SYNTHESIZED VHF TELEMETRY UNIT
PART NO. 242-3422-XYZ

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SYNTHESIZED VHF TELEMETRY UNIT
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The Johnson Data Telemetry Corporation designs and manufactures radios and radio modems to serve a wide variety of data communication needs. The Johnson Data Telemetry Corporation produces equipment for the fixed data market including SCADA systems for utilities, petrochemical, waste and fresh water management markets and RF boards for OEM applications in the Radio Frequency Data Capture market.

DATA TELEMETRY PRODUCT WARRANTY

The manufacturer's warranty statement for this product is available from your product supplier or from the Johnson Data Telemetry Corporation, 299 Johnson Avenue, PO Box 1733, Waseca, MN 56093-0833. Phone (507) 835-8819.

WARNING

This device complies with Part 15 of the FCC rules. Operation is subject to the condition that this device does not cause harmful interference. In addition, changes or modification to this equipment not expressly approved by Johnson Data Telemetry Corporation could void the user's authority to operate this equipment (FCC rules, 47CFR Part 15.19).

DO NOT allow the antenna to come close to or touch, the eyes, face, or any exposed body parts while the radio is transmitting.

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

DO NOT operate the radio unless all the radio frequency connectors are secure and any open connectors are properly terminated.

DO NOT allow children to operate transmitter equipped radio equipment.

SAFETY INFORMATION

Proper operation of this radio will result in user exposure below the Occupational Safety and Health Act and Federal Communication Commission limits.

The information in this document is subject to change without notice.

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SECTION 1

GENERAL INFORMATION

1.1 SCOPE OF MANUAL

This service manual contains alignment and service information for the Johnson Data Telemetry (JDT) DM-3422 VHF Synthesized Telemetry Unit.

This manual concentrates on the RF section of the Data Link (DL) which may be paired with an internal Loader board or 9600 baud Modem board.

Service manuals addressing items specific to the Loader board (Part No. 001-3240-003) and the Modem board (Part No. 001-3295-002) should be referenced for the users specific configuration.

1.2 EQUIPMENT DESCRIPTION

1.2.1 GENERAL

The JDT DM-3422 is a synthesized data transceiver (transmitter and receiver) which operates in the 132-174 MHz VHF frequency range. Transmitter power output is 1-5 watts, 5W at 13.3V nominal. Operation is simplex or half-duplex.

Versions of the DM-3422 covered in this manual are indicated in Section 1.5. The DM-3422 has a frequency stability of ± 2.5 PPM (see Section 3) and is available with or without the Loader/Modem boards.

The number of channels that can be selected with the DM-3422 model is determined by the customer supplied synthesizer loading circuitry. DL-3422 model can be supplied with the DL-3240 Loader board.

In addition to this VHF radio, JDT has a full line of radios and radio modems to meet wireless data communication needs. Both OEM RF decks and complete FCC type approved radios and radio modems are available from 132-174 MHz at VHF, 380-512 MHz at UHF, and 928-960 MHz at 900 MHz in both 5W and 2W units (VHF and UHF). High Specification units are available to meet international requirements and bandwidths to meet U.S.A. refarming requirements. To learn more about the other JDT products, call 1-800-992-7774 or 1-612-890-8155 to speak to a sales representative.

1.2.2 DL-3422 WITH LOADER BOARD

The DL-3422 includes the 8-channel Loader board (Part No. 023-3240-001), which performs synthesizer loading through an RS-232 DB-9 interface. In addition, this board has circuitry which provides electronic control of the following:

Transmit/Receive data conditioning and gating
Carrier Detect
Power Control
Preselector Tracking
Modulation Flatness
Audio/Data Filtering
Sleep/Wake-up to minimize current consumption
Diagnostics that includes:
  Input Voltage Sense
  Input Current Sense
  Ambient Temperature Sense
  RSSI Indicator (RSSI Sense)
  Forward/Reverse Power Sense.

The gating circuits allow user selection of data filtering (standard or wide band) and also pre-emphasis/de-emphasis to be enabled or disabled.

This board is programmed using an IBM® PC or compatible computer and the Johnson Data Telemetry programming software. Programming information is stored by an EEPROM on the Loader board. Refer to Section 3 for programming information.

NOTE: The synthesizer must be loaded each time power is turned on. Therefore, one loader board or customer supplied programming circuit is required for each data transceiver.

1.2.3 DL-3422 WITH DL-3295 MODEM

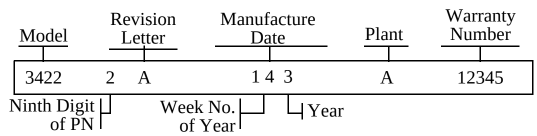
The DL-3496 modem (Part No. 023-3295-001) provides digital data transmission at data rates up to 9600 baud. The DL-3295 operates in Half-Duplex mode. However, two transceivers can be combined to provide Full-Duplex operation. The user interface is a serial port through a 9-pin D-connector configurable to either RS-232 or TTL signal levels. The data format is asynchronous with either 8 or 9 data bits. The modem can operate in either standard DTE/DCE handshake p rotocol or in Data Activation mode which requires only receive and transmit data lines. The baud rates are user selectable from 300 to 9600 baud.

1.2.4 DM-3422 SYNTHESIZER PROGRAMMING

The DM-3422, when used without the Universal Loader Board (Part No. 023-3240-001) requires customer supplied circuitry to load the synthesizer with channel information. The protocol that this circuitry must follow is described in Section 3.

1.3 TRANSCEIVER IDENTIFICATION

The transceiver identification number is printed on a label that is affixed to the PC board. The following information is contained in that number:



1.4 ACCESSORIES

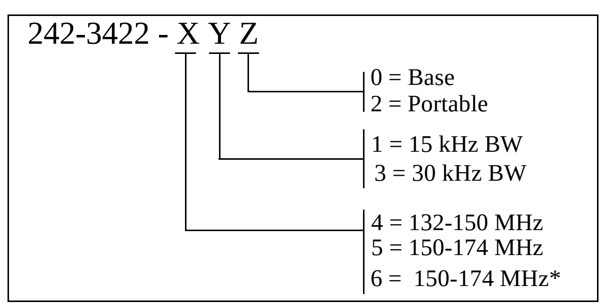
Accessories available for the 3422 data transceiver are listed in Table 1-1.

Table 1-1 ACCESSORIES

Accessory	Part No.
DM-3422 Receive Test Filter	023-3472-040
DL-3295 Telemetry Modem	250-3295-001/101
DL-3240 Loader Kit	023-3240-001
DL-3295-001 Modem Kit	023-3295-001
DL-3282 Modem Kit	250-3282-001
DL-3240 Service Manual	001-3240-003
DL-3295 Service Manual	001-3295-002

1.5 PART NUMBER BREAKDOWN

The following is a breakdown of the part number used to identify this transceiver:



* Refarming compatible (12.5 kHz only)

1.6 FACTORY CUSTOMER SERVICE

The Customer Service Department at JDT provides customer assistance on technical problems and the availability of local and factory repair facilities. Customer Service hours are 7:30 a.m. - 4:30 p.m. Central Time, Monday - Friday. From within the continental United States, the Customer Service Department can be reached at this toll-free number

1-800-992-7774

When your call is answered at JDT, you will hear a brief message that contains the options: “1” for Sales, “2” for Order Entry, “3” for Customer Service, “4” for Marketing, “7” for other issues, or “9” to repeat the message. When you enter a first number of “3”, you may enter “1” for Technical Assistance, “2” for Product Repair or “3” for Warranty. This number may be entered during or after the message using a tone-type telephone. If you have a pulse-type telephone wait until the message is finished and an operator will come on the line to assist you. You can enter the four digit extension number of the person that you want to reach at any time. If you are calling from outside the continental United States, the Customer Service numbers are:

Customer Service Department - (507) 835-6911
FAX Machine - Cust Serv(507) 835-6969

You can contact the Customer Service Department by mail or email. Please include any information that may help solve your problem. The mailing or email addresses are:

Johnson Data Telemetry Corporation
Customer Service Department
299 Johnson Avenue
P.O. Box 1733
Waseca, MN 56093-0514

support@johnsondata.com

1.7 PRODUCT WARRANTY

The warranty statement for this transceiver is available from the Warranty Department at JDT (see address or telephone number in Section 1.6). The Warranty Department may also be contacted for Warranty Service Reports, claim forms, or any questions concerning warranties or warranty service.

1.8 REPLACEMENT PARTS

Replacement parts can be ordered directly from the Service Parts Department. To order parts by phone, dial the toll-free number and then enter “3” as described in Section 1.6. When ordering, please supply the part number and quantity of each part ordered. JDT customers should give their account number.If there is uncertainty about the part number, include the model number of the equipment the part is from (refer to Section 1.3).

You can send your order by mail or FAX (see Section 1.6 for mailing address). Mail orders should be sent to the Service Parts Department.

FAX Machine - Sales (507) 835-6648

1.9 IF A PROBLEM ARISES...

JDT products are designed for long life and failure-free operation. If a problem arises, factory service is available. Contact the Customer Service Department before returning equipment. A service representative may suggest a solution eliminating the need to return equipment.

1.9.1 FACTORY REPAIR

Component level repair is not recommended on the DL-3422 Transceiver. Surface mount technology is used to install many components that require specialized training and equipment to service board level components. JDT's factory is best equipped to diagnose problems and make component level repairs.

When returning equipment for repair, fill out a Factory Request Form for each unit to be repaired regardless of warranty status. These forms are available free of charge by calling Customer Service (see Section 1.6). Describe the problem in the space provided and note any prior physical damage to the equipment. Include a form in the shipping container with each unit. Your phone number and contact name are **important**. There are times when technicians have specific questions that need to be answered in order to identify the problem and repair the equipment.

When returning equipment for repair, use a reference number on your paperwork in case you need to call Customer Service about your unit. That number is referenced on the repair order to make it easier to locate your unit in the lab.

Return authorization (RA) numbers are not necessary unless you have been given one by the Customer Service Department. They require RA numbers for exchange units or if they want to be aware of a specific problem. If you have been given an RA number, reference this number of the Factory Repair Request Form sent with the unit. The repair lab will contact the Customer Service Department when the unit arrives.

3422 UHF SYNTHESIZED TELEMETRY UNIT SPECIFICATIONS

The following are general specifications intended for use in testing and servicing this transceiver. For current advertised specifications, refer to the specification sheet available from the Marketing Department. Specifications are subject to change without notice.

GENERAL

Frequency Range	132-150 MHz/150-174 MHz
Frequency Control	Synthesized
Channel Spacing	15/30 kHz
Mode of Operation	Simplex or Half Duplex
Operating Voltage	+13.3V DC nominal (10-16V DC operational)
Regulated Supply Voltages	+5V DC ±5%
Transmit Enable	3-16V DC at 400 µA max
Receive Enable	3-16V DC ±5% at 400 µA nominal (400 µA during receive)
Transceiver Enable	3-16V DC at less than 400 µA
Power and Data Connector	14-pin in-line socket (Dupont 76308-14)
RF Input/Output	SMA Jack (female)
Operating Temperature	-30°C to +60°C (-22°F to +140°F)
Storage Temperature	-40°C to +85°C (-40°F to +185°F)
Humidity	95% maximum RH at 40°C, non-condensing
Maximum Dimensions	4.585" L, 3.25" W, 2.212" H
FCC Compliance	
DM-3422	Customer must apply
DL-3422	Part 90, Part 15

RECEIVER

Bandwidth	132-150 MHz: 18 MHz with electronic tuning 6 MHz without retuning from 132-150 MHz 150-174 MHz: 24 MHz with electronic tuning 6 MHz without retuning from 150-174 MHz
Frequency Stability	±2.5 PPM from -30°C to +60°C (-22°F to +140°F)
Sensitivity - 12 dB SINAD	≤ 0.35 µV, -116 dBm psophometrically weighted
RF Input Impedance	50 ohms
Selectivity	-70 dB/-60 dB (tN/t/E) for 30 kHz, 60 dB/50 dB (tN/t/E) for 15 kHz
Spurious and Image Rejection	-70 dB
Conducted Spurious Emissions	< -57 dBm
Intermodulation	-70 dB
FM Hum and Noise	-45 dB, 30 kHz channels psophometrically weighted -40 dB, 15 kHz channels psophometrically weighted
Receive Attack Time	< 5 ms
Total Receive On Time	7 ms maximum
Audio	
Distortion	< 3% psophometrically weighted
Buffered Output Level	150 mV RMS nominal at 2.5V DC bias

Discriminator Output	+1/-3 dB from DC to 5 kHz (reference to 1 kHz)(30 kHz BW) +1/-3 dB from DC to 3.0 kHz 15 MHz BW
Output Bias	2.5V DC ±0.5 VDC
Output Impedance	>10k ohms
Data Characteristics	4800/9600 BPS NRZ
RSSI	0.75V to 2.0V DC output from -120 to -60 dBm, attack time < 2 ms

TRANSMITTER

Frequency Stability	±2.5 PPM from -30°C to +60°C (-22°F to +140°F)
Bandwidth	132-150 MHz, 18 MHz without tuning 150-174 MHz, 24 MHz without tuning
Maximum System Deviation	5 kHz (30 kHz), 2.5 kHz (15 kHz)
Modulation	FM/DC coupled
Input Bias	2.5V DC ±1% temperature compensated to ±100 mV. Supplied in Tx/Rx.
Input Impedance	>40k ohms
Distortion	< 3% at 60% of maximum system deviation, 1 kHz tone
Capability	1.8V P-P ±2 dB produces ±5 kHz deviation with a 1 kHz tone
Flatness	±2 dB, DC-5 kHz at 1 kHz (Programmable to ±0.5 dB with diagnostic DAC)
RF Power Output	1-5W ±20% adjustable (5W at 13.3V nominal)
Deviation Symmetry	5%
RF Output Impedance	50 ohms
Duty Cycle	50% (30 sec. max transmit)
Transmitter Adjacent Power	-70 dB
Intermodulation Attenuation	-40 dB
Spurious and Harmonic FM	-20 dBm max.
FM Hum and Noise	-45 dB 30 kHz, -40 dB 15 kHz

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SECTION 2

INSTALLATION

1.1 PRE-INSTALLATION CHECKS

Field alignment should not be required before the 3422 is installed. However, it is still good practice to check the performance to ensure that no damage occurred during shipment. Performance tests are located in Section 6.2.

1.1 INTERFACING WITH DATA EQUIPMENT

1.1.1 DM-3422 (RF Board)

Connector J201 on the data transceiver PC board provides the interface with the data equipment. This is a 14-pin female connector with .025" square pins on 0.1" centers (Dupont 76308-114). The cable (Part No. 023-3472-007) is not included with the data transceiver. An interface cable diagram and pin designations are shown in Figure 2-1.

The following is a general description of the input and output signals on Transceiver Interface connector J201.

Pin 1 (Ground) - Chassis ground.

Pin 2 (+13.3V DC) - Input, transceiver main power. Input range 10-16V DC with ±3 dB variation in output power.

Pin 3 (Tx En) - Input +3-16V DC. Enables transmit circuitry. ≤ 0.3V DC in Rx mode.

Pin 4 (Rx En) - Input +3-16V DC. Enables receive circuitry. ≤ 0.3 V DC in Tx mode.

Pin 5 (RF En) - Input +3-16V DC. Shuts down on-board regulators. To be used as a power save mode.

Pin 6 (Mod In) - Provides a response of ±2 dB from DC to 5 kHz across the RF band (referenced to 1 kHz). It is programmable to 1 dB with the diagnostic DAC. The modulation capability is 250 mV RMS ±3 dB that produces ±5 kHz deviation with a 1 kHz tone. When this input is used, a temperature compensated 2.5V DC bias is required as variations in voltage cause the frequency to change. The transceiver regulatory compliance must be applied for with the customer supplied modulation limiting/filter circuit and chassis.

Pin 7 (Synth Lock) - Output from synthesizer lock detect circuit. Low (< 1V DC) = unlocked, high (>2.5V DC) = locked.

Pin 8 (Synth En) - TTL input. Latch enable signal for synthesizer. 250 ns min. for D, C and B words; 3 ms min. for A0 word. A rising edge latches the data loaded into the synthesizer IC..

Pin 9 (Data) - TTL input. Serial data line used for programming the synthesizer and diagnostic functions.

Pin 10 (Synth Clock) - TTL input. Clock signal for serial data input on Pin 9. Data is valid on the rising edge. 1 MHz max. frequency.

Pin 11 (Diag En) - TTL input. Loads programmed DAC values into DAC (U911) for modulation adjust and power set. Also provides the strobe signal for shift register (u901) for selecting Forward and Reverse power diagnostics. 250 ns min. activates on rising edge.

Pin 12 (RSSI) - Analog output (0.5-2V DC). The Receive Signal Strength Indicator output provides a voltage that increases in proportion to the strength of the RF input signal.

Pin 13 (Demod) - Analog output. The Receiver Demod output level is 150 mV RMS with a modulation signal of 1 kHz at 60% of maximum deviation. The output is DC coupled and referenced to +2.5V DC. Load impedance should be >10k ohms.

Pin 14 (Diag) - Analog Output. This pin is enabled by pin 11. When the Loader board is used it has the capability to test the operating environment through diagnostics. The diagnostic capabilities are in Section 1.2.2

SECTION 3

PROGRAMMING

3.1 INTRODUCTION

The DL-3422 information in Section 3.2 describes synthesizer programming protocol. This information can be used as a basis for designing the synthesizer programming hardware and software.

The DL-3422 VHF Transceiver uses a high performance Fractional-N Synthesizer and Voltage Controlled Oscillator (VCO). The Fractional-N Synthesizer offers high frequency resolution, fast lock times, and improved noise performance over conventional synthesis techniques. With conventional synthesizers, the phase detector comparison frequency must be equal to the channel spacing because the main divider can only change in integer steps. The channel spacing (resolution) of a Fractional-N synthesizer is a fraction of the comparison frequency. With the Fractional-N synthesizer, the comparison frequency is increased to 5 or 8 times the channel step frequency. The total loop division is reduced with a higher comparison frequency which improves phase noise. Lock times are improved because the loop bandwidth can be wider.

3.2 DL-3422 SYNTHESIZER DATA PROTOCOL

3.2.1 INTRODUCTION

Programming the SA-7025 synthesizer IC (U811) is accomplished via the 3-line bus; DATA, CLOCK, and STROBE. Four 24 bit words (D, B, C, and A0) are required to load the synthesizer. The D, C, and B words contain four address bits each; the A0 word has a 1 bit address. Synthesizer frequency acquisition is initiated when the A0 word is loaded. We recommend using modulus 3 and sending the D, B, C, and A0 words for each synthesizer load (LONG load). When the STROBE = low, the clock driver is enabled and the DATA is clocked into the shift registers on the positive edges of the CLOCK. When STROBE = high, the clock is disabled and the data in the shift registers remain stable. The DATA is latched into different working (or temporary) registers depending on the address bit(s). In order to fully program the synthesizer, all four words must be sent with the A0 word sent last. Refer to Table 3-1 and Figure 3-3 for data format information.

3.2.2 PROGRAMMING SYNTHESIZER PARAMETERS

The DL-3422- RF Board is available in three frequency ranges, 132-150 MHz (Band 4), 150-174 MHz (Band 5), and 150-174 MHz (Band 6). Band 6 was designed to be compatible with the FCC’s refarmed VHF band plan therefore, 2.5 kHz channel resolution is used. The Band 4 and 5 versions can be programmed for 5, 6.25, and 7.5 kHz steps depending on user requirements.

Table 3-1   Programming Function Table

Symbol	Bits	Function
NM1	12	Number of main divider cycles when prescaler modulus = 64*
NM2	8 if PR = "01" 4 if PR = "10"	Number of main divider cycles when prescaler modulus = 65*
NM3	4 if PR = "10"	Number of main divider cycles when prescaler modulus = 72*
PR	2	Prescaler type in use PR = "01": modulus 2 prescaler (64/65) PR = "10": modulus 3 prescaler (64/65/72)
NF	3	Fractional-N increment
FMOD	1	Fractional-N modulus selection flag "1": modulo 8 "0": modulo 5
LONG	1	A word format selection flag "0": 24 bit A0 format "1": 32 bit A1 format
CN	8	Binary current setting factor for main charge pumps
CL	2	Binary acceleration factor for proportional charge pump current
CK	4	Binary acceleration factor for integral charge pump current
EM	1	Main divider enable flag
EA	1	Auxiliary divider enable flag
SM	2	Reference select for main phase detector
SA	2	Reference select for auxiliary phase detector
NR	12	Reference divider ratio
NA	12	Auxiliary divider ratio
PA	1	Auxiliary prescaler mode: PA = "0": divide by 4 PA = "1": divide by 1
		*** Not including reset cycles and Fractional-N effects.**

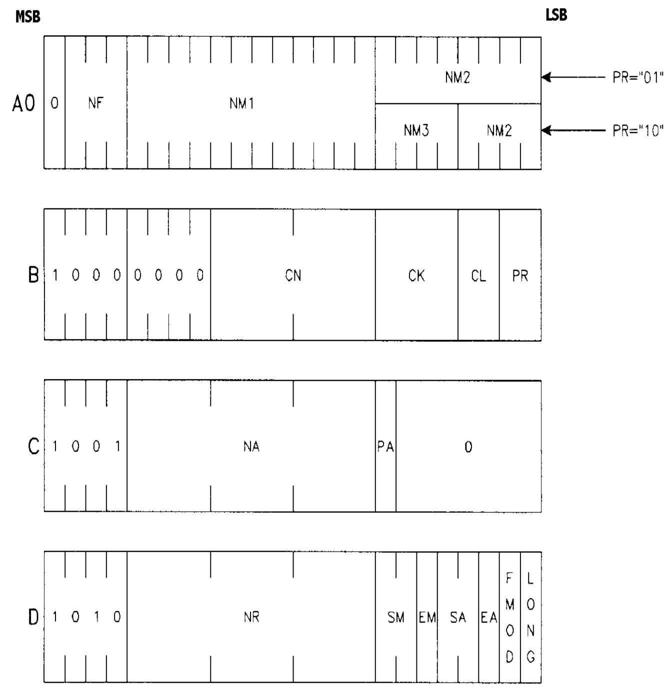

Figure 3-2 Serial Input Word Format

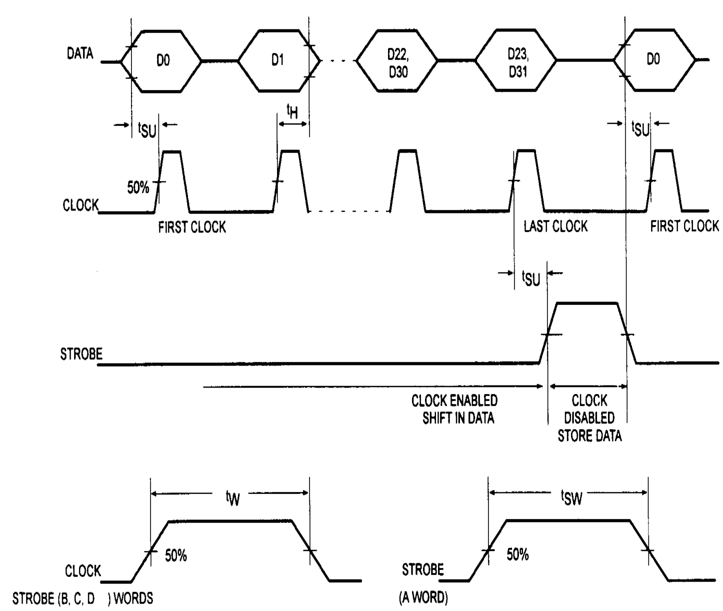

Figure 3-3 Serial Input Timing Sequence

Table 3-2 Serial Interface Specifications

Symbol	Parameter	Test Conditions	Limits MIN	Limits TYP	Limits MAX	Units
fCLOCK	Clock Frequency				10	MHz
t_{SU}	Set-up time: DATA to CLOCK CLOCK to STROBE		30			ns
t_H	Hold Time: CLOCK to DATA		30			ns
t_W	Pulse width; CLOCK Pulse width; STROBE	B, C, D words	30 30			ns
t_{SW}	Pulse width; STROBE	A word, PR = "01" A word, PR = "10"	$\frac{1}{f_{VCO}} \cdot (NM2 \cdot 65) + t_W$ $\frac{1}{f_{VCO}} \cdot [(NM2 \cdot 65) + (NM3 + 1 \cdot 72] + t_W$			ns

3.2.3 GENERAL RADIO PROGRAMMING PARAMETERS

Receive Bandwidth:	132-150 MHz (Band 4), 150-174 MHz (Band 5, 6)
Transmit Bandwidth:	132-150 MHz (Band 4), 150-174 MHz (Band 5, 6)
First IF:	21.45 MHz
Second IF:	450.0 kHz
First LO injection:	153.45 to 195.45 (high side injection)
Second LO injection (LO2):	21.9 MHz (high side injection)
TCXO Frequency (FREF):	14.85 MHz (Band 4, 5), 17.50 MHz (Band 6)
Resolution:	7.5, 6.25, 5.0 kHz (Band 4, 5), 2.5 kHz (Band 6)
Comparison Frequency (FCM):	37.5, 50, 25 kHz (Band 4, 5), 20 kHz (Band 6)
Synthesizer IC:	Phillips SA7025A

D-WORD

The D-Word programs the Reference dividers, sets enable flags for the main auxiliary phase detectors, and sets the modulus.

NR = 396 (for 7.5 kHz resolution)
NR = 297 (for 6.25 kHz resolution)
NR = 594 (for 5.0 kHz resolution)
NR = 875 (for 2.5 kHz resolution) NOTE: applies to Band 6 only.

SM = 00
EM = 1
EA = 1
SA = 00
FMOD = 0 (for 7.5 and 5.0 kHz resolution) Modulo 5
FMOD = 1 (for 6.25 and 2.5 kHz resolution) Modulo 8
LONG = 0
Where: FCM = FREF ÷ NR and RESOLUTION = FCM ÷ FMOD

C-WORD

The C-Word programs the Auxiliary (2nd LO injection frequency) and selects auxiliary preselector mode.

PA = 1
NA = 584 (for 7.5 kHz resolution)
NA = 438 (for 6.25 kHz resolution
NA = 876 (for 5.0 kHz resolution)
NA = 1095 (for 2.5 kHz resolution) NOTE: applies to Band 6 only.

Where: NA = LO2 ÷ FCM

B-WORD

The B-Word programs the Fractional-N charge pump current factor (CN), the binary acceleration factors (CL/CK) and the prescaler modulus. The value of CN should be interpolated for frequencies between the band edges. The recommended range of CN provides the necessary spurious rejection required to meet the adjacent channel specifications across the band.

Table 3-3 CN VALUES VERSUS FREQUENCY AND BAND

Band 4 (132-150 MHz)			Band 5 (150-174 MHz)			Band 6 (150-174 MHz)		
Frequency MHz	Transmit CN	Receive CN	Frequency MHz	Transmit CN	Receive CN	Frequency MHz	Transmit CN	Receive CN
132	78	91	150			150	82	95
150	88	101	174			174	93	106

CK = 0000
CL = 00
PR = 10 (selects modulus 3 prescaler)

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THE A0-WORD

The A0 Word is sent last. the A0 word contains the programming information for the main dividers. The A0 word consists of four divider parameters, NM1, NM2, NM3, and NF described below. After clocking the A0 word, the STROBE line is held high for approximately 3 ms to place the synthesizer in “speed-up” mode to decrease lock times.

NF: Fractional-N increment (3 bits, depends on channel selection and FMOD)

NM1: Number of main divide cycles when prescaler modulus = 64 (12 bits)

NM2: Number of main divide cycles when prescaler modulus = 65 (4 bits, PR = 10).

NM3: Number of main divide cycles when modulus = 72 (4 bits, PR = 10)

The Fractional-N increment (NF) is a 3 bit word that is used to program the synthesizer to channels (frequency steps) that are less then, or a fraction of, the comparison frequency (FCM).

3.2.4 LOCK DETECT

The LOCK detect output from the synthesizer is available for monitoring on J201 pin 7. The LOCK output is high when the main and auxiliary phase detectors indicate a lock condition. The lock condition is defined as less then +1 cycle on the reference input to the synthesizer IC. The LOCK detect line should be monitored to verify a locked condition before transmitting.

EXAMPLE CALCULATION

Program a Band 6 radio to receive at 151.0175 MHz

D-Word Calculation:

NR = 875 (Decimal)
SM = 00
EM = 1
EA = 1
SA = 00
FMOD = 1
LONG = 0

D-Word (Hex) = A3 6B 26

C-Word calculation:

NA = 1095 (Decimal)
PA = 1
C-Word (Hex) = 94 47 80

B-Word calculation:

CN = 95 (Decimal from Table 3-3)
CK = 0000
CL = 00
PR = 10

B-Word (Hex) = 80 5F 2

A0-Word calculation:

When the D-Word is programmed with FMOD = 8 and NR = 875 as described above, the fractional increment resolution is FCM ÷ FMOD = 20 kHz ÷ 8 = 2.5 kHz.

Where FCM = FREF ÷ NR = 17.5 MHz ÷ 875 = 20 kHz.

The total division ratio from the prescaler to the phase detector (with PR= “10”) is expressed as:

N = (NM1 + 2) x 64 + NM2 x 65 + (NM3 + 1) x 72
N’ = (NM1 + 1) x 64 + (NM2 + 1) x 65 + (NM3 + 1) x 72*

*When the fractional accumulator overflows the prescaler ratio = 65 x (64 + 1) and the total division ratio is N’ = N + 1.

In the receive mode, the synthesizer is programmed to the 1st LO injection frequency which is 21.45 MHz above the receive frequency (high side injection).

For this example, LO = 151.0175 + 21.45 MHz = 172.4675 MHz

N = LO ÷ FCM = 172.4675 ÷ .02 = 8623 {Integer part}

NM3 = [INT{64 x FRAC {N ÷ 64} ÷ FMOD}] -1
= INT { (64 x 0.734375) ÷ 8} -1
= 5 - 1 = 4

NM2 = FMOD x FRAC {N ÷ FMOD}
= 8 x FRAC {1023 ÷ 8}
= 8 x 0.875
= 7

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NM1 = INT {N ÷ 64} - NM2 - NM3 - 3
= 134 - 7 - 4 - 3
= 120

NF = FRAC {LO ÷ FCM} x FMOD
= FRAC {171.4625 ÷ 0.02} x 8
= 0.125 x 8
= 3

Where INT = Integer Part
FRAC = Fractional Part

3.3 RECEIVE TO TRANSMIT SEQUENCE

1. Load the synthesizer (D, C, B and A0 words).

2. The RX Enable (J201, pin 4) is changed from a logic high to logic low after the last bit of the A0 Word is sent.

3. The SYNTH ENABLE (SYNTH_EN) should be held in a high state for 3 milliseconds after the A0 Word is sent. This puts the synthesizer in a temporary "speedup mode" which improves lock times. Then, the SYNTH_EN is returned to a low state.

4. After the A0 Word is strobed in, wait 7ms (worst case) before applying a logic high to the 7.5 TX [1] line (J201, pin 3). This allows the synthesizer to attain lock. NOTE: The lock detect line (J201, pin 7) should be monitored and in a lock (logic high) state before enabling the transmitter.

[1] A "ramp-up/-down" circuit should be employed on the Loader to minimize adjacent channel interference caused by the spectral spreading that occurs when a transmitter is suddenly switched on or off. The ramped voltage is applied to the 7.5 TX line (J201, pin 3). The ramp should be approximately 3 ms.

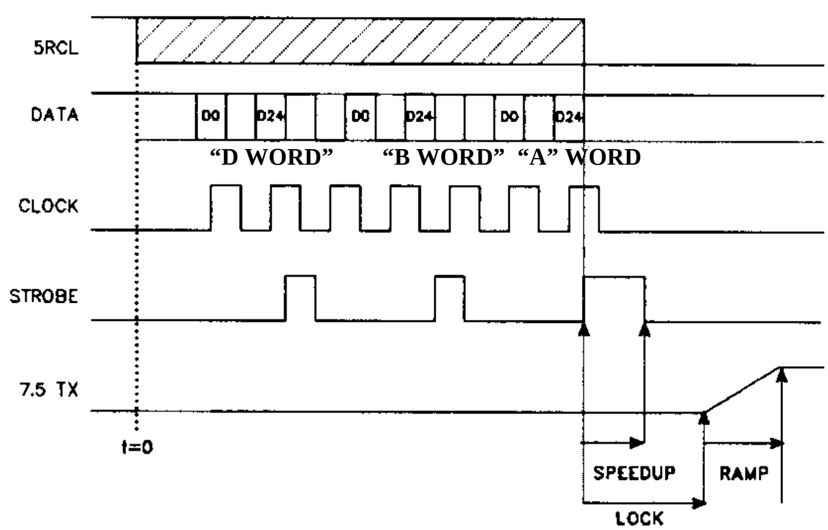

Figure 3-4 Rx to Tx TIMING DIAGRAM

3.4 TRANSMIT TO RECEIVE SEQUENCE

1. Unkey the transmitter by bringing the 7.5 TX low.
2. Allow 3 ms for "ramp-down" [1] after the 7.5 TX is brought low.
3. Apply a logic high to the RX Enable line.
4. Load the synthesizer receive frequency. The SYNTH Enable line should be held high for 3 ms on the last word to place the synthesizer in speedup mode for faster lock times. The SYNTH Enable line should then be returned to logic low.
5. After the A0-Word is strobed in, the synthesizer will initiate frequency acquisition. The Lock Detect line (J201, pin 7) should be monitored and in a lock (logic high) state before valid receive operation.

[1] A "ramp-up/-down" circuit should be employed on the Loader to minimize adjacent channel interference caused by the spectral spreading that occurs when a transmitter is suddenly switched on or off. The ramped voltage is applied to the 7.5 TX line (J201, pin 3). The ramp should be approximately 3 ms.

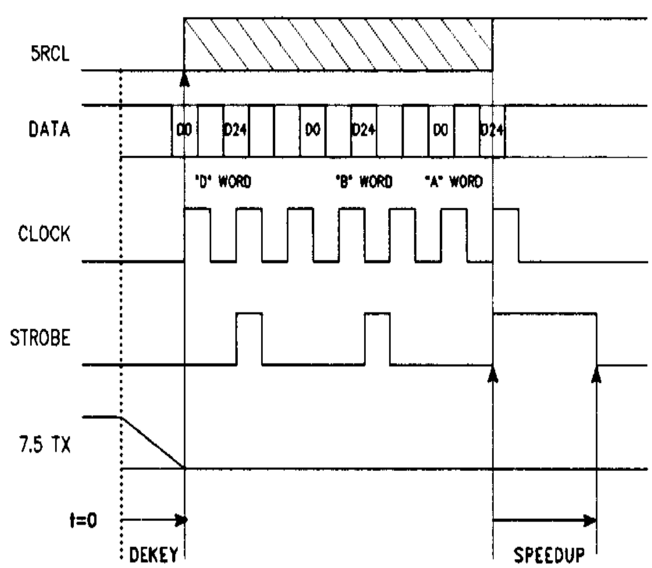

Figure 3-5 TX TO RX TIMING DIAGRAM

SECTION 4

CIRCUIT DESCRIPTION

4.1 GENERAL

4.1.1 INTRODUCTION

The main subassemblies of this transceiver are the RF board, VCO board, TCXO and Loader board. A block diagram of the transceiver is located in Figure 4-1.

The 3422 is available with a reference oscillator stability of ±2.5 PPM. The TCXO (Temperature Compensated Crystal Oscillator) is soldered directly to the RF board. The TCXO is not serviceable.

Table 4-1 Reference Frequency

Band	Frequency
Band 6	17.5 MHz
Band 5	14.85 MHz
Band 4	14.85 MHz

4.1.2 SYNTHESIZER

The VCO (voltage-controlled oscillator) output signal is the receiver first injection frequency in the Receive mode and the transmit frequency in the Transmit mode. The first injection frequency is 21.45 MHz above the receive frequency. The frequency of this oscillator is controlled by a DC voltage produced by the phase detector in synthesizer chip U811.

Channels are selected by programming counters in U811 to divide by a certain number. This programming is performed over a serial bus formed by the Synth Clock, Synth Enable, and Synth Data pins of J201. This programming is performed by the Loader board or user supplied hardware and software (see Section 3).

The frequency stability of the synthesizer in both the receive and transmit modes is established by the stability of the reference oscillator described in the preceding section. These oscillators are stable over a temperature range of -30° to +60° C (-22° to +140° F).

4.1.3 RECEIVER

The receiver is a double-conversion type with intermediate frequencies of 21.45 MHz / 450 kHz. Varactor tuned LC bandpass filters reject the image, half IF, injection, and other unwanted frequencies. A four-pole crystal filter enhances receiver selectivity.

4.1.4 TRANSMITTER

The transmitter produces a nominal RF power output of 5W at 13.3V DC, adjustable down to 1W. Frequency modulation of the transmit signal occurs in the synthesizer. Transmit audio processing circuitry is contained in the Loader board or customer-supplied equipment.

4.1.5 LOADER BOARD

The Loader board, Part No. 023-3240-330, is a plug-in circuit board used to load the synthesizer with a desired frequency and filters data/audio to and from the user interface connector. The Loader board is programmed by a personal computer and software.

4.2 SYNTHESIZER

A block diagram of the transceiver is shown in Figure 4-1 and a block diagram of Synthesizer IC U811 is shown in Figure 4-2. The synthesizer output signal (produced by a VCO) is controlled by a DC voltage produced by the phase detector in U811. The phase detector senses the phase and frequency of the two input signals and causes the VCO control voltage to increase or decrease (if they are not the same). The VCO is then "locked" on frequency.

Synthesizer programming provides the data necessary for the internal prescaler and counters. One input signal is the reference frequency. This frequency is produced by the 14.85 MHz reference oscillator (TCXO). The other input signal is the VCO frequency.

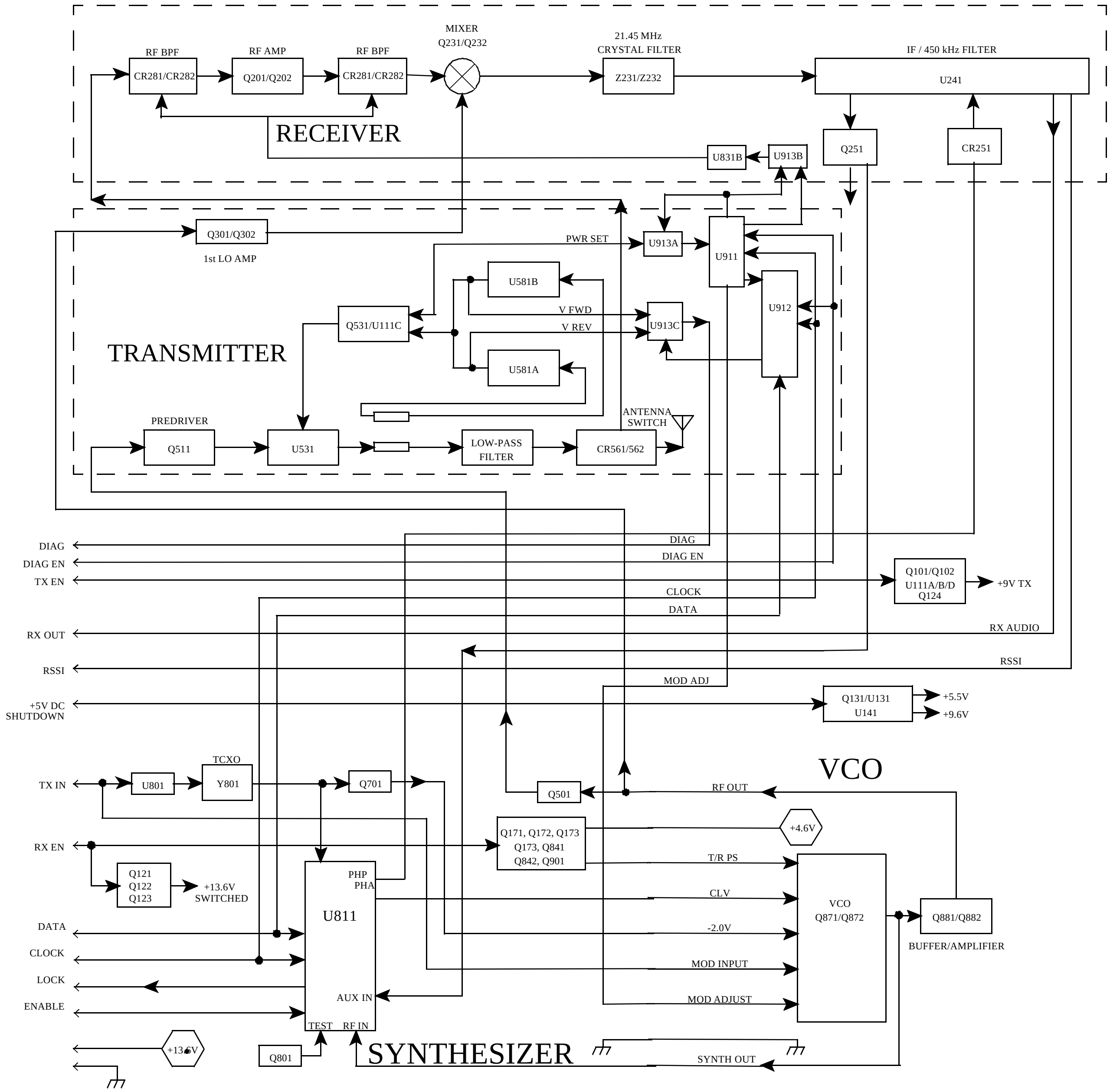

Figure 4-1 Transceiver Block Diagram

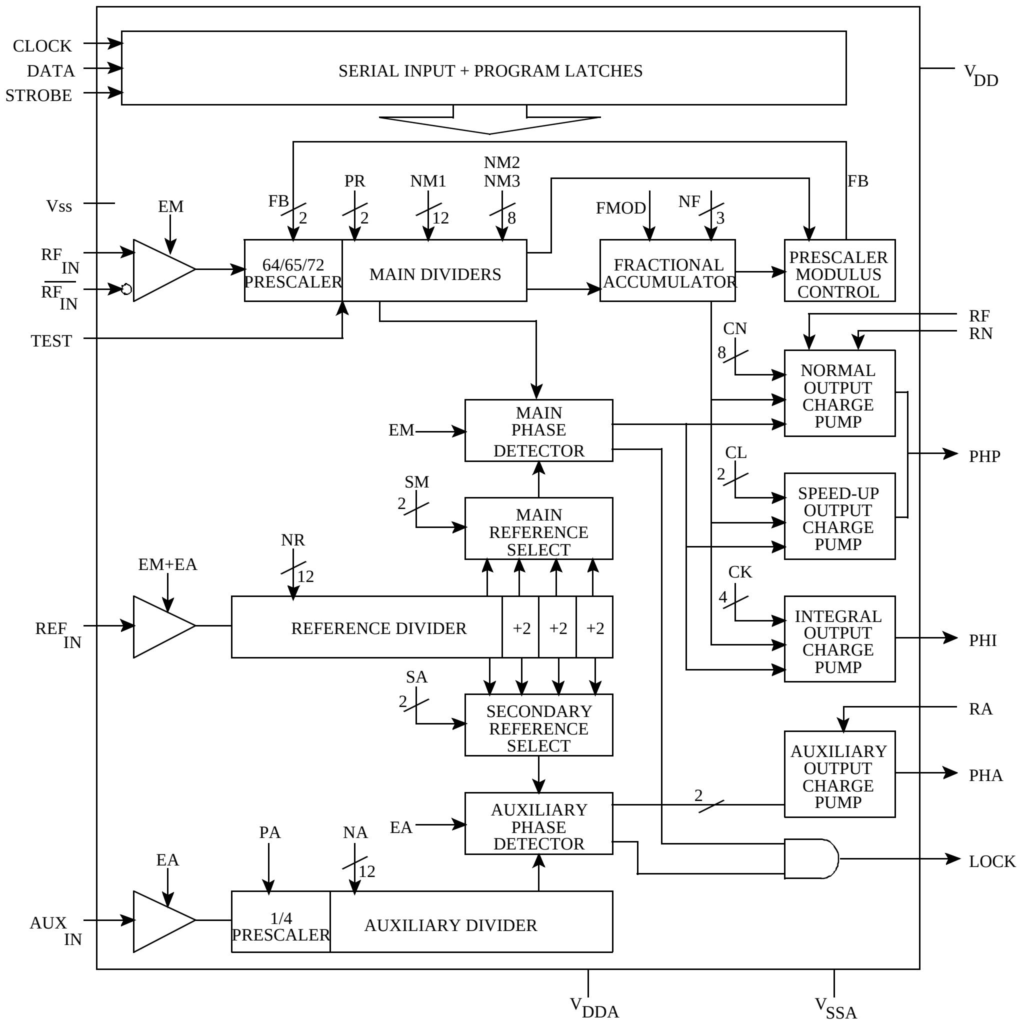

Figure 4-2 U811 Synthesizer Block Diagram

4.2.1 VOLTAGE-CONTROLLED OSCILLATOR

<u>Oscillator (Q872)</u>

The VCO is formed by Q872, several capacitors and varactor diodes, and air wound coil L872. It oscillates at the transmit frequency in transmit mode and first injection frequency in the receive mode (132-174 MHz in transmit and 153.45-195.45 MHz in receive).

Biasing of Q872 is provided by R873, R874 and R876. An AC voltage divider formed by C872, C874 and C875 initiates and maintains oscillation and also matches Q872 to the tank circuit. Air wound inductor L872 is grounded at one end to provide shunt inductance to the tank circuit.

Frequency Control and Modulation

The VCO frequency is controlled in part by DC voltage across varactor diodes CR852, CR853 and CR854. As voltage across a reverse-biased varactor diode increases, its capacitance decreases. Therefore, VCO frequency increases as the control voltage increases. CR852/CR853 and CR854 are paralleled varactors to divide the capacitance and improve linearity. The varactors CR852/CR853 are biased at -2.0V so the control line voltage can operate closer to ground. CR854 is pin shifted in when transmitting to increase the VCO gain in transmit. The control line is isolated from tank circuit RF by choke L852/L853. The amount of frequency change produced by CR852/CR853/CR854 is controlled by series capacitor C854.

The -2.0V applied to the VCO is derived from the TCXO frequency that is amplified by Q902, rectified by CR902 and filtered by C912, C917, C918 and C920 and loaded by resistor R919 on the RF board.

The VCO frequency is modulated using a similar method. The transmit audio/data signal from J201, pin 6 is applied across varactor diode CR861 which varies the VCO frequency at an audio rate. Series capacitors C855/C856 set the amount of deviation produced along with CR862 and C865. R863 provides a DC ground on the anodes of CR861/CR862, and isolation is provided by R862 and C863.

The DC voltage across CR862 provides compensation to keep modulation relatively flat over the entire bandwidth of the VCO. This compensation is required because modulation tends to increase as the VCO frequency gets higher (capacitance of CR852/CR853/CR855 gets lower). CR862 also balances the modulation signals applied to the VCO and TCXO. The D/A Converter U911 can be programmed to apply a compensating voltage to CR862 to adjust the modulation sensitivity between the TCXO and VCO.

The DC voltage applied across CR862 comes from the modulation adjust control R827 on the RF board. R826 applies a DC biasing voltage to CR862; C821 provides DC blocking. RF isolation is provided by C865 and R862.

4.2.2 VCO AND REFERENCE OSCILLATOR MODULATION

Both the VCO and reference oscillator (TCXO) are modulated in order to achieve the required frequency response. If only the VCO was modulated, the phase detector in U811 would sense the frequency change and increase or decrease the VCO control voltage to counteract the change (especially at the lower audio frequencies).

If only the reference oscillator frequency is modulated, the VCO frequency would not change fast enough (especially at the higher audio frequencies). Modulating both VCO and reference oscillators produces a flat audio response. Potentiometers R825 and R827 set the VCO modulation sensitivity so that it is equal to the reference oscillator modulation sensitivity.

4.2.3 CASCODE AMPLIFIERS/VCO (Q871/Q872)

The output signal on the collector of Q871 is coupled to buffer amplifier Q872 which forms a cascade amplifier. This is a shared-bias amplifier which provides amplification and also isolation from the stages that follow. The signal is coupled and matched from the collector of Q872 through inductors and capacitors and a T-pad to amplifier Q882.

4.2.4 AMPLIFIER (Q882)

Amplifier Q882 provides final amplification of the VCO signal. Bias for Q882 is provided by Q881 and several resistors. Matching to the transmitter and receive first injection is provided by L891 and C892. A 6 dB T-pad is used to isolate the transmitter and receive first injection.

4.2.5 VOLTAGE FILTER (Q901)

Q901 on the RF board is a capacitance multiplier to provide filtering of the 8.6V supply to the VCO. R901 provides transistor bias and C901 provides the capacitance that is multiplied. If a noise pulse or other voltage change appears on the collector, the base voltage does not change significantly because of C901. Therefore, base current does not change and transistor current remains constant. CR901 decreases the charge time of C901 when power is turned on. This shortens the start-up time of the VCO. C902 and C903 are RF decoupling capacitors.

4.2.6 VCO FREQUENCY SHIFT (Q841)

The VCO must be capable of producing frequencies from approximately 132-195.45 MHz to produce the required receive injection and transmit frequencies. If this large of a shift was achieved by varying the VCO control voltage, the VCO gain would be undesirably high. Therefore, capacitance is switched in and out of the tank circuit to provide a coarse shift in frequency.

This switching is controlled by the T/R pin shift (RX_EN) on J201, pin 4, Q841/Q842 and pin diode CR851. When a pin diode is forward biased, it presents a very low impedance to RF; and when it is reverse biased, it presents a very high impedance. The capacitive leg is switched in when in transmit and out when in receive.

When J201, pin 4 is high in receive (+5V), Q173 is turned on and the collector voltage goes low. A low on the base of Q172 turns the transistor on and the regulated +9.6V on the emitter is on the collector for the receive circuitry. Q171 applies a low on the base of Q841, the transistor is off and the collector is high. With a high on the base of Q842 and a low on the emitter, this reverse biases CR851 for a high impedance.

The capacitive leg on the VCO board is formed by C852, CR851 and C853. When J201, pin 4 is low in transmit, Q842 is turned on and a high is on the emitter, Q171 is turned off and the collector voltage goes high. A low on the base of Q173 turns the transistor off and the regulated +9.6V is removed from the receive circuitry. With a high on the base of Q841 the transistor is on and the collector is low. With a low on the collector of Q842 and a high on the emitter, this forward biases CR851 and provides an RF ground through C852 and C853 is effectively connected to the tank circuit. This decreases the resonant frequency of the tank circuit.

4.2.7 SYNTHESIZER INTEGRATED CIRCUIT (U811)

Introduction

Synthesizer chip U811 is shown in Figure 4-2. This device contains the following circuits: R (reference), Fractional-N, NM1, NM2 and NM3; phase and lock detectors, prescaler and counter programming circuitry. The basic operation was described in Section 4.2.1.

Channel Programming

Frequencies are selected by programming the R, Fractional-N, NM1, NM2 and NM3 in U811 to divide by a certain number. These counters are programmed by Loader board or a user supplied programming circuit. More information on programming is located in Section 3.

As previously stated, the counter divide numbers are chosen so that when the VCO is oscillating on the correct frequency, the VCO-derived input to the phase detector is the same frequency as the reference oscillator-derived frequency.

The VCO frequency is divided by the internal prescaler and the main divider to produce the input to the phase detector.

4.2.8 LOCK DETECT

When the synthesizer is locked on frequency, the SYNTH LOCK output of U811, pin 18 (J201, pin 7) is a high voltage. When the synthesizer is unlocked, the output is a low voltage. Lock is defined as a phase difference of less than 1 cycle of the TCXO.

4.3 RECEIVER CIRCUIT DESCRIPTION

4.3.1 PRESELECTOR FILTER, RF AMPLIFIER (Q202)

Capacitor C201 couples the receive signal from the antenna switch to the LC preselector filter composed of L201-L203, CR281, CR282, C202-C207. (The antenna switch is described in Section 4.4.4.) The preselector filter is a 2-pole discrete LC varactor tuned bandpass filter adjusted to pass only a narrow band of frequencies to the receiver. This attenuates the image and other unwanted spurious frequencies.

The preselector filter is tuned in frequency by varying the reverse bias voltage of varactors CR281/CR282. The filter control voltage is either generated by Digital to Analog Converter (DAC) U911 or R920 and amplified by U831 to generate a higher voltage swing to the varactors and minimize filter loss. R206 and capacitors C281-C285 filter the varactor voltage and provide RF isolation. The control voltage source is chosen by U913.

Impedance matching between the helical filter and RF amplifier Q202 is provided by C207 and L204. CR201 protects the base-emitter junction of Q202 from excessive negative voltages that may occur during high signal conditions. Q201 is a switched constant current source which provides a base bias for Q202. Q201 base bias is provided by R202/R203. Current flows through R201 so that the voltage across it equals the voltage across R202 (minus the base-emitter drop of Q201). In the transmit mode the receive +9.6V is removed and Q201 is off.

This removes the bias from Q202 and disables the RF amplifier in transmit mode. This prevents noise and RF from being amplified by Q202 and fed back on the first injection line.

Additional filtering of the receive signal is provided by a three pole discrete LC varactor tuned bandpass filter composed of filter L212-L214, L221-L224, CR283-CR285, C214-C217, C221-C223. L211 and C213 provide impedance matching between Q202 and this filter. Resistor R205 is used to lower the Q of L211 to make it less frequency selective. The same control voltage that adjusts to two pole filter on frequency adjusts this filter as well. The inductors are factory tuned to align the filter tracking and should not be adjusted.

4.3.2 MIXER (U231), AMPLIFIER (Q231)

First mixer U231 mixes the receive frequency with the first injection frequency to produce the 21.45 MHz first IF. Since high-side injection is used, the injection frequency is 21.45 MHz above the receive frequency. The RF signal is coupled to the mixer through C232.

The output of U231 is coupled to buffer Q231. C232, R233 and Q231 match the 50 ohm output of U231. The output of Q231 is matched to crystal filter Z231 via L231 and C234. This filter presents a low impedance to 21.45 MHz and attenuates the receive, injection, and other frequencies outside the 21.45 MHz passband.

4.3.3 FIRST LO AMPLIFIER/BUFFER (Q301, Q302)

The first LO amplifier provides amplification and buffering of the receive first injection. R305-R307 form a 3 dB 50 ohm pad. C303 couples the signal to C304 and L301 which match Q302 to 50 ohms. L302 and C307 match Q302 to the mixer Q232. Q301, R301-R304 provide biasing for Q302. R308 enhances the stability of Q302. C302 and C306 provide RF decoupling.

4.3.4 CRYSTAL FILTER (Z231/Z232)

The output of Q231 is matched to the crystal filter, Z231/Z232 by L231, C234 and C237. This filter presents a low impedance to 21.45 MHz and attenuates the receive, injection and other frequencies outside the 21.45 MHz passband.

Z221 and Z222 form a 2-section, 4-pole crystal filter with a center frequency of 21.45 MHz and a -3 dB passband of 8 kHz (15 kHz BW) or 15 kHz (30 kHz BW). This filter establishes the receiver selectivity by attenuating the adjacent channel and other signals close to the receive frequency. C241, and C242 adjust the coupling of the filter. L242, C244, C245 and R243 provide impedance matching between the filter and U241.

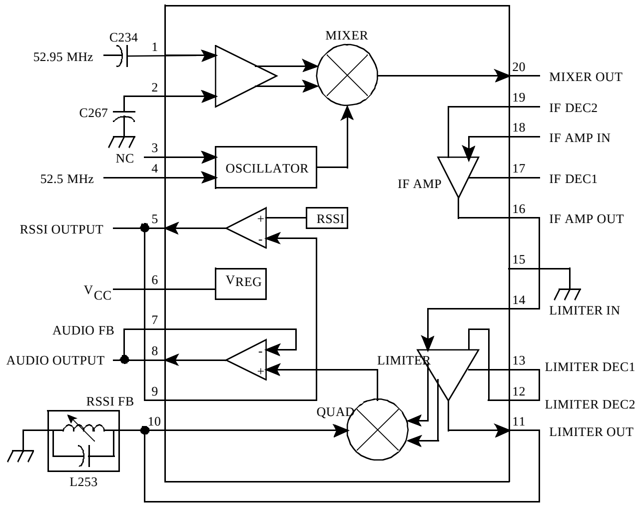

Figure 4-3 U241 Block Diagram

4.3.5 FM IF (U241)

Second LO Oscillator, Buffer (Q251)

As shown in Figure 4-3, U241 contains the second oscillator, second mixer, limiter, detector, and squelch circuitry. The second LO oscillator is built into U241 which provides the base and emitter connections for an internal oscillator transistor. The oscillator tank circuit consists of L251, C253 and CR251. Oscillator feedback is provided by C254, C256 and C257. The oscillator frequency is adjusted by applying a control voltage across R253 to CR251. The control voltage is provided by the charge pump of the auxiliary synthesizer in U811.

The emitter of the oscillator transistor is connected to the common collector buffer amplifier Q251 by C251. R257-R259 and R254 provide bias for Q251. R254 additionally provides an RF load to decrease the buffer level. C258, C259 and L252 filter the unwanted harmonics from the oscillator output. The output of Q251 is coupled to the auxiliary synthesizer phase detector by C814. The oscillator is phase locked at 21.9 MHz with L251 adjusted to center the control voltage.

Second IF Filter

The output of the internal double-balanced mixer is the difference between 21.45 MHz and 21.9 MHz which is 450 kHz. This 450 kHz signal is fed out on pin 3 and applied to second IF filters Z241 and Z242. These filters have passbands of 9 kHz (15 kHz BW), or 20 kHz (30 kHz BW) at the -6 dB points and are used to attenuate wideband noise.

Limiter-Amplifier

The output of Z241/Z242 is applied to a limiter-amplifier circuit in U241. This circuit amplifies the 450 kHz signal and any noise present; then limits this signal to a specific value. When the 450 kHz signal level is high, noise pulses tend to get clipped off by the limiter; however, when the 450 kHz signal level is low, the noise passes through the limiter. C275/C276 decouple the 450 kHz signal.

Quadrature Detector

From the limiter stage the signal is fed to the quadrature detector. An external phase-shift network connected to pin 8 shifts the phase of one of the detector inputs 90° at 450 kHz (all other inputs are unshifted in phase). When modulation occurs, the frequency of the IF signal changes at an audio rate as does the phase of the shifted input. The detector, which has no output with a 90° phase shift, converts this phase shift into an audio signal. L253 is tuned to provide maximum undistorted output from the detector. R255 is used to lower the Q of L253. From the detector the audio and data signal is fed out on pin 9. The audio/data output of U241, pin 9 is applied to J201, pin 13.

Receive Signal Strength Indicator (RSSI)

U241, pin 5 is an output for the RSSI circuit which provides a current proportional to the strength of the 450 kHz IF signal. The voltage developed across R275 is applied to J201, pin 12.

4.4 TRANSMITTER CIRCUIT DESCRIPTION

4.4.1 BUFFER (Q501)

The VCO RF output signal is applied to R892, R893 and R894 that form a resistive splitter for the receive first local oscillator and the transmitter. The VCO signal is then applied to a 50 ohm pad formed by R501, R502, and R503. This pad provides attenuation and isolation. Q501 provides amplification and additional isolation between the VCO and transmitter. Biasing for this stage is provided by R504 and R505, and decoupling of RF signals is provided by C503 . Impedance matching to the predriver is provided by L511 and C512.

4.4.2 PRE-DRIVER (Q511)

Pre-driver Q511 is biased Class A by R511 and R512 and R515. L513, C517 and C518 match Q511 to U531. R514 provides a resistive feedback path to stabilize Q511 and C515 provides DC blocking. C516 bypasses RF from the DC line, and R513 provides supply voltage isolation and ties the +9V transmit supply to the circuit.

4.4.3 FINAL (U531), COMPARATOR (U111C)

RF module U531 has an RF output of 1W to 5W and operates on an input voltage from 10-16V.

Power control is provided by U581, U111, Q531 and a directional coupler A531. The power is adjusted by Power Set Control R535 that provides a reference voltage to U111C. U111C drives Q531 and PA module U531.

One end of the Balun directional coupler is connected to a forward RF peak detector formed by R591, CR591, C591 and U581A. The other end of the directional coupler is connected to a reverse RF peak detector formed by R593, CR592, C593 and U581B.

If the power output of U531 decreases due to temperature variations, etc., the forward peak detector voltage drops. This detector voltage drop is buffered by U581A and applied to inverting amplifier U111C which increases the forward bias on Q531. The increase on Q531 increases the power output level of U531. If the power output of U531 increases, the forward peak detector voltage increases and U111C decreases the forward bias on Q531. The decrease on Q531 decreases the output power of U531.

The output of CR591/CR592 is fed to U581A/B respectively. If the output of either buffer increases, the increase is applied to the inverting input of U111C. The output of U111C then decreases and Q531 decreases the input voltage to U531 to lower the power. The control voltage is isolated from RF by ferrite bead EP532 and C531 decouples RF.

The forward/reverse power voltages from U581A/B are also applied to U913/U912 for outputs on J201.

The low-pass filter consists of L551-L554, and C552-C556. The filter attenuates spurious frequencies occurring above the transmit frequency band. The transmit signal is then fed through the antenna switch to antenna jack J501.

4.4.4 ANTENNA SWITCH (CR561, CR562)

The antenna switching circuit switches the antenna to the receiver in the receive mode and the transmitter in the transmit mode. In the transmit mode, +9V is applied to L555 and current flows through diode CR561, L561, diode CR562, and R561. When a diode is forward biased, it presents a low impedance to the RF signal; conversely, when it is reverse biased (or not conducting), it presents a high impedance (small capacitance). Therefore, when CR561 is forward biased, the transmit signal has a low-impedance path to the antenna through coupling capacitor C562.

L561 and C563 form a discrete quarter-wave line. When CR561 is forward biased, this quarter-wave line is effectively AC grounded on one end by C563. When a quarter-wave line is grounded on one end, the other end presents a high impedance to the quarter-wave frequency. This blocks the transmit signal from the receiver. C561/C563 match the antenna to 50 ohms in transmit and receive.

4.4.5 TRANSMITTER KEY-UP CONTROL

Q121, Q122 and Q123 act as switches which turn on with the RX_EN line. When the line goes low Q121 is turned off, which turns Q122 on, turning Q123 on. This applies 13.6V to U111 before the TX_EN line goes high.

U111A/B provide the key-up and key-down conditioning circuit. C116 and R117 provide a ramp-up and ramp-down of the 9V transmit supply during key-up and key-down which reduces load pull of the VCO during key-up. The conditioning provides a stable 5.5V output by balancing the 5.5V reference with the 5.5V regulated supply.

The output on U111B, pin 7 is applied to comparator U111D, pin 12, the non-inverting input. The output of U111D, pin 14 is applied to the b ase of current source Q124. The output of Q124 is on the emitter and is applied back to the inverting input of comparator U111D, pin 13. A decrease or increase on U111D, pin 13 causes a correction by U111D to stabilize the 9V transmit output. R125/R126 establish the reference voltage on U111D, pin 13. C123 provides RF bypass, C124 provides RF decoupling and C125 stabilizes the output. The 9V transmit voltage is then distributed to the circuits.

4.5 VOLTAGE REGULATORS

4.5.1 +9.6 AND +5.5V REGULATED

The +5V applied on J201, pin 5 is applied to the base of Q131 turning the transistor on. This causes the collector to go low and applies a low to the control line of U141, pin 1 and R131 is a pull-up resistor. The 13.6V from J201, pin 2 is on U141, pin 6 to produce a +9.6V reference output on U141, pin 4. C145 stabilizes the voltage and C146 provides RF decoupling. C144 provides RF bypass and C118 provides RF decoupling. C137 is a bypass capacitor for U131.

The low from the collector of Q131 is also applied to the control line of U131, pin 1. C136 decouples RF and R131 is a pull-up resistor. The 13.6V from J201, pin 2 is on U131, pin 6 to produce a +5.5V output on U131, pin 4. C135 stabilizes the voltage and C136 provides RF decoupling. C137 is a bypass capacitor for U131.

SECTION 5

SERVICING

5.1 GENERAL

5.1.1 PERIODIC CHECKS

This transceiver should be put on a regular maintenance schedule and an accurate performance record maintained. Important checks are receiver sensitivity and transmitter frequency, modulation, and power output. A procedure for these and other tests is located in Section . It is recommended that transceiver performance be checked annually even though periodic checks are not required by the FCC. During the first year, make an additional check or two to ensure no TCXO frequency drifting has occurred.

5.1.2 SURFACE-MOUNTED COMPONENTS

A large number of the components used on the transceiver board are the surface-mounted type. Since these components are relatively small in size and are soldered directly to the PC board, care must be used when they are replaced to prevent damage to the component or PC board. Surface-mounted components should not be reused because they may be damaged by the unsoldering process.

5.1.3 SCHEMATIC DIAGRAMS AND COMPONENT LAYOUTS

Schematic diagrams and component layouts of the PC boards used in this transceiver are located in Section . A component locator guide is also provided to aid in component location.

5.1.4 REPLACEMENT PARTS LIST

A replacement parts list with all the parts used in this transceiver is located in Section . Parts are listed alphanumerically according to designator. For information on ordering parts, refer to Section 1.8.

5.1.5 TCXO MODULE NOT SERVICEABLE

The ±2.5 PPM TCXO module is not field serviceable. Part changes require a factory recalibration to ensure that the oscillator stays within its ±2.5 PPM tolerance.

5.2 SYNTHESIZER SERVICING

5.2.1 INTRODUCTION

When there is a synthesizer malfunction, the VCO is not locked on frequency. When an unlocked VCO is detected by the lock detector circuit, U811, pin 18 goes low (0V).

NOTE: The user-supplied circuitry must disable the transmitter and receiver when an out-of-lock condition is indicated.

When the VCO is unlocked, the f_R and f_V inputs to the phase detector are usually not in phase (see Section 4.1.2). The phase detector in U811 then causes the VCO control voltage to go to the high or low end of its operating range. This in turn causes the VCO to oscillate at the high or low end of its frequency range.

As shown in Figure 4-1, a loop is formed by VCO Q872, amplifier Q871, and the RF IN of U811. Therefore, if any of these components begin to malfunction, improper signals appear throughout the loop. However, correct operation of the counters can still be verified by measuring the input and output frequencies to check the divide number.

Proceed as follows to check the synthesizer I/O signals to determine if it is operating properly.

5.2.2 REFERENCE OSCILLATOR

Check the signal at U811, pin 8. It should be 14.85 MHz for Bands 4 and 5 or 17.5 MHz for Band 6 at a level of approximately 0.5V P-P. If the TCXO module is defective, it is not serviceable and must be replaced with a new module as described in Section 5.1.5.

5.2.3 VCO

Output Level

The output level of Q882 can be measured with an RF voltmeter or some other type of high impedance meter. The minimum level after a power splitter at R851 should be -3 dBm.

Control Voltage

Check the DC voltage at C815 with a channel near the center of the band. If the VCO is locked on frequency, this should be a steady DC voltage near 3V. If it is not locked on frequency, it should be near the lower or upper end of its range (0V or 5.5V).

Output Frequency

Check the VCO frequency at R851. If the VCO is locked on frequency, it should be stable on the transmit channel frequency. If the VCO is not locked on frequency, the VCO control voltage is probably near 0V or 5.5V.

5.2.4 SYNTHESIZER (U811)

Lock Detector

When the VCO is locked on frequency, the lock detect output on J201, pin 7 should be high.

5.3 RECEIVER SERVICING

To isolate a receiver problem to a specific section, refer to the troubleshooting flowchart in Figure 5-1. Tests referenced in the flowchart are described in the following information.

NOTE: Supply voltages are provided by the user.

5.3.1 SUPPLY VOLTAGES AND CURRENT

Measure the supply voltages on the following pins at interface connector J201:

Pin 4 - 5.0V DC Receive
Pin 5 - 5.0V DC

Place a DC ammeter in the supply line to the transceiver and the following maximum currents should be measured:

Pin 4 - 400 µA
Pin 5 - 400 µA

5.3.2 MIXER/DETECTOR (U201)

Data Output

Using a .01 µF coupling capacitor, inject a 21.45 MHz, 1 mV signal, modulated with 1 kHz at ±3 kHz deviation at U241, pin 1. The signal output at U241, pin 8 should be approximately 150 mV P-P.

NOTE: This signal consists of the 1 kHz modulation and harmonics of 450 kHz.

RSSI Output

The RSSI output on J201, pin 12 should be <900 mV DC with no signal applied, and >1.8V DC with a 1 mV input signal.

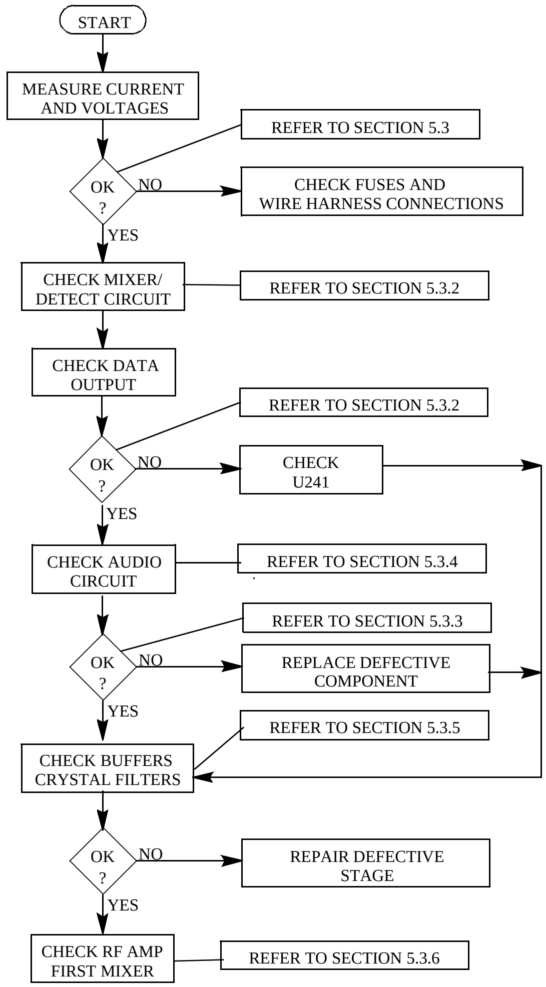

Figure 5-1   RECEIVER SERVICING

5.3.3 SECOND LO (Q401)

Verify that the Second LO signal is present at U241, pin 4. The Second LO should be at 21.90 MHz and not less than 500 mV P-P.

5.3.4 AUDIO BUFFER AMP (U241)

The Data output on J201, pin 13 should be 100-200 mV RMS, with the preceding injection signal. If these levels are not correct, verify proper adjustment of L253 (see Section 6.7). The gain of U241 is 2.8 for 30 kHz radios and 5.5 for 15 kHz radios.

5.3.5 CRYSTAL FILTERS

The 21.45 MHz IF signal is provided to the crystal filters Z221/Z222.

5.3.6 MIXER (Q232)

The mixer converts the RF signal (132-174 MHz) to 21.45 MHz. The Local Oscillator is provided by the VCO and Q302. The level of the LO should be approximately +3 dBm.

5.3.7 LNA (Q202)

The LNA provides approximately 16 dB of gain at 132-174 MHz. Q201 provides active bias to Q202.

5.3.8 PRESCALER FILTERS

The 2-pole and 3-pole LC prescaler filters limit the out-of-band signals from reaching the receiver. The 2-pole filter has approximately 2.5 dB of loss and is composed of L201-L203, CR281/CR282, and C202-C207. The 3-pole filter has approximately 5.5 dB of loss and is composed of L212-L214, CR283/CR284, C214-C217 and C221-C223. These filters are varactor tuned and require a control voltage to tune throughout the band. The voltage on TP281 varies from 2.5V at the low end of the band to over 7V at the high end of the band.

5.3.9 ANTENNA SWITCH

CR561, CR562, L561, C561 and C563 form a Pi-network antenna switch. CR561 and CR562 are reversed biased in Receive Mode.

5.4 TRANSMITTER SERVICING

5.4.1 SUPPLY VOLTAGES AND CURRENT

Measure the supply voltages on the following pins of interface connector J201:

Pin 2 - 13.3V DC nominal
Pin 3 - 3-16V DC
Pin 4 - 0.0V DC (while transmitting)
Pin 5 - 3-16V DC
Pin 6 - 2.5V DC ±1%/1.5V P-P max

Place a DC ammeter in the supply line to the transceiver and the following maximum currents should be measured:

Pin 2 - 2.5A maximum
Pin 3 - 400 µA
Pin 5 - 400 µA

5.4.2 VCO

1. Check VCO after power splitter R894 for power output. (Power output should be at least -3 dBm.)

2. Check 9V Transmit (Q124, emitter).

3. If 9V is not present check Q124, U111, Q121, Q122, Q123, Q101 and Q102 (see Section 4.4.5).

4. Check voltages on Buffer Q501.

   Input = 1.5V DC
   Output = 3.5V DC

   Power output should be at least 2 mW (+3 dBm) at C504 (50 ohm point).

5.4.3 PRE-DRIVER (Q511)

Check voltages on Q511.

Collector = 8.6V DC
Base = 2.2V DC
Emitter = 1.6V DC w/o RF (2.2V DC with RF)

Power output should be at least 100 mW (+13 dBm) at the junction of C517/L518 (50 ohm point).

5.4.4 FINAL AMPLIFIER (U531)

Check the voltages on U531.

Pin 2 = 5.5V DC (varies with power setting)
Pin 3 = 5.0V DC
Pin 4 = 12.7V DC

Power output at C551 should be 7.5-8.0W (+38.7 to +39 dBm).

5.4.5 ANTENNA SWITCH (CR561/CR562)

Check the antenna switch voltages.

CR561 = 8.6V DC
CR562 = 8.0V DC

The loss through the Antenna Switch should be 1.9 to 2.1 dB.

5.4.6 MODULATION INPUT (J201, PIN 6)

Check for audio/data signals at J201, pin 6, Y801, pin 1 and R821, pin 3.

5.4.7 TCXO (Y801)

1. Check Y801, pin 1 for 2.5V DC ±1%.

2. Adjust Y801 to set the transmitter to the frequency of operation.

3. If the frequency cannot be set to the frequency of operation, replace the TCXO.

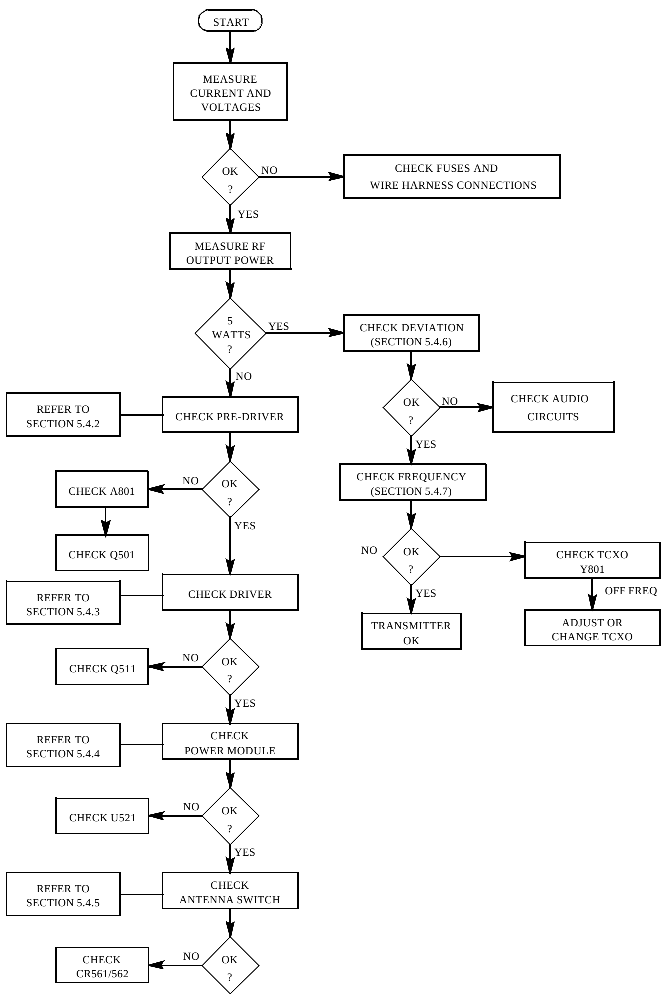

Figure 5-2 TRANSMITTER SERVICING

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SECTION 6

ALIGNMENT PROCEDURE

6.1 GENERAL

Receiver or transmitter alignment may be necessary if repairs are made that could affect tuning. Alignment points diagrams are located in Figure 6-3 or component layouts are located in Section 8.

Fabricated test cables should include power and ground, a transmit keying switch that shorts the keying line to ground, data input and data output. The test setup must apply the various supply voltages and load the synthesizer with channel information.

6.2 TEST EQUIPMENT

- Modulation Analyzer, HP8901 or equivalent
- RF Signal Generator, HP8656 or equivalent
- Power Meter
- Oscilloscope
- Digital Multimeter
- Power Supply, HP8264A or equivalent
- Audio Analyzer, HP8903A or equivalent
- Misc. cables, connectors, attenuators.

6.3 INITIAL SETTINGS

1. Adjust power supply voltage to +13.3V DC.
2. Turn off the power supply.
3. Connect RF and power cables.
4. Turn on the power supply.
5. Apply a 2.5V DC ±0.01V level to J201, pin 6.
6. Using a DC voltmeter, monitor the DC voltage at the junction of R826/R827 (wiper of R827), refer to Figure 6-3.
7. Adjust R827 to 1.50V DC ±0.05V.
8. Monitor the DC voltage at TP801 (see Figure 6-3 for top side access to TP801).
9. Adjust R805 for 2.5V DC ±0.025V.
10. Adjust R535 fully counterclockwise.

6.4 VCO CONTROL VOLTAGE

1. Connect the test setup shown in Figure 6-1.
2. Adjust R535 fully counterclockwise.
3. Load the synthesizer with the HIGHEST channel frequency in the band.
4. Key the transmitter.
5. Adjust C873 for 4.8V DC at TP831.
6. Unkey the transmitter.
7. The voltage at TP831 should be less than 4.9V.
8. Load the synthesizer with the LOWEST channel frequency in the band.
9. Key the transmitter.
10. The voltage at TP831 should be greater than .045V DC.
11. Unkey the transmitter.
12. The voltage at TP831 should be greater than 0.45V.

6.5 TRANSMITTER AND FREQUENCY

NOTE: If the radio is intended to use Diagnostics or is a Radio/Loader board combination go to Section 6.6.

1. Connect the test setup shown in Figure 6-1.
2. Load the synthesizer with a channel frequency in the MIDDLE of the band.
3. Key the transmitter.
4. The voltage at J201, pin 2 should be 13.3V DC.

(Do not transmit for extended periods.)

5. Adjust R535 clockwise for 5.0W +0.5/-0.2W. Adjust voltage and power if necessary.
6. Check the power at a channel frequency on the LOW and HIGH ends of the band. The power output should be 5W ±1W with current less than 2.5A .

6.5.1 MODULATION ALIGNMENT

1. Apply a 1V p-p, 100 Hz, +2.5V DC bias, square-wave to J201, pin 6.

2. Transmit into the modulation analyzer and observe modulation output on the oscilloscope. Set the modulation analyzer high pass filtering OFF and no less than a 15 kHz low pass filter.

3. Preset R827 to 1.5 VDC on the wiper.

4. Load the synthesizer with a channel frequency at the MIDDLE of the band.

5. Adjust R825 for a flat square wave.

6. Apply a 100 Hz, +2.5V DC biased, sine-wave to J201, pin 6. The modulation analyzer should still have the 15 kHz lowpass filter selected.

7. Adjust the audio analyzer output level to achieve a transmit deviation of:

   1.5 kHz for 15 kHz BW radios
   3.0 kHz for 30 kHz BW radios

8. Load the synthesizer with a channel frequency at the LOW end of the band.

9. Input a 100 Hz, +2.5V DC biased, sine-wave and set a 0 dB reference on the Modulation Analyzer.

10. Apply a 1 kHz, +2.5V DC biased, sine-wave. The level should be within ±3.5 dB of the reference at 100 Hz.

11. Load the synthesizer with a channel frequency in the MIDDLE of the band.

12. Input a 100 Hz, +2.5V DC biased, sine-wave and set a 0 dB reference on the Modulation Analyzer.

13. Apply a 1 kHz, +2.5V DC biased, sine-wave. The level should be within ±0.5 dB of the reference at 100 Hz.

14. Load the synthesizer with a channel frequency in the HIGH end of the band.

15. Input a 100 Hz, +2.5V DC biased, sine-wave and set a 0 dB reference on the Modulation Analyzer.

16. Apply a 1 kHz, +2.5V DC biased, sine-wave. The level should be within ±3.5 dB of the reference at 100 Hz.

17. Unkey the transmitter.

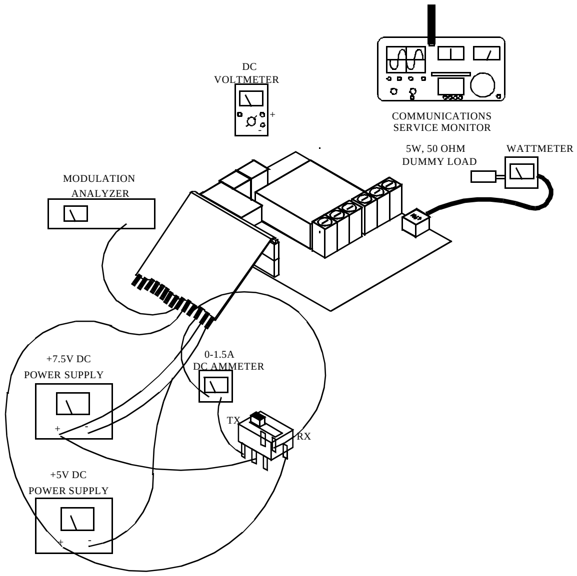

Figure 6-1 TRANSMITTER TEST SETUP

6.6 TRANSMITTER/FREQUENCY WITH LOADER

NOTE: If the radio is not intended to use Diagnostics go to Section 6.5.

NOTE: Subtract the current drawn by the Test Loader or any Interface Units from all measurements.

1. Set the Diagnostic Enable DAC (DAC4) to 255, (FFh).
2. Select a Transmit channel frequency in the MIDDLE of the band. Make sure voltage at J201, pin 2 is 13.3V DC.
3. Adjust R535 fully clockwise for maximum power output.
4. Adjust the Power Adjust DAC setting (DAC1) to set the power output to 5W ±0.3W. Make sure voltage at J201, pin 2 is 13.3V DC.
5. Adjust voltage and power if necessary.
6. Repeat Step 5 for channels on the LOW and HIGH ends of the band.
7. Power output should be 4.7-5.3W (50% duty cycle) and current should be less than 2.5A.
8. Select a Transmit channel frequency in the MIDDLE of the band

9. Adjust the frequency displayed on the Modulation Analyzer to the desired channel frequency by adjusting the TCXO (Y801).

6.6.1 MODULATION ADJUSTMENT

1. Apply a 1V p-p, 100 Hz, 2.5V DC bias, square wave to J201, pin 6.

2. Transmit into the modulation analyzer and observe modulation output on the oscilloscope. The modulation analyzer should not have any high pass filtering selected and no less than a 15 kHz low pass filter.

3. Select a Transmit channel frequency in the MIDDLE of the band. The DAC value should be "125" (the voltage at the wiper of R827 should be set to 1.5V DC).

4. If the square wave is rolled off on the edges, adjust R825 up in value for the flattest square wave.

5. If the square wave is peaked on the edges, adjust R825 down in value for the flattest square wave.

6. Adjust the Modulation Adjust DAC (DAC2) for the flattest square wave.

7. Repeat Step 6 for channels on the LOW and HIGH ends of the band.

8. Input a 100 Hz, 2.5V DC bias, sinewave to J201, pin 6. The modulation analyzer should still have the 15 kHz low pass filter selected.

9. Adjust the audio analyzer output level to achieve a transmit deviation of:
   1.5 kHz for 15 kHz radios or 3 kHz for 30 kHz radios.

10. Select a Transmit channel frequency at the LOW end of the band.

11. Input a 100 Hz, +2.5V DC biased, sine-wave and set a 0 dB reference on the Modulation Analyzer.

12. Apply a 1 kHz, +2.5V DC biased, sine-wave. The level should be within ±0.5 dB of the reference at 100 Hz.

13. Select a Transmit channel frequency in the MIDDLE of the band.

14. Input a 100 Hz, +2.5V DC biased, sine-wave and set a 0 dB reference on the Modulation Analyzer.

15. Apply a 1 kHz, +2.5V DC biased, sine-wave. The level should be within ±0.5 dB of the reference at 100 Hz.

16. Select a Transmit channel frequency in the HIGH end of the band.

17. Input a 100 Hz, +2.5V DC biased, sine-wave and set a 0 dB reference on the Modulation Analyzer.

18. Apply a 1 kHz, +2.5V DC biased, sine-wave. The level should be within ±0.5 dB of the reference at 100 Hz.

19. Unkey the transmitter.

ALIGNMENT PROCEDURE

6.7 RECEIVER

C A U T I O N

Do not key the transmitter with the generator connected because severe generator damage may result.

NOTE: If the radio is intended to use Diagnostics or is a Radio/Loader board combination go to Section 6.8.

NOTE: All distortion and SINAD measurements are performed with psophometric audio filtering.

1. Connect the test setup shown in Figure 6-2.
2. Preset tuning slugs of L201, L203, L212, L221 and L224 flush with the top of the can.
3. Preset tuning slugs of L231 and L242 full clockwise and re-adjust L242 counter-clockwise 2 full turns.
4. Preset C241 to the center position (slot in-line with axis of the part).
5. Load the synthesizer with a receive channel frequency at the LOW end of the band (-21.45 MHz).
6. Apply a -47 dBm signal from the RF signal genertor to J501 on the radio. Adjust deviation for 1.5 kHz with 1.0 kHz tone for 15 kHz radios and 3 kHz deviation with 1.0 kHz tone for 30 kHz radios.

NOTE: Maintain these deviation levels throughout the test when measuring AC levels, SINAD and % distortion.

7. Adjust R920 for 2.5V DC ±0.05V at TP281.
8. Adjust L251 for 2.5V ±0.05V at TP251.
9. Preset L253 for 2.5V DC ±0.05V at J201, pin 13.
10. Lower the RF generator 1.5 kHz for 15.0 kHz radios and 3.0 kHz for 30 kHz radios. Adjust C241 for minimum audio distortion.
11. Reset the generator back to center frequency. Tune L231 counter-clockwise for minimum distortion. Again tune L242 for minimum distortion.
12. Readjust L253 for minimum distortion (use 30 kHz LPF only)

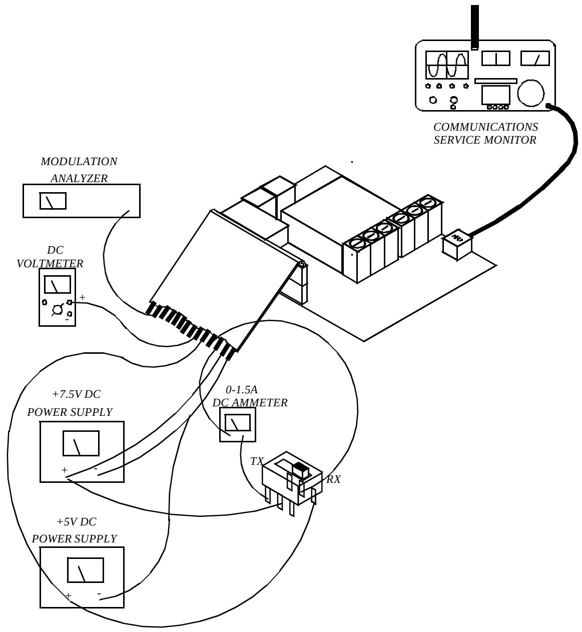

Figure 6-2 RECEIVER TEST SETUP

13. Verify that the receive audio RMS voltage is 150 mV ±50 mV.

14. Measure the % distortion (spec is <3% psophometrically weighted).

15. Adjust the amplitude of the RF signal generator on J501 until an 18 dB SINAD level (psophometrically weighted) is reached.

16. Adjust L221, L212, L224, L201 and L203 in turn for the best SINAD reading adjusting the generator output as necessary to maintain an 18 dB SINAD level. DO NOT turn the slug more than 2-turns from the top of the coil.

17. Turn the slug of L221 1/2-turn clockwise. This helps to center the filter tracking across the band.

18. Measure the 12 dB SINAD sensitivity. The RF input level should be less than -116 dBm (0.35 µV).

19. Load the synthesizer with a receive channel frequency to the MIDDLE of the band.

20. Set the signal generator to the same frequency with an amplitude of -116 dBm.

21. Adjust R920 for the best SINAD reading.

22. Adjust the RF input level until 12 dB SINAD is measured. The RF input level should be less than -116 dBm (0.35 µV).

23. Adjust generator RF level to -120 dBm and measure DC (RSSI) voltage on J201, pin 12 of the radio (spec is less than or equal to 0.90V DC).

24. Adjust generator RF level to -60 dBm and measure DC (RSSI) voltage on J201, pin 12 of the radio (spec is greater than or equal to 1.75V DC).

6.8 RECEIVER WITH LOADER BOARD

C A U T I O N

Do not key the transmitter with the generator connected because severe generator damage may result.

NOTE: If the radio is NOT intended to use Diagnostics or is NOT a Radio/Loader board combination see Section 6.7.

NOTE: All distortion and SINAD measurements are performed with psophometric audio filtering.

1. Set the Diagnostic Enable DAC (DAC 4) to 255, (FFh).

2. Preset tuning slugs of L201, L203, L212, L221 and L224 flush with the top of the can.

3. Preset tuning slugs of L231 and L242 full clockwise and re-adjust L242 counter-clockwise 2 full turns.

4. Preset C241 to the center position (slot in-line with axis of the part).

5. Select a receive channel frequency at the LOW end of the band (-21.45 MHz).

6. Apply a -47 dBm signal from the RF signal generator to J501 on the radio. Adjust deviation for: 1.5 kHz with 1.0 kHz tone for 15 kHz radios or 3 kHz deviation with 1.0 kHz tone for 30 kHz radios.

NOTE: Maintain these deviation levels throughout the test when measuring AC levels, SINAD and % distortion.

7. Adjust the Front End DAC (DAC 3) value to set the voltage on TP281 to 2.5V DC ±0.05V. The DAC setting will be about 74.

8. Adjust L251 for 2.5V ±0.05V at TP251.

9. Preset L253 for 2.5V DC ±0.05V at J201, pin 13.

10. Lower the RF generator 1.5 kHz for 15.0 kHz radios and 3.0 for 30 kHz radios. Adjust C241 for minimum audio distortion

11. Reset generator back to center frequency. Tune L231 counter-clockwise for minimum distortion. Again tune L242 for minimum distortion.

12. Readjust L253 for minimum distortion (use 30 kHz LPF only).

13. Verify that the receive audio RMS voltage is 150 mV ±50 mV.

14. Measure the % distortion (spec is <3% psophometrically weighted).

15. Adjust the amplitude of the RF signal generator on J501 until an 18 dB SINAD level (psophometrically weighted) is reached.

16. Adjust L221, L212, L224, L201 and L203 in turn for the best SINAD reading adjusting the generator output as necessary to maintain an 18 dB SINAD level. DO NOT turn the slug more than 2-turns from the top of the coil.

17. Turn the slug of L221 1/2-turn clockwise. This helps to center the filter tracking across the band.

18. Measure the 12 dB SINAD sensitivity. The RF input level should be less than -116 dBm (0.35 µV).

19. Select a receive channel frequency to the MIDDLE of the band.

20. Set the signal generator to the same frequency with an amplitude of -116 dBm.

21. Adjust the Front-End DAC (DAC 3) value to peak the SINAD reading (this is a very gradual peak).

22. Adjust the RF input level until 12 dB SINAD is measured. The RF input level should be less than -116 dBm (0.35 µV).

23. Adjust generator RF level to -120 dBm and measure DC (RSSI) voltage on J201, pin 12 of the radio (spec is less than or equal to 0.90V DC).

24. Adjust generator RF level to -60 dBm and measure DC (RSSI) voltage on J201, pin 12 of the radio (spec is greater than or equal to 1.75V DC).

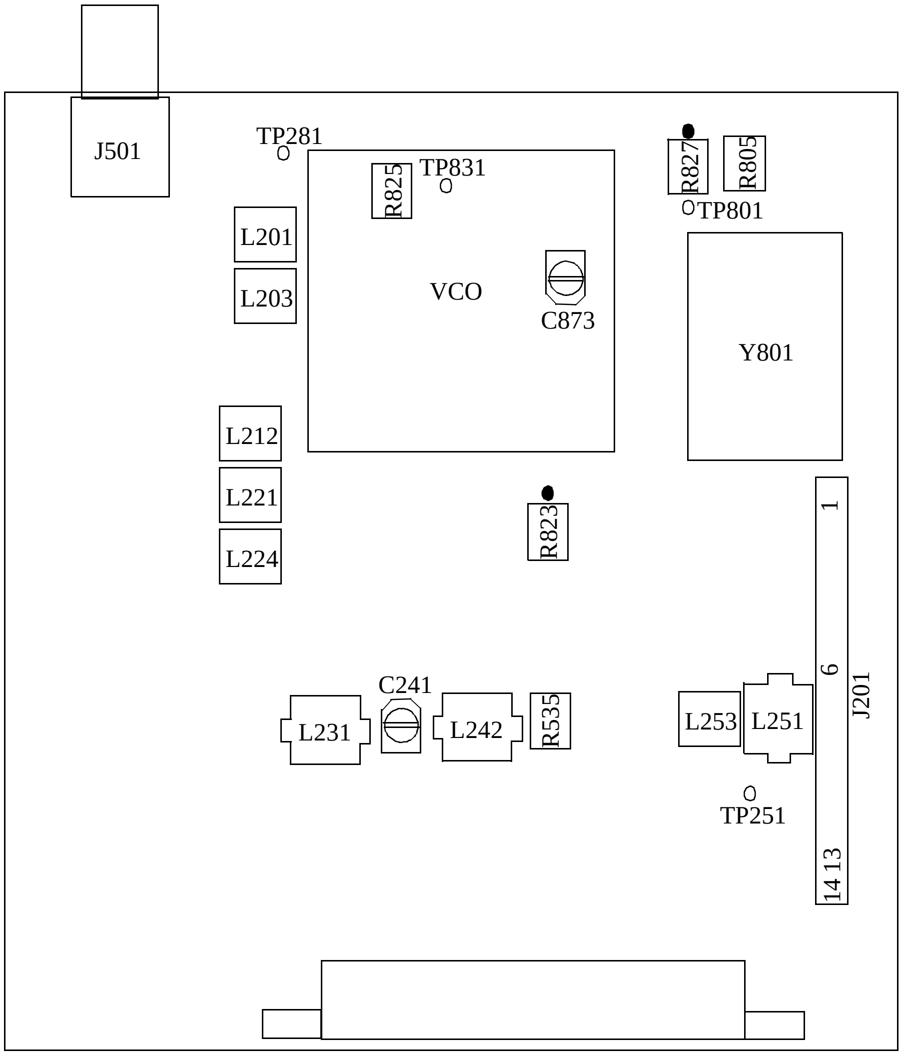

Figure 6-3 ALIGNMENT POINTS DIAGRAM

3422 TRANSCEIVER

PART NO. 242-3422-XXX

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
A 531	Directional coupler	692-5033-001
C 101	.001 µF ±10% X7R 0603	610-3675-102
C 102	1 µF 16V SMD tantalum	610-2625-109
C 103	.001 µF ±10% X7R 0603	610-3675-102
C 104	.01 µF ±10% X7R 0603	610-3675-103
C 105	1 µF 16V SMD tantalum	610-2625-109
C 106	.001 µF ±10% X7R 0603	610-3675-102
C 111	.01 µF ±10% X7R 0603	610-3675-103
C 112	.001 µF ±10% X7R 0603	610-3675-102
C 113	.001 µF ±10% X7R 0603	610-3675-102
C 114	.1 µF ±10% X7R 0603	610-3675-104
C 115	.01 µF ±10% X7R 0603	610-3675-103
C 116	.0082 µF ±10% X7R 0805	610-3605-822
C 121	.001 µF ±10% X7R 0603	610-3675-102
C 122	.001 µF ±10% X7R 0603	610-3675-102
C 123	.01 µF ±10% X7R 0603	610-3675-103
C 124	.001 µF ±10% X7R 0603	610-3675-102
C 125	1 µF 16V SMD tantalum	610-2625-109
C 131	.001 µF ±10% X7R 0603	610-3675-102
C 132	1 µF 16V SMD tantalum	610-2625-109
C 133	.001 µF ±10% X7R 0603	610-3675-102
C 134	.01 µF ±10% X7R 0603	610-3675-103
C 135	1 µF 16V SMD tantalum	610-2625-109
C 136	.001 µF ±10% X7R 0603	610-3675-102
C 137	.01 µF ±10% X7R 0603	610-3675-103
C 141	1 µF 16V SMD tantalum	610-2625-109
C 142	.001 µF ±10% X7R 0603	610-3675-102
C 143	.01 µF ±10% X7R 0603	610-3675-103
C 144	.01 µF ±10% X7R 0603	610-3675-103
C 145	1 µF 16V SMD tantalum	610-2625-109
C 146	.001 µF ±10% X7R 0603	610-3675-102
C 151	.001 µF ±10% X7R 0603	610-3675-102
C 152	.001 µF ±10% X7R 0603	610-3675-102
C 153	.001 µF ±10% X7R 0603	610-3675-102
C 154	.001 µF ±10% X7R 0603	610-3675-102
C 155	.001 µF ±10% X7R 0603	610-3675-102
C 156	.001 µF ±10% X7R 0603	610-3675-102
C 157	100 pF ±5% NPO 0603	610-3674-101
C 158	100 pF ±5% NPO 0603	610-3674-101
C 159	100 pF ±5% NPO 0603	610-3674-101

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
C 160	100 pF ±5% NPO 0603	610-3674-101
C 161	.001 µF ±10% X7R 0603	610-3675-102
C 162	.001 µF ±10% X7R 0603	610-3675-102
C 163	.001 µF ±10% X7R 0603	610-3675-102
C 171	1 µF 16V SMD tantalum	610-2625-109
C 172	.001 µF ±10% X7R 0603	610-3675-102
C 201	.001 µF ±10% X7R 0603	610-3675-102
C 202	15 pF ±5% NPO 0603	610-3674-150
C 203	22 pF ±5% NPO 0603	610-3674-220
C 204	4.7 pF ±.1% NPO 0603	610-3673-479
C 205	4.7 pF ±.1% NPO 0603	610-3673-479
C 206	15 pF ±5% NPO 0603	610-3674-150
C 207	22 pF ±5% NPO 0603	610-3674-220
C 208	.001 µF ±10% X7R 0603	610-3675-102
C 209	.001 µF ±10% X7R 0603	610-3675-102
C 211	.001 µF ±10% X7R 0603	610-3675-102
C 212	.001 µF ±10% X7R 0603	610-3675-102
C 213	27 pF ±5% NPO 0603	610-3674-270
C 214	15 pF ±5% NPO 0603	610-3674-150
C 215	27 pF ±5% NPO 0603	610-3674-270
C 216	4.7 pF ±.1% NPO 0603	610-3673-479
C 217	15 pF ±5% NPO 0603	610-3674-150
C 218	.001 µF ±10% X7R 0603	610-3675-102
C 211	4.7 pF ±.1% NPO 0603	610-3673-479
C 222	15 pF ±5% NPO 0603	610-3674-150
C 223	27 pF ±5% NPO 0603	610-3674-270
C 230	1.8 pF ±.1% NPO 0603	610-3673-189
C 232	.001 µF ±10% X7R 0603	610-3675-102
C 233	.01 µF ±10% X7R 0603	610-3675-103
C 234	56 pF ±5% NPO 0603	610-3674-560
C 235	.01 µF ±10% X7R 0603	610-3675-103
C 237	.01 µF ±10% X7R 0603	610-3675-103
C 241	1.5-5 pF SMD ceramic	612-1602-001
C 242	8.2 pF NPO J 0805	610-3601-829
C 243	3.9 pF NPO J 0805	610-3601-399
C 244	47 pF ±5% NPO 0603	610-3674-470
C 245	.01µF X7R K 0805	610-3605-103
C 246	.01 µF ±10% X7R 0603	610-3675-103
C 250	.01 µF ±10% X7R 0603	610-3675-103
C 251	.01 µF ±10% X7R 0603	610-3675-103
C 252	.01 µF ±10% X7R 0603	610-3675-103
C 253	330 pF ±5% NPO 0603	610-3674-331
C 254	100 pF ±5% NPO 0603	610-3674-101
C 255	.001 µF ±10% X7R 0603	610-3675-102
C 256	100 pF ±5% NPO 0603	610-3674-101
C 257	100 pF ±5% NPO 0603	610-3674-101

SYMBOL NUMBER	DESCRIPTION	PARTNUMBER
C 259	220 pF ±5% NPO 0603	610-3674-221
C 260	.010 µF ±10% X7R 0603	610-3609-103
C 264	47 µF 10V SMD tantalum	610-2624-470
C 265	.01 µF ±10% X7R 0603	610-3675-103
C 266	.001 µF ±10% X7R 0603	610-3675-102
C 267	.01 µF ±10% X7R 0603	610-3675-103
C 268	.01 µF ±10% X7R 0603	610-3675-103
C 271	.01 µF ±10% X7R 0603	610-3675-103
C 272	.01 µF ±10% X7R 0603	610-3675-103
C 273	.01 µF ±10% X7R 0603	610-3675-103
C 275	.01 µF ±10% X7R 0603	610-3675-103
C 276	.01 µF ±10% X7R 0603	610-3675-103
C 277	10 pF ±.1% NPO 0603	610-3673-100
C 278	.01 µF ±10% X7R 0603	610-3675-103
C 279	.01 µF ±10% X7R 0603	610-3675-103
C 281	.001 µF ±10% X7R 0603	610-3675-102
C 282	.001 µF ±10% X7R 0603	610-3675-102
C 283	.001 µF ±10% X7R 0603	610-3675-102
C 284	.001 µF ±10% X7R 0603	610-3675-102
C 285	.001 µF ±10% X7R 0603	610-3675-102
C 301	.001 µF ±10% X7R 0603	610-3675-102
C 302	.01 µF ±10% X7R 0603	610-3675-103
C 303	.001 µF ±10% X7R 0603	610-3675-102
C 304	12 pF ±5% NPO 0603	610-3674-120
C 305	22 pF 5% NPO 0603	610-3674-220
C 306	.001 µF ±10% X7R 0603	610-3675-102
C 307	7.5 pF ±1% NPO 0603	610-3673-759
C 501	.001 µF ±10% X7R 0603	610-3675-102
C 502	.001 µF ±10% X7R 0603	610-3675-102
C 503	.001 µF ±10% X7R 0603	610-3675-102
C 504	.001 µF ±10% X7R 0603	610-3675-102
C 505	22 pF ±5% NPO 0603	610-3674-220
C 506	68 pF ±5% NPO 0603	610-3674-680
C 507	.01 µF ±10% X7R 0603	610-3675-103
C 508	.001 µF ±10% X7R 0603	610-3675-102
C 511	.001 µF ±10% X7R 0603	610-3675-102
C 512	12 pF ±5% NPO 0603	610-3674-120
C 513	.01 µF ±10% X7R 0603	610-3675-103
C 514	.001 µF ±10% X7R 0603	610-3675-102
C 515	.01 µF ±10% X7R 0603	610-3675-103
C 516	.001 µF ±10% X7R 0603	610-3675-102

PARTS LIST

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
C 517	.001 µF ±10% X7R 0603	610-3675-102
C 518	6.8 pF ±.1% NPO 0603	610-3673-689
C 519	.001 µF ±10% X7R 0603	610-3675-102
C 521	.001 µF ±10% X7R 0603	610-3675-102
C 522	1 µF 16V SMD tantalum	610-2625-109
C 523	.01 µF ±10% X7R 0603	610-3675-103
C 524	.001 µF ±10% X7R 0603	610-3675-102
C 531	.001 µF ±10% X7R 0603	610-3675-102
C 532	.001 µF ±10% X7R 0603	610-3675-102
C 533	.001 µF ±10% X7R 0603	610-3675-102
C 534	.001 µF ±10% X7R 0603	610-3675-102
C 535	.001 µF ±10% X7R 0603	610-3675-102
C 536	.01 µF ±10% X7R 0603	610-3675-103
C 541	22 pF±5% NPO 0603	610-3674-220
C 542	68 pF ±5% NPO 0603	610-3674-680
C 543	.01 µF ±10% X7R 0603	610-3675-103
C 544	.001 µF ±10% X7R 0603	610-3675-102
C 544	.001 µF ±10% X7R 0603	610-3675-102
C 545	.001 µF ±10% X7R 0603	610-3675-102
C 551	.001 µF ±10% X7R 0603	610-3675-102
C 552	22 ±5% NPO 0805	610-3601-220
C 553	47 pF ±5% NPO 0805	610-3601-470
C 554	51 pF ±5% NPO 0805	610-3601-510
C 555	47 pF ±5% NPO 0805	610-3601-470
C 556	27 pF ±5% NPO 0805	610-3601-270
C 557	.001 µF ±10% X7R 0603	610-3675-102
C 561	10 pF ±5% NPO 0805	610-3601-100
C 562	.001 µF ±10% X7R 0603	610-3675-102
C 563	15 pF ±5% NPO 0603	610-3674-150
C 564	.001 µF ±10% X7R 0603	610-3675-102
C 581	.001 µF ±10% X7R 0603	610-3675-102
C 591	.001 µF ±10% X7R 0603	610-3675-102
C 592	.01 µF ±10% X7R 0603	610-3675-103
C 593	.001 µF ±10% X7R 0603	610-3675-102
C 594	.01 µF ±10% X7R 0603	610-3675-103
C 801	.01 µF ±10% X7R 0603	610-3675-103
C 802	.001 µF ±10% X7R 0603	610-3675-102
C 803	.01 µF ±10% X7R 0603	610-3675-103
C 804	.01 µF ±10% X7R 0603	610-3675-103
C 805	.001 µF ±10% X7R 0603	610-3675-102
C 806	.01 µF ±10% X7R 0603	610-3675-103
C 807	2.2 pF ±.1% NPO 0603	610-3673-229
C 808	220 pF ±5% NPO 0603	610-3674-221
C 809	220 pF ±5% NPO 0603	610-3674-221
C 810	120 pF ±5% NPO 0603	610-3674-121
C 811	.01 µF ±10% X7R 0603	610-3675-103
C 812	.01 µF ±10% X7R 0603	610-3675-103

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
C 813	.001 µF ±10% X7R 0603	610-3675-102
C 814	.01 µF ±10% X7R 0603	610-3675-103
C 815	.001 µF ±10% X7R 0603	610-3675-102
C 816	5.6 pF ±0.1% NPO 0603	610-3673-569
C 817	1 pF ±0.1% NPO 0603	610-3673-109
C 821	1 µF 16V SMD tantalum	610-2625-109
C 822	.001 µF ±10% X7R 0603	610-3675-102
C 823	.01 µF ±5% X7R 1206	610-3609-103
C 824	.001 µF ±10% X7R 0603	610-3675-102
C 825	.001 µF ±10% X7R 0603	610-3675-102
C 826	1 µF 16V SMD tantalum	610-2625-109
C 831	100 pF ±5% NPO 0603	610-3674-101
C 832	.033 µF ±10% X7R 1206	610-3606-333
C 833	.001 µF ±10% X7R 0805	610-3605-102
C 836	.0047 µF ±10% X7R 0805	610-3605-472
C 841	.01 µF ±10% X7R 0603	610-3675-103
C 842	.001 µF ±10% X7R 0603	610-3675-102
C 843	.01 µF ±10% X7R 0603	610-3675-103
C 844	.001 µF ±10% X7R 0603	610-3675-102
C 845	.01 µF ±10% X7R 0603	610-3675-103
C 846	.001 µF ±10% X7R 0603	610-3675-102
C 847	.01 µF ±10% X7R 0603	610-3675-103
C 848	.001 µF ±10% X7R 0603	610-3675-102
C 849	.01 µF ±10% X7R 0603	610-3675-103
C 850	.001 µF ±10% X7R 0603	610-3675-102
C 851	.001 µF ±10% X7R 0603	610-3675-102
C 852	.001 µF ±10% X7R 0603	610-3675-102
C 853	6.8 pF ±0.1% NPO 0603	610-3673-689
C 854	220 pF ±5% NPO 0603	610-3674-221
C 855	3.9 pF ±0.1% NPO 0603	610-3673-399
C 856	3.9 pF ±0.1% NPO 0603	610-3673-399
C 858	.001 µF ±10% X7R 0603	610-3675-102
C 863	100 pF ±5% NPO 0603	610-3674-101
C 865	100 pF ±5% NPO 0603	610-3674-101
C 866	1 µF 16V SMD tantalum	610-2625-109
C 871	.001 µF ±10% X7R 0603	610-3675-102
C 872	39 pF ±5% NPO 0603	610-3674-390
C 873	2.5-10 pF ceramic SMD	612-1602-002
C 874	47 pF ±5% NPO 0603	610-3674-470
C 875	68 pF ±5% NPO 0603	610-3674-680
C 876	.001 µF ±10% X7R 0603	610-3675-102
C 877	18 pF ±0.1% NPO 0603	610-3674-180
C 881	.001 µF ±10% X7R 0603	610-3675-102
C 882	.01 µF ±10% X7R 0603	610-3675-103
C 883	27 pF ±5% NPO 0603	610-3674-270
C 884	22 pF ±5% NPO 0603	610-3674-220
C 891	.001 µF ±10% X7R 0603	610-3675-102

PARTS LIST

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
C 892	10 pF ±0.1% NPO 0603	610-3673-100
C 893	.001 µF ±10% X7R 0603	610-3675-102
C 901	4.7 µF 16V SMD tantalum	610-2625-479
C 902	.01 µF ±10% X7R 0603	610-3675-103
C 903	.001 µF ±10% X7R 0603	610-3675-102
C 911	.01 µF ±10% X7R 0603	610-3675-103
C 912	.01 µF ±10% X7R 0603	610-3675-103
C 913	.01 µF ±10% X7R 0603	610-3675-103
C 914	.01 µF ±10% X7R 0603	610-3675-103
C 915	.01 µF ±10% X7R 0603	610-3675-103
C 916	.01 µF ±10% X7R 0603	610-3675-103
C 917	1 µF 10V SMD tantalum	610-2624-109
C 918	330 pF ±5% NPO 0603	610-3674-331
C 920	.001 µF ±10% X7R 0603	610-3675-102
C 921	.01 µF ±10% X7R 0603	610-3675-103
CR201	Switching diode SOT-23	623-1504-002
CR251	Varactor BB535 SOD-323	623-5005-022
CR281	Dual varactor MMBV609	623-5005-023
CR282	Dual varactor MMBV609	623-5005-023
CR283	Dual varactor MMBV609	623-5005-023
CR284	Dual varactor MMBV609	623-5005-023
CR285	Dual varactor MMBV609	623-5005-023
CR561	Switch PIN diode SOT-23	623-1504-001
CR562	Switch PIN diode SOT-23	623-1504-001
CR591	Hot carrier diode SOT-23	623-1504-016
CR592	Hot carrier diode SOT-23	623-1504-016
CR851	Switch PIN diode SOT-23	623-1504-001
CR852	Dual varactor MMBV609	623-5005-023
CR853	Dual varactor MMBV609	623-5005-023
CR854	Dual varactor MMBV609	623-5005-023
CR855	Switch PIN diode SOT-23	623-1504-001
CR861	Varactor BB535 SOD-323	623-5005-022
CR862	Varactor BB535 SOD-323	623-5005-022
CR901	Varactor BB535 SOD-323	623-5005-022
CR902	Dual switch diode SOT-23	623-1504-023
EP111	Ferrite bead SMD	617-2503-001
EP200	Mini ceramic xtal pin insolator	010-0345-280
EP501	Ferrite bead SMD	617-2503-001
EP531	Ferrite bead SMD	617-2503-001
EP532	Ferrite bead SMD	617-2503-001
EP533	Ferrite bead SMD	617-2503-010
EP534	Ferrite bead SMD	617-2503-001
HW103	4-40 machine panhead ZPS	675-1604-010
HW104	Grafoil M577xx	018-1007-102
J 201	14-pos single row receptacle	615-7110-214
J 501	Jack right angle PC mount	142-0701-501
L 201	3.5T shielded 5 mm coil	642-1021-003

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
L 202	180 nH ±10% SMD 0805	642-9003-188
L 203	3.5T shielded 5 mm coil	642-1021-003
L 204	15 nH ±10% SMD inductor	642-9003-157
L 211	82 nH ±5% SMD 0805	642-9003-827
L 212	3.5T shielded 5 mm coil	642-1021-003
L 213	270 nH ±10% SMD inductor	642-9003-278
L 214	330 nH ±10% SMD inductor	642-9003-338
L 221	3.5T shielded 5 mm coil	642-1021-003
L 222	270 nH ±10% SMD inductor	642-9003-278
L 223	330 nH ±10% SMD inductor	642-9003-338
L 224	3.5T shielded 5 mm coil	642-1021-003
L 231	1 µH ±6% variable inductor	642-1012-015
L 232	470 nH ±10% SMD inductor	642-9003-478
L 233	470 nH ±10% SMD inductor	642-9003-478
L 242	1 µH ±6% variable inductor	642-1012-015
L 251	1 µH ±6% variable inductor	642-1012-015
L 252	470 nH ±10% SMD inductor	642-9003-478
L 253	680 µH quad coil	642-5102-001
L 301	82 nH ±10% SMD inductor	642-9003-827
L 302	82 nH ±10% SMD inductor	642-9003-827
L 501	3.9 µH SMD inductor	642-9001-399
L 511	56 nH inductor LL2012 F56N	642-9003-567
L 512	1 µH inductor SMD	642-9001-109
L 513	68 nH ±10% SMD 0805	642-9003-687
L 551	43 nH 10-turn air core SMD	642-0030-010
L 552	43 nH 10-turn air core SMD	642-0030-010
L 553	43 nH 10-turn air core SMD	642-0030-010
L 554	43 nH 10-turn air core SMD	642-0030-010
L 555	3.9 µH SMD inductor	642-9001-399
L 561	43 nH 10-turn air core SMD	642-0030-010
L 801	470 nH ±10% SMD 0805	642-9003-478
L 802	470 nH ±10% SMD 0805	642-9003-478
L 803	470 nH ±10% SMD 0805	642-9003-478
L 804	470 nH ±10% SMD 0805	642-9003-478
L 811	120 nH ±10% SMD 0805	642-9003-128
L 812	470 nH ±10% SMD 0805	642-9003-478
L 851	1 µH SMD inductor	642-9001-109
L 852	1 µH SMD inductor	642-9001-109
L 853	1 µH SMD inductor	642-9001-109
L 854	1 µH SMD inductor	642-9001-109
L 855	1 µH SMD inductor	642-9001-109
L 871	82 nH ±10% SMD 0805	642-9003-827
L 872	12.5 nH 4T air core SMD	642-0030-004
L 873	470 nH ±10% SMD 0805	642-9003-478
L 881	82 nH ±10% SMD 0805	642-9003-827
L 891	82 nH ±10% SMD 0805	642-9003-827
MP101	Heat sink	014-0778-047

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
MP102	VHF/UHF module shield	017-2225-756
MP107	Low pass top shield	017-2225-771
MP108	Synthesizer bottom shield	017-2225-772
MP109	Driver bottom shield	017-2225-773
MP110	Low pass bottom shield	017-2225-774
MP801	VCO can	017-2225-751
PC001	PC board	035-3422-050
Q 101	NPN digital transistor	676-0013-046
Q 102	PNP digital transistor	676-0013-032
Q 121	NPN digital transistor	676-0013-046
Q 122	NPN digital transistor	676-0013-046
Q 123	PNP digital transistor	676-0013-032
Q 124	NPN high current SOT-223	676-0006-027
Q 131	NPN digital transistor	676-0013-046
Q 171	NPN digital transistor	676-0013-046
Q 172	PNP digital transistor	676-0013-032
Q 173	NPN digital transistor	676-0013-046
Q 201	PNP gen purp SC-70	676-0013-700
Q 202	NPN low noise SOT-23	676-0003-636
Q 231	Si N-Chnl JFET SOT	676-0006-019
Q 251	NPN low noise SOT-23	676-0003-658
Q 301	PNP gen purp SC-70	676-0013-700
Q 302	NPN low noise SOT-23	676-0003-636
Q 501	Bi-polar MSA2111 SOT-143	676-0003-640
Q 511	NPN low noise SOT-23	676-0003-636
Q 531	NPN high current SOT-223	676-0006-027
Q 801	NPN gen purp SC-70	676-0013-701
Q 841	NPN digital transistor	676-0013-046
Q 842	PNP digital transistor	676-0013-032
Q 871	NPN transmistor NE85619	676-0003-651
Q 872	NPN transmistor NE85619	676-0003-651
Q 881	PNP gen purp SC-70	676-0013-700
Q 882	NPN low noise SOT-23	676-0003-636
Q 901	NPN gen purp SC-70	676-0013-701
Q 902	VHF/UHF amp SOT-23	676-0003-634
Q 911	NPN low noise SOT-23	676-0003-658
R 102	1k ohm ±5% .063W 0603	669-0155-102
R 111	22k ohm ±5% .063W 0603	669-0155-223
R 112	43k ohm ±5% .063W 0603	669-0155-433
R 113	10k ohm ±5% .063W 0603	669-0155-103
R 114	10k ohm ±5% .063W 0603	669-0155-103
R 115	10k ohm ±5% .063W 0603	669-0155-103
R 116	150k ohm ±5% .063W 0603	669-0155-154

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
R 117	150k ohm ±5% .063W 0603	669-0155-154
R121	100k ohm ±5% .063W 0603	669-0155-104
R123	10k ohm ±5% .063W 0603	669-0155-103
R124	470 ohm ±5% 063W 0603	669-0155-471
R125	3.6k ohm ±5% 063W 0603	669-0155-362
R126	5.6k ohm ±5% 063W 0603	669-0155-562
R131	100k ohm ±5% .063W 0603	669-0155-104
R133	51k ohm ±5% .063W 0603	669-0155-513
R134	15k ohm ±5% .063W 0603	669-0155-153
R141	100k ohm ±5% .063W 0603	669-0155-104
R142	15k ohm ±5% .063W 0603	669-0155-153
R171	10k ohm ±5% .063W 0603	669-0155-103
R201	22k ohm ±5% .063W 0603	669-0155-223
R202	150k ohm ±5% .063W 0603	669-0155-154
R203	10k ohm ±5% .063W 0603	669-0155-103
R204	2.2k ohm ±5% .063W 0603	669-0155-222
R205	2.2k ohm ±5% .063W 0603	669-0155-222
R206	82 ohm J 805	669-0105-820
R208	1 ohm J 063W 0603	669-0155-109
R226	470 ohm ±5% 063W 0603	669-0155-471
R233	330 ohm ±5% .063W 0603	669-0155-471
R234	2.7k ohm ±5% .063W 0603	669-0155-272
R243	4.7k ohm ±5% .063W 0603	669-0155-472
R 254	100 ohm ±5% .063W 0603	669-0155-101
R 260	33k ohm ±5% .063W 0603	669-0155-333
R 261	100 ohm ±5% .063W 0603	669-0155-101
R 263	68k ohm ±5% .063W 0603	669-0155-683
R 265	8.2k ohm ±5% .063W 0603	669-0155-822
R 266	33k ohm ±5% .063W 0603	669-0155-333
R 271	3.3k ohm ±5% .063W 0603	669-0155-332
R 272	2.4k ohm ±5% .063W 0603	669-0155-242
R 274	330 ohm ±5% .063W 0603	669-0155-331
R 275	330 ohm ±5% .063W 0603	669-0155-331
R 281	100k ohm ±5% .063W 0603	669-0155-104
R 282	100k ohm ±5% .063W 0603	669-0155-104
R 283	100k ohm ±5% .063W 0603	669-0155-104
R 284	100k ohm ±5% .063W 0603	669-0155-104
R 285	100k ohm ±5% .063W 0603	669-0155-104
R 286	10k ohm ±5% .063W 0603	669-0155-103
R 301	100 ohm ±5% .063W 0603	669-0155-101
R 302	22k ohm ±5% .063W 0603	669-0155-223
R 303	150k ohm ±5% .063W 0603	669-0155-154
R 304	22k ohm ±5% .063W 0603	669-0155-223
R 305	270 ohm ±5% .063W 0603	669-0155-271

PARTS LIST

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
R 306	18 ohm ±5% .063W 0603	669-0155-180
R 307	270 ohm ±5% .063W 0603	669-0155-271
R 308	330 ohm ±5% .063W 0603	669-0155-102
R 501	150 ohm ±5% .063W 0603	669-0155-151
R 502	39 ohm ±5% .063W 0603	669-0155-390
R 503	150 ohm ±5% .063W 0603	669-0155-151
R 504	470 ohm ±5% .063W 0603	669-0155-471
R 505	470 ohm ±5% .063W 0603	669-0155-471
R 511	4.7k ohm ±5% .063W 0603	669-0155-472
R 512	1.8k ohm ±5% .063W 0603	669-0155-182
R 513	10 ohm ±5% .063W 0603	669-0155-100
R 514	560 ohm ±5% .063W 0603	669-0155-561
R 515	100 ohm ±5% .063W 0603	669-0155-101
R 531	120 ohm ±5% 1206 SMD	669-0115-121
R 532	120 ohm ±5% 1206 SMD	669-0115-121
R 533	470 ohm ±5% .063W 0603	669-0155-471
R 534	100k ohm ±5% .063W 0603	669-0155-104
R 535	100k ohm SMD trimmer	662-0130-104
R 536	10k ohm ±5% .063W 0603	669-0155-103
R 561	100 ohm ±5% .063W 0603	669-0155-101
R 562	100 ohm ±5% .063W 0603	669-0155-101
R 565	47k ohm ±5% .063W 0603	669-0155-473
R 573	10k ohm ±5% .063W 0603	669-0155-103
R 307	100 ohm ±5% .063W 0603	669-0155-101
R 308	330 ohm ±5% .063W 0603	669-0155-331
R 501	150 ohm ±5% .063W 0603	669-0155-151
R 502	39 ohm ±5% .063W 0603	669-0155-390
R 503	150 ohm ±5% .063W 0603	669-0155-151
R 504	470 ohm ±5% .063W 0603	669-0155-471
R 505	470 ohm ±5% .063W 0603	669-0155-471
R 511	4.7k ohm ±5% .063W 0603	669-0155-472
R 512	1.8k ohm ±5% .063W 0603	669-0155-182
R 513	10 ohm ±5% .063W 0603	669-0155-100
R 514	560 ohm ±5% .063W 0603	669-0155-561
R 515	100 ohm ±5% .063W 0603	669-0155-101
R 531	120 ohm ±5% 1206 SMD	669-0115-121
R 532	120 ohm ±5% 1206 SMD	669-0115-121
R 533	470 ohm ±5% .063W 0603	669-0155-471
R 534	100k ohm ±5% .063W 0603	669-0155-104
R 574	10k ohm ±5% .063W 0603	669-0155-103
R 581	10 ohm ±5% .063W 0603	669-0155-100

SYMBOL NUMBER	DESCRIPTION	NUMBER
R 582	10k ohm ±5% .063W 0603	669-0155-103
R 583	10k ohm ±5% .063W 0603	669-0155-103
R 584	10 ohm ±5% .063W 0603	669-0155-100
R 586	10k ohm ±5% .063W 0603	669-0155-103
R 591	51 ohm ±5% J 0805	669-0105-510
R 592	1k ohm ±5% .063W 0603	669-0155-102
R 593	51 ohm ±5% J 0805	669-0105-510
R 594	1k ohm ±5% .063W 0603	669-0155-102
R 802	20 ohm ±5% .063W 0603	669-0155-200
R 803	4.7k ohm ±5% .063W 0603	669-0155-472
R 804	10k ohm ±5% .063W 0603	669-0155-103
R 805	10k ohm SMD trimmer	662-0130-103
R 806	33k ohm ±5% .063W 0603	669-0155-333
R 807	27k ohm ±5% .063W 0603	669-0155-273
R 808	22k ohm ±5% .063W 0603	669-0155-223
R 811	4.7k ohm ±5% .063W 0603	669-0155-472
R 812	6.8k ohm ±5% .063W 0603	669-0155-682
R 813	4.7k ohm ±5% .063W 0603	669-0155-472
R 814	6.8k ohm ±5% .063W 0603	669-0155-682
R 815	4.7k ohm ±5% .063W 0603	669-0155-472
R 816	6.8k ohm ±5% .063W 0603	669-0155-682
R 817	4.7k ohm ±5% .063W 0603	669-0155-472
R 821	100k ohm ±5% .063W 0603	669-0155-104
R 822	11k ohm ±5% .063W 0603	669-0155-113
R 823	20k ohm SMD trimmer	662-0130-203
R 825	100k ohm SMD trimmer	662-0130-104
R 826	10k ohm ±5% .063W 0603	669-0155-103
R 827	220k ohm SMD trimmer	662-0130-224
R 828	120k ohm ±5% .063W 0603	669-0155-124
R 829	100k ohm ±5% .063W 0603	669-0155-104
R 831	10 ohm ±5% .063W 0603	669-0155-100
R 832	22k ohm ±5% .063W 0603	669-0155-223
R 838	10k ohm ±5% .063W 0603	669-0155-103
R 841	10k ohm ±5% .063W 0603	669-0155-103
R 842	100 ohm ±5% .063W 0603	669-0155-101
R 843	1.5k ohm ±5% .063W 0603	669-0155-152
R 844	270k ohm ±5% .063W 0603	669-0155-274
R 845	33k ohm ±5% .063W 0603	669-0155-333
R 846	33k ohm ±5% .063W 0603	669-0155-333
R 847	10k ohm ±5% .063W 0603	669-0155-103
R 851	10k ohm ±5% .063W 0603	669-0155-103

PARTS LIST

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
R 852	1.5k ohm ±5% .063W 0603	669-0155-152
R 861	47k ohm ±5% .063W 0603	669-0155-473
R 862	47k ohm ±5% .063W 0603	669-0155-473
R 863	1k ohm ±5% .063W 0603	669-0155-102
R 871	10 ohm ±5% .063W 0603	669-0155-100
R 872	1k ohm ±5% .063W 0603	669-0155-102
R 873	6.8k ohm ±5% .063W 0603	669-0155-682
R 874	10k ohm ±5% .063W 0603	669-0155-103
R 875	10k ohm ±5% .063W 0603	669-0155-103
R 876	390 ohm ±5% .063W 0603	669-0155-391
R 881	100 ohm ±5% .063W 0603	669-0155-101
R 882	22k ohm ±5% .063W 0603	669-0155-223
R 883	150k ohm ±5% .063W 0603	669-0155-154
R 884	22k ohm ±5% .063W 0603	669-0155-223
R 885	18 ohm ±5% .063W 0603	669-0155-180
R 886	18 ohm ±5% .063W 0603	669-0155-180
R 887	68 ohm ±5% .063W 0603	669-0155-680
R 891	1k ohm ±5% .063W 0603	669-0155-102
R 892	18 ohm ±5% .063W 0603	669-0155-180
R 893	18 ohm ±5% .063W 0603	669-0155-180
R 894	18 ohm ±5% .063W 0603	669-0155-180
R 895	330 ohm ±5% .063W 0603	669-0155-331
R 896	56 ohm ±5% .063W 0603	669-0155-560
R 901	1k ohm ±5% .063W 0603	669-0155-102
R 911	10k ohm ±5% .063W 0603	669-0155-103
R 912	10k ohm ±5% .063W 0603	669-0155-103
R 913	22k ohm ±5% .063W 0603	669-0155-223
R 914	1.5k ohm ±5% .063W 0603	669-0155-152
R 915	330 ohm ±5% .063W 0603	669-0155-331
R 916	1.5k ohm ±5% .063W 0603	669-0155-152
R 917	15k ohm ±5% .063W 0603	669-0155-153
R 919	1.0 ohm ±5% .063W 0603	669-0155-105
R 920	100k ohm SMD trimmer	662-0130-104
R 921	10k ohm ±5% .063W 0603	669-0155-103
R 922	47k ohm ±5% .063W 0603	669-0155-473
R 923	47k ohm ±5% .063W 0603	669-0155-473
U 111	Quad op amp MC33174D	644-2020-017
U 131	Voltage regulator adjustable	644-2603-093
U 141	5V reg micro-power SO-8	644-2003-067
U 231	Double balanced mixer	644-0007-014
U 241	FM IF SA676DK	644-2002-037
U 531	5W RF power module	644-4001-062
U 581	Op amp SO-8 MC33172D	644-2019-017
U 801	Single op amp SOT-23-5	644-2016-001

PARTS LIST

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
U 811	Fractional-N synthesizer	644-3954-027
U 831	Op amp SO-8 MC33172D	644-2019-017
U 911	Quad 8-bit TLC5620ID	644-2031-014
U 912	8-stage shift register SOIC	644-3016-094
U 913	Triple 2-chnl mux/demux	644-3016-053
Y 801	14.85 MHz TCXO ±2.5 PPM 17.5 MHz TCXO ±2.5 PPM	618-7009-525 618-7009-521
Z 231	21.45 MHz 4-pole 15 kHz BW	632-0009-019
Z 241	450 kHz 20 kHz BW ceramic	632-2004-013
Z 242	450 kHz 20 kHz BW ceramic	632-2004-013

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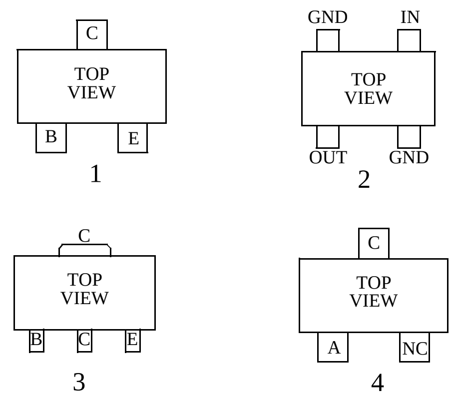
SECTION 8

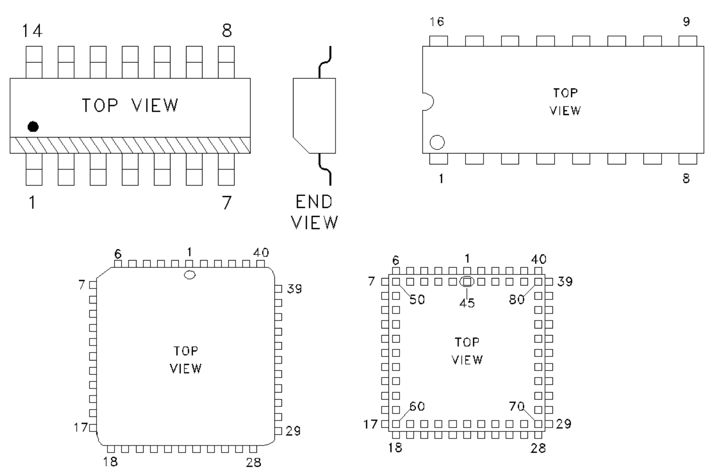
SCHEMATICS AND COMPONENT LAYOUTS

TRANSISTOR AND DIODE BASING REFERENCE TABLE

Part Number	Basing Diagram	Identification
TRANSISTORS		
676-0003-634	1	
676-0003-636	1	
676-0003-640	2	
676-0003-651	1	
676-0003-658	1	
676-0006-027	3	
676-0013-032	1	
676-0013-046	1	
676-0013-700	1	
676-0013-701	1	
DIODES		
623-1504-001	4	
623-1504-002		5A
623-1504-016	4	
623-1504-023		A7
623-5005-022		S
623-5005-023		5LU



INTEGRATED CIRCUITS



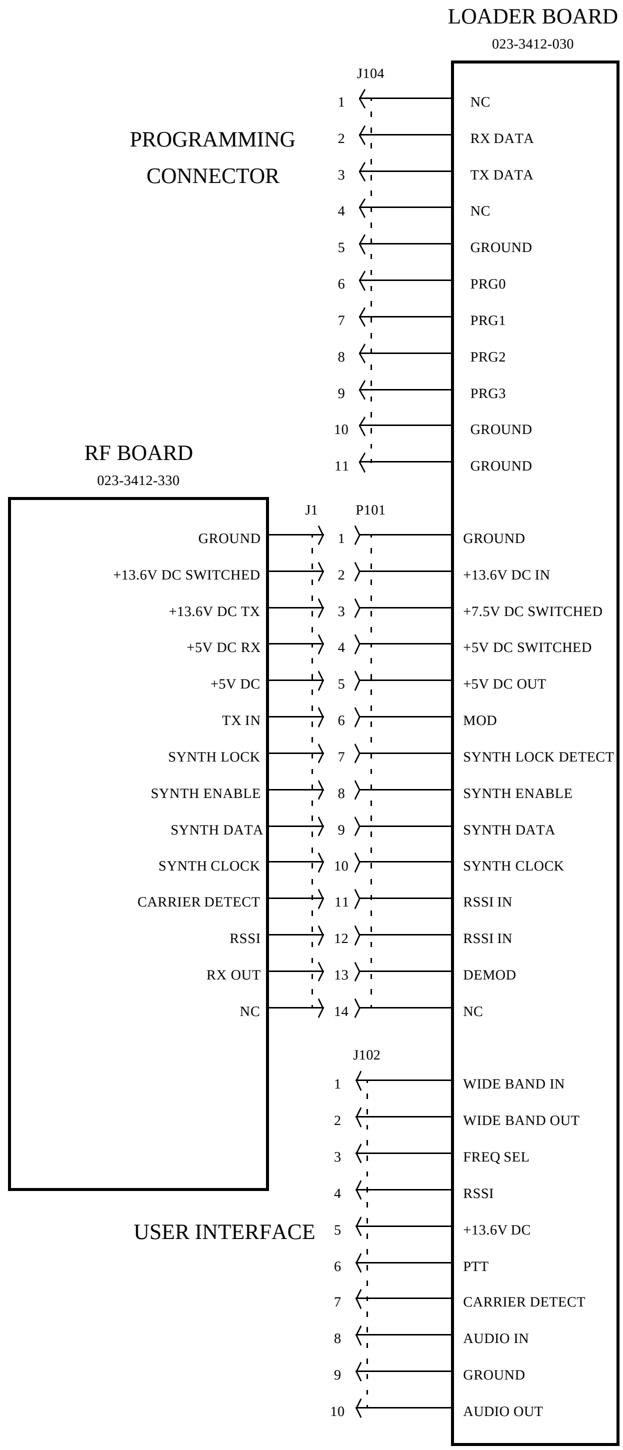


Figure 8-1 3422 INTERCONNECT

Figure 8-2 TRANSCEIVER COMPONENT LAYOUT (COMPONENT SIDE VIEW)

Figure 8-3 TRANSCEIVER COMPONENT LAYOUT (OPPOSITE COMPONENT SIDE VIEW)

Figure 8-4 SCHEMATIC