AES *IntelliNet*

AES Corporation
285 Newbury Street
Peabody,MA 01960-1315 USA

Phone 978-535-7310
Fax 978-535-7313
Info@aes-intellinet.com

SERVICE MANUAL
MODEL 7088-UE

Rev 1.0 July 10,2007

TABLE OF CONTENS

1.SPECIFICATION

GENERAL SPECIFICATIONS

POWER SOURCE·····+13.8VD.C.nominal(+10.8 to +15.6V)

TEMPERATURE RANGE

STORAGE ·····80℃ maximum -40℃ min.
25℃ nominal

OPERATING·····60℃ maximum -20℃ min.

ANTENNA IMPEDANCE·····50Ω

FREQUENCY CONTROL·····PLL SYNTHESISER

FREQUENCY OF OPERATION·····400MHZ-480MHZ

FREQUENCY TOLERANCE AND STABILITY·····±5PPM

HIGH HUMIDITY·····90%

CHANNEL CAPABILITY·····1

NOMINAL DIMENSIONS ·····134mm(L)X60mm(W)X20mm(H)

WEIGHT ·····190g

RADIO DATA TRANSCEIVER NOMINAL PERFORMANCE

PERFORMANCE SPECIFICATIONS·····ETSI 300-113

RF OUTPUT POWER·····5W PROGRAMMABLE

MODULATION TYPE·····FM

INTERMEDIATE FREQUENICES·····21.7MHZ
450KHZ

CHANNEL SPACING·····12.5KHZ,25KHZ

TRANSMIT ATTACK TIME·····<25mS

CURRENT CONSUMPTION

TRANSMIT·····1800mA@5W,

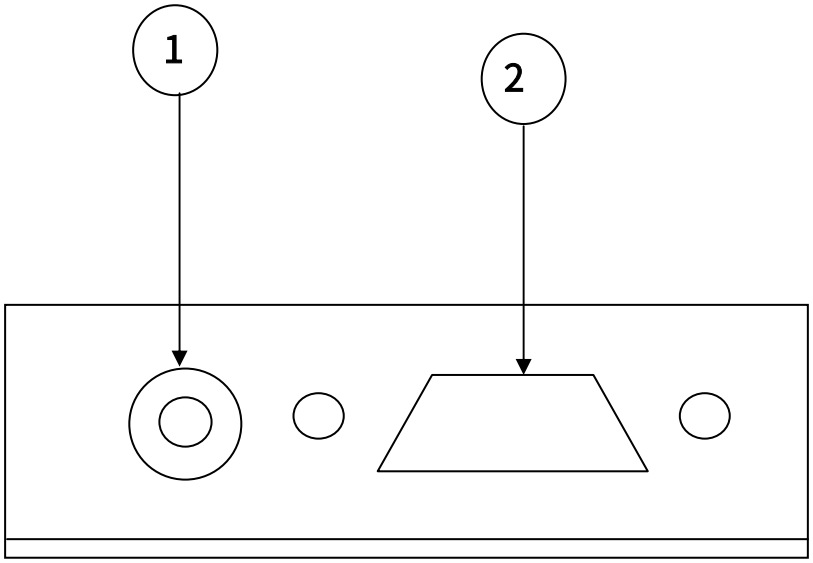
RECEIVE·····85mA

2.CONNECTIONS AND OPERATION

EXTERNAL CONNECTIIONS

1-50Ω BNC SOCKET

2-9 WAY "D" TYPE PLUG(D_SUB)



D-TYPE INTERCONNECTIONS

PIN	FUNCTION	TYPE	RANGE	DESCRIPTION
D_SUB-1	DATA_IN	ANALOGUE	100Mv-2.5VP-P	EXTERNAL MODULATION INPUT
D_SUB-2	DATA_OUT	ANALOGUE	1VP-P	RECEIVER AF OUTPUT
D_SUB-3	PTT	INPUT	0V/+5V	TRANSMIT ENABLE
D_SUB-4	GND	GND	0V	GND
D_SUB-5	B+	V+	+13.8V	POWER SUPPLY
D_SUB-6	CDS	OUTPUT	OPEN/SHORT	RF CARRIER DETECT
D_SUB-7	NC	NC	NC	NC
D_SUB-8	PGM_DATA	INPUT	0V/NC	PROGRAMMER DATA INPUT
D_SUB-9	PGM_ENB	INPUT	0V/5V	PROGRAMMING ENABLE

3.PERFORMANCE TEST AND ALIGNMENT

The alignment and performance test procedures assume the use of the following equipment

Discrete test equipment

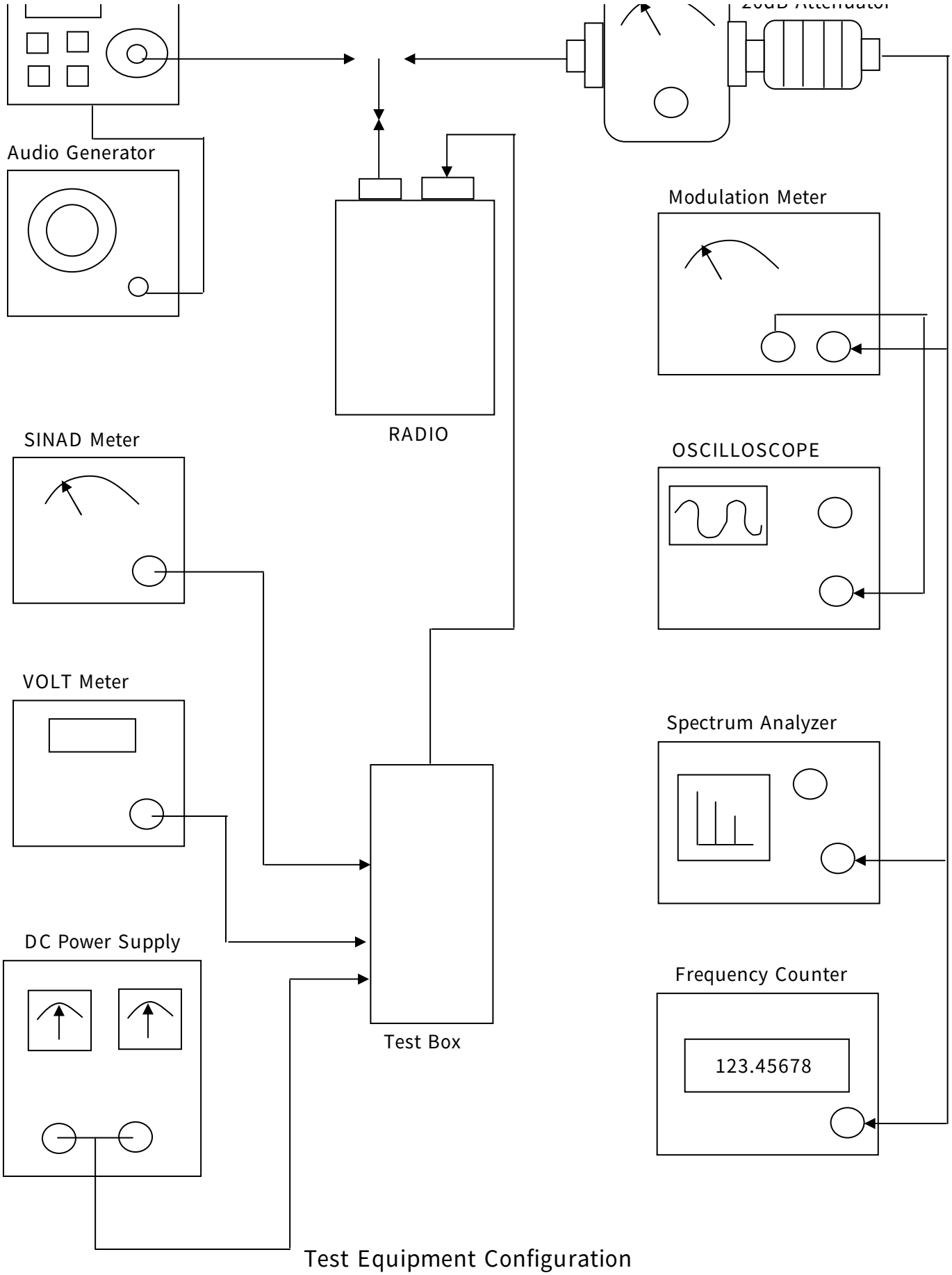
Volt Meter
RF Power Meter.
DC Power Supply,0-15V 2A min
Oscilloscope,20MHz dual beam
RF Frequency Counter,
100KHz-600MHz
AF Signal Generator 0-20KHz
RF Signal Generator
SINAD Meter
Modulation Meter
Audio Power Meter
Spectrum Analyser and notch filter(option)
Coupler(20dB isolation)

Warning:

This device complies with the following of RF energy exposure standards and guidelines:
* United States Federal Communications Commission, Code of Federal Regulations;47CFR part 2 sub-part J
* American National Standards Institute (ANSI)/Institute of Electrical and Electronic Engineers (IEEE) C95. 1-1992
* Institute of Electrical and Electronic Engineers (IEEE) C95. 1-1999 Edition

Please keep 40cm distance away from the antenna.
Only antenna which gain lower than 1.0 can be conntected to the transmitter

4.TEST EQUIPMENT CONFIGURATION



Test Equipment Configuration

5.TRANSMITTER PERFORMANCE TESTS

Power Output

1. Set the power supply voltage to 13.8V dc.and monitor the voltage during transmit.
2. Switch data radio TX and check and record the output power.The nominal output.

power is adjustable between 1 and 5W depending on the programming.

3. Set the PTT switch to OFF.

Peak Deviation

1. Connect the oscilloscope to the output of the modulation meter.
2. Set the AF signal generator to 100Hz at 5V peak-to-peak and connect to DATA_IN Line (pin 1 of D_SUB)
3. Switch data radio to TX and observe the oscilloscope display to check that the 100Hz tone is a square wave.
4. Using the AF signal generator,sweep from 100Hz to 3KHz and record the peak deviation.

5. Check the peak deviation for appropriate channel spacing as follows:
   For 12.5Khz channel spacing,Peak deviation is not greater than 2.5KHz.
   For 25KHz channel spacing,Peak deviation is not greater than 5KHz.

Spectrum Test

It may be necessary to notch the fundamental signal during this test.

1. Connect a spectrum analyser and RF power meter to the antenna socket.
2. Switch data radio to TX.Observe the output spectrum on the spectrum analyser.
3. Adjust notch filter to minimise the carrier.All spurious and harmonics signals should be below-36dBm up to 1GHz and below-30dBm between 1 and 4GHz.
4. Switch off the data radio transmit control.

Receiver Performance Tests

Sensitivity

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

1. Connect the RF signal generator to the data radio BNC antenna connector.
2. Set the RF signal generator to the receive frequency.
3. Connect the leads of the SINAD meter between 0V and pin 2 on D_SUB.
4. Set the deviation to 60% of the peak system deviation.
5. Set the AF generator to 1KHz.
6. Adjust the RF signal generator level until the SINAD Meter reads 12dB.
7. Check that the signal generator RF level is less than -119dBm.

6.TROUBLESHOOTING

The section includes voltage which should assist the engineer to isolate and repair the fault.

Voltage measurements should be made using a high-impedance voltmeter and the values given

are with respect to ground.

Careful alignment,using suitable test equipment,and quality interface cables should ensure that the radio meet their specified performance.

Voltage Charts

Measurement Condition:455.5MHz,13.8V supply,RX Carrier Present.

Transistors.

Ref. No.	RX			TX		
	B	C	E	B	C	E
T101	0	0	0	0.44	2.5	0
T871	4.96	0	4.97	4.3	2.3	4.9
T323	4.5	4.7	3.8	4.5	4.7	3.8

Integrated Circuits

RECEIVER			
Pin	U621	U401	U240
1	1.35v	4.7v	4.5v

2	0v	4.7v	3.8v
3	0v	2.3v	3.3v
4	0v	0v	4.5v
5	6.9v	1.59v	4.1v
6	13.7v	1.59v	4.1v
7	6.9v	0v	0.6v
8	1.35v	0.65v	0.6v
9		0v	0.9v
10		4.58v	4.5v
11		0v	3.6v
12		4.96v	2.2v
13		4.96v	0v
14		0v	0v
15		0v	0v
16		0v	0.9v
17		0v	
18		0v	
19		4.6v	
20		4.6v	

Integrated Circuit Voltages(Receive)

Integrated Circuits

TRANSMIT		
PIN	U701	U607
1	0.1v	1.1v

2	9.1v	1.1v
3	8.9v	1.1v
4	0v	0v
5	0.4v	1.1v
6	0.2v	1.1v
7	12.4v	1.1v
8	13.7v	2.3v

Integrated Circuit Voltages(Transmit)

CIRCUIT DESCRIPTION

TRANSMITTER

The transmitter is comprised of:

- Audio amplifier connection from D_SUB pin 1
- Frequency Synthesiser
- Transmitter
- Automatic Power Control

Audio frequency connections

Processed data from the U601A is applied to the VCO via VR521

Frequency synthesiser circuit

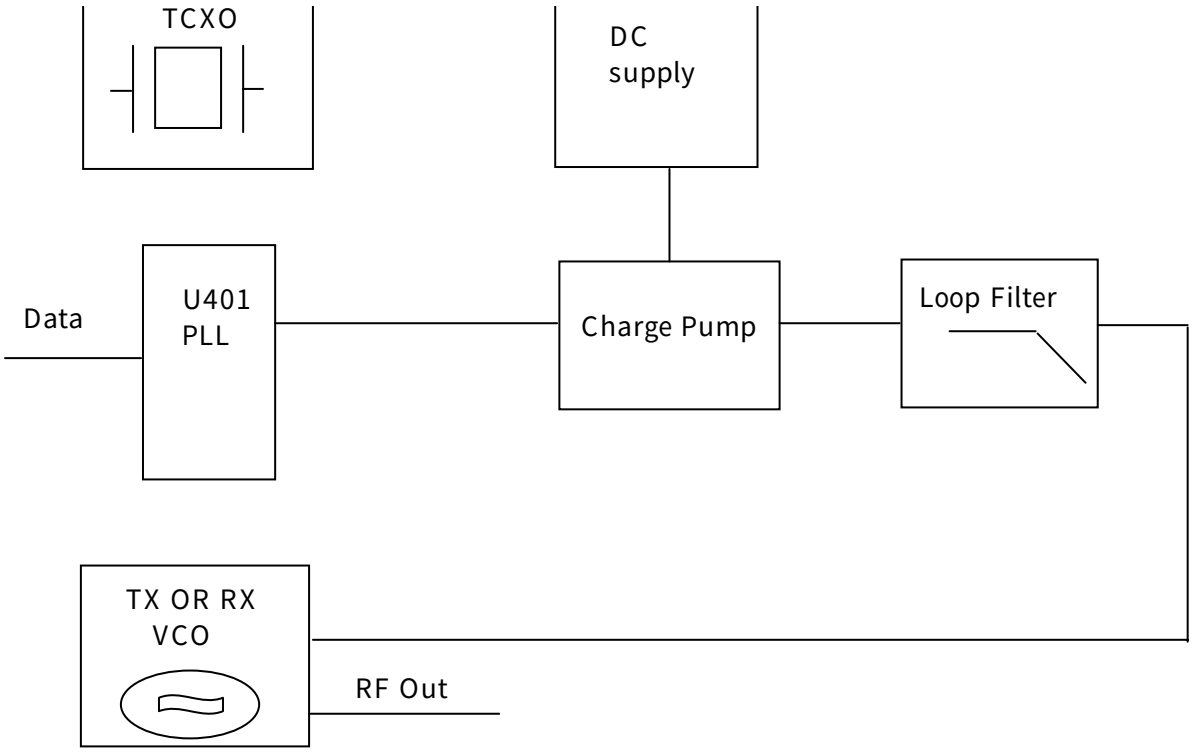
With data received from the EEPROM (U911) the frequency synthesiser circuit controls and Produces the RF carrier frequency for the transmitter during transmit and the local oscillator frequency for the receiver.The frequency synthesiser circuit is comprised of:

- 12.8MHZ VCTCXO
- Voltage Controlled Oscillator (VCO)
- Charge Pump and Loop Filter
- PLL Frequency Synthesiser
- Dual Modulus Prescaler

PLL Synthesiser

The PLL synthesiser circuit is common to both the transmitter and receiver,

The synthesiser comprises:



12.8MHZ VCTCXO

The reference oscillator comprises VR421,CR2(12.8MHZ)and associated resistors and capacitors.

CR2 provides the reference oscillator frequency and the temperature compensation that ensures that the frequency remains stableacross the temperature range(typically±2.5ppm) CR2 PIN2 is the modulation port for the two port modulation system used in the DATARADIO range of radios and is DC coupled.The reference oscillator signal direct input to the PLL synthesiser U401.

Frequency adjustment is provided by VR421

VCO SECTION

The VCO section produces carrier frequencies during transmit and local oscillator frequencies During receive.

The VCO section contains one VCO and three outputs.One for producing carrier frequencies during Transmit and one for producing the local oscillator during receive and the other Output is for PLL IC(U401)Fin.

The VCO section also has Rx and TX powerline filters.

RX and TX power line filters.

Transistor T851、T323 is configured as a 5v power supply ripple filter.The filter reduces the noise on the carrier and local oscillator signals.

The VCO comprises T321,Coil L320,and varactor D303 D302.D303、D302 produces a change in frequency with a change in DC voltage and is controlled by the tuning voltage signal present at the cathode.The local oscillator programmable dividers.DATA is received by U401 at pin 12 from pin 13 of U401.

The RF signal at the collector of T321 is applied to an amplifier/buffer T322.The amplified Signal from T322 passes to the prescaler,U401 pin5.The RF signal at the collector of T321 also Drives the cascode amplifier/buffer formed by T322 and T341.

When D341 is forward biased (TX ON),carrier frequencies at the collector of T341 pass to the Power amplifier and harmonic filter.When D342 is forward biased (RX),local oscillator Frequencies at the collector of T341 pass to the first mixer (T202).

PLL IC

The reference frequency from the VCTCXO,at 12.8 MHZ,is connected to pin 8 of U401(LMX2332 ATM)The appropriate VCO is connected to pin 13.

REFDIV divides the 12.8 MHZ to produce a reference frequency (Fr) of 5 or 6.25 kHz dependent upon channel spacing selected.VARDIV divides the prescaled VCO frequency to produce a variable frequency(Fv).Fv and Fr are fed to the phase detector.

Phase detector

When Fv=Fr,the phase detector output (pins 3 and 18,U401)produces narrow negative pulses And Fv and Fr pulse widths are identical.The signal at pin 3 and 18 is smoothed the loop filter and applied to the VCO.

Out-of-lock detector

The out-of-lock detector produces a series of logic level pulses when the loop is out of lock at pin 10 of U401.

Charge Pump and Loop Filter

Associated resistors and capacitors form the charge pump and loop Filter.The phase detector output from U401 pins 3 by the charge pump to Produce a 0 to 5v tuning voltage signal.

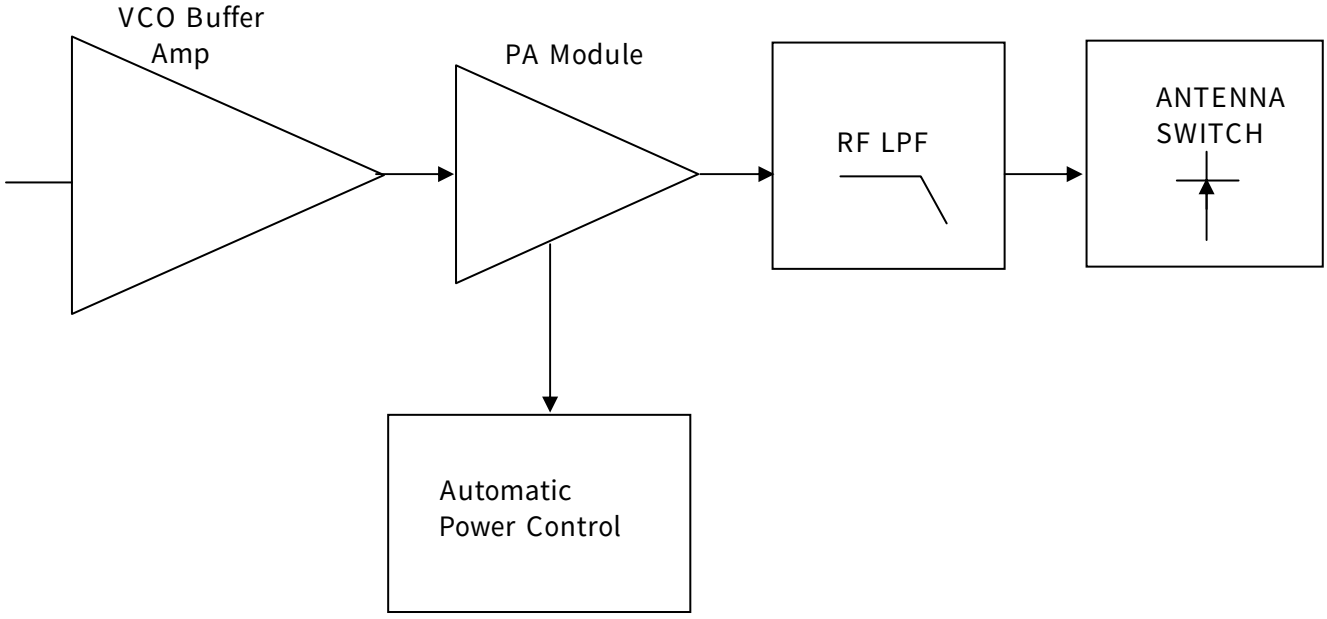
The signal is filtered by the loop filter (R403,E402 and E403)to remove any residual reference Frequency harmonics from the signal.After filtering the signal is applied to the voltage controlled Oscillator module.

Dual modulus prescaler

The prescaler divides the VCO frequency by 64 or 65.

Transmitter

The transmitter comprises:



Buffer

When the radio is in transmit mode the diode D341 is forward biases enabling the modulated RF signal from the VCO to pass to the buffer/pre-amplifier T101 and T102、T105 and associated components.

The output signal is passed from T105 to T107 via a matching network consisting of Inductor L119 and C119.

RF power Amplifier

The signal is then amplified for transmission by T107,which is a RF power amplifier.

Low pass filter

The amplified RF signal is passed through the CAP coupler and is fed to the harmonic low pass filter,comprising L112、L113、L114、L118、C147、C149、C150、C151、C154、C155 and then to the antenna connector(ANT).

Antenna Switch

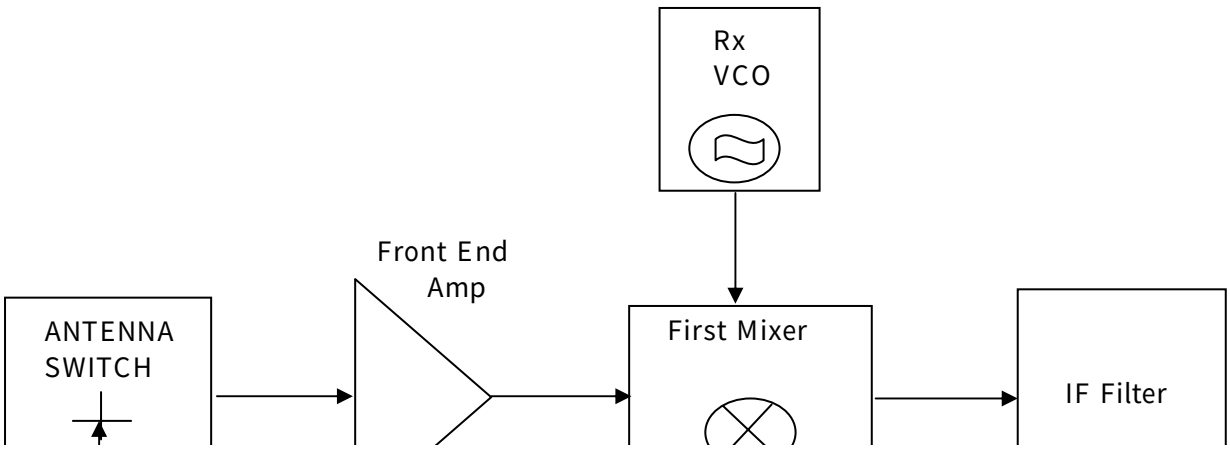
When transmitting,the diodes D101 is forward biased,allowing the RF to pass to the antenna. D102 is shorted to ground which makes L110 look open circuit(1/4 wave tuned stub).This prevents the TX signal from passing to the receiver stage.

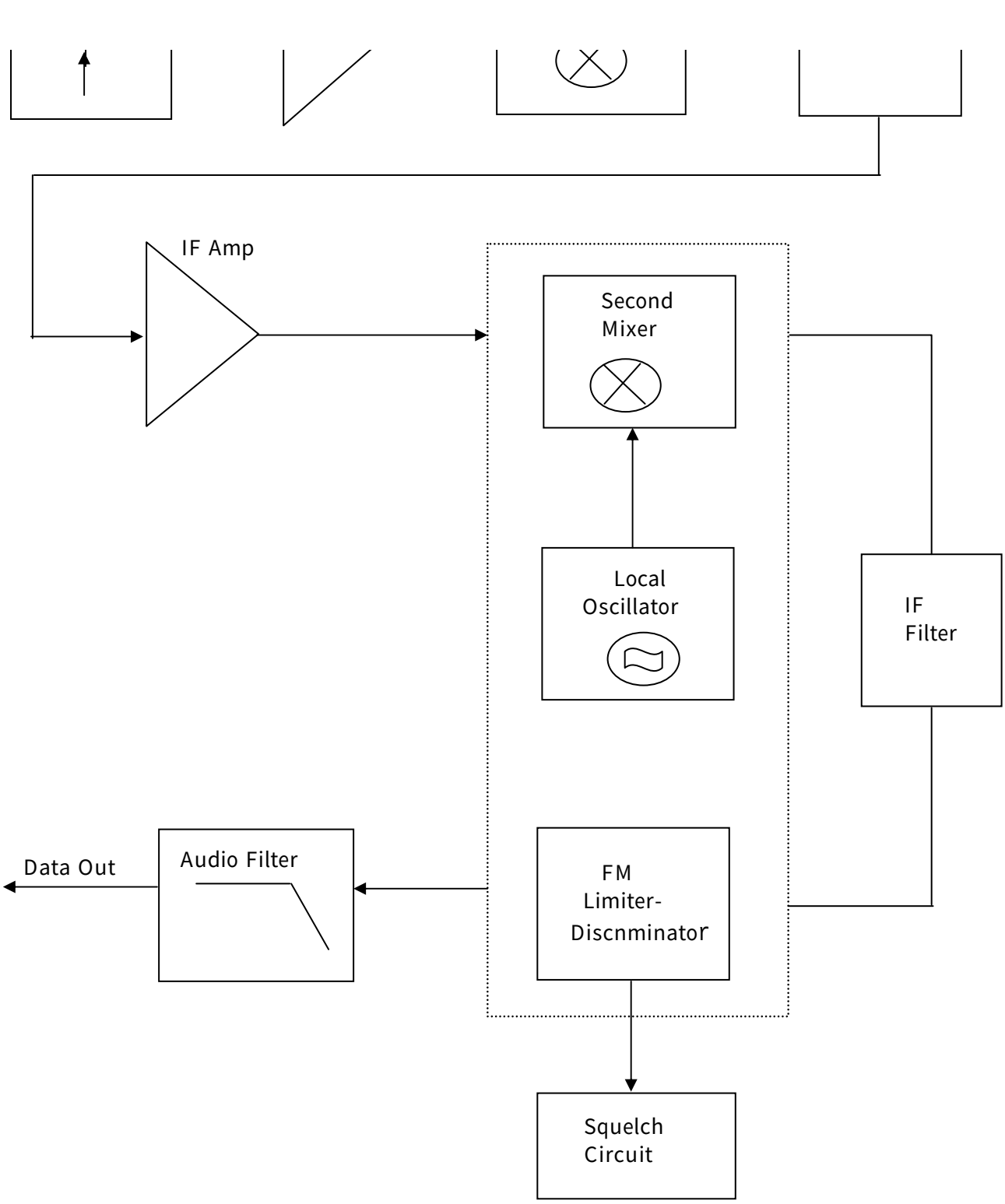
Automatic power control(APC)circuits

The automatic power control contains the U701 transistors T701 and T702.

Receiver

The receiver comprises:





Antenna Switch

In receive,the diode D101 and D102 are reverse biased.L110 is now in circuit,passing the signal from the antenna to the front end without signal loss.

Front End

The receiver signal is routed to T201.It passes through the band pass filter consisting of L204、L202、L203 to T202.

Diode D103 serves as protection from RF overload from nearby transmitters.

The input signal is conpled to the base of T201 which serves as an RF amplifier.
The output of T201 is then coupled to a second bandpass filter consisting of C211 to C212,L206 L207.

The output of the T201,is then coupled to the double-balanced mixer T202.

The receiver front end module is factory pre-tuned and requires no adjustment.
Repair is effected by replacement of the entire module.

First Mixer

T202,2-pole crystal filters FL230 and FL231 and T215 form the First Mixer and First IF Filter.

The difference frequency of 21.7 MHz is taken from T202 and is filtered by the crystal filters FL230 and FL231.The tuned circuits R230 and R235 and associated components provide matching of the crystal filters to ensure a good pass-band response and selectivity.

The IF signal is amplified by T215 and passed to the FM Detector IC.

Second mixer,Second IF,FM detector

The output of the IF amplifier is fed into the narrowband FM IF Integrated Circuit,U240 (TA31136F).This is a single conversion FM receiver which contains the second mixer,second IF amplifier,and FM detector.

Crystal CR240,connected to pin 1 of U240,determines the second local oscillator frequency.
In this case the crystal has a frequency of 21.25MHz.The first IF signal is applied to the mixer and resultant frequency of 450KHz,is the difference between the IF signal and second local oscillator.

The 450KHz IF signal is output from pin 3 and is applied to a 450KHz band-pass filter.

The output of FL240 is passed via pin 5 to a high gain IF amplifier coupled to the adjustable quadrature detector TR240.Any detected signal is produced at pin 9 of U240 and applied to the

Receiver Audio Circuit and the Mute(Squelch)Circuit.

RSSI Circuit

Any noise signal is amplified by U240 internal noise amplifier.Signal is applied to pin12 of U240 The squelch trigger output(pin 14,U240)is applied to the pin 6 of D_SUB.

When noise is present,the voltage at pin 12 of U240 is exceeds 1V.The squelch trigger output is 0V(logic 0)It's make pin 6 of D_SUB open state.

When no noise is present,the voltage at pin 12 of U240 is less than 1V and pin 14 of U240 IS AT 5v(logic 1).This make pin 6 of U240 short state.

Carrier Detect

A Carrier Detect(MUTE DETECT)output is available on pin 6 of D_SUB.

AF Output Low Pass Filter

A low pass filter formed by C631 and R632 removes any extraneous 450KHz energy from the AF output of the FM receiver chip (pin 9 of U240).

The filtered signal is passed to pin 2 of D_SUB.

Microcontroller

The EM78P451AQ microcontroller IC controls the programmable features and frequency synthesizer Data.

Programming Mode

The programming mode allows the user to retrieve of program TX/RX frequencies,HI/LO power Setting and channel spacing,when pin 9 of D_SUB is set to ground.Programming mode will Inhibit,Serial communications can then be made in order to read/program the on-board EEPROM(U911)which contains radio-specific data.

EEPROM

Relevant channel information,such as Rx/Tx frequencies,is stored in the EEPROM(U911)which is a 24LC08.This information may be programmed and erased via the D-type socket.

Power supply circuit

The data radio is supplied with a nominal +13.8V dc power supply input from external equipment which is filtered using C805,L801 and C804.

Tuning up procedure

Transmitter Alignment

Automatic Power Adjustment

Transmit periods longer than 3 minutes are to be avoided.

1. Switch to data radio to TX.
2. Select High power setting.
3. Record the transmit power set.
4. Switch the data radio to transmitter OFF.

Frequency accuracy

1. Whilst transmitting,measure the transmit frequency using the RF frequency counter.
2. On the VCTCXO PCB,adjust trimmer resistor VR421 so that frequency is as close as possiable to the exact required transmit frequency.Ideally it should be within 100Hz at room temperature.

Receiver Alignment

Important note:Before setting up the receiver it is important to check the frequency accuracy alignment is correct as described in the transmitter alignment section.

RF tuning

1. Connect an RF signal generator and SINAD voltmeter.
2. Set the RF signal generator to the receive channel frequency and set to 60% deviation.
3. Set the AF signal to 1KHz.
4. Set the RF level to 1Mv pd(-47.0dBm)
5. Adjust TR240 for a maximum audio output(viewed on oscilloscope).
6. Adjust L203 and L204 for lowest distortion,this is normally less than 3%.
7. Check for an RF voltage signal level of -119dBm and a SINAD meter Reading greater than 12dB.

Repeat steps 7 to 9 as necessary.

Squelch□Carrier Detect Adjustment

1. Set the RF signal generator to the receiver frequency with 60% deviation.Set the AF Signal to 1KHz.
2. Set RF input level to give -114dBm.
3. Adjust VR1 until D_SUB pin 6 changes state from"HIGH"to"LOW".
4. Reduce RF input level to -120dBm and check that CDS line goes HIGH.Switch off the RF generator and disconnect the test equipment.

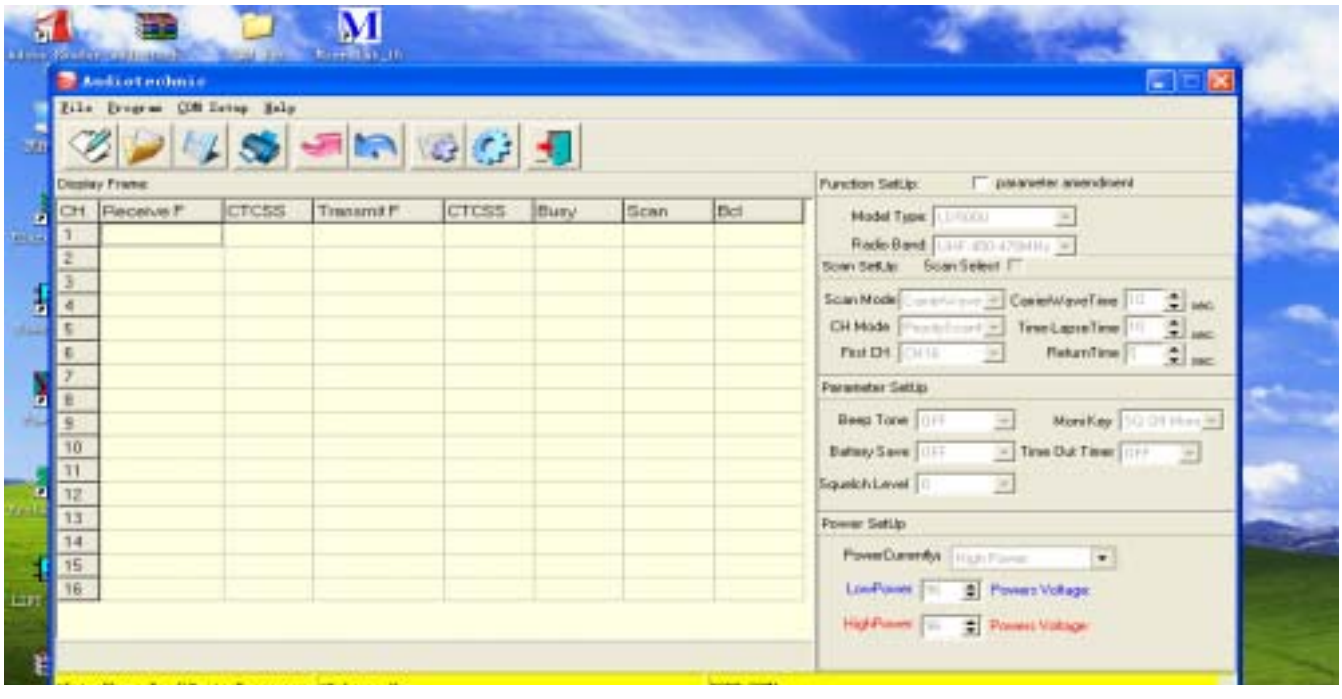
Modulation Deviation Adjustment

1. Connect a power meter,modulation meter and oscilloscope to radio.
2. The radio should be programmed to contain a channel with a frequency in the middle the band of interest with an RF power setting of 1W.
3. Switch the data radio ON.
4. Inject a 1Vrms(3VP-P)SINE wave signal at a frequency of 100Hz into pin 1 of D_SUB
5. Set the data radio to TX
6. Observe the oscilloscope display to check that the 100Hz tone is a square ware by tuning VR521.

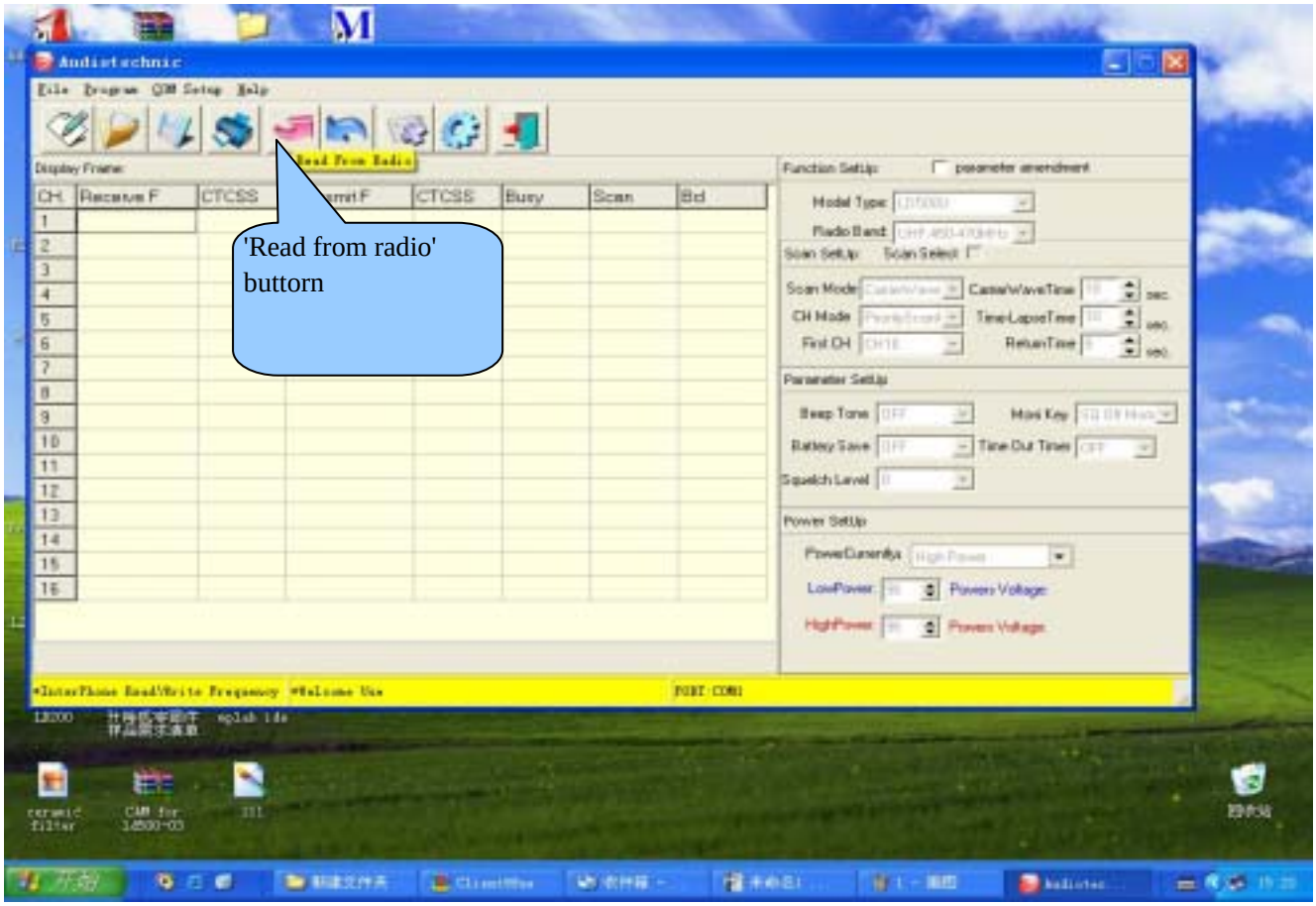
7. Whilst observing the oscilloscope,adjust the deviation and balance potentiometers.VR521 to obtain a good square at the following deviation:
   12.5KHz channel spacing<=2.5KHz dev
   25KHz channel spacing<=5KHz dev
8. It may be necessary to alternate the adjustment of the two potentiometers.
9. Sweep the signal generator between 100Hz and 3KHz.Record the peak deviation. The peak deviation should be as above.If necessary adjust the potentiometers to achieve this.
10. Switch to RX.

PROGRAMMER INSTRUCTION

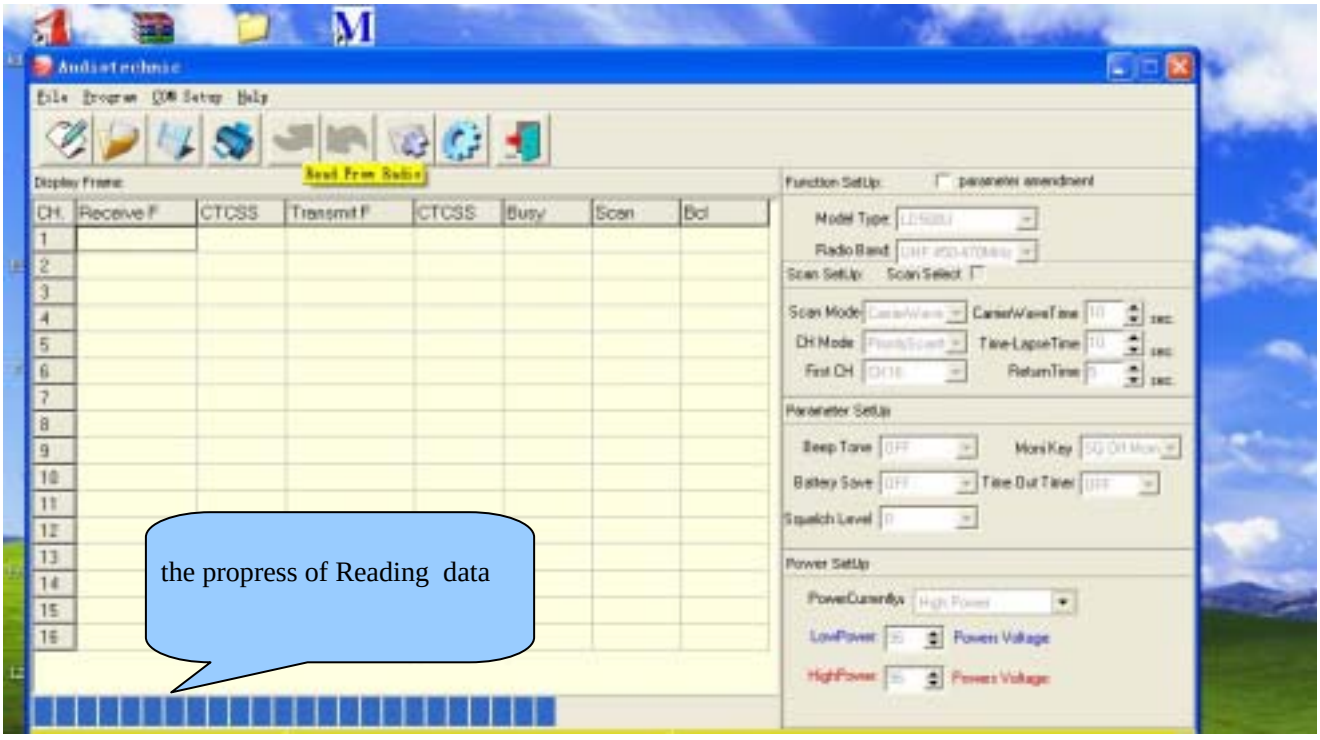
1. Double click AUDIOTECHNIC



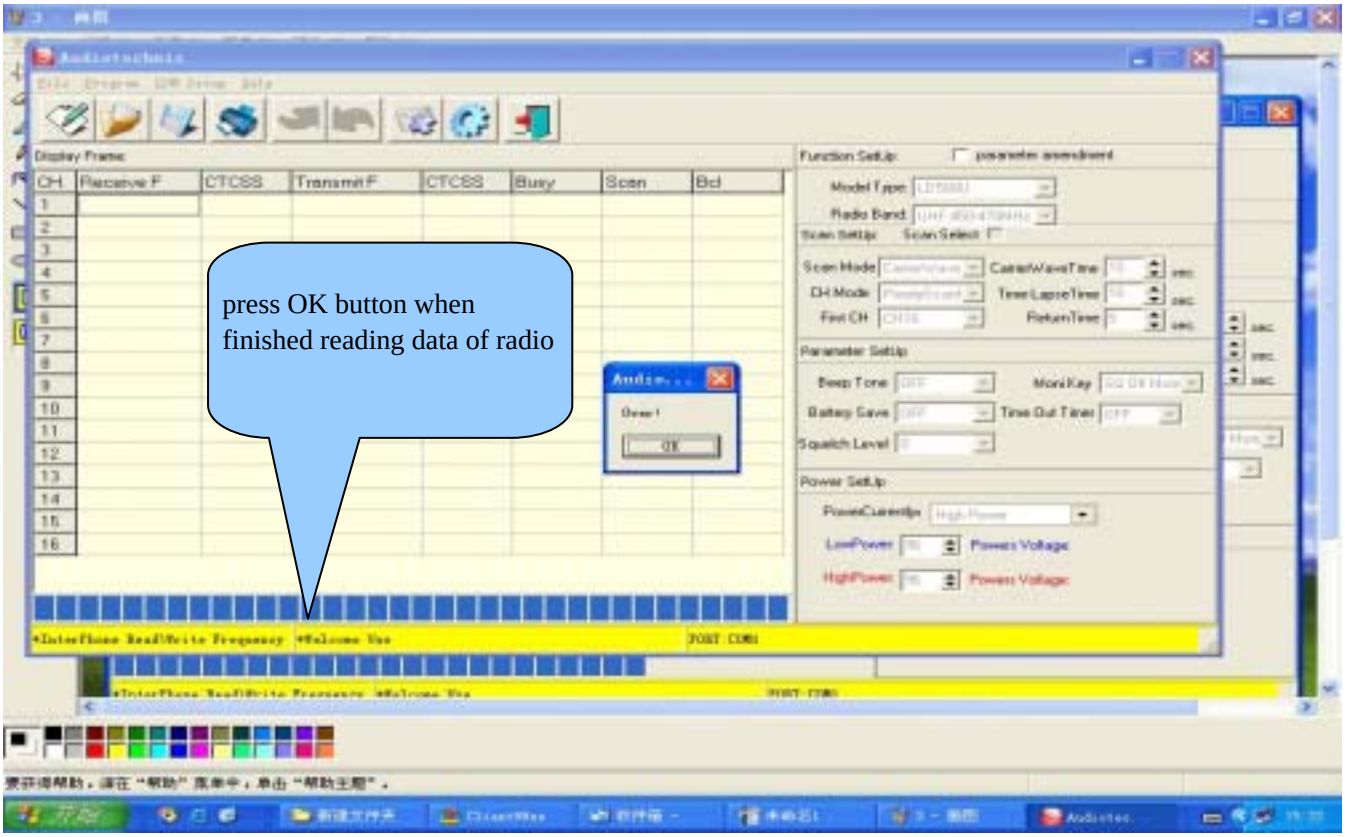
2. press ‘ read from radio ’ button，then it will read channel data from radio.



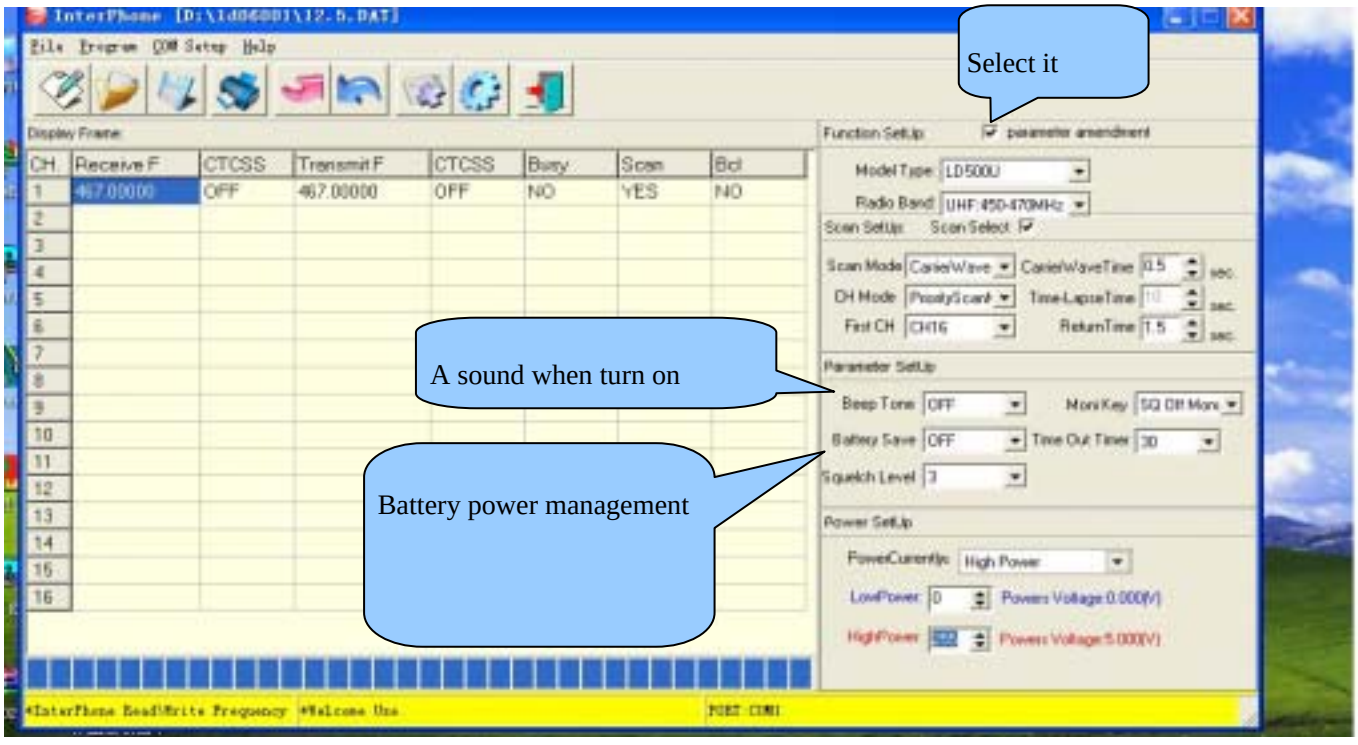
3.next showing as follow



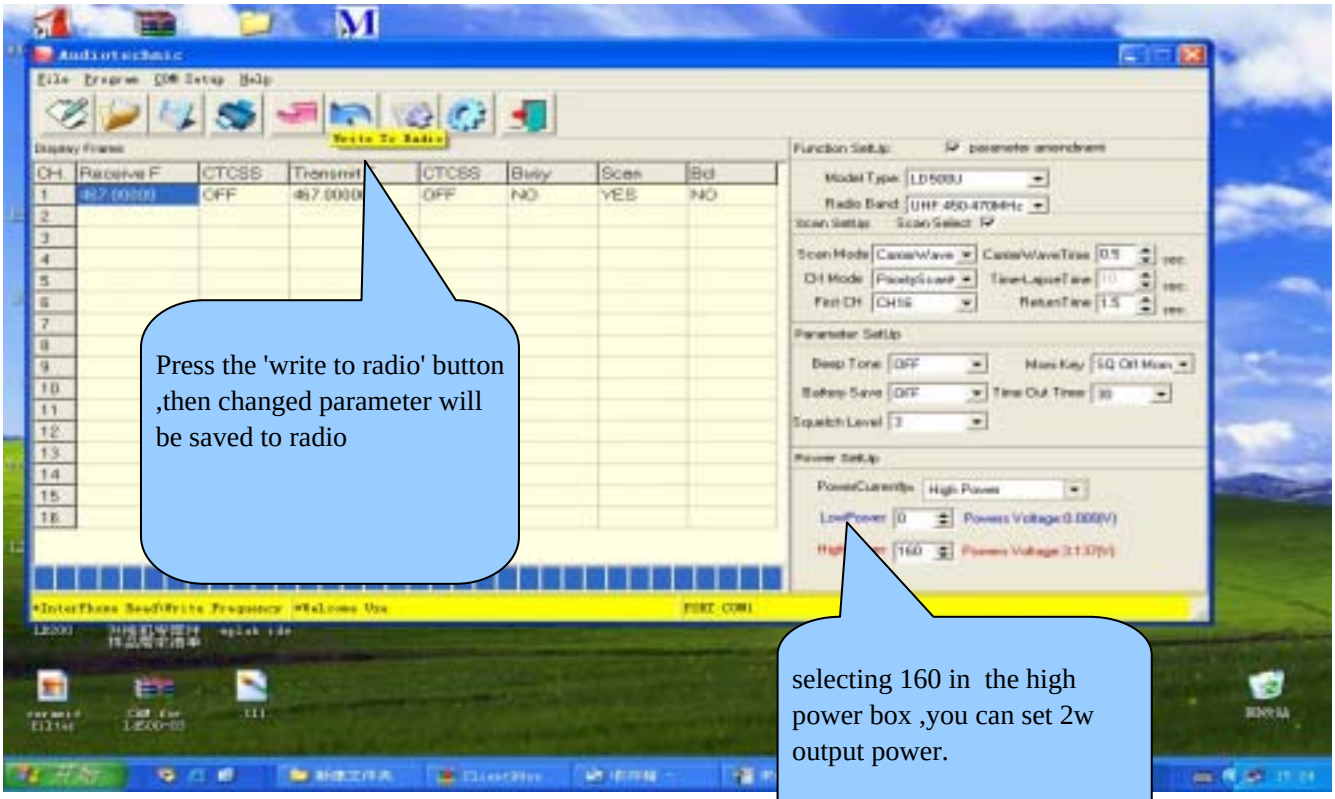
4. finished reading data of radio。

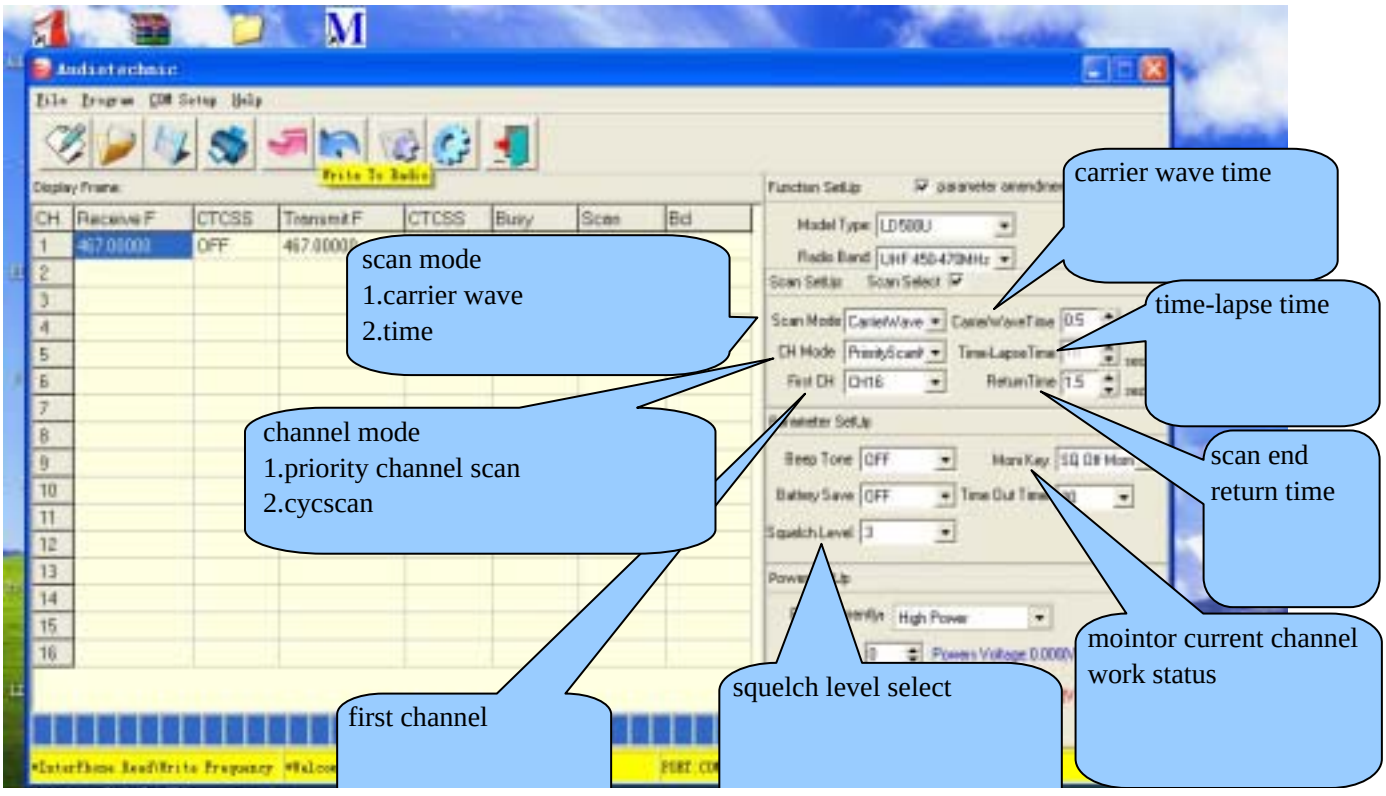


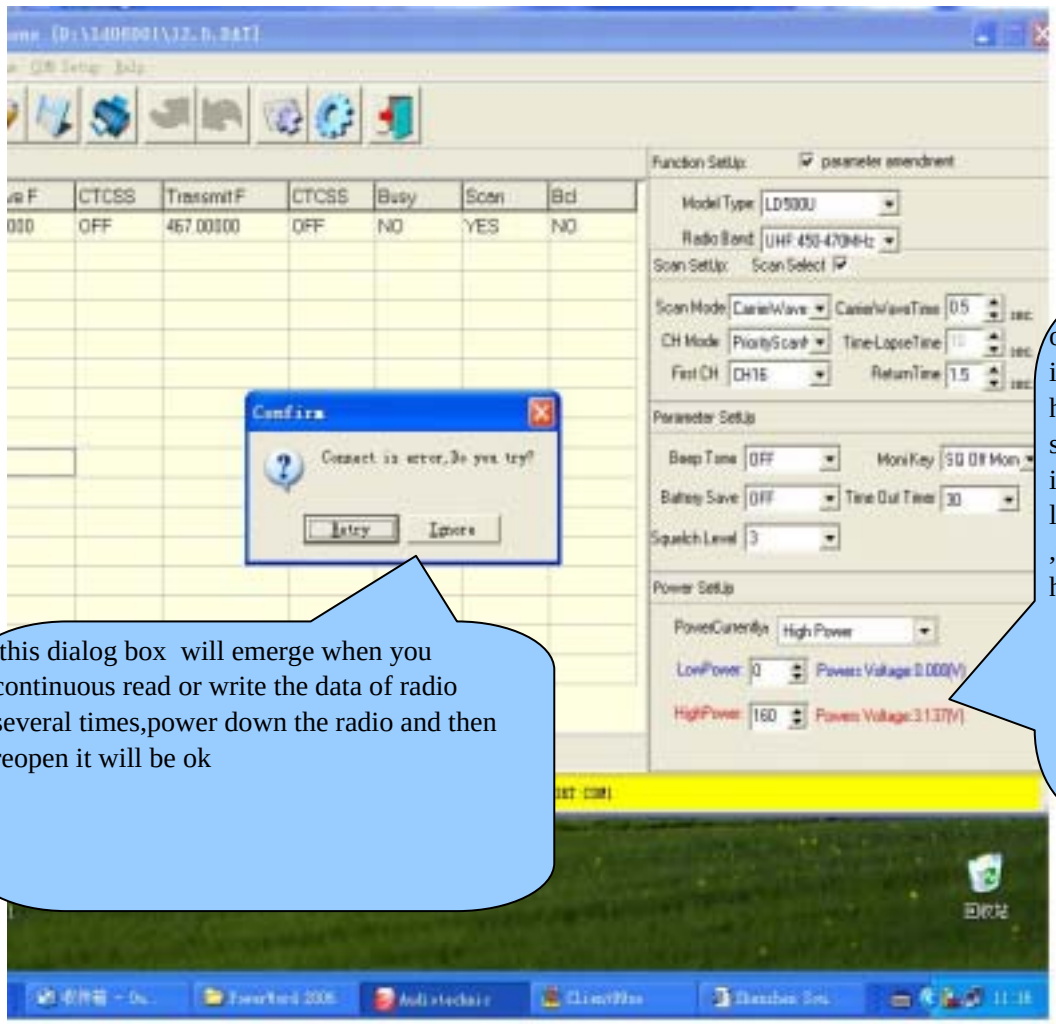
5. then getting into function setup . First , select 'parameter amendment' .



6.If you alter the parameter of 'high power', the output power of radio will be changed, eg. The 255 is the highest power,the 0 is the lowest power







this dialog box will emerge when you continuous read or write the data of radio several times,power down the radio and then reopen it will be ok

only the data in those two box is different ,can the highpower and lowpower be set.for example,if you set 100 in the box of highpoer and lowpower in the same time ,the computer will default the hightpower.