

TPRS

Texas Packet Radio Society

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Modifications to the RCA series 700 UHF mobile trunk mount transceiver for use with data modems.

June 1st, 1990

If you haven't done so already, order
crystals. See Appendix A page 9.

Parts :

The following parts are needed for this
modification:

- 1 Receive XTAL
- 1 Transmit XTAL
- 1 15K Ω 1/8 watt 10%
- 1 10K Ω 1/8 watt 5%
- 1 18pf NPO 5%
- 2 .001 bypas cap
- 1 1200 Ω 1/8watt 10%
- 1 1N914 or 1N4148 diode
- 1 Varicap Diode **Siemens BB409**
- 1 LED 12volt
- 2 Shielded Audio Cables
- 1 Molex Power Connector
Male #03-09-2021
Female 02-09-2103
- 1 Large DPST Power Switch
(from control head)
- 1 Squelch Control (from control head)
- 1 Mic Connector (from control head)
- 1 female DB-9
- 1 Small DPDT switch for DataVoice Switch

Description :

1. Take the covers off.
2. Place the radio with the large round connector facing you and with the component side up. There are a number of different styles of case, but there is a large main connector for the control head and a RF connector, a S0-239. Figure 5 of Appendix D shows a picture of the radio and it boards.
3. Looking at the rear of the radio, there may be 2 assemblies visible. The one on the right with the 3 transformer cans is the exciter board, more about it later. There might be a board on the left at a slightly higher level than the exciter board. This is the Quite Channel Assembly (shown in Figure 5 appendix D). The assembly is held in place by four (4) screws. Remove the 4 mounting screws, there are 3 in the corners. In the back left, the screw has been brought in from the left side about one inch. There will be a harness that makes connections to a board that becomes visible when the assembly is lifted.
4. Carefully turn the radio over. Towards the right rear, there is the solder side of the Low IF board [a 4" x 8" board]. This one board has connections for practically all of the control voltages in the radio.
5. There should be 4 screws that are holding the Low IF board to the chassis standoffs. Remove them. Lift and rotate the Low IF board towards the front of the radio to expose the backside of the board.
6. There were two basic versions of the Low IF board manufactured. The early version used 3 IF cans, the "new" one used 2 IF cans. The new one also used a couple of ICs on the board. Later wiring instructions depend on which version of the Low IF board you are working with. Make a note now.
7. Remove **ALL** the wires coming from the Quite Channel Assembly. Each connection on the Low IF board is numbered. Please note where pins 18, 20, 24 and 31 are located. You will need to use these later. The TexNet NCP

board does not use the Quite Channel Assembly system, squelch, or the audio system. The audio from the discriminator is fed directly into the demodulator section of the 9600 baud modem.

8. Jumper pins 18 and 20 using a short wire jumper. This connection enables transmit push to talk. If the Quite Channel Assembly tone encoder board was not present, then this jumper should be already in place. **BUILDER NOTE:** Salvage connector ends from the PL tone encoder board harness to use as jumpers in the following sections.

9. Locate the silkscreen legend for R24 on the **OLD** Low IF board or R31 on the **NEW** Low IF board. If the Quite Channel Assembly was present this resistor will have already been removed. If the resistor is present, remove the wire stubs and clean the solder from the 2 holes. Put a 15k ohm, 1/8 watt 10% resistor in R24 or R31. This resistor is the audio feed to the first audio pre-amp in the audio chain. Check to be sure of continuity through it.

10. Prepare 2 shielded audio cables 15 to 18 inches long. Label the first cable "RX Data" and have it leads about 1 1/2" long on one end. Label the second cable "Data/Order Wire" and have it leads about 3/4" long. Leave the other end of both cables alone till later.

11. Connect the "RX Data" cable's center lead to the pin 24, either version of the Low IF board. This is the audio from the discriminator. The cable's ground should be connected to pin 31, board ground, this is the same on either board version.

12. Remount the Low IF board, being sure to route the shielded "RX Data" cable along with the wire harness to front of the radio.

13. Turn the radio right side up again. Locate the exciter board. If there are any channel elements plugged in, remove them at this time. The channel elements for TX are rectangular boxes. There are "hold-downs" that keep the elements locked to the board. Notice the guide

pins and the four small pins labeled numbered 1, 2, 3, and 4. Also notice the legends F1, F2, F3, and F4. You'll need to line up one of the channel elements at F1 later when you are ready to setup the radio for tuning.

14. Locate resistors R24 and R25 on the exciter board. They are located near Q4 and the middle transformer can. One lead of R25 goes through the pc board on the edge nearest the rear of the radio.

15. Remove the exciter board. There are 5 screws that hold the board to chassis standoffs.

16. Using the "Data/Order Wire" cable, connect the center conductor to the junction of R24, R25 and the base of Q4. The cable's ground should be connected to the lead of R25 nearest the board edge. This modification will ground this junction shutting off the audio from the microphone, when switch is in data position.

17. Route the "Data/Order Wire" cable along the wire harness to the front of the radio. Remount the exciter board.

18. On the right side there is a module that is to the right of the exciter board with printed numbers 4, 5, 6, 7, 8, and 9. Remove the 5 screws holding the cover. This board is the 'multiplier chain' for the transmitter. There are 2 doubler stages (5, 6, 7, and 8) and a tripler stage (8 and 9).

19. Carefully lift the cover off and move it to one side. It will remain attached via wires that connect to the feed-thru capacitors to pins on the board.

20. Locate the silver mica capacitor labeled C19. It is near the transformer can labeled on the cover with the print 8. It is mounted in two socket pins that allow it to be slipped out. Remove it. Replace it with another silver mica at 10 picofarad. This modification gives better stability of this and the next tripler stage at 445.1.

21. Remount the cover to the multiplier chain.

22. Orient the radio with the large round control head connector facing you. Look in the left corner of the radio nearest you; on the top of the radio chassis there is a wire that may be broken labeled JU1. This wire when connected forces the radio to operate only on one channel, which is the socket in the receiver section and the exciter board that corresponds to F1.

23. If there isn't a wire there, remove the 4 screws holding that piece of pc board material. Carefully lift the section, clean the two small holes and connect them together with a short piece of wire, preferably on the top side so that the modification is obvious. Remount the pc board. **NOTE:** Connecting lead A from the main harness to ground will also enable F1.

24. Remove the RX channel element, which should be located to the right of JU1. Make sure to keep the RX element separated from the TX elements. **BUILDER NOTE:** You might want to mark the base to indicate which is which. The channel elements for RX and TX are rectangular boxes. You will only need to use one RX and one TX channel element. **BUILDER NOTE:** Save the extra TX channel elements, since they are expensive to replace. The only place to buy exact replacements is International Crystal and Manufacturing. In 1986 the elements cost \$78 a piece with crystal.

See Appendix A for crystal ordering.

25. On each side of the element there are dimpled points of the metal can that hold the cover on the element. Pry those dimples open and pull the cover off. Save the plastic wrapper inside the element.

26. The RX channel element has two transistors; the TX channel element has one transistor.

27. The channel elements may have crystals in it. Unsolder the two pins and the ground lead. Save the ground lead connection; you'll need that for the new crystal.

28. Clean the solder off the crystal pins and the ground connection hole.

29. First push the new crystal into the connection pins. Solder the new RX or TX element ground lead strap and then the connection pins.

30. Tightly wrap the element with the plastic wrapper. Line up the variable capacitor with the adjustment opening in the top of the metal can and push the cover back on the element.

31. Push the dimpled points of the cover back into their depressions.

32. Install the receive channel element into the receiver position marked F1.

33. Install one transmit channel element with a new transmit crystal at the pins marked F1 on the exciter board. Again note the guide pins are to the left of the circuit pins. Install the element hold-down bracket.

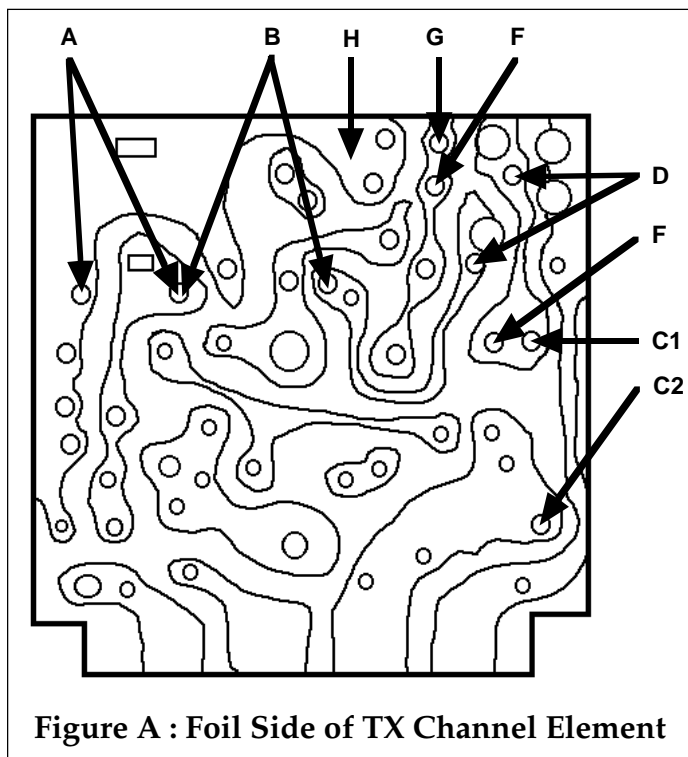
STOP! — At this point, you have not modified the radio sufficiently enough to prevent it from being tuned up by a commercially equipped shop. You need to have the radio re-tuned, on frequency, to work in the 440 ham band.

Appendix D details the tuneup procedure. If you are going to do the tuneup yourself, please be sure not to touch the High IF strip transformers and the Low IF strip transformers. The multiplier strip for the transmit section is a very critical adjustment. The triplers in particular are difficult to tune and will operate on the wrong frequency if mistuned. Appendix C is the schematic of the test meter. It can be very handy when working on the radio.

Return to modification procedures after the radio is tuned up.

34. After the radio is tuned up, then the TX element needs to be modified for the 9600 baud modem. Remove the TX channel element from the exciter board. Remove the cover.

35. Modify the TX crystal channel element referring to Figure A, do the following modifications. Figures B and C show the channel element circuit before and after the modification. Appendix E describes a heater circuit for keeping the TX element at a constant temperature. This can be used on radios located at sites with temperature problems.



36. Remove the 33pf Cap at [A]. Do not destroy the cap, it will be used in step 40.

37. Install the 18 picofarad NPO 5% capacitor at [A] in place of the 33pf cap removed in step 36.

38. Install a jumper wire between points [B].

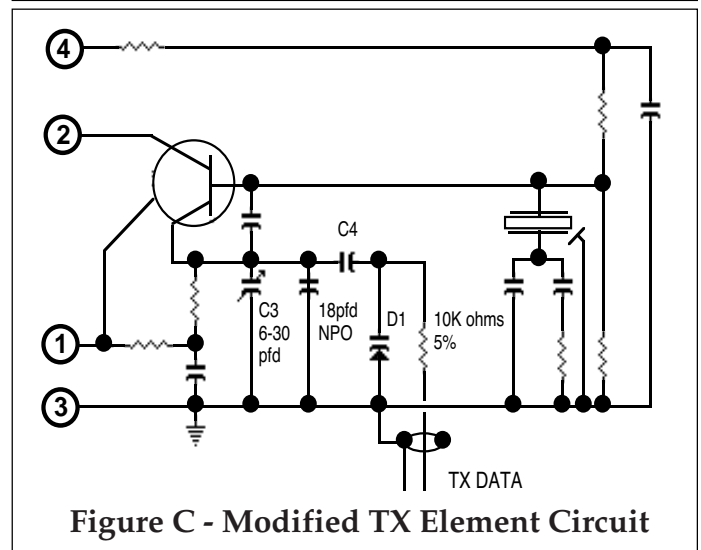
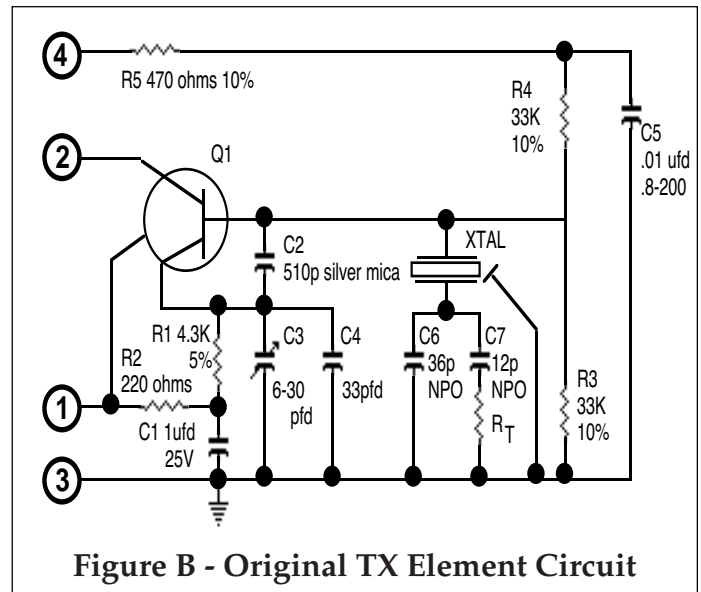
39. Install the varicap diode between [C1] and [C2]. The band side of the diode should be attached to [C1].

40. Reinstall the 33pf cap from step 36 at points labeled [D].

41. Install the 10K ohm, 1/8 watt, 5% resistor at points labeled [F].

42. Prepare and attach a 15 to 18 inch long shielded audio cable with 3/4" leads on center and ground. Mark this cable as "TX Data". The center conductor is attached to point [G]. The shield is attached to point [H].

43. Insert the TX element without the cover on the exciter board. Route the "TX Data" cable it to the front of the radio. **BUILDER NOTE:** Drilling a hole in the element cover, to allow the TX Data cable to pass through, will allow the cover to be placed back onto the element.



Description of TX Element Pins :

Pin 1 is the element switch, when pin is grounded and VCC is present the oscillator works.

Pin 2 is output.

Pin 4 is VCC, the connection goes to a voltage switch in the transceiver that controls power to this element.

Modification Type A & B

You now have the choice of two console modification styles. ModA (complete) is the TexNet Standard. It is the most full featured and allows radios to be used on both data and voice if needed. ModB (simple) is the minimum to allow the radio to operate as a data radio. We suggest you use ModA if in the Texas network to be compatible with other radios in the network, in the case it is necessary to substitute radios. Having similar radios has proven to be very useful. Mod A will be give in detail and Mod B will described after Mod A. Mod B is a subset of modifications described in Mod A.

Modification Type A

44. The bulk of these modifications turn a mobile radio into a self-contained, fixed service unit. You will be mounting all of the various connectors and controls in a new front panel that replaces the old panel. If you received the control head for the unit, parts for the volume control, squelch control, microphone, and speaker are part of the control head. Remove the volume control, squelch control, microphone, and speaker from the control head. On the volume and squelch controls, leave the cables connected. The wiring will help indicate where to attach wires when you re-make the connections to the cable bundle in the transceiver.

45. Figure D shows how each wire will be used in the modification. Appendix B shows the new front panel's dimensions and the placement of parts.

46. The front case is an aluminum casting with 4 counter-sunk screws on the top. Remove the four screws.

47. Turn the radio over, bottom up. Remove the eight countersunk screws on the bottom. At this point only the 2 hex head bolts, one on each side are holding the chassis to the front case.

48. Carefully turn the radio over, top up. Remove both hex head bolts. Pull the front

casting away from the main chassis. The audio amp module on the right side should be loose.

49. Dependent on the case style, the RF connector and the control head connector will need to be removed either from the inside or outside. Also, remove the security lock, but *don't destroy it*.

50. The large round control head connector on the radio has all of the connections necessary to power, operate, and control the radio. Most versions of the radio have very small letters on the wiring indicating the circuit connection to the connector. Check your radio for this before going any further. If the wiring doesn't have the marking, the connector itself has letters on each pin. Make a record and label each wire, if necessary, as you pull them off the connector one by one.

51. Mount the speaker on the standoffs provided on the internal audio amplifier mount. If you are using an original speaker from a control head or remote speaker box, it will fit perfectly on the standoffs. One version of the amplifier that has been found does not have a chassis section. Some other mounting scheme will need to be devised in that instance.

52. Using the dimensions from Appendix B (not to scale), make a new front panel. Use the new front panel as a template to drill and cut holes in the sub-panel where the front panel will be fitted on top of. These holes will allow the new control head components to pass through both the new front panel and sub-panel.

53. Mount the new front panel and the sub-panel on the front casting and then install the controls and connectors. Placement is shown in Appendix B.

Figure D Control Head Cable Connections

2/1/90

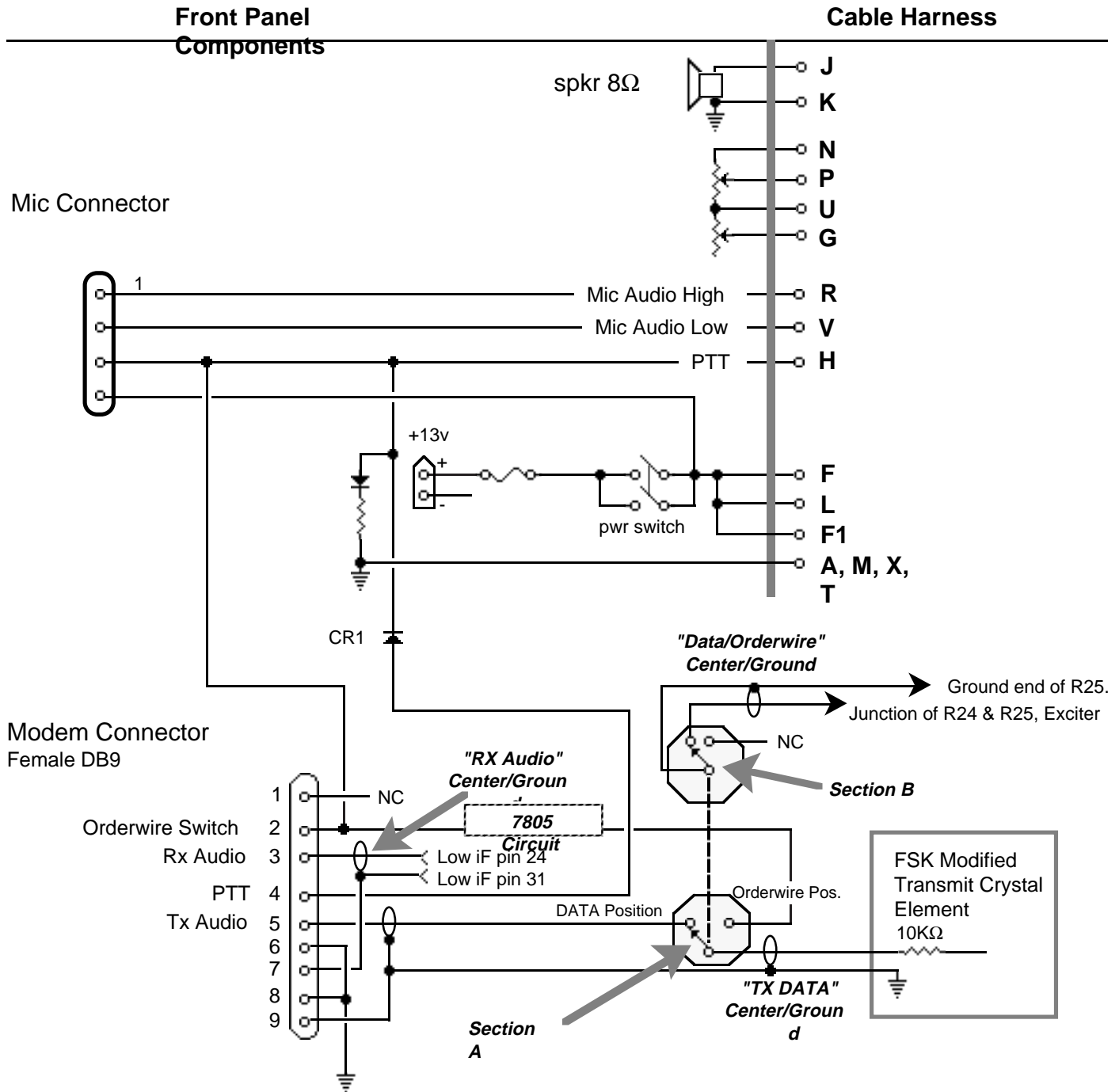


Figure D : Front Panel Diagram

54. The specific connectors are highly suggested to maintain some interchangeability between various site radios. Please use this list for the connectors:

- Large 2 pin Molex, readily available at Radio Shack. Male connector is Molex number 03-09-2021. Female connector is Molex number 02-09-2103. The female socket with male pins goes on the radio. The positive DC voltage goes to the pin in the pointed side of the connector.
- A large Double Position Single Throw switch to be used for power ON/OFF. Be sure the switch can handle 10 Amps.
- Squelch Control from the control head.
- Microphone connector from the control head.
- Standard round fuse holder. Fuse should be a 10 Amp slo-blow.
- Female DB-9 connector to be used for the modem connection.
- A small Double Pole Double Throw switch to switch between data and order-wire operation.
- A LED, your choice of color, to indicate transmit.
- The RF connector is left unchanged. It will need to be re-mounted on the new front panel.

55. On the cable bundle in the 700, cut and cap individually wires B, C, D, E, I, and W.

56. On the audio amplifier module, connect Pin J on the amplifier to the ungrounded lead of the speaker (if the speaker has a grounded lead). Connect Pin K on the amp to the grounded or other lead of the speaker.

57. Pin X and wire X are audio amp ground. Pin F, from the main connector, has two wires attached. Separate the two wires from the connector. Determine which F wire is attached

to Pin F on the Audio amp. Label this wire as F1. The other F wire remains F. Connect F1 to switch on Squelch control. F1 will supply +voltage when squelch switch is on to operate the speaker. This is to allow the speaker amplifier to be turned off to allow lower current drain for those sites which run off batteries.

58. Wire R (should be the center of a shielded cable) goes to Pin 1 on the mic connector, Mic audio High.

59. Wire V, is the shield of wire R and goes to Pin 2 on the mic connector.

60. Wire H, is the Push-to-talk line, it goes to Pin 3 of the mic connector and through diode CR1 to Pin 4 of the DB9 modem connector. The band of the diode should be facing Mic pin 3 - PTT.

61. Pin 4 on the mic connector connects to the main power switch.

62. In the following steps 58 thru 63, the pin numbers refer to the DB9 modem chassis connector. Refer to Figure D.

63. Pin 3 is connected to the center conductor of the cable you installed and labeled "RX Data". Pin 6 is connected to the shield of that cable.

64. Pin 4, PTT, is connected to the wire H through a diode as indicated above in step 46.

65. Pin 5, is connected by the center conductor of a short piece of shielded audio cable to the data side of Section A of the data/order-wire switch.

66. The shield of the cable connected to Pin 5 should be connected to Pin 9 of the DB9 connector.

67. Pin 8 should be connected to chassis ground.

68. On section A of the data/order-wire switch, the center conductor of the cable marked "TX

Data" should be connected to the center/pole connection of the switch. The shield should be grounded to Pin 9 of the DB9 modem connector.

69. The +5VA side of section A is supplied from pin 2 of BD9. This circuit will need to be built and installed here.

70. Section B of the data/order-wire switch, the center/pole connection should be connected to the conductor of the "Data/Order Wire" cable. The ground of the "Data/Order Wire" cable connects to the data side of section B.

Power Connections :

71. Connect power using 14 gauge wire. Attach the positive side of the power connector (the positive is the pin in the pointed end of the Molex connector), to one side of the fuse holder. The other side of the fuse holder should be soldered to the power switch.

72. The other side of the power switch goes to Wires F and L in the cable bundle.

73. Wires A, M, X, T, and LED from power connector are all tied together. M should be grounded to the side chassis rail and the front panel already.

74. Solder wires N and P to the volume control. N is the high side of the pot, P is the wiper.

75. The squelch control wiper is connected to wire G. There is no connection to the high side of the pot.

76. Wire U is connected as a ground return on the low side of both the volume and squelch pots.

77. Solder a 1200 ohm, 1/8 watt, resistor on the lead with the flattened side of the LED. Solder the free end of the resistor to ground. Solder the free end of the LED to pin 3 of the microphone connector (PTT terminal).

78. Re-assemble the front casting on the radio, by reversing steps 46-48.

Modification Type B

ModB (simple) is the minimum to allow the radio to operate as a data radio. Mod B is a subset of modifications described in Mod A.

- Disassemble the front casting on the radio, by using steps 46-48.
- The minimum conversion is to install the receive data and the transmit data connections. To do this follow step 10, 11, and 12 for receive data. Follows steps 34 to 43 for transmit oscillator conversion.
- Use steps 13 to 16 as a guide to locate R25 and install a jumper across it to permanently disable TX Audio.
- Connect the "RX Data" cable to pin 3 and 7 of the DB9.
- Connect the "TX Data" cable to pins 5 and 9 of the DB-9 modem connector.
- Connect pin 4 of DB9 per step 64.
- The audio P.A., Mic connector, squelch, and volume controls can be left out.
- Power can be feed through the original power/control cable. Otherwise follow steps 55, 72. and 73.
- Tape all wires left unused to prevent shorting during radio operation.
- Re-assemble the front casting on the radio, by reversing steps 46-48.

Appendix A - Crystal Ordering Information

For the RCA series 700 radio, you need crystals from International Crystal Manufacturing.

Here's the pertinent info for operation on the TexNet frequency:

Transmit: catalog No. 311190, 445.100000mHz, 12.363888mHz. Xtal/MI559230 TX(406-512mHz)

Receive: catalog no. 311201, 445.100000mHz, 15.948148mHz. Xtal/MI559500 RX(450-512MHz)5PPM

The address and phone number is:

ICM
701 W. Sheridan
P.O. Box 26330
Oklahoma City, OK 73126-0330

1-800-426-9825
(1-800-ICM-XTAL)

They will take Visa or MasterCard.

Appendix B - Front Panel Diagram

Appendix C - Schematic for Test Meter

Appendix D - RCA 700 Tune Procedures
