing the above procedure.

Removing and replacing the front panel

Firstly, remove the main cover, as described above.

With the radio upside down, remove the two black screws which hold the front panel to the base of the radio.

Turn the radio the normal way up. Remove the three screws which secure the front panel to the radio. It is important that you note that one of the screws is different as it secures metal and not plastic.

Remove the front panel.

Replace the front panel by reversing the procedure.

Rx VCO

a. Select Channel 1.

b. Check that the VCO tuning voltage at TP1 is >1.8V

c. Select Channel 3

d. Check that the voltage at TP1 is <10V

e. If the voltage is >10V it will be necessary to repeat paras a to d, reducing the voltage set in para b nearer to 1.8V.

Tx VCO

For UHF only

a. Select Channel 1.

b. Set the PTT switch to on. Check that the VCO tuning voltage at TP1 is >1.5V.

c. Set the PTT switch to off. Select Channel 3.

d. Set the PTT switch to on and check that the voltage at TP1 is <10V.

e. If the voltage is >10V it will be necessary to repeat per as a to d, reducing the voltage set in per a b nearer to 1.5V.

f. Set the PTT switch to off.

TCXO

a. Select Channel 2.

b. Set the PTT switch to on.

c. Using the frequency counter, adjust the TCXO control, so that the transmit frequency is within +/- 100Hz of the required frequency.

d. Set the PTT switch to off.

If no further alignment is to be carried out, it may be necessary to reset the squelch.

2.2.2 Receiver Alignment

The receiver is, by design, a broadband device. It should require no special alignment unless repairs are performed on the receiver.

The following alignment may be performed:

a. Select Channel 1 on the radio.

b. Set the RF generator to the receiver frequency and the RF level to 1mV pd (-47dBm).

c. Set the AF signal to 1kHz.

d. Set the deviation to:

12.5kHz channel spacing 1.5kHz deviation
or 20kHz channel spacing 2.4kHz deviation
or 25kHz channel spacing 3kHz deviation

e. Monitor the audio output level and the distortion, setting the volume control to mid-range.

Squelch

a. Connect the RF signal generator to the radio.

b. Set the RF signal generator to the receive frequency of the current channel on the channel switch.

c. Connect the leads of the SINAD meter and the speaker via the speaker socket on the rear panel.

d. Set the volume control to mid-range.

e. Set the deviation to:

12.5kHz channel spacing 1.5kHz
or 20kHz channel spacing 2.4kHz
or 25kHz channel spacing 3kHz

f. Set the AF generator to 1kHz.

g. With the above setting, reduce the RF level to –130dBm. The radio should be mute. It may be necessary to press the monitor button to achieve mute.

h. Adjust the RF level until the SINAD meter reads 10dB. The radio should unmute.

This completes the receiver alignment process.

2.2.3 Receiver Performance Tests

SINAD or noise quieting sensitivity performance tests may be used to test the sensitivity of the receiver. Both tests are given below.

12dB SINAD Sensitivity

The SINAD performance test may be used to test the sensitivity of the receiver.

a. Connect the RF signal generator, modulated with a 1kHz tone, to the radio.

b. Set the frequency to correspond to the Rx frequency of one of the channels programmed into the radio.

c. Using the Test Box, connect the SINAD voltmeter to the speaker socket on the radio.

d. Press the monitor button and set the volume control to mid-range.

e. Set the RF signal generator deviation to:

12.5kHz channel spacing 1.5kHz dev.
or 20kHz channel spacing 2.4kHz dev.
or 25kHz channel spacing 3kHz dev.

f. Adjust the RF signal generator level until the SINAD meter reads 12dB.

g. Check that the signal generator RF level is < -117dBm (UHF).

Squelch sensitivity

The RF input level to open the squelch is usually set in the range -123.5 to -117dBm (0.15 to 0.3mV). The squelch should open at a. SINAD between 7 and 12dB (no CCITT).

The squelch should close between 2 and 4dB of the value at which it opens.

3 DETAILED FUNCTIONAL DESCRIPTION

3.1 VHF Transmit

1. Buffer
2. Power AMP
3. Low Pass Filter
4. Antenna Switch
5. A.P.C Circuits

Buffer

VCO output level is 0dBm and amplified to +17dBm (UHF)/(VHF). The buffer consists of Q2, 12,13 for isolation and gain.

Power AMP

The P.A Module(Q28) consists of 3-stage(Q18,Q39,Q28) amplifier and amplifies the TX signal from +37dBm to (+46~47)dBm. The input and the output terminal of the P.A Module are matcued 50 OHM.

Low Pass Filter

L21,25,L22,L27,C103,168,296,100,65,297,99 are Chebyshev low pass filter. Unwanted harmonic are reduced by -65 dBc.

Antenna Switch

When transmitting, the diodes D15 and D2 are forward biased enabling the RF signal passage to the antenna. D15,D2 is shorted to ground inhibiting the RF signal to front-end. In receive the diodes D1 and D15/2 are reversed biased passing the signal from the antenna through L24 and C111 to the front-end without signal loss.

Automatic Power Control Circuit

The APC circuit consists of the R109, variable resistor RV1,5, U11, and Transistor Q34, Q37, and Q14,Q15,Q16. The supply current is monitored by difference voltage on R249 which is through for it. If the current is varied by RF power output or other reasons, it produces some bias voltage by U11 and Q34. The differential signal at the output of U11 is passed to Q14 and Q15that produces a constant power output to the antenna. RV5 is used to adjust the RF power level.

12.8 MHz TCXO

The TCXO contains the 2-stage thermistor network compensation and crystal oscillator and modulation ports. Compensation is +/-2.5 PPM or less from -30c to +60c.

PLL IC Dual Modules Prescaler

Input frequency of 12.8 MHz to U1 MB15E03SL pin 16 is divided to 6.25 KHz or 5 KHz by the reference counter, and then supplied to comparator. RF signal input from VCO is divided to 1/64 at prescaler in U1, Divided by A and N counter in IU1 to determine frequency steps, and then supplied to the comparator. PLL comparison frequency is 6.25/5KHz so that minimum programmable frequency step is 5/6.25 KHz. A and N counter is programmed to obtain the desired frequency by serial data in CPU. In comparator, the phase difference between reference and VCO signal is compared. When the phase of reference frequency is leading , Fv is output, but when VCO frequency is leading, Fr is the output. When Fv=Fr, phase detector out is very small 0v pulse. 64/65 modulus prescaler is comprised in U1.

Level Shifter & Charge Pump

The charge pump is used for changing output signals Fr, Fv at PLL IC from 0-5v to 16v necessary for controlling vco.

DC to DC Converter

The DC to DC converter converts the 8v to 15-16v to supply the necessary voltage for wide range frequency in vco.

VCO

The TX and RX VCO generates RF carrier and local frequency and each VCO is switched by a TX/RX power source. It is configured as a Colpitts oscillator and connected to the buffer as a cascade, the bias circuit is a cascade configuration to save power. The varicap diode D201/D202 are low-resistance elements and have different capacitance for reverse bias voltage.

Using the change of reverse bias voltage(2v – 14v), the wanted frequency for each channel can be obtained.

L203 are resonant coils and L303 are used to change the control voltage by the tunning core.

D201 modulation diode modulates the audio signal. C208,C308 compensates the non-linearity of the VCO due to the VCO due to the modulation diode and maintains a constant modulation regardless of frequency.

Microphone Audio Circuit

Microphone audio is fed through the front panel PCB onto the main PCB, where it is amplified, pre-emphasised and limited before being applied to the VCO and TCXO (via pin 1 on TCXO module).

Frequency synthesiser circuit

With data received from the EEPROM (U6) the frequency synthesiser circuit controls and produces the RF carrier frequency for the transmitter during transmit and the local oscillator frequency for the receiver. The frequency synthesiser circuit is comprised of:

- Rx/Tx Voltage Controlled Oscillator (VCO)
- Charge Pump and Loop Filter
- Dual Modulus Prescaler

Voltage Controlled Oscillator

Contains two VCOs. One for producing carrier frequencies during transmit and one for producing the local oscillator frequency during receive. The module also has Rx and Tx power line filters.

RX/TX VCO

The VCO consist of an RX VCO and a TX VCO. It is switched RX/TX by the power source . It is connected to the buffer as a cascade bise in order to save power . The varicap diode D201,D202,D301 are low-resistance elements and produce a change in frequency With a change in reverse bias voltage(1.5~11v) .L203,L303 are resonant coils,which change the control voltage by the tuning core. D201modulation diode, modulates the audio signal.

Charge Pump and Loop Filter

Transistors Q903 to Q904 and associated resistors and capacitors form the charge pump and loop filter. The phase detector output from U1 pins 7 and 8 are combined by the charge pump to produce a 0 – 16 tuning volt signal. The signal is filtered by the loop filter to remove any residual reference frequency harmonics from the signal. After filtering, the signal is applied to the voltage controlled oscillator module.

Dual Modulus Prescaler

The prescaler divides the VCO frequency by 64 or 65.

Power Amplifier and Harmonic Filter

The power amplifier contains transistors Q12, Q13, Q18, Q39, Q28 and associated inductors, capacitors and resistors. When the radio is in transmit mode the diode D1,D15 is forward biased enabling the modulated RF signal from the VCO (amplified by the first stage amplifier / buffer Q12 and Q13) to pass to the pre-driver Q18 via Q39. The output signal is passed from Q39 to Q28 where it is then amplified for transmission. The amplified RF signal is passed through stripline coupler and is fed to the harmonic low pass filter, comprising L21, L25, L22,L27,C103,C168,C296, C100, C65, C297,C99 and then to the antenna connector (ANT). The stripline coupler provides a sample of the RF signal for the automatic power control. During transmit D1,D15 is forward biased which connects the power amp to the antenna. D2,D15 is forward biased inhibiting transmit signal power from being fed to the receiver circuitry.

3.2 VHF Receive

The receiver is comprised of:

- RF amplifier
- First mixer and first IF amplifier
- Second mixer, second IF amplifier and FM detector
- Receiver audio circuit
- Mute (Squelch) circuit

RF amplifier

The receiver Front End module contains two stages of filtering and an amplifier, Q601. The module filters out the unwanted frequencies and provides a gain of typically 12dB for the wanted frequencies. The wanted RF signal at the operating frequency is passed to the first mixer.

The signal received from the antenna is routed through the 7^{th} order Chebyshev low-pass filters contained C601, C603, C604, CL603, C605,C608 and L601, L602, L604 and passed through Front End Module (RF amplifier) via pin 1. The front-end module contains D601 to Q601, the front end module is configured to enable the RF signal at the operating frequency to pass to the first mixer.

First Mixer and First IF Amplifier

The VCO local oscillator signal routed through buffer transistors Q2 is filtered by C14, C15, C16,C17 and L2and L4. D4 produces a difference frequency IF of 45.1MHz from pin 6 of front end module and the filtered VCO local oscillator signal at pin 4. The 45.1MHz difference frequency is filtered by the 2-pole crystal filter FL4,5. The tuned circuit T1 and T2 and associated components provide matching of the crystal filter to ensure good pass-band response and selectivity. The IF signal is amplified by Q3 and passed to the second mixer, second IF and FM detector U2.

Second Mixer, Second IF, FM Detector

U2 is a single conversion FM receiver integrated chip and contains the second mixer, second IF amplifier and FM detector. The second local oscillator frequency is determined by the crystal Y6 connected to pin 1 of U2. The first IF signal is received at pin 16 of U2 and applied to the mixer. The output of the second mixer, a frequency of 455kHz, is the difference between the IF signal and the second local oscillator. The 455kHz passes via pin 5 and is applied to a 455kHz bandpass filter, FL2, (12.5/25kHz channel spacing) or FL3 (12.5kHz channel spacing). The selection of the filters is accomplished by diodes D11 (input) and D12 (output) whose bias is controlled by software and applied to the diodes from pin 98 of the microprocessor (U18). The output of FL2/FL3 is passed via pin 11 to a high gain amplifier coupled to the adjustable quadrature detector Y1 (pin 10). Any detected signal is produced at pin 96 of U18 and applied to the Receiver Audio Circuit and the Mute (Squelch) circuit.

Receiver Audio and Sub-audio Circuit

The receiver audio circuit has been fully controlled by Baseband Process, CMX881 supported by CML using internal software program.

Frequency and CTCSS/DCS data storage

EEPROM

Rx/Tx channels, CTCSS/DCS as well as other data from the programmer are stored in the EEPROM. The data stored is retained without power supplied. This is a non-volatile memory. The EEPROM may have information re-programmed or erased. U6 is an EEPROM with 32Kbite capacity and data is written and read serially

Mute (squelch) Circuit

The mute circuit switches off the power amplifier when no audio signal is present. The squelch circuit consists of U2 and RV2,RV3 and their associated components. The noise signal form pin 9 of U2 is amplified by internal amp of U2and then fed into RV2, RV3. RV2,RV3 is used to adjust the squelch circuit sensitivity and is normally adjusted to produce noise squelch opening sensitivity of 10dB to 12dB SINAD

Speaker Audio Amplifier

After signal detection and audio filtering , Via U14on the RF board, the low level audio is returned to the digital board. This is then routed to Pin22 of U13 to provide speaker audio.

MAINTENANCE AND REPAIR

GENERAL

VHF

The VHF hand portable radio covers the VHF band from 146 to 174MHz. The radio have been factory aligned for operation within frequency band.

Any repair or adjustment should only be made by or under the supervision of a qualified radio service technician.

ALIGNMENT PROCEDURE

The PM-200 V2 Receiver is designed for broad band covering VHF(146-174MHz) and should require no special alignment, unless repairs are performed on the receiver portion.

The only alignment normally required is to squelch circuit, Apply a signal that produes 10dB SINAD, reduce the input to -130dBm, close the squelch control(RV2,RV3,) until the receiver mutes.

Increase the signal to 10dB SINAD reading reference level and adjust RV2 or RV3 until the squelch opens. In high noise environment, some users may prefer to have the squelch opening set somewhat tighter, e.g.:12 to 14dB SINAD.

Should repairs be required, the following procedures should be applied:

VCO

1. Set the unit to the lowest transmitter frequency, 146MHz(VHF), and adjust the VCO L203 to 2.5V and 1.0V respectively.
2. Set the unit to the highest transmitter frequency, 174MHz(VHF), and check that the VCO voltage is below 14 volts.
3. Set the unit to the lowest receiver frequency, 146MHz(VHF), and adjust the VCO 302 to 1.5V.
4. Set the unit to the highest receiver frequency 174MHz(VHF),) and check that the VCO voltage is below 14 volts.

* Note : use L203,L303 to measure the voltage.

Transmitter

Connect the unit to a Service Monitor with the power meter setting to the 46 W scale (or autorange)

TCXO

Set the channel selector to the mid-range frequency 455 MHz, adjust TCXO, for a reading of 445 MHz +/- 200Hz. For the UHF data radio, adjust the TCXO and set the frequency within the required range.

APC

1. Adjust RV5 for fixing up High Power(50W)
2. Adjust RV1 for fixing up Low Power(5W)

3.3 Front Panel PCB

The front panel pcb holds the volume control potentiometer S6 (and built in on/off switch SW POWER); The board also holds a dual colour LED which indicates Transmit (Red), decoding CTCSS (Green) and receiving whilst de-squelched (Amber) produced from Red and Green. The front panel pcb also has the accessory socket wired to it via connector J1, which can be used for either external programming of the radio or as an accessory socket for external speaker and hand microphone.

Software contents

1. Features
2. Message
3. Basic Operation

- Function Keys
- Up button/ Down key
- Programmable function keys
- Emergency KEY
- Two Tone Code Channel Selection
- DTMF Code Channel Selection
- SMS Code Channel Selection
- Group Scan Edit Mode
- All Channel Scan Edit Mode
- Programming
- Clone

4. BASIC FEATURES

- 208Channels
- Channel Spacing
- Output Power
- Beep On/Off Mode
- Light Mode
- Public Address
- Microphone Hook
- Squelch Options
- Transmit Time-Out-Timer/TX Penalty
- Busy Channel Lockout/Marked Idle
- PTT Lockout
- Scanning
- Normal Scan
- Priority Scan
- Priority Look Back
- Scan Channel Delete
- DTMF
- SMS
- TWO TONE

4. Basic Feature
5. FUNCTION display
6. PC Programmer

1. Features

- Wideband frequency separation
- 9 character display with icons
- 2 or 25W Programmable output power
- Programmable 12.5 /25 KHz Channel Spacing
- Programmable function keypad
- Channel Scan
- Priority Channel Scan
- Look Back Channel
- CTCSS/DCS/DTMF tone signaling
- Bush Channel Lock out
- Marked idle
- Time out timer
- Public Address
- Two Tone
- SMS
- DTMF
- Scan List Edit
- Priority Channel Edit
- Programmable On/Off HOOK function

2. Message

STATUS	DESCRIPTION	LED COLOR/ICON	AUDIBLE TONE	DISPLAY
Normal	Power On		Five Beeps	All display Version display
	Correct Call	Green		
	Transmit	Red		
	Busy Channel	Yellow		
	Priority	Icon		
	Button		Single Beep	
	Two Tone received	Icon	Two Beeps	U/D
Warning	Time out timer		Two Beeps	tot
	Busy channel Lock Out		Two Beeps	bLock out
	Penalty		Two Beeps	Penalty
	Penalty End		Single Beep	
	Call Busy			Call Busy
	PTT Lock			Close
Scanning	In Normal Scan Mode	Green Led Blinking Icon		
	In Priority Scan Mode	Green Led Blinking Icon		
	Scan Delete		Single Beep	delete
	Scan All Delete		Single Beep	All del
	Transmit Inhibit In Scanning		Two Beeps	Inhibit
	Receive Only-No TX		Two Beeps	RX only
Error	EEPROM Error		Two Beeps	Eprom Err
	Out of Lock	Red blinking	Two beeps	unLock
	PLL Error			
Mode	Pc Program Read	Red Blinking		Prog- r
	Pc Program Write	Green Blinking		Prog-w
	Clone Master	Red blinking		Master
	Clone Slave	Green Blinking		Slave
	Clone end			Turn OFF
	Scan List Editing	Green		SCAN EDIT
	PSCAN List Editing	Red		PSCAN EDI

3. BASIC Operation

■ Function keys
There will be six push-buttons on the face of the SM5102; Up, Down, P1, P2, P3 and Emergency. below are the default programming settings.

■ Up button/ Down key
- This button will allow the operator to scroll up/down through the available channel. A press-and-release of this button will increase/decrease the channel number. A press-and-hold will scroll through the succeeding channel num.
-Push to select a transmit code channel after pushing [Two Tone code Channel select]
-Push to select a DTMF channel after pushing [DTMF Code Channel Select]
-Push to select a SMS channel after pushing [SMS Code Channel Select]

■ Programmable function keys
- The following functions can be assigned to [P1],[P2],[P3] programmable function keys.
[Power key]
- Push to toggle the transmit Output power between High and Low
- Each channel can be programmed via the PC programmer and KEY to a high-power output, 50 Watts, and a low-power output, 5 Watt.

[Light Key]
- Push to toggle the auto mode or Light off mode.
- AUTO Mode/OFF Mode is Selectable using Light Key. In case of Auto Mode, as pressed the key, the light is bright during the 5 s.

[Monitor Key]
- By pressing one of the option buttons programmed to be the Monitor button, the user shall defeat the programmed squelch operation and un-mute the speaker on the selected channel.

[Lock Key]
- This function can disable all keys except PTT, Emergency Key.

[Scan Key]
- Push to start and cancel scanning operation.

[Public address Key]
- Located under Programmable key, user selectable on or off. When selected and external speaker is attached the radio will output voice audio over the external speaker.

[Two Tone Key]
- Push and toggle the radio enable or disable Two Tone mode

[SMS Key]
- Push to enter the SMS code channel selection mode.
- Then set the desired channel using [UP/DOWN]
- And then Push to transmit the SMS code in the SMS code selection mode .

[1200/2400 bps Key]
- Push and toggle the SMS baud rate 1200 bps or 2400 bps.

[DTMF Key]
- Push to enter the DTMF code channel selection mode.
- Then set the desired channel using [UP/DOWN]
- And then Push to transmit the DTMF code in the DTMF code selection mode .

[GROUP Key]
- Push to enter the group selection mode.
- Then set the desired group using [UP/DOWN]
- And then Push [GROUP] to select the group number.

■ Emergency KEY
– When emergency button is pushed, an emergency signal is automatically transmitted for the specified time period. This is where the DTMF tone to be transmitted as the Emergency Call can be entered. After the emergency call, the transceiver performs transmission and reception alternately with the following conditions:

- Transmits the microphone signals
- Receives the signal and emits audio

When Press the PTT, the function is cancelled.

■ Two Tone Code Channel Selection
If the transceiver has [Two Tone] assigned to it, the automatic Two Tone transmission/reception function is available.
To enable/disable Two Tone, Push the [Two Tone] key assigned by two tone function.
This function key is toggled.

■ DTMF Code Channel Selection
If the transceiver has [DTMF] assigned to it, the automatic DTMF transmission function is available. Up to 9 DTMF channels are available:

To Select DTMF code Channel:

- Push [DTMF] – a DTMF Code channel appears
- Push [UP] or [DOWN] to select the desired DTMF Code channel.
- Push [DTMF] to transmit the DTMF Code in selected DTMF channel.

■ SMS Code Channel Selection
If the transceiver has [SMS] assigned to it, the automatic SMS transmission function is available. Up to 9 SMS channels are available:

To select SMS code Channel
- Push [SMS] – a SMS Code channel appears
- Push [UP] or [DOWN] to select the desired SMS Code channel.
- Push [SMS] to transmit the SMS Code in selected SMS channel.

To change the baud rate:
- Push [1200/2400 bps]

■ SCAN Edit Mode
- You can edit your pre-programmed Group Scan List by adding or deleting scan list from the Group Scan List. To activate scan list editing, press and hold the P1 button on the front of the radio and turn volume on the radio. Upon entering the scan list edit function, the LCD displays the “Scan Edit ” message. To exit the scan list edit function, turn volume off the radio.

1. Select the Scan Group
Each Scan Group would be displayed as “xx_nnn”. xx means group, and nnn means Channel. To activate scan list editing for selected group, press the P1 button. You can change the Scan Group Number by up or down button.

2. Adding or Deleting to Scan List
If each channel is in the ‘Scan Editable List’, Channel Number would display Scan Icon, . To add or delete each channel to Scan Editable List, use P2 button.

■ Priority SCAN Channel Edit
Priority Channel can be setup by PC programmer. Priority Scan List is also editable by the radio. It is called ‘Priority Channel Edit Mode’. If turn on the radio with pressing P2 Button, the radio enters Priority Channel Edit Mode. In the Priority Edit Mode, the LCD displays the “PscanEdit” message.

1.Select the Priority Group
Each Scan Group dispalys “xx_nnn”. ‘xx’ means the current Group and ‘nnn’ means channel. To activate P scan list editing for selected Priority group, press the P1 button. You can change the Priority Group Number by up or down button.

2.Adding or Deleting to P Scan List
If each Channel is included in P Scan Editable List, Channel Number would display P scan Icon. To add or delete channel from P Scan Editable List, use P2 button.

■ Programming
When the SM-2000/5000 Series is powered from the programming interface, the MCU checks PC-program Enable port. If the PC-program enable port is active status, the MCU enters programming Mode. The LCD display" ProGram"

1. Reading
SM-2000 / 5000 assumes PC is ready to receive data. So, If user send the serial Commands though the interface boards, SM-2000 / 5000 will transmit the data. During this sequence, the Red LED is flashed. In PC program Reading Mode, the LCD displays "Prog-r".

2. Writing
SM-2000 / 5000 assumes PC is ready to transmit data. If user send the serial Commands though the interface boards, SM-2000 / 5000 will notify this situation and then make ready to receive the data from PC. After that, the radio informed PC of this status, then PC starts the transmission of data. During this sequence, the Green LED is flashed. In the PC program Writing Mode, the LCD displays "Prog-w".

■ Clone
1.Push and hold UP button when radio turn power on. In this mode, radio will display "Master". The mode is the master wait mode.
2. Push and hold DOWN button when radio turn power on. In this mode, radio will display "Slave" with green led blinking.
3.Connect the cloning cable.
4.Push the master radio DOWN button.
5.After cloning, the slave radio display " TURN OFF" message, and the master radio display " MASTER" message on LCD.

4. BASIC FEATURES

■ 208Channels
The SM5000 Series radio can store up to 208 channels within the same band. These channels can be selected by turning S/W.

■ Channel Spacing
The SM-5000 Series is capable of programmable channel spacing. Each channel can be programmed via the PC programmer, having 12.5KHz or 25KHz channel spacing.

■ Output Power
Each channel can be programmed via the PC programmer and KEY to a high-power output, 50 Watts, and a low-power output, 5 Watt.

■ Beep On/Off Mode
All Beep tones can be globally enabled or disabled via the PC programmer. Power Up alert shall be disabled when Power UP Alert are globally disabled.

■ Light Mode
AUTO Mode/OFF Mode is Selectable using Key. In case of Auto Mode, as pressed the key, the light is bright during the 5 s.

■ Public Address
When selected and external speaker is attached the radio will output voice audio over the external speaker. The radio does not TX a carrier in this mode. P/A will be shown in display when selected. When active allows operator to enable an external speaker and transmit microphone audio only.

■ Microphone Hook
Dealer programmable function. Turned OFF user is not required to ground microphone hook. All decode and scan functions remain the same. Turned ON user is required to ground microphone hook. When microphone is removed from ground all tone decode functions are disabled, scan function is dealer programmable as on or off with microphone removed from hook. Default is off with scan disabled.

■ Squelch Options
The Radio supports 3 kinds of Squelch Options. Different Squelch option can be applied to each channel.
1. CTCSS
38 kinds of TIA/EIA Standard CTCSS Tones can be set up. All tones can be set up using PC Programmer.
- TX Operation: If PTT key is pressed, the Radio occurs CTCSS tone, which is programmed to each channel and goes TX mode. Tone would occur during TX.
- TX close: When TX mode closes, the Squelch Tail Elimination of the radio would work.
- RX Operation: If the CTCSS Tone is detected, the Radio status would be changed from Busy to Correct Call. If the CTCSS Tone is not detected, the radio would keep Busy or be changed from Correct Call to Busy.

2. DCS
The radio supports 83 kinds of TIA/EIA Normal/Inverted DCS Data.
- TX Operation: If PTT key is pressed, the Radio occurs DCS Bit pattern of each channel and goes into TX mode. DCS Bit pattern would occur during TX.
- TX close: When TX mode closes, Squelch Tail Elimination of the radio occurs. At this time, Turn Off Code would be transmitted.
- RX Operation: If the DCS Data Stream is detected, the radio status would be changed from Busy to Correct Call. If the DCS Data Stream is not detected, the Radio would keep Busy or be changed from Correct Call to Busy.

3. Squelch Defeat (Monitor) operation
If the Monitor button is assigned by PC programmer, squelch defeat function would be run by pressing Monitor button. If Press the Monitor button, Squelch option would be closed and you can hear the audio sound through the speaker. If Release the Monitor button, Squelch option would work again.
■ Transmit Time-Out-Timer/TX Penalty
Time-out is a dealer programmable time from 0 – 990 seconds which is the allowed time for a sustained transmission. TX inhibit does not allow a transmission for a dealer programmed time from 0 – 75 s after the time –out has expired to allow a cool off period for the transmitter.

■ Busy Channel Lockout/Marked Idle
The transceiver has several inhibit function which restrict transmission under the following conditions
- Busy Channel Lockout – ON: Upon PTT being pressed, if carrier is present, the radio shall not transmit and an audible alert tone will be given.
- Busy Channel Lockout – OFF: Upon PTT being pressed, the radio shall transmit regardless of the presence of carrier.
- Marked Idle enabled: Can only be enabled if Busy Channel Lockout is ON. If the Busy Channel Lockout is on and carrier is detected, the radio shall be permitted to transmit if the RX squelch option is valid.
- Marked Idle disabled: Eliminates Marked Idle and defaults back to 'Busy Channel Lockout'.

■ PTT Lockout
The radio will allow transmission according to radio busy status.
- Off : 'Off' allows PTT to operate regardless of whether the radio is in an open state (monitor open) or not, and does not change the state of the radio.
- Auto Open: 'Auto Open' opens the monitor of the radio after pressing PTT.
- Lock PTT : 'Lock PTT' prevents the keying of PTT unless the radio is open

■ Scanning
This feature will support three different scanning types. Dealer programming enables each scan type.
- Normal Scan
- Priority Scan
- Priority Look-back

Once the radio has enabled scan, it will traverse through the pre-programmed scan list. The time spent on receiving a channel in the scan list is referred to as the scan speed. When an incoming call is detected and decoded, scanning shall stop and the radio will un-mute. After the call has ended, the radio shall enter Scan Delay Mode for a pre-programmed period of time. If the radio receives a call from the same caller before the Scan Delay expires, the radio will re-enter the Scan Delay Mode and that period of time will reset. If the user is permitted to respond to the caller, the Scan Delay will be reset. When the Scan Delay expires, the radio shall resume scanning

■ Normal Scan
Any number of channels shall be entered into the scan list. This will be equal to or less than the number of programmed channels. The LED shall flash green if programmed to. The flashing green LED will stop when 'CARRIER', or 'CARRIER AND CORRECT TONE'. During scan delay, the LED shall remain clear. When Scan Delay expires and Scan Speed resumes, the LED shall also resume flashing green.

■ Priority Scan
A priority channel can be programmed at the initial radio set-up stage. The priority channel will be part of the list of channels that make up the scan list. The priority channel when used with other scanned channels will operate as follows: P1→S1→P1→S2→P1→S3→P1→S4→P1, etc.

■ Priority Look Back Scan
One channel can be programmed by the dealer to be the Priority channel, which will enable 'Look-back'. This mode of operation can be used outside of the normal scanning mode. Pressing the Scan button shall activate Priority Look-back. The Priority Look-back causes the radio to periodically 'Look-back' to the priority channel for the presence of a carrier regardless of the channel that the user may be on. The frequency that the radio will 'Look-back' to the priority channel can be programmed between 1 to 7 seconds in 1-second increments. When carrier, or carrier and tone, are removed, the radio will revert back to the previously selected channel.

■ Transmitting during Scanning
The radio shall be set to behave in a number of ways when the PTT is pressed during Scan.

- Priority Scan TX – The radio can be set to transmit on the channel on which activity has been detected -OR- transmit on the priority channel if scanning is still active.
- Priority Only TX – If scanning, or listening to an active channel, and the PTT bar is pressed the radio will only transmit on the priority channel. No transmissions shall be allowed to scanned calls. If transmission is attempted a warning tone will be sounded.
- Rx only, No TX – No transmissions allowed during scanning. If transmission is attempted a warning tone will be sounded.
- Normal Scan TX – Radio will only transmit on a stopped channel i.e. to return a call. Attempting to transmit during scanning will cause a warning alert.

■ Scan Channel Delete
Pressing the 'Monitor' key, (when in scan mode and stopped on the channel) shall temporarily delete the channel from the scan list. This shall remove that channel from the scan list until the channel is changed or the radio's power is reset. When power is restored or the scan list channel position is selected again, the originally programmed scan list shall be activated.

■ **DTMF**
1. Receiving an DTMF
- When an DTMF is received
  DTMF data is displayed
- When the received DTMF includes more than 8 characters, "►" appear.
  Push any button to return to the standby condition.

2. Transmitting an DTMF
- 9 DTMF memory channels are available and the messages can be edited via PC Programming and ACC-703.

2.1 DTMF Transmission
2.1.1 Using call memory by PC Programming
① Push [DTMF]to enter the DTMF code memory channel selection mode. Up to 9 DTMF channels are available:
② Push [DTMF] – a DTMF Code channel appears
③ Push [UP] or [DOWN] to select the desired DTMF Code channel.
④ Push [DTMF] to transmit the DTMF Code in selected DTMF channel.

2.1.2 Direct code entry with ACC-703
2.1.2.1 Manual dial Operation
①. while in the standby condition, push [STR] 1 times, to enter the DTMF mode.
- display "DTMF"

② Push the appropriate [0]-[9], A,B,C,D,*,# to enter the desired character.
③ Push the CLR Key. Number or character will be deleted at last Number or character.
④ Push and hold the CLR key. All messages will be deleted. the radio enter the standby mode.
⑤ Push the RCL key. Press the number key. DTMF message which is stored number is displayed at LCD.
⑥ Push the RCL Key. Press the #,* key to removed the displayed data from the LCD. the radio enter the standby mode.
⑦ Push and hold the RCL Key. the radio is changed with Number mode and Alphabet mode.
⑧ Push and hold the STR Key to blink the cursor. Push [*] to move the cursor to left. Push[#] to move the cursor to the right
⑨ Push the STR Key in the edit mode. Press the number key. DTMF message is stored -display[STORE Num]
⑩ Push the SND key to transmitter the DTMF data.

2.1.2.2 Clearing a Dialed Number
When a number has been accidentally entered during auto dial a press and release of the CLR key will delete an individual number. A press and hold of the CLR key will clear the entire dialed number.

2.1.2.3 To Store a Number in Memory
Dial the desired number. Entered number will show in the radio display.
Press and release the STR key.
Press and release any number 0 – 9 to store the number, * and # cannot be used for storing a number.
STORed will show in the radio display indicating the number has been stored in memory under that key.

2.1.2.4 To Recall a Stored number from Memory
Press and release the RCL key.
Press and release the number key from which a number has been stored.
Press SND to dial the recalled number.

If a number has been accidentally recalled repeat steps 1. and 2. until the proper number has been recalled.

2.1.2.5 Clearing a Stored Number
Press and release the RCL key.
Press and release the number key from which a number has been stored. The stored number will show in the radio display.
Press and hold the CLR key to remove the stored number. A new number can now be entered and stored in that location.

2.1.2.5 Decode action
● Stun – this shall prevent any transmission from the radio and will also mute the speaker.
● Revive – this shall re-activate the radio.
● Covert On – a valid address shall cause the radio to cycle between Tx mode and Rx mode. The time periods spent in Tx and Rx modes shall be programmed into the addressee radio, however, it will be the Base Station or DTMF Sender, that remotely turns this feature ON or OFF.
● Covert Off – this shall remotely turn the radios' covert mode off, i.e. the radio will return back to passive receive mode.

■ SMS
1. Receiving an SMS
- When an SMS is received : the SMS data is displayed
- When the received SMS includes more than 8 characters, "►" appear.
Push any button to return to the standby condition.

2. Received message selection
-The Radio memorizes the received messaged for record. UP to 9 messages for SMS, of 40 character SMS can be memorized. The oldest message is erased when the 10th message is received. However, once the radio is powered off, all messages are cleared.

①.Push [SMS] : displays "RECORD"
②.Push[SMS] : Displays message memory
③.Push [UP] or [DOWN] to select the desired message
- When selecting the SMS that includes more than 8 characters, "►" appear.

④. Push and hold the ACC-703 [STR] button to enter the message scroll mode.
⑤. Push the ACC-703 [#],[*] button to scroll the messages.
⑥. Push [SMS] : again to return to the standby condition

3. Transmitting an SMS
- 9 SMS memory channels are available and the messages can be edited via PC Programming and ACC-703.

3.1 SMS Transmission
3.1.1 Using SMS memory by PC Programming
① Push [SMS] to enter the SMS code memory channel selection mode. Up to 9 SMS channels are available:
② Push [UP] or [DOWN] to select the desired SMS Code channel.
③ Push [SMS] to transmit the SMS Code in selected SMS channel.

3.1.2 Direct code entry with ACC-703
① During standby condition, push [STR] 3 times, to enter the SMS mode.
- Display ”SMS”
② Push the appropriate digit key,[0],[9], to enter the desired character.
③ Push the CLR Key. Number or character will be deleted at cursor.
④ Push and hold the CLR key. All messages will be deleted. the radio enter the standby mode.
⑤ Push the RCL key. Press the number key. SMS message which is stored number is displayed at LCD.
⑥ Push the RCL Key. Press the #,* key to removed the displayed data from the LCD. the radio enter the standby mode.
⑦ Push and hold the RCL Key. the radio is changed with Number mode and Alphabet mode.
⑧ Push and hold the # key to work the space key.
⑨ Push and hold the STR Key to blink the cursor. Push [*] to move the cursor to left. Push [#] to move the cursor to the right
⑩ Push the STR Key in the edit mode. Press the number key. SMS message is stored
-Display[STORE Num]
⑪ Push the SND key to transmitter the SMS data.

■ TWO TONE

1. Two Tone Option

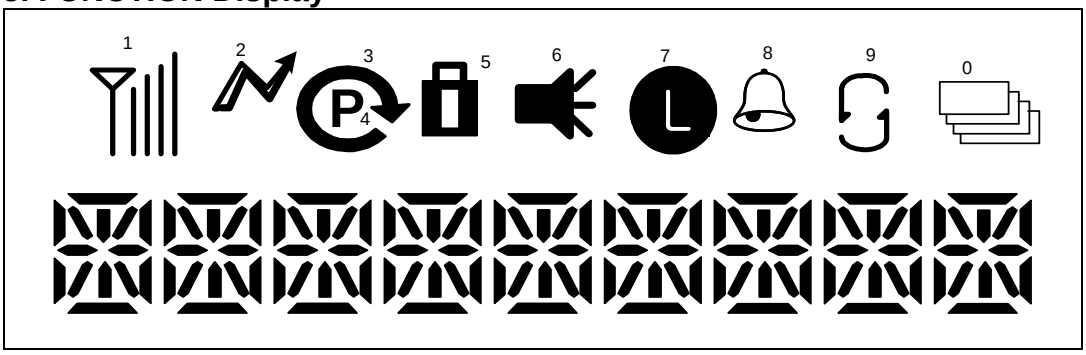
1.1 Two Tone Enable/Disable
- Enable : can receive/transmit two tone.
- Disable : cannot receive/transmit two tone

1.2 Two Tone Decoding Alert
- Enable : It rings alert sound when the radio detects two tone correctly and if no action, alert sound every 3seconds.(but first time, alert sound in 10 seconds one time)
  If you do any action after detecting two tone(ex: push a key or change volume level etc…), then stop the alert sound.
- Disable : No alert sound

1.3 Every Time Two Tone Detect
- Enable : Check the Two Tone whether correct or not whenever receive a Two Tone signal.
- Disable : Check the Two Tone one time only when receive a Two Tone signal firstly,
  From Next time, don’t check the Two Tone. If you change to another channel,
  Radio will repeat above.

2. Two Tone En/Decoding
You can set Individual, Group, Super Group 3 kinds of Two Tones.
2.1 Lead In Time : The time until transmit two tone after pressing PTT key.
2.2 Tone Time : The length of Tone A or Tone B
2.3 Gap Time : The length between tone A and tone B.
2.4 Two Tone Type : You can set a desire Two Tone type with PC Programmer at each channel
- Decoding : It must be correct all tone A, Gap, tone B time and frequency to open speaker.
- Encoding : Transmit Two Tone setting frequency (tone A, gap, tone B) after PTT.

5. FUNCTION Display



1 Signal strength indicator : Indicates relative signal strength level
2 TX Indicator :Appears while transmitting
3 Scan Indicator : Appears at the scan Channel
4 P Scan Indicator : Appears at the Priority scan Channel
5 Key Lock Indicator : Appears during the key lock function is on.
6 Speaker Indicator : Appears when the monitor mode
7 Low Power Indicator : Appears when low output power is selected.
8 Two Tone Detect Indicator: Appears when the Two Tone code is received.
9 Scrambler Indicator
10 Commander Indicator

6. PC Programmer

■ **Computer**

Pentium II processor or faster (recommended)

■ **Operating System**

Microsoft Windows® 98, 2000, NT, XP

7. Program Cable Block

■ **Pc Program & Auto Test Program**

15 pin Connect	9 pin Connect
4	5
5	2
6	3
7	7

■ **Flash Cable**

15 pin Connect	9 pin Connect
1	1,5
2	2
3	3
4	5,1,GND

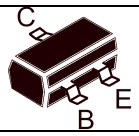
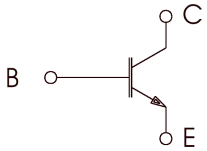
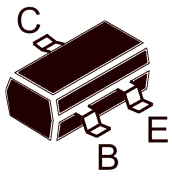
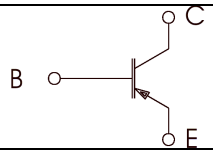
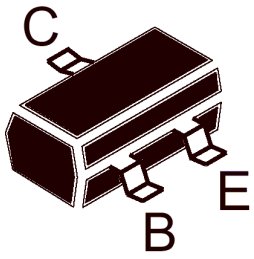
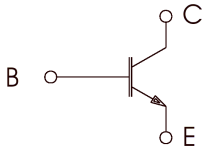
■ **Clone Cable**

15 pin Connect	15 pin Connect
4	5
5	6
6	5

4 TROUBLE SHOOTING GUIDE

SYMPTOMS	CAUSES	COUNTERMEASURES
Unit does not Work	1. Complete discharge of battery (13.8V+/-10%) 2. Regulator 3. 5v voltage source	1. Replace battery. 2. Replace regulator(U20) 3. IC1.Q20 (5v+/-0.2v)
Warning tone& No Work	1. Pll error 2. Filtering Error 3. EEPROM Fail	1. Check U1.Y2.U6 2. Check LPF 3. Re-programming 4. Replace or charge battery
Bad RX Sensitivity (-10 to -60dB)	1. Defective ANT sw 2. Defective front-end 3. Defective DBM 4. IF IC 5. VCO level drop 6. Change of 1'st local frequency	1. Check D1.2.15 2. Check Q601 3. Check D4,T1,T2 4. Replace U2 5. RX VCO level >2dBm 6. Retune TCXO
Defective RX	1. VCO frequency change or level drop 2. Defective voltage Source	1. Repair VCO Defective IF IC 2. Q20
PLL Error	1. Defective 12.8 MHz TCXO 2. Voltage source for RX VCO/ TX VCO 3. Defective PLL IC	1. Replace TCXO. 2. Check RX VCO/TX VCO 3. Replace U1
NO TX Power	1. TX buffer APC 2. Power module 3. APC control	1. Check Q13.12. 2. Replace Power module Q39.28 3. Check Q14.15.16.U11
Low TX power output	1. APC	1. Re-adjust RV1
No modulation	1. SW IC & mic amp IC	1. Check U9.U13.U4
No programming	1. short protector VCC	1. Defective programming lead
NO S.A.T	1. U13	1. Check U13

BASE DIAGRAM

BASE DIAGRAM	MANUFACTURER'S PART NUMBER	REFERENCE NO.	SYMBOL
	KTC5084 KTC3880	Q202.203.302.303	
	AT-41532	Q601	
	KTC4075	Q41.42.43.44.46	
	KTA2014	Q602.641.643	
	PBR951	Q12	
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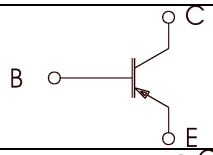
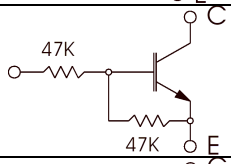
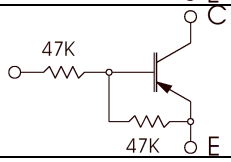
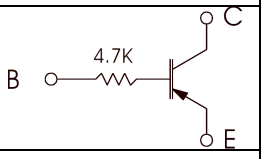
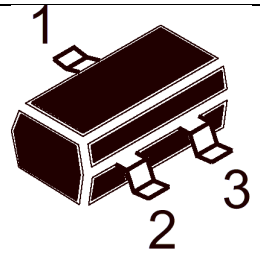
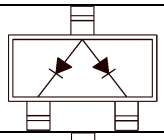
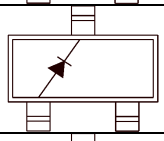
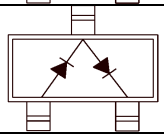
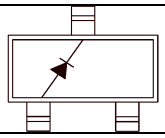
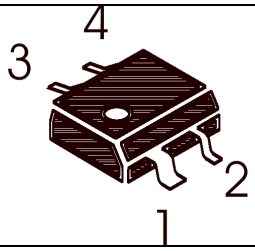
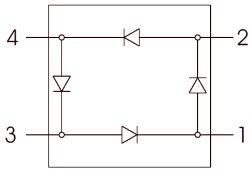
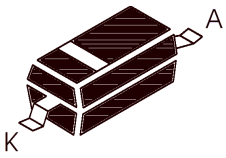
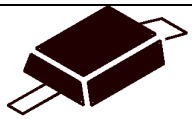
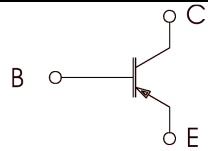
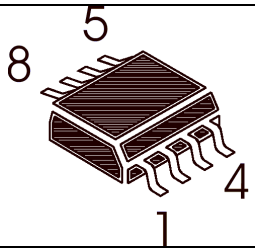
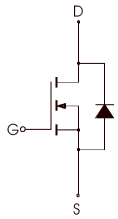
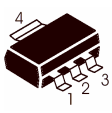
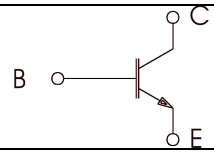
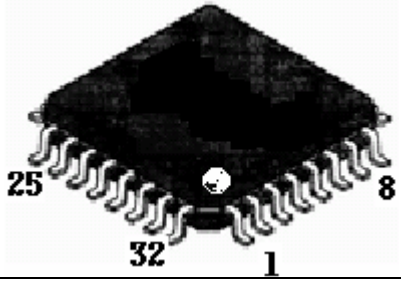
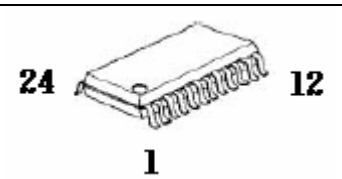
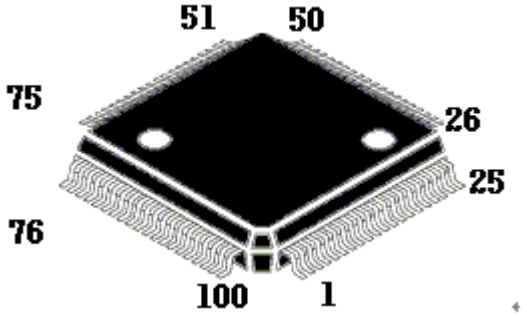
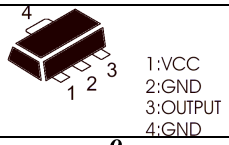
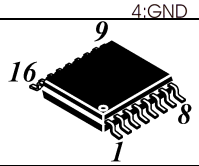
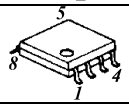
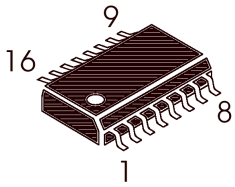
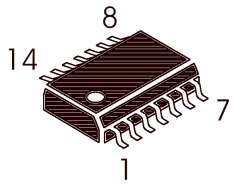
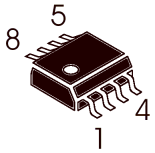
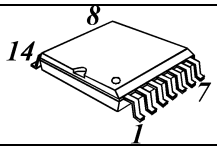
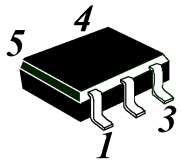
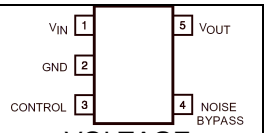
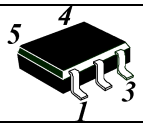
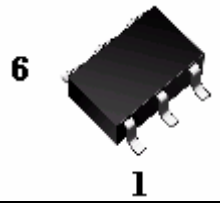
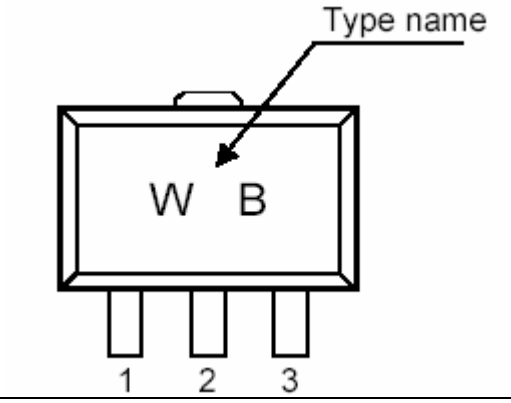
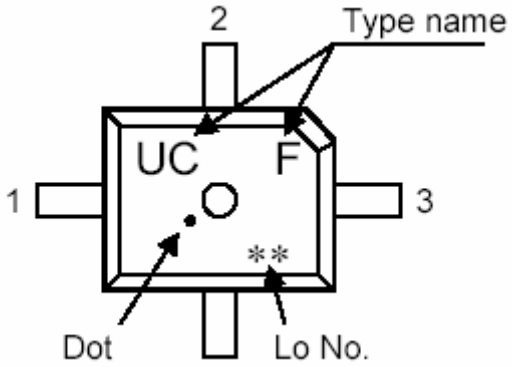
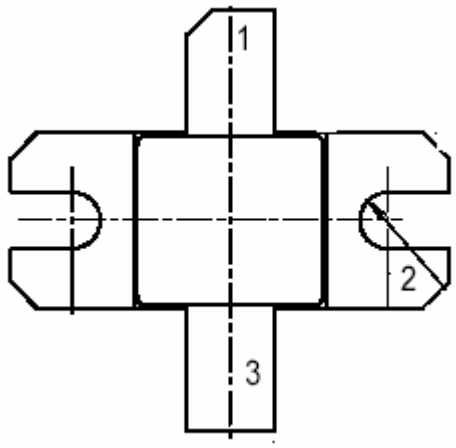
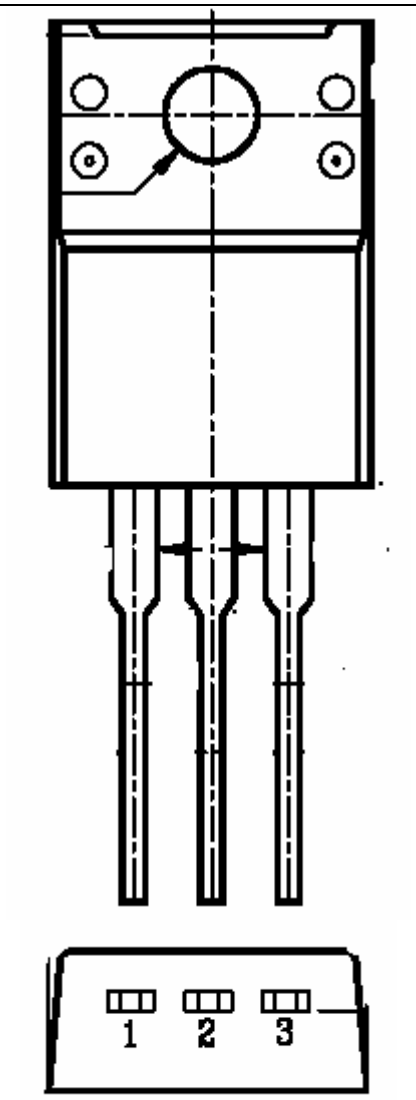
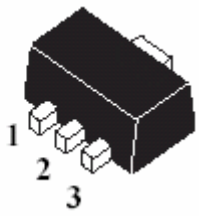
	KTC3875S	Q901.904.7	
	KTA1504S	Q902.903	
	KRC104S (ND) KRC101SNA KRC404V	Q5.6.8.10.16 .19.22.26.27.30.32 34.37.38.48	
	KRA104S (PD) KRA304V] KRA310V KRA226	Q9	
	KRC110S (NK)		
	KRA110S (PK) KRA101S KRA104	Q1.4.11.29.31.33. 36.40.204.304	
BASE DIAGRAM	MANUFACTURER'S PART NUMBER	REFERENCE NO.	SYMBOL
	KDS181 (A3) KDS184	D11.12.8.11.12. 17	
	KDS193 (F3)	D20	
	KDS226 (C3) KDS122V KDS120V	.D601 D201.202 D16.18	

	ZENER (5.6V)	D23.22.5	
	HSMS-2817	D911	
	1SV229 1SV217 MMBV109 HVU300ATRU 1SS314 KDS121V	D201.202.301 D701.901.921	
	KDS160 KDS114	D10	
	SM4004		
	UPP9401	D.2..15	
	KTA1663	Q722 Q23	
	SI4412DY		
 1.EMITTER 2.BASE 3.EMITTER 4.COLLECTOR	BFG35 BLT50		
	XRC5640C.QFP		AUDIO (AUDIO PROCESSOR)

	FX828D5 MT8870D CMX881	U13.34	Codec IC
	HD6473837UX	U18	MCU
	KIA324F		Voltage Detector IC
	MB15E03SL	U1	PLL IC
	TA31136FN	U2	IF IC
	NJM12903V		Comparator
	NJM12904V		OP AMP
	MC14053BD	IC406	MUX./DEMUX.
	MC14066BD MAX232	U3	Analog S/W IC
	DBL5020V KIA324F		OP AMP COMPANDER
	NJM12904V		OP-AMP
	CAT25C32/64	U6	EEPROM
	LM386M TDA7233D KIA358 JRC2073 KIA358 LM358 AD5300	IC203 U4.5.9.11.12. 15.16.7	AUDIO AMP
	MSNBLPS		6TH SWITCHED CAPACITOR LPF IC

	TK71750SCL TK71733SCL TK71730CL	IC1.U22	 VOLTAGE REGULATOR IC
	TC7S66FU KTX301E	Q101	Analog S/W IC Dual switching TR

	KRX201U KRC824E	Q103 Q107.414	Dual Switching TR
	2SK3475 1(Gate) 2(Source) 3(Drain)	Q18	Silicon N-Channel MOS TYPE Amplifier
	2SK3476 1(Gate) 2(Source) 3(Drain)	Q39	Silicon N-Channel MOS TYPE Amplifier
	RD60HUF1 RD70HVF1 RD30HVF1 1(Drain) 2(Source) 3(Gate)	Q28	MOSFET Power Tr

	KTB1367 1(BASE) 2(COLLECTOR) 3(EMITTER) KTA7808 1(EMITTER) 2(COLLECTOR) 3(BASE)	U20.Q14	PNP Transistor
1. BASE 2. COLLECTOR 3. EMITTER 	KTA1663	Q23.47	PNP Epitaxial PlanarTransistor
	MTD20N06HDL	Q25	HDTMOS E-FET TR