Final article has useful troubleshooting procedure

A high performance AM tuner: Pt. 4

This comprehensive trouble shooting article will enable a quick repair for virtually any fault condition experienced with the AM Tuner. No extra tools or equipment are necessary in the fault finding procedure.

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While most readers will have successfully aligned their tuner without problems, there will be the unfortunate few who experience difficulty with some aspect of the circuitry. Perhaps when the tuner was first switched on a fault became evident or alternatively a problem arose during alignment. In either case this article will aid in locating the problem.

As is the case with any fault finding procedure, the problem must be attacked logically and with suitable test equipment. To allow this we have produced trouble-shooting charts which methodically trace through the relevent portions of the circuit. Testing is performed by measuring voltages at key points on the circuit, and a table of expected voltages is provided. Use is made of the alignment unit described last month to provide a suitable RF signal where necessary as well as buffering for the multimeter.

The trouble-shooting charts for the entire AM Tuner and Digital Tuner Readout circuitry are listed under six separate headings any of which can be considered as starting points for fault finding. Two of these starting points are the key locations observed while aligning the tuner: No Signal at Test Point 1 (TP1), and No Signal at Test Point 2 (TP2). The remaining four are all physically observable problems: No Audio, Distortion, No Signal Level Display, and Tuner Readout Display Fault.

It is important that the charts be followed in a logical sequence by testing each block before moving to test the next block. Also each starting point of the chart should be followed in the correct order such that starting points preceding a fault area be tested first. For instance, TP1 should be tested for a signal before testing at TP2. Again, TP2 should be tested first if there is no signal level display or audio signal.

Each block of the chart involves measuring a signal or DC voltage on the circuit and the accompanying voltage table shows those voltages as measured on our prototype tuner. Note that these voltages can be used as a guide only. Generally a correctly operating tuner will exhibit similar voltages to those depicted provided that the readings are made ex-

Voltage Table

TUNER SIGNAL VOLTAGES

		NOTES
Drain of Q1	1.1V	2,3,4
Emitter of Q6	1.0V	2,3,4
S1 of winding L5	1.2V	2,3,4
Drain of Q2, Q3	0.9V	2,3,4
Drain of Q4	2.8V	2,3,4
Drain of Q5	2.8V	2,3,5
Pins 1&2 of IC6	0.8V	2,3,5,6
Pins 10&11 of IC6	0.1V	2,3,5,6
Pins 8&9 of IC6	0.3V	2,3,5,7
Pins 3&6 of IC2	0.2V	2,3,5,7
Pin 3 of IC4	0.1V	2,3,5,7
Pin 6 of IC4	4.0V	1,3,5,7
Pin 6 of IC5	5.7V	1,3,5,7
Pin 17 of IC7	3.0V	1,3,5,7
Pin 3 of IC7	2.0V	1,3,5,7

TUNER DC VOLTAGES

		NOTES
Source of Q1	0.3V	1,3
Source of Q2	2.1V	1,3
Source of Q3	1.9V	1,3
Source of Q4	0.3V	1,3
Source of Q5	0.3V	1,3
Base of Q6	3.9V	1
Base of Q7	1.6V	1
Base of Q8	−1.6V	1
AGC	−1.3V	1,8

DIGITAL TUNER READOUT SIGNAL VOLTAGES

		NOTES
Gate of Q1	0.1V	2,9
Source of Q1	0.1V	2,9
Pins 6&7 of IC1	0.2V	2,9
Pins 14&15 of IC1	0.2V	2,9
Pins 2&3 of IC1	0.2V	2,9
Collector of Q2	1.0V	2,9
Pin 8 of IC18	2.5V	1
Pin 2 of IC19	0.4V	1
Pin 7 of IC19	0.4V	1
Pin 12 of IC19	2.5V	1

NOTES:

1. Measured with 20kΩ/V multimeter set for DCV.
2. Measured using buffer from alignment unit and 20kΩ/V multimeter set for DCV.
3. Link LK2 inserted.
4. 600kHz alignment unit oscillator signal at antenna input with no attenuation. Oscillator and tuner set for 600kHz.
5. 600kHz alignment oscillator signal attenuated with 470kΩ resistor in series to antenna input.
6. Wide/Narrow switch set to narrow position.
7. Wide/Narrow switch set to wide position.
8. Attenuator adjusted for full scale deflection on LED signal meter.
9. Local oscillator connected to Digital Tuner Readout.

actly as we have measured them. The method and conditions of measurement are listed as notes at the base of the table.

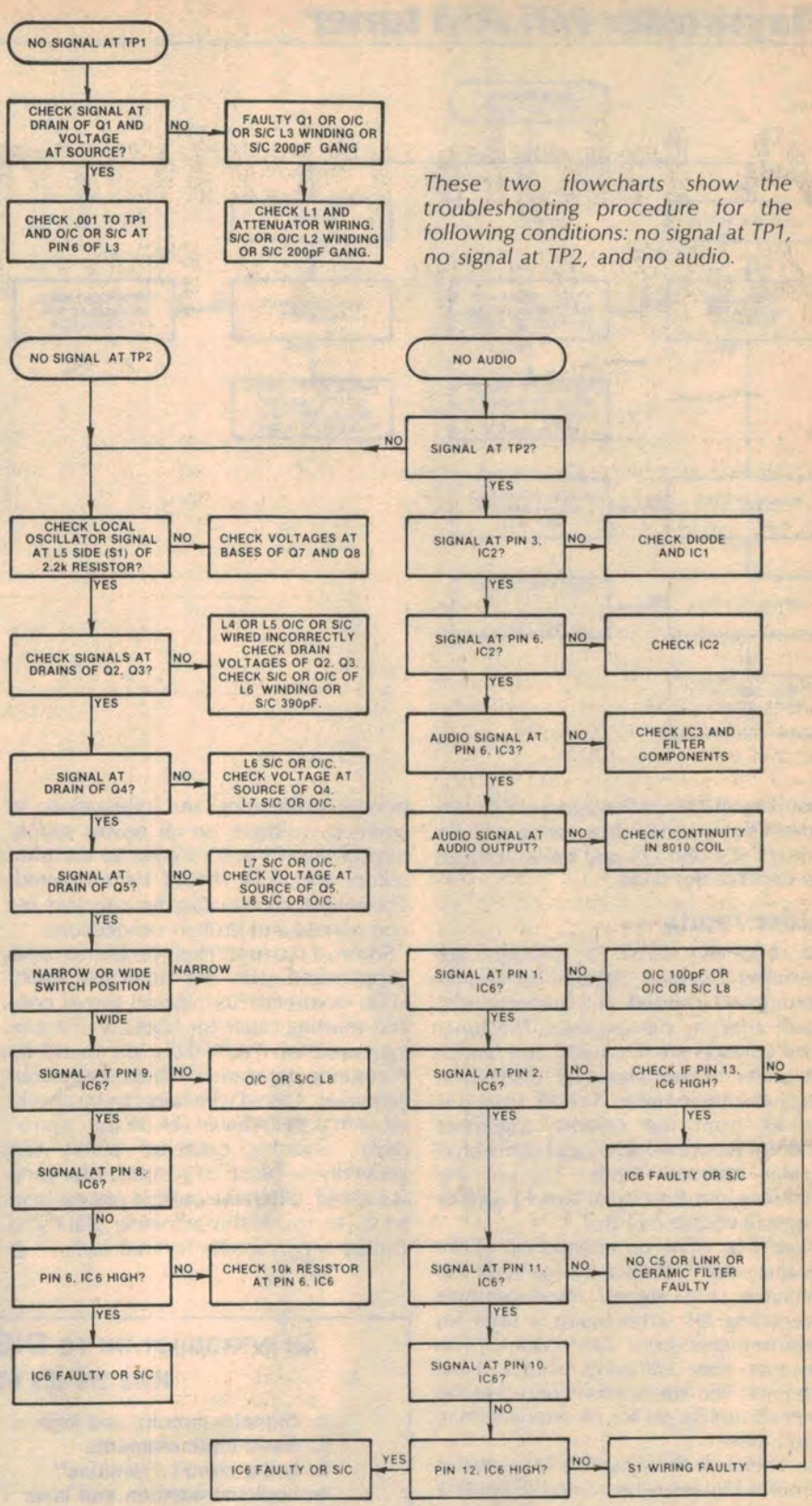
Most of the vertical flowing blocks ask the question whether the signal levels are sufficient at that part of the circuit. In response the chart is followed either vertically for a Yes (Y) if satisfactory, to answer further questions along the circuit, or horizontally for a No (N) where possible causes of the low signal level are noted.

Some of the possible causes listed are Open Circuit (O/C) connections which can easily be checked with a multimeter set on the "ohms" range with the power to the tuner off. Short Circuits (S/C) may be more difficult to check particularly with the tuning coils which have a resistance of about 10Ω. In this case it will be necessary to very precisely adjust the "ohms adjust" control on the multimeter to give a reading of zero with the meter probes shorted. The coil resistance should show a small deflection of the meter needle if not shorted.

Diodes are easily checked by using the multimeter on the "ohms" range and measuring the resistance in both directions. One direction should show a low resistance when the positive lead is at the anode and the high resistance reading when the positive lead is at the cathode. Note that the majority of multimeters, when on the "ohms" range, apply a positive voltage on the common lead of the meter, however, the manual should confirm this. In most cases it will be necessary to lift one side of the diode from the PCB before checks can be made.

Where a possible fault block suggests checking an IC, this involves testing power supplies, checking for any short circuit tracks between the IC pins and for dry joints by measuring the resistance between the IC pin and copper track. If these tests are OK and the fault persists, then the IC can be considered suspect.

Checking FET operation can only be done satisfactorily with the FET in circuit. The source voltages of each FET are listed in the Tuner DC Voltage table to indicate the voltage for a correctly biassed FET. If all other tests are OK, such as no S/C or O/C coils and no shorting capacitor plates, and no signal is present at the drain, then the FET can be considered suspect.



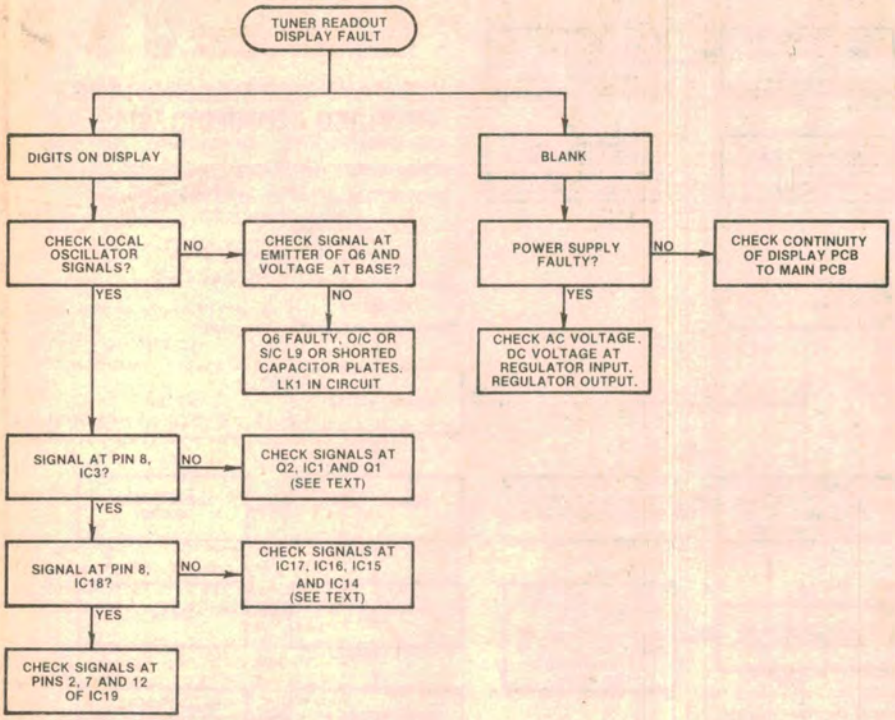
These two flowcharts show the troubleshooting procedure for the following conditions: no signal at TP1, no signal at TP2, and no audio.

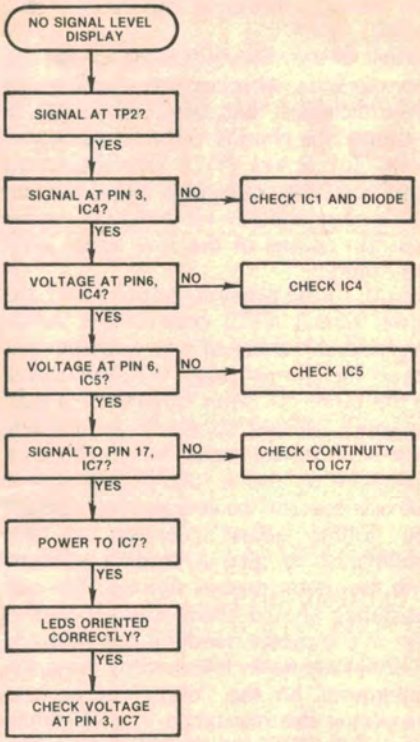
Tuner readout faults

When checking the Digital Tuner Readout circuit, voltages are given for digital signals. For example pin 8 of IC18 gives a reading of 2.5V which represents the average voltage produced by the 50% duty cycle signal. Similar voltages can be measured at pin 12 of IC17, 16, 15 and 14. Lack of voltages at any of these points may indicate a faulty IC, shorted pins or open circuit connections.

The Latch Enable, LE, pin 5 can be traced on IC12, IC11, IC10 and IC9 and should read about 4.4V on the multimeter. The Preset Enable, PE, on pin 1 of IC5, IC6, IC7 and IC8 should read 0.4V.

The following voltages must be measured while the local oscillator is applied to the input of the digital tuner readout. If the voltage at the collector of Q2 is correct then the signal can be followed to pin 2 of IC3 which should read 2.5V due to the 50% duty cycle. Similarly the voltage at pin 12 of IC4





should read 2.5V. If the signal at Q2 is incorrect then it should be followed back through IC1 and Q1 and these voltages are listed in the table.

Tuner faults

Most of the Tuner DC voltages are measured using a 20kΩ/V multimeter with link LK1 inserted. This prevents AGC action affecting the readings. The tuner signal voltages are measured mainly with the buffer of the alignment unit which drives the multimeter. The RF source is derived from the 600kHz alignment oscillator (set to 600kHz) and connected to the antenna input. To set the frequency, use the Digital Tuner Readout as described last month.

Note that while no attenuation of the signal is used to reduce the signal of this oscillator for signal measurements preceeding Q5, attenuation is used for measurements from Q5 onward. This prevents the following stages from overload. The attenuation control of the tuner should be set for no attenuation in both cases.

To attenuate the signal a 470kΩ resistor is inserted in series between the 600kHz alignment oscillator output and antenna input. This method of attentuation is used rather than setting the signal level display with the attenuator (as described in the alignment article last month) since it cannot be guaranteed that the circuitry up to the signal level display is functioning correctly.

Before proceeding with fault finding, inspect all the PCBs for correct component positioning and orientation. In addition, voltages on all power supply pins of the ICs and supplies to the transistors and FETs should be measured. The wiring should also be checked for correctness and broken connections.

Some of the most likely problems to be experienced with the tuner are faulty FETs, incorrectly terminated toroid coils and shorting capacitor plates on the tuning capacitor. Faulty FETs are found by measuring the source voltage as described earlier. Toroid windings can be checked with a multimeter set on the "ohms" range. Shorting capacitor plates can generally be heard to scrape as the gang is rotated. Often the outside plate is bent so as to touch the adjoining plate and can be simply gently levered back.