3492 Synthesized 900 MHz Transceiver Service Manual

First Printing
June 1997

Part No. 001-3492-001 6-97mwp Printed in U.S.A.

3492 SYNTHESIZED 900 MHZ TRANSCEIVER
SERVICE MANUAL

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. In addition, the Johnson Data Telemetry Corporation provides wireless communication solutions to the mobile data market serving public safety, utilities and industrial users.

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 the 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 JDT DM3492 900 MHz Synthesized Telemetry Unit.

This manual concentrates on the RF section of the data link which may be paired with an internal Loader board or 9600 baud Modem board.

Service manuals addressing items specific to the Loader board (001-3240-001) and the Modem board (001-3276-001) should be referenced for the users specific configuration.

1.2 EQUIPMENT DESCRIPTION

1.2.1 GENERAL

The JDT DM3492 is a synthesized data transceiver (transmitter and receiver) which operates in the 928-960 MHz UHF frequency range. Transmitter power output is 1-5 watts, 5W at 13.3V nominal, and operation is simplex or half duplex.

In addition to this 900 MHz 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 DL3492 WITH LOADER BOARD

The DL3492 (Part No. 242-3492-5x0) includes the 8-channel Loader Board (Part No. 023-3240-001), which performs synthesizer loading through an RS-232 DB-9 interface. The Loader 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 include:
  Input Voltage Sense
  Input Current Sense
  Ambient Temperature Sense
  RSSI Indicator (RSSI Sense)
  Forward/Reverse Power Sense.

The gating circuits allow the type of data filtering to be selected (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 3.3 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 DL3492 WITH MODEM

The DL3492 (Part No. 242-3492-5x0) includes the 9600 baud Modem (Part No. 023-3276-001), which supports the RNET™ communication protocol, allowing data communication between the Johnson Data Telemetry high specification synthesized products and the Motorola RNET radio/modems.

The Modem features include:

- User Programmable Data Rates; 9600, 4800, 2400 and 1200 baud in a 25 kHz bandwidth.
- RS-232 compatible.
- Simplex or Half-Duplex operation.
- RTS-CTS handshaking protocol with option for configuring any two units as a digital repeater.
- Supports asynchronous, serial or transparent data formats.
- Front panel LEDs provide indication for Transmit, Receive and Power.
- Built-In Diagnostics reported both locally and "Over-The-Air":
  Reports specific unit programming
  Loopback test feature
  RSSI
  Forward and Reflected Power
  Temperature
  Supply Voltage
- 8-Channels programmable with option to switch channels remotely "Over-The-Air".

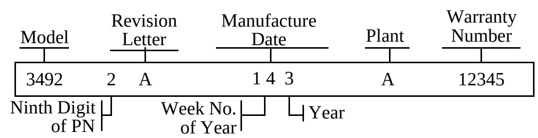
This board is programmed using an IBM PC or compatible computer and the RSS programming software. The 3276 Modem Programming Kit (Part No. 023-3276-005) includes programming instructions contained in the RSS Manual.

1.2.4 DM3492 SYNTHESIZER PROGRAMMING

The DM3492, 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

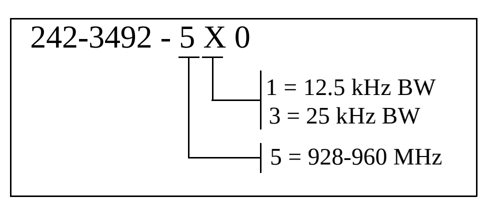
Accessories available for the 3492 data transceiver are listed in Table 1-1.

Table 1-1 ACCESSORIES

Accessory	Part No.
3276 Service Manual	001-3276-001
3240 Service Manual	001-3240-001
Interface cable	023-3472-007

1.5 PART NUMBER BREAKDOWN

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



1.6 FACTORY CUSTOMER SERVICE

The Customer Service Department of the Johnson Data Telemetry Corporation 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. There is also a 24-hour emergency technical support telephone number. 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 the Johnson Data Telemetry Corporation, you will hear a brief message informing you of numbers that can be entered to reach various departments. 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. When you enter a first number of "3", another number is requested to further categorize the type of information you need. You may also enter the 4-digit extension number of the person that you want to reach if you know what it is.

FAX Machine - Sales	(507) 835-6485
FAX Machine - Cust Serv	(507) 835-6969

If you are calling from outside the continental United States, the Customer Service telephone numbers are as follows:

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

You may also contact the Customer Service Department by mail. Please include all information that may be helpful in solving your problem. The mailing address is as follows:

Johnson Data Telemetry Corporation
Customer Service Department
299 Johnson Avenue
P.O. Box 1733
Waseca, MN 56093-0833

1.7 PRODUCT WARRANTY

The warranty statement for this transceiver is available from your product supplier or from the Warranty Department, Johnson Data Telemetry Corporation, 299 Johnson Avenue, PO Box 1733, Waseca, MN 56093-0833. This information may also be requested by phone from the Warranty Department. The Warranty Department may also be contacted for Warranty Service Reports, claim forms, or any questions concerning warranties or warranty service by dialing (507) 835-6970.

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. Johnson Data Telemetry dealers also need to give their account number.

If there is uncertainty about the part number, include the designator (C112, for example) and the model number of the equipment the part is from (refer to Section 1.3).

You may also send your order by mail or FAX. The mailing address is as follows and the FAX number is shown in Section 1.6.

Johnson Data Telemetry Corporation
Service Parts Department
299 Johnson Avenue
PO Box 1733
Waseca, MN 56093-0833

1.9 FACTORY RETURNS

Repair service is normally available through local authorized Johnson Data Telemetry Land Mobile Radio Service Centers. If local service is not available, the equipment can be returned to the factory for repair. However, it is recommended that you contact the Field Service Department before returning equipment. A service representative may be able to suggest a solution to the problem so that return of the equipment would not be necessary. If using the toll-free number in the preceding section, enter "3".

Be sure to fill out a Factory Repair Request Form #271 for each unit to be repaired, whether it is in or out of warranty. These forms are available free of charge by calling the repair lab (see Section 1.6) or by requesting them when you send a unit in for repair. Clearly describe the difficulty experienced in the space provided and also 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 very important because there are times when the technicians have specific questions that need to be answered in order to completely identify and repair a problem.

When returning equipment for repair, it is also a good idea to use a PO number or some other reference number on your paperwork in case you need to call the repair lab about your unit. These numbers are referenced on the repair order to make it easier and faster to locate your unit in the lab.

Return Authorization (RA) numbers are not necessary unless you have been given one by the Field 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 on the Factory Repair Request Form sent with the unit. The repair lab will then contact the Field Service Department when the unit arrives.

3492 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	928-960 MHz
Frequency Control	Synthesized
Channel Spacing	12.5/25 kHz with 6.25 kHz Channel steps
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 Current	70 mA maximum
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, 2.2" H
FCC Compliance	Parts 90, 94, 15
DM3492	Customer must apply

RECEIVER

Bandwidth	32 MHz
Frequency Stability	±1.5 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	65 dB 25 kHz, 60 dB 12.5 kHz
Spurious and Image Rejection	70 dB
Conducted Spurious Emissions	< -57 dBm
Intermodulation	70 dB
FM Hum and Noise	-40 dB, 25 kHz channels, -35 dB, 12.5 kHz channels
Receive Attack Time	< 5 ms
Total Receive On Time	7 ms maximum
Audio	
Distortion	< 3% psophometrically weighted
Response	±1/-3 dB 0 to 2.5 kHz for 12.5 kHz Channel, 0 to 5 kHz for 25 kHz Channel
Output Bias	2.5V DC ±0.5V DC
Buffered Impedance	>10k ohms
Buffered Audio Level	150 mV ±50 mV
RSSI	0.7V to 2.0V DC output from -120 to -60 dBm

TRANSMITTER

Frequency Stability	±1.5 PPM from -30°C to +60°C (-22°F to +140°F)
Bandwidth	32 MHz
Maximum System Deviation	5 kHz (25 kHz Channel), 2.5 kHz (12.5 kHz Channel)
Frequency Spread	32 MHz
Modulation	FM/DC coupled
Wideband Data Input Bias	2.5V DC ±1%
Narrow Band Input	AC coupled
Input Impedance	>50k ohms
Audio Distortion	< 3% at 3 kHz deviation, 1 kHz tone (with user interface board narrow band data port
Audio Response	±2 dB, DC to 5 kHz dev with a 1 kHz tone Programmable to ± dB using DAC
Flatness	±1 dB across 32 MHz bandwidth
RF Power Output	1-5W ±20% adjustable (5W at 13.3V DC 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	-40 dB 25 kHz, -35 dB 12.5 kHz

SECTION 2 INSTALLATION

2.1 PRE-INSTALLATION CHECKS

Field alignment should not be required before the 3492 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.

2.2 INTERFACING WITH DATA EQUIPMENT

2.2.1 DM3492 (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.

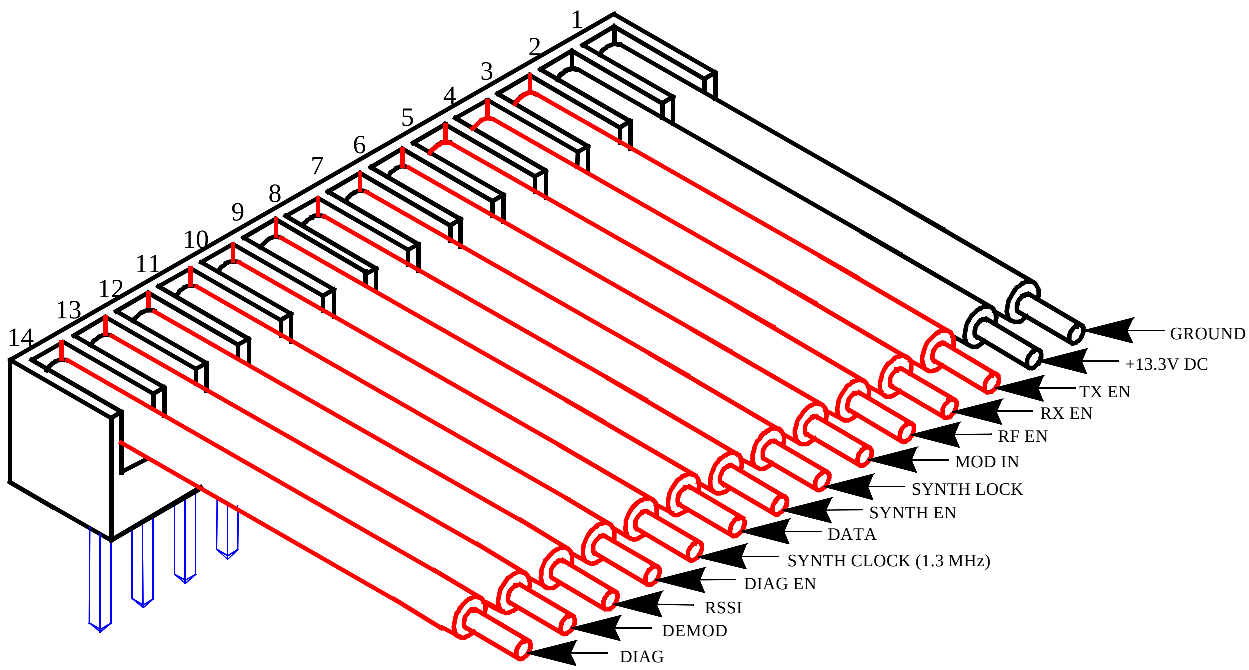
Pin 10 (Synth Clock) - TTL input. Clock signal for serial data input on Pin 9. Data is valid on the rising edge. 1 MHz max. frequency.

Pin 11 (Diag En) - TTL input. Loads programmed DAC values into DAC (U900) 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



PART NO. 023-3472-007

Figure 2-1   DM3492 INTERFACE CABLE

SECTION 3   PROGRAMMING

3.1 INTRODUCTION

DM3492 - The 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 required.

3.2 DM3492 SYNTHESIZER DATA PROTOCOL

3.2.1 GENERAL

The 928-960 MHz band is divided into two segments for the purpose of reducing VCO gain. The "LOW" band covers the 928-944 MHz segment and the "HIGH" band covers the 944-960 MHz segment. The VCO band selection is accomplished by capacitive pin-switching. The band switching is implemented in both the transmit and receive modes. The front-end filters and transmitter line-up cover the entire 928-960 MHz band without adjustment.

Receive Bandwidth	928-960 MHz
Transmit Bandwidth	928-960 MHz
First IF	87.850 MHz
Second IF	450.0 kHz
First LO Injection	840.150-872.150 MHz*
Second LO Injection	87.40 MHz*
TCXO Frequency	17.50 MHz
Resolution	6.25 kHz
Loop Comparison Freq.	50 kHz

* Low Side Injection

A diagram of the 32 Bit Synthesizer Serial Data Stream with definitions of the bits is shown in Figure 3-1.

Clock	1 MHz (max)
Synth Enable	250 ns (min) (for D, C and B words approximately 3 ms for A0 word)
D00-D23	D, C, B and A0 words

3.2.2 SYNTHESIZER DATA

In order to implement the band selection and Tx/Rx frequency shift mentioned in Section 3.2.1, an additional shift register was added to the synthesizer section. Therefore, an additional 8 Bits of data are added to ***each*** of the synthesizer load words (D/C/B/A0) as shown in the serial data stream in Figure 3-1.

3.2.3 D-WORD CALCULATION (24 BITS)

The D-Word programs the Main, Reference and Auxiliary dividers, and sets the modulus (refer to Figures 3-2 and 3-6).

NR = 350	Ftcxo/50 kHz=350 where Ftcxo=17.5 MHz
SM = 00	Reference select for main phase detector
EM = 1	Main divider enable flag
SA = 00	Reference select for aux phase detector
EA = 1	Auxiliary divider enable flag
FMOD = 1	Selects modulus 8
LONG = 0	Send all 4 words with A0

D Word = 0xA1 0x5E 0x26

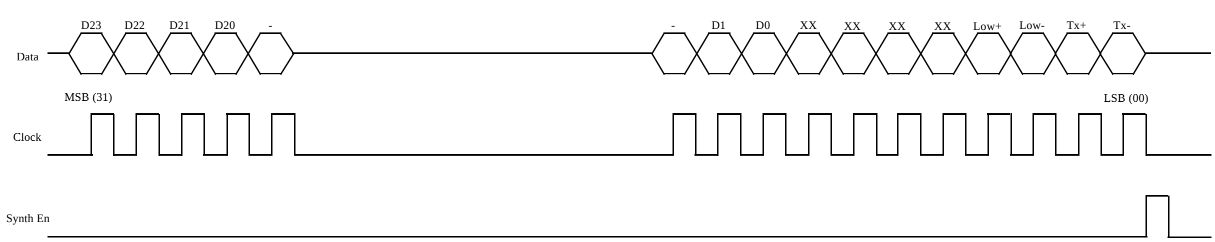


Figure 3-1   32-BIT SYNTHESIZER SERIAL DATA STREAM

3.2.4 C-WORD CALCULATION (24 BITS)

The C-Word enables the auxiliary prescaler, and sets the auxiliary divide ratio for the secondary (Second LO) loop (refer to Figures 3-4 and 3-7).

PA = 0	Sets aux prescaler mode to ÷ 4
NA = 437 (0x1B5)	Auxiliary divide ratio 87.4 MHz ÷ (4 x 437) = 50 kHz

C-Word = 0x91 0xB5 0x00

3.2.5 B-WORD CALCULATION (24 BITS)

The B-Word programs the Fractional-N charge pump current setting factor. The Binary acceleration factors (CL/CK) and prescaler type (modulus 3).

The value of CN should be interpolated for frequencies between the band edges. With these recommended values of CN, the transceiver should have the fractional spurs minimized far below the levels needed to make 70 dB adjacent channel Rx or Tx specifications.

The Charge Pump Current setting (CN) could be changed on a channel-by-channel basis for ultimate rejection of the Fraction N spurious responses close into the carrier frequency. the 3492 synthesizer has an adjust (R823) for the fractional compensation current. The factory preset value will allow CN to be set to the following ranges:

(Refer to Figures 3-3 and 3-7)

Frequency in a Band	CN
Lowest Tx	110
Highest Tx	115
Lowest Rx	100
Highest Rx	105

CN = *	(Channel/Frequency dependent variable) (110-115 Tx) (100-105 Rx)
CK = 0000	Binary acceleration factor for integral charge pump
CL = 00	Binary acceleration factor for proportional charge pump
PR = 10	Selects modulus 3 prescaler

B-Word = 0x80 (8 bit CN) 0x02

3.2.6 A0-WORD CALCULATION (24 BITS)

The A0-Word is sent last (see Figure 3-5). The A0-Word contains the data for the loop dividers and is programmed on a channel-by-channel basis. The Functional-N (NF) word is a 3 bit word that programs the synthesizer to the fractional steps determined by the fractional modulus selection flag (1 = modulus 8) and the loop comparison frequency (50 kHz). The frequency resolution (i.e. step size) is then 50 kHz ÷ 8 = 6.25 kHz.

NF=*	Fractional increment for modulus 8 (3 bits)
NM1=*	Number of main divider cycles when prescaler modulus equals 64 (12 bits)
NM2=*	Number of main divider cycles when prescaler modulus equals 65 (4 bits, PR=10)
NM3=*	Number of main divider cycles when prescaler modulus equals 72 (4 bits, PR=10)

* Indicates frequency/channel dependant variable.

EXAMPLE: To program an 18.75 kHz channel:

NF = 18.75 kHz ÷ 6.25 kHz
NF = 3

NM1, NM2 and NM3 are calculated as follows:

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

Where:

N =	Total division ratio
NM1 =	Number of main divider cycles when prescaler modulus equals 64
NM2 =	Number of main divider cycles when prescaler modulus equals 65
NM3 =	Number of main divider cycles when prescaler modulus equals 72

Example:

Calculate NM1, NM2 and NM3 to Rx 944.150 MHz

Rx LO = 944.15 - 87.85 = 856.3 MHz (Synth Freq)
(87.85 MHz IF with Low Side Injection)

N = Rx LO ÷ FCM = 856.3 ÷ 0.05 = 17126
(FCM = Loop Reference Frequency)

$$
\begin{aligned}
NM3 &= (INT(64 \times FRAC\ [N \div 64]) \div 8) - 1 \\
&= (INT(64 \times 0.59375) \div 8) - 1 \\
&= (INT(38 \div 8)) - 1 \\
&= 4 - 1 \\
&= 3
\end{aligned}
$$

$$
\begin{aligned}
NM2 &= 8 \times FRAC\ [N \div 8] \\
&= 8 \times 0.75 \\
&= 6
\end{aligned}
$$

$$
\begin{aligned}
NM1 &= INTEGER\ [N \div 64] - NM2 - NM3 - 3 \\
&= 267 - 6 - 3 - 3 \\
&= 255
\end{aligned}
$$

3.2.7 TX / RX FREQUENCY SHIFT AND BAND SELECTION

As mentioned in 3.2.2, in order to implement the band selection and Rx/Rx an additional 8 bits of data are added to each of the synthesizer load words (D/C/B/AO) (see Figure 3-1). The frequency bands and Transmit/Receive Bits are defined as follows:

Low Band	928-944 MHz
High Band	>944 MHz to 960 MHz

xx	Don’t care
Low+	Low Band Select (1=lowband, 0=highband)
Low-	Low Band Select (0=lowband, 1=highband)
Tx+	Transmit Select (1=Tx mode, 0=Rx mode)
Tx-	Transmit Select (0=Tx mode, 1=Rx mode)

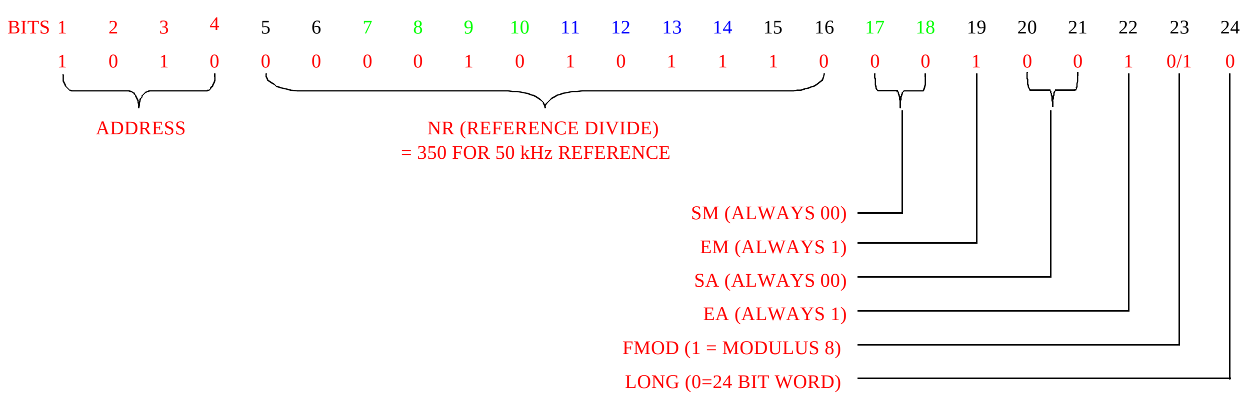


Figure 3-2 D-WORD

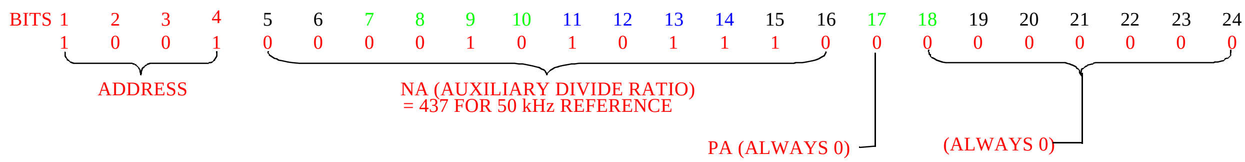


Figure 3-3 C-WORD

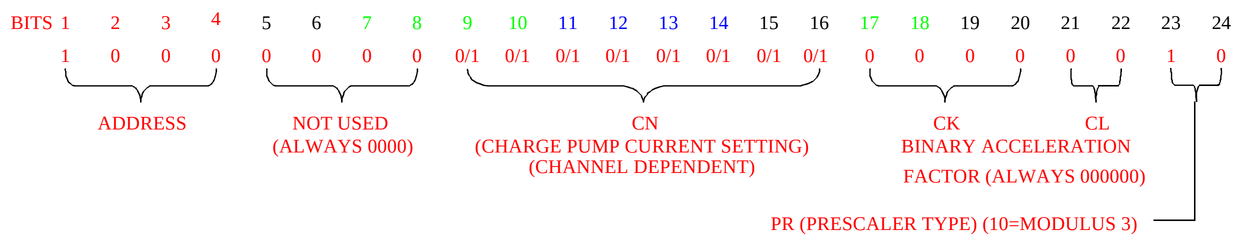


Figure 3-4 B-WORD

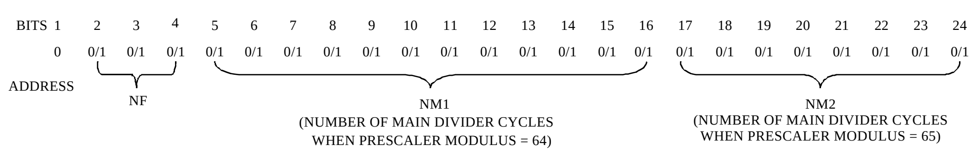
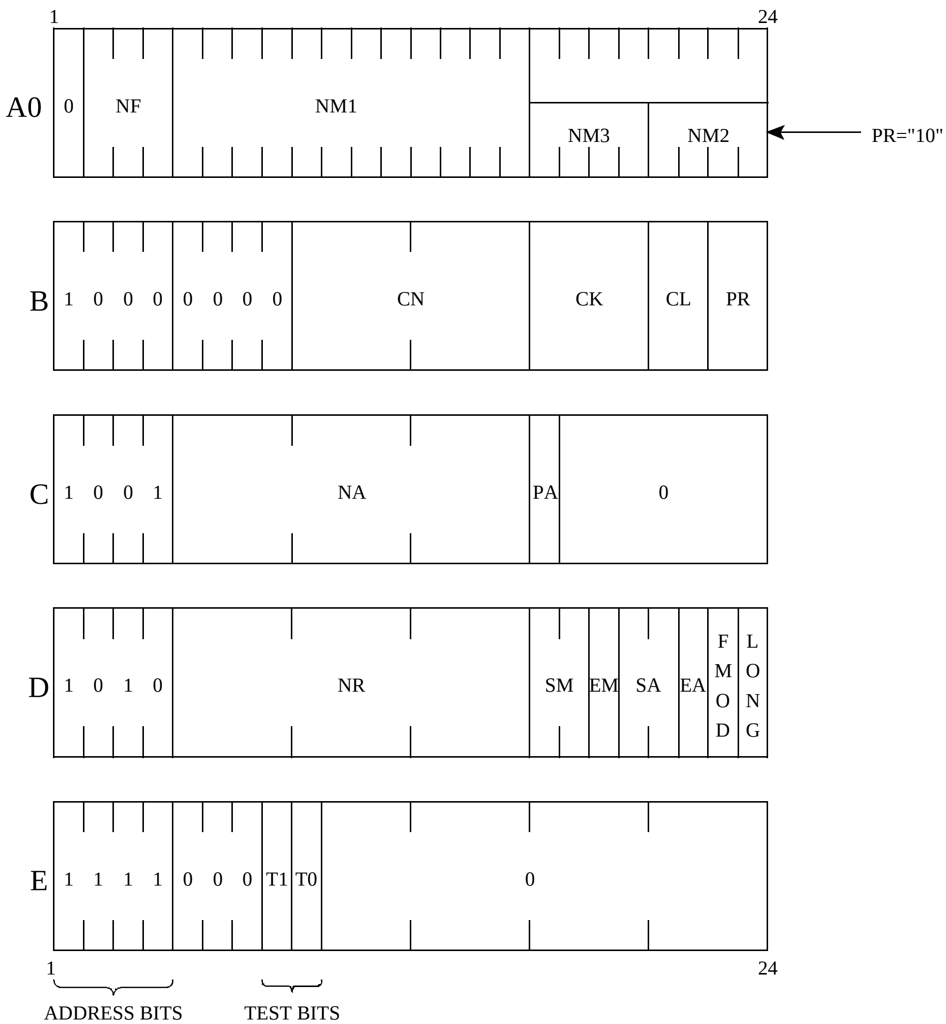


Figure 3-5 A0-WORD



NOTE: E-Word not used in Synthesizer load.

Figure 3-6 SERIAL INPUT WORD FORMAT

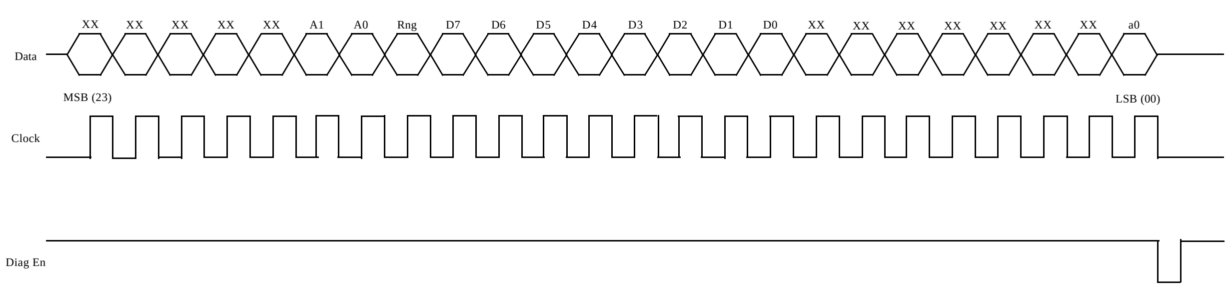


Figure 3-7 DIAGNOSTIC SERIAL DATA STREAM

3.2.8 RADIO DIAGNOSTICS

The diagnostic features allow the user to program a Digital-To-Analog Converter (DAC) to adjust RF output power and modulation flatness without removing the radio from the enclosure. Bit "a0" can be set to provide an analog voltage representative of the forward and reverse RF power at the radio interface connector J201, pin 14. This feature can be used to monitor the condition of the transceiver and antenna/ feedline. Figure 3-7 is a diagram of the Diagnostic Serial Data Stream with definitions of the bits. It is 19 bits long, the front (MSBs) can be padded with "Don't Cares" (XXs) to get to 24 bits.

Clock	1 MHz (max)
Diag Enable	250 ns (min)
XX	Don't Care

DAC Bits

A1-A0 = DAC Output Select

00=Power Set	Data=0x00 to 0xFF, RNG=1
01=Mod Adj	Data=0x00 to 0xFF, RNG=1
11=DAC Control Select	Data=0x00 to 0xFF, RNG=1

RNG = Range Select (max output) (Ref=5.5V÷2)
0 = 1 x Ref
1 = 2 x Ref

D7-D0 = D/A Data
0x00 = 0.0V
0xFF = 1 x Ref (RNG=0)
0xFF = 2 x Ref (RNG=1)

Shift Register Bits:

a0 = Diagnostic Select to J201, pin 14 (Analog Voltage)
0 = Forward Power
1 = Reverse Power

3.3 RECEIVE TO TRANSMIT SEQUENCE

1. Synthesizer is loaded (D, C, B and A0 words). Refer to Figure 3-8.

2. The state of the RX_EN line does not have to be changed until the last bit is sent. However, Recieve will cease as soon as it is changed.

3. The SYNTH ENABLE line should be held HIGH for 2 to 3 milliseconds after the last word is sent. This puts the frequency synthesizer in a SPEEDUP MODE and slightly improves lock times then the Synth Enable should be returned to a low state.

4. After the last word is strobed in, 7 milliseconds (worst case) should elapse before TX_EN is turned ON. This allows the synthesizer to come within 1 kHz of the desired frequency.

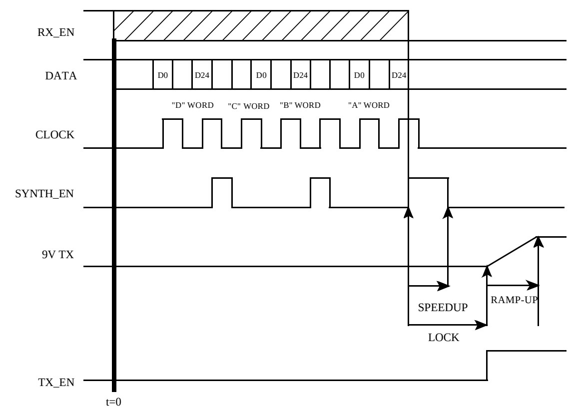


Figure 3-8 RX TO TX TIMING DIAGRAM

"Ramp-Up" is the amount of time required for the transmitter to reach full power once the TX EN has been applied. The Ramp-Up circuitry (located on the transceiver) minimizes adjacent channel interference caused by spectral spreading (sinx/x) when the transmitter is keyed. The Ramp-Up time is approximately 3 ms.

3.4 TRANSMIT TO RECEIVE SEQUENCE

1. TX_EN is turned OFF. This signal is shaped. Refer to Figure 3-9.

2. The synthesizer load process could begin slightly before, but when the last bit is strobed in the synthesizer it will become unlocked.

3. The RX_EN line should switch from low to high AFTER the TX_EN is switched. The RX_EN not only turns the RX circuits on but also Pin Shifts the VCO.

4. For quickest lock times the SYNTH ENABLE line on the last load word should be held high for 2 to 3 milliseconds. It MUST NOT be left high as the synthesizer in the SPEEDUP mode has poor noise performance and would degrade the Receive performance.

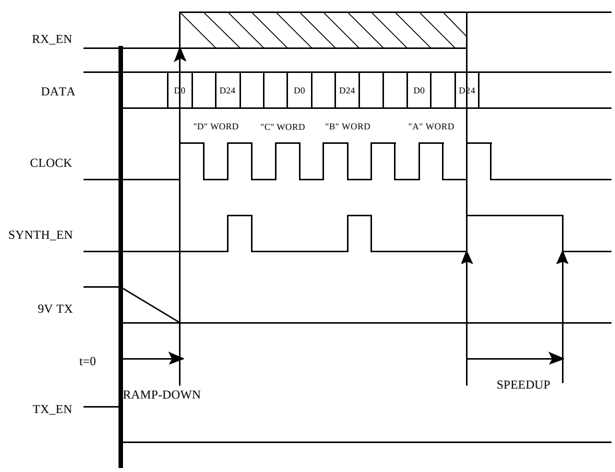


Figure 3-9 TX TO RX TIMING DIAGRAM

Speedup is 2 to 3 ms
Lock is approximately 7 ms
Ramp is approximately 3 ms
Dekey is approximately 3 ms

"Ramp-Down" is the amount of time required for the transmitter output power to be reduced before switching off the transmitter and enabling the receiver with the RX EN. The Ramp-Down circuitry (located on the transceiver) minimizes adjacent channel interference caused by spectral spreading (sinx/x) when the transmitter un un-keyed. The Ramp-Down time is approximately 3 ms.

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SECTION 3 PROGRAMMING

3.1 INTRODUCTION

DM3492 - The 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 required.

3.2 DM3492 SYNTHESIZER DATA PROTOCOL

3.2.1 GENERAL

The 928-960 MHz band is divided into two segments for the purpose of reducing VCO gain. The "LOW" band covers the 928-944 MHz segment and the "HIGH" band covers the 944-960 MHz segment. The VCO band selection is accomplished by capacitive pin-switching. The band switching is implemented in both the transmit and receive modes. The front-end filters and transmitter line-up cover the entire 928-960 MHz band without adjustment.

Receive Bandwidth	928-960 MHz
Transmit Bandwidth	928-960 MHz
First IF	87.850 MHz
Second IF	450.0 kHz
First LO Injection	840.150-872.150 MHz*
Second LO Injection	87.40 MHz*
TCXO Frequency	17.50 MHz
Resolution	6.25 kHz
Loop Comparison Freq.	50 kHz

* Low Side Injection

A diagram of the 32 Bit Synthesizer Serial Data Stream with definitions of the bits is shown in Figure 3-1.

Clock	1 MHz (max)
Synth Enable	250 ns (min) (for D, C and B words approximately 3 ms for A0 word)
D00-D23	D, C, B and A0 words

3.2.2 SYNTHESIZER DATA

In order to implement the band selection and Tx/Rx frequency shift mentioned in Section 3.2.1, an additional shift register was added to the synthesizer section. Therefore, an additional 8 Bits of data are added to ***each*** of the synthesizer load words (D/C/B/A0) as shown in the serial data stream in Figure 3-1.

3.2.3 D-WORD CALCULATION (24 BITS)

The D-Word programs the Main, Reference and Auxiliary dividers, and sets the modulus (refer to Figures 3-2 and 3-6).

NR = 350	Ftcxo/50 kHz=350 where Ftcxo=17.5 MHz
SM = 00	Reference select for main phase detector
EM = 1	Main divider enable flag
SA = 00	Reference select for aux phase detector
EA = 1	Auxiliary divider enable flag
FMOD = 1	Selects modulus 8
LONG = 0	Send all 4 words with A0

D Word = 0xA1 0x5E 0x26

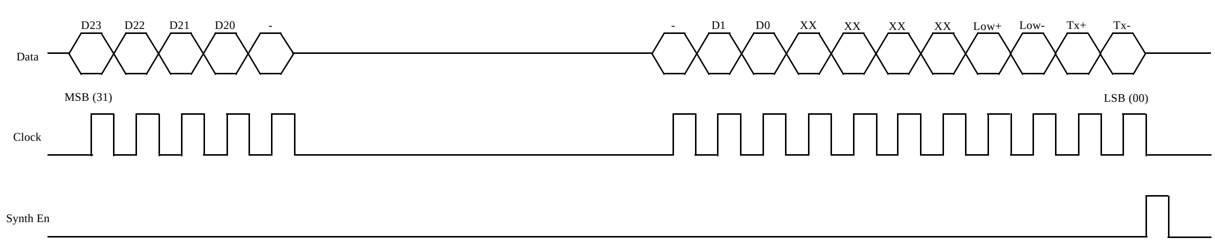


Figure 3-1 32-BIT SYNTHESIZER SERIAL DATA STREAM

3.2.4 C-WORD CALCULATION (24 BITS)

The C-Word enables the auxiliary prescaler, and sets the auxiliary divide ratio for the secondary (Second LO) loop (refer to Figures 3-4 and 3-7).

PA = 0	Sets aux prescaler mode to ÷ 4
NA = 437 (0x1B5)	Auxiliary divide ratio 87.4 MHz ÷ (4 x 437) = 50 kHz

C-Word = 0x91 0xB5 0x00

3.2.5 B-WORD CALCULATION (24 BITS)

The B-Word programs the Fractional-N charge pump current setting factor. The Binary acceleration factors (CL/CK) and prescaler type (modulus 3).

The value of CN should be interpolated for frequencies between the band edges. With these recommended values of CN, the transceiver should have the fractional spurs minimized far below the levels needed to make 70 dB adjacent channel Rx or Tx specifications.

The Charge Pump Current setting (CN) could be changed on a channel-by-channel basis for ultimate rejection of the Fraction N spurious responses close into the carrier frequency. the 3492 synthesizer has an adjust (R823) for the fractional compensation current. The factory preset value will allow CN to be set to the following ranges:

(Refer to Figures 3-3 and 3-7)

Frequency in a Band	CN
Lowest Tx	110
Highest Tx	115
Lowest Rx	100
Highest Rx	105

CN = *	(Channel/Frequency dependent variable) (110-115 Tx) (100-105 Rx)
CK = 0000	Binary acceleration factor for integral charge pump
CL = 00	Binary acceleration factor for proportional charge pump
PR = 10	Selects modulus 3 prescaler

B-Word = 0x80 (8 bit CN) 0x02

3.2.6 A0-WORD CALCULATION (24 BITS)

The A0-Word is sent last (see Figure 3-5). The A0-Word contains the data for the loop dividers and is programmed on a channel-by-channel basis. The Functional-N (NF) word is a 3 bit word that programs the synthesizer to the fractional steps determined by the fractional modulus selection flag (1 = modulus 8) and the loop comparison frequency (50 kHz). The frequency resolution (i.e. step size) is then 50 kHz ÷ 8 = 6.25 kHz.

NF=*	Fractional increment for modulus 8 (3 bits)
NM1=*	Number of main divider cycles when prescaler modulus equals 64 (12 bits)
NM2=*	Number of main divider cycles when prescaler modulus equals 65 (4 bits, PR=10)
NM3=*	Number of main divider cycles when prescaler modulus equals 72 (4 bits, PR=10)

* Indicates frequency/channel dependant variable.

EXAMPLE: To program an 18.75 kHz channel:

NF = 18.75 kHz ÷ 6.25 kHz
NF = 3

NM1, NM2 and NM3 are calculated as follows:

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

Where:

N =	Total division ratio
NM1 =	Number of main divider cycles when prescaler modulus equals 64
NM2 =	Number of main divider cycles when prescaler modulus equals 65
NM3 =	Number of main divider cycles when prescaler modulus equals 72

Example:

Calculate NM1, NM2 and NM3 to Rx 944.150 MHz

Rx LO = 944.15 - 87.85 = 856.3 MHz (Synth Freq)
(87.85 MHz IF with Low Side Injection)

N = Rx LO ÷ FCM = 856.3 ÷ 0.05 = 17126
(FCM = Loop Reference Frequency)

$$NM3 = (INT(64 \times FRAC[N \div 64]) \div 8) - 1$$
$$= (INT(64 \times 0.59375) \div 8) - 1$$
$$= (INT(38 \div 8)) - 1$$
$$= 4 - 1$$
$$= 3$$

$$NM2 = 8 \times FRAC[N \div 8]$$
$$= 8 \times 0.75$$
$$= 6$$

$$NM1 = INTEGER[N \div 64] - NM2 - NM3 - 3$$
$$= 267 - 6 - 3 - 3$$
$$= 255$$

3.2.7 TX / RX FREQUENCY SHIFT AND BAND SELECTION

As mentioned in 3.2.2, in order to implement the band selection and Rx/Rx an additional 8 bits of data are added to each of the synthesizer load words (D/C/B/AO) (see Figure 3-1). The frequency bands and Transmit/Receive Bits are defined as follows:

Low Band	928-944 MHz
High Band	>944 MHz to 960 MHz

xx	Don’t care
Low+	Low Band Select (1=lowband, 0=highband)
Low-	Low Band Select (0=lowband, 1=highband)
Tx+	Transmit Select (1=Tx mode, 0=Rx mode)
Tx-	Transmit Select (0=Tx mode, 1=Rx mode)

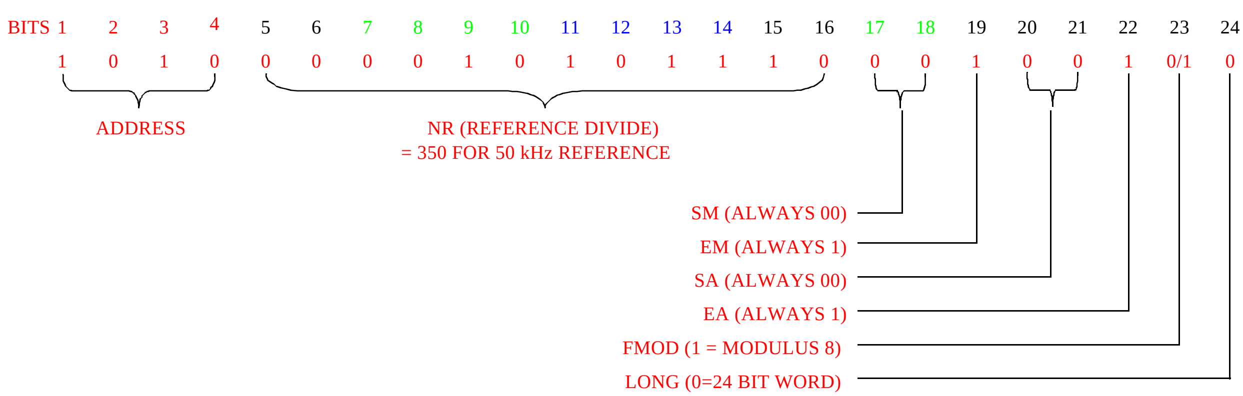


Figure 3-2 D-WORD

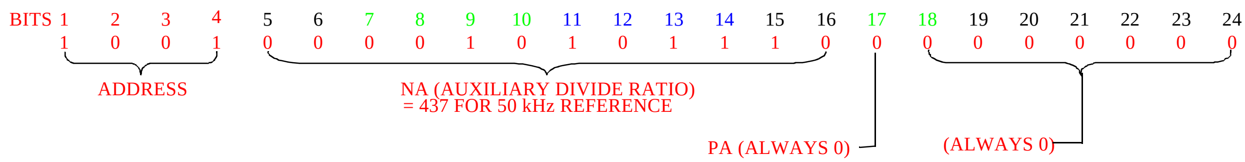


Figure 3-3 C-WORD

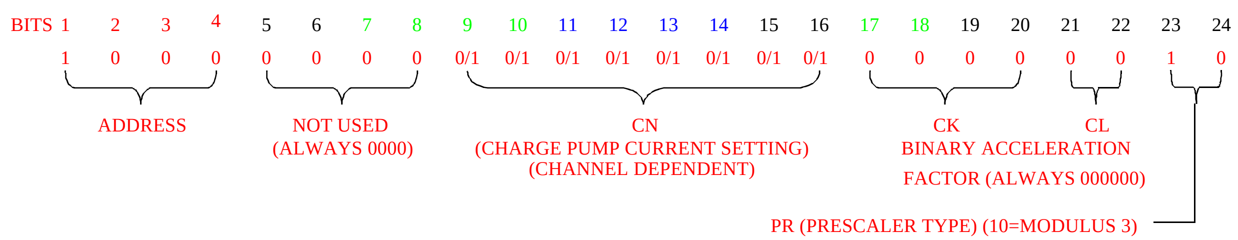


Figure 3-4 B-WORD

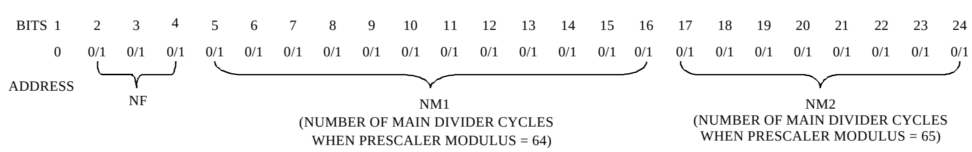
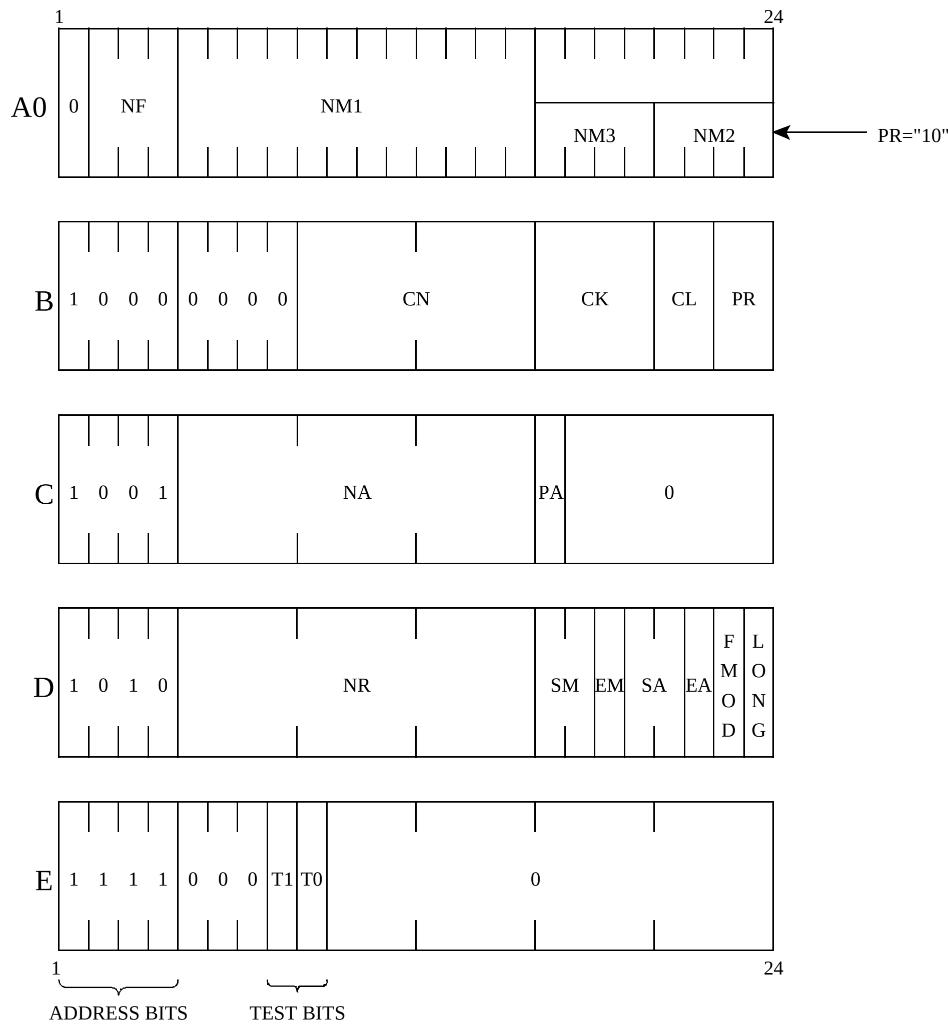


Figure 3-5 A0-WORD



NOTE: E-Word not used in Synthesizer load.

Figure 3-6 SERIAL INPUT WORD FORMAT

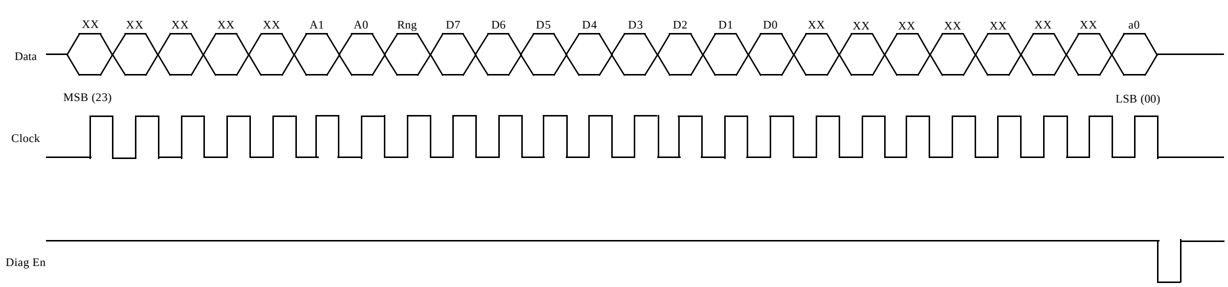


Figure 3-7 DIAGNOSTIC SERIAL DATA STREAM

3.2.8 RADIO DIAGNOSTICS

The diagnostic features allow the user to program a Digital-To-Analog Converter (DAC) to adjust RF output power and modulation flatness without removing the radio from the enclosure. Bit "a0" can be set to provide an analog voltage representative of the forward and reverse RF power at the radio interface connector J201, pin 14. This feature can be used to monitor the condition of the transceiver and antenna/feedline. Figure 3-7 is a diagram of the Diagnostic Serial Data Stream with definitions of the bits. It is 19 bits long, the front (MSBs) can be padded with "Don't Cares" (XXs) to get to 24 bits.

Clock	1 MHz (max)
Diag Enable	250 ns (min)
XX	Don't Care

DAC Bits

A1-A0 = DAC Output Select

00=Power Set	Data=0x00 to 0xFF, RNG=1
01=Mod Adj	Data=0x00 to 0xFF, RNG=1
11=DAC Control Select	Data=0x00 to 0xFF, RNG=1

RNG = Range Select (max output) (Ref=5.5V÷2)
0 = 1 x Ref
1 = 2 x Ref

D7-D0 = D/A Data
0x00 = 0.0V
0xFF = 1 x Ref (RNG=0)
0xFF = 2 x Ref (RNG=1)

Shift Register Bits:

a0 = Diagnostic Select to J201, pin 14 (Analog Voltage)
0 = Forward Power
1 = Reverse Power

3.3 RECEIVE TO TRANSMIT SEQUENCE

1. Synthesizer is loaded (D, C, B and A0 words). Refer to Figure 3-8.

2. The state of the RX_EN line does not have to be changed until the last bit is sent. However, Recieve will cease as soon as it is changed.

3. The SYNTH ENABLE line should be held HIGH for 2 to 3 milliseconds after the last word is sent. This puts the frequency synthesizer in a SPEEDUP MODE and slightly improves lock times then the Synth Enable should be returned to a low state.

4. After the last word is strobed in, 7 milliseconds (worst case) should elapse before TX_EN is turned ON. This allows the synthesizer to come within 1 kHz of the desired frequency.

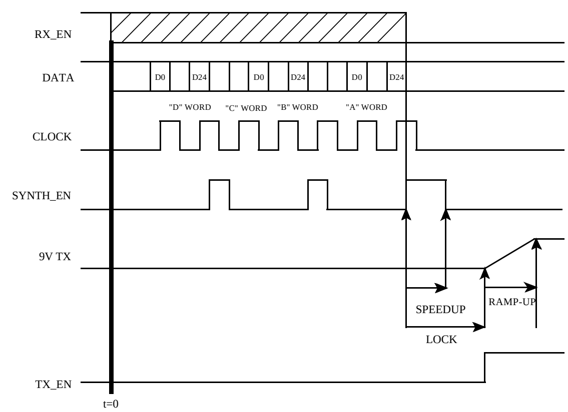


Figure 3-8 RX TO TX TIMING DIAGRAM

"Ramp-Up" is the amount of time required for the transmitter to reach full power once the TX EN has been applied. The Ramp-Up circuitry (located on the transceiver) minimizes adjacent channel interference caused by spectral spreading (sinx/x) when the transmitter is keyed. The Ramp-Up time is approximately 3 ms.

3.4 TRANSMIT TO RECEIVE SEQUENCE

1. TX_EN is turned OFF. This signal is shaped. Refer to Figure 3-9.

2. The synthesizer load process could begin slightly before, but when the last bit is strobed in the synthesizer it will become unlocked.

3. The RX_EN line should switch from low to high AFTER the TX_EN is switched. The RX_EN not only turns the RX circuits on but also Pin Shifts the VCO.

4. For quickest lock times the SYNTH ENABLE line on the last load word should be held high for 2 to 3 milliseconds. It MUST NOT be left high as the synthesizer in the SPEEDUP mode has poor noise performance and would degrade the Receive performance.

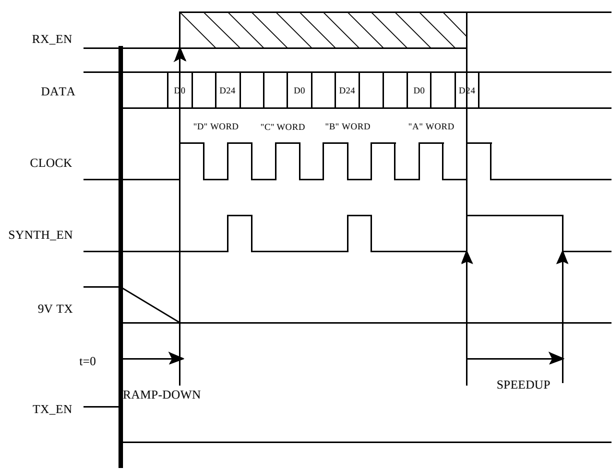


Figure 3-9 TX TO RX TIMING DIAGRAM

Speedup is 2 to 3 ms
Lock is approximately 7 ms
Ramp is approximately 3 ms
Dekey is approximately 3 ms

"Ramp-Down" is the amount of time required for the transmitter output power to be reduced before switching off the transmitter and enabling the receiver with the RX EN. The Ramp-Down circuitry (located on the transceiver) minimizes adjacent channel interference caused by spectral spreading (sinx/x) when the transmitter un un-keyed. The Ramp-Down time is approximately 3 ms.

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SECTION 4 CIRCUIT DESCRIPTION

4.1 GENERAL

4.1.1 INTRODUCTION

The main subassemblies of this transceiver are the RF board, VCO board, TCXO, Loader board or Modem. A block diagram of the transceiver is located in Figure 4-1. The 3492 is also available in Transmit only and Receive only models.

The 3492 has a reference oscillator stability of ±1.5 PPM. The 17.5 MHz TCXO (Temperature Compensated Crystal Oscillator) is soldered directly to the RF board. The TCXO is not serviceable.

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 87.85 MHz below the receive frequency. The frequency of this oscillator is controlled by a DC voltage produced by the phase detector in synthesizer chip U800.

Channels are selected by programming counters in U800 to divide by a certain number. This programming is performed over a serial bus formed by the Synth Clock, Synth Enable, and Data pins of J201. This programming is performed by the Loader board, modem 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 TCXO. The TCXO is 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 87.85 MHz / 450 kHz. 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, modem or customer-supplied equipment.

4.2 SYNTHESIZER

Programming of the synthesizer provides the data necessary for the internal prescaler and counters. One input signal is the reference frequency. This frequency is produced by the 17.5 MHz reference oscillator (TCXO). The other input signal is the VCO frequency.

A block diagram of the synthesizer is shown in Figure 4-1 and a block diagram of Synthesizer IC U800 is shown in Figure 4-2. As stated previously, the synthesizer output signal is produced by a VCO (voltage controlled oscillator). The VCO frequency is controlled by a DC voltage produced by the phase detector in U800. 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.

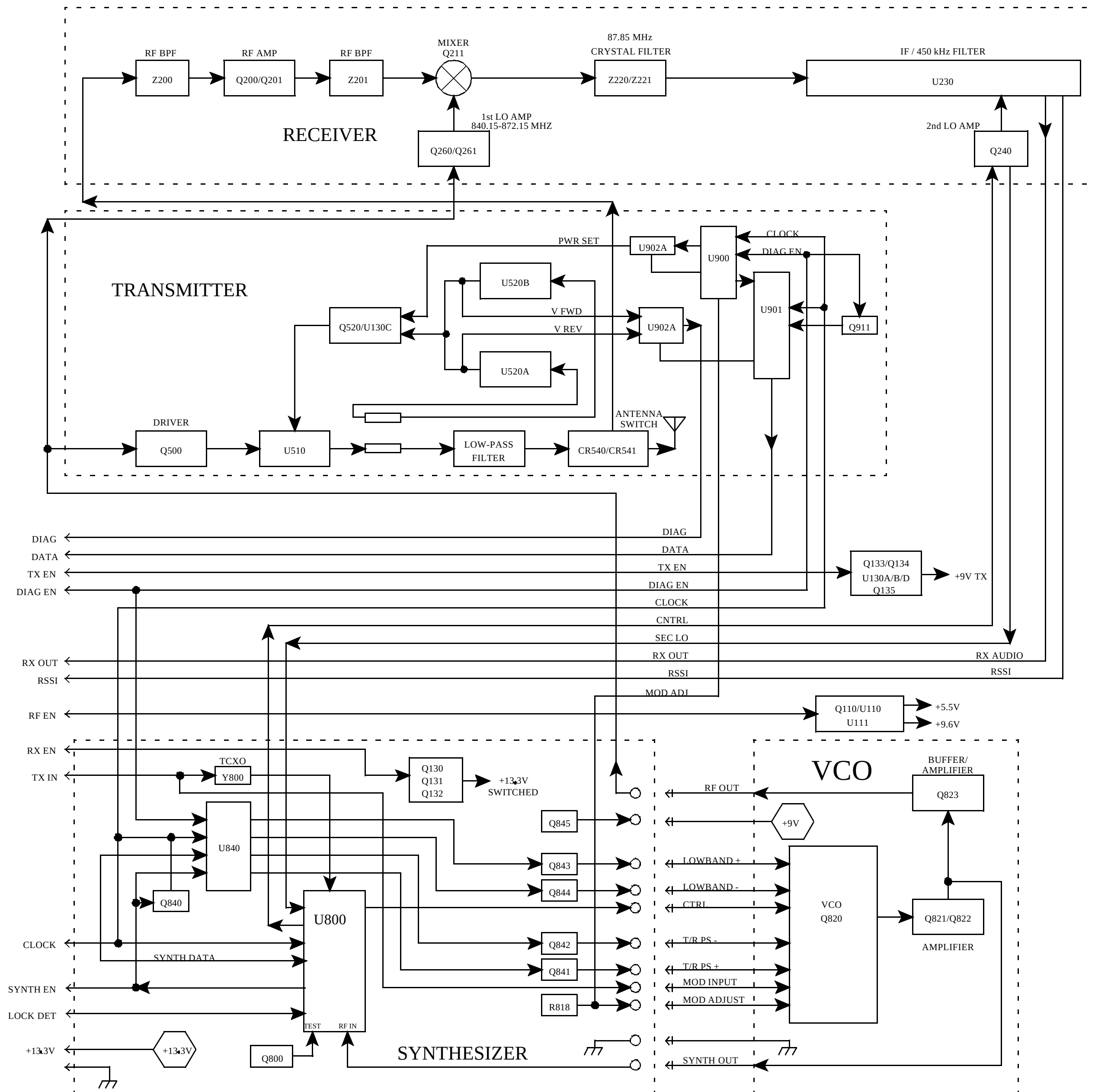


Figure 4-1 TRANSCEIVER BLOCK DIAGRAM

4.2.1 VOLTAGE-CONTROLLED OSCILLATOR

Oscillator

The VCO is formed by Q820, several capacitors and varactor diodes, and ceramic resonator L826. It oscillates at the transmit frequency in transmit mode and first injection frequency in the receive mode (928-960 MHz in transmit and 840.150-872.150 MHz in receive).

Biasing of Q820 is provided by R823, R824 and R826. An AC voltage divider formed by C844 and C845 initiates and maintains oscillation and also matches Q820 to the tank circuit. Resonator L826 is grounded at one end to provide shunt inductance to the tank circuit.

Frequency Control and Modulation

The VCO frequency is controlled by a DC voltage across varactor diode CR824. As voltage across a reverse-biased varactor diode increases, its capacitance decreases. The VCO frequency increases as the control voltage increases. The control line is isolated from tank circuit RF by choke L825. The amount of frequency change produced by CR824 is controlled by series capacitor C836.

The VCO frequency is modulated with the transmit audio/data signal from J201, pin 6 is applied across varactor diode CR822 which varies the VCO frequency at an audio rate. Series capacitors C825/C824 couple the VCO to CR822. R821 provides a DC ground on the anodes of CR822/CR823, and isolation is provided by R820 and C826. C827 is an RF bypass.

The DC voltage across CR823 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 CR824/CR825/CR826/CR827 gets lower). CR823 also balances the modulation signals applied to the VCO and TCXO. The DAC can be used to adjust the VCO modulation sensitivity.

The DC voltage applied across CR823 comes from the modulation adjust control R818 on the RF board. R820 applies a DC biasing voltage to CR822; C815 provides DC blocking. RF isolation is provided by C827, R822 and R817.

4.2.2 VCO AND REFERENCE OSCILLATOR MODULATION

Both the VCO and reference oscillator (TCXO) are modulated in order to achieve a flat frequency response. If only the VCO were modulated, the phase detector in U800 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. Potentiometer R818 sets the VCO modulation sensitivity so that it is equal to the reference oscillator modulation sensitivity.

4.2.3 CASCADE AMPLIFIERS

The output signal on the collector of Q820 is coupled by C846 to buffer amplifier Q821/Q822. This is a cascade amplifier which provides amplification and also isolation between the VCO and the stages which follow. The signal is capacitively coupled from the collector of Q822 to the base of Q821. The resistors in this circuit provide biasing and stabilization, and C852 and C854 are RF bypass capacitors.

4.2.4 AMPLIFIER

Amplifier Q823 provides amplification and isolation between the VCO, Receiver and Transmitter. C851 provides matching between the amplifiers. Bias for Q823 is provided by R840, R842 and R843. Inductor L833 and capacitor C860 provide impedance matching on the output.

4.2.5 VOLTAGE FILTER

Q845 on the RF board is a capacitance multiplier to provide filtering of the +9.6V supply to the VCO. R845 provides transistor bias and C842 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 C842. Therefore, base current does not change and transistor current remains constant. CR840 decreases the charge time of C842 when power is turned on. This shortens the start-up time of the VCO. C840 and C841 are RF decoupling capacitors.

4.2.6 VCO FREQUENCY SHIFT

The VCO must be capable of producing frequencies from 840-960 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.

The 928-960 MHz band is divided into two segments, 928-944 MHz and 944-960 MHz. The band selection is controlled by shift register U840, digital transistors Q843/Q844 and pin diode CR820 on the VCO board.

A frequency shift of 87.85 MHz is required to go from transmit to receive mode and visa versa. Transmit to receive frequency shift is accomplished by programming shift register U840 which drives the digital transistors Q841/Q842. In Transmit mode, Q841/Q842 forward bias pin diode CR821 which switches in an inductive transmission line in parallel with the VCO resonator causing the VCO frequency to increase. In Receive mode Q841/Q842 reverse bias CR821 which switches out the inductive transmission line and lowers the VCO frequency for the mixer injection.

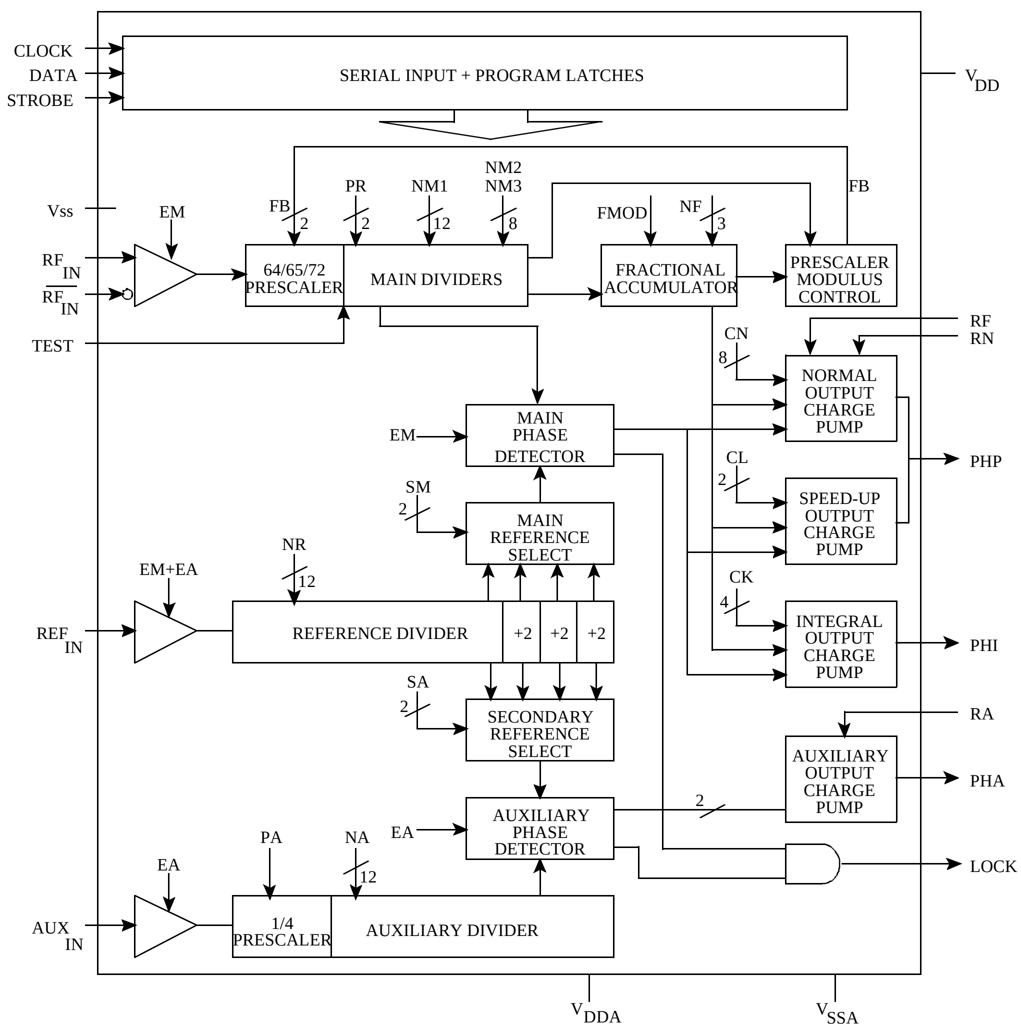


Figure 4-2 U800 SYNTHESIZER BLOCK DIAGRAM

4.2.7 SYNTHESIZER INTEGRATED CIRCUIT (U800)

Introduction

Synthesizer chip U800 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 U800 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 U800, pin 18 (J201, pin 7) is 3V. When the synthesizer is unlocked, the output is a less than 1V. Lock is defined as a phase difference of less than 1 cycle of the TCXO.

4.3 RECEIVER CIRCUIT DESCRIPTION

4.3.1 CERAMIC FILTER, RF AMPLIFIER

Capacitor C200 couples the receive signal from the antenna switch to ceramic filter Z200. (The antenna switch is described in Section 4.4.3.) Z200 is a bandpass filter that passes only a narrow band of frequencies to the receiver. This attenuates the image and other unwanted frequencies.

Impedance matching between the Z200 and RF amplifier Q201 is provided by C201, C203 and L200. CR200 protects the base-emitter junction of Q201 from excessive negative voltages that may occur during high signal conditions. Q200 is a switched constant current source which provides a base bias for Q201. Q200 base bias is provided by R200/R201. Current flows through R202 so that the voltage across it equals the voltage across R200 (minus the base/emitter drop of Q200). In the transmit mode the receive +9.6V is removed and Q200 is off. This removes the bias from Q201 and disables the RF amplifier in transmit mode. This prevents noise and RF from being amplified by Q201 and fed back on the first injection line.

Additional filtering of the receive signal is provided by Z201. L201 and C206 provide impedance matching between Q201 and Z201. Resistor R205 is used to lower the Q of L201 to make it less frequency selective.

4.3.2 MIXER

First mixer Q211 mixes the receive frequency with the first injection frequency to produce the 87.85 MHz first IF. Since low-side injection is used, the injection frequency is 87.85 MHz below the receive frequency. The RF signal is coupled to the mixer through C211. L212 and C214 tune the mixer output to 87.85. R214 lowers the Q of L212.

4.3.3 FIRST LO AMPLIFIER

The first injection frequency from the VCO is coupled to the First Local Oscillator (LO) amplifier Q260/Q261 through C266. L261/C265 match Q260 to the VCO.

Q261 is a switched constant current source which provides a base bias for Q260. Q261 base bias is provided by R264/R265. Current flows through R263 so that the voltage across it equals the voltage across R264 (minus the base/emitter drop of Q261). In the transmit mode the receive +9.6V is removed and Q261 is off. This removes the bias from Q260 and disables the First LO amplifier in transmit mode.

4.3.4 CRYSTAL FILTER, FIRST IF SECTION

Z220 and Z221 form a 2-section, 4-pole crystal filter with a center frequency of 87.85 MHz and a -3 dB passband of 8 kHz (12.5 kHz BW) or 15 kHz (25 kHz BW). This filter establishes the receiver selectivity by attenuating the adjacent channel and other signals close to the receive frequency. C223, C224, and L221 adjust the coupling of the filter. L222, C226, C227 and R223 provide impedance matching between the filter and U230.

4.3.5 SECOND LO/MIXER/DETECTOR

Oscillator and Mixer

As shown in Figure 4-3, U230 contains the second oscillator, second mixer, limiter, detector, and squelch circuitry. The control line from synthesizer U800 is on U230, pin 4. R250/C252/CR240 stabilize the base current of the oscillator control line. C243/ C245 provide the feedback for the Colpitts oscillator. The 87.4 MHz output of the oscillator is on U230, pin 3 and is coupled to buffer Q240. Bias for Q240 is provided by R242/R243/R245. The output of Q240 is coupled to the auxiliary input of U800, pin 10 to maintain the control line. The 87.85 MHz IF signal is mixed with the 87.4 MHz second LO to produce the 450 kHz Second IF.

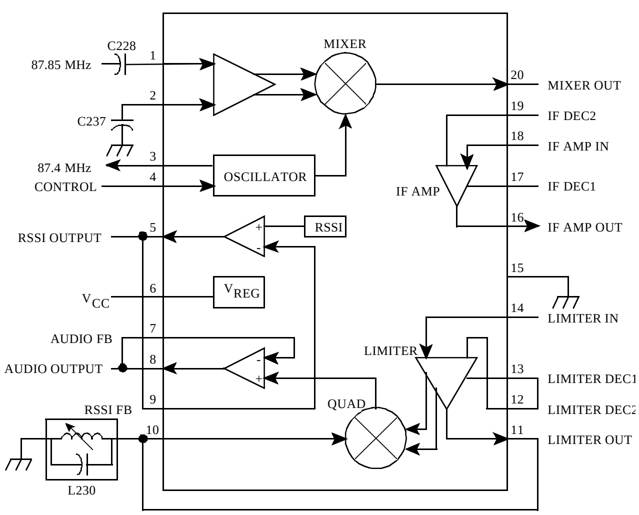


Figure 4-3 U230 BLOCK DIAGRAM

Second IF Filter

The output of the internal double-balanced mixer is the difference between 87.85 MHz and 87.4 MHz which is 450 kHz. This 450 kHz signal is fed out on pin 20 and applied to second IF filters Z230 and Z231. These filters have passbands of 9 kHz (12.5 kHz BW), or 20 kHz (25 kHz BW) at the -6 dB points and are used to attenuate wideband noise.

Limiter-Amplifier

The output of Z230/Z231 is applied to a limiter-amplifier circuit in U230. 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. C233/C234 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 U230, pin 10 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. L230 is tuned to provide maximum undistorted output from the detector. R232 is used to lower the Q of L230. From the detector the audio and data signal is fed out on pin 8. The audio/data output of U230, pin 8 is applied to J201, pin 13.

Audio/Data Amplifier

The audio/data output of U230, pin 8 is applied to J201, pin 13.

Receive Signal Strength Indicator (RSSI)

U230, pin 5 is an output for the RSSI circuit which provides a voltage proportional to the strength of the 450 kHz IF signal. The RSSI voltage is applied to J201, pin 12.

4.4 TRANSMITTER CIRCUIT DESCRIPTION

4.4.1 DRIVER

The VCO RF output signal is applied to R846, R847 and R848 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 R500, R501, and R502. This pad provides attenuation and isolation. Q500 provides amplification and additional isolation between the VCO and transmitter. Biasing for this stage is provided by R503 and R504, and decoupling of RF signals is provided by C504. Impedance matching to the power amplifier is provided by L500/C505.

4.4.2 FINAL, COMPARATOR

RF module U510 has an RF output of 1 to 5W and operates on an input voltage from 10-16V.

Power control is provided by U520, U130, Q520 and a stripline directional coupler. The power is adjusted by Power Set Control of U900 that provides a reference voltage to U130C. U130C drives Q520 and PA module U510 when using the DAC. When not using the DAC, the set voltage is applied through U902, pin 2.

One end of the stripline directional coupler is connected to a forward RF peak detector formed by R535, CR530, C531 and U520A. The other end of the stripline directional coupler is connected to a reverse RF peak detector formed by R537, CR531, C534 and U520B.

If the power output of U510 decreases due to temperature variations, etc., the forward peak detector voltage drops. This detector voltage drop is buffered by U520A and applied to inverting amplifier U130C which increases the forward bias on Q520. The increase on Q520 increases the power output level of U510. If the power output of U510 increases, the forward peak detector voltage increases and U130C decreases the forward bias on Q520. The decrease on Q520 decreases the output power of U510.

The output of CR530 and CR531 are fed to U520A/B respectively. If the output of either buffer increases, the increase is applied to the inverting input of U130C. The output of U130C then decreases and Q520 decreases the input voltage to U510 to lower the power. The control voltage is isolated from RF by ferrite bead EP510 and C511 decouples RF.

The forward/reverse power voltages from U520A/B are also applied to U901 for Diagnostic outputs on J201, pin 14.

The low-pass filter consists of C541, L540, C542, L541, C543, L542 and C544. 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.

4.4.3 ANTENNA SWITCH

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 L543 and current flows through diode CR540, L544, diode CR541, and R540. 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 CR540 is forward biased, the transmit signal has a low-impedance path to the antenna through coupling capacitor C546.

L544 and C552 form a discrete quarter- wave line. When CR541 is forward biased, this quarter-wave line is effectively AC grounded on one end by C552. 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. C545/C546 matches the antenna to 50 ohms in transmit and receive.

4.4.4 TRANSMIT KEY-UP CONTROL

When 3-16V is applied to J201, pin 3 (TX_EN) is applied to the base of Q133 it turns the transistor on and causes the collector to go low. This low is on the base of Q134 and turns the transistor on to apply +5.5V to U130A, pin 2. C130 and C131 decouple RF. The +5.5V from Q134 is divided by R132/R133 to produce a +3.6V reference on U130A, pin 3. C136, C137, C138 and C139 provide RF decoupling.

Q130, Q131 and Q132 act as switches that turn on with the RX_EN line. When J201, pin 4 goes low, Q130 is turned off, which turns on Q131 that turns on Q132. This applies +13.3V to U130 before the TX_EN line on J201, pin 3 goes high.

U130B provides the key-up/key-down conditioning circuit. C141/R137 provide a ramp up/ramp down of the +9V TX during key-up/key-down which reduces load pull of the VCO during key-up.

The output on U130B, pin 7 is applied to the non-inverting input of comparator U130D, pin 12. The output of U130D, pin 14 is applied to the base of current source Q135. The output of Q135 is on the emitter and is applied back to the inverting input of comparator U130D, pin 13. A decrease or increase at U130D, pin 13 causes a correction by U130D to stabilize the +9V transmit output. R140/R141 establishes the reference voltage on U130D, pin 13. C144 provides RF bypass, C143 provides RF decoupling and C145 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 +3-16V applied on J201, pin 5 is applied to the base of Q110 turning the transistor on. This causes the collector to go low and applies a low to the control line of U110, pin 2 and R110 provides supply voltage isolation. The +13.3V from J201, pin 2 is on U110, pin 6 to produce a +5.5V reference output on U110, pin 4. C110 stabilizes the voltage and C114/C111 provide RF decoupling. C117 provides RF bypass and C123 provides RF decoupling. C119 helps to stabilize the voltage when the +5.5V supply first turned on.

The low from the collector of Q110 is also applied to the control line of U111, pin 2. The +13.3V from J201, pin 2 is on U111, pin 6 to produce a +9.6V output on U111, pin 4. C118 provides RF bypass and C122 provides RF decoupling. C120 helps to stabilize the voltage when the +9.6V supply first turned on.

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 6. 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 8. 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 7. 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 ±1.5 PPM TCXO module is not field serviceable. Part changes require a factory recalibration to ensure that the oscillator stays within its ±1.5 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, U800, 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 U800 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 Q820, amplifier Q821/Q822, and the RF IN of U800. 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 U800, pin 8. It should be 17.5 MHz 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

<u>Output Level</u>

The output level of Q823 can be measured with an RF voltmeter or some other type of high impedance meter. The minimum level after a power splitter at R846 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 R841. 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 (U800)

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 - 3-16V DC Receive
Pin 5 - 3-16V 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

Data Output

Using a .01 µF coupling capacitor, inject a 87.85 MHz, 1 mV signal, modulated with 1 kHz at ±3 kHz deviation (for 25 kHz radios) ±1.5 kHz (for 12.5 kHz radios) at U230, pin 1. The signal output at U230, 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.

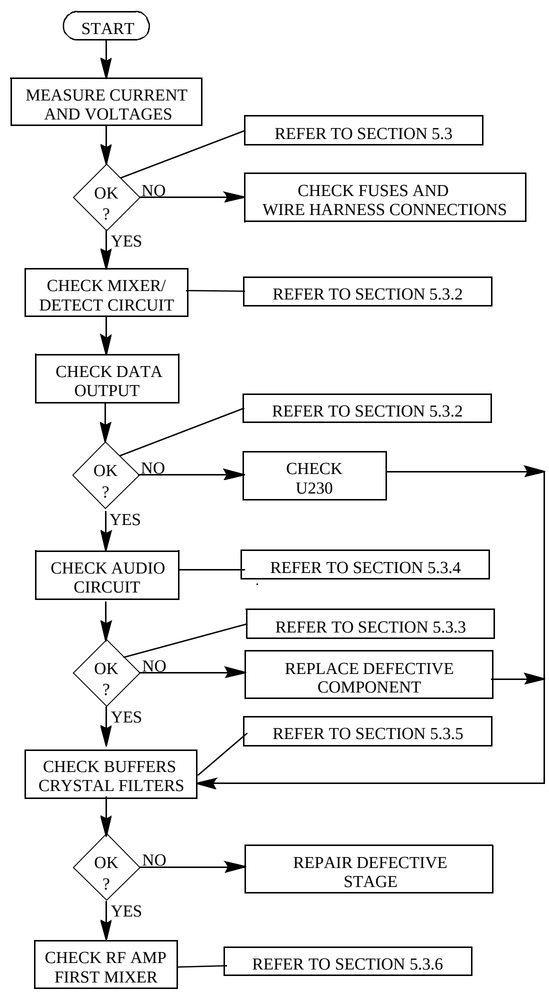


Figure 5-1 RECEIVER SERVICING

5.3.3 SECOND LO

Verify that the Second LO signal is present at R245. The Second LO should be at 87.40 MHz and not less than 250 mV P-P.

5.3.4 AUDIO BUFFER AMP

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 L230 (see Section 6.7). The gain of U230 is 2.8 for 25 kHz radios and 5.8 for 12.5 kHz radios.

5.3.5 CRYSTAL FILTERS

The 87.85 MHz IF signal is provided to the crystal filters Z220/Z221.

5.3.6 MIXER

The mixer converts the RF signal (928-960 MHz) to 87.85 MHz. The Local Oscillator is provided by the VCO and Q260/Q261. The level of the LO should be approximately +3 dBm.

5.3.7 LOW NOISE AMPLIFIER (LNA)

The LNA provides approximately 12 dB of gain at 928-960 MHz. Q200 provides active bias to Q201.

5.3.8 ANTENNA SWITCH

CR540, CR541, L544, C551 and C552 form a Pi-network antenna switch. CR540 and CR541 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 for power output. (Power output should be at least -3 dBm.)

2. Check 9V Transmit (Q135, emitter).

3. If 9V is not present check Q133/Q134, U130, Q135, Q130, Q131 and Q132 (see Section 4.4.4).

4. Check voltages on Driver Q500.

   Input = 1.5V DC
   Output = 3.5V DC

   Power output should be at least 2 mW (+3 dBm) at C506 (50 ohm point).

5.4.3 FINAL AMPLIFIER

1. Check the voltages on U510.

   Pin 2 = 9V DC
   Pin 3 = 5.0V DC (varies with power setting)
   Pin 4 = 13.3V DC

   Power output at C540 should be 7.5-8.0W (+38.7 to +39 dBm).

5.4.4 ANTENNA SWITCH

1. Check the antenna switch voltages.

   CR540 = 8.6V DC
   CR541 = 8.0V DC

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

5.4.5 MODULATION INPUT

1. Check for audio/data signals at J201, pin 6, Y800, pin 1 and A840, pin 3.

5.4.6 TCXO

1. Check Y800, pin 1 for 2.5V DC ±1%.

2. Adjust Y800 to set the transmitter to the frequency of operation.

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

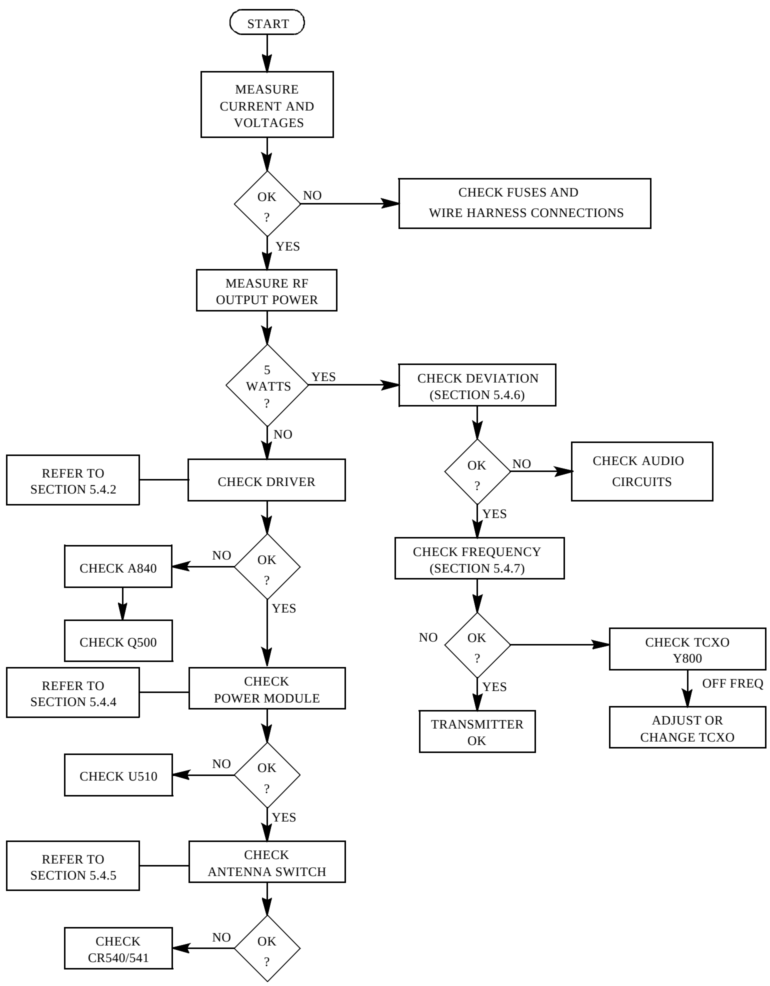


Figure 5-2 TRANSMITTER SERVICING

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 6-5 or component layouts are located in Section 8.

Fabricate test cables by referring to Figure 2-1. This cable 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
- Frequency Counter and "sniffer" probe
- Power Meter
- Oscilloscope
- Digital Multimeter
- 20 dB Attenuator
- 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. Using a DC voltmeter, monitor the DC voltage at the junction of R812/R814 (wiper of R814), refer to Figure 6-5.
6. Adjust R814 to 2.1V DC ±0.05V.
7. Verify the bias voltage at J201, pin 6 is +2.5V DC ±0.05V.

6.4 VCO CONTROL VOLTAGE

1. Connect the test setup shown in Figure 6-1.
2. Adjust R525 fully counterclockwise.
3. Load the synthesizer with the HIGHEST channel frequency in the band.
4. Key the transmitter.
5. Verify the voltage at TP800 is < 5V DC.
6. Unkey the transmitter.
7. Load the synthesizer with the LOWEST channel frequency in the band.
8. Key the transmitter.
9. Verify the voltage at TP800 is > 1V DC.
10. Unkey the transmitter.

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 R525 clockwise for 5.0W ±1W. 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 4-6W with current less than 2.5A.

6.5.1 MODULATION ALIGNMENT

1. Apply a 1V, 100 Hz 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 R818 to the center position.

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

5. Adjust R818 for a flat square wave.

6. Apply a 100 Hz sine-wave to J201, pin 6. The modulation analyzer should still have the 15 kHz low-pass filter selected.

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

   1.5 kHz for 12.5 kHz BW radios
   3.0 kHz for 25 kHz BW radios

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

9. Input a 100 Hz sine-wave and set a 0 dB reference on the Modulation Analyzer.

10. Apply a 1 kHz sine-wave. The level should be within ±2 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 sine-wave and set a 0 dB reference on the Modulation Analyzer.

13. Apply a 1 kHz sine-wave. The level should be within ±2 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 sine-wave and set a 0 dB reference on the Modulation Analyzer.

16. Apply a 1 kHz sine-wave. The level should be within ±2 dB of the reference at 100 Hz.

17. Unkey the transmitter.

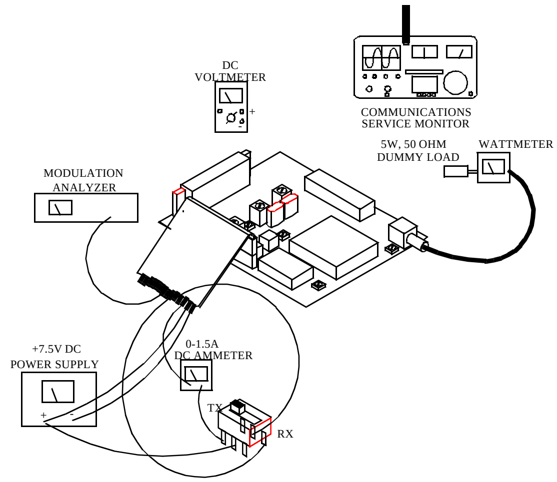


Figure 6-1 TRANSMITTER TEST SETUP

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, 100 Hz 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".

4. If the square wave is peaked on the edges, adjust R818 down in value for the flattest square wave.

5. Repeat Steps 3 and 4 for channels on the LOW and HIGH ends of the band.

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

7. Adjust the audio analyzer output level to achieve a transmit deviation of:
   1.5 kHz for 12.5 kHz radios or
   3 kHz for 25 kHz radios.

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

9. Input a 100 Hz sine-wave and set a 0 dB reference on the Modulation Analyzer.

10. Apply a 1 kHz sine-wave. The level should be within ±2 dB of the reference at 100 Hz.

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

12. Input a 100 Hz sine-wave and set a 0 dB reference on the Modulation Analyzer.

13. Apply a 1 kHz sine-wave. The level should be within ±2 dB of the reference at 100 Hz.

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

15. Input a 100 Hz sine-wave and set a 0 dB reference on the Modulation Analyzer.

16. Apply a 1 kHz sine-wave. The level should be within ±2 dB of the reference at 100 Hz.

17. Unkey the transmitter.

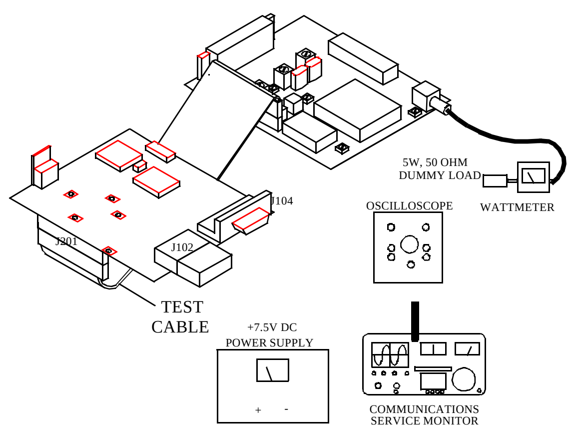


Figure 6-2 TX WITH LOADER TEST SETUP

6.7 RECEIVER

CAUTION

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

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

1. Connect the test setup shown in Figure 6-3.

2. Preset tuning slugs of L212 and L222 flush with the top of the can.

3. Preset C223 to the center position (slot in-line with axis of the part).

4. Re-adjust L212 and L222 clockwise 2 turns.

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

6. Apply a -47 dBm signal from the RF signal genertor to J501 on the radio. Adjust deviation for:
 1.5 kHz with 1 kHz tone for 12.5 kHz radios
 3 kHz with 1 kHz tone for 25 kHz radios.

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

7. Preset L230 for 2.5V DC ±0.05V at J201, pin 13.

8. Set RF signal generator to -105 dBm, ***unmodulated***.

9. Set generator frequency to :
 3 kHz below channel center on 12.5 kHz radios
 5 kHz below channel center on 25 kHz radios

10. Adjust C223 (first) and L212 for peak RSSI voltage. (Use 2V scale on DVM.)

11. Apply a -47 dBm signal from the RF signal generator to J501 on the radio with standard deviation levels.

12. Adjust L222 for minimum distortion (psophometrically weighted).

13. Set RF signal generator to -105 dBm, ***unmodulated***.

14. Adjust L212 for peak RSSI voltage. (Use 2V scale on DVM.)

15. Apply a -47 dBm signal from the RF signal generator to J501 on the radio with standard deviation levels.

16. Adjust L230 for maximum receive audio voltage.

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

18. Verify that the receive audio DC voltage is 2.5V ±0.3V.

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

20. Adjust the amplitude of the RF signal generator on J501 until an 12 dB SINAD level (psophometrically weighted) is reached.

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

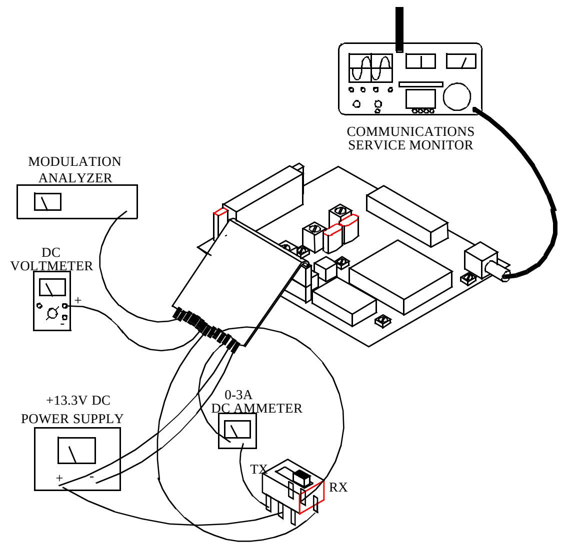


Figure 6-3 RECEIVER TEST SETUP

22. Load the synthesizer with a receive channel frequency to the LOW end of the band.

23. Verify the RF generator amplitude level is less than -116 dBm at 12 dB SINAD.

24. Load the synthesizer with a receive channel frequency to the HIGH end of the band.

25. Verify the RF generator amplitude level is less than -116 dBm at 12 dB SINAD.

26. 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).

27. 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 0.8V DC).

28. 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 1.7V DC).

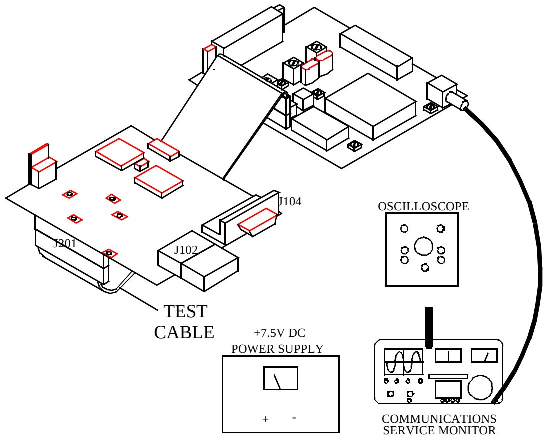


Figure 6-4 Rx WITH LOADER TEST SETUP

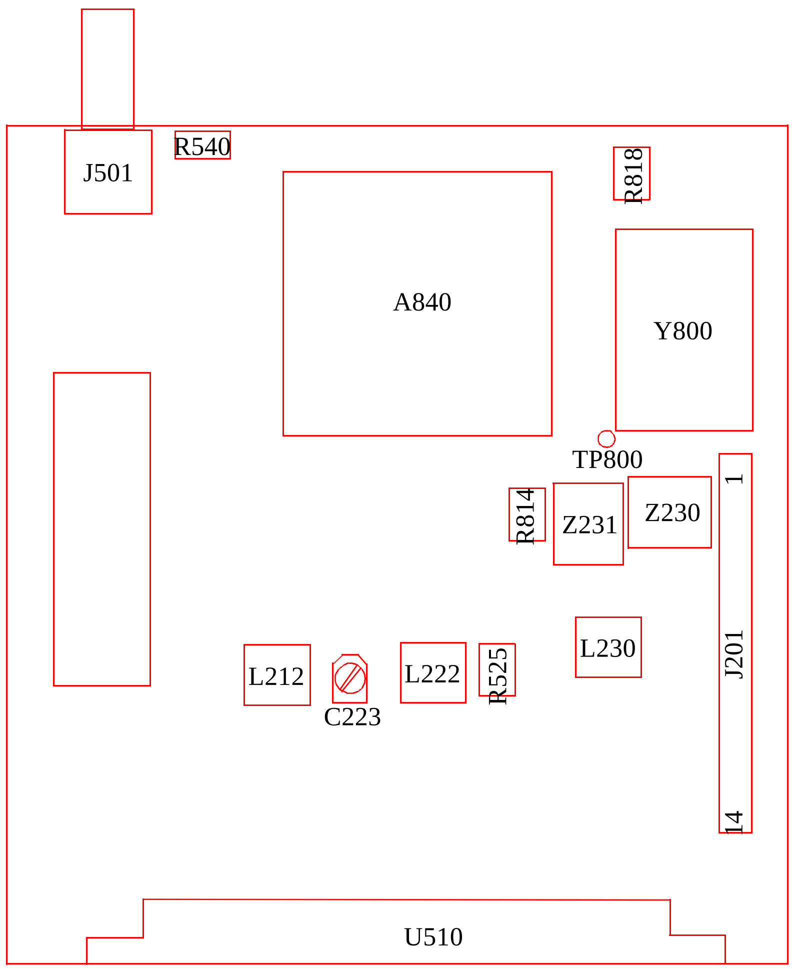


Figure 6-5 ALIGNMENT POINTS DIAGRAM

SECTION 7 PARTS LIST

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
	3492 TRANSCEIVER	
	PART NO. 242-3492-510 (12.5 kHz)	
	PART NO. 242-3492-530 (25 kHz)	
A 840	VCO 928-960 MHz	023-3492-540
C 100	22 pF ±5% NPO 0603	510-3674-220
C 101	1 µF 16V SMD tantalum	510-2625-109
C 110	1 µF 16V SMD tantalum	510-2625-109
C 111	22 pF ±5% NPO 0603	510-3674-220
C 112	1 µF 16V SMD tantalum	510-2625-109
C 113	22 pF ±5% NPO 0603	510-3674-220
C 114	22 pF ±5% NPO 0603	510-3674-220
C 115	.01 µF ±10% X7R 0603	510-3675-103
C 116	.01 µF ±10% X7R 0603	510-3675-103
C 117	.01 µF ±10% X7R 0603	510-3675-103
C 118	.01 µF ±10% X7R 0603	510-3675-103
C 119	1 µF 16V SMD tantalum	510-2625-109
C 120	1 µF 16V SMD tantalum	510-2625-109
C 122	22 pF ±5% NPO 0603	510-3674-220
C 123	22 pF ±5% NPO 0603	510-3674-220
C 130	22 pF ±5% NPO 0603	510-3674-220
C 131	22 pF ±5% NPO 0603	510-3674-220
C 132	1 µF 16V SMD tantalum	510-2625-109
C 133	.01 µF ±10% X7R 0603	510-3675-103
C 134	1 µF 16V SMD tantalum	510-2625-109
C 135	22 pF ±5% NPO 0603	510-3674-220
C 136	22 pF ±5% NPO 0603	510-3674-220
C 137	.01 µF ±10% X7R 0603	510-3675-103
C 138	22 pF ±5% NPO 0603	510-3674-220
C 139	.1 µF ±5% X7R 1206	510-3609-104
C 140	.01 µF ±10% X7R 0603	510-3675-103
C 141	.0082 ±10% X7R 0805	510-3605-882
C 142	22 pF ±5% NPO 0603	510-3674-220
C 143	.01 µF ±10% X7R 0603	510-3675-103
C 144	22 pF ±5% NPO 0603	510-3674-220
C 145	1 µF 16V SMD tantalum	510-2625-109
C 146	22 pF ±5% NPO 0603	510-3674-220
C 170	22 pF ±5% NPO 0603	510-3674-220
C 171	22 pF ±5% NPO 0603	510-3674-220
C 172	22 pF ±5% NPO 0603	510-3674-220
C 173	22 pF ±5% NPO 0603	510-3674-220
C 174	22 pF ±5% NPO 0603	510-3674-220
C 175	22 pF ±5% NPO 0603	510-3674-220
C 176	22 pF ±5% NPO 0603	510-3674-220
C 177	22 pF ±5% NPO 0603	510-3674-220
C 178	22 pF ±5% NPO 0603	510-3674-220
C 179	22 pF ±5% NPO 0603	510-3674-220
C 180	22 pF ±5% NPO 0603	510-3674-220
C 181	22 pF ±5% NPO 0603	510-3674-220
C 182	22 pF ±5% NPO 0603	510-3674-220
C 200	22 pF ±5% NPO 0603	510-3674-220
C 201	22 pF ±5% NPO 0603	510-3674-220
C 202	.01 µF ±10% X7R 0603	510-3675-103
C 203	3.3 pF ±0.1pF NPO 0603	510-3673-339
C 204	.01 µF ±10% X7R 0603	510-3675-103
C 206	2.2 pF ±0.1pF NPO 0603	510-3673-229
C 207	22 pF ±5% NPO 0603	510-3674-220
C 210	.01 µF ±10% X7R 0603	510-3675-103
C 211	22 pF ±5% NPO 0603	510-3674-220
C 213	2.2 pF ±0.1pF NPO 0603	510-3673-229
C 214	9.1 pF ±0.1pF NPO 0603	510-3673-919
C 217	.01 µF ±10% X7R 0603	510-3675-103
C 218	22 pF ±5% NPO 0603	510-3674-220
C 219	22 pF ±5% NPO 0603	510-3674-220
C 220	.01 µF ±10% X7R 0603	510-3675-103
C 223	1.5-5 pF SMD ceramic	512-1602-001
C 224	2.4 pF ±0.1pF NPO 0603	510-3673-249
C 225	.01 µF ±10% X7R 0603	510-3675-103
C 226	6.2 pF ±0.1pF NPO 0603	510-3673-629
C 227	10 pF ±0.1pF NPO 0603	510-3673-100
C 228	.01 µF ±10% X7R 0603	510-3675-103
C 230	.01 µF ±10% X7R 0603	510-3675-103
C 231	.01 µF ±10% X7R 0603	510-3675-103
C 232	.01 µF ±10% X7R 0603	510-3675-103
C 233	.01 µF ±10% X7R 0603	510-3675-103
C 234	.01 µF ±10% X7R 0603	510-3675-103
C 235	10 pF ±0.1pF NPO 0603	510-3673-100
C 236	.01 µF ±10% X7R 0603	510-3675-103
C 237	.01 µF ±10% X7R 0603	510-3675-103
C 240	47 µF 10V SMD tantalum	510-2624-470
C 241	.01 µF ±10% X7R 0603	510-3675-103
C 242	22 pF ±5% NPO 0603	510-3674-220
C 243	18 pF ±5% NPO 0603	510-3674-180
C 244	.001 µF ±10% X7R 0603	510-3675-102
C 245	15 pF ±5% NPO 0603	510-3674-150
C 246	.01 µF ±10% X7R 0603	510-3675-103
C 248	.001 µF ±10% X7R 0603	510-3675-102

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
C 249	.1 µF ±5% X7R 1206	510-3609-104
C 250	.01 µF ±10% X7R 0603	510-3675-103
C 251	.01 µF ±10% X7R 0603	510-3675-103
C 252	1 µF 16V SMD tantalum	510-2625-109
C 253	.01 µF ±10% X7R 0603	510-3675-103
C 261	22 pF ±5% NPO 0603	510-3674-220
C 262	22 pF ±5% NPO 0603	510-3674-220
C 263	22 pF ±5% NPO 0603	510-3674-220
C 264	.01 µF ±10% X7R 0603	510-3675-103
C 265	5.6 pF ±0.1pF NPO 0603	510-3673-569
C 266	22 pF ±5% NPO 0603	510-3674-220
C 267	22 pF ±5% NPO 0603	510-3674-220
C 268	22 pF ±5% NPO 0603	510-3674-220
C 269	.01 µF ±10% X7R 0603	510-3675-103
C 270	1.8 pF ±0.1pF NPO 0603	510-3673-189
C 500	22 pF ±5% NPO 0603	510-3674-220
C 501	.01 µF ±10% X7R 0603	510-3675-103
C 502	68 pF ±5% NPO 0603	510-3674-680
C 503	10 pF ±0.1pF NPO 0603	510-3673-100
C 504	22 pF ±5% NPO 0603	510-3674-220
C 505	22 pF ±5% NPO 0603	510-3674-220
C 506	22 pF ±5% NPO 0603	510-3674-220
C 510	22 pF ±5% NPO 0603	510-3674-220
C 511	22 pF ±5% NPO 0603	510-3674-220
C 512	22 pF ±5% NPO 0603	510-3674-220
C 513	22 pF ±5% NPO 0603	510-3674-220
C 514	1 µF 16V SMD tantalum	510-2625-109
C 515	22 pF ±5% NPO 0603	510-3674-220
C 516	1 µF 16V SMD tantalum	510-2625-109
C 517	1 µF 16V SMD tantalum	510-2625-109
C 518	22 pF ±5% NPO 0603	510-3674-220
C 520	.01 µF ±10% X7R 0603	510-3675-103
C 521	22 pF ±5% NPO 0603	510-3674-220
C 522	22 pF ±5% NPO 0603	510-3674-220
C 523	.01 µF ±10% X7R 0603	510-3675-103
C 524	22 pF ±5% NPO 0603	510-3674-220
C 526	.01 µF ±10% X7R 0603	510-3675-103
C 527	22 pF ±5% NPO 0603	510-3674-220
C 528	22 pF ±5% NPO 0603	510-3674-220
C 529	22 pF ±5% NPO 0603	510-3674-220
C 530	.01 µF ±10% X7R 0603	510-3675-103
C 531	10 pF ±0.1pF NPO 0603	510-3673-100
C 533	.01 µF ±10% X7R 0603	510-3675-103
C 534	10 pF ±0.1pF NPO 0603	510-3673-100
C 540	22 pF ±5% NPO 0603	510-3674-220
C 541	6.2 pF ±5% NPO 0805	510-3601-629
C 542	4.3 pF ±5% NPO 0805	510-3601-439
C 543	3.9 pF ±5% NPO 0805	510-3601-399
C 544	3.3 pF ±5% NPO 0805	510-3601-339
C 545	2.7 pF ±5% NPO 0805	510-3601-279
C 546	22 pF ±5% NPO 0603	510-3674-220
C 547	22 pF ±5% NPO 0603	510-3674-220
C 548	68 pF ±5% NPO 0603	510-3674-680
C 549	.01 µF ±10% X7R 0603	510-3675-103
C 550	10 pF ±0.1pF NPO 0603	510-3673-100
C 551	2.4 pF ±5% NPO 0805	510-3601-249
C 552	10 pF ±0.1pF NPO 0603	510-3673-100
C 800	.01 µF ±10% X7R 0603	510-3675-103
C 801	22 pF ±5% NPO 0603	510-3674-220
C 802	.01 µF ±10% X7R 0603	510-3675-103
C 803	22 pF ±5% NPO 0603	510-3674-220
C 804	.01 µF ±10% X7R 0603	510-3675-103
C 805	.01 µF ±10% X7R 0603	510-3675-103
C 806	.01 µF ±10% X7R 0603	510-3675-103
C 807	22 pF ±5% NPO 0603	510-3674-220
C 808	1.5 pF ±5% NPO 0603	510-3674-159
C 809	2.7 pF ±0.1pF NPO 0603	510-3673-279
C 810	22 pF ±5% NPO 0603	510-3674-220
C 811	22 pF ±5% NPO 0603	510-3674-220
C 812	22 pF ±5% NPO 0603	510-3674-220
C 813	22 pF ±5% NPO 0603	510-3674-220
C 814	22 pF ±5% NPO 0603	510-3674-220
C 815	1 µF 16V SMD tantalum	510-2625-109
C 816	22 pF ±5% NPO 0603	510-3674-220
C 817	100 pF ±5% NPO 0603	510-3674-101
C 818	.039 µF ±5% X7R 1206	510-3609-393
C 819	.0039 µF ±10% X7R 0805	510-3605-392
C 820	.0039 µF ±10% X7R 0805	510-3605-392
C 821	1 µF 16V SMD tantalum	510-2625-109
C 822	22 pF ±5% NPO 0603	510-3674-220
C 823	10 pF ±0.1pF NPO 0603	510-3673-100
C 840	.01 µF ±10% X7R 0603	510-3675-103
C 841	22 pF ±5% NPO 0603	510-3674-220
C 842	4.7 µF 10V SMD tantalum	510-2624-479
C 843	.01 µF ±10% X7R 0603	510-3675-103
C 844	.01 µF ±10% X7R 0603	510-3675-103
C 845	.01 µF ±10% X7R 0603	510-3675-103
C 846	.01 µF ±10% X7R 0603	510-3675-103
C 847	.01 µF ±10% X7R 0603	510-3675-103
C 850	22 pF ±5% NPO 0603	510-3674-220
C 851	22 pF ±5% NPO 0603	510-3674-220
C 852	22 pF ±5% NPO 0603	510-3674-220
C 853	22 pF ±5% NPO 0603	510-3674-220
C 854	.01 µF ±10% X7R 0603	510-3675-103
C 855	.01 µF ±10% X7R 0603	510-3675-103

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
C 856	.01 µF ±10% X7R 0603	510-3675-103
C 900	.01 µF ±10% X7R 0603	510-3675-103
C 901	.01 µF ±10% X7R 0603	510-3675-103
C 902	.01 µF ±10% X7R 0603	510-3675-103
C 903	.01 µF ±10% X7R 0603	510-3675-103
CR200	Switching diode SOT-23	523-1504-002
CR240	Varactor BB535 SOD-323	523-5005-022
CR530	Hot carrier SOT-23	523-1504-016
CR531	Hot carrier SOT-23	523-1504-016
CR540	PIN switch diode SOT-23	523-1504-001
CR541	PIN switch diode SOT-23	523-1504-001
CR840	Varactor BB535 SOD-323	523-5005-022
EP130	Ferrite bead SMD	517-2503-001
EP200	Mini cer crystal pin insulator	010-0345-280
EP510	Ferrite bead SMD	517-2503-001
EP511	Ferrite bead SMD	517-2503-001
EP512	Ferrite bead SMD123	517-2503-010
EP513	Ferrite bead SMD	517-2503-001
HW102	Grafoil MHW 806 (25 kHz)	018-1007-104
HW104	900 MHz module shield	017-2225-754
HW104	4-40 machine panhead ZPS	575-1604-010
J 201	14-pin single row header	515-7110-214
J 501	Jack right angle PC mount	142-0701-501
L 200	2.2 nH ±10% 0805 SMD	542-9003-226
L 201	8.2 nH inductor LL2012	542-9003-826
L 210	22 nH ±10% SMD	542-9003-227
L 211	15 nH inductor LL21012	542-9003-157
L 212	270 nH variable SMT	542-5103-157
L 221	0.39 µH inductor SMD	542-9001-398
L 222	270 nH variable SMT	542-5103-157
L 230	680 µH quad coil	542-5102-001
L 240	120 nH 50 x 80 chip	542-9007-121
L 260	10 nH ±10% 0805 SMD	542-9003-107
L 261	2.7 nH ±10% 0805 SMD	542-9003-276
L 262	10 nH ±10% 0805 SMD	542-9003-107
L 500	1 µH inductor SMD	542-9001-109
L 540	8 nH air core inductor SMD	542-0030-003
L 541	12.5 nH air core inductor SMD	542-0030-004
L 542	8 nH air core inductor SMD	542-0030-003
L 543	1 µH inductor SMD	542-9001-109
L 544	2T 24 AWG 0.08 ID	542-0030-002

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
MP101	Heat sink	014-0778-047
MP102	Grafoil MHW 806	018-1007-104
MP102	900 MHz shield (25 kHz)	017-2225-754
MP107	Low pass	017-2225-771
MP108	Synthisizer bottom shield	017-2225-772
MP801	VCO can	017-2225-751
MP806	Crystal filter shield	017-2225-699
Q 100	NPN digital 47k/47 transistor	576-0013-046
Q 101	PNP digital 10k/47 transistor	576-0013-032
Q 110	NPN digital 47k/47 transistor	576-0013-046
Q 130	NPN digital 47k/47 transistor	576-0013-046
Q 131	NPN digital 47k/47 transistor	576-0013-046
Q 132	PNP digital 10k/47 transistor	576-0013-032
Q 133	NPN digital 47k/47 transistor	576-0013-046
Q 134	PNP digital 10k/47 transistor	576-0013-032
Q 135	NPN high current SOT-223	576-0006-027
Q 200	PNP gen purp SC70 MSB1218	576-0013-700
Q 201	NPN low noise SOT-23	576-0003-636
Q 211	Dual gate GaAS	576-0006-405
Q 240	VHF/UHF amp SOT-23	576-0003-634
Q 260	NPN low noise SOT-23	576-0003-636
Q 261	PNP gen purp SC70 MSB1218	576-0013-700
Q 500	Bipolar MMIC SOT-143	576-0003-640
Q 520	NPN high current SOT-223	576-0006-027
Q 800	NPN gen purp SC70 MSD1819	576-0013-701
Q 840	NPN digital 47k/47 transistor	576-0013-046
Q 841	NPN digital 47k/47 transistor	576-0013-046
Q 842	NPN digital 47k/47 transistor	576-0013-046
Q 843	NPN digital 47k/47 transistor	576-0013-046
Q 844	NPN digital 47k/47 transistor	576-0013-046
Q 845	NPN gen purp SC70 MSD1819	576-0013-701
Q 911	NPN Si SOT-23	576-0003-658
R 110	100k ohm ±5% 0.063W 0603	569-0155-104
R 111	51k ohm ±5% 0.063W 0603	569-0155-513
R 112	15k ohm ±5% 0.063W 0603	569-0155-153
R 113	100k ohm ±5% 0.063W 0603	569-0155-104
R 114	15k ohm ±5% 0.063W 0603	569-0155-153
R 130	100k ohm ±5% 0.063W 0603	569-0155-104
R 131	1k ohm ±5% 0.063W 0603	569-0155-102
R 132	22k ohm ±5% 0.063W 0603	569-0155-223
R 133	43k ohm ±5% 0.063W 0603	569-0155-433
R 134	10k ohm ±5% 0.063W 0603	569-0155-103
R 135	10k ohm ±5% 0.063W 0603	569-0155-103
R 136	150k ohm ±5% 0.063W 0603	569-0155-154
R 137	150k ohm ±5% 0.063W 0603	569-0155-154
R 138	10k ohm ±5% 0.063W 0603	569-0155-103

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
R 139	470 ohm ±5% 0.063W 0603	569-0155-471
R 140	3.6k ohm ±5% 0.063W 0603	569-0155-362
R 141	5.6k ohm ±5% 0.063W 0603	569-0155-562
R 148	10k ohm ±5% 0.063W 0603	569-0155-103
R 200	12k ohm ±5% 0.063W 0603	569-0155-123
R 201	39k ohm ±5% 0.063W 0603	569-0155-393
R 202	300 ohm ±5% 0.063W 0603	569-0155-301
R 203	39k ohm ±5% 0.063W 0603	569-0155-393
R 205	2.2k ohm ±5% 0.063W 0603	569-0155-222
R 212	10 ohm ±5% 0.063W 0603	569-0155-100
R 213	1k ohm ±5% 0.063W 0603	569-0155-102
R 214	10k ohm ±5% 0.063W 0603	569-0155-103
R 215	160 ohm ±5% 0.063W 0603	569-0155-161
R 223	1.5k ohm ±5% 0.063W 0603	569-0155-152
R 230	3.3k ohm ±5% 0.063W 0603	569-0155-332
R 231	2.4k ohm ±5% 0.063W 0603	569-0155-242
R 232	39k ohm ±5% 0.063W 0603	569-0155-393
R 233	33k ohm ±5% 0.063W 0603	569-0155-333
R 234	7.5k ohm ±5% 0.063W 0603 (12.5 kHz BW)	569-0155-752
	18k ohm ±5% 0.063W 0603 (25 kHz BW)	569-0155-183
R 240	100 ohm ±5% 0.063W 0603	569-0155-101
R 241	75k ohm ±5% 0.063W 0603 (12.5 kHz BW Only)	569-0155-753
R 242	68k ohm ±5% 0.063W 0603	569-0155-683
R 243	22k ohm ±5% 0.063W 0603	569-0155-223
R 244	10 ohm ±5% 0.063W 0603	569-0155-100
R 245	1k ohm ±5% 0.063W 0603	569-0155-102
R 246	100k ohm ±5% 0.063W 0603	569-0155-104
R 247	330 ohm ±5% 0.063W 0603	569-0155-331
R 248	330 ohm ±5% 0.063W 0603	569-0155-331
R 249	22k ohm ±5% 0.063W 0603	569-0155-223
R 250	4.7k ohm ±5% 0.063W 0603	569-0155-472
R 260	2.2k ohm ±5% 0.063W 0603	569-0155-222
R 261	390 ohm ±5% 0.063W 0603	569-0155-391
R 262	39k ohm ±5% 0.063W 0603	569-0155-393
R 263	220 ohm ±5% 0.063W 0603	569-0155-221
R 264	12k ohm ±5% 0.063W 0603	569-0155-123
R 265	39k ohm ±5% 0.063W 0603	569-0155-393
R 266	100k ohm ±5% 0.063W 0603	569-0155-104
R 267	8.2k ohm ±5% 0.063W 0603	569-0155-822
R 500	270 ohm ±5% 0.063W 0603	569-0155-271
R 501	18 ohm ±5% 0.063W 0603	569-0155-180
R 502	270 ohm ±5% 0.063W 0603	569-0155-271
R 503	470 ohm ±5% 0.063W 0603	569-0155-471
R 504	470 ohm ±5% 0.063W 0603	569-0155-471

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
R 520	470 ohm ±5% 0.063W 0603	569-0155-471
R 521	10k ohm ±5% 0.063W 0603	569-0155-103
R 522	100k ohm ±5% 0.063W 0603	569-0155-104
R 525	100k ohm SMD trimmer	569-0130-104
R 526	10k ohm ±5% 0.063W 0603	569-0155-103
R 527	10k ohm ±5% 0.063W 0603	569-0155-103
R 528	10 ohm ±5% 0.063W 0603	569-0155-100
R 529	10k ohm ±5% 0.063W 0603	569-0155-103
R 531	10 ohm ±5% 0.063W 0603	569-0155-100
R 532	10k ohm ±5% 0.063W 0603	569-0155-103
R 534	1k ohm ±5% 0.063W 0603	569-0155-102
R 535	51 ohm ±5% 0.063W 0603	569-0155-510
R 536	1k ohm ±5% 0.063W 0603	569-0155-102
R 537	51 ohm ±5% 0.063W 0603	569-0155-510
R 540	100 ohm ±5% 0.75W 2010	569-0135-101
R 541	47k ohm ±5% 0.063W 0603	569-0155-473
R 800	4.7k ohm ±5% 0.063W 0603	569-0155-472
R 801	4.7k ohm ±5% 0.063W 0603	569-0155-472
R 802	4.7k ohm ±5% 0.063W 0603	569-0155-472
R 803	6.8k ohm ±5% 0.063W 0603	569-0155-682
R 804	6.8k ohm ±5% 0.063W 0603	569-0155-682
R 805	6.8k ohm ±5% 0.063W 0603	569-0155-682
R 806	20 ohm ±5% 0.063W 0603	569-0155-200
R 808	4.7k ohm ±5% 0.063W 0603	569-0155-472
R 809	10k ohm ±5% 0.063W 0603	569-0155-103
R 810	4.7k ohm ±5% 0.063W 0603	569-0155-472
R 811	51 ohm ±5% 0.063W 0603	569-0155-510
R 812	4.7k ohm ±5% 0.063W 0603	569-0155-472
R 813	16k ohm ±5% 0.063W 0603	569-0155-163
R 814	100k ohm SMD trimmer	569-0130-104
R 815	120k ohm ±5% 0.063W 0603	569-0155-124
R 816	39k ohm ±5% 0.063W 0603	569-0155-393
R 817	10k ohm ±5% 0.063W 0603	569-0155-103
R 818	220k ohm ±5% 0.063W 0603	569-0155-224
R 819	68k ohm ±5% 0.063W 0603	569-0155-683
R 820	10k ohm ±5% 0.063W 0603	569-0155-103
R 821	10 ohm ±5% 0.063W 0603	569-0155-100
R 822	18k ohm ±5% 0.063W 0603	569-0155-183
R 823	10k ohm ±5% 0.063W 0603	569-0155-103
R 840	10k ohm ±5% 0.063W 0603	569-0155-103
R 841	3.9k ohm ±5% 0.063W 0603	569-0155-392
R 842	10k ohm ±5% 0.063W 0603	569-0155-103
R 843	3.9k ohm ±5% 0.063W 0603	569-0155-392
R 844	10k ohm ±5% 0.063W 0603	569-0155-103
R 845	4.7k ohm ±5% 0.063W 0603	569-0155-472
R 846	24 ohm ±5% 0.063W 0603	569-0155-240
R 847	24 ohm ±5% 0.063W 0603	569-0155-240

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
R 848	24 ohm ±5% 0.063W 0603	569-0155-240
R 849	24 ohm ±5% 0.063W 0603	569-0155-240
R 900	10k ohm ±5% 0.063W 0603	569-0155-103
R 901	10k ohm ±5% 0.063W 0603	569-0155-103
R 911	10k ohm ±5% 0.063W 0603	569-0155-103
R 912	47k ohm ±5% 0.063W 0603	569-0155-473
R 913	47k ohm ±5% 0.063W 0603	569-0155-473
R 914	1k ohm ±5% 0.063W 0603	569-0155-102
U 110	Voltage regulator adjustable	544-2603-093
U 111	Voltage regulator adjustable	544-2603-093
U 130	Quad op amp SO-14 331	544-2020-017
U 230	FM IF SA676DK	544-2002-037
U 510	6W power module 900 MHz	544-4001-049
U 520	Op amp SO-8 MC33172D	544-2019-017
U 800	Fractional-N synthesizer	544-3954-027
U 840	8-stage shift register SOIC	544-3016-094
U 900	Quad 8-bit TLC5620ID	544-2031-014
U 901	8-stage shift register SOIC	544-3016-094
U 902	3 2-chnl analog mux/demux	544-3016-053
Y 800	17.5 MHz TCXO ±1.5 PPM	518-7009-521
Z 200	944 MHz 3-pole ceramic	532-2006-040
Z 201	944 MHz 3-pole ceramic	532-2006-040
Z 220	87.85 MHz 4-pole 8 kHz BW (12.5 kHz BW)	532-0009-021
Z 220	87.85 MHz 4-pole 15 kHz BW (25 kHz BW)	532-0009-022
Z 221	87.85 MHz 4-pole 8 kHz BW (12.5 kHz BW)	532-0009-021
Z 221	87.85 MHz 4-pole 15 kHz BW (25 kHz BW)	532-0009-022
Z 230	450 kHz 9 kHz BW ceramic (12.5 kHz BW)	532-2004-015
Z 230	450 kHz 20 kHz BW ceramic (25 kHz BW)	532-2004-013
Z 231	450 kHz 9 kHz BW ceramic (12.5 kHz BW)	532-2004-015
Z 231	450 kHz 20 kHz BW ceramic (25 kHz BW)	532-2004-013

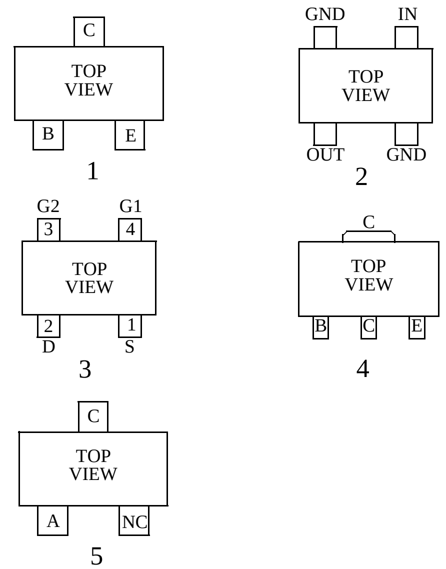
VCO 928-960 MHz
Part No. 023-3492-540

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
C 820	22 pF ±5% NPO 0603	510-3674-220
C 821	22 pF ±5% NPO 0603	510-3674-220
C 822	22 pF ±5% NPO 0603	510-3674-220
C 824	1.5 pF ±0.1 pF NPO 0603	510-3673-159
C 825	2 pF ±0.1 pF NPO 0603	510-3673-209
C 826	22 pF ±5% NPO 0603	510-3674-220
C 827	22 pF ±5% NPO 0603	510-3674-220
C 830	22 pF ±5% NPO 0603	510-3674-220
C 831	22 pF ±5% NPO 0603	510-3674-220
C 832	22 pF ±5% NPO 0603	510-3674-220
C 833	6.8 pF ±0.1 pF NPO 0603	510-3673-689
C 834	1 pF ±0.1 pF NPO 0603	510-3673-109
C 835	22 pF ±5% NPO 0603	510-3674-220
C 836	4.3 pF ±0.1 pF NPO 0603	510-3673-439
C 838	1 pF ±0.1 pF NPO 0603	510-3673-109
C 840	.001 µF ±10% X7R 0603	510-3675-102
C 841	22 pF ±5% NPO 0603	510-3674-220
C 842	2.2 pF ±0.1 pF NPO 0603	510-3673-229
C 844	3.9 pF ±0.1 pF NPO 0603	510-3673-399
C 845	3.9 pF ±0.1 pF NPO 0603	510-3673-399
C 846	2.7 pF ±0.1 pF NPO 0603	510-3673-279
C 850	22 pF ±5% NPO 0603	510-3674-220
C 851	4.7 pF ±0.1 pF NPO 0603	510-3673-479
C 852	22 pF ±5% NPO 0603	510-3674-220
C 853	22 pF ±5% NPO 0603	510-3674-220
C 854	22 pF ±5% NPO 0603	510-3674-220
C 860	22 pF ±5% NPO 0603	510-3674-220
C 861	4.3 pF ±0.1 pF NPO 0603	510-3673-439
C 863	2 pF ±0.1 pF NPO 0603	510-3673-200
CR820	PIN switch diode SOT	523-1504-001
CR821	PIN switch diode SOT	523-1504-001
CR822	Varactor SOD-323 BB535	523-5005-022
CR824	Varactor SOD-323 BB535	523-5005-022
L 820	68 nH ±10% SMD 0805	542-9003-687
L 821	68 nH ±10% SMD 0805	542-9003-687
L 822	68 nH ±10% SMD 0805	542-9003-687
L 823	68 nH ±10% SMD 0805	542-9003-687
L 825	68 nH ±10% SMD 0805	542-9003-687
L 826	Resonator 0.5" long SMD	542-9004-011
L 830	68 nH ±10% SMD 0805	542-9003-687
L 831	12 nH inductor LL2012	542-9003-127
L 832	3.3 nH inductor ceramic	542-9003-336
L 833	10 nH inductor LL2012	542-9003-107

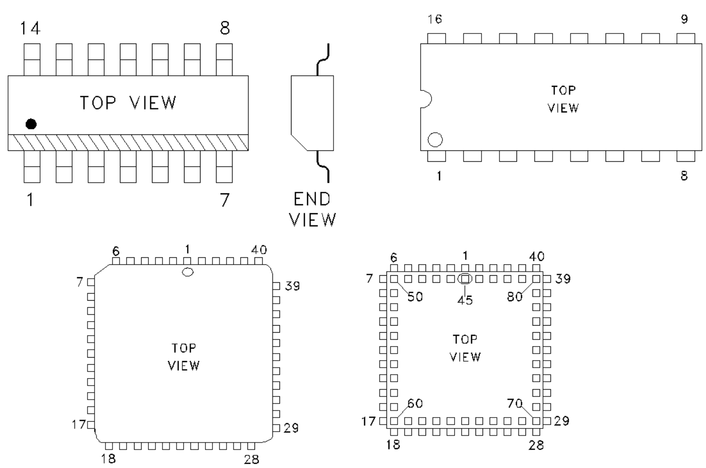
SYMBOL NUMBER	DESCRIPTION	PART NUMBER
Q 820	NPN transistor NE85619	576-0003-651
Q 821	NPN transistor NE85619	576-0003-651
Q 822	NPN transistor NE85619	576-0003-651
Q 823	NPN transistor NE85619	576-0003-651
R 820	10k ohm ±5% 0.063W 0603	569-0155-103
R 821	100 ohm ±5% 0.063W 0603	569-0155-101
R 822	10k ohm ±5% 0.063W 0603	569-0155-103
R 823	10k ohm ±5% 0.063W 0603	569-0155-103
R 824	3.3k ohm ±5% 0.063W 0603	569-0155-332
R 825	10 ohm ±5% 0.063W 0603	569-0155-100
R 826	150 ohm ±5% 0.063W 0603	569-0155-151
R 827	10 ohm ±5% 0.063W 0603	569-0155-100
R 830	4.3k ohm ±5% 0.063W 0603	569-0155-432
R 831	5.6k ohm ±5% 0.063W 0603	569-0155-562
R 832	3k ohm ±5% 0.063W 0603	569-0155-302
R 833	200 ohm ±5% 0.063W 0603	569-0155-201
R 835	200 ohm ±5% 0.063W 0603	569-0155-201
R 836	200 ohm ±5% 0.063W 0603	569-0155-201
R 840	100 ohm ±5% 0.063W 0603	569-0155-101
R 842	27k ohm ±5% 0.063W 0603	569-0155-273
R 843	3.9k ohm ±5% 0.063W 0603	569-0155-392

SECTION 8 SCHEMATICS AND COMPONENT LAYOUTS

TRANSISTOR AND DIODE BASING REFERENCE TABLE		
TRANSISTORS		
Part Number	Basing Diagram	Identification
576-0003-636	1	
576-0003-640	2	
576-0006-027	4	P1F
576-0006-405	3	U72
576-0013-032	1	6D
576-0013-046	1	8C
576-0013-700	1	BR
576-0013-701	1	ZR
DIODES		
523-1504-001	5	4D
523-1504-002	5	5A
523-1504-016	5	5F
523-5005-022	5	5B



INTEGRATED CIRCUITS



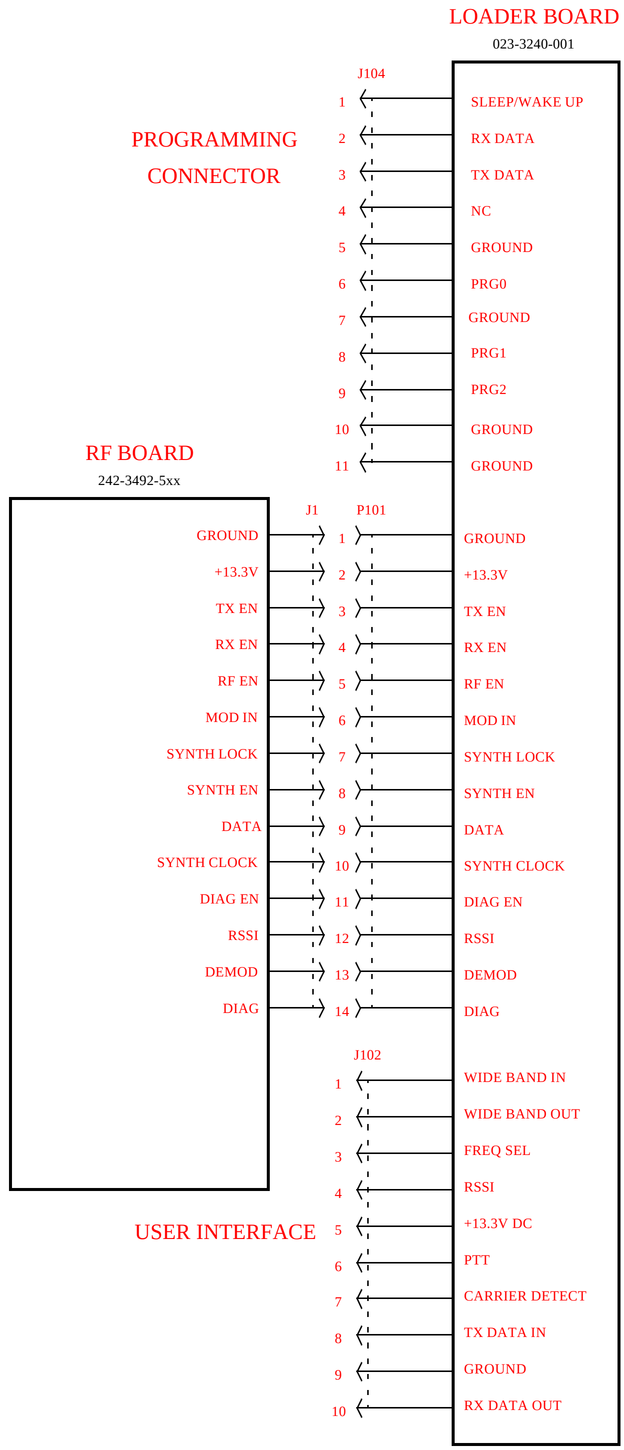


Figure 8-1 LOADER BOARD INTERCONNECT

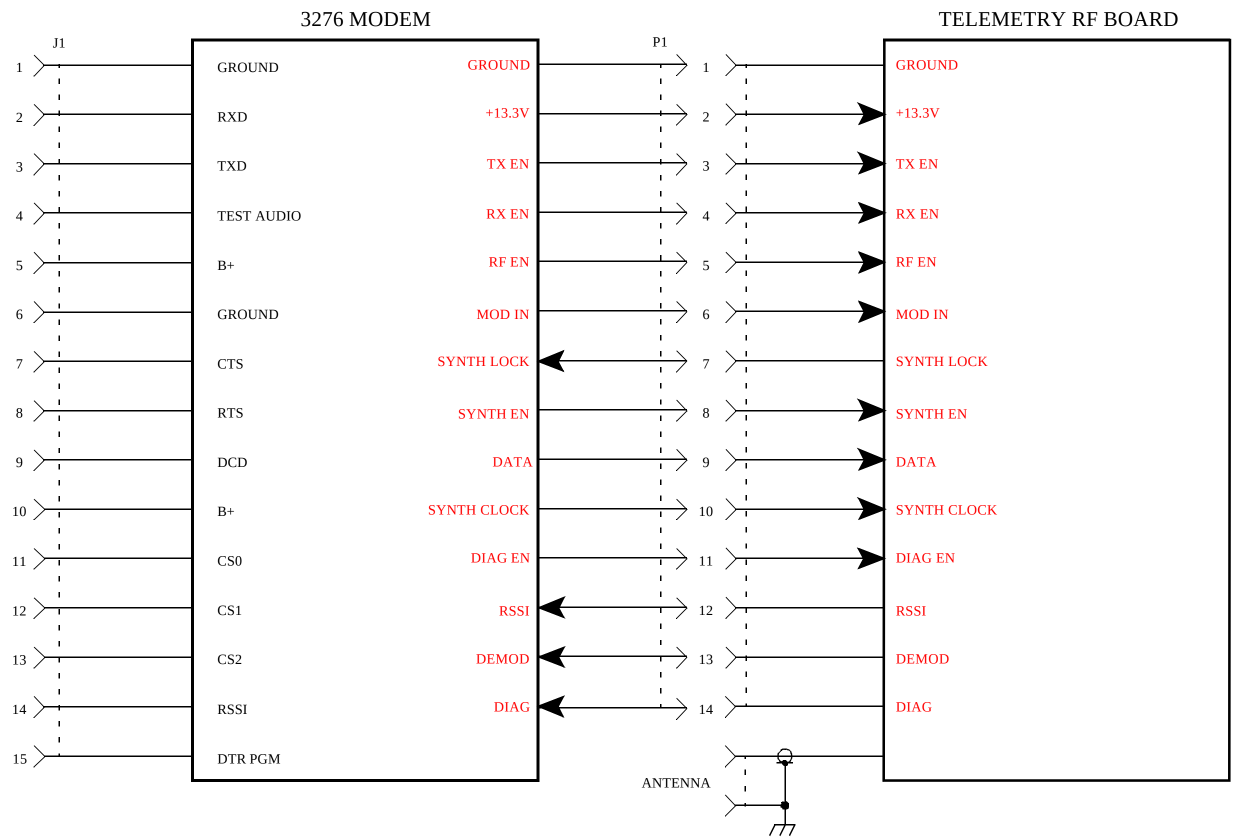


Figure 8-2 MODEM INTERCONNECT

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

Figure 8-4 TRANSCEIVER COMPONENT LAYOUT (OPPOSITE COMPONENT SIDE VIEW)

Figure 8-5 SCHEMATIC 1 OF 2

Figure 8-6 SCHEMATIC 2 OF 2

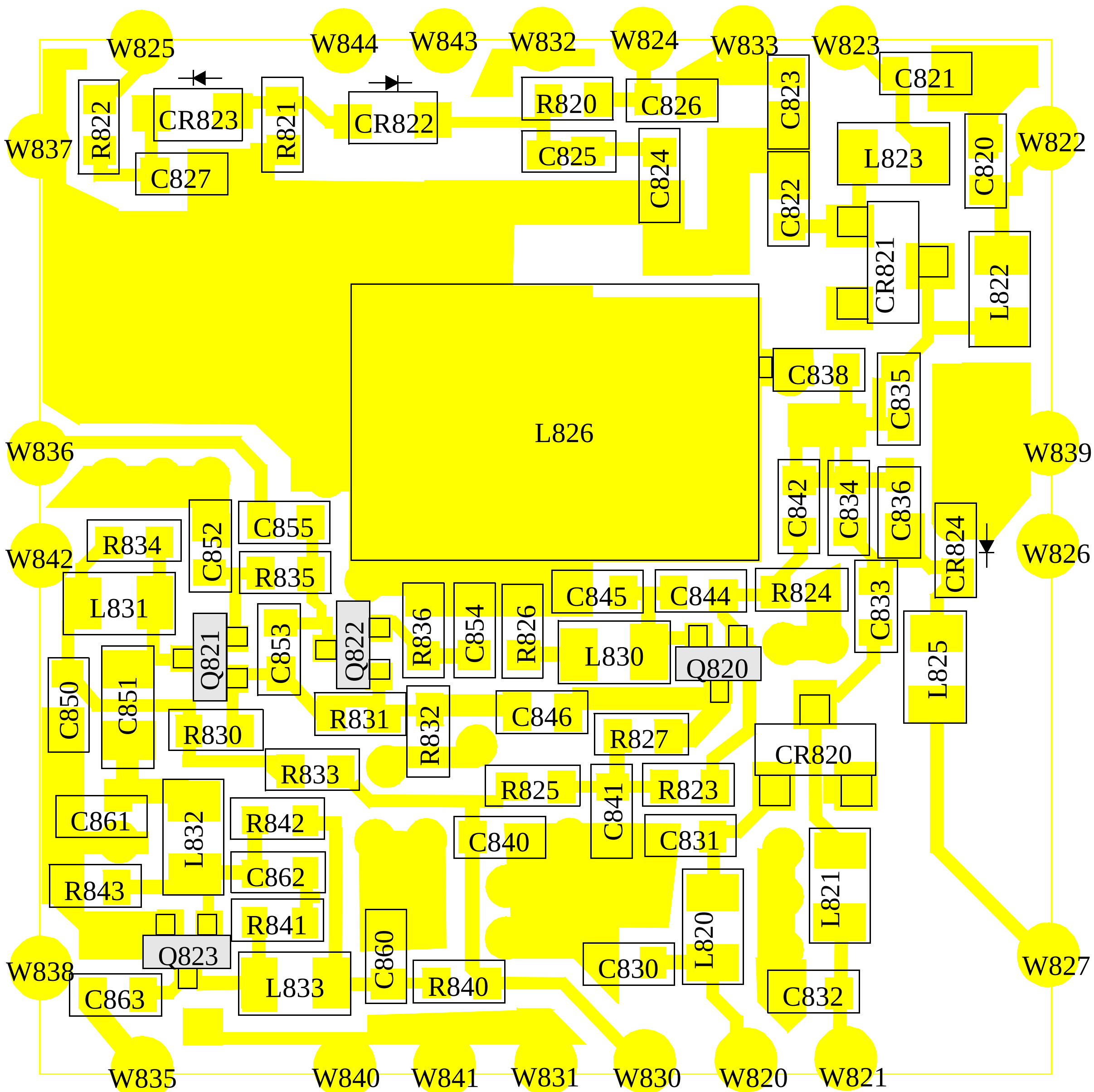


Figure 8-7   VCO COMPONENT LAYOUT

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