MODULE 17

TRANSMIT AND RECEIVE CONTROL HEAD FAULT ISOLATION

OBJECTIVE

Given TO 31S1-2TSC60-12, isolate Transmit and Receive Control Head faults IAW para 5-58 thru 5-106.

PREREQUISITES

1. Must complete Modules 1, 2, 3, 15, and 16.

2. Must be able to use the 7404A-1 Source Generator.

INFORMATION

In this module we'll discuss testing of the computer system. This test is used to ensure that everything functions properly and to isolate faults in the Control Heads. You will test one portion of the system at a time. If there is no malfunction, you will continue to another portion of the system. If there is a malfunction, you will analyze the lamp indicators to determine where the malfunction lies. The TO explanations, although a little confusing, are fairly complete in guiding you to the defective circuit card or component. The purpose of this module is to help you through the confusion.

You're going to need to refer to the -12 TO while completing this module. Get with your trainer and coordinate use of the TO with him/her, since it may be needed in the van for maintenance. Read para 5-58 thru 5-70, then return to the module.

The TO says that this particular procedure is used when a Radio Control Group is determined to be inoperative. There are also malfunctions that this procedure can detect that are not identified during normal operation or the performance tests. Therefore, it is a good idea to perform the diagnostic tests on each Control Head periodically, at least once a year.

The first step in the diagnostic analysis is to remove the Transmit Control Head from the OK-145, since it contains the computer you will be testing. Next, you will replace the hardwire memory card with the Auxiliary Control Module. The hardwire memory card contains the program telling the computer how to function. In this case, you're reprogramming the computer with the diagnostics program.

When performing these tests, the lamps on the Control Head front panel and on the Maintenance Display indicate either the test was completed or it failed. When a test fails, the combination of lamps will usually indicate which portion of the test failed. For an example, look at Figure 5-7 of the TO.

This figure is a flow chart for Test 1. The first test is the Literal Branch test. If this test fails, the Fault lamp on the Transmit Control Head lights. All other lamps, except the Unit Power indicator, should be off. The next test is the Literal Accumulator Load test.

If this test fails, both the OPR lamp and Fault lamp light. Look at the indications in the right column of Figure 5-7 for the remainder of this test. Each portion has its own fault indications. In all cases the Fault lamp comes on. However, by looking at which other lamps are lit, you can determine which part of Test 1 failed. If the entire test is completed with no faults, the Prove and

Initiate lamps light, and you are done. When a failure occurs, you may have to consult para 5-71 thru 5-106.

If any part of Test 1 fails, the computer locks itself in a continuous loop of that test so you can isolate the defect. Take a look at para 5-72 thru 5-81. Paragraph 5-72 provides troubleshooting procedures for each possible fault indication. Simply search through para 5-73 thru 5-81 for the indication shown, and the TO will direct you in troubleshooting that fault. If you don't get any lights on the Control Head, but the Maintenance Display lamps show correct, follow the troubleshooting procedure in para 5-107. Pretty simple, huh! The hard part is finding the correct troubleshooting paragraph in the TO. At times, you just have to thumb through that part of the TO, page by page, until you find it.

Let's cover one additional bit of information before we continue with the diagnostic tests. Most of the computer circuit cards are multi-layer cards. That means that there is more than one layer of circuits sandwiched together. Multi-layer boards require special soldering techniques and equipment. In addition, a large majority of the integrated circuits on these boards are no longer available. The Illustrated Parts Breakdown codes all of these boards "limited field repair, depot overhaul." If you don't have the skills, equipment, or parts to repair a card, you are authorized to NRTS it and replace the entire board. In such cases, you may not need to troubleshoot the board down to the component. Discuss this subject with your trainer before you continue so that you will be aware of local procedures.

Now, back to the diagnostics. If all goes well with Test 1, and you do get all the correct lights, pressing the Initiate button puts the system into Test 2. Again, if there

is any malfunction, the computer locks into a loop so you can troubleshoot it. Paragraph 5-82 of the TO provides you the troubleshooting procedure for this test.

The remainder of the diagnostic tests are summarized in para 5-70f. This paragraph outlines all the steps required to perform the tests but provides no explanations or details. Paragraphs 5-92 thru 5-106 of the TO not only provide you step-by-step instructions for performing the tests, they also provide more information about each test. Keep these two sections of the TO in mind as you proceed. Use para 5-70f like a PMI workcard set and, if you need more information, refer to para 5-92 thru 5-106.

Once Test 2 is completed, pressing the Initiate button puts the system into Test 3. This test, as well as Test 4, is a little different from Tests 1 and 2. Read para 5-92 and 5-93 for explanations of Tests 3 and 4 before continuing.

These two tests do not lock up the computer. So you can perform Test 4 even though Test 3 may have failed. Both of these tests identify malfunctions on cards that you cannot repair in the field. So if you get a fault, you must replace the appropriate circuit card. Paragraphs 5-92 and 5-93 explain why a particular card must be replaced and which card to replace. Now on to Test 5.

Now we're getting into tests that are more difficult to understand. Test 5 exercises a portion of the computer memory by putting ones and zeros in memory and reading them back. The Maintenance Display is your troubleshooting aid for this test. Paragraphs 5-94 thru 5-98 explain this test and how to interpret the data. You may not completely understand the TO explanation, but don't worry about it.

Read those paragraphs now **very carefully,** and then we'll discuss what the TO is trying to explain.

Was that reading assignment confusing? If you weren't confused by those explanations, you're in the wrong business. Actually this test is quite simple. It exercises the memory registers on card A7A6. If the test detects any faults, the Fault lamp on the Transmit Control Head is illuminated and the lamps on the Maintenance Display should provide you with an idea of which integrated circuit is bad. However, if you know there is a problem on the circuit card, do you really care which integrated circuit is bad? Do you have the skills and equipment to replace the defective chip? Do you have the replacement part?

If the answer to all these questions is yes, then by all means, replace the chip and get back on the air. However, chances are that even if you do have the skills and the required equipment, you don't have the part. However, in your WRSK kit you have a replacement circuit board. So, you simply replace the board and turn in the defective one.

After Test 5 is completed, setting the 1kHz and 0.1kHz transmit frequency thumbwheels to 0-0 and pressing the Initiate button puts you into test 6. Look at Figure 5-12 in the TO. Test 6 has 12 subtests. You can jump back and forth among the first ten of these subtests (0-9) by setting the 1kHz and 0.1kHz thumbwheels to the number of the subtest and then pressing the Initiate button. For example, to perform Subtest 1 you leave the 1kHz thumbwheel at 0, set the 0.1kHz thumbwheel to 1, and press the Initiate button to put the system into Subtest 1.

Subtests 10 and 20 latch the computer into those particular tests, and the only way to get out of them is to turn off power to the Control Head and start again at Test

1. Read para 5-99 thru 5-101 and 5-70f1, and then we'll discuss each of the first six subtests.

Subtest 1 checks transmit logic level monitor word 1, which is the frequency word. Remember, the logic level monitor words contain the status of the front panel switches. These words are sent from the front panel to the computer. In this case, we are looking at the status of the transmit frequency thumbwheels. As long as you are in this subtest (the 1kHz thumbwheel is set to 0 and the 0.1kHz thumbwheel is set to 1), the status of the transmit frequency thumbwheels is sent to the Maintenance Display each time the Initiate button is pressed.

The TO directs you to change the frequency thumbwheels to 1-9-0-0-0-1 (19.0001MHz), press the Initiate button, and then read the lamps on the Maintenance Display. These tests are easier to understand if you have a listing of the control and monitor words to follow. So, get TO 31S1-2TSC60-52 and look up Table 4-2. This table shows the make-up of the logic level monitor word.

Remember, the frequency word is made up of BCD representations of each thumbwheel. There are 24 bits of data (0 thru 23) and there are 24 lamps on the Maintenance Display. So, bit 0 is represented by lamp 1, bit 1 by lamp 2, and so on to bit 23, which is represented by lamp 24. The TO states that lamps 4, 5, 8, and 24 should be lit for this subtest. IAW the table, lamp 4 indicates the 10MHz thumbwheel is set to 1, lamps 5 and 8 indicate the 1MHz thumbwheel is set to 9, and lamp 24 indicates the 0.1kHz thumbwheel is set to 1.

While in subtest 1, you can change any of the thumbwheels except the last two, press the Initiate button, and compare the Maintenance Display lamp indications with the numbers dialed on the thumbwheels.

CAUTION

Changing either of the last two thumbwheels (1kHz or 0.1kHz) will take the system out of this subtest and initiate another test. Do **not** change these two thumbwheels while performing this subtest.

The latter part of the Subtest-1 procedure in the TO requires you to randomly change the thumbwheels and observe the Monitor Data indicators on the Maintenance Display. We recommend going through all the positions on each thumbwheel (except the 1kHz and 0.1kHz thumbwheels) and observe that the Maintenance Display reflects each position properly. This thoroughly checks out each thumbwheel and its associated circuitry. After you have cycled each thumbwheel through all its positions, set the last two to 02, press the Initiate button, and the system is placed into Subtest 2. Read through para 5-70f2, and then we'll discuss the test.

Again, Table 4-2 lists each bit of the logic level monitor word for the transmit mode. You can interpret each of the 24 lamps on the Maintenance Display by following this table. Exercise each of the switches that are monitored by this word and ensure that each switch functions correctly in each position. When you are satisfied that all front panel switches and the computer are working properly, set the last two thumbwheels to 03 and proceed to Subtest 3, para 5-70f3 in the TO.

NOTE

In this module, we are only discussing procedures. **Don't actually touch any equipment without your trainer's direction.**

By now, you should be somewhat familiar with Table 4-2. You should realize that it is used to enable you to interpret the Maintenance Display lamps and to exercise all the thumbwheel positions, which is necessary for a thorough check-out. Now, read para 5-70f4 thru 5-70f6 for Subtests 4, 5, and 6.

These three subtests are basically the same as the ones we just discussed, except that these tests check out the Receive Control Head. Don't forget to exercise all the switch positions when performing these tests, **except** for the last two thumbwheel switches.

Subtest 7 will require a test set that we haven't discussed, the 7404A-1 Source Generator/Display Unit. The 7404A-1 is a signal simulator and display unit that simulates functional units in the Direct Digital Control (DDC) system. It simulates either a loop coupler unit, an LCU and Device Control Unit (DCU), or a DCU and Device Control Functional Element (DCFE). The 7404A-1 is a self-contained unit which provides all the necessary signals in any mode of simulation. In special applications, however, it is possible to use external devices to control the clock and data information.

In all of the diagnostic tests, we will use the 7404A-1 to simulate the DCU/DCFE so that the computer will be fooled into thinking it is actually talking to the Receiver or the

Transmitter. In other words, we'll check out the interfacing of the computer with the CCCS bus.

The TO provides you step-by-step instructions on setting up and using the 7404A-1, so there's no need to go into them here. Read para 5-70f7, and then we'll discuss what you have read.

The await monitor circuit on the 7404A-1 lights the Await Monitor lamp when a monitor word with an address which matches the selected address has been received. At the end of the monitor word, the lamp is turned off. When the 7404A-1 receives a control word and address that matches the address selected on the front panel, it displays the data in the control word on the front panel lamps. It then sends a monitor word that contains the data selected on the front panel switches to the computer.

In this subtest the control word is received from the computer, and the monitor word is sent back to the computer. The next time the computer sends a control word, it contains the data sent from the 7404A-1 on the previous monitor word. The 7404A-1 then receives the second control word and displays the data on the front panel lamps. At this point you should check the lamps and make sure the data matches what you selected on the switches.

The remainder of the subtest checks that the computer sends out control words matching the addresses selected on the 7404A-1. The front panel lamps, except for the Await Monitor lamp, are ignored for the remainder of the test. The Await Monitor lamp may often be difficult to see. Sometimes it requires turning off the ceiling lights in the van in order to see it.

The TO states in para 5-70f8 that Subtest 8 requires test equipment not authorized at the organizational or intermediate level of maintenance. However, para 5-103 provides complete instructions on performing the test and identifies the equipment required as two 7404A-1s. Chances are your unit has more than one 7404A-1. If so, Subtest 8 can be performed by following the procedures in para 5-103. If you do not have the proper test equipment, skip this test and go on to Subtest 9 (para 5-70f9).

Subtest 9 sends a word to the Maintenance Display, where you observe if the proper lamps are lit. This test is only valid when performed immediately after Subtest 7 is completed. If you try to perform the test a second time by pressing the Initiate button again, you will get false data on the Maintenance Display. To perform the test again you must first reaccomplish Subtest 7, and then proceed immediately to subtest 9.

Subtest 10 is somewhat different than the previous discussed tests. This subtest sends a monitor word that you specify to the computer. Then, the computer sends that monitor word back to the 7404A-1 so you can verify that it is correct. The last few bits of the monitor word are the bits that turn on the sideband indicators on the Audio Control Unit which allows you to verify their operation. This test locks itself into a loop so that you cannot proceed to another test from it. To proceed, you must turn off power to the OK-145 which resets the computer. Now read para 5-70f10 and 5-105.

To proceed to Subtest 20, you must step through the first six tests. Step 20 is the same kind of latch test as was discussed in Subtest 10. Varying the switches on the 7404A-1 allows you to exercise the front panel lamps of the Transmit Control Head. Now read para 5-106.

Well, this completes our discussion of the diagnostic analysis. Diagnostics can be a very useful tool for you to ensure the entire computer system is functioning properly. It is also invaluable in troubleshooting the computer. Remember, normal operation and performance tests do not necessarily exercise all the functions of the computer system. So after each repair action, you should perform the diagnostics to make sure you've taken care of all the problems.

ADDITIONAL INSTRUCTIONS

Answer the review questions and check your answers with the confirmation key. Review the material in the module for any questions you missed. Next, ask your trainer for the KEP questions. After your trainer checks your answers and reviews the questions missed with you, go on to the performance procedures.

REVIEW QUESTIONS

1. What does installing the Auxiliary Control Module accomplish?

2. How can you tell if the system has failed one of the diagnostic tests?

3. What must you do to perform diagnostic Test 2 if the computer failed Test 1?

4. Assume that a malfunction is not detected by the diagnostic tests. What is a probable reason that it was not detected, and how may you ensure malfunctions will be detected?

5. When performing Subtest 1, the transmit frequency word test, which thumbwheels can you **not** test? Why?

6. When performing Subtests 1 thru 6, how do you determine if the indications on the Maintenance Display Panel are correct?

7. The 7404A-1 Source Generator is used for what purpose in these diagnostic tests?

8. Assume you are performing the diagnostic tests. You get no fault indications, but you don't see the Await Monitor lamp on the 7404A-1 come on. What should you do?

PERFORMANCE PROCEDURES

Have your trainer demonstrate performance of the Transmit and Receive Control Head diagnostic analysis. Then practice performing these tests under the supervision of your trainer until you feel confident. Your trainer will annotate your training records when he/she feels you are proficient.