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AUTHOR Miller, Elmo E.
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ABSTRACT

As a companion to a research report describing the evaluation of a simulation-style instructional package for training in electronic equipment maintenance, this appendix includes: (1) a copy of the instructor's lesson plan; (2) a handout on power supply procedure; (3) samples of troubleshooting simulations; (4) instructor recording forms; (5) quizzes; (6) questionnaire forms and results; and (7) a list of developmental by-products. (EMH)

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FINAL REPORT

INSTRUCTIONAL STRATEGIES USING LOW-COST SIMULATION FOR ELECTRONIC MAINTENANCE

Volume II: Appendices

by

Elmo E. Miller, Ph.D.

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Work Unit SIMELEM

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INSTRUCTIONAL STRATEGIES

USING LOW-COST SIMULATION FOR ELECTRONIC MAINTENANCE

VOLUME II:
APPENDICES

CONTENTS--VOLUME II

APPENDIX A

INSTRUCTOR MATERIALS:
MAIN BODY OF LESSON PLANS

LESSON PLAN: DS 2.16114, ENERGIZING AND CONTROL CIRCUITS

Practical Exercise PE 3

SUBJECT DEVELOPMENT	(Time)	INSTRUCTOR/ACTIVITY — TIME MIN. 310
5. ENERGIZING AND CONTROL CIRCUITS.		Paragraph references will be to TM 9-1430-533-12-2-1, and Figures to TM 9-1430-533-12-2-2.
a. General	(5)	Discuss modes of operation, time delay, per Paragraph 3-14, Define Local, Remote, Standby, and Radiate Ready.
6. CHECKS AND ADJUSTMENTS	(20)	
a. Local Standby Energizing		Demonstrate checks and adjustments with photo mock-ups, using Table 3-8, Steps 1-3. STEP 1. Demonstrate on mock-up. STEP 2. Describe proper reading for line volt meter, and adjustment. SLIDE 1: PHASE LIGHT SLIDE 2: LINE VOLT METER SLIDE 3: ADJUSTMENT FOR LINE VOLT METER STEP 3. When in "local" operation, Standby button on transmitter slide must be used, because of interlock activated by door. SLIDE 4: STANDBY BUTTON, TRANSMITTER SIDE SLIDE 5: RECORDING THE TIME.
b. Remote Standby Energizing		Point out differences between "Local" and "Remote" energizing. SLIDE 6: BLANK
7. FAULT ISOLATION		
a. General		Point out that starting point for FIP is finding a fault while performing checks and adjustments (Table 3-8), or an operator reporting trouble in performing these checks. This sends the maintenance man to TM 9-1430-533-12-2-1, Table 23-4.

SUBJECT DEVELOPMENT	(Time)	INSTRUCTOR/ACTIVITY	TIME MIN. 310

7.

b. STEP 1 (10) Explain what to do if Phase Light does not come ON (STEP 1 in Fault Isolation Procedures [FIP]).

SLIDE 7: PHASE LIGHT

SLIDE 8: CONNECTOR PLUG FOR TESTING 416 VAC

Refer to handout: "Phase Relationships". Discuss exact values expected when testing for phase relationships using handout.

c. STEP 2 (45) Describe what to do if STEP 2 (FIP) is bad. Begin by demonstrating this step on photo mock-up. Then trace circuit in functional diagrams (Figure 24-4). First point out Line Volt Meter (Zone C7) so that student knows where circuit tracing is going. Then go to starting point (Zone B2) and trace circuit, pointing out likely test points along the way and how to use them.

SLIDE 9: MAIN POWER DISTRIBUTION BOX

SLIDE 10: LINE VOLT METER

SLIDE 11: FUSE PANEL

Block Titles. Hand out Chassis locator diagrams. Describe how to use block title and number in functional diagrams to find the components on the IHIPIR.

d. STEP 3 (80) Describe what to do if STEP 3 (FIP) shows fault. Note that this would be the case when radar did not go into Standby during checks and adjustments. Distribute handout: "Interlock Locator". Illustrate some of these with typical slides.

SLIDE 12: 300 VDC DRAWER INTERLOCK

SLIDE 13: CLOSE UP OF 300 VDC DRAWER INTERLOCK

SLIDE 14: INTERLOCK RSG CONTROL PANEL

(1) Demonstrate STEP 3 (Interlock tests) on simulator without going into circuit tracing at this time. Be careful to divide tests clearly into clusters, and have students mark them off in their books.

The first cluster (STEP 3a) involves testing both indicator lamps.

SLIDE 15: TESTING INDICATOR BULB

SUBJECT DEVELOPMENT	(Time)	INSTRUCTOR/ACTIVITY	TIME MIN. 310

7.d. (continued)

The second cluster (STEPS 3b through 3g) involves the Transmitter Interlocks.

SLIDE 16: OPERATING TEST SWITCH, X MTR.

The third cluster (STEPS 3h through 3k) involves the Radar Set Group Interlocks.

SLIDE 17: TEST SWITCH RSG

The last cluster (STEPS 3L through 3n) involves relays and other circuits between Interlocks and Standby Light.

SLIDE 18: FUNCTION METER

SLIDE 19: BLANK

(2) Circuit Tracing. First note Standby lamps in Figure 24-3, Zones B29 and B35, as noted in STEP 3m. These are the end points of the circuit, and the original symptom. Then trace circuits for each cluster of Interlocks tests as you would in FIP, as follows:

First cluster: Point out Indicator Lamps in Figure 25-3 and relate them to lamps on photo mock-ups.

Second cluster: Point out test switches on Figure 25-3 and relate them to photo mock-ups. Then trace circuit, starting in Figure 24-3, Zone D5, pointing out likely test points and how to use them, ending at Zone A16.

Third cluster: Continue tracing Interlock circuits from Zone C16 to Zone B24, pointing out likely test points and how to use them.

Last cluster: Finish tracing circuit, pointing out likely test points.

SLIDE 20: FUNCTION METER, POSITION 14

8. TRANSMITTER FUNCTION CHECKS, FAULT ISOLATION (30)

a. General

DISCUSS: The checks and the corresponding FIP depend upon being in (False) Radiate. Those before are whatever Power Supplies can be checked during the 5 ± 2 minute wait.

SLIDE 21: RADIATE PUSHBUTTON

SUBJECT DEVELOPMENT	(Time)	INSTRUCTOR/ACTIVITY	TIME MIN. 310
8. b. Checks and Adjustments		Demonstrate Table 3-9, STEP 2 (Weekly).	
c. Fault Isolation		Demonstrate STEP 10 of FIP with photo mock-up, without going into circuit tracing at this time. Then trace corresponding circuits, discussing likely test points. In STEP 10c, if you can not get the lights to extinguish by the prescribed procedures, you will have to replace one of the power supply modules for the MO or PA behind the X MTR panels 1 and 2.	
9. FIP PRACTICE PROBLEMS	(70)	Demonstrate various practice problems (Appendix A) on photo mock-up, as time permits.	
10. CHECK ON LEARNING	(20)	Have students perform FIP as time permits.	
11. SUMMARY	(5)	During the past eight (8) periods we have studied the Energizing and Control Circuits on a Functional Level. We have traced the STANDBY signal path, energizing relays, and illuminating lamps, and preparing the circuits for the RADIATE command. After the circuits were properly conditioned for it, the RADIATE command was traced through the circuits, energizing relays, illuminating lamps, and causing voltages to be applied to the RADIATE circuits. Then the test circuits were discussed and you saw how the Energizing circuits could be quickly checked by the use of the Interlock Test Switches if the proper indications were not observed while Energizing the Radar.	
12. CLOSING STATEMENT	(5)	Power applied to the circuits at the correct time is essential to the operation of the IHIPIR. It is also essential that if a trouble exists it be corrected in a minimum amount of time. As an Improved Hawk Firing Section Mechanic, it will be your responsibility to accomplish this.	

LESSON PLAN: DS 2.16114, ENERGIZING AND CONTROL CIRCUITS

Practical Exercise PE 1

SUBJECT DEVELOPMENT	(Time)	INSTRUCTOR/ACTIVITY	TIME MIN.
4. CHECK PROCEDURES	(90)		
a. Demonstrate		Tables 3-8, STEPS 1, 2, 3, and 3-9 (TM 9-1430-533-12). The Assistant Instructor will explain the reasons for the various checks.	
b. Practice		Have students, in pairs, perform the above check procedures, utilizing the procedures in Appendix A. Students not performing the check procedures on the equipment will watch the tape/slide demonstration of these procedures, until each student can demonstrate them on the photo mock-ups to his partner.	
5. FAULT ISOLATION	(90)		
a. Demonstrate		Instructor will demonstrate Tables 23-4, STEPS 1-6 (TM 9-1430-533-12-2-1) as performed when everything checks out OK.	
b. Practice		Have students, in pairs, perform the above Fault Isolation Procedures (FIP), utilizing the procedures in Appendix B. Student pairs not on the equipment will practice these FIP on the photo mock-ups.	
6. TROUBLE-SHOOTING	(90)	The Instructor will follow the procedures in Appendix B for performance of troubleshooting using the Fault Isolation Procedures (FIP). Students not performing on the equipment will perform troubleshooting problems, in pairs, using the photographic mock-ups and the problems listed in Appendix C.	

GENERAL APPROACH TO AC, DC POWER DISTRIBUTION

Distinguish functional groupings. Familiarize students with the four (4) kinds of BITE meters, and where associated power supplies are located.

Detailed discussion of each functional group, circuitry. Distinguish transitions sharply by changing color photos hung on mock-up.

I. First MO and PA group.

(1) Checks and Adjustments: Only the central visual idea (the meters, adjustments, power supplies) and what is done; skip over routine stuff (e.g., interlock bypass).

(2) Carry on to FIP, visual orientation. Trace circuits in schematics as if various sample steps indicate bad, and give analysis.

This is true schematic reading, because it's in a real problem-solving situation, including visualization of the critical parts involved.

II. Same for LVPS.

III. Same for ±12.6, ±50 VDC.

IV. Same for 300, 90, 28 VDC.

LESSON PLAN: DS 2.16316, AC AND DC POWER DISTRIBUTION

Practical Exercise PE 3

SUBJECT DEVELOPMENT	(Time)	INSTRUCTOR/ACTIVITY	TIME MIN.
4. GENERAL	(5)	SLIDE 1: BLANK	
a. Review		Discuss the conditions necessary for the following indicator lights to illuminate: (1) Standby — Check Procedures (Table 3-8, STEPS 1-3) — FIP (Table 23-4, STEPS 1-3) (2) Radiate Ready — (Table 3-9) — (STEP 10) (3) (False) Radiate — (Table 3-9) — (STEP 10)	
5. FUNCTIONAL GROUPING	(15)	(Pass out handout on Functional Grouping.) It is very critical that the student understand that the Power Supplies fall into four fundamental groups, based upon which Power Supplies are being checked, and the Test Meters (BITE) which are used to check them. The sequence of check procedures and checks and FIP are somewhat arbitrary: while waiting for the Radiate Ready Light, the man checks out all Power Supplie that can be checked in STANDBY. Otherwise, they could be done in any order. The following is a visual preview of these sets.	
a. MO and PA Power Supplies, Filament Power		Refer to the two indicators for Filament Power on the photo mock-ups. Show where corresponding Power Supplies are located. State normal indication. Refer to corresponding blocks in Figure 24-2. SLIDE 2: MO, PA METERS SLIDE 3: MO, PA FILAMENT POWER SUPPLIES NOTE that MO and PA Power Supplies are checked out much later. Also, that FIP is later, as part of nransmitter checks.	
b. Low Voltage Power Supplies		Locate Dgn. PS Monitor on photo mock-ups. Show where corresponding Power Supply is located. SLIDE 4: DGN. POWER SUPPLY TEST METER SLIDE 5: DEGENERATION (DGN.) POWER SUPPLY Discuss switch positions, and normal indication. Discuss "Ripple" test. Point out corresponding blocks in Figure 24-2. Go to RSG side and do the same for LVPS.	

SUBJECT DEVELOPMENT	(Time)	INSTRUCTOR/ACTIVITY	TIME MIN.

5.b. (continued)

SLIDE 6: LOW VOLTAGE POWER SUPPLY (LVPS) TEST METER

SLIDE 7: 250, 150, -100 VDC POWER SUPPLY, FRONT

SLIDE 8: 250, 150, -100 VDC POWER SUPPLY, BACK

NOTE that the +100 VDC Power Supply is in a different drawer, along with a different Power Supply, although functionally it belongs with the Low Voltage Power Supply (LVPS).

SLIDE 9: 6.3 VDC POWER SUPPLY, RSG

SLIDE 10: +100 VDC POWER SUPPLY (ARROW)

c. ±12.6, ±50 VDC Power Supplies

Locate Voltage Monitor on photo mock-up. Show where corresponding Power Supply is located.

SLIDE 11: ±12.6, ±50 VDC METER, SWITCH

SLIDE 12: ±12.6, ±50 VDC POWER SUPPLY

Discuss switch positions, and normal indications. Refer to corresponding blocks on Figure 24-2. NOTE that the +100 VDC on the label is misleading because that Power Supply belongs to a different group, and is monitored elsewhere.

d. Unregulated Power Supply

Refer to drawer of 300 VDC Power Supply.

SLIDE 13: FUNCTION METER

SLIDE 14: UNREGULATED POWER SUPPLY

SLIDE 15: BLANK

6. MO and PA Power Supplies, Filament Power Supplies (30)

Hang photo of these power supplies on the photo mock-up, in order to thoroughly familiarize students with their appearance and location as you discuss them.

a.

Demonstrate checks and adjustments for the Filament (Flmt.) Power Supplies (Table 3-8, STEPS 4, 5, 6) using photo mock-ups.

(1) STEP 4. Going into this space (using bypass procedure).

SLIDE 16: GENERAL AREA OF HVPS AND ADJUSTMENTS

SUBJECT DEVELOPMENT	(Time)	INSTRUCTOR/ACTIVITY	TIME MIN.
6.a. (continued)		(1) continued. Switch to PA Ø 1 ... SLIDE 17: HVPS TEST SET ... and adjust to green area. SLIDE 18: PA ADJUSTMENT Mention that the same would be done for the other PA Phases. NOTE that MO has no corresponding adjustment. SLIDE 19: BLANK (2) STEPS 5, 6. Demonstrate with photo mock-up.	
b.		Demonstrate FIP for Flmt. Power Supplies, Table 23-4, STEPS 6 and 7.	
7. Low Voltage Power Supplies	(55)	(Remove photos of Flmt. Power Supplies; hang photos of 250/150/-100 VDC, 6.3 VDC, X MTR; 6.3, +100, and 250/150/-100 RSG Power Supplies.)	
a.		Demonstrate checks and adjustments of 6.3 VDC Power Supplies using photo mock-up; Table 3-8, STEPS 7, 8, and 9, and Table 3-10, STEPS 2a-2f. SLIDE 20: 6.3 VDC ADJUSTMENTS, RSG SLIDE 21: BLANK	
b.		Demonstrate FIP for 6.3 VDC Power Supplies using photo mock-up (Table 23-4, STEPS 4, 5, 8, 9, 22, and 26). On each step trace circuits and note likely test points as if each step is bad, in turn.	
c.		Demonstrate checks and adjustments of 250, 150, ±100 VDC Power Supplies on photo mock-up (Table 3-10, STEPS 1, 2f.1-2o).	
d.		Demonstrate FIP for 250, 150, ±100 VDC Power Supplies using photo mock-ups (Table 23-4, STEPS 23-25, and 27-29). For each, trace circuits and note likely test points if that step gives a bad indication.	
8. ±12.6, ±50 VDC Power Supplies	(30)	(Remove previous photos; hang photos of these Power Supplies.	
a.		Demonstrate checks and adjustments on photo mock-up (Table 3-10, STEP 3).	
b.		Demonstrate FIP with photo mock-ups (Table 23-4, STEPS 17-21) Trace circuits, discussing likely check points.	

SUBJECT DEVELOPMENT	(Time)	INSTRUCTOR/ACTIVITY	TIME MIN.
9. UNREGULATED POWER SUPPLY	(20)	(Remove line drawings from previous work; hang photos of this Test Meter and Power Supply.)	
a.		Demonstrate checks and adjustments (Table 3-10, STEP 4) using photo mock-up.	
b.		Demonstrate FIP with photo mock-ups (Table 23-4, STEPS 30, 31). NOTE that the 28 VDC has already been checked out in STEP 3, and where Auxillary 28 VDC came in earlier, and where it is located. Trace circuits, discussing likely test points.	
10. 416/240 VAC CIRCUITS	(15)	Turn to Figure 24-2; discuss how these circuits are controlled by circuit breakers, referencing the photo mock-ups for locations. Discuss STANDBY and RADIATE conditions.	

LESSON PLAN: DS 2.16316, AC AND DC POWER DISTRIBUTION

Practical Exercise PE 1

SUBJECT DEVELOPMENT	(Time)	INSTRUCTOR/ACTIVITY	TIME MIN.
4. CHECK PROCEDURES	(180)		
a. Demonstrate		Tables 3-8, 3-10, and 3-11, STEPS 10 and 11 (TM 9-1430-533-12). Point out location of corresponding Power Supplies as you proceed. The Assistant Instructor will explain the reasons for the various checks.	
b. Practice		Have students, in pairs, perform the above check procedures, utilizing the procedures in Appendix A. Students not performing the check procedures on the equipment will watch the tape/slide demonstration of these procedures until each student can demonstrate them on the photo mock-ups.	
5. FAULT ISOLATION	(90)		
a. Demonstrate		Instructor will demonstrate Tables 23-4, 23-5 (TM 9-1430-533-12-2-1) as performed when everything checks out OK.	
b. Practice		Have students, in pairs, perform the above Fault Isolation Procedures (FIP) utilizing the procedures in Appendix B. Student pairs not on the equipment will practice these FIP on the photo mock-ups.	
6. MAINTENANCE ALLOCATION CHART	(20)	Refer student to TM 9-1430-533-12-2-1, p. B-3. NOTE: Utilizing Paragraphs B-1 through B-3, the instructor will explain the use of the Maintenance Allocation Charts on pages B-3 through B-9.	
7. TROUBLE-SHOOTING	(215)	The instructor will follow the procedures in Appendix B for performance of troubleshooting using the Fault Isolation Procedures (FIP). Troubles to be used are listed in Appendix C. Students not performing on the equipment will perform troubleshooting problems, in pairs, using the photographic mock-ups and the problems listed in Appendix D.	

LESSON PLAN: DS 2.16520, TRANSMITTER RF GENERATION,

ARC DETECTION, AND MODULATOR BIAS CIRCUITS

SLIDE 1: BLANK

OVERVIEW. Post the large color photo mock-ups of equipment. Refer to Figure 24-17.

SLIDE 2. (Behind Transmitter Panel 3)

The RF generation components seen in SLIDE 2 are represented schematically in Figure 24-17, pages 24-100 and 24-101. Note the Arc Detection and Modulator Bias Circuits (Figure 24-20) are present in the Ferrite Switch Control and Power Supply which appear in upper-right corner of the slide.

Focussing in on the RF Generation--

SLIDE 3. MO and PA (→MO, →PA)

Point out MO in SLIDE 3, and relate to MO on page 24-100. Also relate PA to page 24-101, zone B7.

To better see how RF Generation takes place, we have to remove the PA and take the system out of the equipment.

SLIDE 4. RF GENERATION CHAIN, WITH PA REMOVED.

Note MO (in red) and trace rectangular wave guides across to the right (first open arrow, ⇨), down (second arrow, ↓, points to where it turns downward) and behind the other components where it is obscured, then across to the PA input port, through the PA and exits through the output port (tip of curved solid arrow) and across and behind the local oscillator where it is obscured (last open arrow, ⇨, tip points to where it disappears). Then it goes along the right side, around to the back, near the MO where it exits to the Transmitter antenna.

SLIDE 5. TRANSMITTER ANTENNA

Turn to page 24-102. The wave-guide continues through the pedestal and into the antenna. Trace it, emerging from the rotary coupling (first arrow) up and across (second arrow at bend), then through the flexible coupling, and down to the place where it leaves this housing (last arrow).

4. RF GENERATION SEQUENCE

Next, you are going to describe the sequence in greater detail, combining the physical appearance (via a series of slides), the functional relationships (Figure 24-17), and the indications on BITE and other indicators. (The particulars of Arc Detection, Modulator Bias, and procedures will be discussed later.)

4.a. MO-DC 2.

Next, greater detail in the first part of chain.

SLIDE 6: MO through DC 2

Point out and relate to components in Figure 24-17, as you discuss functional operation of the following components. (First arrow points to where it emerges from MO and turns 90° and goes across the picture. Second arrow shows where the waveguide turns downward. Third arrow tip shows where it disappears from view):

(1) MO (red); note that this generates carrier frequency, range modulated.

(2) ATI load (in black).

(3) Ferrite Modulator (round).

(4) Adjustable short and directional coupler, DC1 (projecting upward); Trace to Figure 25-25, zone C1, page 25-60. Note that this is monitored on Function Monitor, switch position 5, and point this out on Color Photo mock-up. Note where waveguide turns down.

(5) DC-2, leading to jack (J1) for waveguide.

(6) CR-1. Note how this branches off <u>after</u> the other connection leaves main waveguide, just as in schematic diagram. Note that this is monitored on Forward RF Power Meter, pointing it out on photo mock-ups. Trace to Figure 25-22, zone A-1, page 25-56, where it is monitored by Forward RF Power (point out on mock-up, noting that switch is in MO position). Note the Crystal (CR-1) is contained in A4, pointing this out on slide, and where they would see A4 printed. Describe resistance test for crystal.

4.a. (continued)

SLIDE 7: WAVEMETER

Note where wavemeter is plugged into jack, and screw adjustment on MO that is being turned with screwdriver. Rough setting of MO Tuning Control setting from table 3-21 in 12-1 manual, according to assigned frequency. (Some number between 1 and 15.) Then, adjust for a null on wavemeter.

4.b. Detail from Ferrite Switch to PA.

Note how waveguide goes down and disappears from view. To see Ferrite Switch A5, you have to move in, and look about from the viewpoint of the butt end of screwdriver.

SLIDE 8: FERRITE SWITCH A5.

A5 is the cylindrical case in background (top arrow) seen just above the PA mounting flange. Ferrite Switch A15 (middle arrow) can also be seen. (PA input port, bottom arrow.)

SLIDE 9: DC 3, AT 2, and FERRITE SWITCH A15.

Continuing down the waveguide, point out DC 3 (right arrow), the right angle intersection of the waveguides. Note AT 2 (50 watt load) going straight down. Also note Ferrite Switch A15 (left arrow) appearing below input port of PA.

Note that Ferrite Switches A5 and A15 are where the Microwave Switch Bias from Figure 24-20 is applied.

SLIDE 10: FERRITE SWITCH A15 FROM ABOVE (ARROW).

SLIDE 11: DC 6, CRYSTAL MOUNT.

DC 6 attaches to the bottom of the main wave guide just before it reaches the PA input port. From DC 6 Reflected RF Power is measured (point out meter on mock-up). The corresponding crystal is in the silver colored mount, and is accessible via the knurled cap on the top (arrow). This crystal mount is somewhat different in appearance than most of the crystal mounts; more typical mounts can be seen in the SLIDE, upper center portion.

Note that the Reflected RF Power Meter is used to adjust PA input cavity (minimum reflected RF power, null in the green area).

SLIDE 12: ADJUSTING PA

4.b. (continued)

The PA is a three cavity tunable klystron. The middle (idler) and output cavities are tuned for maximum forward RF power (Forward RF Power Meter peaks). Note where this is monitored in the schematic (zone B9, note "Power Amplifier Monitor") with one path going to Forward RF Power Meter, the other to RF Power Output Meter on the RSG side.

SLIDE 13: CRYSTAL BALANCE ADJUSTMENT

Note that DC7 is bolted to the PA klystron. The slide shows adjustment of crystal balance (arrow) which is represented on the schematics in Figure 24-20, zone B1.

SLIDE 14: After the PA.

DC7, the Ion Probe (straight arrow) is located right after the output port, appearing as a silver "T"-shaped assembly. Note that the Crystal Mount A7 is not located here, but would be found at the other end of the wire. Discuss general function of Ion Probes.

After the waveguide turns left (curved arrow), there are three directional couplers, with waveguides turning up from the bottom of the main waveguide. The first two have Crystal Mounts and are used to monitor the Power Amplifier at the Transmitter Side (Forward RF Power, Switch in PA position) and at the RSG Side (RF Power Output). The third Directional Coupler (attaching to the flexible coupling) supplies RF Carrier plus noise to the Degeneration Block which is seen in the forward part of this area, to the left of the PA (to be discussed in a later block of instruction).

SLIDE 15: FRONT VIEW OF ASSEMBLY.

Next, the waveguide is obscured from view (at tip of arrow) as it goes behind the local oscillator. Then it turns around the right side, emerging here...

SLIDE 16: RIGHT QUARTER FRONT VIEW

...where it can be identified by the hoses (center) attaching to the Null Load (arrow).

4.b. (continued)

SLIDE 17: RIGHT VIEW

Here both the Null Load (left arrow) and the High Power Load AT3 (right arrow, with fins) can be seen. The High Power Isolator (red tag) should also be located on schematics (zone B9). The Phase Modulator A12 can be seen around the corner (top arrow). For a better look....

SLIDE 18: REAR VIEW

The Ferrite Modulator A12 (seen from the back; open arrow) is a long cylinder. Here the Phase Modulation Bias is applied from Figure 24-20. Also, the coding modulation is applied to the RF carrier. The coding modulation is the last one applied.

Note the Ion Probe (lower arrow) connected to the waveguide right after the Ferrite Modulator (a silver "T"-shaped attachment). The RF Noise Test Jack (J1), seldom used, is connected to the waveguide via DC5 just before the exit port (last arrow).

The Ion Probe is connected to....

SLIDE 19: ION TEST SWITCH.

as well as to the Arc Ionization Detector.

SLIDE 20: ANTENNA PEDESTAL

The RF energy leaves the X-MTR Group (turn to page 24-103) and enters the antenna via the pedestal where the Rotary Coupler A5 (zone B-13) allows for training the Antenna in Azimuth. The components within the pedestal are inaccessible.

SLIDE 21: TRANSMITTER ASSEMBLY.

The waveguide enters from the left via Rotary Coupler A1 (first arrow) which allows for training in Elevation. The waveguide goes up and right where a dehumidifier is attached (second arrow) just before the flexible waveguide W3 (copper colored). The other directional couplers attach before the waveguide exits (last arrow) for Antenna Reflector.

Directional Coupler DC2 (solid arrow) provides Arc Detection by comparison with carrier at DC7 (just after PA), in Summing Network (Figure 24-20, zone B2). Both can also be monitored by Function Meter, Position 2.

4.b. (continued)

The other Directional Couplers here go to the Receiver for comparison with the signal received, and to the Simulator Control Group.

SLIDE 22: BLANK

5. ARC DETECTION AND MODULATOR BIAS.

First, trace Arc Detection Circuit.

SLIDE 23: CRYSTAL BALANCE

In Figure 24-17, zone C7, there is an adjustment on the 4db attenuator for crystal balance. This is monitored at...

SLIDE 24: FUNCTION MONITOR METER, POSITION 2.

Next circuit goes to....

SLIDE 25: FERRITE SWITCH CONTROL AND POWER SUPPLY.

Figure 24-20, zone B1. After Summing Network, you can measure....

SLIDE 26: XTAL BAL

in zone B2. Tracing down and to the left,

SLIDE 27: ARC DETECTOR TEST

there is the Arc Detector Test Pushbutton. Trace circuit across and explain.

SLIDE 28: RADIATE INTERLOCK OPEN INDICATOR AND RESET.

Describe the functions shown in SLIDE 28, zones B8 and B9.

SLIDE 29: BLANK.

Next Describe ARC IONIZATION DETECTION circuits.

SLIDE 30: ION PROBE

Start with Ion Probe (arrow) in zone B8 of Figure 24-17.

5. (continued)

Then describe the function of Ion Probe Test Switch (zone A10)

SLIDE 31: ION PROBE TEST SWITCH IN OPERATION

Distinguish between above test switch and the...

SLIDE 32: IONIZATION TEST SWITCH

... which is shown schematically in Figure 24-20, zone D2. Describe functioning of this curcuit.

SLIDE 33: BLANK

MODULATION BIAS CIRCUITS

Discuss these circuits referring to Figure 24-20 and 24-17.

SLIDE 34: MODULATION BIAS ADJUST

SLIDE 35: BLANK.

6. TEST METERS AND INDICATORS

Discuss the RF Generation from the viewpoint of where you can get some measurement or indicator of the process, beginning with the MO in Figure 24-17, zone B1.

7. Use FIP if time permits.

LIST OF SLIDES FOR DS 2.16520, TRANSMITTER RF GENERATION, ARC DETECTION, AND MODULATOR BIAS CIRCUITS.

SLIDE	TITLE
1	BLANK
2	BEHIND TRANSMITTER PANEL 3
3	MO and PA (→MO, →PA)
4	RF GENERATION CHAIN, WITH PA REMOVED
5	TRANSMITTER ANTENNA
6	MO through DC 2
7	WAVEMETER
8	FERRITE SWITCH A5
9	DC 3, AT 2, and FERRITE SWITCH A15
10	FERRITE SWITCH A15 FROM ABOVE (ARROW)
11	DC 6, CRYSTAL MOUNT
12	ADJUSTING PA
13	CRYSTAL BALANCE ADJUSTMENT
14	AFTER THE PA
15	FRONT VIEW OF ASSEMBLY
16	RIGHT QUARTER FRONT VIEW
17	RIGHT VIEW
18	REAR VIEW
19	ION TEST SWITCH
20	ANTENNA PEDESTAL
21	TRANSMITTER ASSEMBLY
22	BLANK
23	CRYSTAL BALANCE
24	FUNCTION MONITOR METER, POSITION 2
25	FERRITE SWITCH CONTROL AND POWER SUPPLY
26	XTAL BAL
27	ARC DETECTOR TEST
28	RADIATE INTERLOCK OPEN INDICATOR AND RESET
29	BLANK
30	ION PROBE
31	ION PROBE TEST SWITCH IN OPERATION
32	IONIZATION TEST SWITCH
33	BLANK
34	MODULATION BIAS ADJUST
35	BLANK

APPENDIX B

HANDOUT: FUNCTIONAL GROUPING OF POWER SUPPLY PROCEDURES

HANDOUT

FUNCTIONAL GROUPING OF
POWER SUPPLY PROCEDURES

	BITE Power Supply Block TM 9-1430-533-12-2-2, Figure 24-2	Corresponding steps in check procedures	Corresponding steps in FIP (Table 23-4)
I (MO, PA filament power)	MO flmt amps, MO flmt PS PA flmt volts, PA flmt PS Transmitter Noise* MO power PA power	Table 3-8; steps 4, 5, 6	steps 6, 7
II	A. Dgn PS, LVPS 6.3 VDC B. Dgn PS, LVPS 250, 150, ±100 VDC	steps 7, 8, 9	steps 4, 5, 8, 9
		Table 3-10; steps 1, 2	steps 11-16 22-29
III (±12.6, ±50 VDC)	VOLTAGE MONITOR ±12.6, ±50 VDC	step 3	steps 17-21
IV (Unregulated power supply)	FUNCTION MONITOR 300, 90, 28 VDC	step 4	steps 30, 31

STANDBY

RADTATE

*Checks done later in Table 3-11, steps 10, 11.
FIP done later as part of Tables 23-5 and 23-6.

APPENDIX C

PAPER TROUBLESHOOTING WITH MOCK-UPS: INSTRUCTIONS AND PROBLEMS

TROUBLESHOOTING PROBLEMS
WITH
PHOTOGRAPHIC MOCK-UPS

Instructions to students for using photo mock-ups for troubleshooting practice:

1. Practice in pairs. A mock-up will be provided for each pair. If there is one extra student, he should join another pair and all three should take turns being tutor.

2. Tutor. Take turns being tutor on every other problem. The tutor will read the problem silently, and tell his partner only the symptom.

3. Troubleshooter. The other student does the troubleshooting. He points out switches and controls he would operate, explaining what action he is performing, and what meters and indicators he is checking. He refers to published check procedures and Fault Isolation Procedures as appropriate. If he needs to check behind the panels, refer to one of the drawings in looseleaf binder (numbered according to the code on the face of the panel).

4. The tutor tells the troubleshooter what indications he would get (not whether they are "good" or "bad") at each step of the way, according to the problem described. The tutor should allow the student to go off on "wild goose chases" following irregular lines of search that have little chance of success. In this, the tutor is guided by the known trouble and how it would show up in the Fault Isolation Procedures, and by the analysis given with the problem.

5. When the troubleshooter describes the trouble and necessary corrective action, or when he gives up, critique as appropriate. If the wording of the problem is confusing, or if the problem seems unrealistic, write your questions and criticisms on the problem sheet. Your comments will be useful in helping us to improve training for future classes.

PROBLEM 1

SYMPTOM: Radar will not go into STANDBY.

TROUBLE: Defective 28 volt auxillary power supply.

CORRECTIVE ACTION: Replace 28 volt auxillary power supply.

ANALYSIS: In Step 3a (TM 9-1430-533-12-2) with trouble installed, neither Interlock Test Indicator Lamp illuminates when pressed. (It is unlikely both lamps would be bad at the same time.) Check that main power circuit breaker is in "ON" position. Check lamp circuit or other handy point for power (Press and hold STANDBY button while doing this). A no-power indication should lead operator to 28 volt auxillary power supply as the most probable source of the problem (refer to Figure 24-3, zone D3). From Figure 25-3, zones A4 and C4, you see that auxillary 28 VDC supplies voltage to both Interlock Test Indicator bulbs.

PROBLEM 2

SYMPTOM: Phase light will not come on.

TROUBLE: Wire B is broken in cabling.

CORRECTIVE ACTION: Replace cable.

ANALYSIS: Phase light does not come on, so you contact the power generator mechanic. He says everything seems OK at the generator, so you disconnect the cable to the IHIPIR (first shutting OFF power at the generator). With power back ON, using your multimeter, you find there is no voltage between Wire B and any other, although all the rest seem OK. Therefore, you replace the cable, after which phase light comes on.

PROBLEM 3

SYMPTOM: Radar will not go into STANDBY.

TROUBLE: Radar transmitter fan intake vent is closed.

CORRECTIVE ACTION: Open vent.

ANALYSIS: In FIP, Step 3, Radar does not go into STANDBY. On mock-up, troubleshooter should go through sub-steps 3a (both indicators illuminate), 3b (illuminates), 3c (illuminates), 3d (illuminates), 3e (does not illuminate). Therefore, fault must be in group IV. Referring to Figure 24-3, zone B9-B11, he finds that it could be: 1) Auxillary Exhaust Vent; 2) Radar Transmitter Fan Interlock; 3) Exhaust Vent Interlock; or 4) in the cabling somewhere. Upon checking all three vent doors, he finds that radar Transmitter Fan door is closed (A16, zone B10).

PROBLEM 4

SYMPTOM: Radar will not go into STANDBY.

TROUBLE: Loose wire coming into INTERLOCK on Drawer $\pm$12.6, $\pm$50, +100 VDC PS.

CORRECTIVE ACTION: Attach wire to INTERLOCK.

ANALYSIS: In FIP Step 3, radar does not go into STANDBY, so sub-steps are performed on mock-up. Sub-step 3a (both indicators illumniate); 3b (illuminates), 3c (illuminates), and so on (all illuminating) through X-MTR side ending in Step 3g. At Step 3h troubleshooter should note that he closes X-MTR console door before operating INTERLOCK test switch on RSG side. (If not, give him "not illuminated" indication on Step 3h, then remind him he has to close X-MTR side door.) Steps 3h, 3i (illuminate), 3j (does not illuminate). Troubleshooter should then indicate $\pm$12.6, $\pm$50, +100 VDC drawer on mock-up, stating he would test voltage both sides of switch, expecting 28 VDC if it is good (Figure 24-3, zone B21, S1). At that point he would notice broken wire.

PROBLEM 5

SYMPTOM: Radar will not go into STANDBY.

TROUBLE: Defective CR4, zone C2, Figure 24-3.

CORRECTIVE ACTION: Replace CR4.

ANALYSIS: In FIP Step 3, radar goes into STANDBY only momentarily, dropping out as button is released. Sub-steps 3a through 3k get illuminate indications (these could be skipped if the Troubleshooter knows that the symptom could not be INTERLOCK). In Step 3L, Function Meter in A3, switch position 14, reads in right hand yellow area. Sub-step 3m does give "STANDBY" as long as button is held.

It therefore falls to Step 3n. Since the 28 VDC power supply was checked out in Sub-step 3L, fault must be further along, perhaps at CR4 (Figure 24-3, zone C2) or in the STANDBY relay K6, or in the wiring somewhere. Taking readings with multimeter along this circuit (expecting 28 VDC if good), Troubleshooter should narrow it down to CR4.

PROBLEM 6

SYMPTOM: STANDBY light does not come ON.

TROUBLE: Defective STANDBY indicator bulb.

CORRECTIVE ACTION: Replace bulb.

ANALYSIS: When STANDBY button is pushed and blowers begin to operate, Troubleshooter should realize that radar is in STANDBY. He should check STANDBY indicator on RSG side which will be on. This should lead to replacement of the bulb.

PROBLEM 7

SYMPTOM: Line Volt Meter does not read in upper green area.

TROUBLE: Fuse F30 defective, but indicator does not illuminate.

CORRECTIVE ACTION: Replace F30.

ANALYSIS: In performing daily checks, Step 2, Line Volt Meter will not register any voltage, and adjustment. Going to FIP, Step 2, the circuit is traced in Figure 24-4. Tests with multimeter should narrow down fault to F30, which Troubleshooter should be able to locate on mock-up.

PROBLEM 11

SYMPTOM: Radar will not go into RADIATE

TROUBLE: A17P13-B Broken

CORRECTIVE ACTION: Replace cable.

ANALYSIS: During daily checks, in Table 3-9, Step 4, Radar would not go into RADIATE. This sends you to the FIP, index to indicators (Table 23-1), the Abreviated FIP (Table 23-3), then to FIP in Table 23-4. In Step 10, Radar would not go into (False) RADIATE, so you would do the substeps. Assume a "Q" Radar since this is the kind of serial number you would have in the school. In Step 10c(3) you would get a bad indication (Group 7 indicator light does not illuminate). Tracing out this circuit and making tests you would find that the cable A17P13 is broken as it leaves Pin B in Zone D48.6.

PROBLEM 12

SYMPTOM: Radar will not go into RADIATE.

TROUBLE: A6P2 (A6 Defective)

CORRECTIVE ACTION: Replace A6.

ANALYSIS: During daily checks, in Table 3-9, Step 4, Radar would not go into RADIATE. This sends you to the FIP, index to indicators (Table 23-1), the abreviated FIP (Table 23-3), then to the FIP in Table 23-4. In Step 10, Radar would not go into RADIATE, so you would do the substeps. Assume a "Q" Radar since this is the kind you would have in school. In Step 10c(3) you would get a "bad" indication (with Group 7 indicator light does not illuminate). Tracing out this circuit and making tests, you would find that the signal (28 VDC) is lost at A6P2-d, zone C44, but is present at W1P3-5. You would therefore replace A6. Have student locate this on mock-ups (Behind Transmitter Panel 3).

PROBLEM 13

SYMPTOM: Radar will not go into RADIATE.

TROUBLE: A17P23-T Broken

CORRECTIVE ACTION: Replace cable.

ANALYSIS: During daily checks, in Table 3-9, Step 4, Radar does not go into RADIATE. This sends you to index to indicators, abreviated FIP, then to FIP Table 23-4. First bad checks are Step 10, then Step 10e. In this circuit, A17P23-T (Figure 24-3, zone D50) is broken. The reason for this: tracing the Radiate command to the right, you eventually get to K3 in zone C59, which must be energized to get input to the +250, +150, -100 VDC power supply (Figure 24-7, B1) when traced from Figure 24-4, zone A37.

PROBLEM 14

SYMPTOM: 50 VDC RCUR does not READ.

TROUBLE: J9 unplugged.

CORRECTIVE ACTION: Plug J9 in again.

ANALYSIS: During daily checks, in Table 3-10, Step 3g, the Voltage Monitor does not register. Going to the index to indicators and abbreviated FIP leads you to FIP, Table 23-4. All checks good up to Step 19. Tracing the circuit indicating and making checks, you find J9 unplugged (Figure 24-10, zone A1).

PROBLEM 14

SYMPTOM: 50 VDC does not READ.

TROUBLE: J9 unplugged.

CORRECTIVE ACTION: Plug J9 in again.

ANALYSIS: The trouble lies in the +50 VDC lines since the +50 VDC did not read. In the FIP taking a reading at J9, pin 22, 23, 24, produces good readings at the chassis input; however, output readings at J1-6 are bad.

PROBLEM 15

SYMPTOM: 12-6 does not read.

TROUBLE: Defective J1 pin 7, A12

CORRECTIVE ACTION: Replace chassis A3.

ANALYSIS: The trouble lies in the +12.6 VDC line since all other power supply readings are good. Follow FIP readings at Figure 24-4, J4 pin A, B, & C, are good. On Figure 24-10, readings at J11 pin 22, 23, & 24 are also good. However, the output at J1-7 is bad.

PROBLEM 16

SYMPTOM: -50 VDC does not read.

TROUBLE: C2 shorted.

CORRECTIVE ACTION: Replace chassis.

ANALYSIS: The trouble lies in the -50 VDC since all other power supply readings are good. Following FIP readings at J10, pin 22, 23, & 24 are good. However, the output at J1-10 is bad.

PROBLEM 17

SYMPTOM: 6.3 right and left does not read.

TROUBLE: Primaries of T1 burnt out.

CORRECTIVE ACTION: Replace A8 (T1 is not a plug-in module).

ANALYSIS: Since right and left 6.3 VDC does not read we cannot say for sure that the power supply is bad (could be the input). Following FIP, the reading at the filter network is zero. This means the trouble is back to the left. Readings at the input to the 6.3 VDC power supply on pins A, B, and C of T1 reveal good indications. However, the secondaries have no readings.

PROBLEM 18.

SYMPTOM: 300 VDC does not read.

TROUBLE: K1 burnt out

CORRECTIVE ACTION: Replace A1 of A1.

ANALYSIS: Since all other power supply indications are good, the problem lies in the 300 VDC line. Following FIP, the readings at Figure 24-4, zone D12, prove good. On Figure 24-8, zone A1, pins 1, 2, and 3 of T1 prove good readings also. The reading at A3TB6-1 is bad. So the fault must lie in the power supply.

PROBLEM 19

SYMPTOM: 90. VDC does not read.

TROUBLE: Secondary T2 burnt out.

CORRECTIVE ACTION: Replace A1A1

ANALYSIS: Since the 90 VDC is the only voltage that has no reading, the fault must lie in the 90 VDC line. Following FIP check the input on Figure 24-8, zone C1, pins 1, 2, and 3 of T1, provides good readings. The reading at A3TB6-5 is bad. The fault must lie in the power supply.

PROBLEM 20.

SYMPTOM: 250 VDC does not read.

TROUBLE: V8 removed

CORRECTIVE ACTION: Replace V8 or change Chassis A2.

ANALYSIS: Since all other power readings are good, the fault lies in the 250 VDC line. The input to the chassis must be good since the -100 VDC and the +150 VDC are good. A reading at the +250 VDC, J4 is bad, so the fault must be in the power supply.

PROBLEM 21

SYMPTOM: 150 VDC high, unable to adjust

TROUBLE: R62 shorted

CORRECTIVE ACTION: Replace A2

ANALYSIS: Since all power readings are good and the +150 VDC is the only one reading high, the chassis input must be good. At J5 the reading is high also, so the power supply must be defective.

PROBLEM 22

SYMPTOM: No reading 28 VDC, 90 VDC or 300 VDC.

TROUBLE: F25, 26, 27 blown.

CORRECTIVE ACTION: Replace fuses.

ANALYSIS: Since there are no readings on the 300, 90, or 28 VDC, the trouble must lie in the chassis or before. Following the FIP, the fuses F8, 9, and 10 are found defective.

PROBLEM 23

SYMPTOM: RSG 250 VDC does not read.

TROUBLE: V3 defective.

CORRECTIVE ACTION: Replace V3 or chassis.

ANALYSIS: Since all other readings are good, the fault lies in the 250 VDC line. Following FIP, Figure 24-7, zone A20, readings at pins 1, 2, and 3 of T1 prove good while no reading is obtained at A3TB5-11. The fault must lie in the power supply.

APPENDIX D

INSTRUCTOR RECORDING FORMS

(HumRRO recording forms are like these except that they omit general instructions and have provision for recording the time taken.)

INSTRUCTOR RECORDING FORM

STUDENT _____

GENERAL PRACTICES

Set-up

1. Doors on HIPIR will be closed but not fastened.
2. Work from table on Radar Set Group end of radar.

Conduct

1. Don't lead the student--let him take the first step or make the first motion toward the next step.
2. Manuals. If the student is going to need manuals when he gets to the other side, remind him to take them with him if he doesn't think of it. (Not an error.) As standard practice, we don't want to count time for coming all the way back.

ERRORS

1. Instructor will count errors. He will compare his count with time keeper's count after each exercise and resolve differences. But instructor's count is considered the authority.
2. Counting errors
   (One for each time you have to correct him, coach him, or get him back on the track. Do not allow him to persist in error or guess for long periods.)

WEEKLY CHECK PROCEDURES: Tables 3-8, 3-9, 3-10. (Max time = 10 minutes)

Instructions to student:

1. You're going to go through check procedures on the Radar with the Power OFF.
2. You have ten (10) minutes to do Tables 3-8, 3-9, and 3-10. See how far you can get in that time.
3. Follow the manual. You don't have to read the manual word-for-word. You just have to do the steps.
4. Actually press the buttons or operate switches. Point to meters, and report the normal readings. Then indicate what corrective adjustments you could take if reading were not as expected.

During checks:

Table 3-9, Step 2--he doesn't have to actually go outside--just tell what he would do.

ERROR TALLY

LAST STEP IS COMPLETED _____, OR FINISHED ☐

Instructor Recording Form (Continued)

PROBLEM 1 (Max time = 5 minutes)

Instructions to student:
1. During daily checks, HIPIR would not go into standby.
2. So start with step 3 of FIP, p. 23-10.

During performance:
As student operates interlock selector switch, say whether indicator light illuminates.

Interlock indicator light goes on until Step 3f (Xmtr, group 5).

ERROR TALLY:

Student should:
(1) identify circuit in schematics;
(2) find 2 good check points;
(3) state test equipment (multimeter);
(4) normal indication, 28 VDC.

PROBLEM 2 (Max time = 5 minutes)

Instructions to student:
You're performing FIP, Table 23-4. You've finished Step 9 and the Radiate Ready light has come on. Take it from there.

During performance:
Step 10: radar goes into (false) radiate, so he should skip the rest of this step.
Steps 11-14: meter reads yellow area.

Fault Step 15: meter does not read +100 VDC.

ERROR TALLY:

Student should:
(1) identify circuit in schematics;
(2) find 2 good check points;
(3) test equipment (multimeter):
(4) State normal indication is 416 VAC up to T_1, 100 VDC if taken at output of Power Supply.

INSTRUCTOR RECORDING FORM

STUDENT _____

CHECK PROCEDURES: Table 3-11, Step 19. (Max time = 8 minutes)
In step 3, adjustments did not put meters into green area, thus sending him to step 19

ERROR TALLY (One for each time you have to correct him, coach him, or get him back on the track. Do not allow him to persist in error or guess for long periods.)

LAST STEP IS COMPLETED _____, or FINISHED ☐

PROBLEM 1 (Max time = 7 minutes)

SYMPTOM: During daily checks, the Forward RF Power meter does not come up to green area (Table 3-11, Step 37). In the abreviated Fault Isolation Procedures (12-2 manual, p. 23-5), the Power (Step 1) checks out and the Transmitting System checks out until Forward RF Power in Step 2 is reached. Have the student take it from there.
(Fault is Crystal Detector CR1 in A4 Zone A1, Figure 25-22.)

ERROR TALLY:

Student should locate CR1 and measure resistance both ways.

APPENDIX E

QUIZZES

1. Energizing and Control Circuits
2. Power Supplies Quiz
3. Transmitter RF Generation, Arc Detection, and Modulator Bias Circuits

NAME_____

ENERGIZING AND CONTROL CIRCUITS
(OPEN BOOK QUIZ)

1. If the radar will not go into Standby, what is the most likely cause?

   ( ) a. Interlock Open
   ( ) b. 6.3 VDC Power Supply Bad
   ( ) c. HVPS Liquid Level Low
   ( ) d. battle short switch closed.

2. In local, your radar does not go into Standby. In FIP, Step 3a, neither of the Interlock Indicator Lights come on. What is the likely cause?

   ( ) a. bulb bad
   ( ) b. Interlock Open
   ( ) c. 28 VDC Auxillary Power Supply
   ( ) d. 28 VDC Power Supply (in 300 VDC Power Supply drawer)
   ( ) 3. Standby relay K-1

3. When working with Fault Isolation Procedures, how can you locate specific panels and chassis on the radar?

   ( ) a. by the page number in the manuals.
   ( ) b. by the number with the title of panels in the Functional Schematic diagrams.
   ( ) c. by the Locational View Diagrams in TM 9-1430-533-12-2.
   ( ) d. by using the index in TM 9-1430-533-12-2-1.

4. With Transmitter cover open, which Standby button is operational?

   ( ) a. The button near the meter just checked.
   ( ) b. The button on the Transmitter side.
   ( ) c. The button on the Radar Set Group side.
   ( ) d. The IBCC button.

5. What event causes the Radiate Ready Light to illuminate?

( ) a. Radar in Standby.

( ) b. Radiate Ready button is pushed.

( ) c. Radiate button is pushed.

( ) d. 5 minute timer runs down after Standby.

6. In Step 3L of the FIP, what power supply are you checking out and where is it located?

( ) a. The 28 VDC Power Supply, in RSG upper left drawer.

( ) b. The 28 VDC Auxillary Power Supply behind center panel in RSG side.

( ) c. The 416 VAC coming from the generator.

( ) d. The +100 VDC Power Supply on the RSG side.

THE POWER SUPPLIES QUIZ

The Power Supplies Quiz displays line drawings of the two sides of the Radar on which there are code numbers for locating the Power Supplies. The student's task is to select the correct locator code for each of the nine Power Supply locations.

POP QUIZ

TRANSMITTER RF GENERATION, ARC DETECTION,
AND MODULATOR BIAS CIRCUITS

DIRECTIONS:

1. You have replaced the Master Oscillator (MO) for the HIPIR, assigned frequency 11 (eleven). What is the proper setting for the MO tuning control?

___ a. 52.5
___ b. 50.0
___ c. 87.5
___ d. 70.0

2. Where does high frequency noise cancellation occur?

___ a. Isomodulator
___ b. MO Power Supply
___ c. Phase Modulator
___ d. High Power Isolator
___ e. Power Amplifier

3. Where does low frequency noise cancellation occur?

___ a. Isomodulator
___ b. MO
___ c. Phase Modulator
___ d. High Power Isolator
___ e. Power Amplifier

4. In the Power Amplifier (PA), V2, which cavities are adjusted for minimum reflected power and which for maximum forward power?

Input Cavity:

____ a. Minimum reflected power
____ b. Maximum forward RF power

Idler (Center) Cavity:

____ a. Minimum reflected power
____ b. Maximum forward RF power

Output Cavity:

____ a. Minimum reflected power
____ b. Maximum forward RF power

POP QUIZ: TRANSMITTER RF GENERATION, ARC DETECTION, AND MODULATOR BIAS CIRCUITS

5. HIPIR drops out from Radiate and goes to Radiate Ready. The cause could be:

___ a. Micro-wave switch bias missing (Figure 24-17, zone C4).

___ b. Crystal Detector (A7) CR1 is open.

___ c. Arcing detected by Ion Probe.

___ d. Ranging Modulation missing from the carrier.

(You may check more than one answer.)

6. (following question 5 above) As radar drops to Radiate Ready, the Radiate Interlock lamp comes on; you wait 90 seconds and the Radiate Interlock lamp goes out. What is the likely fault?

___ a. Micro-wave switch bias missing (Figure 24-17, zone C4).

___ b. Crystal Detector (A7) CR1 is open.

___ c. Arcing detected by Ion Probe.

___ d. Ranging Modulation missing from the carrier.

(You may check more than one answer.)

7. (following question 6 above) If the Radiate Interlock lamp does <u>not</u> go out in the 90 second waiting period, you press the Interlock Release and the Indicator Lamp goes out. What was the likely fault that caused the HIPIR to drop to Radiate Ready?

___ a. Micro-wave switch bias missing (Figure 24-17, zone C4).

___ b. Crystal Detector (A7) CR1 is open.

___ c. Arcing detected by Ion Probe.

___ d. Ranging Modulation missing from the carrier.

(You may check more than one answer.)

8. In performing your checks, Table 3-11, Step 3i, the forward RF power meter indication is low. Corrective action would be:

___ a. to check MO frequency.

___ b. to adjust PA cavities.

___ c. to adjust isomodulator bias.

___ d. to balance arc detection circuits.

POP QUIZ: TRANSMITTER RF GENERATION, ARC DETECTION, AND MODULATOR BIAS CIRCUITS.

9. Where is Isomodulator Bias adjusted?

___ a. Isomodulator adjustable short.

___ b. MO Power Supply.

___ c. Ferrite switch control and power supply.

___ d. Transmitter test set.

10. Where is Isomodulator Bias monitored?

___ a. Isomodulator adjustable short.

___ b. MO Power Supply.

___ c. Ferrite switch control and power supply.

___ d. Transmitter test set.

11. In the action covered by questions 9 and 10 above, what do you adjust for?

___ a. A minimum value.

___ b. A maximum value.

___ c. A set value given in TM 9-1430-533-12-1.

12. What equipment is used to monitor the output frequncy of the transmitter?

___ a. an oscilloscope.

___ b. Transmitter test set.

___ c. Wavemeter test set.

___ d. simulator control group.

___ e. forward RF power meter.

APPENDIX F

QUESTIONNAIRE FORMS AND RESULTS

(The questionnaire following the unit on RF Generation, Arc Detection, and Modulator Bias Circuits is the same as the one for the Power Distribution System except for the reference to the unit covered.)

QUESTIONNAIRE

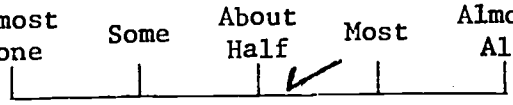
(This covers only the Power Distribution System.)

We are interested in getting your impression of the effectiveness of instruction on the IHIPIR Radar. Your answers will be confidential; only class averages will be reported.

Answer the following questions by putting a check (√) anywhere along the scale.

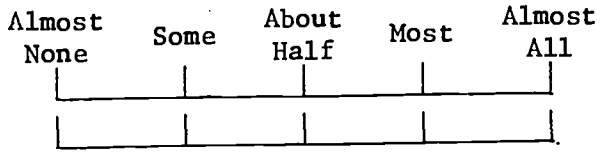
EXAMPLE:

1. How much of the information you received in class seemed useful in the maintenance job?



The response in the above example indicates that the person thought that somewhat more than half the information was useful. (Notice that you can check between the marks if the terms like "half" or "most" don't quite fit your response.)

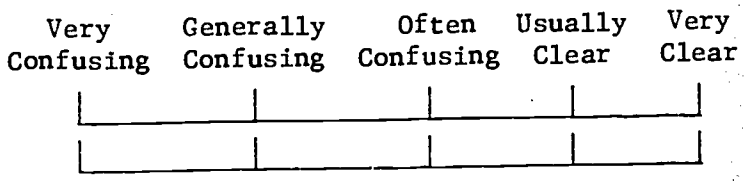
1. How much of the information you received in class seemed useful in the maintenance job?



   a. IN THE CLASSROOM?

   b. ON THE STATION?

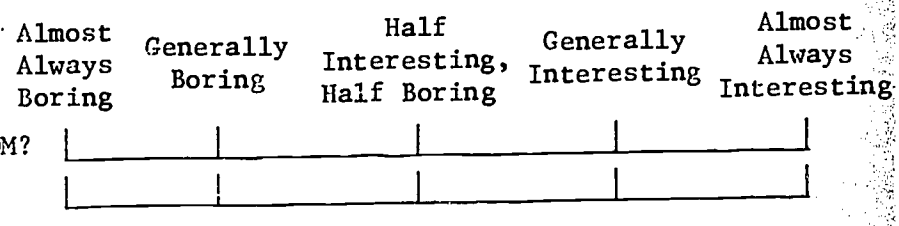
2. How clear were the explanations and instructions?



   c. IN THE CLASSROOM?

   d. ON THE STATION?

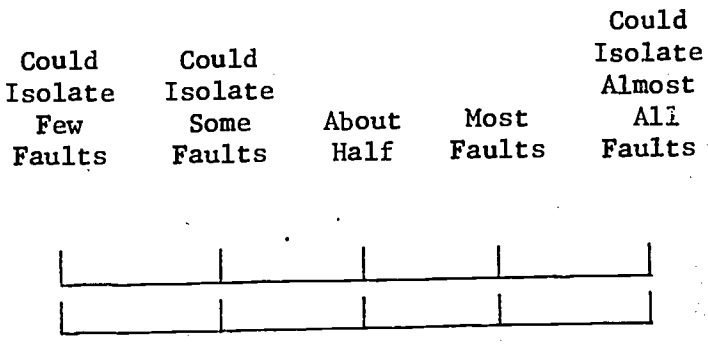
3. How often did you find the instruction interesting?



   e. IN THE CLASSROOM?

   f. ON LAB STATION?

4. When you took the test, how confident did you feel about your ability to troubleshoot the general run of problems that would come up in these systems?



   g. IN THE CLASSROOM?

   h. ON LAB STATION?

51

Other comments?

RESULTS OF ATTITUDE SURVEYS

The scale for each item in the preceding questionnaires were divided into nine intervals for scoring, with ONE being least favorable, FIVE being the mid-point, and NINE being the most favorable. Results are as follows:

POWER DISTRIBUTION ATTITUDE MEASURES

ITEM	CLASS	RATING: 1	2	3	4	5	6	7	8	9
a	5	1	0	2	1	0	5	3	5	4
	6	0	0	2	1	2	4	3	4	2
	7	2	0	5	3	1	4	4	0	1
	8	1	0	2	2	3	2	5	1	0
b	5	1	0	2	1	0	3	1	9	5
	6	0	0	2	0	3	1	5	3	4
	7	0	0	1	0	1	6	5	5	4
	8	1	0	0	2	0	2	6	2	4
c	5	0	0	0	2	0	4	5	9	1
	6	0	1	0	1	3	3	5	2	3
	7	0	0	0	1	6	1	7	4	1
	8	1	0	2	0	4	2	7	0	0
d	5	0	0	0	1	0	2	4	9	6
	6	1	0	0	1	0	1	6	3	4
	7	0	0	0	0	1	2	4	6	9
	8	0	0	0	1	1	3	8	1	3
e	5	0	2	0	0	4	6	2	7	2
	6	1	0	1	0	7	1	7	0	1
	7	2	1	2	1	9	1	4	0	0
	8	1	1	3	1	4	0	3	2	2
f	5	0	2	0	0	1	3	3	9	4
	6	1	0	0	0	2	1	6	2	5
	7	0	0	0	0	2	3	3	6	8
	8	0	1	0	0	2	1	2	3	8

(continued)

ITEM	CLASS	RATING 1	2	3	4	5	6	7	8	9
g	5	0	1	0	1	2	6	6	2	4
	6	2	0	2	1	3	1	3	3	3
	7	0	0	0	0	5	4	5	1	5
	8	0	0	2	1	4	3	2	1	4
h	5	0	1	0	2	0	3	3	6	7
	6	1	0	2	0	2	0	4	3	5
	7	0	0	0	1	2	5	5	3	6
	8	1	0	1	0	3	1	7	2	2

QUESTIONNAIRE

(Results in parentheses.)

CLASSROOM USE OF COLOR PHOTOS AND SLIDES

Your Primary Instructor used color photos and slides in his classroom presentation on Energizing and Control, AC and DC Power Distribution, and RF Generation and Arc Detection.

1. Do you think that using these visual aids was: (CHECK ONE)

- *(--)* ☐ Critical to understanding the presentation?
- *(16)* ☐ A definite help?
- *(20)* ☐ Somewhat helpful?
- *(01)* ☐ Not helpful?
- *(--)* ☐ More confusing than helpful?

ON STATION

TAPE/SLIDE DEMONSTRATION

For those same units, you viewed a tape/slide demonstration of checks and adjustments.

2. Did you find this: (CHECK ONE)

- *(03)* ☐ Very helpful?
- *(08)* ☐ Helpful?
- *(14)* ☐ Somewhat helpful?
- *(09)* ☐ Of Little Help?
- *(03)* ☐ A waste of time?

FAULT ISOLATION PROBLEMS

As a supplement to your practice with the equipment on station, you were given some practice problem sheets to be used with the color mock-ups (Power Distribution Systems).

3. Did you find these: (CHECK ONE)

- *(07)* ☐ Very helpful?
- *(15)* ☐ Helpful?
- *(09)* ☐ Somewhat helpful?
- *(01)* ☐ Of little help?
- *(01)* ☐ A waste of time?

APPENDIX G

LIST OF DEVELOPMENTAL BY-PRODUCTS UNDER SIMEL'EM

LIST OF DEVELOPMENTAL BY-PRODUCTS UNDER SIMELEM

I. LESSON PLANS

II. COLOR PHOTO MOCKUPS -- 36"x60" (one pair); and 24"x40" (eleven pair).

III. SLIDES COORDINATED WITH LESSON PLANS (three sets).

IV. INTERIOR DRAWINGS OF HIPIR, COORDINATED WITH SMALLER COLOR PHOTOS.

V. PAPER TROUBLE-SHOOTING PROBLEMS.

VI. COLOR PHOTOS OF INDIVIDUAL POWER SUPPLIES.

VII. HANDOUTS:

A. FUNCTIONAL GROUPING OF POWER SUPPLIES AND ASSOCIATED PROCEDURES.

B. ILLUSTRATION OF PHASE RELATIONSHIPS IN A THREE-PHASE AC SOURCE.

C. INTERLOCK LOCATOR DIAGRAM, ILLUSTRATING FOUR MAJOR TYPES.

D. CHASSIS LOCATOR DIAGRAMS (developed by Ratheon).

VIII. TAPE/SLIDE DEMONSTRATIONS OF WEEKLY CHECKS AND ADJUSTMENTS: TABLES 3-8, 3-9, 3-10, and 3-11 (Steps 1, 4, 5, 8, 18, 19).