MODULE 34
RF POWER METER FAULT ISOLATION

OBJECTIVE

Given TO 31S1-2TSC60-12, isolate RF power meter faults IAW Table 5-25 and para 5-22 thru 5-25.

PREREQUISITES

1. Must complete Modules 1, 2, 3, 15, 20, 21, 25, and 29 thru 33.

2. Must be able to use an HP-410B VTVM.

INFORMATION

You can measure RF output power of the TSC-60 using the RF power meter on the RF patch panel or the multimeter on the Maintenance Display. Either meter or both may become defective. Although they are checked periodically, these meters should be tested and adjusted whenever their readings appear to be faulty. In this module we'll discuss how to test and adjust them. First, let's see how the measurements are taken.

Look at Figure 23 in your Diagrams booklet. The output of the PA is sampled by a directional coupler. This RF sample is rectified and filtered to produce two DC voltages that represent the forward and reflected power. The two DC voltages are sent to the 309F-1 digital-to-analog converter and to the RF patch panel RF power meter circuits.

The system contains two adjustments, one for the level of the DC voltage from the directional coupler and one for the power meter on the RF patch panel. The digital-to-analog converter is not adjustable. So, to calibrate the system, You must first find out the exact output power. You determine this using test equipment calibrated by PMEL. Next, you adjust the system so the two meters (Maintenance Display multimeter and the RF patch panel power meter) both read that measured output.

To measure the output power of the PA, the procedure calls for a locally fabricated test fixture (-12 TO Figure 5-1). This test fixture is nothing more than a voltage divider to reduce the RF voltage to within the range of the voltmeter (less than 300 volts). You measure the RF voltage and compute the power output power using the formula E2/R. E is the measured AC voltage times 3 (because of the voltage divider), and R is the resistance of the dummy load (50-ohms).

Once you've figured out the exact power the PA is putting out, you need to calculate what the Maintenance Display multimeter should read. In the FORWARD POWER position, the multimeter does **not** read actual power. Instead, it reads proportional power: 1.00 for full rated power (2500 watts) and less than 1 when the power is less. The formula for figuring out what the meter **should** read is the square root of the actual power divided by 2500. For example, 2000 watts would read .894. The multimeter usually has a multiplier that you need to figure in to get the decimal in its proper place. In this case the multiplier is by .1 to obtain the correct reading. In other words, for a full 2500 watts of output power, the meter will display 10.00. Multiplying the display by .1 will give you the 1.000 reading you're looking for.

Once you know the actual output power of the PA and what the multimeter should read, you will need to make an adjustment if the meter reading is incorrect. This is a simple adjustment that is made at the directional coupler. All you're doing when making this adjustment is changing the level of the DC voltage that represents the forward power. You simply adjust the voltage until the multimeter reads what it should.

Next, you look at the power meter on the RF patch panel. You've already calculated the actual power output; so this meter should read that power. If not, there is a simple adjustment inside the RF patch panel to correct the reading. Once you do this, you're done with the RF power meter test and adjustment procedures. Now let's discuss briefly what's **not** in the TO.

The TO doesn't cover reflected power. The DC voltage representing reflected power from the directional coupler is adjustable also. It should be calibrated just like the forward power. However, adjusting the reflected power reading is a little more difficult than forward power. This is because reflected power is a lot less than forward power, particularly when transmitting into a dummy load. Also, our method of measuring voltage across the dummy load doesn't work for measuring the actual reflected power. So now what?

First, you need a method of measuring the actual reflected power. This can best be done using a Thru-line Wattmeter. This is a Wattmeter that is connected in series with the coax between the PA and the dummy load, or antenna. When measuring reflected power, this is best done on an antenna. Even though the antennas for the TSC-60 are very good antennas with very low VSWR, they will measure more reflected power than you will using the dummy load. The easiest method is to measure the reflected power and then

adjust the reflected power calibration resistor on the directional coupler for the correct meter reading. In this case, the worse the antenna, the better the calibration. This is because a good antenna will read very low reflected power, which makes adjustment difficult and less accurate. An antenna with a little higher VSWR will help to make the adjustment a little more accurate.

Another item not covered in the TO is using the Thruline Wattmeter to calibrate the forward power readings instead of the locally fabricated test fixture and the VTVM. Simply connect the Wattmeter in series with the dummy load at the coax connector on the side of the load. Using this method, you won't need to calculate the forward power. Instead, you just read the meter. This is an acceptable method of performing the adjustment.

Now you know what to adjust, why it's necessary, and how to perform the adjustment. The procedures for the 10kW PA are the same as for the 2.5kW PA; so if you can do one, you should be able to do the other. Now read the measurement procedure in Table 5-25 of the -12 TO and the adjustment procedures in para 5-22 and 5-23 or 5-24 and 5-24, as appropriate for your equipment.

One final note. There is a WARNING in the TO that there could be hazardous voltages in the dummy load if the Transmitter is keyed. The TO says to ensure all Transmitters are unkeyed before connecting the test fixture. We suggest that a better safety precaution would be to disconnect the coax going into the side of the dummy load before connecting the test fixture. With this coax disconnected the Transmitter cannot be keyed. You can reconnect it after the test fixture is installed.

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. For a voltage of 330 volts across the dummy load, what is the output power of the PA?

2. What should the Maintenance Display multimeter indicate when the output power of the PA is 2500 watts?

3. When calibrating the forward power meter readings, which adjustment should be made first, and why?

4. What meter indications would you get if both the Maintenance Display multimeter and the power meter on the RF patch panel were set to read forward power on the same PA at the same time?

5. What caution should you take when connecting the test fixture to the dummy load, and why?

PERFORMANCE PROCEDURES

Have your trainer demonstrate the RF Power Meter Test. Then practice the procedures until you feel confident. Your trainer will annotate your training records when he/she feels you are proficient.