$25.00 U.S.

Sonologic 5000 Troubleshooting Manual

97-1078-01
REV. B

NOTE

It is essential that all instructions in this manual be followed precisely to ensure proper operation of the equipment.

Kistler-Morse®

97-1078-01
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NOTICE

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CAUTION

Follow these rules if welding is done on the vessel. The electrical current of the welder may pass through the transducer causing damage to it and possibly to the signal processor if these precautions are not followed.

1. Disconnect the transducer cable from the signal processor. If possible, remove the transducers or insulate them electrically. (Transducers that have fabreeka pads only require removing the mounting bolts. The pads will act as insulation.)

2. Ground the welder as close to the welding joint as possible.

Table of Contents

Chapter 1. Troubleshooting Flow Charts

INTRODUCTION

This chapter contains sections describing the Kistler-Morse Sonologic 5000 and how it operates. The flow charts at the back of the chapter will assist in deciding the course of action to take to troubleshoot your unit. Be sure to refer to the flow charts before continuing with the rest of the manual.

PHYSICAL DESCRIPTION

The 5000 consists of an ITU board, a filter board, and a display board. The ITU board contains the transmitter, receiver, and microprocessor. The filter board shapes the returning echo, and the display board contains a six-digit LCD, the setpoint relays, and the 4-20 mA output option. Also, the transducer is wired to the display board.

DESCRIPTION OF OPERATION

The Sonologic 5000 operates by transmitting sound waves from the transducer and measuring the time it takes to receive an echo. It then calculates the distance the sound waves have traveled.

The transmitter sends a pulse to the transducer which emits a sound pulse lasting one to two milliseconds. During the transmit time, the receiver is turned off to avoid reading the actual transmit pulse and thereby falsely giving a full-vessel indication. After the transmit pulse, the receiver is turned on and receives the return echo. The return echo is channeled through the transducer to the filter card, where any extraneous noise is filtered out and the echo is shaped. It then travels to the receiver section of the ITU where the echo is rectified, then converted to a digital pulse (detect). The microprocessor uses this pulse to measure the elapsed time and calculate the distance to the target.

If, for any reason, the return echo is too weak, it will not be converted to a digital pulse and the microprocessor will cause the display to flash, indicating loss of echo. (In this instance the echo does not trigger a detect pulse due to it's amplitude being less than the qualify comparator level.) When troubleshooting a Sonologic 5000 there are four parts to check;

- Transmitter
- Receiver, including filter module
- Microprocessor section and display
- Serial communications

Before proceeding further, you should first record the Monitor Mode parameters as described in Step 5 of the "System Troubleshooting" section of the Sonologic 5000 Manual. Use the accompanying Monitor Mode description to analyze the readings. (See Section 2.0.)

TRANSMITTER

You must first be certain that you have a good connection to your transducer. Listen closely to the Sonocell, you should be able to hear a ticking sound. If you do not hear the sensor ticking, then carefully check all connections and splices from the electronics to the sensor. If you still do not hear ticking then troubleshoot the transmitter as described in Chapter 2. In Chapter 2 you will find a subsection for checking the power supply.

RECEIVER SECTION

The receiver can be checked with the aid of an oscilloscope. The idea is to track the return echo through the filter and receiver sections of the ITU to determine if the returned echo is too weak or if there is a faulty component in the electronics. A weak echo can be caused by the conditions in the vessel or a problem with the sensor. Follow the oscilloscope procedure in Chapter 2.

The microprocessor can be tested by checking the Monitor Mode in Chapter 2. The serial communications can be troubleshot using Chapter 3.

Troubleshooting Flow Charts

INITIAL CHECKOUT

CHECK INSTALLATION
WIRING OF SYSTEM

↓

LOOK AT APPLICATION INSIDE
VESSEL IF POSSIBLE

↓

ENTER AND/OR CHECK SET-UP
PARAMETERS

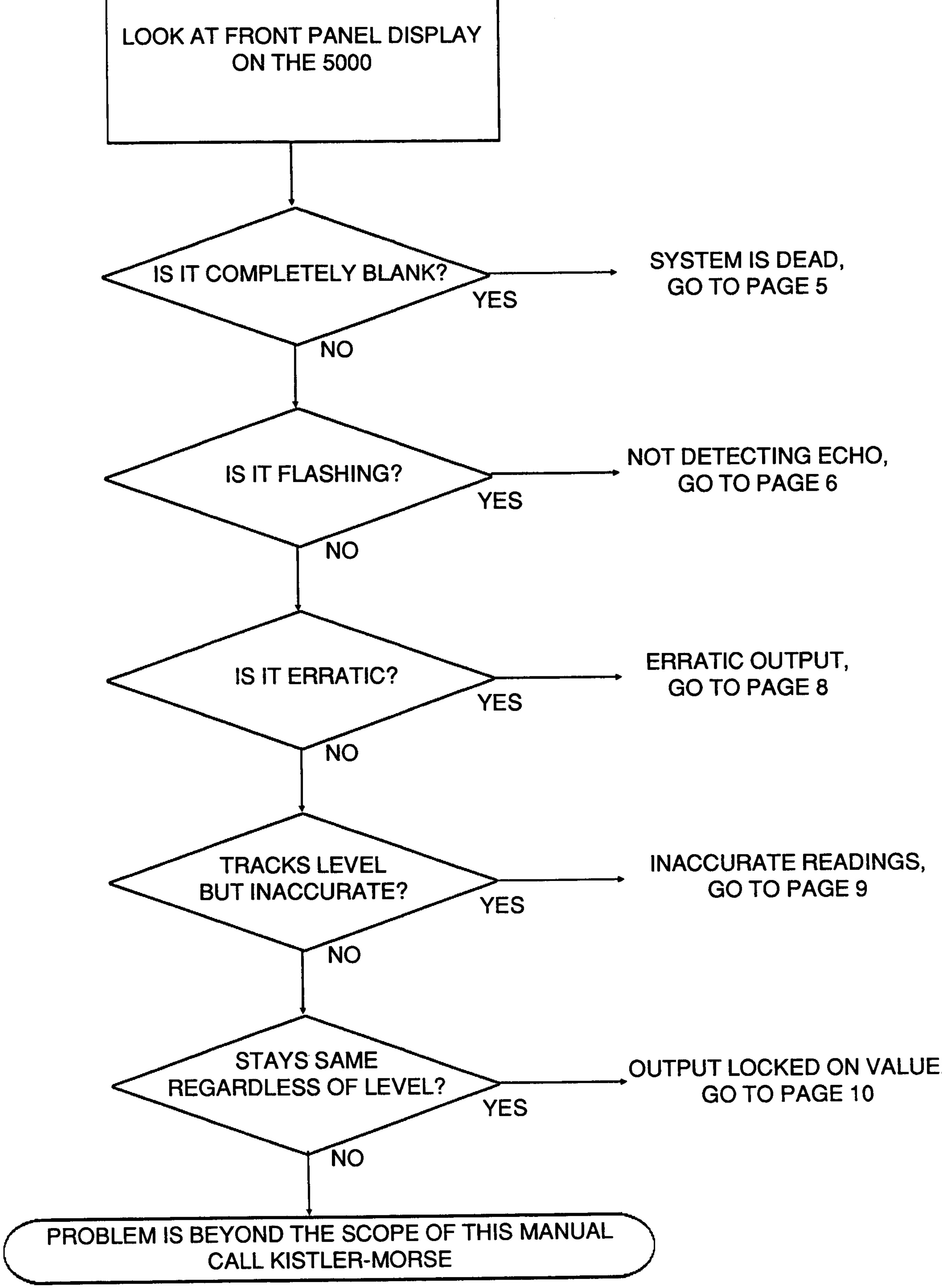
↓

OBSERVE SYSTEM OPERATION

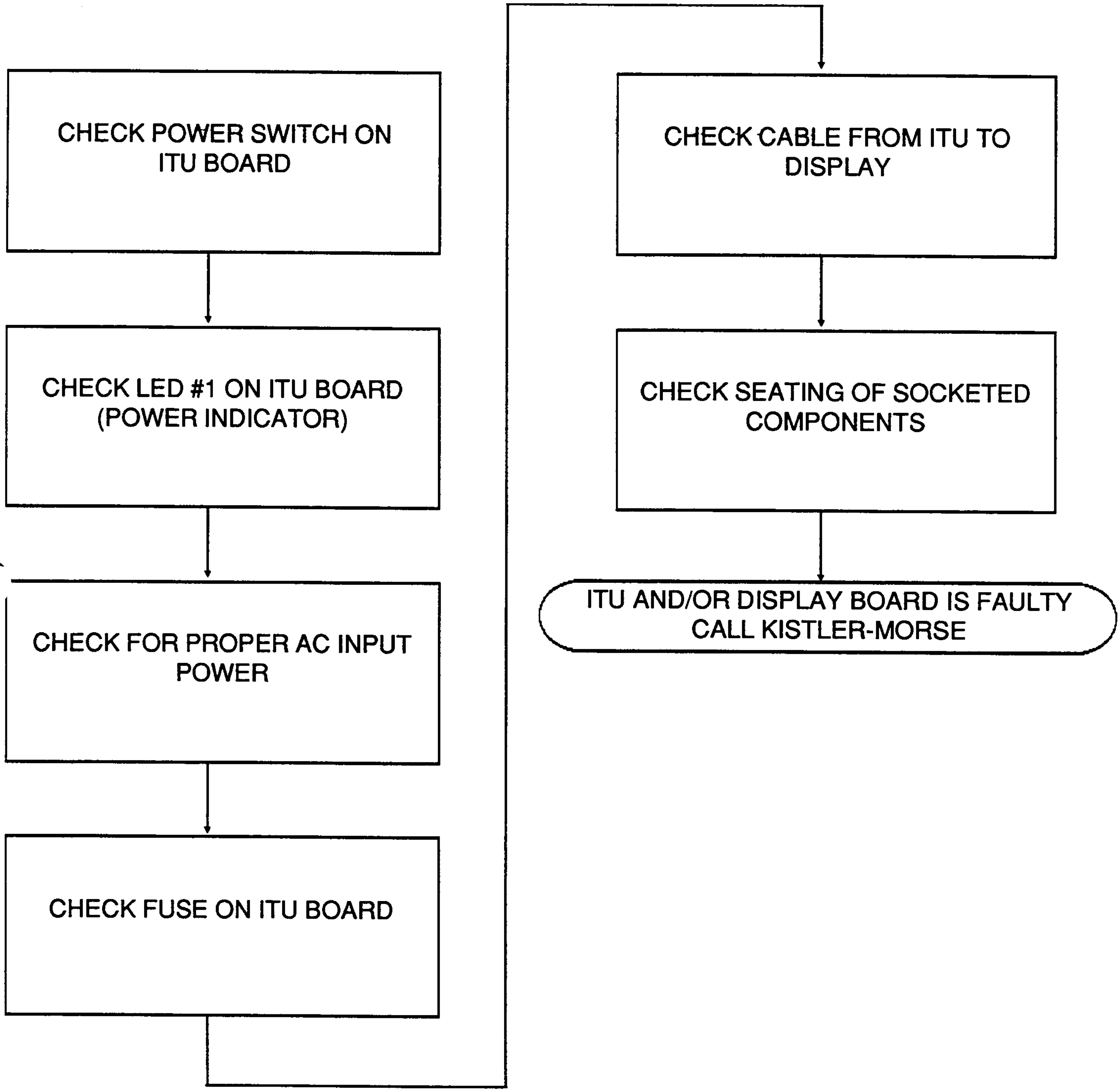
↓

GO TO PAGE 4 - DISPLAY
FUNCTIONALITY

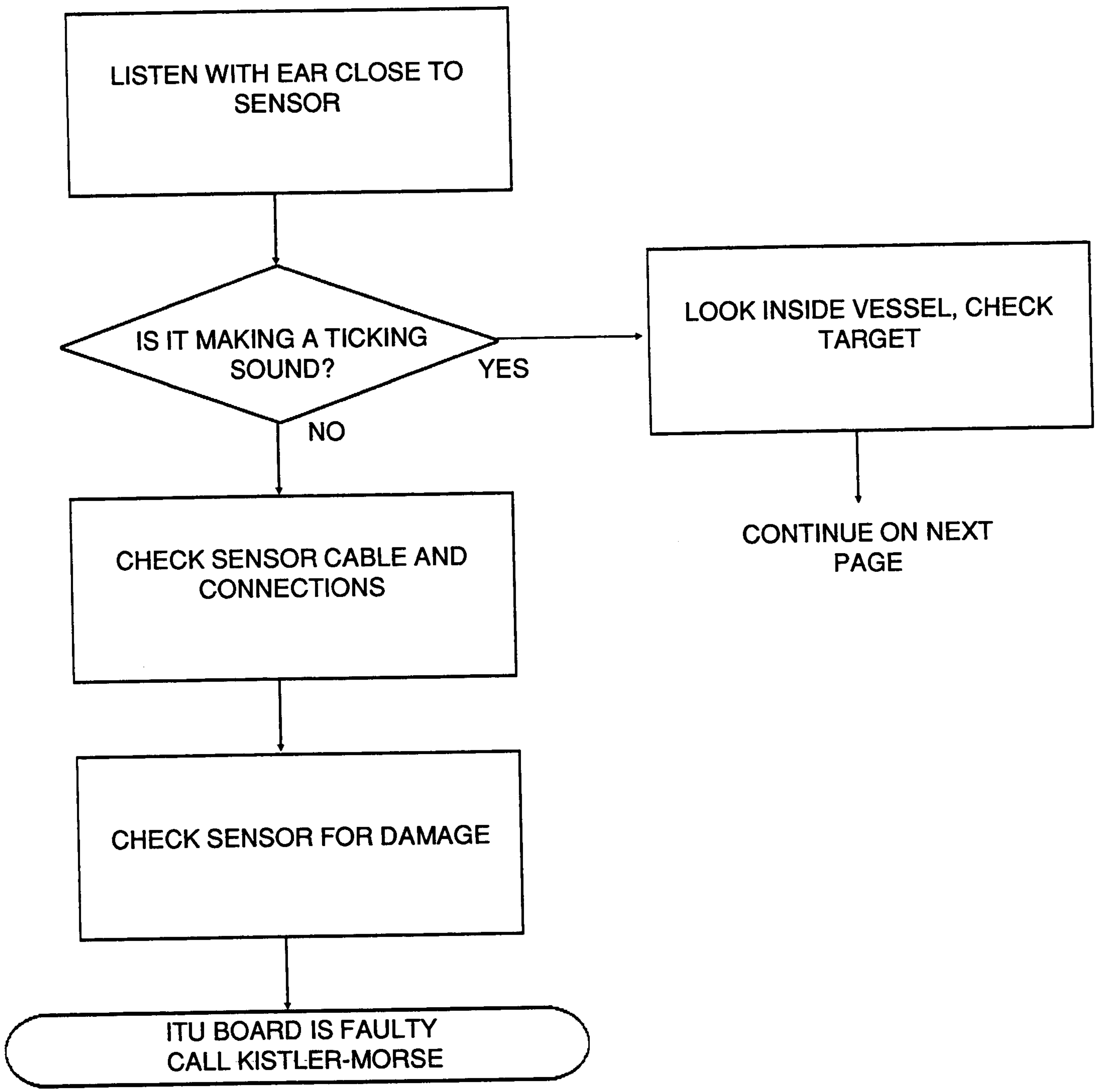
DISPLAY FUNCTIONALITY



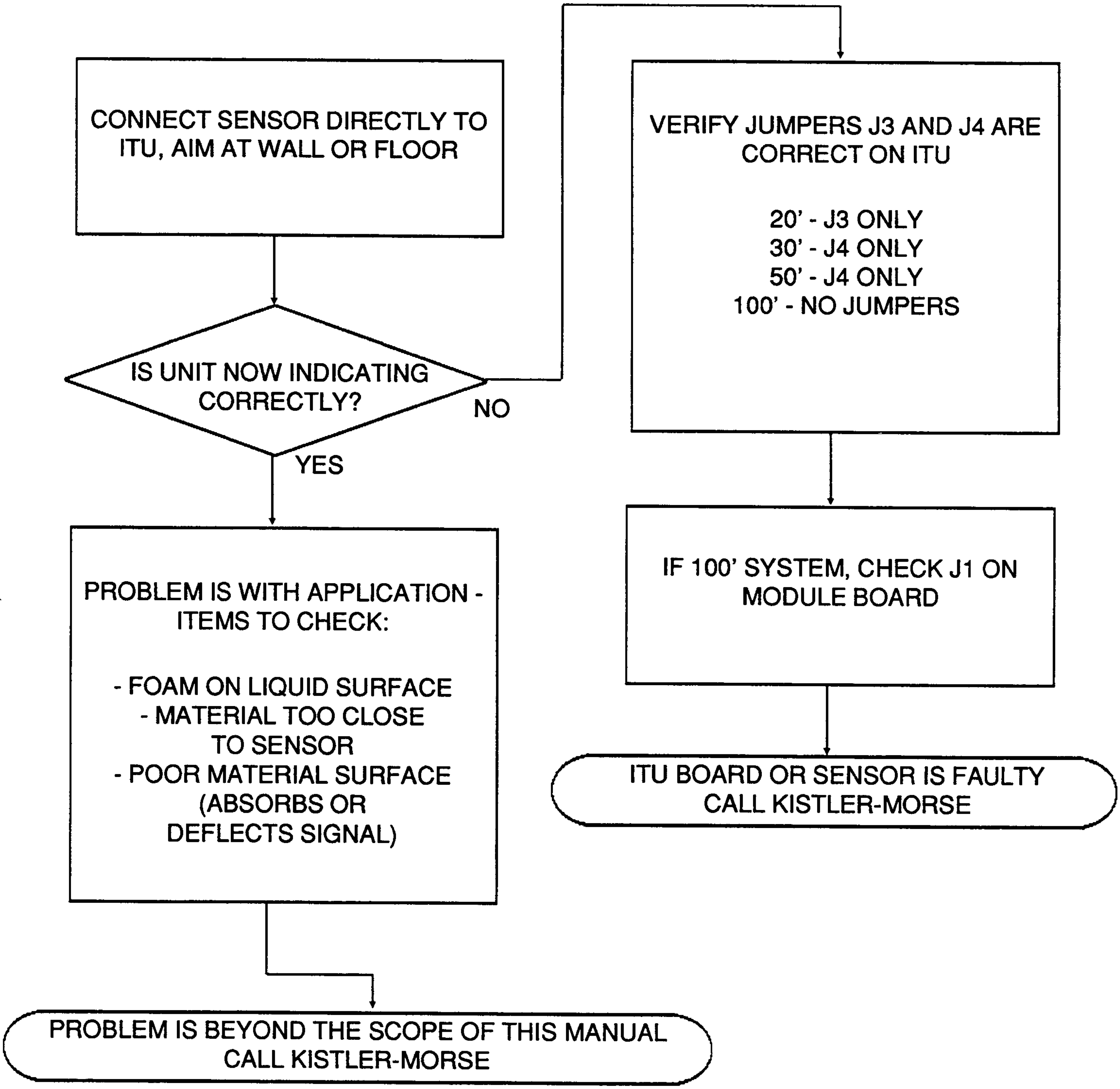
SYSTEM IS DEAD



NOT DETECTING ECHO



NOT DETECTING ECHO (CONT'D.)



ERRATIC OUTPUT

CONFIRM PROPER SENSOR CABLE AND POLARITY

↓

CHECK FOR ACOUSTICAL NOISE IN VESSEL

↓

CHECK FOR INDUCED ELECTRICAL NOISE

↓

MAKE SURE WINDOW SIZE SETTING IS ZERO

↓

PROBLEM IS BEYOND THE SCOPE OF THIS MANUAL
CALL KISTLER-MORSE

INACCURATE READINGS

CHECK SET-UP PARAMETERS (ESPECIALLY FULL POINT AND OPERATING SPAN)

↓

CHECK FOR ERROR DUE TO TEMPERATURE CHANGES (CHECK TEMPERATURE SENSOR IF SO EQUIPPED)

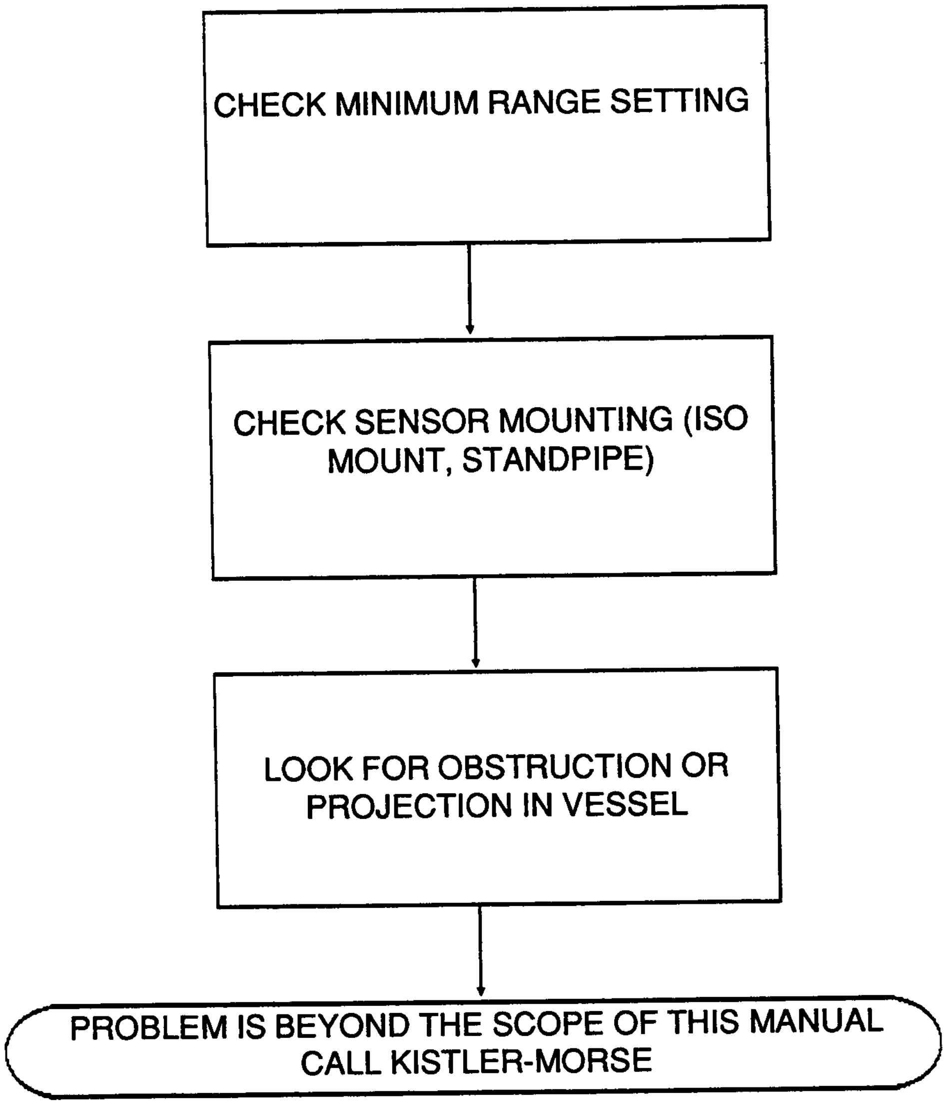
↓

CHECK FOR ERROR DUE TO VAPORS IN AIRSPACE

↓

PROBLEM IS BEYOND THE SCOPE OF THIS MANUAL
CALL KISTLER-MORSE

OUTPUT LOCKED ON VALUE



Chapter 2. Troubleshooting the Sonologic 5000 with an Oscilloscope

INTRODUCTION

This section describes how to use an oscilloscope to troubleshoot the Sonologic 5000. Hidden functions called "Monitor Mode Functions" are also described and explained how to use for troubleshooting. A diagnostic checklist is provided at the back of this chapter to assist you while performing the troubleshooting procedures. Use the checklist to record the different parameter values for later reference.

TROUBLESHOOTING WITH AN OSCILLOSCOPE

The following procedure can be performed if you can hear the Sonocell ticking. This procedure only tests the receiver section therefore you must be certain the transmitter is working.

1. Just about any scope will work. However a dual trace is preferable.
2. Set the scope as follows;

   a. Channel amplitude = 5V/division (.5V/division if using 10:1 Probe).

   b. Time/division = 5 ms/division (if target is more than 25 feet or 8 meters from the sensor, set the scope to 10 ms/division).

   c. Trigger mode = normal

   d. Trigger source = external

   e. Set " Channel Mode " to whichever channel input you are using. If using both channels, set to "chop". Be sure all the variable calibration adjusts attached to the time and

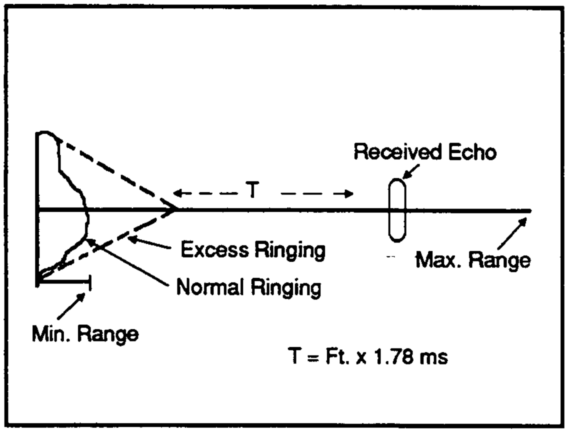


Figure 2-1. (TP5) Transmit Burst.

amplitude switches are completely clockwise, or otherwise stated in the calibration mode.

3. Attach probe from the external trigger input on the scope to TP 16 on the ITU (marked scope trigger). Refer to Figure A-1 in Appendix A.

   Attach the probe from Channel one input on the scope to TP5 (marked final amp output) on the ITU. This test point allows you to see the echo after it has traveled through the filter to the ITU.

4. You should see a trace on the scope that is triggered by each transmit pulse of the ITU. If your scope is triggering with the transmit pulse but your sensor is not ticking, you may have either a bad sensor connection or a defective sensor. Check the wiring and replace the sensor if the wiring checks out.

5. If your system is working properly, you should see a signal similar to Figure 2-1. Adjust your horizontal position control so the transmit pulse is at the beginning of the display. You may have to adjust the trigger level knob to stabilize the image. Adjust the vertical position knob to center the image vertically.

   If the echo is not seen at TP5, check the filter module for proper installation. Ensure all pins on the ITU are correctly aligned with the filter module connectors. If this does not resolve the problem the filter module may be bad. If available exchange the filter module with a new one and test again at TP5.

   The transmit pulse should not "ring" any longer than a time corresponding to the minimum range for your unit (1.8 ms for 20', 3.6 ms for 50', 5.4 ms for 100') see Figure 2-1. If the transmit pulse is too long, consult the factory for advice. You can temporarily extend the minimum range (Function E) if you wish to avoid detecting the ringing, but you will not be able to measure any material within whatever distance you have entered in Function E. The minimum range parameter adjusts the time that the receiver is turned off. Extending the minimum range will help avoid receiving the actual transmission.

6. Attach the probe from channel two input to TP6 (non-delay detect). You should see a pulse at the same time as the RECEIVED echo. If the echo at TP5 is less than .5V amplitude, you will not see a non-delay detect pulse. If there is a weak echo but no detect pulse or only an occasional detect pulse, you should consider the following;

   a. Is your target between the minimum and maximum range distances set in Functions E and F ? You cannot receive echo's from outside these ranges.

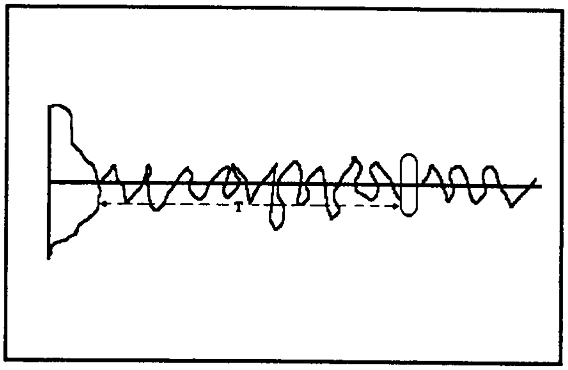


Figure 2-2. False Detect Pulses.

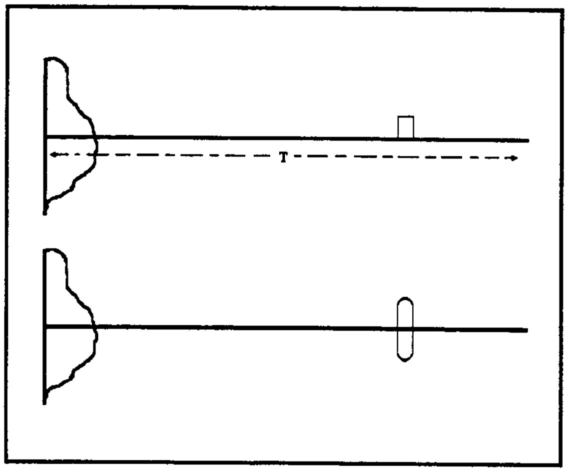


Figure 2-3. Example of a Detect Pulse.

b. Is there a steep slope to the material below the sensor? The sound wave may not be returning to the sensor. Instead it may be getting lost in the vessel. If you suspect this to be the case then aim the sensor in towards the slope of the material just until you are able to receive a consistent echo of the correct amplitude.

c. Is material falling into the vessel between the sensor and the target? If this is the case you will need to move the sensor so that it has a clear line of sight to the material.

d. If the preceding steps do not solve the problem you may want to remove the sensor from the vessel. With the sensor removed try aiming it at a wall, ceiling or the floor to see if you can get a good echo . When doing this set Function D (windowing) to 0 first and insure the target you are aiming at is within the span setting you have programmed the unit with.

e. If while the sensor is in the vessel you see any other echo's at TP5 other than the real material level, check inside the vessel for any beams, pipes, or equipment that may be in the way. If the vessel is filling or is noisy, you may see a little noise between the transmit pulse and the echo. So long as the noise is too weak to be detected at TP6, it will not be a problem.

f. If this noise is large enough it can cause false detect pulses, and possibly make the real echo impossible to see (Figure 2-2). In this case check the wiring connections to the sensor for corrosion or poor connections. This noise can also be injected if the coaxial cable from the sensor run too closely to AC power lines. Insure the coax is run in it's own dedicated conduit.

7. Attach the Channel two probe to TP10 (qualify comparator output). You should see a detect pulse as shown in Figure 2-3. If you have a pulse at TP4 and TP6, but not at TP10, youmay have a bad U7.

8. Attach the Channel two probe to TP3 (delay output). You should see a pulse similar to the one at TP5, (Final Amp Out), it may be a little greater in amplitude. If you have a pulse at TP5 but not at TP3, the U6 I.C. may be bad.

9. Attach the Channel two probe to TP4. You should see a pulse similar to the one at TP6. If you have a pulse at TP6 but not at TP4, the U5 I.C. may be bad.

MONITOR MODE FUNCTIONS

To enter the Monitor Mode, hold the yellow button down and press the red button once. The display will jump from reading a level reading to show the Monitor functions. The functions are 1 through 9 and A through P. To move through the functions use the up and down buttons, to return to the level reading press the red button.

1. Transducer Period

(20' = 150; 15' = 115; 30'/50' = 225; 100' = 356)

If this function reads incorrectly, then your transmit frequency will be wrong. To clear this condition, try defaulting all set up and monitor parameters by turning off the power to the ITU and then holding in the blue button while you reapply power to the ITU (yellow button for metric). The resetting of the parameters will be complete when you see a zero flash in the far right digit of the display, at this time you may release the blue button.

NOTE

This procedure will reset all functions to the factory defaults, therefore you should make notes of all range and span settings prior to doing this procedure. After the default is complete you will need to reenter all span and range settings.

Go back into the Monitor Mode and verify if the correct transducer period is being displayed. If the value is still incorrect , check the version of firmware (I.C. chip U-10) on the ITU board. Also make sure you have the correct ITU and Filter card. The part numbers on the frimware, ITU and the filter module should end with -01 for 20', -02 for 30'/50', -03 for 100', or -04 for 15' systems.

If the installation consists of multiple units with different ranges and sensors, it could be as simple as mismatching the sensors to the electronics. Verify that all sensors match up to the correct electronics.

2. 4 mA Point (790)

Calibrates the 4 mA output to 4mA when the display reads "0". Applicable only to units with 4-20 mA option. This function is the digital D/A value for the output.

3. 20 mA Point (3980)

Calibrates the 20mA output

4. Echo Loss Timer (30)

When the display reads maximum or full scale this is the time (in seconds) from when the echo is lost to when the display will flash and the relays are set into failsafe mode. The timer is reset when any echo is received.

NOTE

Functions 5 through C represent 10-bit DAC values (0 to 1023 decimal) where each bit represents a control voltage change of approximately 5 mV.

5. Transmitter Oscillator Control Voltage (100-950)

This represents the voltage controlling the oscillator. If it reads "0", or 1023, check jumper installation at J3 and J4.

6. Transmitter Power (0-1023)

This represents the power being applied to the transducer. A "1023" reading represents 33 VDC at R48 in the transmitter. This reading will usually start out high and adjust downward until the receive echo has stabilized. You may hear the sensor's ticking getting softer as it adjusts.

7. Receiver Gain (35)-15',20'50' (50)-100'

This value is limited by the value set in Function J. The receiver will decrease its gain under noisy conditions but otherwise this reading should be the same as Function J.

8. Qualify Comparator Level (Noise) (100)

This represents a voltage level that the receive echo amplitude must exceed in order to be detected at TP9. It will normally be the same as Function E but may rise under noisy conditions.

9. Peak Level Comparator Level (400)

This represents the voltage level at which a peak value of the echo is detected at TP7. It is equal to the qualify level plus the peak offset (Function 9 = Function 8 + Function F).

A. TVG End (0 to 1023)

Control voltage to the time variable gain state. This value can only rise as high as Function H. TVG will remain at "0" unless the echo is weak.

B. Temperature Compensation (0-1023)

Will be zero unless a temperature compensation probe is being used. Then it will vary with the probe's output. If the probe is at room temperature it should read approximatly 740-750 (20° C or 68° F).

C. 5 Volt Output (0-1023)

0-1023 corresponds to 0-5 V on the auxilliary output on the ITU and 0 to 100% on the display.

D. Transmit Bursts In Cycles (15)

The number of cycles during the transmit burst. Independent of the frequency.

E. Qualify Comparator Offset (100)

Comparator voltage above the noise level.

F. Peak Comparator Offset (300)

Comparator voltage above the qualify comparator level.

H. Max TVG Set (1023)

Maximum level to which Function A is allowed to rise.

J. Near Gain Set (50)-100' (35)-15',20',50'

Sets gain level under quiet conditions.

L. Noise Offset (50)

Sets voltage offset from the normal qualify comparator level during noise conditions.

P. Raw Target (variable)

Distance in inches to the nearest detected target. If vessel is noisy, this number may be jumping around.

MANUALLY SETTING THE POWER AND GAIN TO FIXED VALUES

The Model 5000's signal processor is designed to automatically adjust the power and gain relative to the level of the target in the vessel. The power level determines the loudness of the signal the transducer sends at the target. A target at the bottom of the vessel requires a louder signal than a target at the top. The gain is the sensitivity of the signal processor to receive the return echo. As the material in the vessel fluctuates, the signal processor constantly adjusts the point within the operating span where the gain reaches its highest sensitivity.

Sometimes, however, due to conditions in the vessel it is necessary to manually set the power and gain to fixed values in order to reduce interfering factors. Satisfactory results will be achieved on a trial and error basis, by optimizing power and gain values, observing the effects, and returning to this procedure to readjust the settings. The values you set for power and gain will stay in memory even after the power to the unit has been turned off.

To re-enable the automatic adjustment of the power and gain, you must load the factory set default parameter values. Remember that all of the user parameters will be defaulted to the factory default values. If you have manually changed any of the user parameter values from something other than the default values, you will have to perform the procedures to re-enter those values.

Follow this procedure.

1. Hold down the Green FUNCTION Key and press the Red FUNCTION Key for about one second to get into the Factory Mode.
2. Use the Red FUNCTION Key to scroll to Function 'F'.
3. Press the Blue ENTER Key. Three bars will appear on the display to indicate readiness.
4. Use the Green Key and\or Yellow Key to scroll the numerals on the display to zero (0).
5. Press the Blue ENTER Key to enter the value into memory. The Fixed Mode is now enabled.
6. Use the Red FUNCTION Key to scroll to Function 'H'. This function is used to set the gain.

7. Press the Blue ENTER Key to get the three bars on the display

8. Use the Green Key and\or Yellow Key to scroll to the desired value. The range is 0 to 40. Entering 0 will keep the gain low through the entire operating span. Entering 40 increases the gain to maximum at a point between the transducer and the end of the operating span. Decreasing this value moves the point of maximum gain farther out from the transducer.

9. Press the Blue ENTER Key to enter the value into memory.

10. Use the Red FUNCTION Key to scroll to Function 'L'. This function is used to set the power level.

11. Press the Blue ENTER Key. Three bars will appear on the display to indicate readiness.

12. Use the Green Key and\or Yellow Key to scroll to the desired value. 40 is the lowest power setting, 1023 highest power setting.

13. Press the Blue ENTER Key to enter the value into memory. After two or three seconds, the display will automatically return to material monitoring if no other keys are pressed.

Kistler-Morse®

TECHNICAL DATA

SONOLOGIC

DIAGNOSTIC CHECKLIST

User Parameters

FUNCTION	PRESENT VALUE	NEW VALUE
1) Full Point		
2) Operating Span		
3) Standard Units		
4) Mode		
5) Set Point 1 On		
6) Set Point 1 Off		
7) Set Point 1 Fail		
8) Set Point 2 On		
9) Set Point 2 Off		
A) Set Point 2 Fail		
B) 4-20 MA Fail		
C) Averaging		
D) Window Size		
E) Minimum Range		
F) Maximum Range		
H) Special Units		
I) Display Format		

Monitor Mode

FUNCTION	VALUE
1) Sensor Period	
2) 4 MA Cal.	
3) 20 MA Cal.	
4) Loss Timer	
5) Frequency	
6) Power	
7) Near Gain	
8) Noise	
9) Peak Level	
A) TVG End	
B) Temp. Comp.	
C) 5 Volt Out	
D) Xmit Cycles	
E) Qual. Offset	
F) Peak Offset	
H) Max TVG	
J) Near Gain Set	
L) Noise Offset	
P) Raw Target Distance	

REFERENCE ______________________________

Chapter 3. Troubleshooting Serial Communications and the PCBs

INTRODUCTION

The purpose of this chapter is to provide a method of determining the cause of system problems and how to fix them. The areas covered are: Serial Communication Troubleshooting and Troubleshooting the PCBs.

Serial Communication Troubleshooting covers proper cable interface between units, baud rate and address settings, and possible problems with the host and slave units.

Troubleshooting the PCBs, points out what items on the PCBs to check visually, how to test the PCBs (primarily the ITU board), what values you should test for, and what test equipment is needed.

Follow these troubleshooting procedures to identify and resolve system problems. Contact your local distributer or the Kistler-Morse Technical Services Department if assistance is needed.

SERIAL COMMUNICATIONS TROUBLESHOOTING

Serial Communication between the host unit and the ITUs (slave units) is done through an RS-422 cable. Incorrect installation of the cable to either the host or the slave, as well as, improper setup of a system's addresses and baud rate will cause the system to malfunction or to not function at all. These types of problems usually occur during the initial installation of the system.

The latest version of the ITU board (P/N 63-1175) has four LEDs to indicate power on (LED1), transmit data (LED2-TX), receive data (LED3-RX), and to indicate if the computer circuitry is malfunctioning (LED4).

When the ITU receives data from the host, LED3-RX will flicker. When transmitting a response back to the host LED2-TX will flicker. If these LEDs do not flicker during transmission and receiving, the problem will be one of the following: the host's inability to transmit and/or receive data, theITU's inability to transmit and/or receive data, a faulty RS-422 cable, or improper address or baud rate.

The following troubleshooting procedure will try to isolate the problem as being in the host unit, the slave unit, the RS-422 cable, or caused by incorrect address and baud rate setup. Once the problem is isolated, the appropriate corrective action can be performed.

1. PROBLEM

The host unit and the slave units are powered up but the slaves are not receiving data.

POSSIBLE CAUSE

The host was powered up before the slave units.

CORRECTIVE ACTION

With all of the slave units completely powered up, cycle the power to the host unit. This will reset the host. Barring any other problems, the host should now communicate with the slave units.

POSSIBLE CAUSE

The address of the data being sent by the host is not the same address as the slave.

CORRECTIVE ACTION

Determine the address of the slave. Send the data again using the correct address. Refer to the operations manual for the dipswitch settings of the ITU addresses.

POSSIBLE CAUSE

The baud rate of the host is different from that of the slave(s).

CORRECTIVE ACTION

Change the baud rate at either the host or the slave so that they match. Remember that all of the slaves interfaced with the host must have the same baud rate.

POSSIBLE CAUSE

The two wires of the RS-422 cable running from host 'transmit' to the slave 'receive' are switched, resulting in the wrong polarity. The LED on the ITU board will light continuosly if this is the case.

CORRECTIVE ACTION

Switch the two cable wires to correct the polarity. The LED will flicker when data is transmitted by the host and received by the slave.

POSSIBLE CAUSE

The RS-422 cable is faulty.

CORRECTIVE ACTION

To determine if the cable is faulty:

1. Disconnect power at both ends.
2. Disconnect the two wires of the cable at the 'receive input' of the ITU and connect the two ends togther.
3. Disconnect the other end of the cable from the 'data transmit' of the host unit.
4. Use an ohmmeter to check the cable for continuity.
5. If there is no continuity, the cable is faulty and should be replaced.

POSSIBLE CAUSE

The ITU board is faulty.

CORRECTIVE ACTION

Replace the ITU board.

POSSIBLE CAUSE

The transmit function of the host unit is not working.

CORRECTIVE ACTION

Consult the manual to the host unit to determine what course of action you should take.

2. PROBLEM

The ITU is receiving data from the host but is not transmitting a response.

POSSIBLE CAUSE

The ITU board is faulty.

CORRECTIVE ACTION

Replace the ITU board.

3. PROBLEM

The ITU is receiving data from the host and is transmitting a response, but the host is not receiving it.

POSSIBLE CAUSE

The two wires of the RS-422 cable running from the slave 'transmit' to the host 'receive' are switched, resulting in the wriong polarity.

CORRECTIVE ACTION

1. Look at the order of the cable wires attached to the 'receive input' on the host.
2. Place an LED tester across the wires (positive-to-minus, minus-to-positive). If the polarity is wrong, the LED will light continuously.
3. Switch the two wires on the cable to correct the polarity. THe LED will flicker when data is transmitted by the slave and received by the host.

POSSIBLE CAUSE

The RS-422 cable is faulty.

CORRECTIVE ACTION

To determine if the cable is faulty:

1. Disconnect power at both ends.
2. Disconnect the two wires of the cable at the 'receive input' of the host unit and connect the two ends together.
3. Disconnect the other end of the cable from the 'data transmit' on the ITU board.

4. Use an ohmmeter to check the cable for continuity.
5. If there is no continuity, the cable is faulty and should be replaced.

POSSIBLE CAUSE

The 'receive' function of the host unit isn't working.

CORRECTIVE ACTION

Consult the manual to the host unit to determine what course of action you should take.

TROUBLESHOOTING THE PCB

Careful visual inspection is all that is needed to perform many of the troubleshooting procedures in this section. The electrical tests described should be performed with a digital voltmeter (DVM).

1. PROBLEM

The ITU board is completly dead.

CORRECTIVE ACTION;

1. Check that the power switch is in the ON position.
2. Check that LED1 on the ITU board is lighted. This indicates that power is making it from the power source to the unit and that the problem is not in the cable or power source.
3. Check that the power cable is firmly connected to the terminal block (TB1) on the ITU board. Tighten it down if needed.
4. Check that the fuse at F1 hasn't blown. Replace if necessary.
5. Check that all of the socketed components are securly connected.

2. PROBLEM

The ITU is not operating even though LED1 is lighted, indicating that power is applied to the unit.

CORRECTIVE ACTION

1. Check to see if LED4 is lighted. If so, there is a malfunction in the computer circuitry. Replace the ITU board to correct the problem.

2. Check that all of the socketed components are securely connected.

3. PROBLEM

The ITU is operating but isn't measuring correctly.

CORRECTIVE ACTION

1. Check the placement of jumpers J3 and J4 on the ITU board.

   a. An ITU with an SC4-100 Sonocell (100-foot measurement span) does not have a jumper.

   b. An ITU with an SC1-50 or SC1-030 Sonocell (30/50-foot measurement span) has a jumper on J4.

   c. An ITU with an SC1-020 Sonocell (20-foot measurement span) has a jumper on J3.

2. If your ITU has an SC4-100 Sonocell, check that jumper JP1 on the Filter Module card is on pins 1 and 2.

3. Check that the Sonocell is securely connected to the terminal block (TB1) on the filter module.

NOTE

The following procedures should be performed with the Sonocell disconnected from the ITU board and requires the use of a digital voltmeter.

4. Connect the negative lead of the DVM to ground and the positive lead to R48 on the ITU board. The DVM should read approximately 33 volts. This procedure checks that transistors Q5 and Q6 and diodes CR13 and CR14 are sound. An approximate voltage reading of 0 to 5 volts will be read if any of these components are defective.

5. Leave the negative lead connected to ground and place the positive lead of the DVM on the emitter lead of Q4. This will measure the high voltage supply. An approximate voltage of 42v +/-5V should be present.

6. With the negative lead still connected to ground, check the output (labeled '0') of U28. The DVM should read 5 V.

   a. Check the output of U29. The DVM should read 12 V.

   b. Check the output of U30. THe DVM should read -12 V.

Appendix A. Circuit Board Assembly Drawings

INTRODUCTION

This section contains assembly drawings for the ITU board, the Display board, and the Filter Module boards. Also included is the Sonologic 5000 engineering wiring diagram.

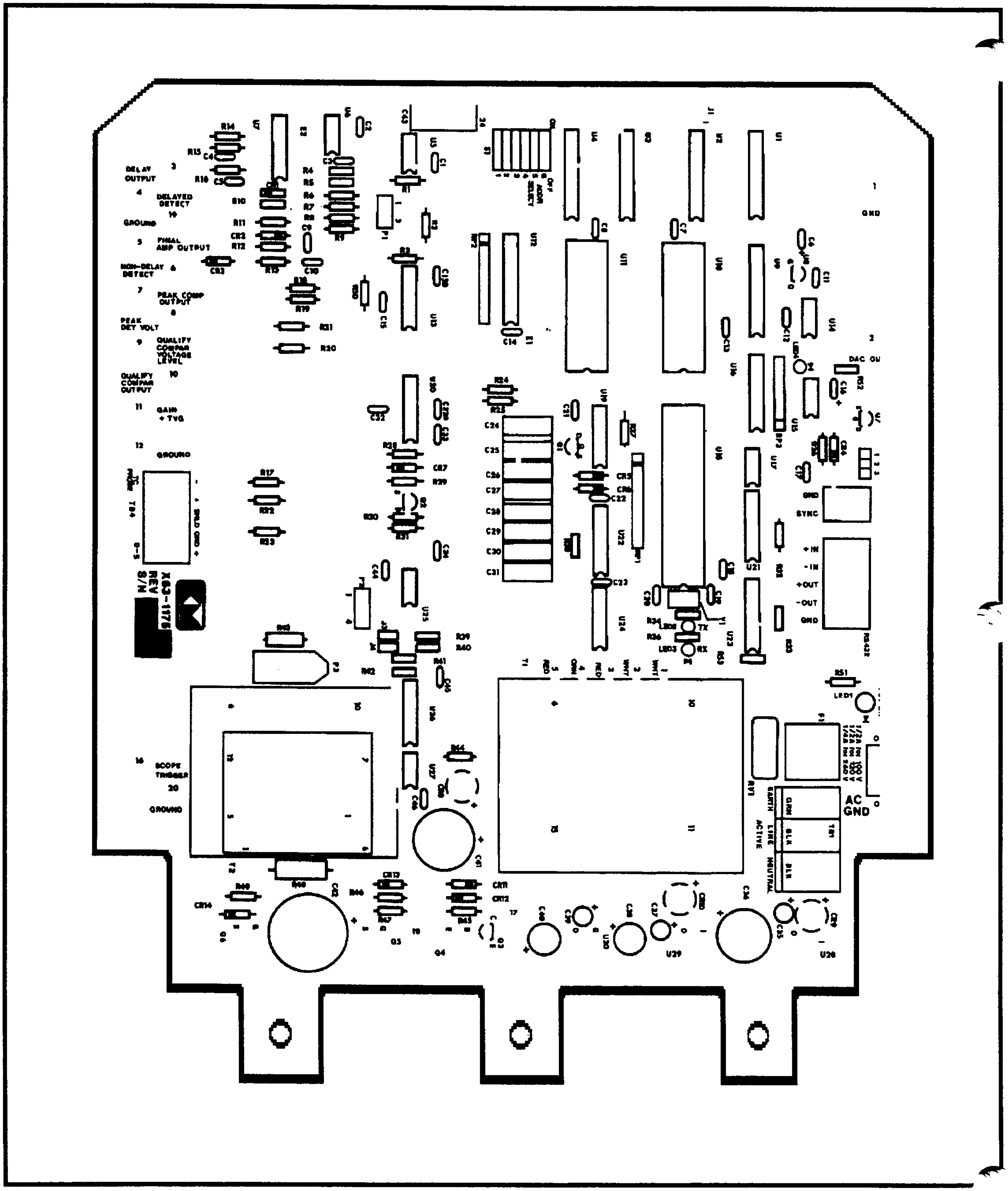


Figure A-1. Assembly Drawing of the Intelligent Transceiver Unit (ITU) Board, P/N 63-1175.

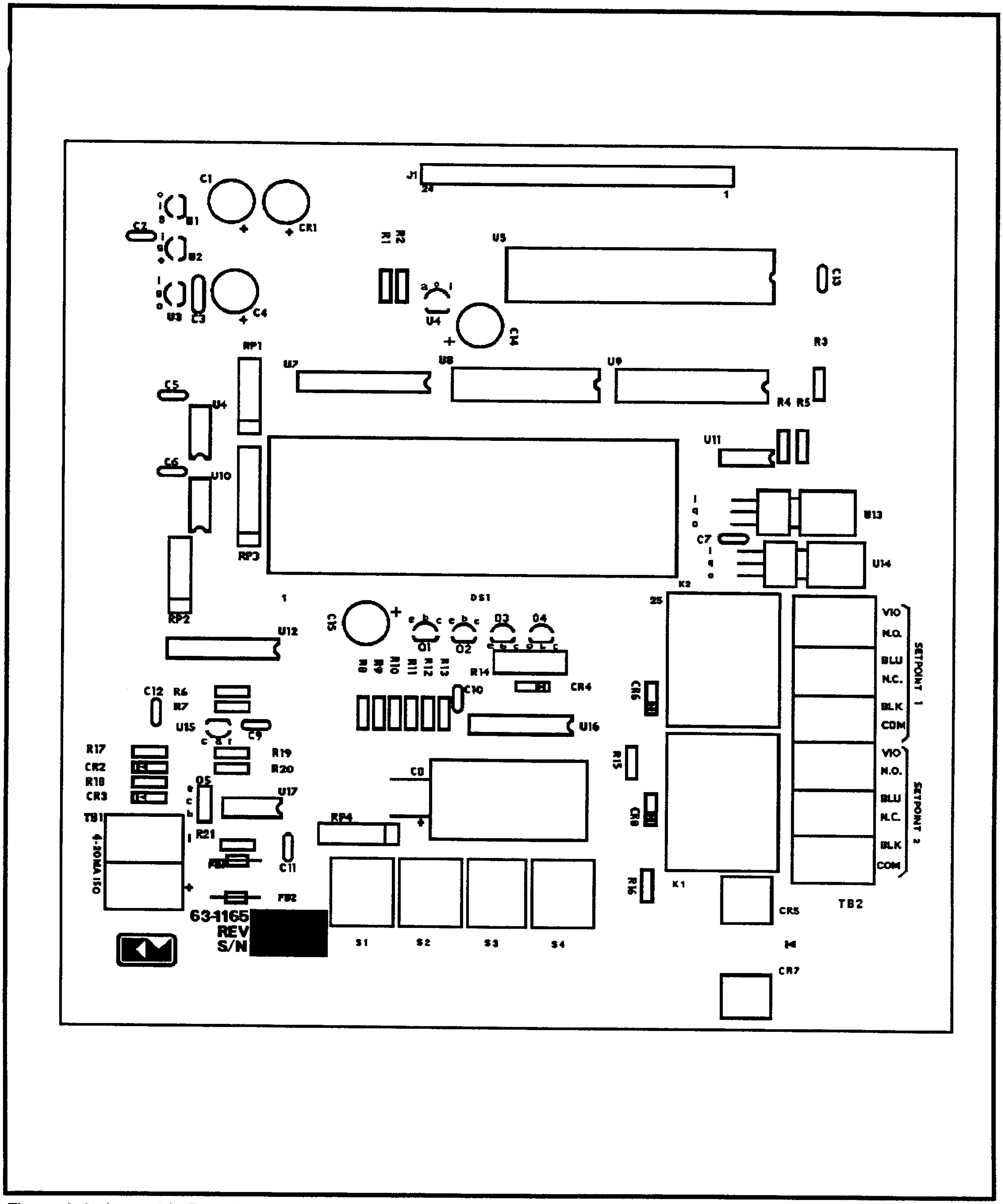


Figure A-2. Assembly Drawing of the Display Board, P/N 63-1165.

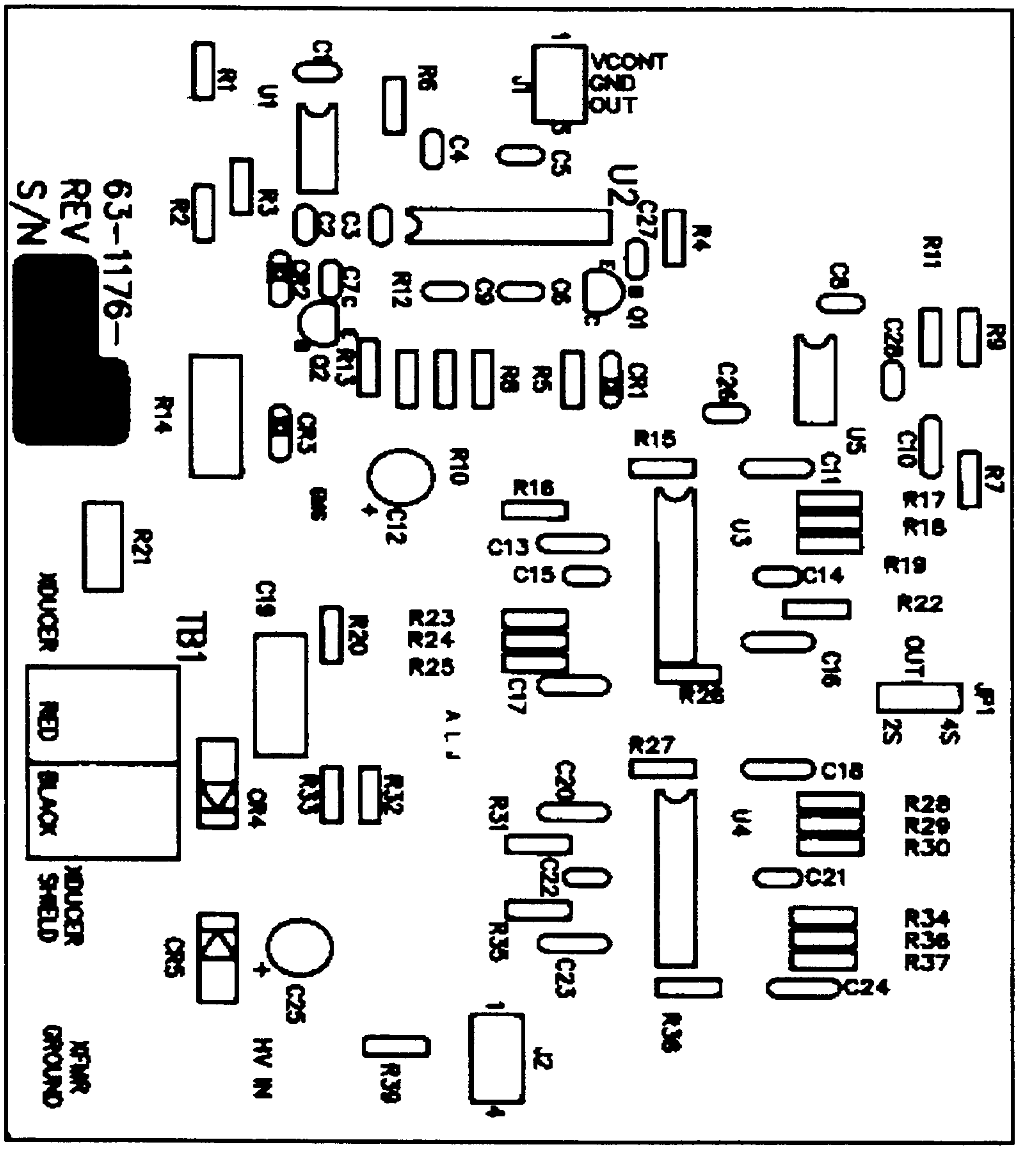


Figure A-3. Assembly Drawing of the Filter Module Board (20-, 30-, and 50-foot Systems), P/N 63-1176.

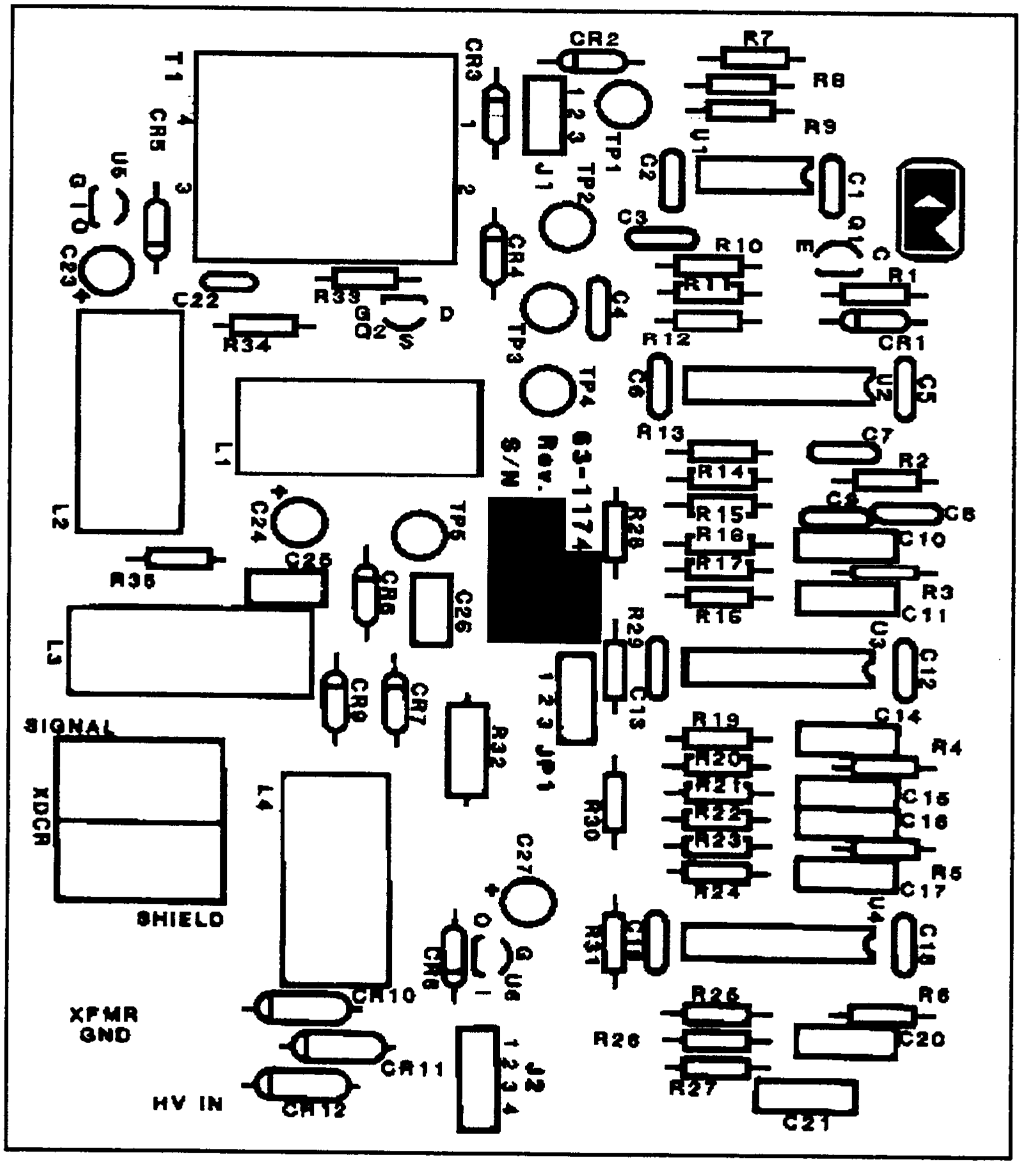


Figure A-4. Assembly Drawing of the Filter Module Board (100-foot System), P/N 63-1174.

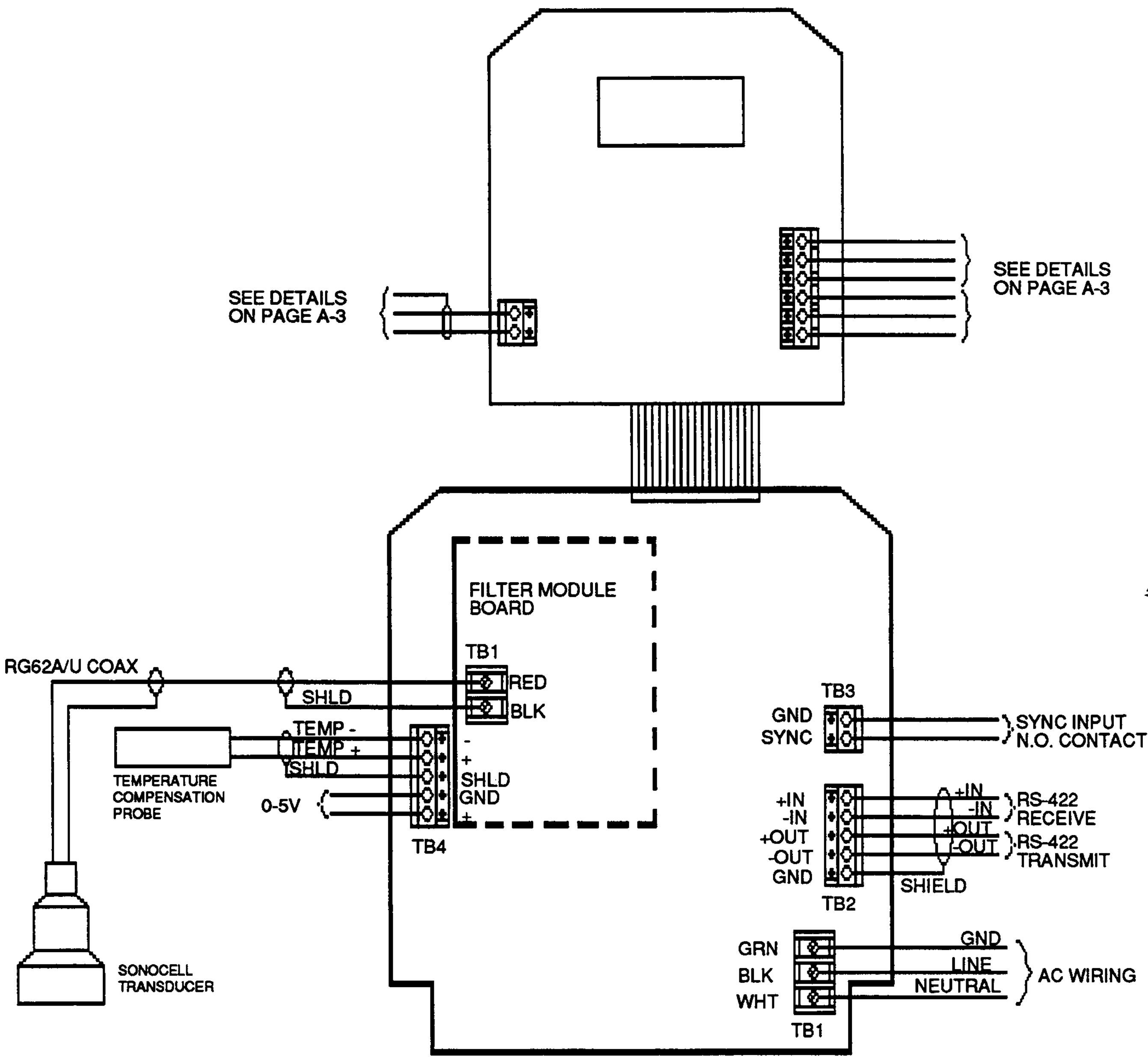


Figure E-5. Intelligent Transceiver Unit Wiring Diagram.