$25.00 U.S.

Sensor Switching Unit

97-1073-01
REV. B

NOTE

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

Kistler-Morse®

97-1073-01
REV. B
June 1994

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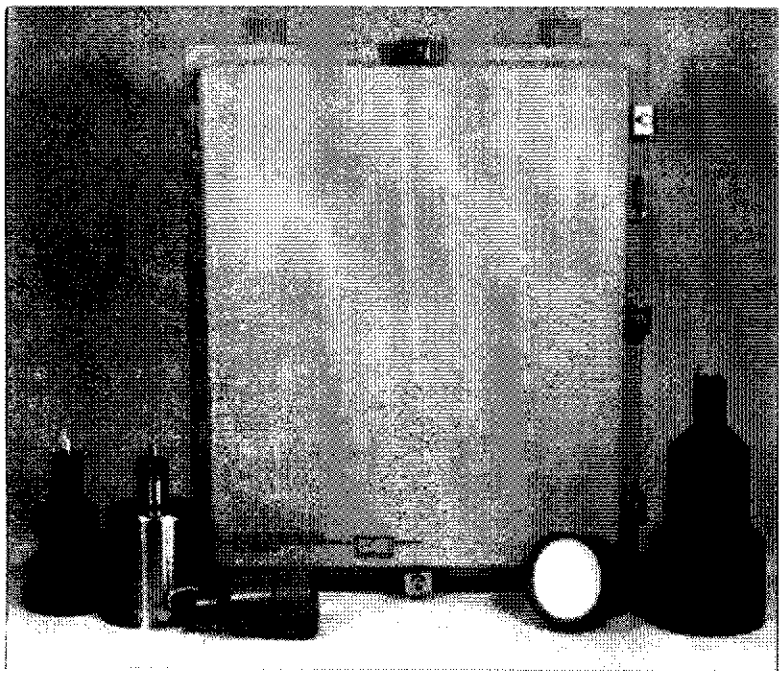


Figure 1-1. Sensor Switching Unit.

Chapter 1. Equipment Description

INTRODUCTION

The Kistler-Morse Sensor Switching Unit (SSU) is an advanced ultrasonic signal generator/processor. Used with up to eight Sonocell transducers of the same frequency, the SSU provides a noncontact method of measuring the level of solids, liquids, and slurry material contained in vessels of any construction. The SSU's serial port allows it to interface with any level indicator that communicates in a serial network.

Two SSUs, each with a maximum of eight Sonocells, can be used with the Kistler-Morse 5510 Autoscan Level Indicator to form the Sonologic Multi-Point Level System. Up to 15 SSUs can be used in a ROPE Inventory Management System.

DESCRIPTION

The ITU board, Filter Module board, and Sensor Switching Module board make up the Sensor Switching Unit and are housed in a watertight, steel enclosure (Figure 1-1) that meets NEMA-4 standards. The circuit boards are accessed by loosening clamps on the enclosure and opening the front panel. All electrical connections are made directly to the terminal blocks on the backplane. (See chapter 2 for installation and wiring instructions.) The Sensor Switching Unit is calibrated and monitored via the serial network (RS-422) using a host device capable of supporting serial communication.

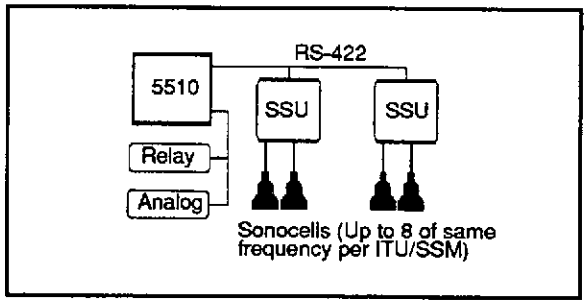


Figure 1-2. Block Diagram of a Typical Sensor Switching Unit Multi-Point System.

PRINCIPLE OF OPERATION

The Sensor Switching Unit provides microprocessor-controlled ultrasonic signal generation and receiving, and is an integral part of a complete multipoint level measuring system. A typical installation is shown in Figure 1-2.

A Sonocell transducer (up to eight of the same frequency per SSU) is mounted above the material in each storage vessel. The SSU can be mounted as far away as 500 to 750 feet from the Sonocell, depending on the Sonocell model. A pulsed signal is generated by the SSU which the transducers direct at the surface of the material in the form of ultrasonic sound waves. The echoes of the sound waves are picked up by the transducer and returned to the SSU for processing. The SSU measures the time required for the sound waves to travel from the Sonocell to the material surface and return to the transducer. The time is converted into distance by the SSU from which material level data is derived. This data is communicated to the level indicator (e.g. 5510, ROPE) via an RS-422 serial digital data network.

With optional Optomux units connected to the RS-422 data network, data from the SSU can be used by the level indicator to control auxiliary equipment or to output a proportional 4-20 mA current source for control of level indicators or feeder equipment. This is done as a result of the material level exceeding or dropping below setpoints.

RS-422 DIGITAL COMMUNICATIONS

The Sensor Switching Unit features RS-422 digital communications for data transmission to remote terminals or host computer systems. There are three autoselectable transmission (baud) rates: 300, 1200, and 9600 baud. Up to 64 addresses can be selected.

ENCLOSURE

Safety is enhanced by protecting the SSU in a sealed, steel enclosure that meets NEMA-4 standards. Many safety features are built into the enclosure and ITU electronics, however, the unit is very easy to wire, program, and adjust.

HAZARDOUS ENVIRONMENTS

The Sonocell transducer has Factory Mutual approval for operation in hazardous environments. In these situations, the transducer is installed inside the hazardous area and the SSU installed outside, up to 750 feet (229 m) from the transducer depending on the transducer model.

Caution

Check with Kistler-Morse for specific hazard approvals before using the ITU in a hazardous area.

Chapter 2. Hardware Installation

INTRODUCTION

This chapter contains instructions for installing and wiring the Sensor Switching Unit. Follow these instructions carefully as well as the transducer mounting instructions in the Sonocell transducer manual.

UNPACKING AND INSPECTION

Remove the Sensor Switching Unit from the shipping carton and inspect for any damage that may have occurred during shipping. If any shipping damage is evident, note it on the shipping receipt and notify the carrier immediately.

Compare the packing list that is shipped with the unit with the contents of the shipping carton to ensure that all parts have been received.

INSTALLING THE TRANSDUCER

Installation instructions for the transducer are contained in the manual that is packed with the transducer. Follow the simple installation instructions found in that manual, then return to this manual for the remaining installation instructions for the SSU.

INSTALLING THE SENSOR SWITCHING UNIT

If it is operated continously, the Sensor Switching Unit can be used in temperatures of 14°F to 122°F (-10°C to 50°C). However, a location that maintains a normal temperature between 32°F and 122°F (0°C to 50°C) is recommended. For temperatures below 14°F, consult the Kistler-Morse factory.

The SSU enclosure can be mounted as far as 750 feet (229 m) from the transducer, depending on the measuring span of the specific transducer model you ordered. Refer to Table 2-1 for maximum separation distance between the SSU and the Sonocell transducer.

Model Number	Measurement Span	Maximum Separation Distance
SC1-20	20 feet (6.1 m)	500 feet (152 m)
SC1-030 K/T	30 feet (9.1 m)	600 feet (183 m)
SC1-50	50 feet (15.2 m)	600 feet (183 m)
SC4-100	100 feet (30.4 m)	750 feet (229 m)

Table 2-1. *Maximum Separation Distance Between Sensor Switching Unit and Sonocell Transducer.*

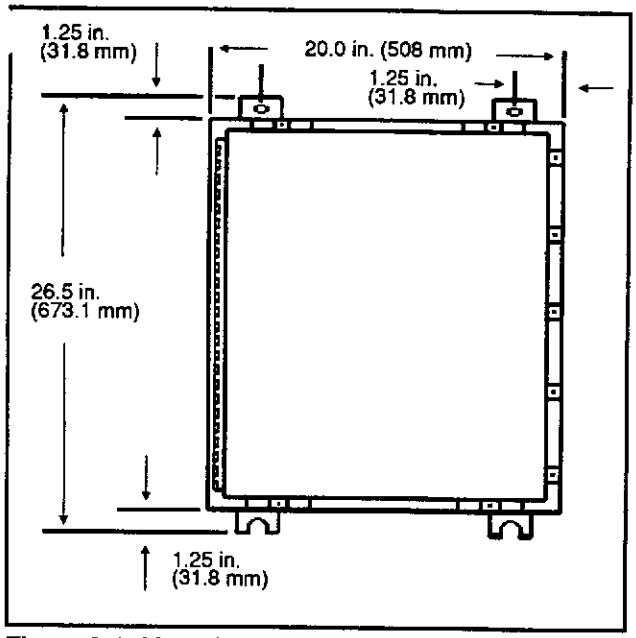


Figure 2-1. Mounting the Enclosure.

Mounting Instructions

CAUTION

Remove the circuit boards during enclosure installation by removing the four screws that secure the circuit board mounting plate and taking out the entire assembly (ITU board, Filter Module board, and Sensor Switching Module board). Keep assembly in a safe, clean location until you are ready to reinstalled it in the enclosure.

1. Before mounting the enclosure, drill or punch cable access holes in the enclosure near the terminal blocks where the cable wires will be routed.

NOTE

The AC power cable, transducer coaxial cable(s), RS-422 cable, and temperature compensation probe cable (if applicable) must be routed through separate conduits.

2. Choose a location that allows sufficient clearance for enclosure front panel to open. Provide clearance near cable access holes for easy cable routing.

3. You must supply the appropriate hardware for securing the SSU enclosure to your wall. Drill the holes and bolt the enclosure to the wall referring to Figure 2-1.

4. Carefully replace the circuit board mounting plate.

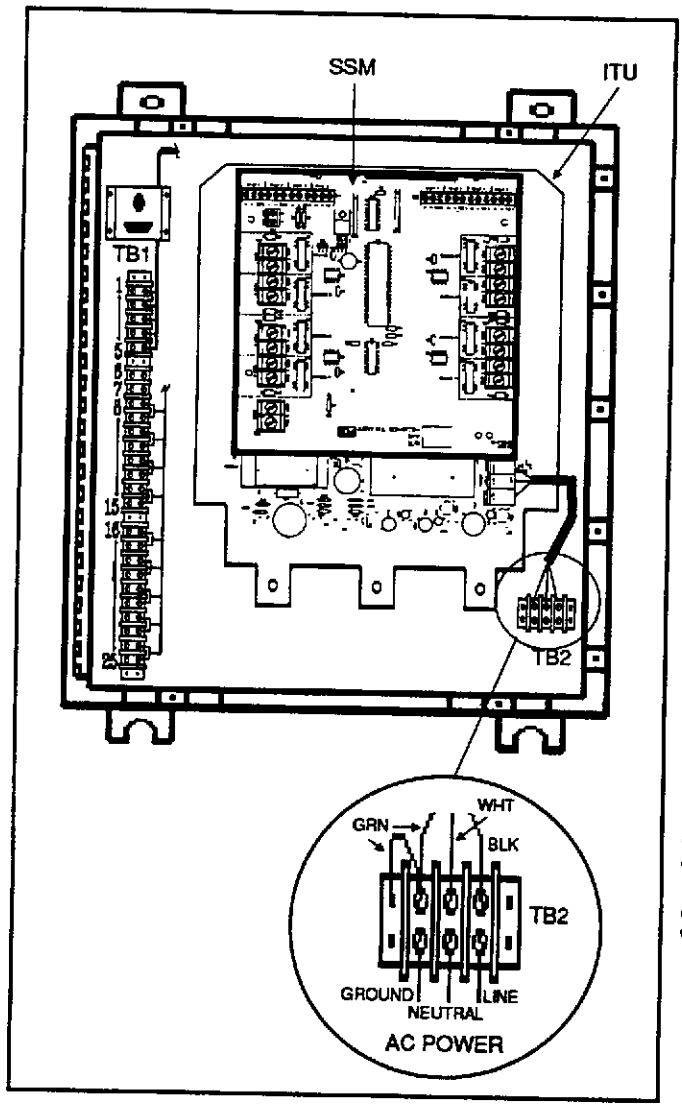


Figure 2-2. Wiring the AC Power to the ITU.

GENERAL WIRING INSTRUCTIONS

When wiring the various components of this system, make sure that the AC power cable, transducer coaxial cable(s), and RS-422 cable are routed through separate conduits. Also, make sure that the cabling inside the SSU enclosure is as short as possible, avoiding cable runs across circuit board components.

Use sealed conduit or strain relief fittings suitable for a water-tight application over the conduit entries. The SSU enclosure is water-tight provided that proper seals are maintained.

The SSU circuit boards arrive from the factory prewired to the terminal blocks on the circuit board mounting plate. Wire the AC power, transducers, RS-422, and temperature compensation probe(s) to the terminal blocks as described in this chapter.

Perform the wiring procedures in the order indicated in this chapter to ensure safety and ease of access.

Wiring AC Power

The SSU operates on the voltages and frequencies indicated in Appendix A.

1. Install conduit or a strain relief fitting in the previously drilled hole (step 1 of **Mounting Instructions**) near the AC terminal block (TB2) on the mounting plate.

2. Route the power lines to TB2.

3. Connect the ground lead to the "GROUND" terminal, the line lead to the "LINE" terminal, and the neutral lead to the "NEUTRAL" terminal as shown in Figure 2-2.

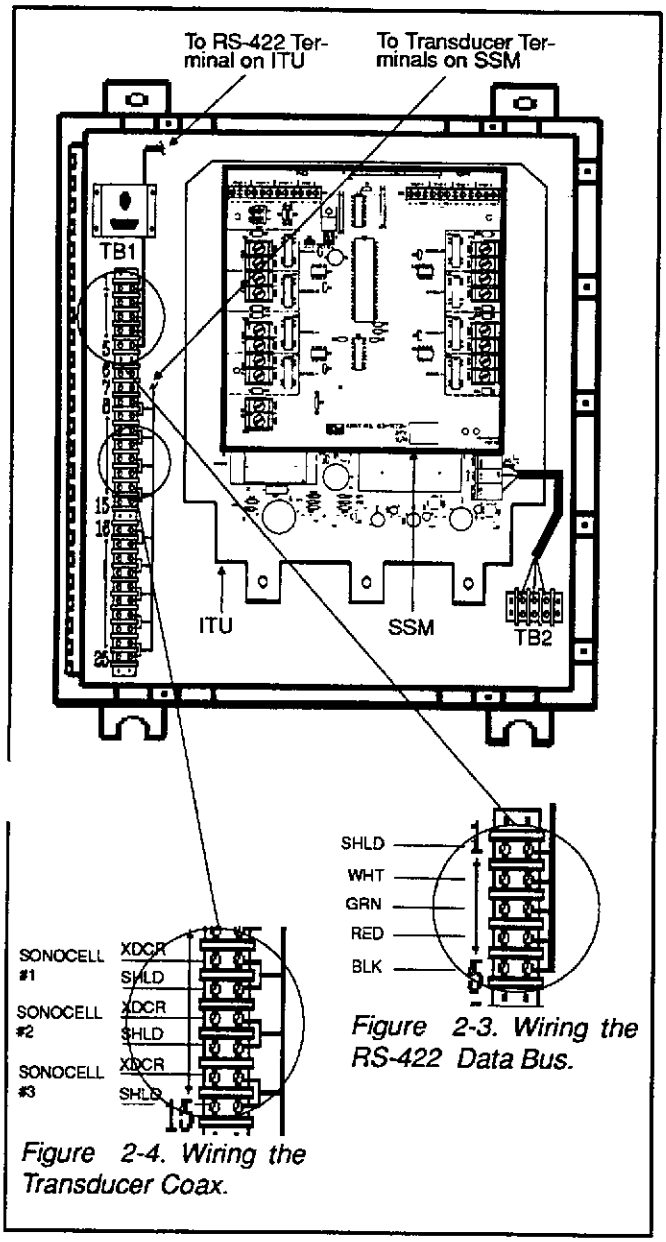


Figure 2-3. Wiring the RS-422 Data Bus.

Figure 2-4. Wiring the Transducer Coax.

Wiring the RS-422 Data Bus

The RS-422 data bus uses a shielded, dual twisted pair cable. Kistler-Morse recommends Belden No. 9729, or equivalent.

1. Install conduit or a strain relief fitting in one of the previously drilled holes in the enclosure near TB1 on the circuit board mounting plate.
2. Route the dual twisted pair to TB1, pins 1-5.
3. Connect the leads as shown in Figure 2-3.
4. Connect additional ITUs together in series if applicable.

Wiring Transducer Coax

Consult the transducer manual for installation and cable requirements for the Sonocell Transducer.

Note

Do not route the transducer coax cables in the same conduit with the RS-422 data bus cables.

1. Install conduit or a strain relief fitting in one of the previously drilled holes in the enclosure near TB1.
2. Route the RG62A/U coax cables from up to eight Sonocells to TB1 on the backplate. Always begin with pin 10 and wire the Sonocells sequentially, never skipping any pins. For example, if you are going to wire only four Sonocells, use pins 10 through 17.
3. Connect the center conductor to "XDCR" and coax Shield to "SHLD" as shown in Figure 2-4.

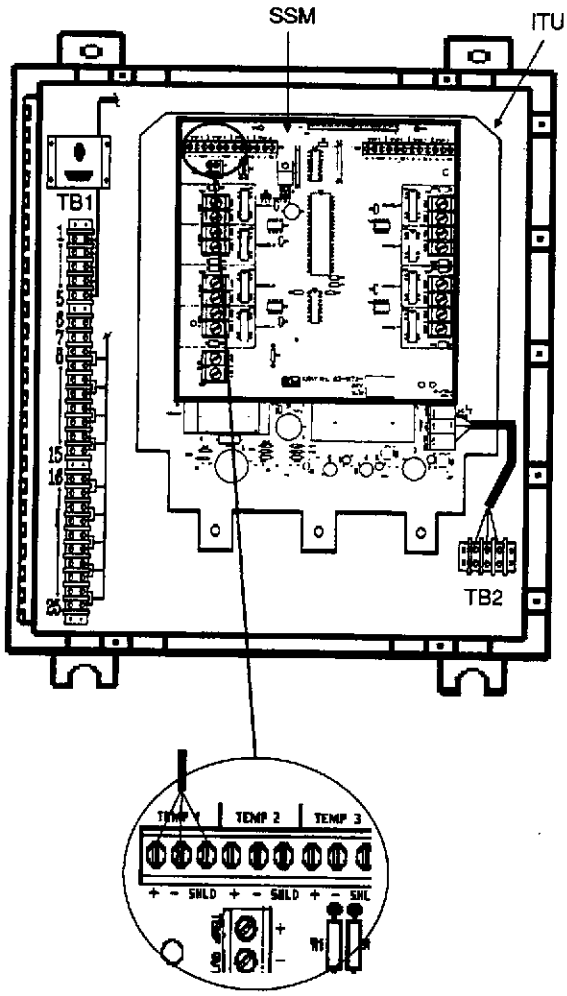


Figure 2-5. Wiring the Temperature Compensation Probe(s) to the SSM Board.

Wiring Temperature Compensation (TC) Probe (Optional)

The ITU is designed to compensate ultrasonic level readings for temperature variations that occur in the transducer operating environment. An optional Temperature Compensation (TC) Probe is available from Kistler-Morse for this purpose. It should be located in close proximity to the transducer and connected to the ITU per the following wiring instructions. (The TC probe uses Belden 8790 wire or equivalent.)

1. Install conduit or a strain relief fitting in the previously drilled hole in the enclosure near TB1 and TB2 on the Sensor Switching Module Board.

2. Route the temperature compensation probe wires to TB1 and/or TB2. See Figure 2-5.

3. Connect positive lead to "+", negative lead to "-", and shield to "SHLD".

Chapter 3. Equipment Setup

GENERAL INFORMATION

This chapter discusses Sensor Switching Unit calibration and address assignments. The read and write ASCII commands (serial communication protocol) the host uses to communicate with the SSUs are also explained.

Calibration of the SSUs is performed using an IBM AT or XT (or compatible) computer with ROPE 6000 Inventory Management software, a 5510 Autoscan Level Indicator, a Data-Pak, or a serial communication programming device; e.g., a programmable logic controller (PLC), personal computer.

SSUs are daisy-chained together and interfaced with a host using RS-422 four-conductor cables. Table 3-1 describes the serial data port specifications.

Baud Rate (auto-selected)	300, 1200, 9600 (Default—9600)
Word Length	8 Bits
Stop Bits	1
Parity	None
Interface Cable	4-conductor shielded, Belden 9729 or equivalent
Total Cable Length	4000 feet (1.2 Km)

Table 3-1. *RS-422 Serial Data Port Specifications.*

If you are using SSUs in a ROPE inventory management system, refer to the F7 - Control Setup section in chapter 6 of the ROPE Software User's Manual for calibration instructions. The 5510 and Data-Pak manuals contain instructions for calibrating the SSU with those devices.

Note

Assign addresses before referring to the manual of the host unit for calibration procedures.

PRESET PARAMETER VALUES

The SSU comes from the factory with preset default operating parameters. Unless specified otherwise, the factory set parameter values will be as shown in Table 3-2. Some values depend upon the model of transducers used with the SSU. If changes in parameter values are required, follow the calibration procedures in the manual of the host unit.

FUNCTION PARAMETER	SC1-20	SC1-50/ SC1-030K/T	SC1-100
SETUP			
(1) Full Point	0	0	0
(2) Operating Span	240 in. (6 m)	600 in. (15 m)	1200 in. (30 m)
(3) Standard Display Units	Ft/tenths (M/tenths)	Ft/tenths (M/tenths)	Ft/tenths (M/tenths)
(4) Mode	1=Air Space	SAME	SAME
SETPOINTS AND FAIL-SAFE			
(5) Setpoint 1 ON	90%	90%	90%
(6) Setpoint 1 OFF	88%	88%	88%
(7) Setpoint 1 Fail-Safe	2=Hold last valid status	2=hold last valid status	2=hold last valid status
(8) Setpoint 2 ON	10%	10%	10%
(9) Setpoint 2 OFF	12%	12%	12%
(A) Setpoint 2 Fail-Safe	2=Hold last valid status	2=Hold last valid status	2=Hold last valid status
(B) 4-20 mA Fail-Safe	2=Hold last valid status	2=Hold last valid status	2=hold last valid status
SPECIAL FUNCTIONS			
(C) Averaging Factor	1=None	1=None	1=None
(D) Window Size	0=None	0=None	0=None
(E) Minimum Range	12 in. (30 cm)	24 in. (60 cm)	36 in. (90 cm)
(F) Maximum Range	300 in. (7.6 m)	720 in. (18 m)	1440 in. (36 m)
(H) Special Display Units	0	0	0
(J) Display Format	Digit 1=0	Digit 1= 0	Digit 1 = 0

Table 3-2. *Factory Set Default Parameter Values.*

ADDRESS ASSIGNMENTS

Before the SSU(s) can function, an address must be assigned to each Sonocell transducer by setting the S1 dipswitch on the ITU board. (Refer to Figure D-1 for dipswitch location.) Each Sensor Switching Unit in the system has a block of eight address assignments, one address for each transducer. The settings of SW1, SW2, and SW3 determine a particular SSU in the system with SW4, SW5, and SW6 determining the addresses of the sensors connected to that SSU.

If only four of a possible eight transducers are wired to one SSU (TB1 pins 10 through 17), assign in sequence addresses 00 to 03 to the transducers. If a second SSU is added to the system, addresses 08 to 15 are used for its transducers. Addresses 04 to 07, even though they are not used by the first SSU, are still reserved for that SSU.

With a total of sixty-four addresses available and eight addresses reserved for each SSU, a maximum of eight SSUs (sixty-four transducers) can be daisy chained in one system. If part of a ROPE Inventory Management System, up to fifteen SSUs can be used in one system.

Refer to Table 3-3 when setting the S1 dipswitch to obtain the desired address for each transducer.

Note

Each Sonocell transducer must have its own address. Assigning the same address to more than one transducer will cause a malfunction in the system. Also, if address switches SW4, SW5, and SW6 are set for more sensors than are actually connected, system performances may be degraded.

	SW1	SW2	SW3	SW4	SW5	SW6	ADDRESS	
	SSU Group			Sensor Group				
SSU 1	0	0	0	0	0	0	00	(00)
	0	0	0	0	0	1	01	(01)
	0	0	0	0	1	0	02	(02)
	0	0	0	0	1	1	03	(03)
	0	0	0	1	0	0	04	(04)
	0	0	0	1	0	1	05	(05)
	0	0	0	1	1	0	06	(06)
	0	0	0	1	1	1	07	(07)
SSU 2	0	0	1	0	0	0	08	(08)
	0	0	1	0	0	1	09	(09)
	0	0	1	0	1	0	0A	(10)
	0	0	1	0	1	1	0B	(11)
	0	0	1	1	0	0	0C	(12)
	0	0	1	1	0	1	0D	(13)
	0	0	1	1	1	0	0E	(14)
	0	0	1	1	1	1	1F	(15)
SSU 3	0	1	0	0	0	0	10	(16)
	0	1	0	0	0	1	11	(17)
	0	1	0	0	1	0	12	(18
	0	1	0	0	1	1	13	(19)
	0	1	0	1	0	0	14	(20)
	0	1	0	1	0	1	15	(21)
	0	1	0	1	1	0	16	(22)
	0	1	0	1	1	1	17	(23)
SSU 4	0	1	1	0	0	0	18	(24)
	0	1	1	0	0	1	19	(25)
	0	1	1	0	1	0	1A	(26)
	0	1	1	0	1	1	1B	(27)
	0	1	1	1	0	0	1C	(28)
	0	1	1	1	0	1	1D	(29)
	0	1	1	1	1	0	1E	(30)
	0	1	1	1	1	1	1F	(31)

SW ON = 0, SW OFF = 1

Table 3-3. *Dipswitch Setting - SSU Transducer Addresses*

	SW1	SW2	SW3	SW4	SW5	SW6	ADDRESS	
	SSU Group			Sensor Group				
SSU 5	1	0	0	0	0	0	20	(32)
	1	0	0	0	0	1	21	(33)
	1	0	0	0	1	0	22	(34)
	1	0	0	0	1	1	23	(35)
	1	0	0	1	0	0	24	(36)
	1	0	0	1	0	1	25	(37)
	1	0	0	1	1	0	26	(38)
	1	0	0	1	1	1	27	(39)
SSU 6	1	0	1	0	0	0	28	(40)
	1	0	1	0	0	1	29	(41)
	1	0	1	0	1	0	2A	(42)
	1	0	1	0	1	1	2B	(43)
	1	0	1	1	0	0	2C	(44)
	1	0	1	1	0	1	2D	(45)
	1	0	1	1	1	0	2E	(46)
	1	0	1	1	1	1	2F	(47)
SSU 7	1	1	0	0	0	0	30	(48)
	1	1	0	0	0	1	31	(49)
	1	1	0	0	1	0	32	(50)
	1	1	0	0	1	1	33	(51)
	1	1	0	1	0	0	34	(52)
	1	1	0	1	0	1	35	(53)
	1	1	0	1	1	0	36	(54)
	1	1	0	1	1	1	37	(55)
SSU 8	1	1	1	0	0	0	38	(56)
	1	1	1	0	0	1	39	(57)
	1	1	1	0	1	0	3A	(58)
	1	1	1	0	1	1	3B	(59)
	1	1	1	1	0	0	3C	(60)
	1	1	1	1	0	1	3D	(61)
	1	1	1	1	1	0	3E	(62)
	1	1	1	1	1	1	3F	(63)

SW ON = 0, SW OFF = 1

(Table 3-3 continued)

SERIAL COMMUNICATIONS PROTOCOL

The host writes information to the SSU in addition to requesting and receiving sensing information. Table 3-4 lists the characters and their definitions the host uses to write and request information.

NOTE

The SSU will transmit a "!" (21 Hex) within one character time (i.e., 1 ms-9600 baud, 8 ms-1200 baud, 33 ms-300 baud) to acknowledge that a request for data was received. A response to the request will be transmitted within 300 milliseconds (worst case).

>	Start of message character
1	Command for update level data
4	Command for update control data
A	Acknowledge message
aa	2-digit address (ASCII Hex) of SSU 00H-0FH
hhh	3-digit hex, 4-20 mA output data, ASCII (4096 bit)
d..d	1 - 4 character data ASCII decimal
ddd.d	Update value in user units with decimal (ASCII)
f	Failsafe: 1 = error or fault 0 = OK
N	Not acknowledged
n	Model number 0 to 3
p	Setpoint status: 0 = both off; 1 = setpoint 1 on and setpoint 2 off; 2 = setpoint 2 on and setpoint 1 off; 3 = both on
P	Request parameter command
Q	Change parameter command
r	Carriage return (0DH) (end of message character)
ss	2-digit checksum (ASCII Hex). See "Checksum Calculation" on the next page.
x	Function (parameter) number

Table 3-4. *Key to Protocol*

NOTE

All commands are case sensitive, i.e. upper and lower case characters are not interpreted the same.

When the host unit transmits a request to the SSU, a "greater than" (>) symbol begins the character string. The next two characters (aa) will be the hexadecimal address of the SSU, followed by a command. (See Table 3-5 for the list of commands.) A set of parameters may follow a command, which is then followed by the checksum value. The character string is then terminated with a carriage return.

Command Character Hex/ASCII		Command	Host Request Format	SSU Response Format
31	1	Level and Failsafe Data	>aa1ssr	Addd.dfssr
34	4	4-20, Setpoint, Failsafe Data	>aa4ssr	Ahhhpfssr
35	5	Combo of 1, 4, # Commands	>aa5ssr	A[1,4,#]r
3F	?	K-M Firmware Info	>aa?ssr	A[message]r
23	#	Product and Model Numbers	>aa#ssr	A5nssr
29	)	Turn On Manual Mode	>aa)ssr	Ar
2F	/	Load Single CH English Defaults	>aa/ssr	Ar
5C	\	Load Single CH Metric Defaults	>aa\ssr	Ar
3A	:	Load All 8 CH English Defaults	>aa:ssr	Ar
3B	;	Load All 8 CH Metric Defaults	>aa;ssr	Ar
2B	+	Manual Sensor Select	>aa+ssr	Ar
50	P	Get User Parameter Data	>aaPxssr	Addddssr
51	Q	Store User Parameter Data	>aaQxddddssr	Ar
52	R	Get All User Parameters	>aaRssr	A[string]r
53	S	Get All System Parameters	>aaSssr	A[string]r
55	U	Get a System Parameter	>aaUxssr	Addddssr
56	V	Store a System Parameter	>aaVxddddssr	Ar

Table 3-5. *Standard Sensor Switching Unit Commands.*

The SSU compares the checksum values and acknowleges the command by sending back an 'A', which may or may not be followed by data. If the checksums do not match, the SSU will respond with an 'N' and a carriage return, which means "Not Acknowledged". The command will then have to be resent. Refer to Table 3-5 for examples of host/SSU communications.

NOTE

A "Not Acknowledge" response will occur for the following reasons: 1) invalid checksum, 2) invalid command, and 3) invalid parameter value.

When an SSU sends a response to a request from the host, the ASCII character string always begins with the letter 'A'. The 'A' tells the host that the message received by the SSU was acknowledged.

The next group of characters will be the actual response to the request from the host. The number of characters in the response is determined by the request. (Table 3-5 shows requests and responses for the various commands.) The response (represented by 'ddd.d' in the character string) will be a number between 000.0 and 999.9. Leading zeros will be used if the number is less than four digits.

Like the request from the host, the SSU will send a two-character checksum in the character string, which is represented by the 'ss' in the Table 3-5 example. The response is terminated with a carriage return at the end of the string.

CHECKSUM CALCULATION

The host and the SSU communicate in ASCII code. Each character of the code has a hex value. When the host requests information from the SSU, the checksum is tabulated by adding together the hex values of the characters that follow the > in the character string. The sum of the hex values is included at the end of the character string. When the SSU receives the request, it also adds together the hex values of the characters that follow the >. It then compares the checksum value received from the host with its own tabulation. The checksums must match before the SSU will send an "Acknowledge" response to the host. If for some reason the checksums do not match, the SSU will send a "Not Acknowledge" (Nr) response.

When the SSU sends information to the host in response to a request, it calculates the checksum automatically and includes it in the character string.

Below is an example of a checksum calculation resulting from the host requesting level data from an SSU whose address is 3. The following characters are sent to the SSU:

03194 Carriage Return

Checksum = 30H + 33H + 31H = 94H
"0" 3" "1"

ASCII string transmitted to the SSU would be:

3E	30	33	31	39	34	0D Hex
">"	0	3	1	9	4	CR"

The SSU response to this command would be:

(Level data = 38.4) (Fail-safe = 0)

A038.402D Carriage Return

Checksum = 30H + 33H + 38H + 2EH + 34H + 30H = 12DH
"0" "3" "8" "." "4" "0"

Ignoring the overflow, the checksum is 2DH.

ASCII string returned to host would be:

41	30	33	38	2E	34	30	32	44	0D	Hex
"A	0	3	8	.	4	0	2	D	CR"	

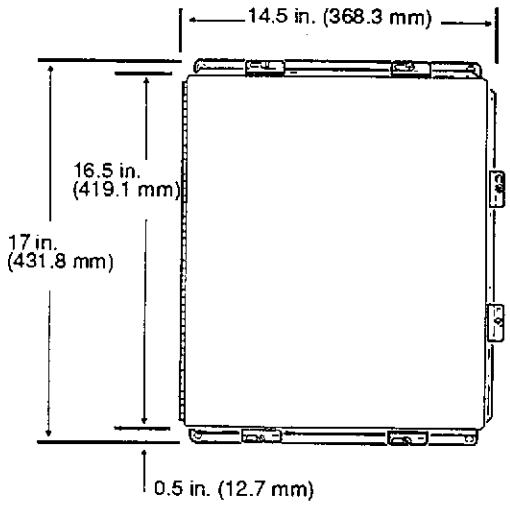


Figure A-1. Enclosure Dimensions.

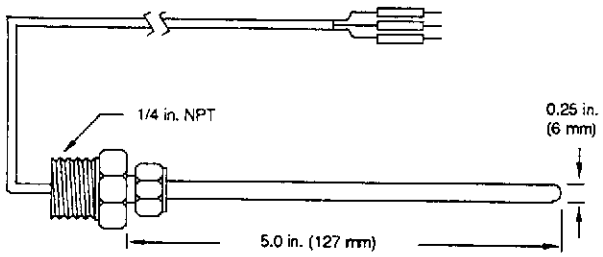


Figure A-2. Temperature Compensation Probe.

Appendix A. Specifications and Configurations

SPECIFICATIONS - Intelligent Transceiver Unit

Accuracy: 1% of span in approved bulk solid applications; 0.25% of span in approved liquid applications.

Repeatability: 1% of span

Enclosure Rating: NEMA-4 (IP 54/55); Meets FCC specification for RFI/EMI noise emission.

Shipping Weight: 30 lbs (13.6 kg)

Voltage Rating: 100, 117, or 234 Vac, 50/60 Hz, +/- 10%; 30 VA

Temperature
Continuous Operation: 14° to 122° F (-10° to 50° C)
Cold Start: 32° to 122° F (0° to 50° C)
Storage: -40° to 158° F (-40° to 70° C)

Humidity: 1% to 95% (noncondensing inside enclosure)

Serial Interface: Addressable RS-422 @ 300, 1200, or 9600 baud

Recommended Distance: 4000 feet (1.2 kilometers) maximum from SSU to host device. From transducer to ITU, refer to the Sonocell transducer specifications.

Appendix B. Troubleshooting

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 distributor or the Kistler-Morse Technical Services Department if assistance is needed. Refer to Appendix D for service information.

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 a 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). (Refer to Figure E-1 in Appendix E for LED location on the ITU board.)

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, the ITU'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 either 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 unit 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 Table 3-3 in chapter 3 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 slave 'receive' are switched, resulting in the wrong polarity. The LED on the ITU board will light continuously 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 together.

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 slave 'transmit' to host 'receive' are switched, resulting in the wrong 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 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 described in this section. The electrical tests described should be performed with a digital voltmeter (DVM).

1. PROBLEM

The ITU board is completely 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 b. (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 securely 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 SC3-100 Sonocell (100-foot measurement span) does not have a jumper.

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

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

2. If your ITU has an SC3-100 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 terminal block (TB1) on the filter module.

   NOTE

   The following procedures should be performed with the Sonocells disconnected from the ITU board and require 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 bad.

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 ou
   (labeled 'O') of U28. The DVM should read 5 V.

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

8. Check the output of U30. The DVM should read -12 V.

Appendix C. Kistler-Morse Service

Kistler-Morse (K-M) maintains a fully trained staff of field service engineers who are capable of providing you with complete product assistance. Based in offices located in Bothell, Washington (corporate headquarters) and Antwerp, Belgium (European office), our engineers provide:

- Technical assistance by telephone via our toll free number.
- Application assistance on-site or by telephone.
- Start-up assistance on-site.
- Troubleshooting on-site, or by telephone.
- Warranty (replacement) or spare parts assistance.
- Training on-site, or at our corporate service center.
- Equipment updates to our latest configuration.
- Additional information on these services follows.
- Start-up and training.

The user must mechanically install the Sonocell transducers, and perform all field wiring and conduit installation. The electronics should be mounted, with AC power connected, but not energized. The junction boxes should also be mounted.

Kistler-Morse will check all field wiring for errors. The system will be powered up and checked out for proper electrical operation.

Recommendations for the maximum performance of the systems will be given. Instructions to plant personnel will be offered to cover maintenance and operation of the system.

TROUBLESHOOTING

Our engineers will troubleshoot systems for mechanical, electrical calibration, and wiring errors. Normal component repairs and wiring errors will be corrected, including replacement of nonrepairable printed circuit boards.

RETURN MATERIAL AUTHORIZATION

If a part needs to be sent to the factory for repair, contact Kistler-Morse and ask for an RMA (Return Material Authorization) number. The RMA number identifies the part and its owner and must be included with the part when it is shipped to the factory.

SERVICE CALLS

Service calls by a qualified Kistler-Morse field service engineer can be scheduled but are not covered in the product warranty. Contact Kistler-Morse at the corporate office or European office for scheduling and rate information.

PRODUCT WARRANTY

Kistler-Morse warrants equipment of its own manufacture to be free from defects in material and workmanship for one year from date of shipment to original user, subject to the terms and conditions of this warranty. Kistler-Morse will replace or repair, at our option, any part found to be defective. Buyer must return any part claimed defective to Kistler-Morse, transportation prepaid.

A complete, unabridged explanation of our product warranty is available from Kistler-Morse on request.

ADDRESS AND TELEPHONE NUMBERS

Corporate Office

All mail sent to the corporate office should be addressed:

Kistler-Morse Corporation
19021 120th Avenue NE
Bothell, WA 98011-9511

Telephone: 206/486-6600
Toll Free: 800/426-9010
Fax: 206/402-1500
Internet: KMCorp@AOL.Com

European Office:

Rucaplein 531
B2610 Antwerp, BELGIUM

Telephone: 32.3.218.99.99
Fax: 32.3.230.78.76

Appendix D. Circuit Board Assembly Drawings and Wiring Diagram

INTRODUCTION

This section contains assembly drawings for the ITU board, the Filter Module Boards, and the Sensor Switching Module board. Also included are technical illustrations (TIs) and the Sensor Switching Unit engineering wiring diagram.

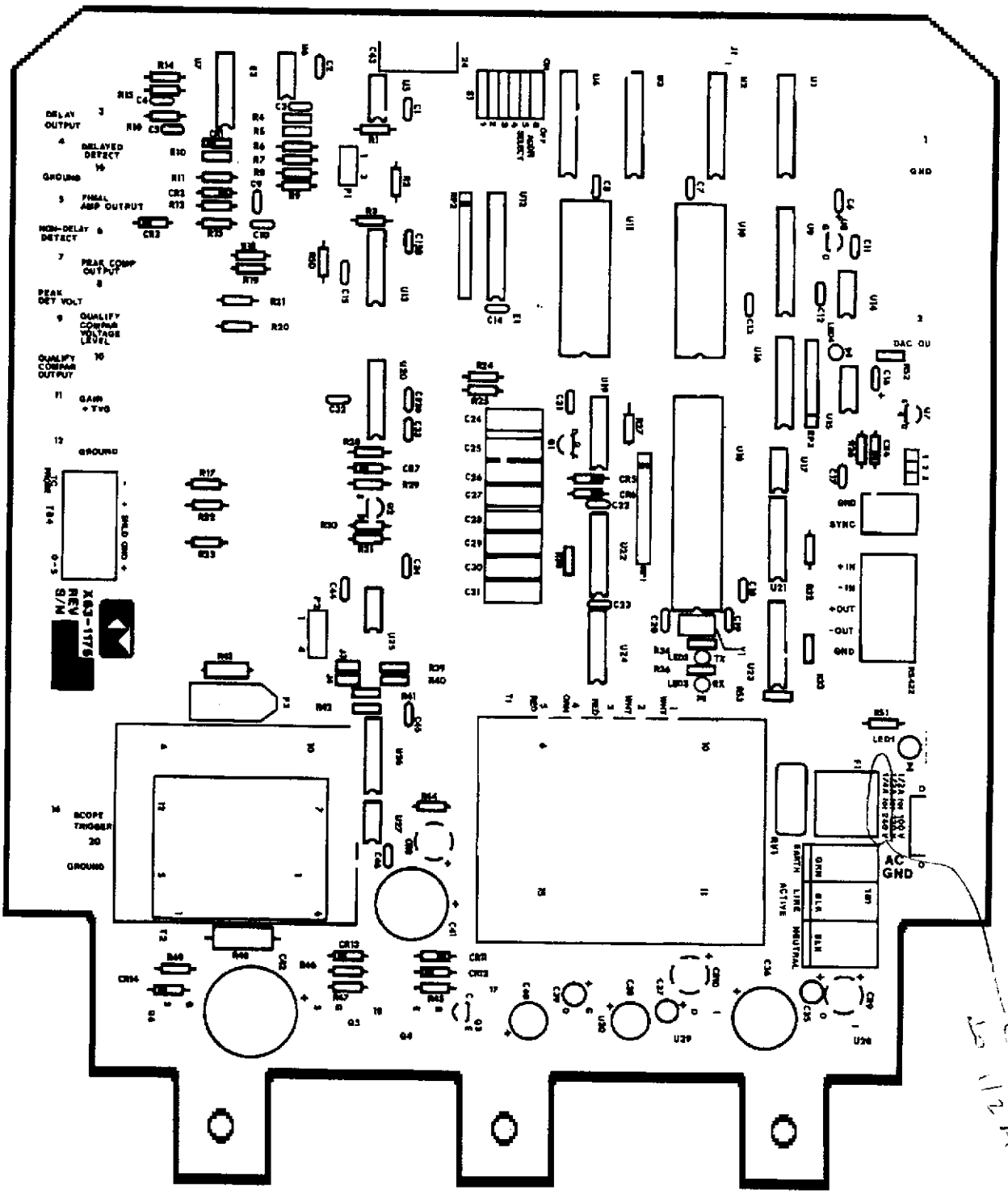


Figure D-1. Assembly Drawing of the Intelligent Transceiver Unit (ITU) Board, P/N 63-1175.

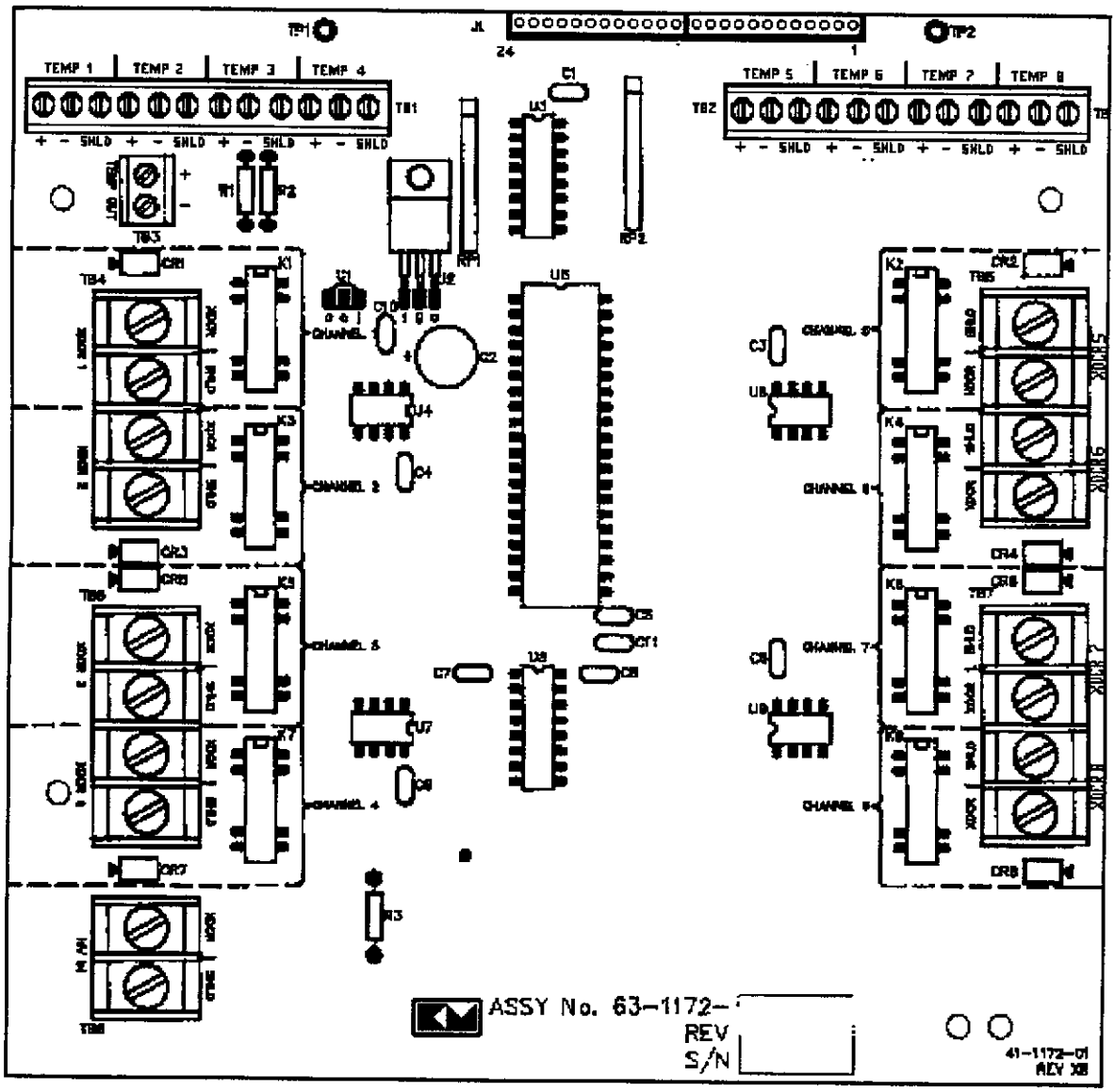


Figure D-2. Assembly Drawing of the Sensor Switching Module Board, P/N 63-1172.

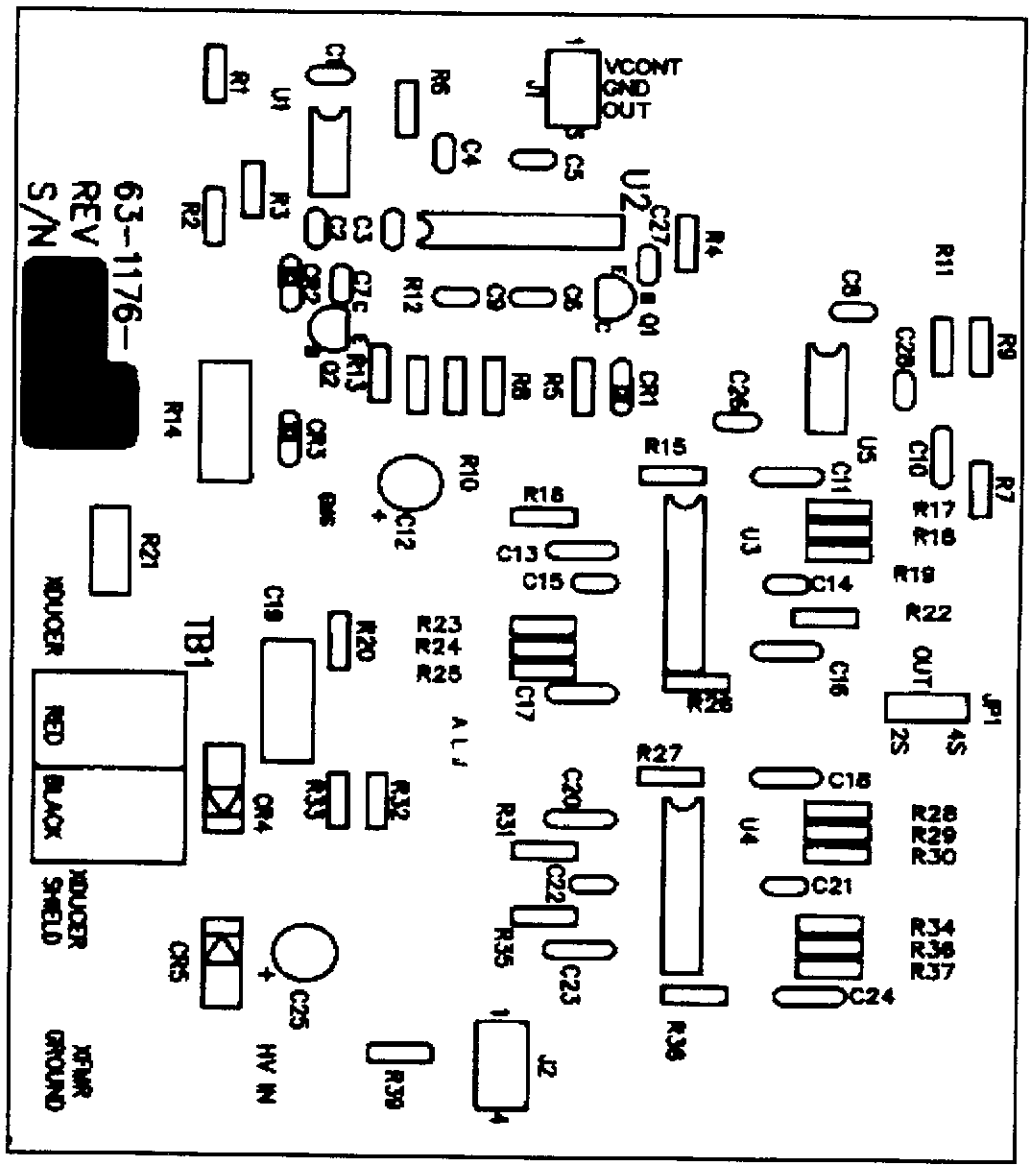


Figure D-3. Assembly Drawing of the Filter Module Board (20-, 30-, and 50-foot Systems), P/N 63-1176.

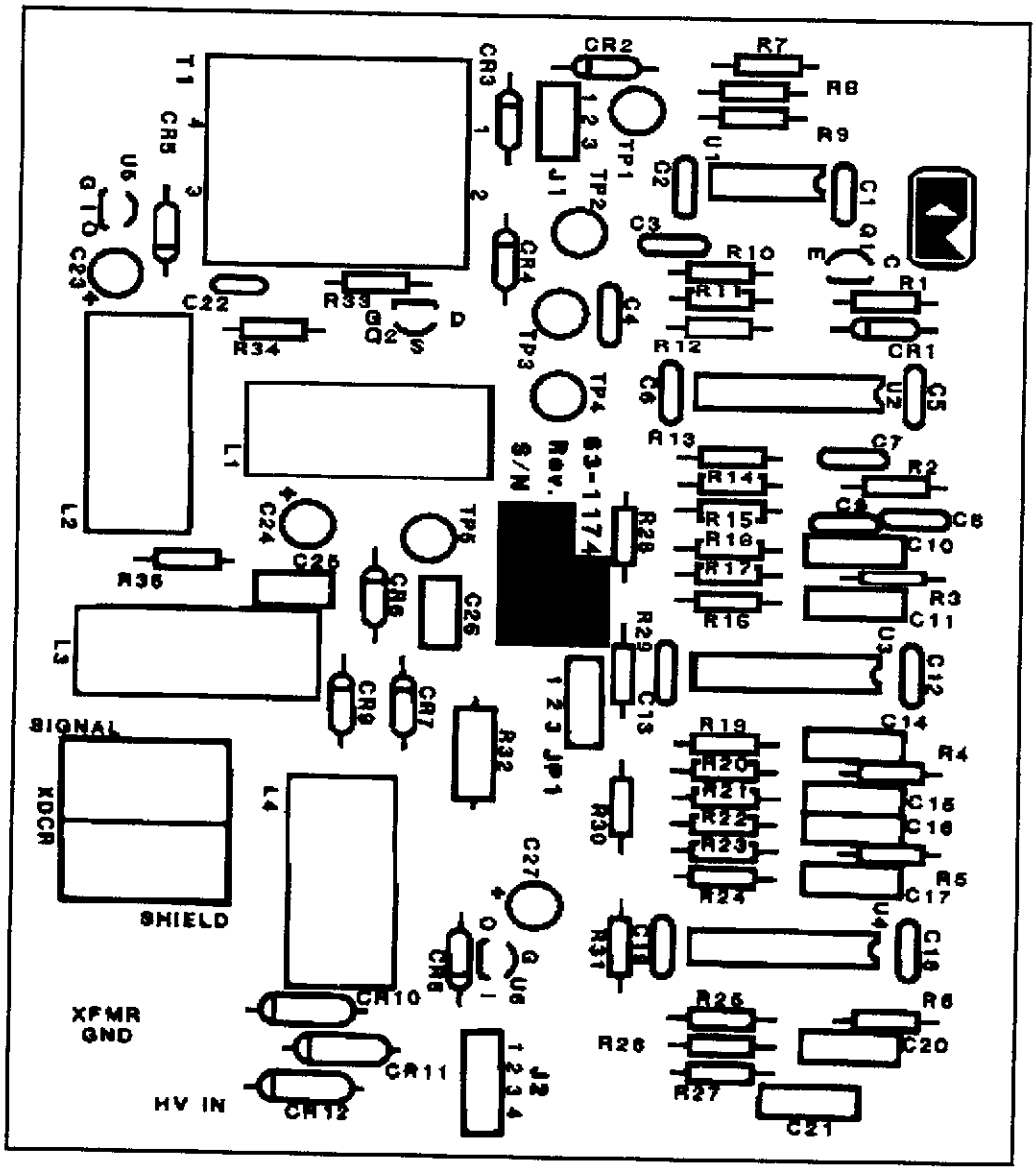


Figure D-4. Assembly Drawing of the Filter Module Board (100-foot System), P/N 63-1174.

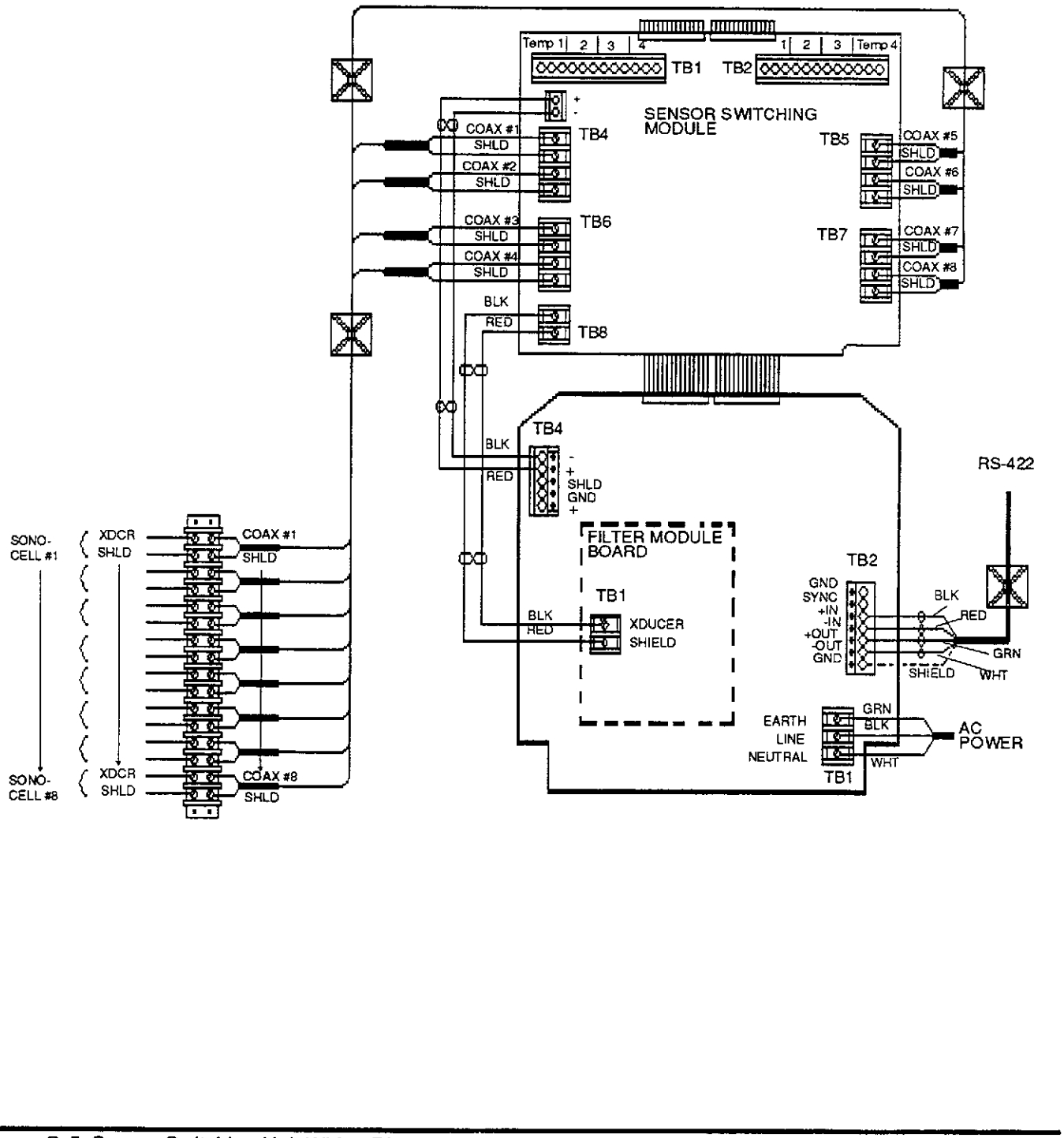
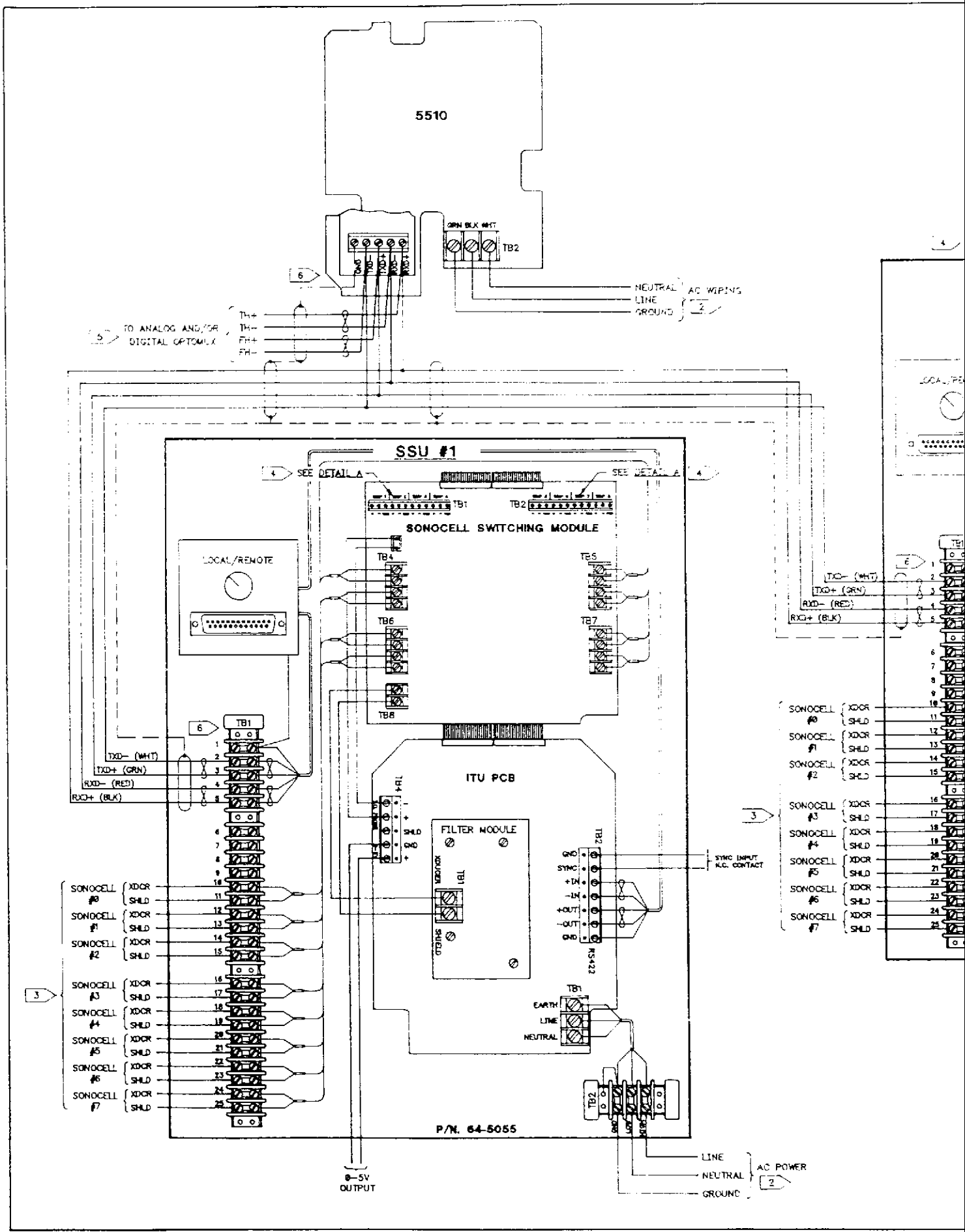


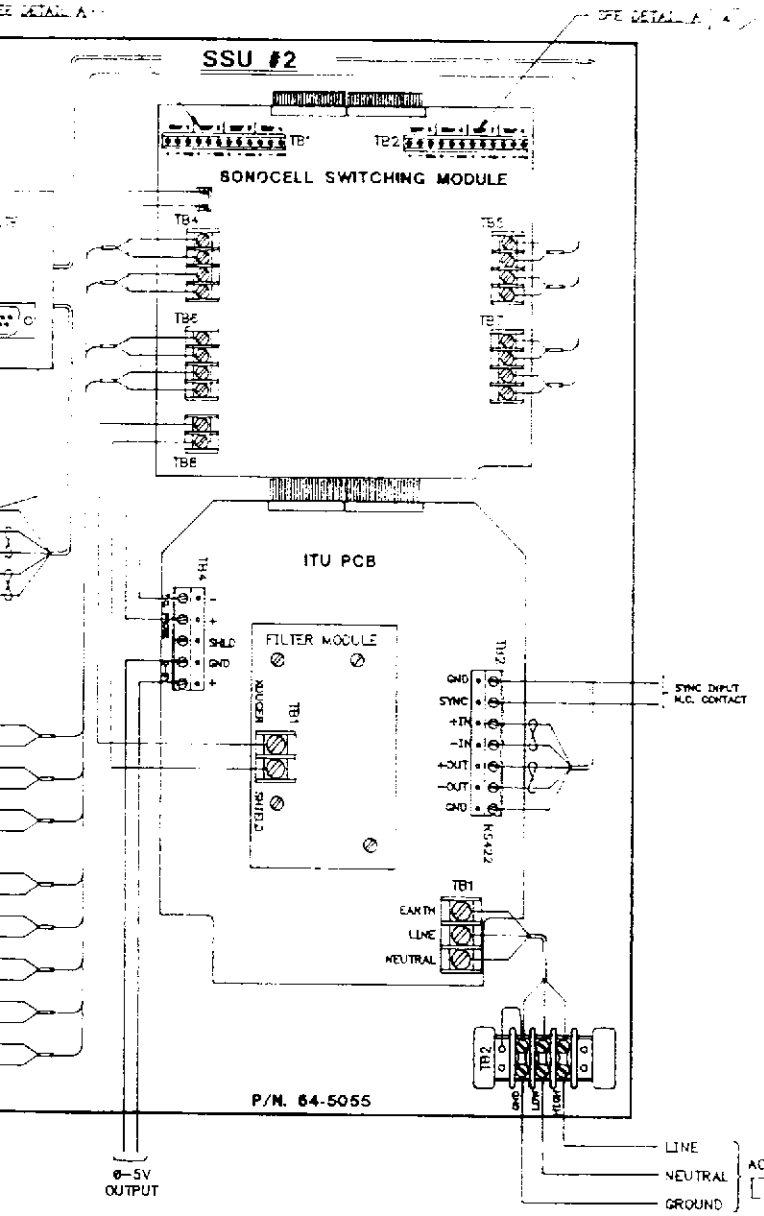
Figure D-5. Sensor Switching Unit Wiring Diagram.

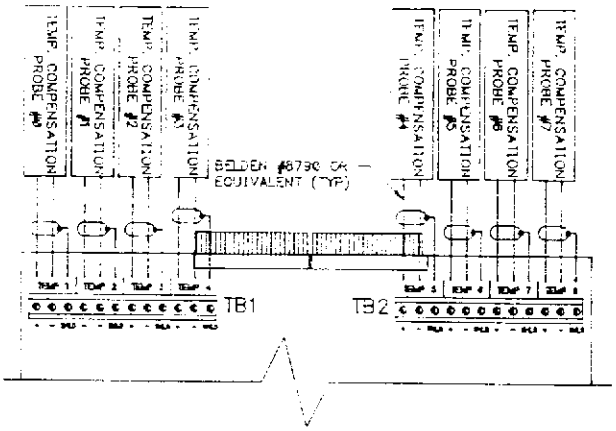

5510
TB2
GRN BLK WHT
NEUTRAL
LINE
GROUND
AC WIRING
TH+
TH-
FH+
FH-
TO ANALOG AND/OR DIGITAL OPTOMUX
SSU #1
SEE DETAIL A
SONOCELL SWITCHING MODULE
TB1
TB2
TB4
TB5
TB6
TB7
TB8
LOCAL/REMOTE
ITU PCB
FILTER MODULE
TB3
TB1
TXD- (WHT)
TXD+ (GRN)
RXD- (RED)
RXD+ (BLK)
SONOCELL #0
SONOCELL #1
SONOCELL #2
SONOCELL #3
SONOCELL #4
SONOCELL #5
SONOCELL #6
SONOCELL #7
XDCR
SHLD
SYNC INPUT N.C. CONTACT
GND
SYNC
+IN
-IN
+OUT
-OUT
RS422
EARTH
LINE
NEUTRAL
P/N. 64-5055
0-5V OUTPUT
AC POWER
GROUND

REVISIONS				
LTR	DESCRIPTION	CHECKED	DATE	APPROVED
NEW	INITIAL RELEASE		1/2/97	

NOTES: (UNLESS OTHERWISE SPECIFIED)

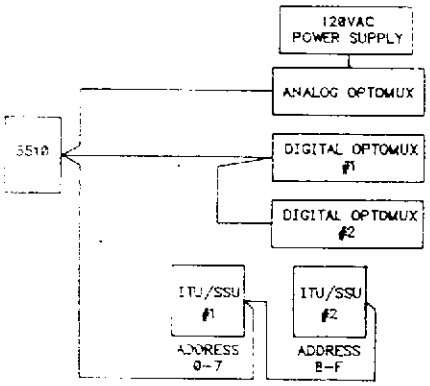
1. ALL WIRING SHOWN (LABELED) CUSTOMER INSTALLED.
2. ROUTE ALL A.C. WIRING SEPARATE FROM ALL OTHER WIRING.
3. RUN SONOCELL CABLES IN A SEPERATE, DEDICATED CONDUIT. IF OPTIONAL TEMPERATURE COMPENSATION PROBE IS USED, ITS CABLE CAN BE RUN IN THE SAME CONDUIT. DO NOT RUN SONOCELL CABLES FOR MORE THAN ONE SSU IN THE SAME CONDUIT.
4. IF SEPARATE TEMPERATURE COMPENSATION PROBE IS USED FOR EACH MEASUREMENT POINT, CONNECTIONS ARE TO "TB1" AND "TB2" ON THE SSU SONOCELL SWITCHING MODULE. IF A SINGLE TEMPERATURE COMPENSATION PROBE IS USED FOR ALL MEASUREMENT POINTS, IT MUST BE CONNECTED TO "TB4" ON THE ITU PCB.
5. SEE DRAWING TI-S8.OPTO-01 AND TI-SO.OPTO-02 FOR DIGITAL AND ANALOG OPTOMUX WIRING.
6. TO PREVENT GROUND LOOPS, GROUND THE RS422 SIGNAL SHIELD WIRE ONLY AT THE MODEL 5510 INDICATOR SIGNAL GROUND CONNECTION.
7. SONOCELL CABLE MAY BE CUT AND SPLICE AS REQUIRED. WHEN ROUTED THROUGH CONDUIT, SPLICE SHOULD NOT BE AT LOW POINT WHERE MOISTURE CAN ACCUMULATE.





DETAIL A

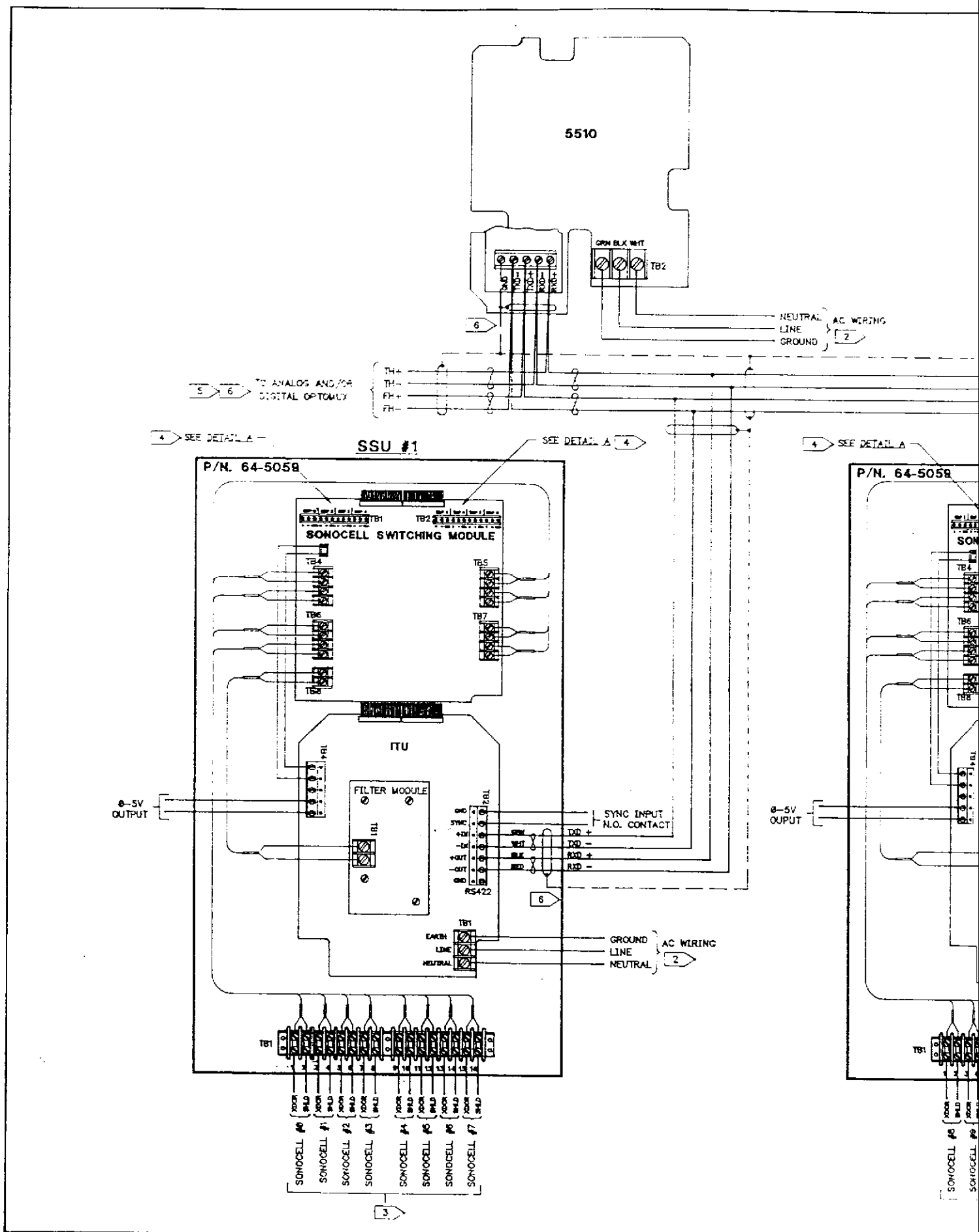
HOOKING-UP OPTIONAL TEMPERATURE PROBES (TYP ITU/SSU #1 AND ITU/SSU #2)



5510 - SSU BLOCK DIAGRAM

5510 WILL COMMUNICATE WITH 2 SSU UNITS OR A COMBINATION OF ITU AND SSU UNITS FOR A TOTAL OF 16 MEASUREMENT POINTS.

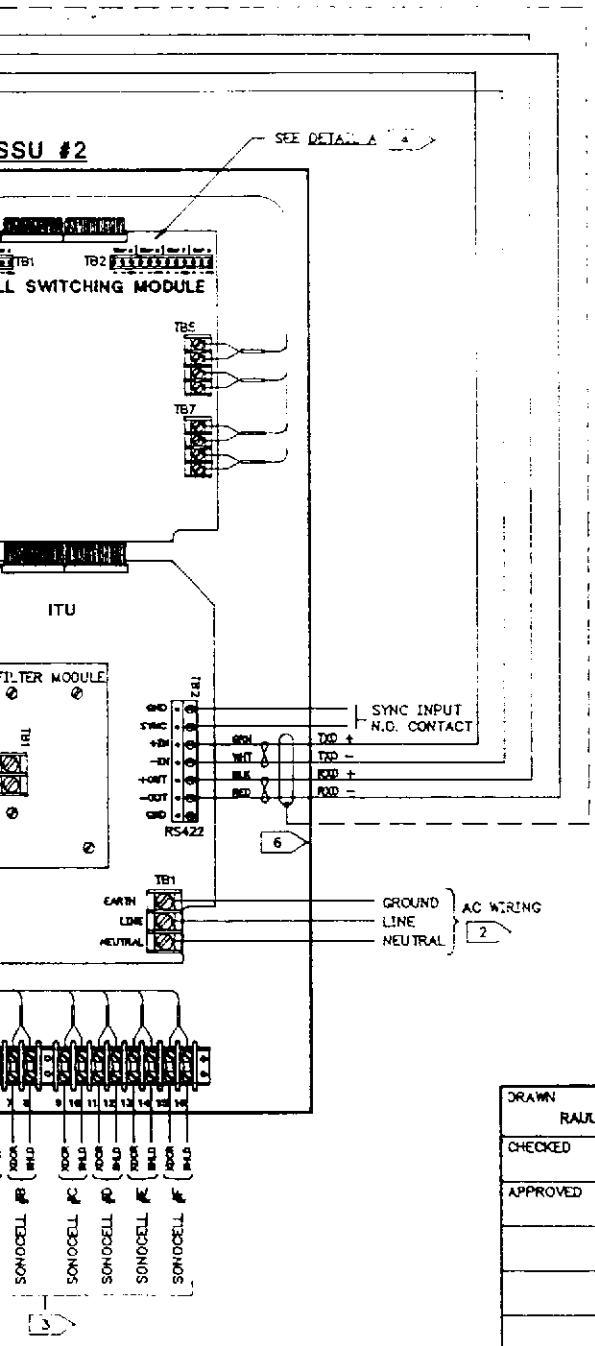
DRAWN: RAUL COLLADO	DATE: 10/31/96	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	Kistler-Morse Corp. Redmond, Wa 98073
CHECKED		TOLERANCES: DECIMAL .X± ---, .XX± ---, .XXX± ---; ANGULAR ± --°	TITLE: MODEL 5510 INDICATOR / SSU INTERCONNECT DIAGRAM (SSU P/N 64-5055)
APPROVED		DO NOT SCALE DRAWING	
		SCALE ---	
		FINISH ---	SIZE: D; DWG. NO: TI-SO.5510-02; REV: NEW
		USED ON: (REF ONLY)	ACAD #: S551002; DATE: 12/27/96; SHT. 1 OF 1

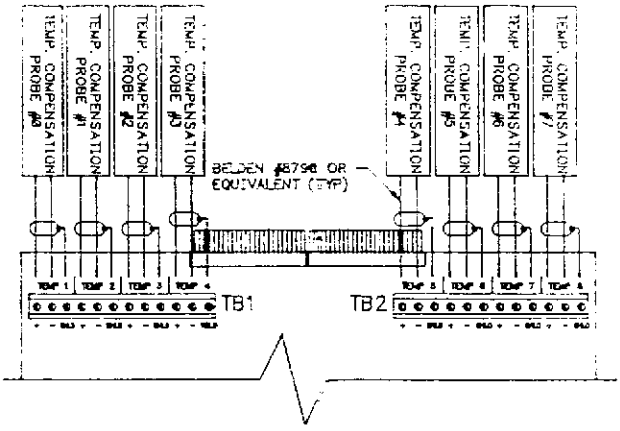

5510
GRN BLK WHT
TB2
GND
TXD-
TXD+
RXD-
RXD+
6
NEUTRAL
LINE
GROUND
AC WIRING
2
TH+
TH-
FH+
FH-
5
6
TO ANALOG AND/OR DIGITAL OPTOMUX
4
SEE DETAIL A
SSU #1
SEE DETAIL A
4
P/N. 64-5059
TB1
TB2
SONOCELL SWITCHING MODULE
TB4
TB5
TB6
TB7
TB8
ITU
FILTER MODULE
TB1
0-5V OUTPUT
SYNC INPUT
N.O. CONTACT
TXD +
TXD -
RXD +
RXD -
RS422
6
EARTH
LINE
NEUTRAL
GROUND
LINE
NEUTRAL
AC WIRING
2
TB1
XDCR
SHLD
SONOCELL #0
SONOCELL #1
SONOCELL #2
SONOCELL #3
SONOCELL #4
SONOCELL #5
SONOCELL #6
SONOCELL #7
3
4
SEE DETAIL A
P/N. 64-5059
0-5V OUPUT

REVISIONS				
LTR	DESCRIPTION	CHECKED	DATE	APPROVED
NEW	INITIAL RELEASE		1/2/91	SAS

NOTES: (UNLESS OTHERWISE SPECIFIED)

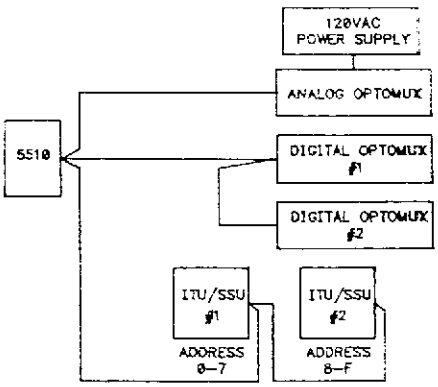
1. ALL WIRING SHOWN (LABELED) CUSTOMER INSTALLED.
2. ROUTE ALL A.C. WIRING SEPARATE FROM ALL OTHER WIRING.
3. RUN SONOCELL CABLES IN A SEPERATE, DEDICATED CONDUIT. IF OPTIONAL TEMPERATURE COMPENSATION PROBE IS USED, ITS CABLE CAN BE RUN IN THE SAME CONDUIT. DO NOT RUN SONOCELL CABLES FOR MORE THAN ONE SSU IN THE SAME CONDUIT.
4. IF SEPARATE TEMPERATURE COMPENSATION PROBE IS USED FOR EACH MEASUREMENT POINT, CONNECTIONS ARE TO "TB1" AND "TB2" ON THE SSU SONOCELL SWITCHING MODULE. IF A SINGLE TEMPERATURE COMPENSATION PROBE IS USED FOR ALL MEASUREMENT POINTS, IT MUST BE CONNECTED TO "TB4" ON THE ITU PCB.
5. SEE DRAWING TI-S0.OPTO-01 AND TI-SO.OPTO-02 FOR DIGITAL AND ANALOG OPTOMUX WIRING.
6. TO PREVENT GROUND LOOPS, GROUND THE RS422 SIGNAL SHIELD WIRE ONLY AT THE MODEL 5510 INDICATOR SIGNAL GROUND CONNECTION.
7. SONOCELL CABLE MAY BE CUT AND SPLICE AS REQUIRED. WHEN ROUTED THROUGH CONDUIT, SPLICE SHOULD NOT BE AT LOW POINT WHERE MOISTURE CAN ACCUMULATE.





DETAIL A

HOOKING-UP OPTIONAL TEMPERATURE PROBES
(TYP ITU/SSU #1 AND ITU/SSU #2)



5510 - ITU/SSU BLOCK DIAGRAM

5510 WILL COMMUNICATE WITH 2 SSU UNITS OR A COMBINATION OF ITU AND SSU UNITS FOR A TOTAL OF 16 MEASUREMENT POINTS.

DRAWN: RAUL COLLADO	DATE: 10/31/90	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	Kistler-Morse Corp. Redmond, Wa 98073
CHECKED		TOLERANCES: DECIMAL .X± ---- .XX± ---- .XXX± ---- ANGULAR ± -- °	TITLE: MODEL 5510 INDICATOR /SSU INTERCONNECT DIAGRAM (SSU P/N. 64-5059)
APPROVED		DO NOT SCALE DRAWING	
		SCALE ----	
		FINISH ----	SIZE D; DWG. NO. TI-SO.5510-03; REV. NEW
		USED ON: (REF ONLY)	ACAD # S551003; DATE 10/28/90; SHT. 1 OF 1