HARRIS COMMUNICATIONS AND INFORMATION HANDLING

SERVICE BULLETIN

MAINTENANCE AND MODIFICATION DATA

Broadcast Products Division

Bulletin No. AM-138-TLH

Equipment: MW-1/1A **Date** February, 1980

SUBJECT: Troubleshooting Tips

This bulletin contains several practical troubleshooting procedures which you will find useful if you have trouble or suspect a problem with your transmitter. Note that some of the various tests pertain to the same type problem. While this is not intended to be a complete troubleshooting guide, we feel it will cover most questions or problems you might have.

We suggest you keep this in your technical manual for a handy reference.

AUDIO DRIVER OUTPUT DISTRIBUTION

The following test is often useful in localizing the cause for distortion, a lack of positive peak capability, or a faint fault indication.

1) Connect the positive lead of a VOM to terminal 3 of the gating and power control board A15.

2) Connect the negative lead to the bottom side of F2 on A15. Normally the voltage measured will be 0.1 - 0.4vdc (measured on a Simpson 260) with the transmitter operating around 1kw.

3) Make the same measurement at the bottom of F3-F7. Some variance in these readings is expected due to component tolerances.

   A high reading is an indication of:

   a) an open fuse on the gating board (A15 F2-F7)

   b) an open fuse in the +70 volt line (A25)

c) an open fuse in the +140 volt line (A26)

d) a shorted modulator transistor Q1-Q5 on one of the two PA modules associated with the fuse with the high reading.

e) a damaged socket for one of the PA modules associated with the fuse having the high reading.

A zero reading is an indication there is no electrical connection between the fuse and the associated PA modules.

PA MODULES DUTY CYCLE

The following test should be used in determining the cause for a faint fault indication.

If you have an oscilloscope with 15MHz bandwidth or better, you can easily check the RF duty cycle at the output of each module.

1) Connect the oscilloscope to the output of each PA module with X10 probe.

2) Observe a square wave whose peak to peak amplitude is the "PA VOLTS" value and whose duty cycle is 50% ± 5%. Some ringing on the square wave should also be observed.

An error in amplitude is a problem associated with the modulator section of the module. Measure the voltage at the fuse on the PA module in question. It should be equal to the "PA VOLTS" reading within 0.3 volts.

An error in duty cycle is caused by:

a) A severe gain mismatch between Q6 and Q7. Try swapping Q6 for Q7.

b) A fault with the transformer assembly T1.

PA MODULE LOADING SHARING

Using a VOM that has the capability of measuring several DC amperes, you can check the amount of current each module is drawing.

1) Turn the transmitter off.

2) Remove one of the F1-F12 fuses from A25 and substitute the dc ammeter, with the + lead on the +70 volt bar.

CAUTION: Be sure that the ammeter leads will not short to ground. The power supply is capable of extremely high short circuit current.

3) Disconnect any audio from the audio input.

4) Turn the transmitter back on and allow time for the regulator to adjust.

5) Read the current on the meter. It should be 1/12 of the "PA AMPS" reading. "PA AMPS" should never exceed 24.

6) Using the same procedure, check the current drain of the other PA modules.

7) If necessary, make adjustments to L1-L12 to achieve uniform current drain. Compressing a coil results in a decrease in PA current for the module associated with that coil. Expanding a coil causes an increase in current. Be sure to dip "PA volts" after making an adjustment.

   A severe imbalance in current may be a fault of the module. Try interchanging modules to see if the current imbalance follows the module.

   Typically L11 and L12 will have to be slightly compressed in relation to L1-L10 in order to achieve a balance.

   There will not likely be any symptoms of a problem in this area. The purpose of the test is to obtain equal stress amoung the PA modules.

AUDIO DRIVER (A17) OUTPUT VOLTAGE SWING

This test is often useful in finding the reason for a lack of positive peak capability and distortion, especially at high modulation levels.

Operate the transmitter with A15 F2-F7 removed. Measure the audio driver output with a scope at P16-12 or A15 terminal 3. Audio must be applied to the transmitter. The output voltage swing will be about 130 volts and very much clipped. "PA VOLTS" will be around 60.

A low peak to peak voltage swing could be an indication of:

1) an abnormally low AF DVR HI voltage. Check multimeter.

2) A17, CR4 and/or CR5 shorted.

3) A17, CR2 shorted.

4) A17, Q2 partially shorted.

"BUMPER" CIRCUIT OPERATION, A17 Q4 CIRCUITRY

1) Operation of this circuit can be checked at turn on with A15 F2-F7 removed. "AF DVR CONTROL" will be about 24 volts initially but will decrease to less than 15 volts when "PA VOLTS" reaches 60.

   Results other than this could be caused by:

   a) Q4 shorted ("AF DVR CONTROL" will remain at 24 volts while "PA VOLTS" reaches 60 or higher)

   b) A17 CR3 shorted (no "AF DVR CONTROL," no "PA VOLTS")

   c) A17 Q3 shorted ("PA VOLTS" pinned, "AF DVR CONTROL" zero)

RF DRIVER MODULATION

Use this test to help troubleshoot carrier shift, distortion, poor modulation capability, or an abnormal "RF DVR AMPS" reading.

1) Modulate the transmitter to 100% with a tone.

2) Connect a X10 scope probe to the junction of L18 and L19 above the IPA module.

3) Observe the modulation envelope at this point.

4) The envelope should be about 50-70% modulated. Normally it will be somewhat distorted but not clipped.

   A cause for no modulation at the RF DRIVER would be A15 F1 being open.

   Causes for clipping on the positive excursion would be:

   a) A25 F13 open

   b) A26 F13 open

   c) shorted transistor(s) in the modulator section of the RF DRIVER module.

   Cause for clipping on the negative excursion would be:

   a) Q2, Q5 shorted on the RF DRIVER MODULE.

VSWR OVERLOAD OPERATION

1) VSWR overloads can be caused by improper transmitter loading adjustment or improper REL/VSWR circuit adjustment. The loading control should be adjusted such that PA AMPS reads 22 when PA volts reads 50. With the correct loading ratio having been established, the REL/VSWR circuit should be adjusted for a zero reading on the power meter in the REL/VSWR position. With the REL/VSWR reading nulled to zero, rotate the PA loading control in the direction which lowers PA AMPS. Make sure the transmitter is not being modulated. The REL/VSWR reading will increase as you rotate the loading control. The VSWR trip circuit threshold should be 500-700 on the meter. After making or checking the correct VSWR trip adjustment, return the loading control to its proper setting.

2) VSWR overloads can be caused by improper impedance external to the transmitter. See if a problem exists when operating on the internal dummy load. The dummy load impedance is typically 52 ohm + j5. Assuming the transmitter has worked previously on the antenna, a failed capacitor in the ATU or phasor is the most probable cause of the VSWR.

3) If the VSWR trips are caused by something internal to the transmitter and occur only with high positive modulation try disconnecting E1, the glass spark gap. Check also for loose connections in the output network, including the contact roller in L14, the loading coil.

4) If the VSWR overload is of a continuous nature (i.e., no power output because of it), remove A15 F2-F7. The transmitter will then operate with PA VOLTS at approximately 60 and PA AMPS at zero. It will not attempt to produce RF power output as it does during the VSWR cycling. With no RF output, a real VSWR overload is not possible. A VSWR overload under these conditions would indicate a problem in the VSWR trip circuit (A18 Q3, Q4, or Q6).

   If the overloads cease under these conditions only, the VSWR condition is real and of a fairly extreme nature such as an open or short in the antenna system. Be sure to test the transmitter on the dummy load.

5) If a normal (zero) REL/VSWR reading is indicated, yet VSWR overloads occur during modulation on the antenna, there are two possible causes. A voltage breakdown could be occurring with one of the capacitors in the ATU or phasor. If the overload occurs with any frequency of modulation, this is likely

the cause. If the overload seems particularly sensitive to high frequency modulation, then narrow antenna bandwidth is indicated. Note the action of the REL/VSWR meter. An upward deflection with modulation is a symptom of the effects the antenna bandwidth limits. The greater the meter reading, the more limited the bandwidth. It also depends on the amount of high frequency audio. Note: The REL/VSWR trip circuit appears to be more sensitive with modulation. The REL/VSWR reading does not have to reach 500-700 in order to trip with modulation. If the transmitter indicates that the antenna bandwidth is sharply limited, an antenna impedance sweep should be made and an antenna broadbanding scheme should be considered.

6) Tower static is characterized by a gradual buildup on the REL/VSWR meter, usually during poor weather conditions. This static buildup continues until the tower base ball gaps arc over. The REL/VSWR reading then falls to zero indicating the charge has cleared. A static drain choke at the tower base to ground should prevent tower static buildup.

7) Guy wire static is similar to a nearby lightning strike in that no charge is registered on the REL/VSWR meter. Instead, the static charge builds up on the guy wires and ultimately arcs across the insulators to the tower. The charge is then removed by the static drain choke and/or the ball gaps at the base of the tower. The guy wire static buildup may be prevented with RF chokes across the insulators or by using non-metallic guy wires. Arcing across the insulators may be reduced or eliminated by cleaning them.

DC OVERLOADS

DC overloads fall into two categories:

1) Those which occur at transmitter turn on, immediately shutting the transmitter off.

   a) Remove A15 F2-F7. Turn the transmitter on. The PA modules should not draw any current, regardless of the audio driver output. Observe the PA VOLTS meter. If it pins, the problem is on the audio driver such as Q3 shorted, Q1 shorted, F2 blown, CR1 shorted.

   b) If the transmitter still DC overloads at turn on with A15 F2-F7 removed, observe whether K2 pulls in momentarily. If K2 does not, the power supply is not being energized, therefore, a real DC overload is not possible. Look for a fault in the protection circuitry such as A22 Q3 shorted (A22 K4 would always be closed) A18 Q1 (can be removed for test purposes. It only lights the DC LED).

2) DC overloads during normal programming.

   a) The normal DC overload setting is made at 1100 watts output with 100% modulation at 20 hz.

   b) If correct adjustment is not achievable, A22 C3 may be open. Its purpose is to slow the overload circuit down. You might find that the transmitter will not overload when modulated with 1 Khz.

      It is not normal to experience DC overloads during ordinary programming. If the sensitivity is set correctly and overloads persist, then it is evident that the audio going into the transmitter contains subaudible signals whose amplitude is sufficient to trip the DC overload.

LINE REGULATOR (T2) OPERATION

1) Check the 140 V supply reading. Its normal factory setting is 135 V.

2) Observe the position of the wiper contact of T2 during normal operation on high power. Preferably, it will be in the middle portion of its range.

3) If the wiper contact is positioned at or near either extreme, change the tap on T1. If the wiper contact on T2 is counter-clockwise viewed from the top, move the tap on T1 to a higher voltage setting.

4) Check to see if the A22 regulator circuitry is working by turning the front panel regulator adjust control. Typically, the range of voltage adjustment is 10 volts.

5) On A22, K1 closes to lower the supply voltage. K2 closes to raise the supply voltage. During normal operation, these relays will operate every several seconds.

6) Typical failure modes of the A22 regulator circuit are:

   a) Always raising - Q2 shorted

   b) Always lowering - CR5 shorted (check voltage) Q1 shorted CR1, CR2 shorted (check voltage drop)

      CAUTION: A22 pins 6 and 15 are not fused from the 140 V supply. Be very cautious when attaching meter leads to these terminals.