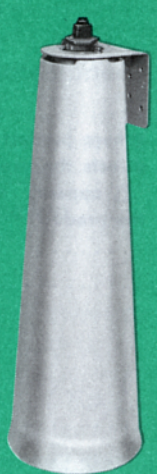
BAILEY FISCHER & PORTER

INSTRUCTION BULLETIN
(Includes Parts List)
TRANSMITTERS
50US3000 Rev.5

ULTRASONIC OPEN CHANNEL FLOW/LEVEL TRANSMITTER AND OPTIONAL FLOW RECORDER

Transmitter Unit with
optional digital indicator and totalizer (Flow)



Transducer with optional megaphone

PN24423C

This revision of Instruction Bulletin 50US3000 replaces PN 24423A. The following information has been revised: Figure 20, page 37.

Read these instructions before starting installation; save these instructions for future reference.

The instructions given herein cover generally the description, installation, operation and maintenance of subject equipment. F&P reserves the right to make engineering refinements that may not be reflected in this Bulletin. Should any questions arise which may not be answered specifically by these instructions they should be directed to the Fischer & Porter Co. for further detailed information and technical assistance.

⚠ **SYMBOL DEFINITION**

Where product damage or unsafe conditions might exist, ⚠ directs the user to refer to this bulletin for specific information. ⚠ appears next to the information indicated by ⚠ on the product.

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ADDENDA
for
ULTRASONIC OPEN CHANNEL FLOW/LEVEL TRANSMITTER AND OPTIONAL FLOW RECORDER
Instruction Bulletin

The information on the attached sheet supplements the information provided in the 50US3000 Instruction Bulletin regarding the use of the TEST selector switch. Read these instructions before starting installation; save these instructions for future reference.

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Publication 24519
[Supplements Publication 24423C]

Use of the TEST Selector Switch

The 50US3000 contains a TEST selector switch shown in Figure 15 on page 19 of Instruction Bulletin 50US3000. During normal operation this switch is set to 0 as described on pages 8 and 16 of the instruction bulletin. The other settings are used to perform built-in diagnostics as described on page 23 of the instruction bulletin.

The following caution regarding the use of this switch applies only to any unit containing a Rev. 4 integrated circuit in position U112 on the main printed circuit board (see Figure 18 in IB50US3000). The revision level is printed on the IC chip.

CAUTION

If the 50US3000 is powered up with the TEST selector switch set to position 1, 2, 4, 5, 6, or A, the unit may not actually come up in the selected mode, and the output can not be relied upon.

If the unit is accidently powered-up in one of these diagnostic modes, turn the TEST selector switch to the normal (0) position for a second, then switch back to the desired test position.
This will restore proper operation.

Note that when the unit is powered up in normal mode (switch set to 0), then switched to any diagnostic mode setting, the diagnostic output will be accurate.

TWO YEAR WARRANTY

SERIES 50US3000 ULTRASONIC FLOW AND LEVEL TRANSMITTERS

Bailey-Fischer & Porter Company ("B-F&P") warrants that all Series 5OUS3000 Transmitters manufactured by B-F&P and sold to Buyer will, if installed and used in accordance with B-F&P's installation and users' manuals and other instructions, be free from defects in material and workmanship for a period of two years after shipment. The foregoing warrpnty does not apply to any defect caused by the negligent or intentionally improper acts or omissions of Buyer or its personnel or agents or any third party, or by a defect which Buyer does not report to B-F&P within two weeks after discovery.

B-F&P's sole and exclusive obligation for any breach of the warranty set forth above shall be to repair or replace, at its option and free of charge, any item returned to it by Buyer during the warranty period which, after reasonable examination, proves to have a defect covered by the warranty. Buyer shall be responsible for all shipping costs for warranty service, and B-F&P shall bill and Buyer shall pay for all services on items submitted by Buyer which prove not to be due to defects covered by the warranty.

Except as expressly provided above, B-F&P MAKES NO EXPRESS OR IMPLIED REPRESENTATIONS OR WARRANTIES OF ANY KIND OR NATURE WHATSOEVER WITH RESPECT TO THE SERIES 50US3000 TRANSMITTERS, AND ALL WARRANTIES, INCLUDING SPECIFICALLY BUT WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE HEREBY DISCLAIMED.

b-F&P's sole and exclusive monetary liability for any matter whether by contract, tort (including negligence) or otherwise, and regardless of the nature of the claim or form of action relating thereto, shall be the general money damages equal to the actual monetary damage to Buyer, but in no event more than the lesser of the amount which Buyer paid for the item which gave rise to the damage or $50,000. Notwithstanding the foregoing, B-F&P shall not be liable to Buyer for damages for injury, including death, to any person, for any claims of any kind by a third party or for any loss of business or lost profits. IN NO EVENT SHALL B-F&P BE LIABLE TO BUYER FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES OF ANY KIND, EVEN IF B-F&P WAS AWARE OF THE POSSIBILITY OF SUCH DAMAGES.

PURCHASE DATE:_____ PURCHASED FROM: _____

SERIAL NUMBER:_____ _____

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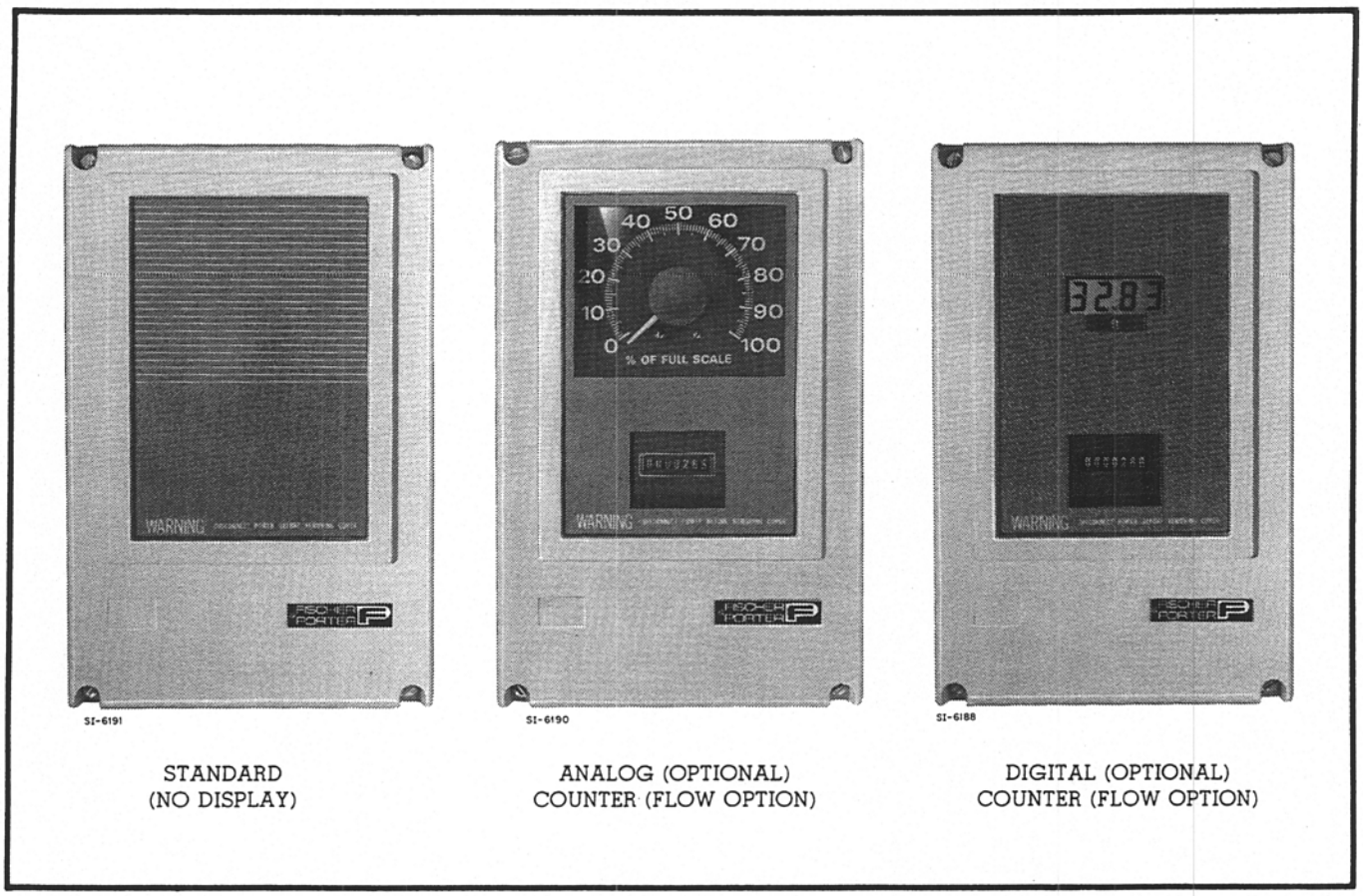


STANDARD
(NO DISPLAY)

ANALOG (OPTIONAL)
COUNTER (FLOW OPTION)

DIGITAL (OPTIONAL)
COUNTER (FLOW OPTION)

FIGURE 1. TRANSMITTER UNIT DISPLAY VERSIONS.

SECTION I
SERIES 50US3000 ULTRASONIC FLOW/LEVEL METER

INTRODUCTION

I. Description

The Fischer & Porter Series 50US3000 Ultrasonic Flow/Level Meter measures flow in open channels and tank levels and produces a linear output signal of 4-20 mA dc with flow/level and scaled pulse for flow totalization. The Flow/Level meter consists of a Transducer with reference reflector and a Transmitter Unit and employs an ultrasonic beam to detect the level of a stream passing through a flume or over a weir, or the level of liquid in a tank. Level measurement of the flume or weir is converted to flow by an integral microcomputer.

The Series 50US3000 Ultrasonic Flow/Level meter is available in two versions; a Flow meter, identified as the 50US3100, and a Level meter, identified as the 50US3200. Both versions of the meter are essentially the same, hence all comments, unless otherwise mentioned, pertain to both versions. Set-up information is detailed in the Operation section and in brief on decals affixed to the back side of the swing-out chassis cover, as shown in Figure 2.

The Series 50US3100 is a flow transmitter, however, it is optionally available as a flow recorder. See Section II at the back of this bulletin.

The Transducer is a weatherproof unit, suitable for installation in a hazardous environment. The Transducer generates the ultrasonic signal and receives the echo from the target (level) surface. A reference reflector is employed to make measurements independent of sound velocity variations such as those due to air or gas temperature changes.

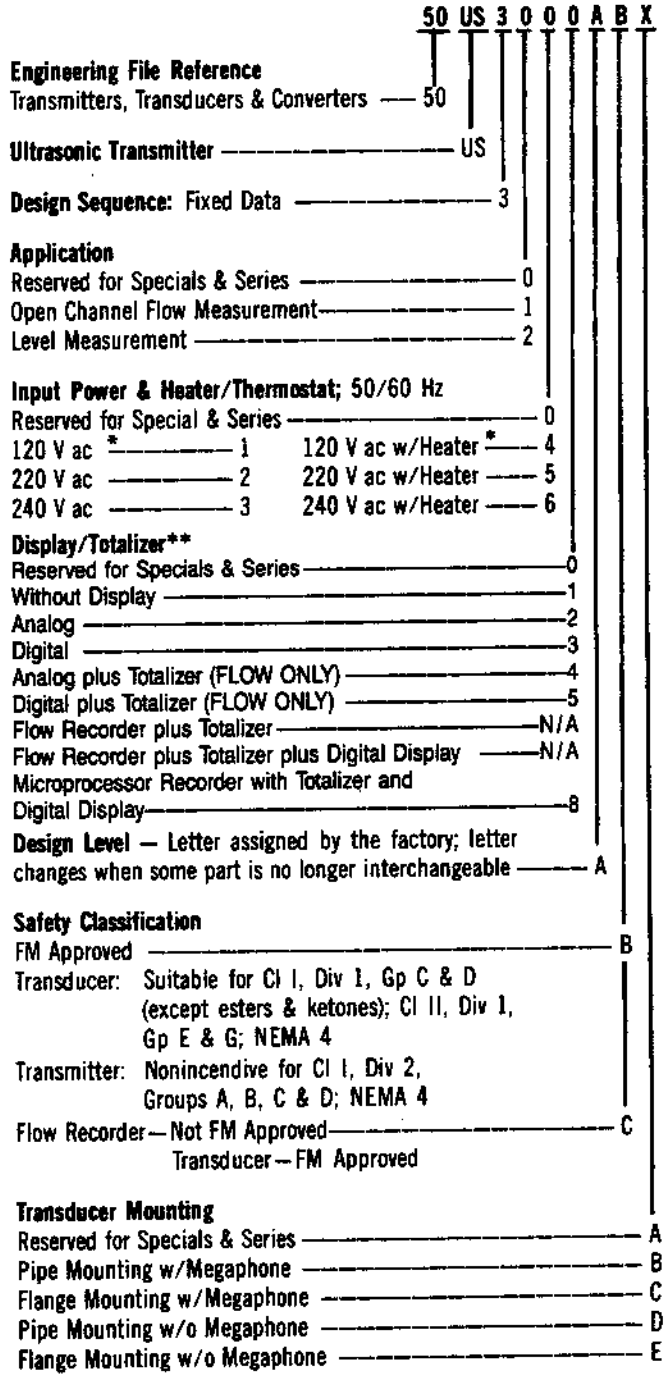
The Transmitter Unit is suitable for outdoor installation in a hazardous environment. Basically, the Transmitter Unit contains the microcomputer and electronic circuits for level measurement and software for flow/volume computation. Digital switches are provided for selection of the operating parameters such as zero, span and alarms as well as diagnostic routines. An interior view of the Transmitter Unit is shown in Figure 2.

The Transmitter Unit provides a 4-20 mA dc analog signal that is linear with respect to flow, level or volume and can be transmitted to remote instruments, such as recorders, controllers, etc. A scaled pulse output signal (flow only) is supplied and can be used to drive a remote electromechanical or electronic counter only.

*60 Hz for FLOW RECORDER (when 4th digit is 6 or 7)
**Local totalizer option excludes remote totalizing because of internal circuit drive limitation.

Optional items available for the Ultrasonic Flow/Level meter include a digital or analog display to provide local indication of flow/level. The analog meter reads percent of flow/volume. The digital meter displays selected engineering units. Also available are a 7-digit counter** for flow, a megaphone for the Transducer, a heater-thermostat and two mounting options. Optional sunshades are available for both the Transmitter Unit and the recorder.

II. Model Number Breakdown



N/A = NOT AVAILABLE

III. Specifications

NOTE: The specifications listed in this section apply to both the Ultrasonic Flow Meter (50US3100) and to the Ultrasonic Level Meter (50US3200), except where otherwise indicated.

Performance Characteristics

Power Requirements . . . . . 120 V ac, ±10%, 50/60 Hz; 220/240 V ac, ±10%, 50/60 Hz; 12 VA max consumption

Accuracy

•Flow Meter . . . . . Varies with span and flume/weir selection. Those listed include head measurement and characterization.

Span (in)	Span (cm)	Triangular Weir	All Others
4	10.2	±2.0% of span	±1.0% of span
8	20.3	±1.3% of span	±0.8% of span
12	30.5	±1.2% of span	±0.7% of span
72	182.9	±1.1% of span	±0.6% of span

•Level Meter . . . . . (varies with range)

Range (ft)	Range (m)	Accuracy
2	0.6	±1.0% of span
5	1.5	±0.8% of span
10	3.0	±0.7% of span
33	10.1	±0.6% of span

Zero-Span Switch Setting Resolution

•Flow Meter . . . . . 0.01 in or 0.1 cm
•Level Meter . . . . . 0.01 ft or 0.01 m

Output

Current . . . . . 4-20 mA dc into a 0 to 750 ohm load

Scaled Pulse (Flow) . . . . . Contact closure 30 V dc, 0.3 A max. 100 ms pulse width. 1 to 9999 pulses/hr. Automatic dropout below 2.6% of max. flow.

Alarm Relay Contact

•Flow Meter . . . . . Switch selectable for either "low" (0%) or "high" (100%) of flow. Contact Closure 30 V dc, 0.3 A max.

•Level Meter . . . . . Two alarms, each switch selectable (Hi/Lo) and adjustable between 0 and 99% (1% switch resolution.) Contact closure 30 V dc, 0.3 A max.

Display

Standard . . . . . None
Analog (optional) . . . . . 0-100% linear dial flow/volume indicator
Digital (optional) . . . . . 4 digit, 1/2" high LCD reading in any user-selected engineering units, with decimal point.
Counter (optional, flow only) . . . 7-digit non-resettable totalizer.

*If unit is mounted in direct sunlight, it is mandatory that the optional sunshade be used to keep the temperature in the case from exceeding the maximum allowable limit.

Characterization

•Flow Meter
Channel Types . . . . . Flumes: Parshall, Palmer-Bowlus, Rectangular (British Standard), and Leopold-Lagco. Weirs: Rectangular, Triangular, Cipolletti & Linear.

•Level Meter
Tank Configuration . . . . . Linear, Horizontal cylindrical tanks with flat ends and spherical tanks.

Materials

Transducer
Standard . . . . . PVC housing with silicone rubber encapsulation. Reference reflector is PVC. Megaphone is fiberglass, reinforced epoxy.
Optional . . . . . 8-inch Class 150 PVC mounting flange.

Transmitter Unit
Standard . . . . . Glass-filled polyester base (GE Valox) and polycarbonate cover. Surface mounting bracket is coated steel.

Environmental

Relative Humidity 0-100%
Class . . . . . Indoors or outdoors weather and rust resistant NEMA 4 (IEC 529 IP 65)

Temperature Limits
Transducer (standard) . . . . . −30 to +65°C (−22 to +150°F)
Transmitter Unit (standard) . . . −10 to +52°C (+14 to 125°F)*
−25 to +52°C (−13 to +125°F) with optional heater.

Transducer Cable

Standard . . . . . 25 ft (7.6 m) coaxial cable
Optional . . . . . Longer lengths available to 500 ft (150 m). A connector kit is provided.

Mounting

Transducer
Standard . . . . . Aluminum mounting bracket supplied for surface or pipe (1-1/2 or 2 inch) mounting
Optional . . . . . 8-inch Class 150 flange

Transmitter Unit
Standard . . . . . Surface mounting.

Diagnostics

Standard . . . . . Built-in diagnostics to check analog output, contact output, set-up switches and the microcomputer.

Shipping Information

Weight . . . . . 20 lbs (9.1 kg)
Cubage . . . . . 1.7 ft³ (0.05 m³) for basic unit.

IV. Principle of Operation

Operation of the flow/level meter is based on the Ultrasonic echo ranging technique and flow/volume computation. The Transducer sends an ultrasonic signal and receives a returned echo from two points: the first echo, after an elapsed time of t_R, is from a reference reflector located at a fixed distance R from the Transducer, and a second echo from the liquid surface, at a distance B, from the Transducer with round trip travel time of t_B. The distance "B" calculation is based on time ratio, hence it is independent of Ultrasonic velocity variations such as those caused by temperature changes.

$$B = \frac{t_B}{t_R} \times R$$

Based on zero (Z) and span (S) switch setting the level or head "H" in percent of full span is then calculated as;

$$H = \frac{Z-B}{S} \times 100$$

The head value can then be translated to flow or tank volume according to the particular channel or tank geometry. For example: a typical flow "Q" can be expressed as;

$$Q = kH^n$$

where k and n are constants related to a particular channel.

INSTALLATION

I. Inspection

The Ultrasonic Flow/Level meter, consisting of the Transducer and Transmitter Unit with standard mounting hardware is shipped in a single container. Items such as signal cable, or optional mounting hardware may be packaged separately. An itemized packing list is attached to each carton.

Inspect the instruments immediately upon arrival for indications of damage that may have occurred during transit. In most cases a careful visual inspection is all that is required to establish apparent damage. All damage claims should be reported to the shipping agent before installation. If the equipment is inoperable the damage should be brought to the attention of the Fischer & Porter Company Service Department. Instructions covering repair or replacement of the damaged item will be provided promptly.

II. Location

The Transmitter Unit is suitable for outdoor installation, within the specified minimum and maximum temperature limits, as given in Part III, Specifications. *Windows of units with indicators should not face the sun. In warmer geographical areas the Transmitter Unit should be mounted out of direct sunlight, or use optional sunshade.* See Figure 10.

Electrical power must be made available for connection to the Transmitter Unit, as specified on the instrument data tag.

The Transmitter Unit, designated 50US3100 for Flow and 50US3200 for Level, is FM approved and is rated nonincendive for Class I, Division 2, Groups A, B, C & D, NEMA 4.

The Transmitter Unit must be located within the 25-foot cable length of the Transducer unless an Extension Cable Assembly is specified. When installed in hazardous locations, all wiring must comply with Articles 501-502 of ANSI/NFPA 70 (National Electrical Code) in addition to Figure 11, Flow Interconnection Diagram and Figure 12, Level Interconnection Diagram.

III. Mounting

A. Transducer

NOTE

The ultrasonic radiating signal path from the Transducer to the measured level must be free from any obstruction that could reflect this signal and cause erroneous readings.

The Transducer may be surface or pipe mounted, as shown in Figure 8, Outline and Mounting Dimensions. Care must be taken when mounting the Transducer so that its radiating surface will be level within 2 degrees. A spirit* (carpenter's) level can be used. Three leveling screws are accessible through holes in the Transducer mounting bracket to facilitate precise level adjustment. Hold the level against the face of the Transducer and then adjust the leveling screws.** In the case of the megaphone, hold the level across the bottom of the megaphone and adjust the leveling screws.** Dimensions for proper positioning of the Transducer for the particular head generating device are also provided in Figure 8, Outline and Mounting Dimensions, Transducer.

Four holes have been provided in the Transducer mounting bracket to accept 1/4 inch mounting screws (not supplied by F&P). When surface mounting is desired the mounting bracket can be used as a template for determining hole location. When pipe mounting is desired the pipe mounting hardware (supplied in a separate skin pack) must be used for mounting to a 1-1/2 inch (DN 40) or 2 inch (DN 50) horizontal or vertical pipe. Piping is not supplied unless specified. (Piping is only available from F&P

*Required for installation if Transducer was not provided with a leveling circle.

**Loosen holding screws before adjusting the leveling screws, then tighten the holding screws. See Figures 8 & 9 for screw locations.

for Parshall or Palmer-Bowlus Flumes manufactured by Warminster Fiberglass Co.) A typical pipe mounting arrangement is shown in Figure 6, Typical Flow Measurement Installation.

NOTE

As regards the distance between the face of the Transducer and the maximum liquid level, the Transducer should be mounted as close as possible to the minimum distance of 18 inches (46 cm) for flow and 2 feet (0.6 m) for level.

Flange Mounting

An optional flange mounted transducer is available for 8-inch diameter stilling well (Figure 9) or for top of tank mounting (Figure 7).

To make a measurement the ultrasonic signal must be reflected back to the Transducer from the surface of the liquid or slurry. To assure this —

1. As mentioned above, the face of the Transducer must be parallel with the level surface within 2 degrees. The leveling screws in the Transducer bracket make this an easy adjustment and assure maximum echo strength.

2. Liquids with turbulent surfaces may not reflect the transmitted pulse back to the Transducer. The surface may be turbulent because of the way the tank is being filled or because there is a mixer in the tank. In such cases a stilling well should be used, which will ensure a smooth surface for proper operation of the unit.

A length of 8-inch or larger diameter pipe serves as a stilling well. The inside surface of the pipe must be smooth. PVC pipe is most commonly used. The Transducer may be mounted in the stilling well using the optional mounting flange. If the stilling well is made of 2 lengths of pipe the joined inside surface

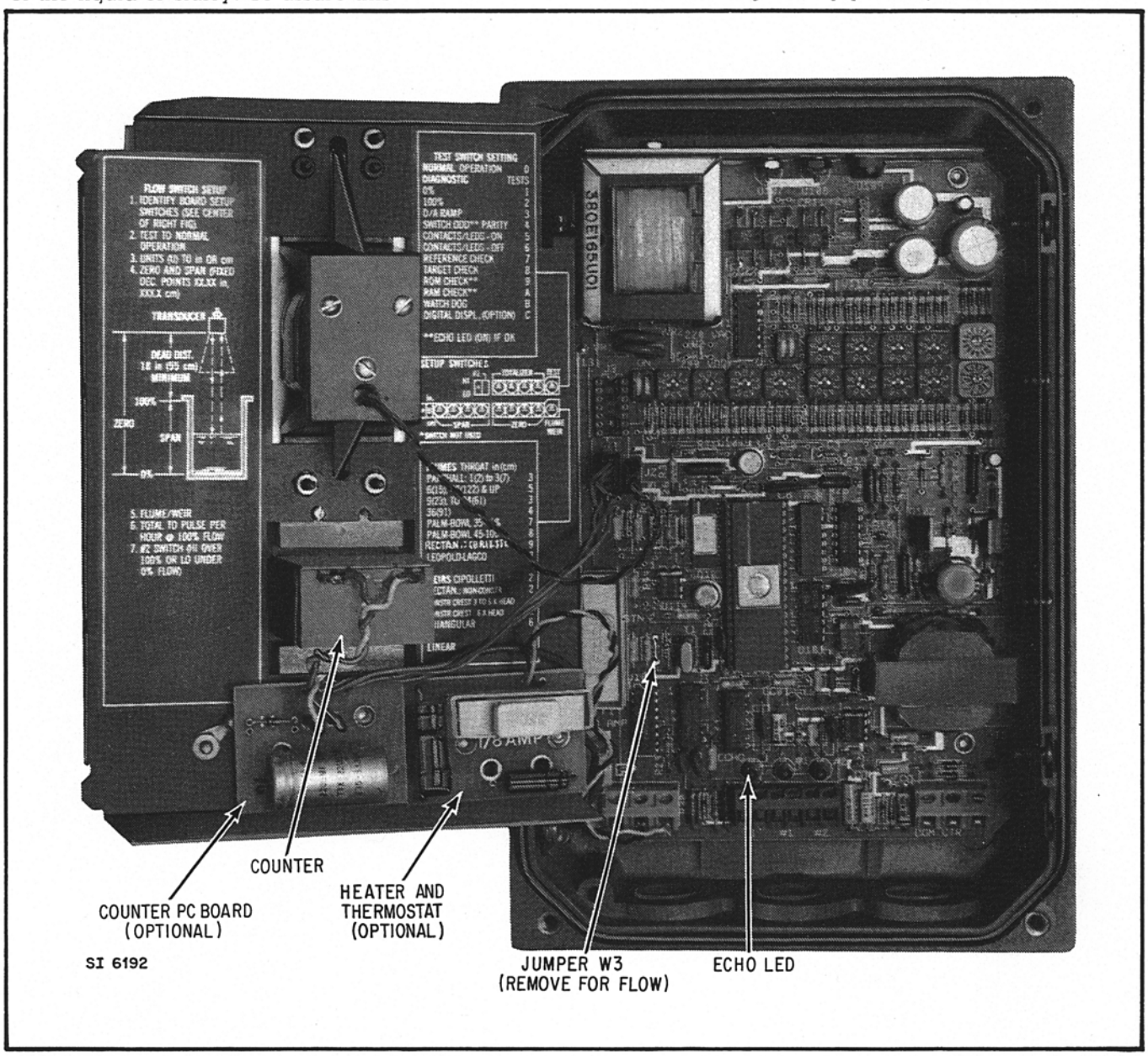


FIGURE 2. INTERIOR VIEW OF TRANSMITTER UNIT (COUNTER AND DECALS PERTAIN TO FLOW)

must be clean and smooth and be as far as possible from the Transducer. If the joint is flanged **do not use a gasket.**

B. Transmitter Unit

The Transmitter Unit is shipped ready for surface or wall mounting. Outline dimensions and mounting hardware are shown in Figure 10. Suitable mounting bolts must be supplied by the user. The Transmitter Unit is mounted by capturing the two mounting bolts in the slotted holes in the bracket. The mounting bolts (top and bottom) are then tightened with an open end wrench.

IV. Electrical Interconnections

Electrical wiring for the Ultrasonic Flow/Level meter consists of connection of the coaxial Transducer signal cable, the power input cable and applicable output cables for signal transmission to remote equipment. Interconnection wiring is shown in Figures 11 and 12.

The Series 50US3000 Transmitter Unit uses compression type terminal strips. When installing wiring use care to assure good electrical connections. Remove ¼-inch of insulation from wires before inserting them into the terminal strips and securely tighten the screws.

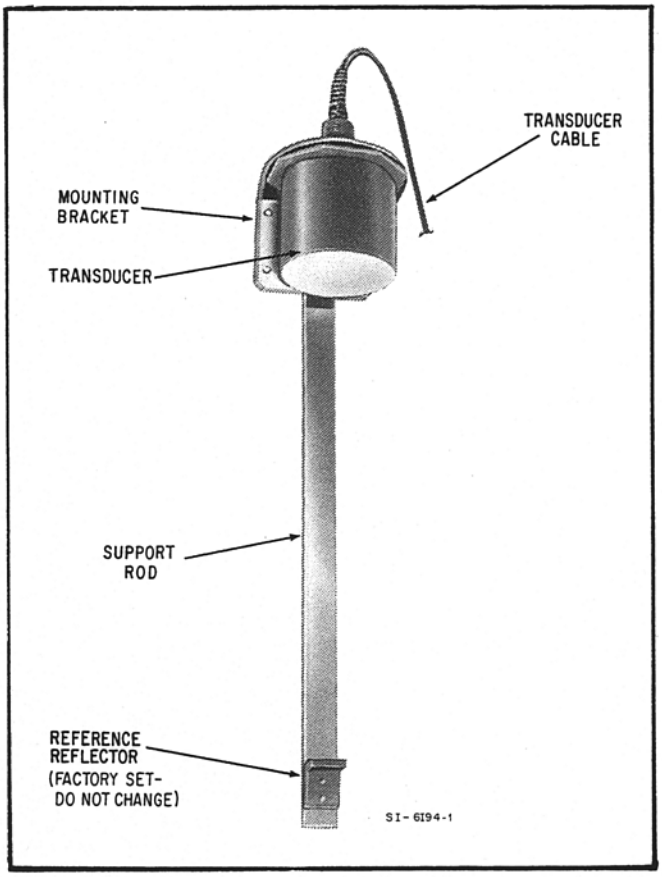


FIGURE 3. TRANSDUCER ASSEMBLY (Early Design)

A. Transducer Wiring

A 25-foot length of cable is supplied as an integral part of the Transducer. For greater distances, up to 500 ft (150 m), use optional extension cable, which is furnished with co-axial cable connectors and instructions. (Whenever the total cable length exceeds 200 ft., the transducer must be "matched" to the transmitter unit. This matching is a factory procedure.) The cable center conductor is to be connected to terminal "CTR" of TB3 and the cable shield to terminal "COM" of TB3, in the Transmitter Unit. The Transducer cable should be run in electrical conduit, as shown in Figures 11 and 12. *Do not run any other wiring in the same conduit with the Transducer cable.*

B. Power Wiring

The Ultrasonic Flow/Level meter is set for 110/120 or 220/240 V ac, 50 or 60 Hz line power, as specified on the data tag.

WARNING

Hazardous supply voltage can cause severe injury or death. Disconnect main power before installation.

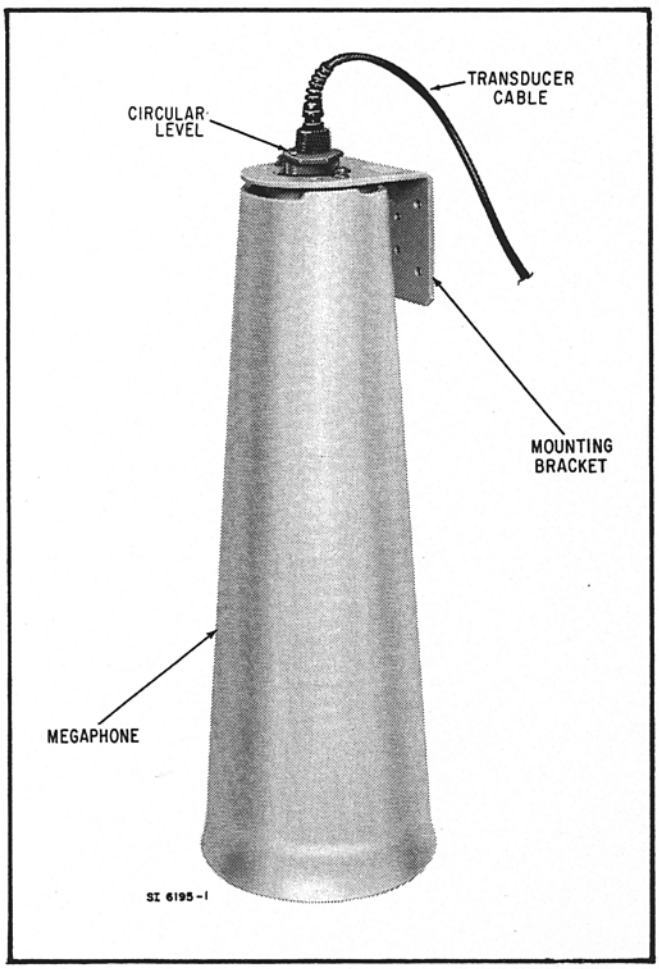


FIGURE 4. TRANSDUCER WITH MEGAPHONE (Standard)

The power wiring is to be furnished by the user. Number 18 AWG insulated power lines are suitable. A separate protective ground wire must be run from the terminal board (terminal "G") to earth ground at the point of supply.

Connect the power input and ground lines as follows:

"L" (or phase) to terminal L.
"N" (or neutral) to terminal N.
Earth Ground to terminal G.

C. Output Wiring

Number 18 AWG insulated cable is suitable for all signal outputs, as shown in the lower half of Figures 11 and 12.

OPERATION

I. Setup Procedure

The Series 50US3000 Ultrasonic Flow/Level Meter only requires application oriented setting of the switches in accordance with the particular flow or level installation.

Operating parameters are selected by means of the setup switches which are mounted on the pc board. The ZERO and SPAN switches are accessible when the cover is removed and the swing-out chassis cover is opened. The swing-out chassis includes a summary of the setup procedure in the form of decals. The respective switches are identified by their function as shown in Figures 13 & 14 and the schematic diagram, Figure 20.

The TEST selector switch (Figure 15) permits selection of NORMAL OPERATION and various diagnostic tests, such as 0%, 100%, etc. Transmitter setup procedures for both Flow and Level operation are outlined separately below.

NOTE

For Optional Digital Display of Engineering Units refer to Figure 5 and Sections I & J.

II. Initial Setup

A thin, narrow blade screwdriver (or common alignment tool) will be needed to turn the miniature rotary switches to the proper positions.

1. Flow Setup Switches (50US3100)

a. Refer to Figures 13 and 15 during the following and proceed as follows.

b. Set the TEST switch to NORMAL OPERATION which is position 0 (triangular indicator should

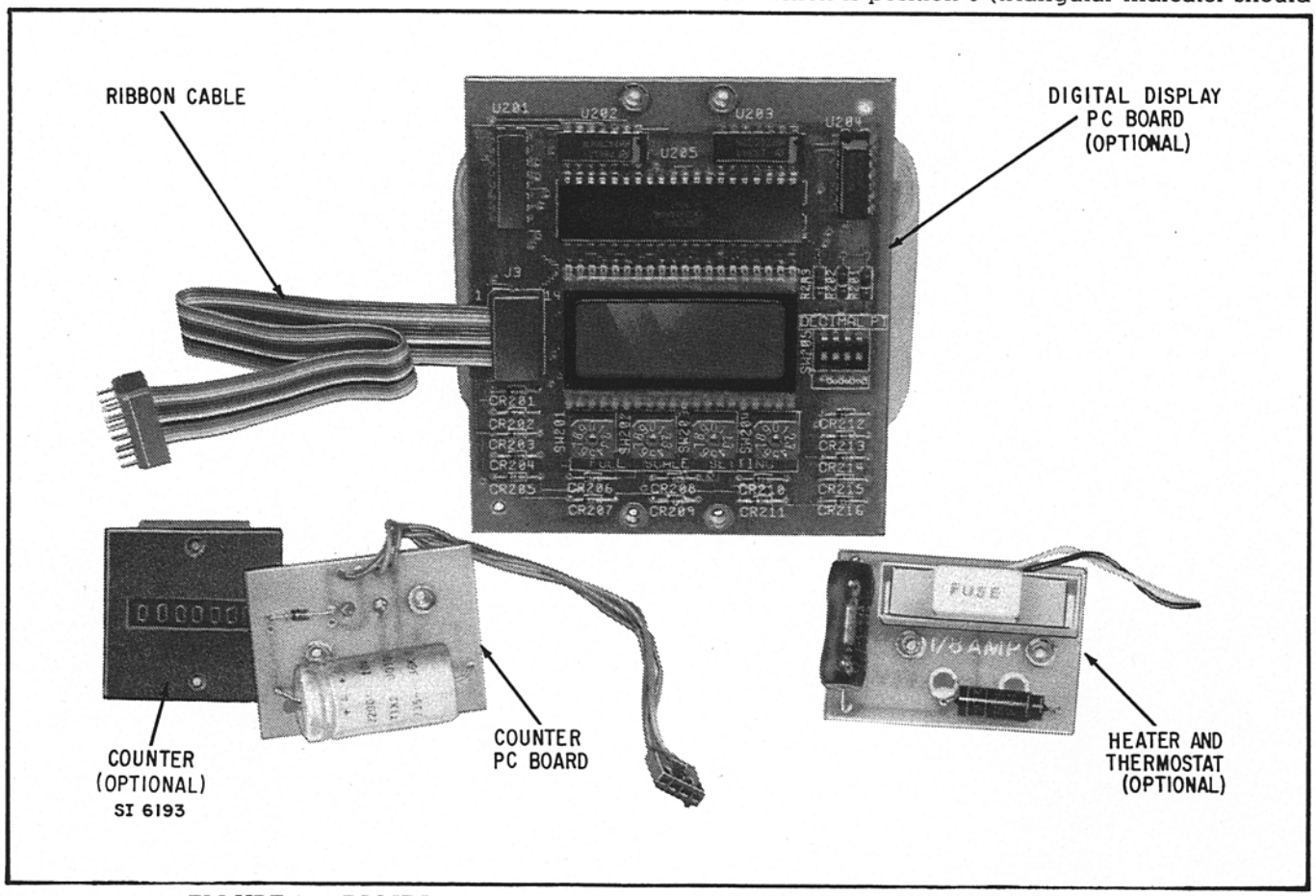


FIGURE 5. DIGITAL DISPLAY BOARD, HEATER/THERMOSTAT & COUNTER (OPTIONAL ACCESSORIES)

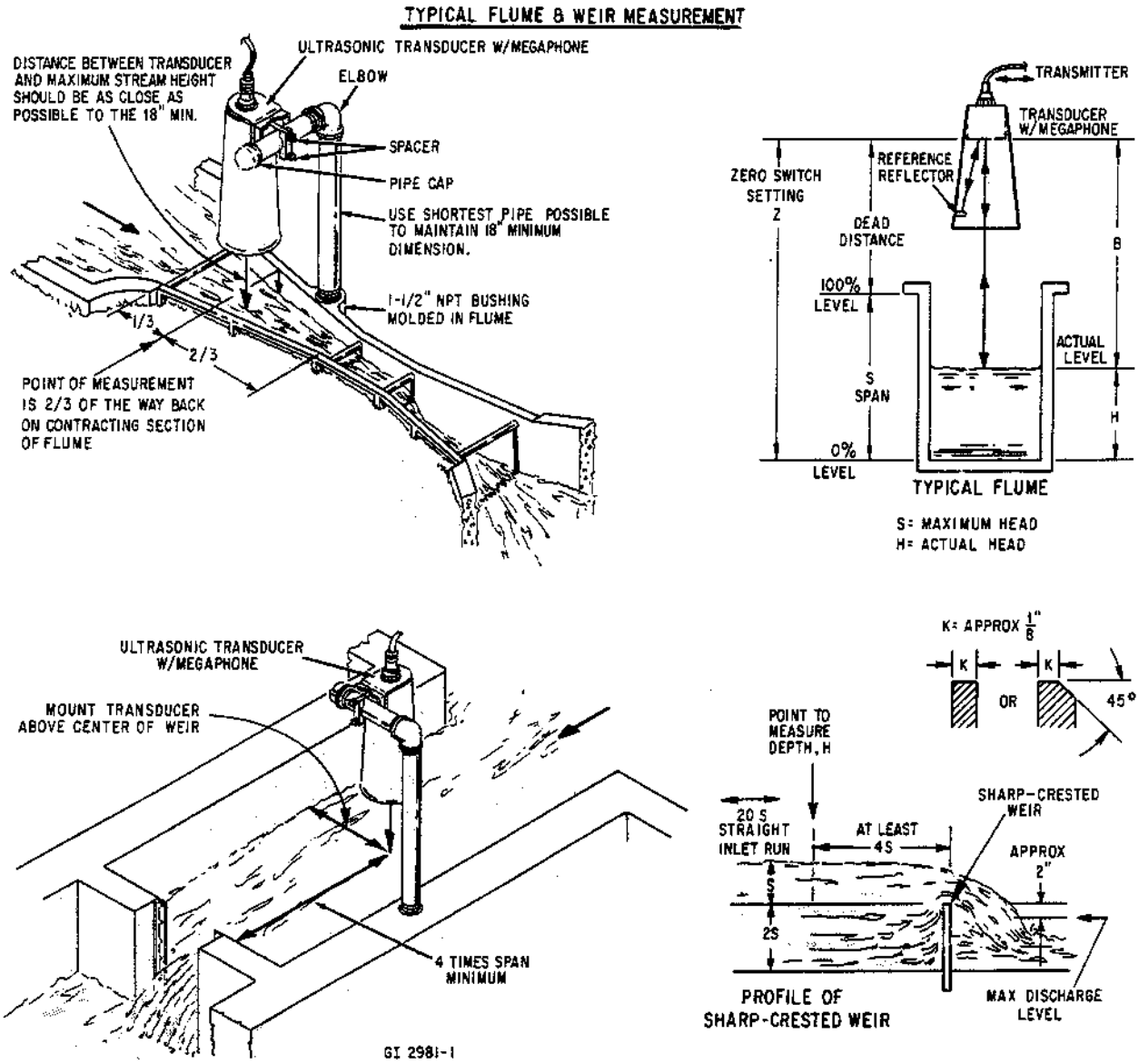


FIGURE 6. TYPICAL TRANSDUCER INSTALLATION FOR FLOW MEASUREMENT.

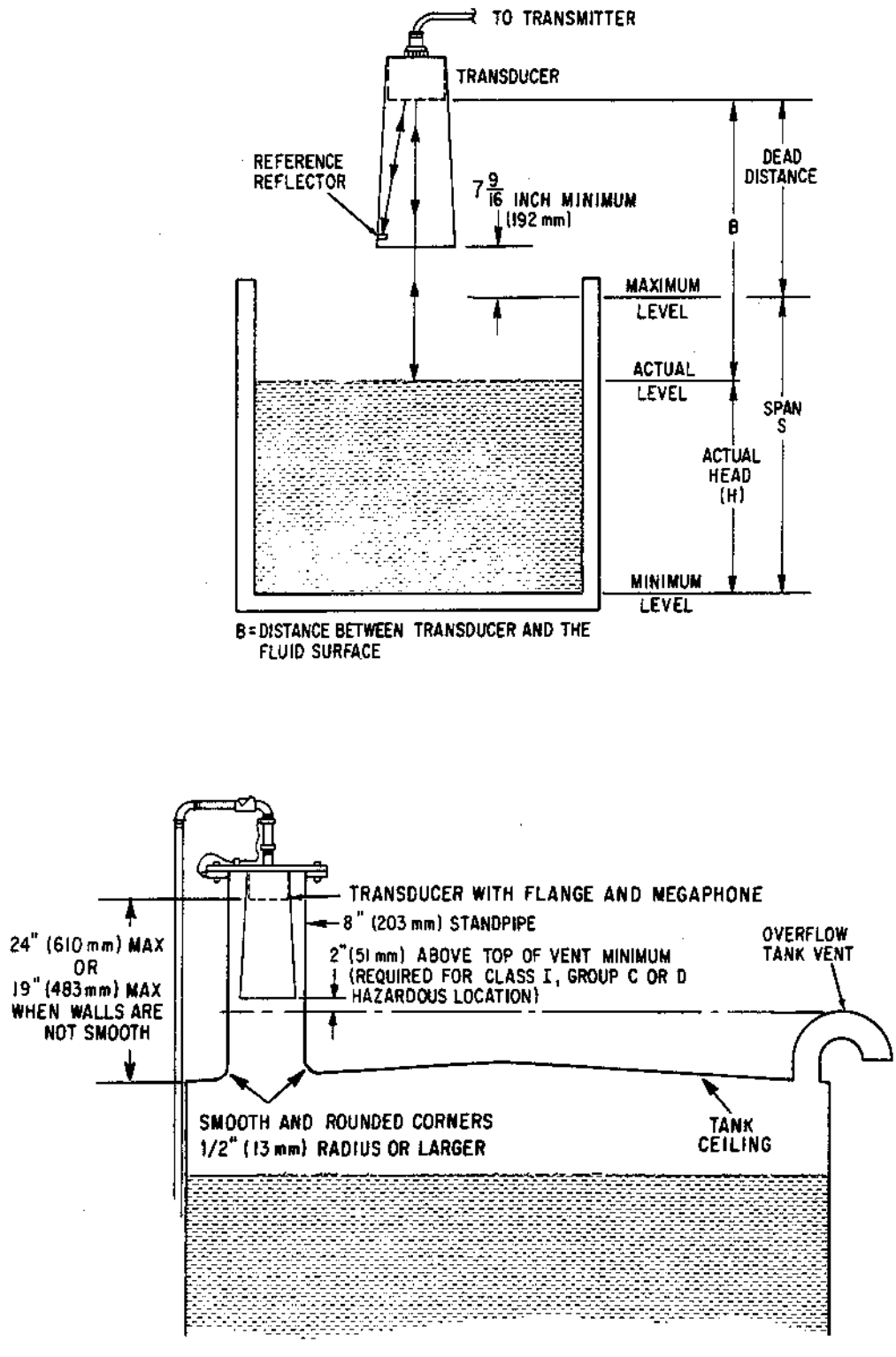


FIGURE 7. TYPICAL TRANSDUCER INSTALLATION FOR LEVEL MEASUREMENT.

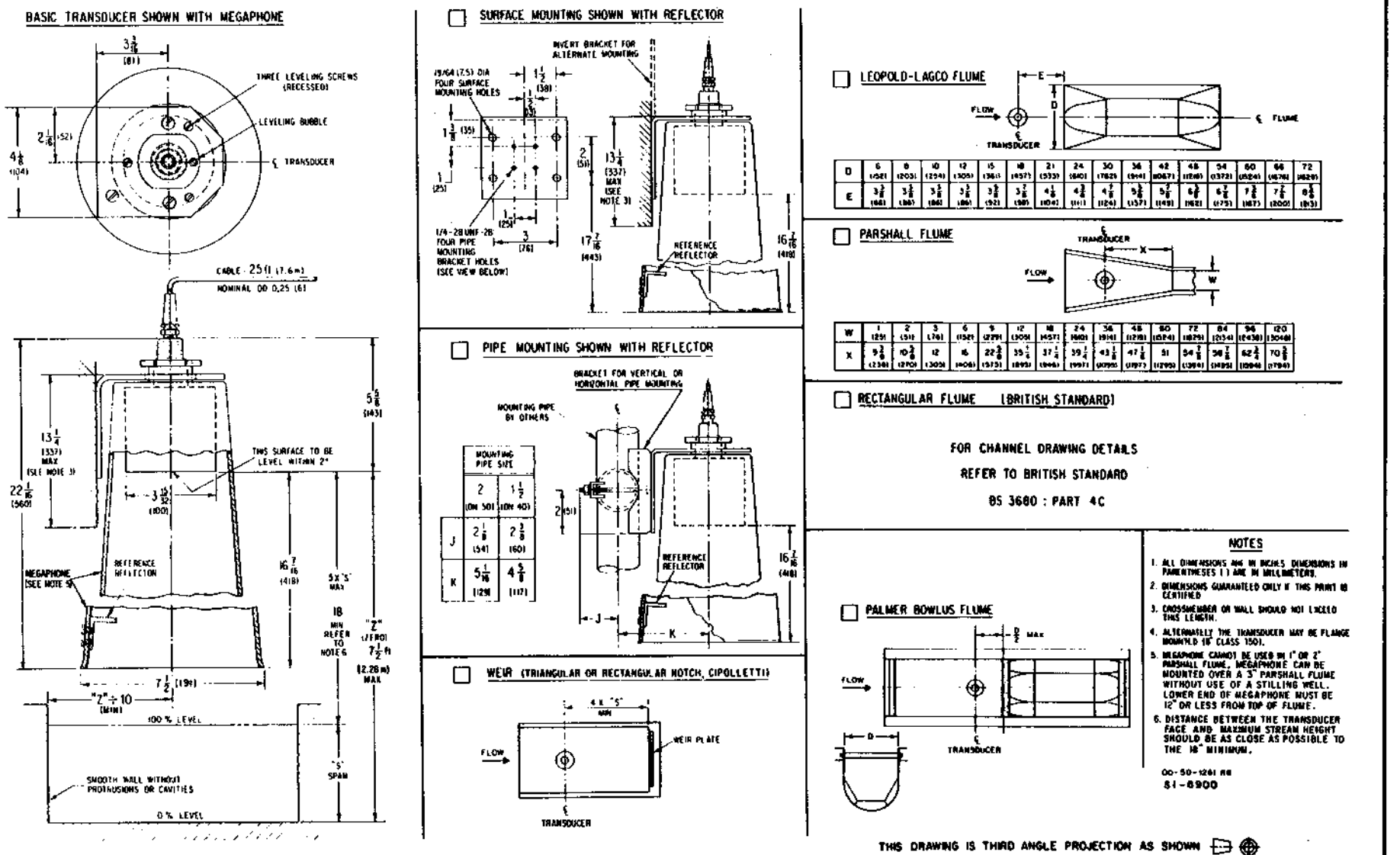


FIGURE 8. OUTLINE AND MOUNTING DIMENSIONS FOR TRANSDUCER IN FLOW APPLICATION.

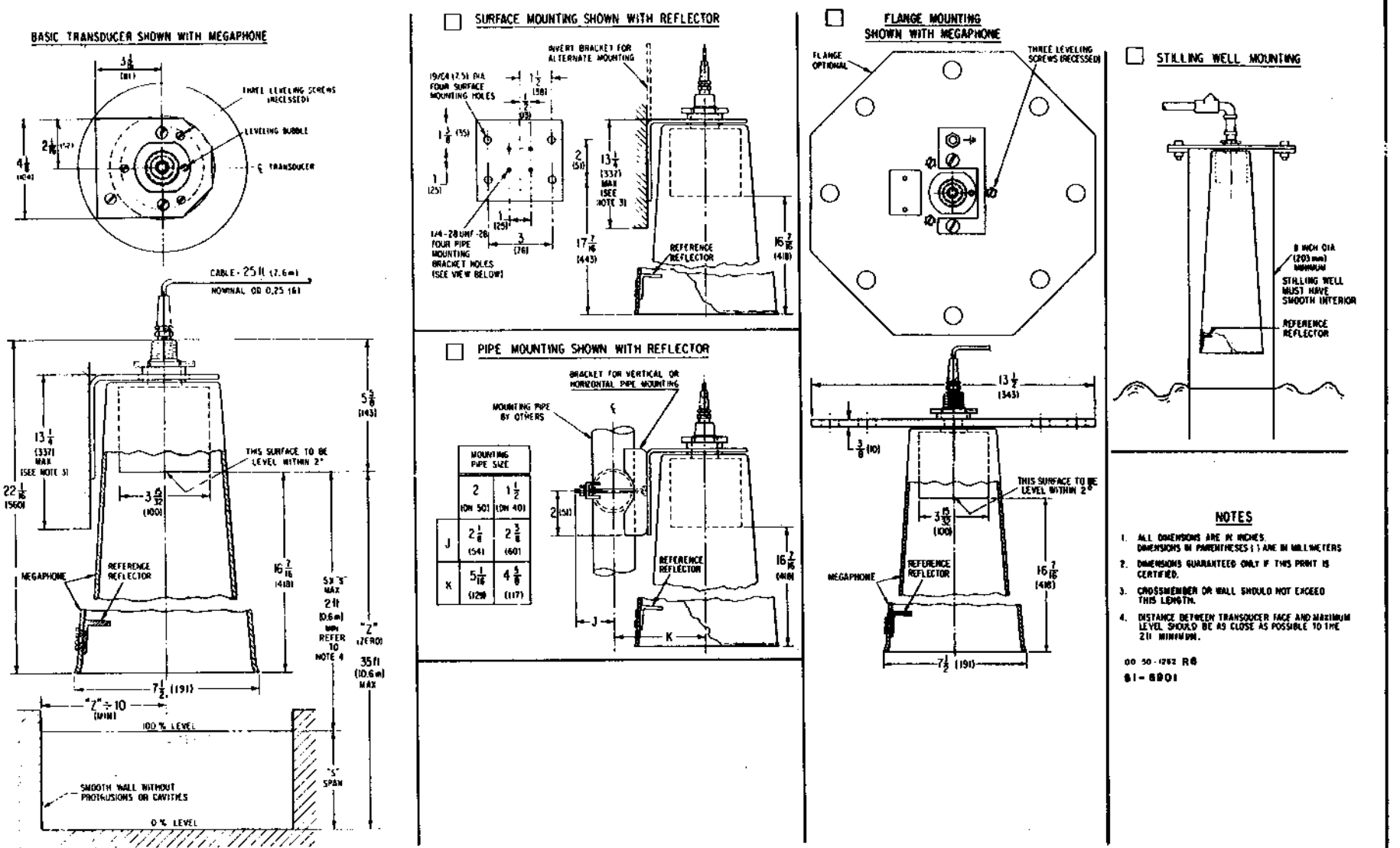


FIGURE 9. OUTLINE AND MOUNTING DIMENSIONS FOR TRANSDUCER IN LEVEL APPLICATION.

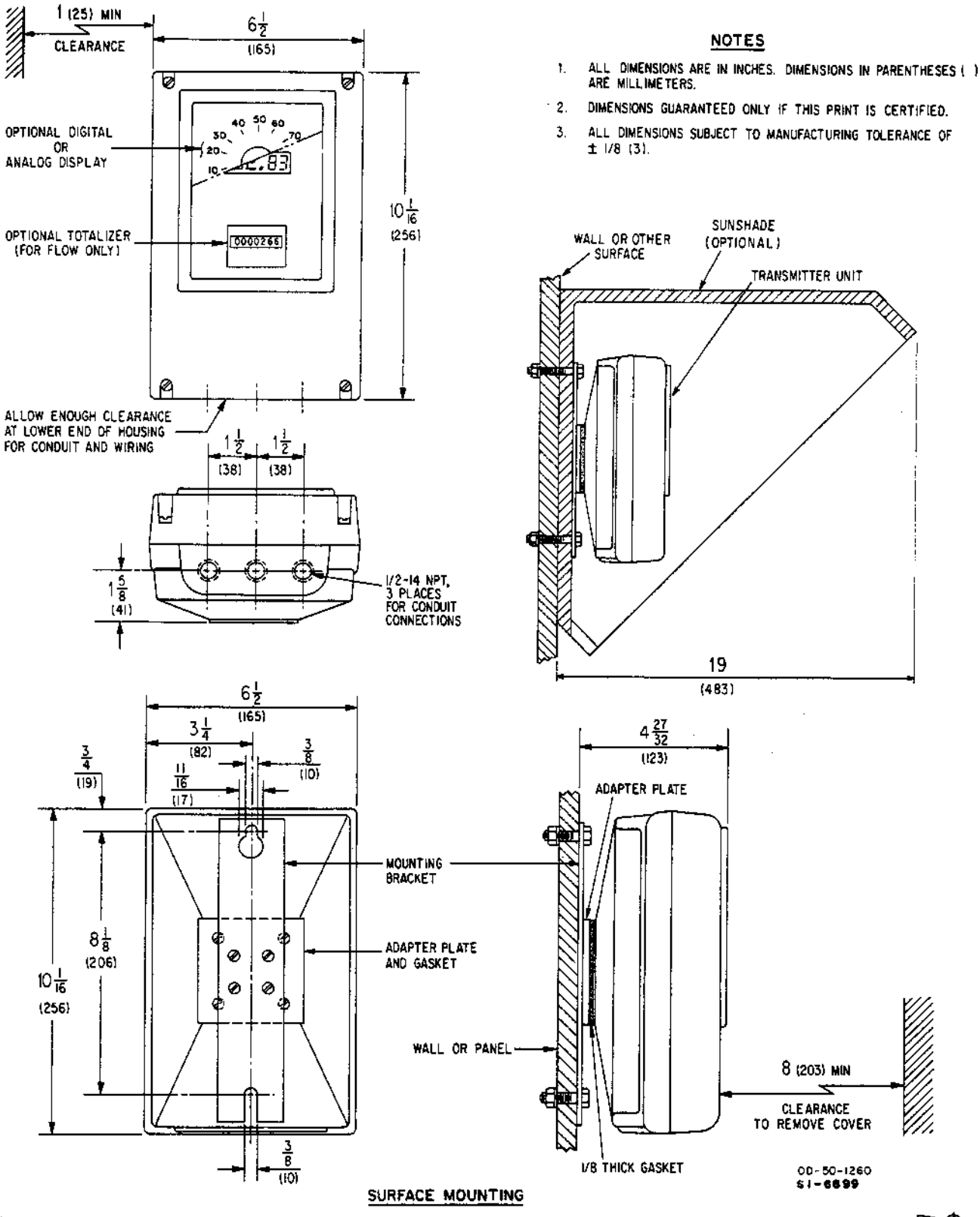
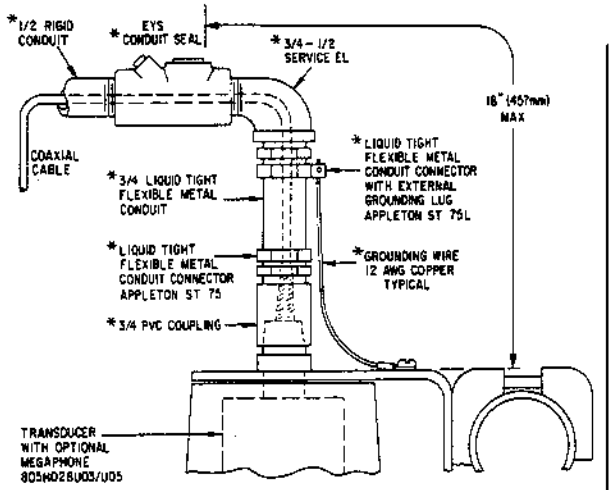
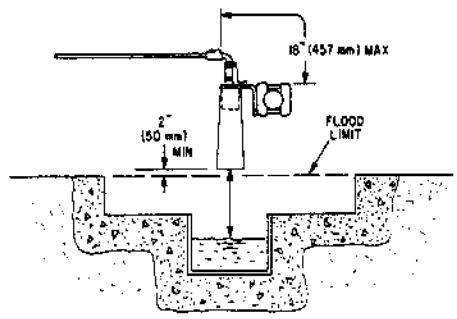


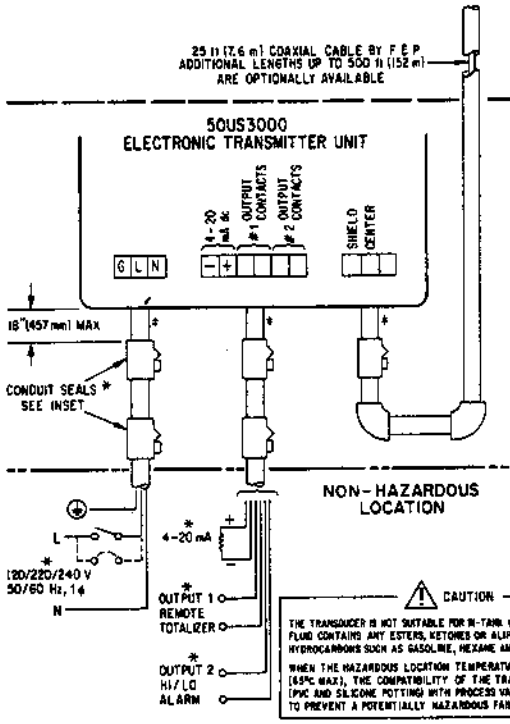
FIGURE 10. OUTLINE AND MOUNTING DIMENSIONS FOR TRANSMITTER UNIT.



DIVISION 1
TRANSDUCER MOUNTING DETAIL REQUIREMENTS



DIVISION 1
OPEN CHANNEL MOUNTING REQUIREMENTS
REFER TO OD-50-1261
FOR FLUME/WIER REQUIREMENTS



- SUITABLE FOR CLASS I, DIV 1, GROUP C & D (EXCEPT ESTERS & KETONES) CLASS II, DIV 1, GROUP E & G, OUTDOOR HAZARDOUS LOCATIONS, NEMA 4
- NONINCENDIVE FOR CLASS I, DIVISION 2, GROUPS A, B, C & D, OUTDOOR HAZARDOUS LOCATIONS, NEMA 4

INSTALLATION REQUIREMENTS

- NON-HAZARDOUS LOCATIONS: WIRING SHALL COMPLY WITH NATIONAL ELECTRICAL CODE AND LOCAL ELECTRICAL CODE REQUIREMENTS.
- HAZARDOUS LOCATIONS: WIRING TO BE IN CONDUIT. BOXES, FITTINGS AND SEALS TO COMPLY WITH ARTICLE 501 OR 502 OF ANSI/NFPA 70 AND LOCAL ELECTRICAL CODE REQUIREMENTS.

* EQUIPMENT NOT BY F & P (%) TO BE IN NON-HAZARDOUS AREA UNLESS APPROVED FOR DIVISION 1 OR 2.

‡ CAUTION: BONDING BETWEEN CONDUIT CONNECTIONS IS NOT AUTOMATIC AND MUST BE PROVIDED AS PART OF THE INSTALLATION.

- ALL EXTERNAL WIRING SUPPLIED BY USER, EXCEPT WHERE NOTED.
- TOTALIZER AND ALARM CONTACTS ARE RATED AT 30 V dc, 0.3 A MAX.
- INDUCTIVE LOADS SUCH AS REMOTE COUNTERS OR RELAYS SHOULD HAVE A COIL SHUNTING DIODE (CATHODE CONNECTED TO "+" SIDE OF COIL).

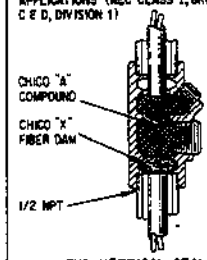
CAUTION

THE TRANSDUCER IS NOT SUITABLE FOR IN-TANK USE WHEN THE PROCESS FLUID CONTAINS ANY ESTERS, KETONES OR ALIPHATIC (STRAIGHT CHAIN) HYDROCARBONS SUCH AS GASOLINE, HEXANE AND FUEL OILS.

WHEN THE HAZARDOUS LOCATION TEMPERATURE EXCEEDS 40°C (65°C MAX), THE COMPATIBILITY OF THE TRANSDUCER MATERIALS (PVC AND SILICONE POTTING) WITH PROCESS VAPORS MUST BE VERIFIED TO PREVENT A POTENTIALLY HAZARDOUS FAILURE.

TYPICAL APPROVED SEAL

CROUSE-HINDS EYS 216 CONDUIT SEAL WITH CHICO "A" SEALING COMPOUND, IS APPROVED FOR EXPLOSION-PROOF APPLICATIONS (NEC CLASS I, GROUPS C & D, DIVISION 1)



EYS VERTICAL SEAL

EYS HORIZONTAL SEAL

INSET
1/2 CONDUIT SEALS TO BE SUPPLIED BY CUSTOMER

FIGURE 11. INTERCONNECTION DIAGRAM FOR FLOW TRANSMITTER.

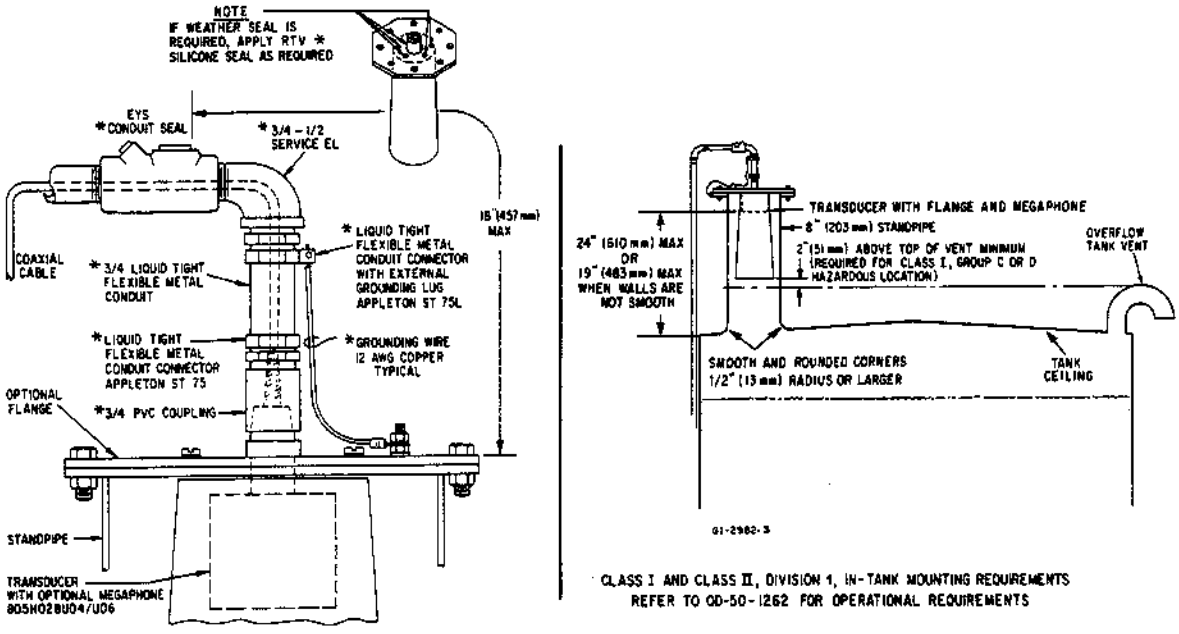


FIGURE 12. INTERCONNECTION DIAGRAM FOR LEVEL TRANSMITTER.

point to 0). All other switch positions except position F of the TEST switch are used for self-diagnostic tests. Position F uses a fixed room temperature reference value, without temperature compensation.

c. Units

Set rocker switch "U" to desired units (in or cm). This setting will determine the distance units for both zero and span (see Figure 13).

Press rocker switch "in" on the end of the switch corresponding to the tag on the instrument, e.g. press the top of the rocker "in" to select inches on the "U" switch or high on alarm switch. Press bottom or rocker "in" to select centimeters on the "U" switch or low on alarm switch.

d. Zero and Span

Set the four decimal rotary ZERO switches to indicate the distance between the face of the Transducer and the channel zero flow level. In a similar manner set the SPAN switches to indicate the distance from the zero level to the maximum level. Note that the ZERO and SPAN switches' decimal point is fixed—(XX.XX) for inch units and (XXX.X) for centimeter units (as selected in step c above).

If the flow device is dry, reset the zero switch setting to obtain a mean zero reading on the digital display. If both a dry zero surface and a maximum level (or a temporary surface at maximum level) can be established, fine adjustments of the zero and span switches can be made to provide the best possible accuracy of the digital display.

e. Flume/Weir Selector Switch

The Flume/Weir Selector switch (Figure 13) permits characterization of the level signal to provide a linear flow signal for the particular flow channel geometry used. The various positions of the Flume/Weir selector switch (except "0", which is linear) select the proper characterization for the different types of flumes and weirs available (See Specifications).

The Flume/Weir switch is a 16-position, miniature rotary switch mounted on the right side of the pc board. The detent positions begin with zero (0) and ascend clockwise to 9 and then use letters A to F.

The decal on the swing-out chassis cover (Figure 2) below the setup switches lists all the standard channel types for flow characterization. Set the FLUME/WEIR switch to the position which corresponds to the particular installation. For example, for a Parshall flume with a 9-inch (23-cm) throat the switch would be set to position 3.

f. Totalizer

The Totalizer switches set the totalizer pulse rate in terms of the desired number of pulses per hour for 100% of flow. For example, assuming a maximum flow of 3 million gallons per day, the flow in gallons per hour will be —

$$\frac{3{,}000{,}000\ g/day}{24\ h/day} = 125{,}000\ g/h$$

Set the TOTALIZER switches to 1250, which will produce one count for every 100 gallons.

NOTE: Internal drop-out is fixed at 2.6%, i.e., no totalizer pulses will be produced below 2.6% of flow.

g. Alarm

Alarm rocker switch #2 is used to select a Hi or Lo alarm condition. Isolated alarm contact #2 will close when the output exceeds 100% if the Hi alarm was selected or when the output drops below 0% if the Lo alarm was selected. The alarm relay contacts remain open at all other times. Note: An alarm hysterisis algorithm designed to prevent alarm "jitters" has been included in the program. (A 10-second alarm switch-over delay is to be expected.)

2. Level Setup Switches (50US3200)

a. Refer to Figures 14 and 15 during the following discussion and proceed as follows.

b. Set the test switch to NORMAL OPERATION which is position 0 (triangular indicator should point to 0). All other switch positions of the TEST switch are used for self-diagnostic tests.

c. Units

Set rocker switch "U" to desired units (ft or m). This setting will determine the distance units for both zero and span, see Figure 14.

Press rocker switch "in" on the end of the switch corresponding to the tag on the instrument, e.g., press the top of the rocker "in" to select feet on the "U" switch or high on alarm switch. Press bottom of rocker "in" to select meters on the "U" switch or low on alarm switch.

d. Zero and Span

Set the four decimal rotary ZERO switches to indicate the distance between the face of the Transducer and the tank zero level. In a similar manner set the SPAN switches to indicate the distance from the zero level to the maximum level. Note that the ZERO and SPAN switches' decimal point is fixed—(XX.XX) for both feet and meter units.

If the tank is empty or the flow device is dry, reset the zero switch setting to obtain a mean zero reading on the digital display.

If both a dry zero surface and a maximum level (or a temporary surface at the maximum level) can be established, fine adjustments of the zero and span

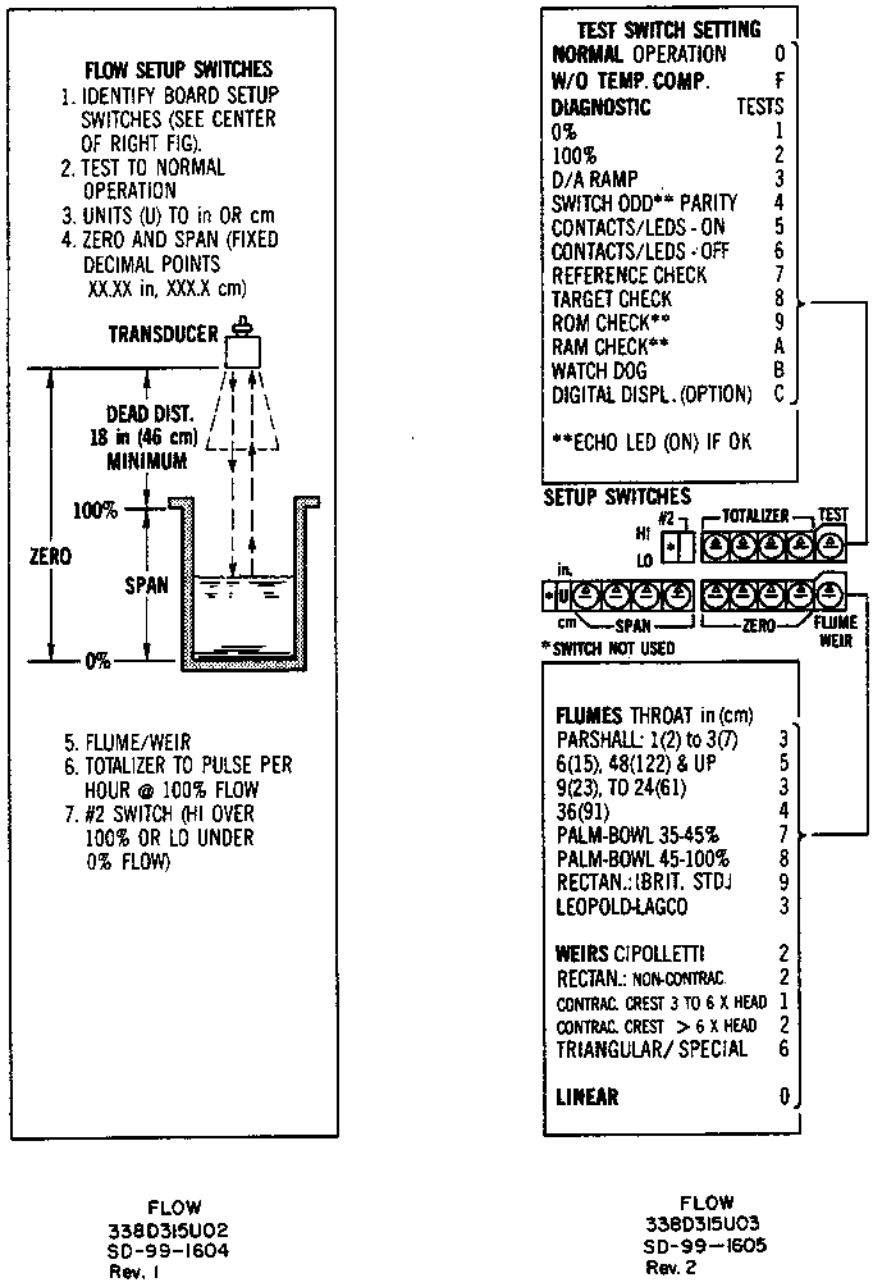
switches can be made to provide the best possible accuracy of the digital display.

e. Tank Type Volume

The decal on the swing-out chassis cover (Figure 14) below the setup switches lists the tank types which are considered to be standard. Set the TANK TYPE switch to the position which corresponds to the type of tank being measured. For example, for a spherical tank the switch would be set to 2.

f. Alarms

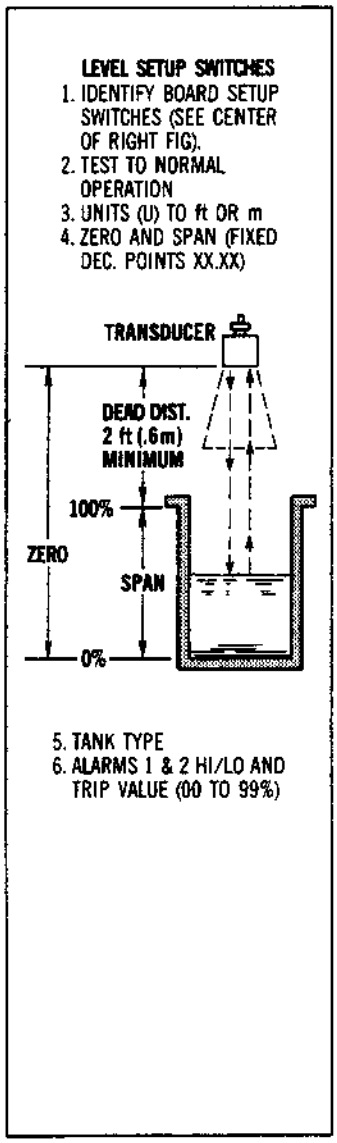
The two isolated alarm contacts of relay #1 and relay #2 can be individually selected for Hi or Lo operation. Each alarm is set by two digital switches for values from 00% to 99%. The alarm contacts will close when the output exceeds the Hi alarm setting or drops below the Lo setting. The alarm contacts remain open at all other times. Note: an alarm hysterisis algorithm designed to prevent alarm "jitter" has been included in the program. (A 10-second alarm switch-over is to be expected.)



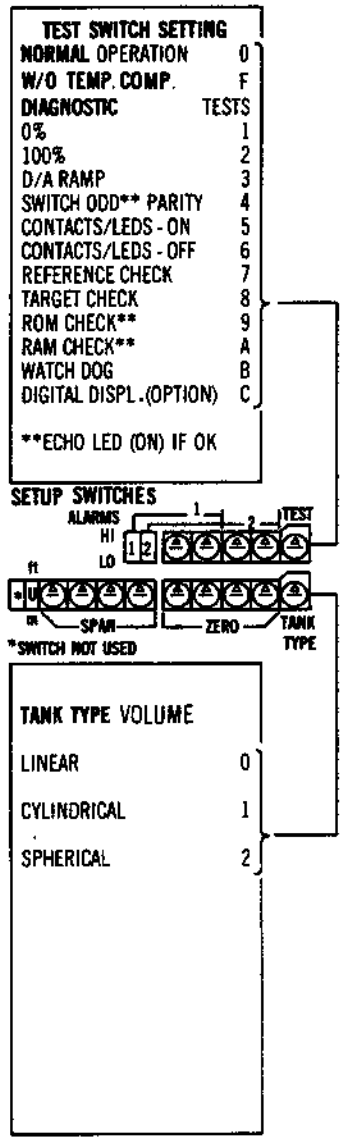
FLOW
338D315U02
SD-99-1604
Rev. 1

FLOW
338D315U03
SD-99-1605
Rev. 2

FIGURE 13. FLOW SETUP SWITCHES.



LEVEL
338D315U04
SD-99-1606
Rev. 1



LEVEL
338D315U05
SD-99-1607
Rev. 2

FIGURE 14. LEVEL SETUP SWITCHES.

TABLE I. FLUME/WEIR CHARACTERIZATION

FLUMES	FLUME SIZE inches (centimeters)	FLUME/WEIR SWITCH POSITION*
Parshall	1(2), 2(5), 3(7) 6(15) 9(23), 12(30), 18(46), 24(61) 36(91) 48(122) & Up	3 5 3 4 5
Palmer-Bowlus	35 - 45% of Flume capacity 45 - 100% of Flume capacity	7 8
Rectangular (British Standard)		9
Leopold-Lagco		3

WEIRS	TYPE	FLUME/WEIR SWITCH POSITION
Cipoletti		2
Rectangular	Non-contracted Fully Contracted, Crest Length 3 to 6 times Maximum Head Fully Contracted, Crest Length 6 or more times Maximum Head	2 1 2
Triangular		6
Linear		0

***NOTE:** Switch positions D & E are intended for future use.

TABLE II. LEVEL CHARACTERIZATION

TANK TYPE (VOLUME)	TYPE POSITION
LINEAR	0
CYLINDRICAL HORIZONTAL WITH FLAT ENDS	1
SPHERICAL	2

NOTE: Switch positions D & E are intended for future use.

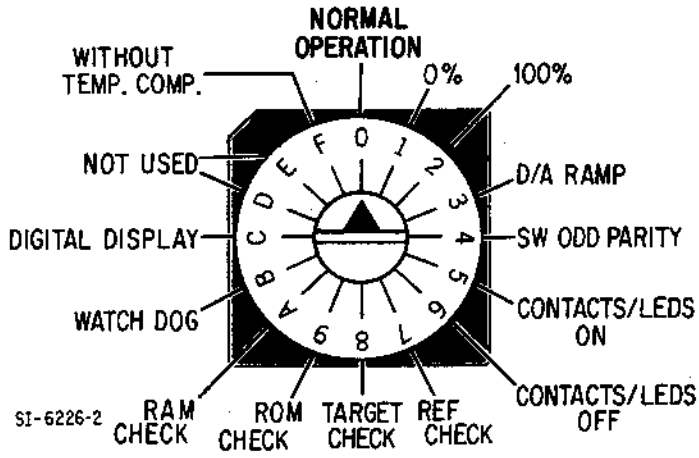


FIGURE 15. TEST SWITCH POSITIONS FOR FLOW/LEVEL METER.

CIRCUIT DESCRIPTION

I. General Discussion

The Ultrasonic Flow/Level Meter is basically an echo ranging instrument consisting of a Transducer, which generates and receives the ultrasonic signal, and a Transmitter Unit that functions to convert the process signal data to analog transmission and display (analog or digital). The Transmitter Unit is controlled by a single chip microcomputer which contains all of the system programs. These programs control instrument operation, computations and diagnostics.

To supplement the following discussion refer to the schematic diagram of the Ultrasonic Flow/Level Meter, Figure 20. The main printed circuit board layout is shown in Figure 18. The schematic diagram for optional units such as heater/thermostat and counter are shown on the main schematic diagram, Figure 20. The Digital Display Board is shown in Figures 17 and 19.

An as aid to understanding the following circuit description refer to the simplified schematic diagram shown in Figure 16. This diagram is broken down to the same functional blocks as the main schematic diagram.

The circuit description covers both the Flow and Level meters unless otherwise noted.

A. Microcomputer

The microcomputer generates the transmit pulses, enables the receiver amplifier, reads the setup switches and provides discrete and analog output drive. It interfaces with other circuits via ports PØ to P3. The 8051 Microcomputer Read Only Memory (ROM) stores all of the operational program constants as well as flow/volume characterization data and the built-in diagnostic routines. Microcomputer internal hardware counters are used to measure echo travel time and control instrument cycle time.

B. Transmitter Unit

The microcomputer provides the transmit drive pulses that are amplified and fed to MOSFETS Q102 and Q103. Each MOSFET receives alternately 3 pulse bursts, each 19 μs wide. This signal is then applied to step-up transformer T2 whose output drives the ultrasonic transducer. The "SYNC" test point is provided for an oscilloscope sync connection. Note that following the pulse burst the Transducer will "ring" for a short period; i.e., drive signal amplitude will decay gradually.

C. Receiver

The received echo is amplified by operational amplifier U102 and AGC (Automatic Gain Control) amplifier U104. AGC Enable input is used to control amplifier gain according to the particular cycle mode (reference and target). Test points ECO, ECO1 and ECO2 are provided for oscilloscope monitoring. The echo amplitude at test point ECO2 should be greater than 1.2 V to be acknowledged. The ringing attenuator Q106 is switched on for a few milliseconds at the beginning of the receive time frame to suppress transducer ringing which could have a greater amplitude than a distant echo signal.

D. Comparator

The comparator uses "zero crossing" circuitry to detect an echo. An input echo amplitude which exceeds the comparator's threshold voltage (1.2 V) will cause the output to swing to +5 V which is divided and fed back as a 1.2 V bias to the comparator input. Thus the input signal has to drop 1.2 V to change the comparator output back to zero. This last transition constitutes a zero crossing which sends an echo interrupt signal to the microcomputer.

E. Analog Output and LED/Relays

The analog output circuit converts the 8-bit digital input data initially into a voltage (0 to 2.55 V) via the D/A converter U113. Operational amplifier U114 translates this voltage into a 0 to 22 mA signal; 0 to 100% yields a 4 to 20 mA range. The use of high precision resistors eliminates the need for any zero-span analog adjustment. Diode CR21 is needed for optional analog display, so that the analog output signal is not affected by the optional analog meter.

Totalizer and Alarm LED/Relays and ECHO LED are driven by corresponding U101 drivers. Totalizer and alarm contact closure is indicated by a corresponding "ON" LED. The ECHO LED blinks when an echo is received.

F. Application Setup Switches

The application setup switches set the operation constants such as zero and span, flow/volume characterization and diagnostic selection. These switches are read, via port PØ, every instrument cycle. Switches S1 to S12 are rotary decimal type. Switches S13 and S14 are rotary hexadecimal (16 position) type. Switches S15 and S16 are rocker switches.

G. Watch Dog

The microcomputer programs periodically reset the watch dog counter so that it does not reach "time-out" (full count). However, if due to some disturbance (such as lightning) the microcomputer gets out of step (computer instructions are no longer executed correctly), then the watch dog circuit will time out and reset the microcomputer. The watch dog circuit also provides the power up reset.

H. Power Supply

The power supply provides four output voltages, −5 V, +5 V, +8 V and +24 V. These voltages can be readily monitored at J4. The primary of transformer T1 is wired to operate at line voltages of 120 or 220

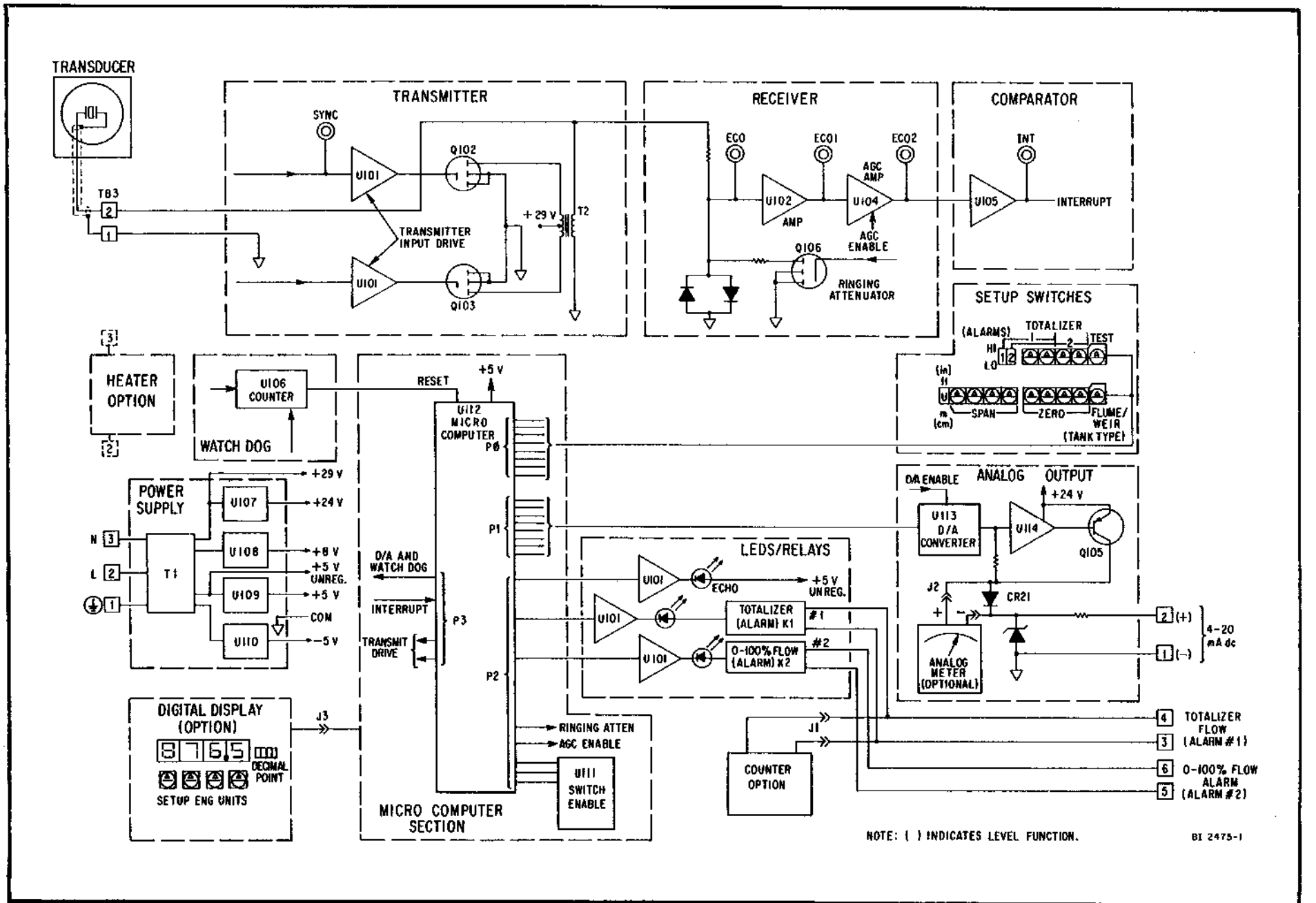


FIGURE 16. SIMPLIFIED SCHEMATIC DIAGRAM, FLOW/LEVEL METER CIRCUIT

or 240 V ac, 50/60 Hz. The instrument name plate indicates the voltage for which the particular unit is suitable.

I. Analog Meter (Optional)

The analog meter (optional), shown inside the output section of the schematic diagram, is connected across diode CR21 via J2. For correct readings a load of 0 to 750 ohms should be connected to output terminals 1 and 2 of TB2. The linear scale meter reads from 0 to 100% of full span.

J. Digital Display (Optional Unit)

This optional readout provides a 4-digit LCD display (with 3-decimal point selection) in any engineering units. Switches S201, S202, S203, S204 and S205 (decimal point) are set for engineering units which correspond to 100% output. A 0% output produces 0000 on the digital display. Values below 0% are displayed as negative 3 digits. A blinking display of 9999 indicates an over-range condition, and −999 indicates an under-range measurement. The digital display pc board is plugged into the main pc board via a ribbon cable and connector J3. The board contains an 8-bit data bus which is connected to port P1 of U112, and a display enable bit connected to port 3 bit 1. The engineering units setup switches are enabled one byte at a time (U111 pins 7 and 9). Switch S205 is a local decimal point selection switch and hence is not read by the microcomputer.

K. Counter (Optional Local Unit, for Flow only)

The counter is a non-resettable 7-digit unit. It utilizes the contacts of relay #1 which are normally used for remote totalizing. NOTE: A local counter eliminates remote totalizing.

L. Heater/Thermostat (Optional Unit)

The Heater/Thermostat unit extends the minimum transmitter ambient temperature limit from −10°C (14°F) to −25°C (−13°F). It consists of a power resistor, line fuse, and thermostat assembly and is shown on the main schematic diagram.

M. Power Supply

Line power is introduced to the Transmitter via terminals L (phase) and N (neutral) of the terminal board. Interconnection wiring routes the ac power to a line fuse (F1) and to the primary winding of transformer T1. The primary winding is tapped to accept line voltages other than 120 V. These taps are selected via copper cuts and jumpers for 220 or 240 V ac line power.

Varistors VR1 and VR2 are connected across the primary windings of transformer T1 to protect the instrument against high voltage transients by clamping the transient voltage to a safe value.

Transformer T1 has three separate secondary windings which are used to provide four (4) regulated dc voltages and two (2) unregulated dc voltages.

The majority of the IC's are powered by the +5 V, −5 V and +8 V regulated dc supply buses. The +24 V dc supply powers the analog output driver stages. The unregulated +29 V dc supply provides power for the ultrasonic driver circuit and the unregulated +5 V powers relays K1 and K2. All dc voltages are referenced to system common (not ground). Voltage test points are identified on the pc board as shown in Figure 18.

MAINTENANCE

I. Service Approach

The Series 50US3000 Ultrasonic Flow/Level Meter does not require any periodic maintenance. However, to ensure proper operation the face of the Transducer as well as the reference reflector (Figure 3) should be kept free of dirt and contamination.

If a problem arises in the field, recommended troubleshooting should be limited to narrowing down the problem to the circuit board or transducer assembly. Once this has been determined the board or transducer can be replaced with a spare unit or the F&P Exchange Policy can be utilized. This will result in minimum down-time and technician labor. A list of assemblies is given on Page 27. Individual components are listed on Page 29.

II. Troubleshooting

A. General

The 50US3000 contains a number of switch-selectable diagnostic routines which will assist in pinpointing the problem. System troubleshooting will consist of isolating the cause of the malfunction to either the Transducer, Transmitter Unit electronics, or interconnecting cables. Test equipment required consists of a multimeter for conventional voltage and resistance analysis; at times an oscilloscope might be helpful. Refer to the Circuit Description section and the applicable schematic diagram to supplement the following troubleshooting procedures. To RESET the instrument turn the power off and back on, or temporarily remove and replace the fuse.

WARNING

The supply voltage and the high voltage ultrasonic drive signal are shock hazards. All standard safety precautions should be observed when servicing this equipment.

The following discussion assumes that all of the Transmitter Unit setup switches such as zero and

span have been preset as outlined in the Operation section of this bulletin. Most test measurements can be made at the Transmitter Unit terminal board or at test points provided on the printed circuit board.

When a malfunction is evident, the recommended initial procedure is to verify that proper ac line power is being received and, if so, that power supply dc output voltages are within normal limits. The instrument power requirements are given on a data tag attached to the Transmitter Unit housing. Procedure for the power supply check is outlined below.

CAUTION

Do not power up unit without microcomputer U112 in place.

B. Power Supply Check

1. Remove the four screws from the corners of the Transmitter Unit cover and remove the cover.

2. Set multimeter to 250 V ac range (typical) and measure ac line power at terminals "L" and "N" of the terminal board. The measured voltage must be compatible with the nominal line power requirements for the particular instrument; i.e., either 120 or 220/240 V ac ±10%, 50 or 60 Hz ±5%. If ac power voltage is correct proceed to step 2.

If nominal ac power is not present check the power line wiring to the instrument. If ac power is in order turn off the power, open the chassis swing-out cover by loosening the two cover locking screws, and check the main board fuse. Replace fuse if blown.

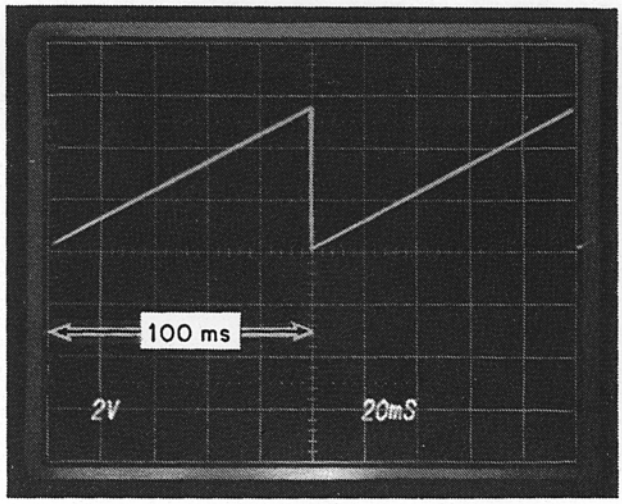
3. When ac power is present at terminals "L" and "N" set multimeter for dc measurement. Power supply voltage test points are identified on the schematic diagram and the pc board as J4. Voltage readings should be within the tolerance of ±5%. All voltage readings are taken with respect to COM of J4.

+24 V dc
+8 V dc
+5 V dc
COM
−5 V dc

C. Built-In Diagnostics

After checking the power supply, the following built-in diagnostic tests are available. Each diagnostic pertains to a specific test that may assist in localizing the problem. The recommended action to be taken as a result of failure of any of the tests is to replace the main pc board. All of the tests are invoked by means of the TEST switch (Figure 15). Output current tests require a load of 0 to 750 ohms across the current output terminals.

TEST SWITCH POSITION	DESIGNATION	REMARKS
0	Normal Operation	
F	w/o Temp. Comp.	
1	0%	4 mA dc Output
2	100%	20 mA dc Output
3		0-22 mA dc Output across 250Ω (saw-tooth wave)



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TEST SWITCH POSITION	DESIGNATION	REMARKS
4	SWITCH ODD PARITY	Check all switches for binary bit parity*
5	CONTACTS/LEDS - ON	All LEDS are turned ON and relay contacts #1 & #2 CLOSED
6	CONTACTS/LEDS - OFF	All LEDS are turned OFF and relay contacts #1 & #2 OPEN
7	REFERENCE CHECK	Instrument in REFERENCE only MODE**
8	TARGET CHECK	Instrument in TARGET only MODE**
9	ROM CHECK	Checks program integrity; ECHO LED will be ON if check is positive.
A	RAM CHECK	Checks Data Memory; ECHO LED will be ON if check is positive.
B	WATCH DOG	ECHO LED will blink if check is positive.
C	DIGITAL DISPLAY	LCD display board switch setting***

*Test Routine counts the total number of switch binary bits that are in the logical "1" state, to establish parity. If the number of bits is ODD, ECHO LED will be ON; if the number of bits is EVEN, ECHO LED will be OFF. For example; given switch positions 1, 2, 4, 7, 8 are counted as ODD, while 0, 3, 5, 6, 9 are EVEN. An individual switch can be checked by observing the ECHO LED while stepping through the switch ODD or EVEN positions. For example, if at a given point ECHO LED is ON and a particular switch is set to 2, then ECHO LED should be OFF in positions 0, 3, 5, 6 & 9 and ON in other switch positions.

**In this mode the instrument cycle does not change and the optional digital display will indicate a quasi hexadecimal value proportional to distance. Hexadecimal numerals above 9 are displayed as:

A = −, B = E, C = H, D = L, E = P, & F = blank.

***Replace Digital Display Board if test is negative (fails).

D. Normal Operation Indicator

In normal operation the ECHO LED (Figure 2) blinks when an echo is received. In addition, a "clicking" sound can be heard near the Transducer. This clicking sound is due to the instrument sampling rates. The short fast rate that lasts for 2 seconds establishes the reference, while the slower rate that is repeated for 10 seconds is used for target level measurement.

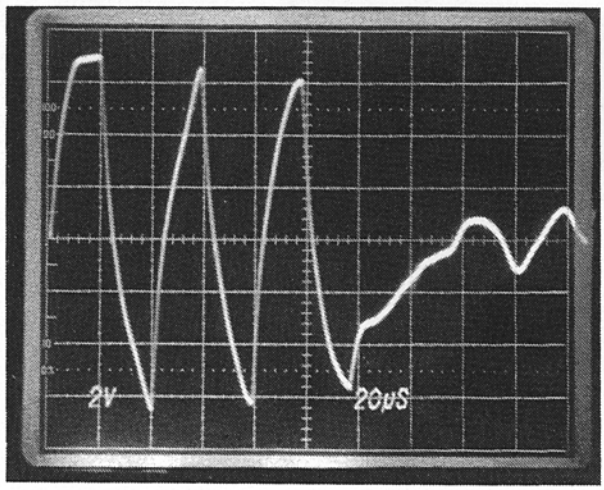
If it is desirable to operate without a reference cycle (fixed refererce) then select switch position "F". Operation with fixed reference has a faster response than the normal mode because it skips the two second reference cycle. Although position "F" will provide accurate operation at 25°C (77°F) it does not compensate for sound velocity variations due to temperature changes.

If the clicking sound can be heard but the ECHO LED is OFF, check for an empty channel or tank, or Transducer aim. (See Installation section.) A flat metal or cardboard plate of approximately 2 × 2 ft. (0.5 × 0.5 m) can be used to simulate level. (NOTE: Plate should be placed within the range of the ZERO and SPAN setting.) If problem is not corrected, i.e., ECHO LED is still OFF, proceed as follows:

a. Connect a spare Transducer directly to the Transmitter Unit (if one is not available, proceed to section b.) Aim the spare Transducer at an ultrasonic reflective surface such as a wall. (NOTE: ZERO and SPAN switch setting should agree with the Transducer-to-target distance.) If ECHO LED blinks, then check installed Transducer wiring. If wiring is in order replace Transducer; otherwise, replace main pc board.

b. If a spare Transducer is not available an oscilloscope can be used in the following manner:

Disconnect the Transducer cable from the Transmitter Unit. Connect two 1/4 W resistors to form a 100-to-1 attenuation circuit (such as 100 kΩ and 1 kΩ). With the power turned off connect the 1 kΩ resistor to the Transducer shield terminal and the 100 kΩ lead to the "center" of the same terminal. Connect the oscilloscope common lead to the shield and the probe to the junction of the 100 kΩ and 1 kΩ resistors. Connect the 'scope external sync terminal to Transmitter Unit pc board SYNC test point. Set Test Switch (Figure 15) to position 8 (Target Check). Now observe the waveform on the 'scope.



If waveform is as shown above and ECHO LED is blinking, replace Transducer. If not, replace main pc board. (See Section 4.)

E. Removal of Main PC Board

a. Turn power switch OFF.

b. Label and disconnect all power line, Transducer and output wires from the terminal block.

c. Remove the chassis from the case by loosening and removing the 4 chassis mounting screws (2 on each side).

d. Disconnect all option cables.

e. Turn chassis over and remove the 4 screws that secure the main pc board.

f. Replace main pc board and assemble units in reverse order.

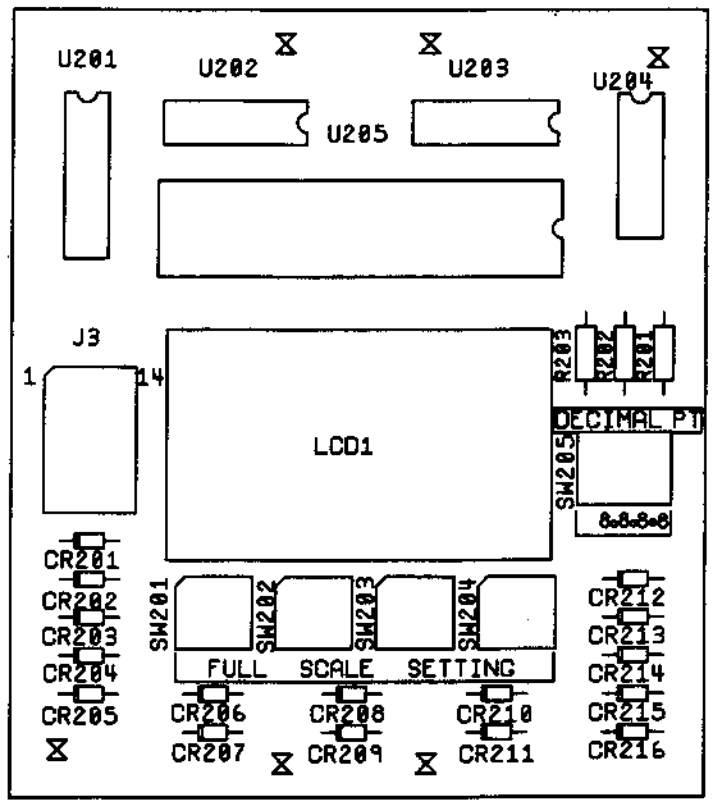


FIGURE 17. DIGITAL DISPLAY PC BOARD LAYOUT DIAGRAM.

J1-COUNTER
J2-ANALOG OUTPUT
J3-DIGITAL DISPLAY
J4-TEST

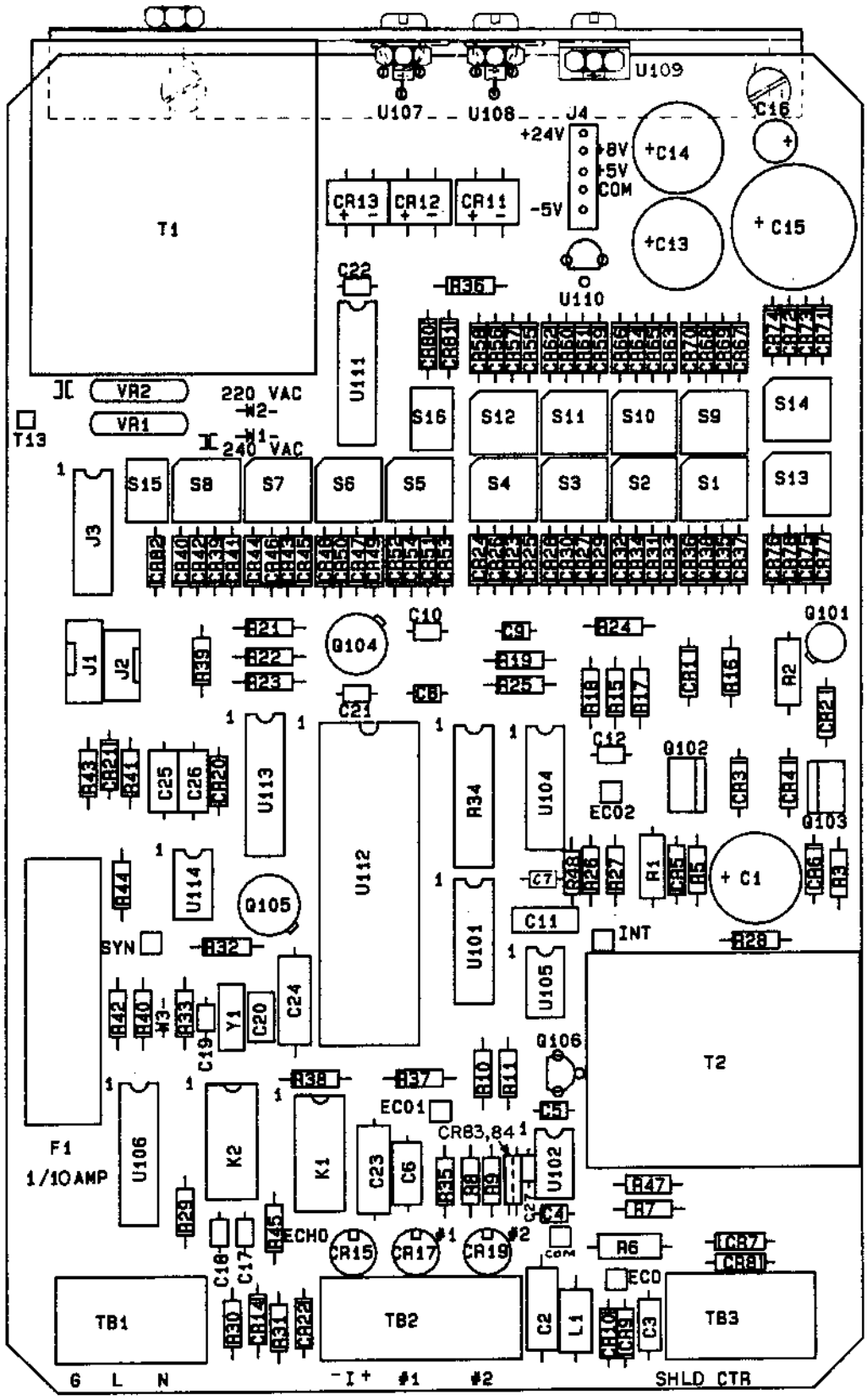


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FIGURE 18. PC BOARD COMPONENT LAYOUT DIAGRAM.

LIST OF PARTS

REPLACEABLE ASSEMBLIES

ASSEMBLY DESCRIPTION		PART NUMBER
MAIN PC BOARD ASSEMBLY (GENERAL *)	LEVEL 120 V	686B522U01
	FLOW 120 V	6868522U02
	FLOW 220 V	6868522U03
	LEVEL 220 V	686B522U04
	FLOW 240 V	686B522U05
	LEVEL 240 V	686B522U06
ANALOG METER ASSEMBLY		624B339U02
DIGITAL DISPLAY ASSEMBLY		624B339U03
COUNTER/TOTALIZER		624B339U04
HEATER/THERMOSTAT		
120 V		624B339U05
220/240 V		624B339U06
SUN SHIELD		123H002U01
TRANSMITTER UNIT		
COVER		641B038U06
Cover Mask (Blank)		332A216U02
Cover Mask (Analog meter with counter)		332A216U03
Cover Mask (Analog meter without counter)		332A216U04
Cover Mask (Digital readout with counter)		332A216U05
Cover Mask (Digital readout without counter)		332A216U06
Cover Mask (with register)		332A216U07
COVER GASKET ("O" RING)		101A702U01
TRANSDUCER ASSEMBLIES		
Pipe Mounted with Megaphone		805H028U03
Flange Mounted with Megaphone		805H028U04
Pipe Mounted without Megaphone		805H028U05
Flange Mounted without Megaphone		805H028U06
CABLE EXTENSION		
Furnished with Transducer		7.6 m (25 ft)
Additional Length up to 150 m (500 ft)		614B713U01,
available in Kit Form		173C103U03
(Specify Length Required)		
PIPE MOUNTING KIT		623A258U06
TRANSDUCER MOUNTING ASSEMBLY		BM-50-1068
Uses 1-1/2" NPT Socket for Warminster Fiberglass		
Flumes Only (Parshall or Palmer-Bowlus)		630B076U01

*Can be used as a spare for all U01 to U06. See Table below.

MAIN PC BOARDS 6868522U01 to U06 are derived from 686B522U01 by means of jumpers & copper cuts. Refer to Figures 18 & 20.

	JUMPERS			
	W-1*	W-2*	W-3	MAIN PC BOARD
LEVEL 120 V	OUT	OUT	IN	686B522U01
FLOW 120 V	OUT	OUT	OUT	686B522U02
FLOW 220 V	OUT	IN	OUT	686B522U03
LEVEL 220 V	OUT	IN	IN	686B522U04
FLOW 240 V	IN	OUT	OUT	686B522U05
LEVEL 240 V	IN	OUT	IN	686B522U06

*Jumpers W-1 & W-2 also need 2 copper cuts.
See Figure 20, Power Input section.

ULTRASONIC FLOW/LEVEL TRANSMITTER

DIGITAL DISPLAY BOARD - 624B339U03

SYMBOL	DESCRIPTION	PART NUMBER
CR201-216	DIODE, Type 1N4151	166B112U15
J3	CABLE ASSEMBLY	172M072U01
LCD1	DISPLAY, 4-digit	177A101U01
R201-203	RESISTOR, Metal Film: 100 kΩ, 1/4 W	161K231U01
U201	RESISTOR PACK, 47 kΩ	161W011U01
SW201-204	SWITCH, 10 position	154G150U01
SW205	SWITCH, 4 position	154B078U04
U202,U204	INTEGRATED CIRCUIT, Type 74C02	177B077U50
U203	INTEGRATED CIRCUIT, Type 74C906	177B077U52
U205	INTEGRATED CIRCUIT, LCD Driver, Type 7211AN	177B045U09

LIST OF REPLACEABLE PARTS

50US3000 ULTRASONIC LEVEL METER
MAIN BOARD — 686B522U01

SYMBOL	DESCRIPTION	PART NUMBER
C1,13	CAPACITOR, 220 µF, 50 V	160A041U04
C2	CAPACITOR, 0.0039 µF, 100 V	160H482U05
C3	CAPACITOR, 0.001 µF, 200 V	160H483U05
C4,5,9,10,12, 21,22,26	CAPACITOR, 0.1 µF, 50 V	160C061U01
C6,25	CAPACITOR, 0.01 µF, 80 V	160H485U09
C7,8	CAPACITOR, 0.0027 µF, 100 V	160C061U05
C11	CAPACITOR, 0.56 µF, 50 V	160C058U05
C14	CAPACITOR, 470 µF, 35 V	160A044U02
C15	CAPACITOR, 2200 µF, 16 V	160A039U01
C16	CAPACITOR, 33 µF, 16 V	160A039U04
C17,18	CAPACITOR, 220 pF, 100 V	160C061U03
C19	CAPACITOR, 10 pF, 100 V	160C061U02
C20	CAPACITOR, 5 pF, 500 V	160G074U04
C23,24	CAPACITOR, 0.001 µF, 600 V	160B607U01
C27	CAPACITOR, 330 pF, 100 V	160C061U04
CR1,2,9,10,14, 21,23-78,80-84	DIODE, Type 1N4151	166B112U15
CR3,4	DIODE, Type 1N4744A	166B113U17
CR5,6	DIODE, Type 1N4759A	166B113U32
CR7,8	DIODE, Type 1N4002	166B136U01
CR11,12,13	DIODE, Type FWB	166E017U01
CR15,17,19	DIODE, Type LED	166F002U01
CR20	DIODE, Type 1N5231B	166B146U09
CR22	DIODE, Type 1N5357B	166B121U25
F1	FUSE, 1/10 A Slo-Blo	151A017U01
F1	FUSE, Clips	151F021U01
F1	FUSE, Extractor	353C875U02
F1	FUSE, Shield	351C167U01
F1	FUSE, 1/16 A (220/240 V)	151A017U01
J1	CONNECTOR, 4 pin	172F375U02
J2	CONNECTOR, 3 pin	172F375U01
K1,K2	RELAY	163L014U01
L1	INDUCTOR	164E092U01
Q101	TRANSISTOR, Type 2N2222	156B127U08
Q102,103	TRANSISTOR, Type IRF 542	156B171U04
Q104,105	TRANSISTOR, Type 2N2905	156B126U06
Q106	TRANSISTOR, Type VN0104N3	156B188U01
R1,2	RESISTOR, Metal Film: 332 Ω, 1%, 1/2 W	161T013U51
R3,10,32,36	RESISTOR, Metal Film: 1000 Ω, 1%, 1/4 W	161T021U01
R5,43	RESISTOR, Metal Film: 100 Ω, 1%, 1/4 W	161T020U01
R6,47	RESISTOR, Metal Film: 4640 Ω, 1%, 1/2 W	161T014U65
R7,9	RESISTOR, Metal Film: 22.1 kΩ, 1%, 1/4 W	161T022U34
R8	RESISTOR, Metal Film: 249 Ω, 1%, 1/4 W	161T020U39
R11	RESISTOR, Metal Film: 200 kΩ, 1%, 1/4 W	161T023U30
R15,21	RESISTOR, Metal Film: 6.81 kΩ, 1%, 1/4 W	161T021U81
R16	RESISTOR, Metal Film: 1500 Ω, 1%, 1/4 W	161T021U18
R17,19,23,24, 26,33	RESISTOR, Metal Film: 10 kΩ, 1%, 1/4 W	161T022U01
R18,22	RESISTOR, Metal Film: 2210 Ω, 1%, 1/4 W	161T021U34
R25	RESISTOR, Metal Film: 33.2 kΩ, 1%, 1/4 W	161T022U51
R27	RESISTOR, Metal Film: 19.1 kΩ, 1%, 1/4 W	161T022U28
R28	RESISTOR, Metal Film: 15 kΩ, 1%, 1/4 W	161T022U18
R29	RESISTOR, Metal Film: 51.1 kΩ, 1%, 1/4 W	161T022U69
R30	RESISTOR, Metal Film: 562 kΩ, 1%, 1/4 W	161T023U73
R31	**RESISTOR, Metal Film: 100 kΩ, 1%, 1/4 W**	**161T023U01**
R34	RESISTOR PACK, 47 kΩ	161W011U01
R35	RESISTOR, Metal Film: 392 Ω, 1%, 1/4 W	161T020U58
R37,38	RESISTOR, Metal Film: 681 Ω, 1%, 1/4 W	161T020U81
R39,40	RESISTOR, Metal Film: 29.375 kΩ, .05%, 1/8 W	161T094U02
R41,42	RESISTOR, Metal Film: 24.9 kΩ, .05%, 1/8 W	161T094U03
R44	RESISTOR, Metal Film: 100 Ω, .05%, 1/8 W	161T094U01
R45	RESISTOR, Carbon Comp: 10 Ω, 1%, 1/4 W	161T019U01
R48*	RESISTOR, Carbon Comp: 39M Ω, 5% 1/4W	161K236U15

* Factory selected, may vary with date code of U104. e.g., 39MΩ for date code 8545.

50US3000 ULTRASONIC LEVEL METER
MAIN BOARD

SYMBOL	DESCRIPTION	PART NUMBER
S1-12	SWITCH, 10 position	154G150U01
S13,14	SWITCH, 16 position	154G150U02
S15,16	SWITCH, 2 position	154B076U08
T1	TRANSFORMER, Power	380E165U01
T2	TRANSFORMER, High Voltage	380E166U01
TB1,3	TERMINAL STRIP, 3 point	171C145U01
TB2	TERMINAL STRIP, 6 point	171C013U06
U101	INTEGRATED CIRCUIT, Type 7407	177B302U01
U102,114	INTEGRATED CIRCUIT, Type CA3140AE	177B445U01
U104	INTEGRATED CIRCUIT, Type MC1352	177B033U01
U105	INTEGRATED CIRCUIT, Type LM311	177B079U01
U106	INTEGRATED CIRCUIT, Type 4060	177B021U08
U107	INTEGRATED CIRCUIT, Type MA78L24	177B431U04
U108	INTEGRATED CIRCUIT, Type MC78L09ACP	177B431U05
U109	INTEGRATED CIRCUIT, Type LM341P-5	177B428U02
U110	INTEGRATED CIRCUIT, Type LM79L05	177B443U02
U111	INTEGRATED CIRCUIT, Type 74LS259	177B300U58
U112	INTEGRATED CIRCUIT, Type 8051 (8751)	699B204U01
U113	INTEGRATED CIRCUIT, Type AD558	177B405U01
VR1,2	VARISTOR, Type 130AL10	161V001U01
W3	JUMPER WIRE, 1" Long	173B066U10
Y1	CRYSTAL, 12 MHz	166D003U07

CHASSIS ASSEMBLY — 624B339U01

PART DESCRIPITON	PART NUMBER
CHASSIS ASSEMBLY	612B366U02
CHASSIS ASSEMBLY COVER	612B186U02
HINGE PIN	398B231T10
RETAINING RING	106A104U01

ANALOG METER ASSEMBLY (4-20 mA) — 624B339U02

PART DESCRIPITON	PART NUMBER
METER	692B028U01
CONNECTOR, 3 POSITION	172F380U01
CONTACT	170D030U01
#4-40 Hex Nut	080F200T10
#4-40 Lockwasher	085D004T10

HEATER & THERMOSTAT — 120 V — 624B339U05

SYMBOL	DESCRIPTION	PART NUMBER
------	HEATER ASSEMBLY	686B520U02
F201	FUSE: 1/8 A	151A007U01
R201	HEATER: 2 k , 8 W, 120 V	161S088U07
S201	THERMOSTAT	157B029U01

HEATER & THERMOSTAT — 220/240 V — 624B339U06

SYMBOL	DESCRIPTION	PART NUMBER
------	HEATER ASSEMBLY	686B520U03
F201	FUSE: 1/16 A	151B021U01
R201	HEATER: 8 k , 8 W, 220/240 V	161S088U18
S201	THERMOSTAT	154L002U01

COUNTER BOARD ASSEMBLY — 624B339U04

SYMBOL	DESCRIPTION	PART NUMBER
------	COUNTER	665B025U02
	PC BOARD	686B520U01

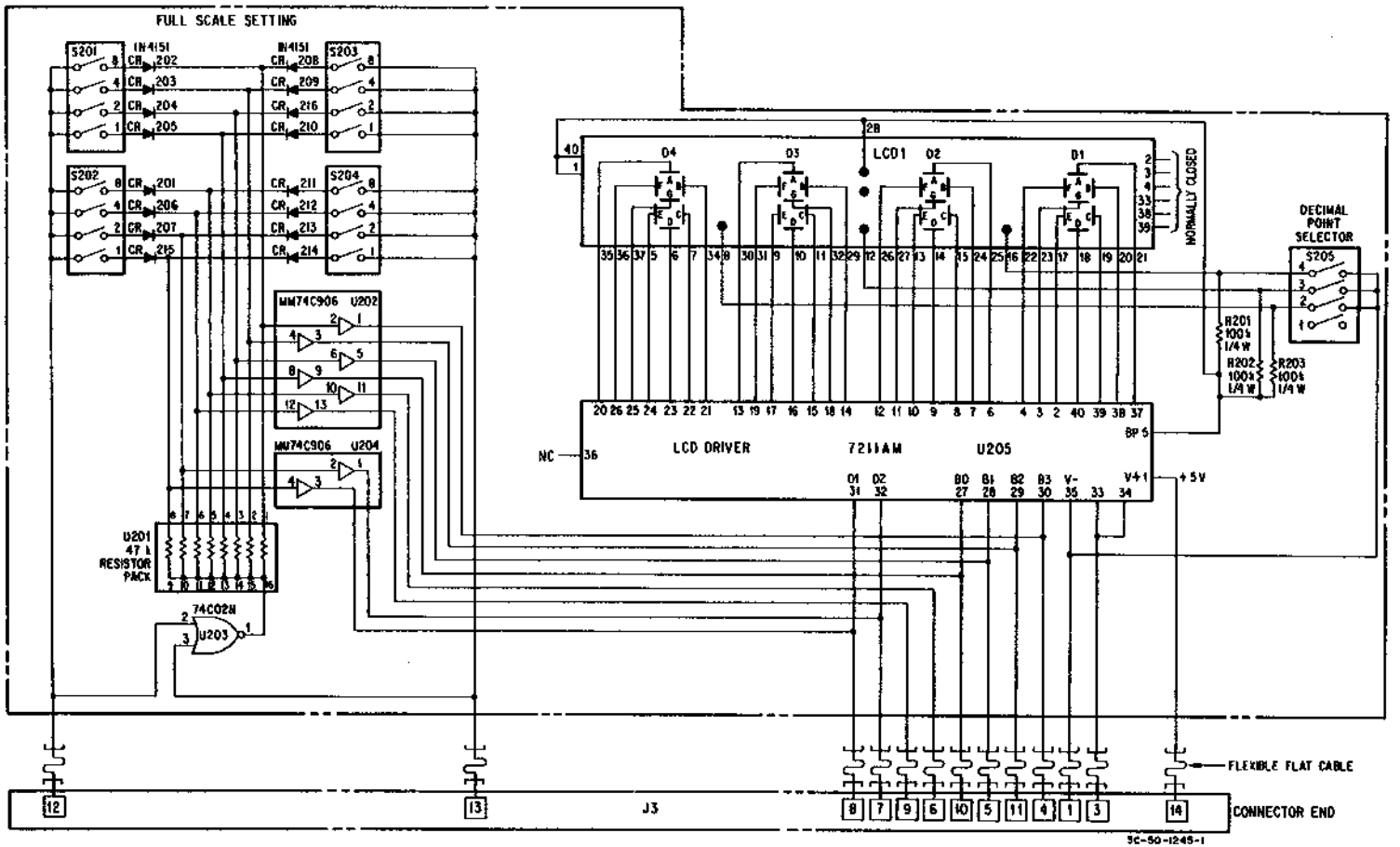


FIGURE 19. DIGITAL DISPLAY BOARD SCHEMATIC DIAGRAM.

SECTION II
Model 50US3148B Ultrasonic Flow Recorder

I. Description

The F&P Model 50US3148 is an ultrasonic (U/S) open channel flowmeter, recorder and totalizer which consists of the following subassemblies:

- U/S flowmeter
- Single pen recorder with indicator and totalizer

The subassemblies are contained within a large-case circular chart recorder.

User's Manual Model 1392 describes the recorder while U/S flowmeter and digital display information is provided in Section I of this bulletin.

II. Specifications

Performance Characteristics

Power Requirements ..... 108 to 125 Vac, 60 Hz; 150 VA max consumption with heater

Accuracy

•Flow Meter ..... Varies with span and flume/weir selection. Those listed include head measurement and characterization.

Span (in)	Span (cm)	Triangular Weir	All Others
4	10.2	±2.0% of span	±1.0% of span
8	20.3	±1.3% of span	±0.8% of span
12	30.5	±1.2% of span	±0.7% of span
72	182.9	±1.1% of span	±0.6% of span

Zero-Span Switch Setting Resolution

•Flow Meter ..... 0.01 in or 0.1 cm

Alarm Relay Contact ..... Switch selectable for either "low" (0%) or "high" (100%) of flow. Contact closure 30 V dc, 0.3 A max.

Circular Chart Recorder

Chart Drive** ..... 7 day/revolution, 120 V, 60 HZ
Circular Chart ..... 7 day, Linear Scale.
Pen ..... Blue

Display (in addition to chart)

Counter and digital indicator ... Vacuum florescent display

Class

Transducer and recorder ..... Indoors or outdoors, weather and rust resistant NEMA 4 (IEC 529 IP65).

Temperature Limits

Transducer ..... -30 to +65°C (-22 to +150°F)
Recorder ..... -25 to +52°C (-13 to +125°F)*
Recorder with heater and thermostat ..... To -25°C (-32°F)

Shipping Information Including Transducer

Weight ..... 33 lb (15 kg)
Cubage ..... 3.0 ft³ (.09 m³)

INSTALLATION

Mounting and mechanical cutout information is provided in User's Manual Model 1392. Refer to Figure B, in Section II of this bulletin, for wiring diagrams of electrical interconnections. Transducer wiring is discussed in Section I, under subsection IV, Electrical Interconnections.

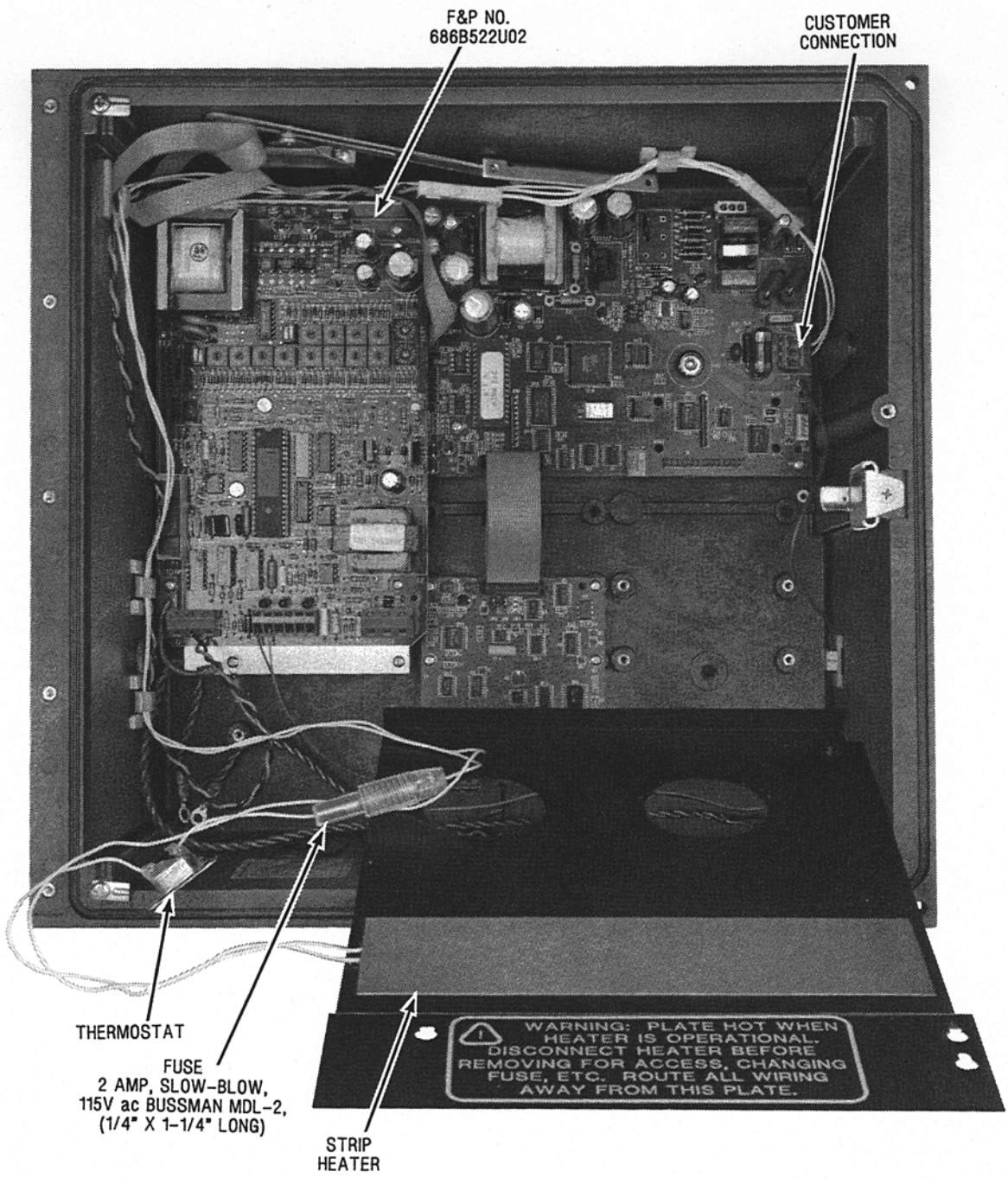
Power connections for the Flow Recorder are shown in Figures A & B of this section.

Initial setup of the flow recorder is expalined in Section I under subparagraph II. Initial Setup. Figures 13 & 14 are illustrations of decals which provide quick reference for the setup switches. These decals are affixed to the front of the removeable chart plate.

Operation procedures for the Circular Chart Recorder are provided in User's Manual Model 1392.

** Other chart speeds available through on-site configuration.

* If unit is mounted in direct sunlight, it is mandatory that the optional sunshade be used to keep the temperature in the case from exceeding the maximum allowable limit.



PART NO. LA203434 INCLUDES STRIP HEATER, THERMOSTAT AND FUSE. SI-7329

FIGURE A. ULTRASONIC FLOW RECORDER, DOOR OPEN & CHART PLATE REMOVED.

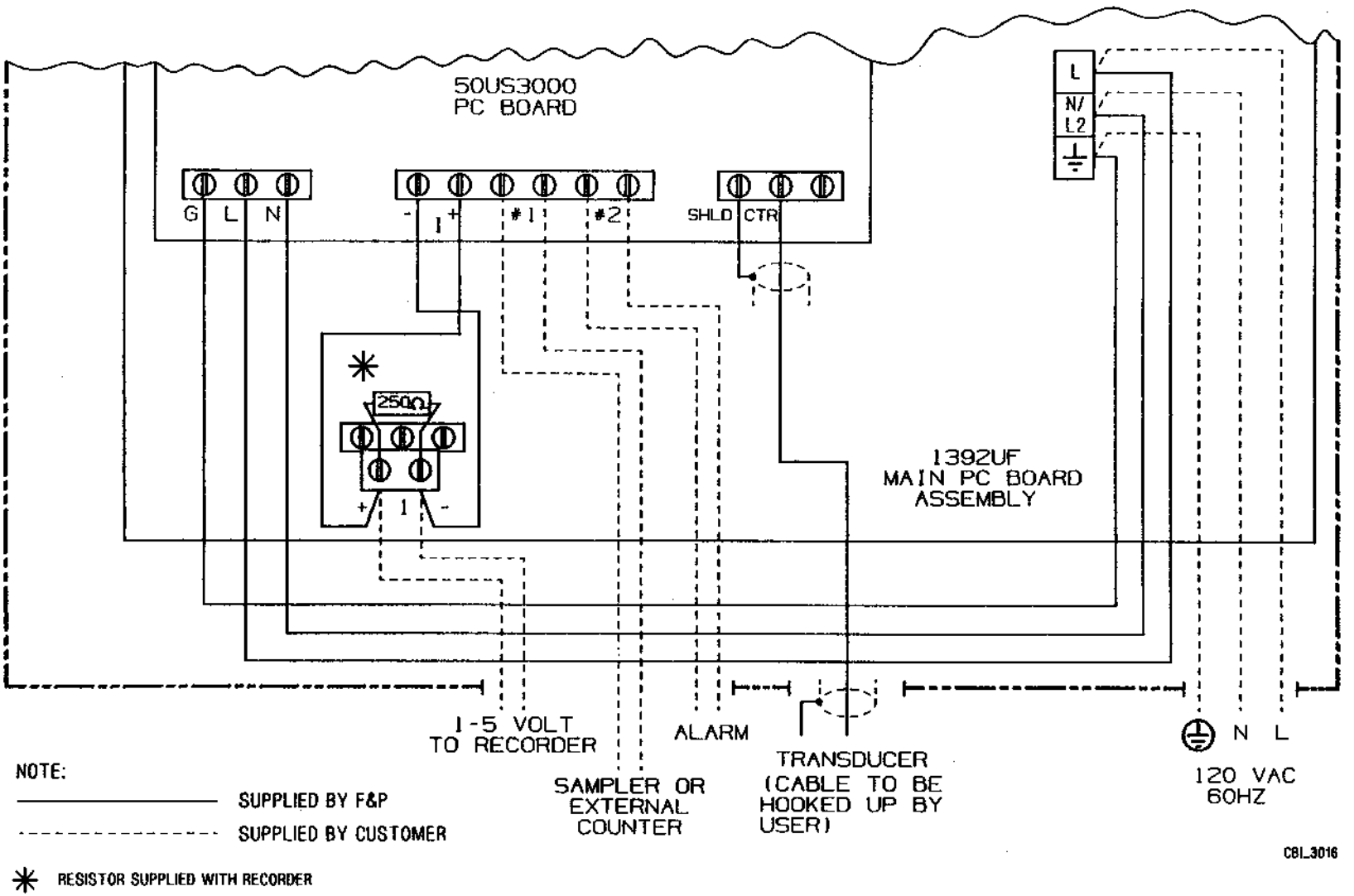


FIGURE B. INTERCONNECTION WIRING DIAGRAM

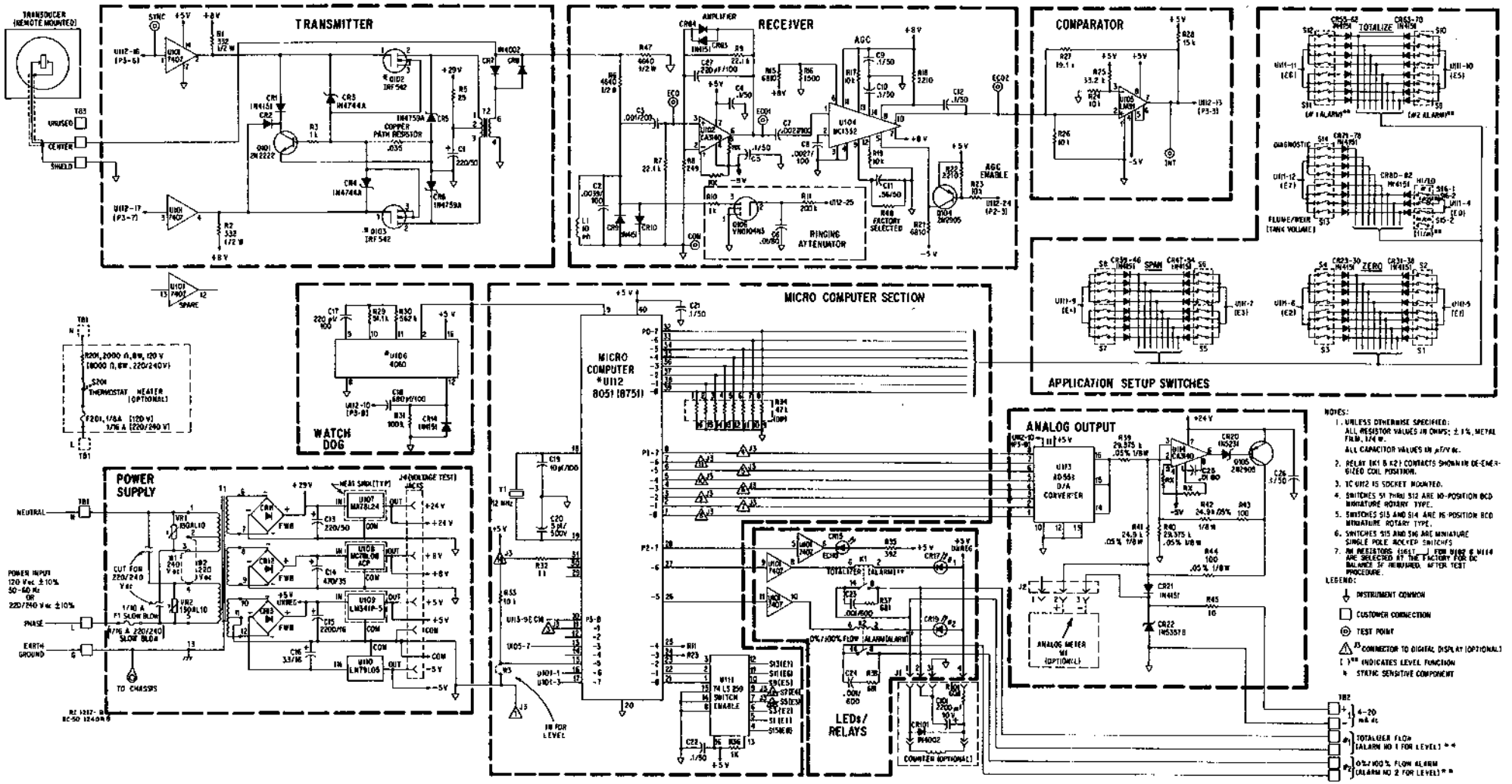


FIGURE 20. 50US3000 SERIES FLOW/LEVEL METER SCHEMATIC DIAGRAM.

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