INSTALLATION AND OPERATION
of
S-4401
Portable Discrete Sampler

Publication No. 717662 (05443-000)
INSTALLATION AND OPERATION

of

TEXAS NUCLEAR
manning products

Model S-4401
Portable Discrete Sampler

Publication No. 717662
(05443-000)
Rev 1.0

March 1989

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1.0 INTRODUCTION

1.1 Preface

The Texas Nuclear/Manning S-4401 Portable Sampler offers many features to make the job of collecting precise liquid samples safe and convenient. Its usefulness to you will be increased by spending a few moments scanning this manual for helpful hints.

Even if you do not intend on putting your sampler into service at the time of its arrival it is suggested that you unpack and examine it on arrival. This is to assure you have everything and that the sampler wasn’t damaged in shipment. Although we double check all our shipments, it pays to be sure and you will benefit by getting to know your equipment. The pre-installation setup followed by taking a test sample is recommended and will exercise the electronic and mechanical components of the instrument.

1.2 General Description

The S-4401 Portable Discrete Sampler is a versatile precision instrument for drawing and storing samples of liquid for subsequent analyses. The unit has microprocessor-based digital controls easily programmed by a touch-pad control panel. The sampler’s precision measuring chamber with external volume adjustment allows setting of sample volumes from 50 ml to 500 ml per sample with \( \pm 0.5 \) ml or better repeatability. To ensure representative samples, the unit self-purges before and after each sampling action to clear the intake tube of obstructions and residue from the previous sample. The powerful vacuum system creates a sample transport velocity of 1.0 m/sec (3.1 ft/sec) or better through the 7.6m (25 ft) of .95 cm (.375 in) I.D. tubing (std). This high speed transport velocity minimizes “settling out” of suspended solids. The nylon reinforced PVC inlet hose has a weighted strainer to further prevent clogging or drawing excess air. In the unlikely event that clogging occurs and a full sample is not taken, the sampler will purge and try again. The rotating spout assembly, single or multiple samples in each of the 24 individual bottles. The unit automatically shuts down at the completion of the 24 bottle sequence (std). The sampler can be transported by one person and can be installed from the top of a manhole without requiring physical entry by the installer.

1.3 Hardware Description

The S-4401 consists of three major subassemblies: the top cap, the equipment chassis, and the bottle case containing twenty-four 500 ml polypropylene autoclavable sample bottles. The equipment chassis and top cap are constructed
Photograph not available.

Figure 1-1. S-4401 Portable Discrete Sampler
Figure 1-2. S-4400 Sampler, Cap, Equipment Chassis, and Bottle Case
of ABS plastic, the bottle case of polyethylene. As a unit, the three assemblies form an environment-resistant enclosure.

Power for the unit is supplied by either a 12-volt wet cell battery or an optional AC power supply. A low battery warning is indicated when the word HELP appears on the control panel LCD display when voltage drops to 10.8 Vdc, indicating the need to recharge or replace the battery.

1.2.1 Top Cap

The removable top cap, which protects the sampler interior from the external environment, is secured to the equipment chassis with three latches.

1.2.2 Equipment Chassis

The equipment chassis includes the microprocessor-based digital control panel and system electronics, the transparent PVC sample measuring chamber with a scale in milliliters for observing sample volume, the compressor and air valves with associated tubing, the solenoid pinch valve, the stepper motor and gears for spout rotation, and the battery.

1.2.3 Bottle Case

The rugged ABS bottle case holds 24 sample bottles. The optional superinsulated bottle case has the interior of its double wall filled with polystyrene foam which acts as an insulator, ice can be added to maintain lower temperatures for biological preservation of the sample.

1.2.4 Touch-Pad Digital Control Panel

The panel has 24 entry pads mounted flush in the sealed membrane switch panel and a 4-digit LCD display. The controller electronics contain an 8-bit, state-of-the-art, low energy consumption microprocessor with two kilobytes of permanent program memory (ROM) and sufficient temporary memory (RAM) to contain all the sampling sequence instructions which the user enters through the control panel keyboard. The controller responds with an audible beep when any function key is pressed, and the display prompts the user with a flashing cursor (underline) whenever it is waiting for a digit to be entered. The controller has an accurate real-time clock which continuously displays the time when power is present at the battery terminals and no modes are programmed. Time is recoverable during any programmed mode when DISPLAY and CLOCK are pressed.

The electronics are mounted on the back of the control panel. (See Figures 4-2 and 4-3 for controller disassembly.) The controller is mounted in a molded plastic housing.
Figure 1-3. Photo of underside of equipment chassis clearly showing 2 fuse holders and the sample discharge spout
DO NOT USE ORGANIC SOLVENTS OR ABRASIVES ON THE CONTROLLER PANEL. MOST ESPECIALLY DO NOT USE ACETONE.

Figure 1-4. Touch-Pad Digital Control Panel
1.3 Functional Description (See Figure 1-5)

NOTE: Wherever * appears it means the * KEY on the Touch Pad Digital Control Panel (See Figure 1-4).

1.3.1 Basic Sampling Modes

TIME,* START MODE

An extremely simple mode, the * START mode, waits one hour then takes one sample per bottle each hour for 24 samples, after which all sampler operation stops.

TIME

In the TIME mode, samples are taken at user-selected time intervals ranging from 1 minute to 99 hours, 59 minutes increments of 1 minute.

TIME, DELAY START

The first sample may be delayed from 1 minute to 99 hours, 59 minutes, and this time delay is independent of the time between samples.

FLOW

In the FLOW mode, samples are taken after one momentary external contact closure from a flowmeter. NOTE: If the external contact is still closed at the end of the sample cycle, the controller will revert to the * START time mode and take 1 sample per hour until 24 bottles have been filled.

FLOW, DELAY START

In the FLOW mode, DELAY START operates as a pulse accumulator permitting 2 to 9999 momentary external contact closures between each sample.

TIME INTERVAL OVERRIDE OF FLOW MODE (* 02)

A programmable default time may be added to the FLOW mode by means of the * 02 command. * 02 causes a sample to be taken after the expiration of the time interval if the external flow contact has not closed first. If the contact does close first, it resets the default timer.

"OVERFLOW MONITOR" TIME DEFAULT IN FLOW MODE

If the external flow contact is still closed when the sample cycle is completed, the controller reverts to the * START time mode and takes one sample per hour until 24 bottles have been addressed. The sampler remains in the * START mode even if the external contact later opens.
1.3.2 Utility Functions

RESET

Pressing this key once will illuminate the LED's identifying the current programmed mode. The LED's will remain on for 30 seconds, then the display will continue as it was before RESET was pressed.

Pressing RESET twice within 30 seconds clears and resets the controller. The current programmed mode is cancelled.

TEST CYCLE

Permits the user to check the sampler through one complete sampling sequence. To activate the TEST CYCLE the RESET key is first pressed twice to cancel any current programmed mode. Then pressing TEST CYCLE will initiate one complete sample sequence.

REAL TIME CLOCK

The DISPLAY key is pressed once to blank any current display. Pressing the CLOCK key displays the time with flashing colon for 10 seconds. The display then will return to the current operating mode.

ERROR

If an illegal number such as 12 hours, 63 minutes is keyed in, the display responds with EEEE (for error) and 5 audible beeps. When CLEAR is pressed once, the least significant (right) digit is removed. When CLEAR is pressed successively 3 more times, the remaining three digits are removed.

LOW BATTERY

If battery voltage becomes too low to drive the compressor valves, the controller will go into LOW BATTERY ALERT, will block any further sampling and will display the work HELP. If a fresh battery is then connected to the second battery terminal before the depleted battery is disconnected, the keyed in parameters of the operating mode will be preserved.

1.3.3 The Sample Cycle

The first action following a sample command is the advancement of the sample distribution spout to the next higher numbered bottle. The sampling cycle begins with a purging action. The solenoid valves connect the positive side of the compressor to the measuring chamber. The pinch bar at the bottom of the chamber is held closed, forcing the pressurized air out through the intake hose to purge the line of possible obstructions. The action takes 6 seconds. When the purging is completed the controller switches the solenoid valves to the suction side.
of the compressor. The pinch bar remains closed and the suction draws the fluid up the intake hose into the measuring chamber.

1.4 Option

The option consists of the A1 + A2 Analog Option Package. This option is not available as a field retrofit to the standard S-4401 sampler and must be stipulated at the time the original order is placed.

1.4.1 Analog Option A1

SOFTWARE

The A1 option software package consists of three programs which accept analog signals from external level or flow meters:

1. Programmable analog flow mode. The *05 mode.
2. Programmable analog level mode. The *06 mode.
3. Programmable stage (hydrologic event) mode. The *09 mode.

HARDWARE

- Analog-to-digital circuit board (See Figure 4-2).
- Additional Read Only Memory (ROM) and Random Access Memory (RAM) on the processor board (See Figure 4-2).
- 10-socket connector mounted on the equipment chassis which provides three functions (See Figure 2-1):

1. Analog level or flow input: 4-20 mA or 0-20 mA, 1-5 VDC, 0-1 VDC
2. A contact closure output upon completion of the entire sampling sequence (useful for activating a second sampler).
3. Remote start from an external contact closure.

1.4.1.1 Programmable Analog Flow Mode (*05)

The sampler will accept a 4-20 mA, 0-20 mA DC, 0-1 VDC, or 1-5 VDC analog signal representing a continuous flow rate in volume per unit time from an external device. The flow rate signal is continuously integrated by the *05 mode to accumulate volume units of total flow. The operator enters a time unit (second, minute, hour, day). He also enters one number which is an accumulated volume of flow. [Any volume unit may be used because the same unit (cubic feet, gallons) is present in both the flow rate and the accumulated flow.] A sample will be taken each time an additional volume of flow of this amount is accumulated.
1.4.1.2 Programmable Analog Level Mode (*06) (See Figure 1-6)

In this mode the sampler will accept a 0-20 mA, 4-20 mA, 0-1 VDC, or 1-5 VDC analog signal from an external device which represents water levels and will sample at programmed levels. Notice in Figure 1-6 that a second sample at any level will not be taken until the next higher or lower level has been sampled.

1.4.1.3 Programmable Stage (Hydrologic Event) Mode (*09) (See Figure 1-7)

The purpose of the *09 Hydrologic Stage Mode is to provide a series of samples that begins only after the start of an unusual event (e.g., a storm runoff), takes samples representative of the rapidly rising level and then the gradually falling level of the event, and finally stops sampling as the event ends.

In the *09 mode the following parameters are entered: one rising and one falling differential stage, and from one to six threshold stages, each with its own default time.

No sample is taken until the water level rises to the lowest threshold stage. A sample is then immediately taken, and the default time for that stage begins counting down. If the water rises more than the rising differential stage EH before the default time elapses, a sample is taken. If not, a sample is taken when the default time elapses. This process continues as the water rises through the higher threshold stages, each having its own default time. When the water begins to fall, a sample is taken only after it has fallen by an amount equal to the falling differential stage EL or when the default time for that threshold stage has elapsed.

Note that there can be a different default time for each threshold stage, but that there is only one rising differential stage and only one falling differential stage.

The following symbols appear in the display in the following order to prompt the user to enter the stage and default time parameters (Refer to the example shown in Figure 1-7, where for simplicity only two of the six possible threshold stages are used.):

HH  (Maximum Analog Level)
The difference between HH and HL is the span.

HL  (Minimum Analog Level)

EH  (Positive Differential Stage)
Rising change in water level, which causes a sample to be taken.

EL  (Negative Differential Stage)
Falling change in water level, which causes a sample to be taken.
- The difference between HL and LL is the span. HL and LL are expressed in the same linear units above the datum.

- Any number, up to and including 50 intermediate sampling levels L 01, L 02, ..., L 50 may be entered. They may have any separations. The lowest sampling level, L 01, must be greater than LL. The highest sampling level may or may not equal HL. If it equals HL, it must be entered separately from HL (as L 07 is in the figure).

- The resolution is $\frac{1}{256}$ of the difference between HL and LL. If a level is entered which is not an integer multiple of $\frac{1}{256}$ of the span the nearest multiple will automatically be computed and displayed.

- A second sample is never taken at any level until after a sample is taken at the next higher or the next lower level.

Figure 1-6. An example of Programming the * 06 Analog Level
Figure 1-7. Example of the 09 Programmable Hydrologic Stage Mode
L 01  (Lowest Threshold Stage)
Water level at which the first sample will be taken, and which is associated
with default time P 01.

P 01  (Default Time 1)
Time to next sample after level L 01 is exceeded if positive differential stage
threshold HH is not first exceeded.

L 02, P 02  Succeeding higher levels at which samples will be taken.
L 03, P 03  and which are associated with default times P 02, P 02, etc.
...
L 06, P 06  No more than six threshold stages may be defined.

RESOLUTION

The resolution is one part in 256 of the span, whatever span is entered. Whenever
a stage level is entered that is not an integer multiple of 1/256th of the span, the
display, after a short pause, will automatically correct the entry to the nearest
integer multiple.

1.4.2 Option (A2)

This option has two operating modes: The * 03 Adjustable Purge and Draw mode,
and the * 04 Programmable Time Interval mode.

1.4.2.1 * 03 Adjustable Purge and Draw Mode

The Adjustable Purge and Draw mode option is especially effective when it is
practical to reduce the "on-time" of the sampler when lower lifts and/or shorter
hoses are used, thus conserving battery power, or when longer hose lengths are
used such that additional purge and draw times are needed (consult factory for
recommendations).

The purge time may be adjusted from 5 to 25 seconds.
The draw time may be adjusted from 5 to 150 seconds.

IMPORTANT: The specification of 125 sample sequences to be run from a
fully charged 16 amp-hour lead acid battery is based on a purge time not
exceeding 7 seconds and a draw time not exceeding 20 seconds. Purge
and/or draw times exceeding these values reduce the number of sample
sequences obtainable from the standard battery. For long purge and draw
times, it is recommended that the optional AC/DC power supply, Part No.
06272-001, or a larger external battery be used.
1.4.2.2 * 04 Programmable Time Interval Mode

The Programmable Time Interval mode permits selecting up to 12 different time intervals between sampling events in the TIME mode. Any total number of samples may be programmed: greater than, equal to, or less than 24.

1.4.3 Toxic Materials Option S-4401T

With the toxic materials option, all wetted part, i.e., materials in contact with the medium, are constructed of either teflon, glass, or stainless steel which are recognized and acceptable as non-contamination materials.

This option permits the sampling of a wide variety of toxic substances such as hydrocarbon or chlorine-based compounds. Since very low-concentration samples of these substances may be contaminated by contact with PVC and polypropylene, the standard S-4401 sampler may not be appropriate.

The Toxic Materials Option includes:

- Chamber top and bottom of Teflon TFE
- Intake sample hose of bondable Teflon TFE (3/8" [.95 cm] I.D.)
- Glass measuring chamber with protective mesh stocking
- Sampler chamber outlet tubing of Teflon
- Twenty four 350 ml glass sample bottles
- Teflon spout

1.5 Specifications

1.5.1 Controller

**CONTROLLER PANEL:**

Polycarbonate membrane switch assembly with 24 touch pads and 4-digit Liquid Crystal Display (LCD).

**TIME CONTROL:**

1 minute to 99 hours, 59 minutes (selectable in 1 minute increments).

**FLOW CONTROL:**

1 to 9999 external contact closures (per sample) from external flowmeter.

**DELAY START (OF TIME CONTROL):**

1 minute to 99 hours, 59 minutes (selectable in 1 minute increments).
1.4.2.2 * 04 Programmable Time Interval Mode

The Programmable Time Interval mode permits selecting up to 12 different time intervals between sampling events in the TIME mode. Any total number of samples may be programmed: greater than, equal to, or less than 24.

1.4.3 Toxic Materials Option S-4401T

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This option permits the sampling of a wide variety of toxic substances such as hydrocarbon or chlorine-based compounds. Since very low-concentration samples of these substances may be contaminated by contact with PVC and polypropylene, the standard S-4401 sampler may not be appropriate.

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- Glass measuring chamber with protective mesh stocking
- Sampler chamber outlet tubing of Teflon
- Twenty four 350 ml glass sample bottles
- Teflon spout

1.5 Specifications

1.5.1 Controller

CONTROLER PANEL:

Polycarbonate membrane switch assembly with 24 touch pads and 4-digit Liquid Crystal Display (LCD).

TIME CONTROL:

1 minute to 99 hours, 59 minutes (selectable in 1 minute increments).

FLOW CONTROL:

1 to 9999 external contact closures (per sample) from external flowmeter.

DELAY START (OF TIME CONTROL):

1 minute to 99 hours, 59 minutes (selectable in 1 minute increments).
MULT SAMPLE:
Permits programming from 2 to 10 samples in each bottle.

MULT BOTTLE:
Permits programming of 2 to 10 bottles to be filled in rapid succession.

BOTTLE ADVANCE:
Advances the spout clockwise to the next higher-numbered bottle. The current bottle number can be seen through the observation hole next to the measuring chamber.

Since the spout automatically advances at the start of each sample cycle, when starting a sequence, locate the spout at the preceding counterclockwise number, e.g., to start at bottle number 1, locate the spout at bottle 24, etc. The spout will move to bottle number 1 when the sample cycle begins.

REAL TIME CLOCK:
Programmed into digital display in hours and minutes, 00:00 to 23:59.

TEST CYCLE:
Initiates one complete sample cycle.

1.5.2 Detailed Specifications

TEMPERATURE LIMITS:
0°C to 50°C (32°F to 122°F)

SAMPLE BOTTLES:
Twenty-four 500 ml polypropylene bottles with caps.

Power:
12 VDC, 16 AH wet cell battery (standard).
12 VDC, 18 AH sealed lead battery (optional).
AC/DC power supply (optional).

FUSE:
Two 3 AG, 10 amp, 32 Volts, Part No. 01544-04
SIZE & WEIGHT:

Height 28.7 in. (72.9 cm)
Diameter 19.8 (50.4 cm)
Weight (without battery) 33.5 lbs. (15.2 kg)

ACCESSORIES:

Suspension Harness
Battery Charger
AC/DC Power Supply
Flowmeter Connector Cable

INPUTS/OUTPUTS:

Power Two 2-pin connectors (standard)
Signal One 4-socket connector (standard)
Flow Pulse Input (Switch closure approx. 10 msec.)
Sample Event Output (500 msec. closure between pins C and D on the connector)
One 10-Socket Connector (Only with A1 analog input option)

Analog Inputs
Remote Start Input
Sequence Complete Output

SEQUENCE OF OPERATION (See Figure 1-8):

Purge 6 seconds
Draw Until chamber is full. Default time—20 seconds
Measure 13 seconds
Discharge measured sample 8 seconds

SAMPLE TRANSPORT VELOCITY:

Minimum of 5 ft/sec (1.5 m/sec) at 3 ft (1 m) of lift and 2.5 ft/sec (.75 m/sec) at 20 ft (6.1 m) of lift.

INLET HOSE:

0.375 in. (.95 cm) I.D. nylon reinforced PVC, 25 ft (7.6 m) in length with weighted PVC strainer. Longer hose available.

MAXIMUM SAMPLE LIFT:

22 ft (6.7 m)
SAMPLE VOLUME:
50 ml to 500 ml ± 5 ml, externally adjustable at chamber top.

MINIMUM NUMBER OF SAMPLE SEQUENCES:
125, run from a fully charged, 16 amp-hour wet-cell lead acid battery in good condition at 65°F (18.3°C) and based on a purge time not exceeding 7 seconds and draw time not exceeding 20 seconds. Purge and/or draw times exceeding these values will reduce the number of sample sequences obtainable from the standard battery, Part No. 01390-07. For more samples or longer purge and draw times it is recommended that the optional AC/DC power supply, Part No. 06272-001, or a large external battery be used.

1.5.3 Optional Controls

A1 Option

ANALOG FLOW INPUT (* 05):
Integrates an external flow rate signal (4-20 mA, 0-20 mA, 1-5 VDC, or 0-1 VDC) and provides a scaled pulse output to activate sampler on flow proportional basis. Fully adjustable to four significant digits (9999) with X1, X10, X100, X1000 scaling factors.

ANALOG LEVEL INPUT (* 06):
Accepts an analog signal (4-20 mA, 0-20 mA, 1-5 VDC, or 0-1 VDC) that represents water level span. Program samples at up to 50 discrete level values (rising or falling).

HYDROLOGIC EVENT SAMPLING (* 09):
Accepts an analog signal (4-20 mA, 0-20 mA, 1-5 VDC, or 0-1 VDC) that represents water level span. Program samples based on combination of parameters: water level, differential rising and falling water levels, and time defaults. (Criteria suggested by U.S. Geological Survey. This program is designed to provide optimal representative sampling of an hydrologic event.)

A2 Option

ADJUSTABLE PURGE & DRAW (* 03):
Program nonstandard duration times (in seconds). Shorter times (shorter hose and low lift applications) decrease power consumption. Longer times allow use of longer hoses at high lifts (increase power consumption).
PROGRAMMABLE TIME INTERVALS (* 04):

Accepts up to 12 different time intervals between sample events. Intervals from 1 minute to 99 hours 59 minutes in increments of 1 minute.
Figure 1-8. S-4401 Sample Sequence Flow Chart
2.0 INSTALLATION & SAMPLE RECOVERY

2.1 Installation

NOTE: Because of shipping regulations, the 16 amp-hour 12-volt wet cell battery, Part Number 01390-07, is shipped dry; electrolyte is not supplied. For filling and charging instructions consult the "Battery Application Note" shipped with the unit. The minimum number of sample sequences is 125, when fully charged and in good condition at 65°F (18.3°C). Operating at lower temperatures will probably require more frequent recharging. Battery life is based on purge time not exceeding 7 seconds and draw time not exceeding 20 seconds. Purge and/or draw times exceeding these values will reduce the number of sample sequences obtainable from the standard battery. For more samples or longer purge and draw times, it is recommended that the optional AC/DC power supply or a large external battery be used.

2.1.1 Optional AC/DC Power Supply

Where AC power is readily available to the sampler installation site, it may be desirable to use this source instead of the 12-volt battery.

The optional power supply is a sealed waterproof unit available for either 115 VAC (Part Number 06272-001) or 230 VAC 50/60 Hz, (Part Number 006272-002). Output is rated 12 VDC, 7 amps.

The AC/DC power supply package fits in the battery well on the equipment chassis and can be secured with the battery hold-down strap. The output fuse, rated 3AG, 10 amp, Part Number 03408-103, is accessible at the exterior fuse holder. The integral cable connects to either of the two-pin connectors on the equipment chassis. (See Figure 2-1).

2.1.2 Pre-Installation Setup

a. Release the three external latches, remove the top cap and place a fully charged battery in the rectangular depression adjacent to the measuring chamber.

b. Using the two bolts and nuts supplied (for wet cell battery), connect the battery cable red lead to the positive (red) terminal and the black lead to the negative terminal of the battery.

c. Connect the battery cable to either of the two receptacles located closest to the battery (See Figure 2-1). The purpose for having two battery connectors is to permit a fresh battery to be connected to the unused
Figure 2-1. S-4401 Sampler Equipment Chassis, Top View
terminal before the depleted battery is disconnected. (Internal diodes
prevent cross-charging.) This will save any program previously entered.

d. Connect the intake hose to the short hose extending from the measuring
chamber. The connector is a female quick-disconnect type.

2.1.3 Checkout

NOTE: While not mandatory, a functional checkout is recommended to assure
proper operation and to familiarize personnel with the procedures affective the
various functions and modes of operation.

Setting Sample Size

The following can be accomplished with the sampler resting on a level surface
such as a table or test bench, or on the floor.

a. Place a container of several gallons of clean water near the sampler.

b. Submerge the open end of the intake hose in the water.

c. Adjust the volume of the sample by turning the knob marked "ADJUST"
clockwise (See Figure 2-1). DO NOT TURN COUNTERCLOCKWISE. This
rotates the spiral tube around a slotted tube and lowers the exit port until it
reaches the bottom and suddenly appears at the top. Compare the exit
port (at eye level) with the milliliter gradients on the chamber to determine
the sample volume (See Figure 2-2).

NOTE: For convenience, it should be set to the volume to be taken in field
operation. It may be necessary to repeat this step several times to obtain
desired volume setting.

Upon completion of preliminary sample volume adjustment, outlined above, fine
adjustment of chamber volume can be made as follows:

a. Obtain a beaker graduated in milliliters.

b. Remove the equipment chassis from the bottle case and position the beaker
under the spout. Press RESET, twice, press TEST CYCLE. (A sample will
be taken immediately.)
FIGURE 2-2. Checking Sample Volume at Eye Level
c. When the sample is discharged into the beaker, compare the milliliter reading on the beaker with the level of the exit port.

d. Adjust the spiral tube for more or less volume as necessary.

**NOTE:** When taking multiple samples, be sure the sample volume setting is low enough that the sample bottle will not overflow; e.g. 2 samples, 250 milliliters or less; 5 samples, 100 milliliters or less, etc.

### 2.1.4 Field Installation

The S-4401 Sampler can be installed on a firm, level surface adjacent to the flow to be sampled or suspended in a harness near or above (such as a manhole) the channel.

**NOTE:** For manhole installation, the S-4401 has optionally available a suspension harness, Part No. 01777-00.

#### 2.1.4.1 Surface Installation

a. Position the sampler and remove the top cap.

b. Place the intake hose strainer in the channel flow (See Figure 2-3).

**NOTE:** The intake hose strainer should be placed in the channel main flow, not in an eddy or at the edge of the flow. Where the possibility of clogging of the strainer openings by debris exists, provisions should be made for deflecting such debris.

Vertical position of the intake will depend on the type of sample to be taken; for example, placement at the bottom of the flow will result in heavier concentration of solids in the sample, while placement at or near the top of the flow will eliminate most solids and detect oils, fats, and other floating or suspended contaminates.

**NOTE:** The heavy strainer supplied with the intake hose is usually sufficient to prevent the intake from being pulled to the surface of a fast channel.

c. Set the distribution spout at bottle 24. The spout will move to bottle number 1 when the sample cycle begins.

d. If flow proportional samples are to be taken, place the flowmeter in position and connect the flowmeter cable to the 4-pin connector on the equipment chassis (See Figure 2-4). Refer to Section 3 for Flow Mode Programming.
Figure 2.3. Positioning Intake Hose and Strainer
J4 PIN IDENTIFICATION (AI' OPTION)

NOTES: 1. Mating Connector, Part NO. 02818-00 Provided with AI Option.
        2. Suggest use of 20 to 22 gauge wire.
Figure 2-4. External Connections and Means of Interfacing Flowmeter
NOTE: A dimple is provided in the bottle case for the exit of the flowmeter cable and intake hose. Consult flowmeter manual for control settings.

e. If time interval sampling is desired, refer to Section 3 for Time Programming Procedures.

f. Install and latch the top cap.

2.1.4.2 Manhole Installation

a. Set the distribution spout at bottle 24. The spout will move to bottle number 1 when the sample cycle begins.

b. Enter the desired sampling program (See Section 3 and install and latch the sampler top cap.

c. Connect the suspension harness to the sampler.

d. Position the end of the intake hose in the channel flow. (See NOTE Paragraph 2.1.4.1 (b) for correct positioning of hose.)

e. Lower the suspension harness and sampler into the manhole. Place the ring at the top of the harness onto the user supplied manhole hook or suspension bar.

2.2 Sample Recovery

Immediate sample recovery is not required since the sampler will automatically shut down when the 24 sample bottles are full. However, sample analyses may dictate the need for quick recovery (sample freshness, chemical additives, etc.).

NOTE: If samples are taken on a flow proportional basis, disconnect and remove the flowmeter and its mounting bracket (if mounted above sampler).

a. Raise the sampler out of the manhole and set it on a level surface. Pull the remaining intake hose up.

b. Remove the sampler top cap.

c. If installed, disconnect the flowmeter cable.

d. Remove the equipment chassis from the bottle case.

e. Attach a blank label or piece of masking tape to the bottle case and note date(s) and location of collection.
f. If the sampler is to be reinstalled for continued sampling, remove and identify the full sample bottles and install empty bottles.

2.2.1 Cooling the Samples

It is often desirable to maintain the sample at temperatures low enough to preserve the bacterial content for analysis. The optional superinsulated bottle case is designed to permit the addition of cube or crushed ice.

The following procedure is recommended for cooling:

a. Obtain about 17 pounds of cube or crushed ice, put it in the inverted top cap of the sampler and add water to about half the height of the ice. Let the water cool as long as possible. For best results, it should be no more than 32.2 degrees F (0.1 degrees C) before being used.

b. Fill the volume below the sample bottles with ice then put the sample bottles in place.

c. Put the bottle hold-down plate in place and secure. Fill the center space with as much of the ice and cold water as possible. The water is necessary as a transfer medium to remove heat from the samples. If the water is initially much above the temperature of melting ice, the length of time the samples can be held at low temperature will be greatly reduced.
3.0 PROGRAMMING THE S-4401 SAMPLER

3.1 Introduction

NOTE: Wherever * appears, it means the * KEY on the Touch Pad Digital Control Panel (See Figure 1-4).

The sampler is controlled by a microprocessor via a keyboard with liquid crystal display (LCD), and is capable of accepting instructions to execute any of a wide variety of TIME and FLOW sampling sequences.

Basic Sampling Modes:

The "* START" command initiates the simplest of the TIME sequences: After a one hour delay one sample is taken every hour until 24 samples have been taken, at which time sampling action stops.

In the TIME mode, samples are taken at user-selected time intervals ranging from 1 minute to 99 hours, 59 minutes, in increments of 1 minute. Using TIME and DELAY START, the first sample may be delayed from 1 minute to 99 hours, 59 minutes. This time delay is independent of the time between samples, and thereafter it will continue in any other programmed mode. In the FLOW mode, samples are taken after one momentary external contact closure from an external flowmeter which is connected to the J5 external connector (See Figure 2-1), using an accessory cable, Part No. 01559-04.

NOTE: If the external contact is still closed at the end of the sample cycle, the controller will revert to the * START time mode and take 1 sample per hour until 24 samples have been taken. The sampler remains in the * START mode even if the external contact later opens.

In the FLOW mode, DELAY START operates as a pulse accumulator permitting 2 to 9999 momentary external contact closures between each sample.

TEST CYCLE immediately initiates the standard sampling cycle (See The Sampling Cycle).

The controller also supports an accurate real-time clock which runs whenever a power source is connected, which may be set from the keyboard using a 24-hour basis, and which may be observed at any time that a sample sequence is running by pressing DISPLAY, CLOCK. When no modes are programmed, real time will normally appear on the LCD display.

3.1.1 Keyboard Programming Instructions for the Standard S-4401 Sampler

The following illustrations show step-by-step procedures for programming the utility functions and the sampling modes of the standard S-4401 Discrete Sampler.
3.1.2 Keyboard Programming Instructions for the S-4401 Sampler with A1 and/or A2 Options

ANALOG OPTIONS (A1)

Programmable Analog Flow Mode (* 05)
Programmable Analog Level Mode (* 06)
Programmable Stage (Hydrologic Event) Mode (* 09)

A2 OPTIONS

Adjustable Purge & Draw (* 03)
Programmable Time Intervals (* 04)
Independently Time and Spout Advance (*01)
TIME MODE

* START

The * START mode takes one sample per bottle per hour, after an initial delay of one hour, and stops after 24 bottles.

---

<table>
<thead>
<tr>
<th>STEP</th>
<th>DISPLAY BEFORE NEXT KEY IS Pressed</th>
<th>NEXT, PRESS</th>
<th>RESULT:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>O RESET</td>
<td>Turns on LED’s identifying current operating mode for 10 seconds</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>O RESET</td>
<td>Cancels current time mode Displays real time clock</td>
</tr>
<tr>
<td>3</td>
<td>4400</td>
<td>O *</td>
<td>Select the * sequence.</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>START</td>
<td>Start the sequence.</td>
</tr>
</tbody>
</table>

01:00

The display begins counting down the time to the first sample.
(HRS:MIN)
**TIME MODE**

**PROGRAMMABLE SINGLE TIME INTERVAL**

Moves spout after the time interval 24 times and stops. This example uses a 1 hour 30 minute interval.

![Time mode diagram](image)

<table>
<thead>
<tr>
<th>STEP</th>
<th>DISPLAY BEFORE NEXT KEY IS Pressed</th>
<th>NEXT, PRESS</th>
<th>RESULT:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>O RESET</td>
<td>LED’s identifying the current operating mode, if any, come on.</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>O RESET</td>
<td>Cancels current mode. Displays real time.</td>
</tr>
<tr>
<td>3</td>
<td>4400</td>
<td>O Time</td>
<td>Select TIME mode.</td>
</tr>
<tr>
<td>4</td>
<td>:</td>
<td>01 30</td>
<td>Select and ENTER time interval between samples. (HRS:MIN)</td>
</tr>
<tr>
<td>5</td>
<td>01:30</td>
<td>ENTER</td>
<td>Start the sequence. The first time interval begins counting down.</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>START</td>
<td>The sequence stops after 24 spout advances.</td>
</tr>
</tbody>
</table>

Page 3-4
## TIME MODE

### TIME DELAY START

<table>
<thead>
<tr>
<th>STEP</th>
<th>DISPLAY BEFORE NEXT KEY IS Pressed</th>
<th>NEXT, PRESS</th>
<th>RESULT:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>O Time</td>
<td>ENTER</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>O Delay Start</td>
<td>ENTER</td>
</tr>
<tr>
<td>3</td>
<td>09:30</td>
<td>ENTER</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>START</td>
<td>09:30</td>
</tr>
</tbody>
</table>
FLOW MODE
FIRST CLOSURE START

This sequence will automatically take one sample per bottle (for each external contact closure at connector J5) and 24 bottles.

---

<table>
<thead>
<tr>
<th>STEP</th>
<th>DISPLAY BEFORE NEXT KEY IS PRESSED</th>
<th>NEXT, PRESS</th>
<th>RESULT:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>O RESET</td>
<td>Identifies current operating mode by turning on LEDs.</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>O RESET</td>
<td>Cancels current mode. Displays real time clock.</td>
</tr>
<tr>
<td>3</td>
<td>4400</td>
<td>O Flow</td>
<td>Selects FLOW mode. FLOW LED comes on.</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>START</td>
<td>START sequence.</td>
</tr>
<tr>
<td></td>
<td>0000</td>
<td></td>
<td>Display ready to count external contact closures.</td>
</tr>
<tr>
<td></td>
<td>0001</td>
<td></td>
<td>First closure occurs. First sample is taken.</td>
</tr>
<tr>
<td></td>
<td>0019</td>
<td></td>
<td>Display counts closures. (Sequence stops after 24 samples.)</td>
</tr>
</tbody>
</table>
FLOW MODE

DELAY START

A programmable number of external contact closures before each sampling event.

<table>
<thead>
<tr>
<th>STEP</th>
<th>DISPLAY BEFORE NEXT KEY IS PRESSES</th>
<th>NEXT, PRESS</th>
<th>RESULT:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>O RESET</td>
<td>Display continues as before. LED's identifying current mode come on for 30 seconds.</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>O RESET</td>
<td>Cancels current mode. Displays real time clock.</td>
</tr>
<tr>
<td>3</td>
<td>4400</td>
<td>O Flow</td>
<td>Select FLOW mode. FLOW LED comes on.</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>O Delay Start</td>
<td>Select DELAY START. DELAY START LED comes on.</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>O 0 0 1 3</td>
<td>Select and enter number of closures before each sample is taken.</td>
</tr>
<tr>
<td>6</td>
<td>0013</td>
<td>ENTER</td>
<td>START the sequence.</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>O START</td>
<td></td>
</tr>
<tr>
<td>STEP</td>
<td>DISPLAY BEFORE NEXT KEY IS PRESSED</td>
<td>NEXT, PRESS</td>
<td>RESULT:</td>
</tr>
<tr>
<td>------</td>
<td>-----------------------------------</td>
<td>-------------</td>
<td>---------</td>
</tr>
<tr>
<td></td>
<td>0000</td>
<td></td>
<td>Display ready to count external contact closures.</td>
</tr>
<tr>
<td></td>
<td>0013</td>
<td></td>
<td>First sample is taken after the programmed number of closures.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sequence stops after 24 bottles.</td>
</tr>
</tbody>
</table>
## TIME INTERVAL OVERRIDE OF FLOW MODE

### * 02

<table>
<thead>
<tr>
<th>STEP</th>
<th>DISPLAY BEFORE NEXT KEY IS PRESSED</th>
<th>NEXT, PRESS</th>
<th>RESULT:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STEP</td>
<td>DISPLAY BEFORE NEXT KEY IS PRESSED</td>
<td>NEXT, PRESS</td>
<td>RESULT:</td>
</tr>
<tr>
<td>------</td>
<td>-----------------------------------</td>
<td>-------------</td>
<td>---------</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>0 4</td>
<td>Select and ENTER the number of samples per bottle.</td>
</tr>
<tr>
<td>10</td>
<td>04</td>
<td>ENTER</td>
<td>START the sequence.</td>
</tr>
<tr>
<td>11</td>
<td>START</td>
<td></td>
<td>Display counts external flow contact closures.</td>
</tr>
<tr>
<td></td>
<td>0000</td>
<td></td>
<td>First sample is taken on first external closure.</td>
</tr>
<tr>
<td></td>
<td>0001</td>
<td></td>
<td>Sequence stops after 24 bottles.</td>
</tr>
<tr>
<td></td>
<td>0024</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**MULTIPLE BOTTLES PER SAMPLING EVENT**

From 2 to 10 bottles per sample event may be chosen to function with any flow mode and with any time mode except the *START.*

<table>
<thead>
<tr>
<th>TIME</th>
<th>FLOW</th>
<th>DISPLAY</th>
<th>START</th>
<th>CLEAR</th>
<th>0</th>
<th>ENTER</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>01:49</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**S T E P**

<table>
<thead>
<tr>
<th>DISPLAY BEFORE</th>
<th>NEXT KEY IS Pressed</th>
<th>RESULT:</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENTER</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>1</strong></td>
<td>ENTER</td>
<td>Select and ENTER a TIME or FLOW function. Do not press START yet.</td>
</tr>
<tr>
<td><strong>2</strong></td>
<td><strong>02</strong></td>
<td>Select multiple bottle function (MULT BOTTLE)</td>
</tr>
<tr>
<td><strong>3</strong></td>
<td>ENTER</td>
<td>Select and ENTER number of bottles per sample.</td>
</tr>
<tr>
<td><strong>4</strong></td>
<td>START</td>
<td>START the sequence.</td>
</tr>
<tr>
<td></td>
<td>OR ANOTHER FUNCTION</td>
<td></td>
</tr>
</tbody>
</table>
MULTIPLE SAMPLES PER BOTTLE

From 2 to 10 samples per bottle may be chosen to function with any flow mode and with any time mode except the *START.

---

**01:49**

---

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>T</td>
<td>DISPLAY BEFORE</td>
<td>E</td>
<td>NEXT KEY</td>
</tr>
<tr>
<td>T</td>
<td>E</td>
<td>NEXT, PRESS</td>
<td>P</td>
<td>RESULT:</td>
</tr>
<tr>
<td>P</td>
<td>S</td>
<td></td>
<td>S</td>
<td></td>
</tr>
</tbody>
</table>

- **STEP 1**: Enter a TIME or FLOW function. Do not press START yet.
- **STEP 2**: Select Multiple Sample function. (MULT SAMPLE)
- **STEP 3**: Select and enter number of samples per bottle.
- **STEP 4**: Either START the sequence. OR ANOTHER FUNCTION

---

Page 3-12
UTILITY FUNCTION
REAL TIME CLOCK

14:27

TO OBSERVE THE CLOCK DURING OPERATION:

1

2

TIME displayed with flashing colon for 10 seconds.

09:17

TO SET THE CLOCK:

3

(Cannot be set while in an operating mode.)

4

ENTER TIME on 24 hour basis.

5

 Colon flashes.

6

14:27
UTILITY FUNCTION
RESET, TEST CYCLE, BOTTLE ADVANCE

RESET
1  O RESET
Press RESET twice to cancel any mode or sequence except the real time clock.

TEST CYCLE
2  Test Cycle
Can only be used when controller is reset. Starts one complete sampling cycle as shown in Figure 1-8.

BOTTLE ADVANCE
3  Bottle Adv.
Advances the spout one bottle, clockwise each time it is pressed. Can only be used when controller is RESET.
UTILITY FUNCTION

ERROR

Results from illegal digits (such as *more than* 59 minutes) being entered. Times out in 15 seconds.

---

**DISPLAY BEFORE**

**NEXT KEY**

**IS Pressed**

**PRESS**

RESULT:

<table>
<thead>
<tr>
<th>Button</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 BEEPS</td>
<td>Clears ERROR signal.</td>
</tr>
<tr>
<td>1 EEEE</td>
<td>Continue.</td>
</tr>
</tbody>
</table>

---

Page 3-15
UTILITY FUNCTION
CLEAR

Used to clear digits from the display before ENTER has been pressed.

01:49

1 2 3
4 5 6
7 8 9
0 ENTER
CLEAR

1234

<table>
<thead>
<tr>
<th>STEP</th>
<th>DISPLAY BEFORE NEXT KEY IS PRESSED</th>
<th>NEXT, PRESS</th>
<th>RESULT:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>01:49</strong></td>
<td>CLEAR</td>
<td>Undesired entry, but ENTER not pressed yet: CLEARS 4th digit</td>
</tr>
<tr>
<td>2</td>
<td><strong>01:4</strong></td>
<td>CLEAR</td>
<td>CLEARS 3rd digit</td>
</tr>
<tr>
<td>3</td>
<td><strong>01:</strong></td>
<td>CLEAR</td>
<td>CLEARS 2nd digit</td>
</tr>
<tr>
<td>4</td>
<td><strong>0:</strong></td>
<td>CLEAR</td>
<td>CLEARS 1st digit</td>
</tr>
<tr>
<td></td>
<td><strong>-</strong></td>
<td><strong>4</strong></td>
<td>ENTER desired digit</td>
</tr>
<tr>
<td></td>
<td><strong>4:-</strong></td>
<td></td>
<td>ETC.</td>
</tr>
</tbody>
</table>

Page 3-16
If the battery voltage falls to a level below which one complete sampling cycle cannot be completed, the controller will stop operating and display HELP.

**IMPORTANT:** If OPTION A1, Analog Functions, or OPTION A2, Adjustable Purge and Draw is present, and parameters have been entered into them, the parameters will be preserved if a fresh battery is connected before the low battery is disconnected.
UTILITY FUNCTION
DISPLAY

(1) Pressing the DISPLAY key lights the LED's of all the active keys.
(2) Pressing a lighted key then displays for 10 seconds a parameter related to that key's function.

<table>
<thead>
<tr>
<th>STEP</th>
<th>DISPLAY BEFORE NEXT KEY IS PRESSED</th>
<th>NEXT, PRESS</th>
<th>RESULT:</th>
</tr>
</thead>
</table>

WHEN TIME MODE IS OPERATING

<table>
<thead>
<tr>
<th>01:30</th>
<th>Display</th>
<th>Time</th>
<th>DISPLAY normally shows the remaining TIME before the next sample.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>09:30</th>
<th>Display</th>
<th>Delay Start</th>
<th>Shows the full TIME interval for 10 seconds.</th>
</tr>
</thead>
</table>

If DELAY START is lighted:

<table>
<thead>
<tr>
<th>01:00</th>
<th>Display</th>
<th>Delay Start</th>
<th>Shows the full DELAY START time for 10 seconds.</th>
</tr>
</thead>
</table>

WHEN FLOW MODE IS OPERATING

<table>
<thead>
<tr>
<th>00 03</th>
<th>Display</th>
<th>Flow</th>
<th>DISPLAY normally shows how many sampling events have occurred.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>00 03</th>
<th>Display</th>
<th>Flow</th>
<th>DISPLAY does not change.</th>
</tr>
</thead>
<tbody>
<tr>
<td>UTILITY FUNCTION</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DISPLAY, CONTINUED</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>S</th>
<th>T</th>
<th>DISPLAY BEFORE NEXT KEY</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>P</td>
<td>NEXT, PRESS</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RESULT:</th>
</tr>
</thead>
</table>

WHEN FLOW MODE IS OPERATING (CONTINUED)

If DELAY START is lighted:

<table>
<thead>
<tr>
<th>00 02</th>
</tr>
</thead>
</table>

DISPLAY shows the remaining number of contact closures before the next sample.

<table>
<thead>
<tr>
<th>00 13</th>
</tr>
</thead>
</table>

Shows the total number of external contact closures for 10 seconds.

WHEN MULTIPLE SAMPLE IS LIGHTED

<table>
<thead>
<tr>
<th>03 02</th>
</tr>
</thead>
</table>

DISPLAY shows the number of samples per bottle and the number of samples taken so far for 10 seconds.

WHEN MULTIPLE BOTTLE IS LIGHTED

<table>
<thead>
<tr>
<th>04 03</th>
</tr>
</thead>
</table>

DISPLAY shows the number of bottles per sampling event and the number of bottles filled so far for 10 seconds.
**OPTION A1**

**PROGRAMMABLE TOTALIZING ANALOG FLOW MODE**

This example uses a maximum flow rate of 4000 volume units per minute, and takes a sample every 150,000 volume units.

![Keypad Diagram]

<table>
<thead>
<tr>
<th>STEP</th>
<th>DISPLAY BEFORE NEXT KEY IS PRESSED</th>
<th>NEXT, PRESS</th>
<th>RESULT:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>O 4 0 0 0</td>
<td>Select 05 mode.</td>
</tr>
<tr>
<td>2</td>
<td>4 0 0 0</td>
<td>O 5</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0 5</td>
<td>ENTER</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>P I</td>
<td>4 0 0 0</td>
<td>Enter the 4 significant digits of the maximum flowrate. In this example 4000 volume units.</td>
</tr>
</tbody>
</table>

Turns on LED’s identifying current mode, if any, for 10 seconds.

Cancels current mode. Displays real time clock.
<table>
<thead>
<tr>
<th>STEP</th>
<th>DISPLAY BEFORE NEXT KEY IS PRESSED</th>
<th>NEXT, PRESS</th>
<th>RESULT:</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>P2</td>
<td>0 0 0 0</td>
<td><strong>Enter</strong> Enter the 4 significant digits of the minimum flowrate. In this example 0000 volume units.</td>
</tr>
<tr>
<td>6</td>
<td>P3</td>
<td>0 0 0 1</td>
<td><strong>Enter</strong> Enter the time interval between samples of the analog current (voltage) signal. Hours: minutes</td>
</tr>
<tr>
<td>7</td>
<td>P4</td>
<td>1 5 0 0</td>
<td><strong>Enter</strong> Select and <strong>Enter</strong> the 4 most significant digits of the totalized FLOW that causes a sample event.</td>
</tr>
<tr>
<td>8</td>
<td>P5</td>
<td>0 1 0 0</td>
<td><strong>Enter</strong> Select and <strong>Enter</strong> the multiplier of the totalized flow (the numbers that were entered at P4): 0001, 0010, 0100, or 1000. In this example: 0100.</td>
</tr>
<tr>
<td></td>
<td>16 SECOND PAUSE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td><strong>Start</strong> Starts the 05 mode. Display begins counting down the time to the first analog voltage (current) sample.</td>
</tr>
</tbody>
</table>

00:01
OPTION A1

PROGRAMMABLE LEVEL MODE

* 06

The user selects any vertical unit and uses or does not use a decimal point as required. All entries must have the implied decimal in the same position. The resolution is 0.4% of the span.

This example uses a span of 34.5 vertical units, having a maximum of 37.0 and a minimum of 2.5 units. (Refer to Figure 1-6.)

---

![Diagram of control panel with buttons and numbers]

---

<table>
<thead>
<tr>
<th>STEP</th>
<th>DISPLAY BEFORE NEXT KEY IS PRESSED</th>
<th>NEXT, PRESS</th>
<th>RESULT:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>RESET</td>
<td>LED's identifying current operating mode, if any, come on for 10 seconds.</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>RESET</td>
<td>Cancels current mode. Displays real time clock.</td>
</tr>
<tr>
<td>3</td>
<td>4400</td>
<td>* 0 6</td>
<td>Select and ENTER * 06 mode.</td>
</tr>
<tr>
<td>4</td>
<td>HL 0370</td>
<td></td>
<td>SETTING THE SPAN: Select the upper limit of the span in vertical units.</td>
</tr>
<tr>
<td></td>
<td>0370</td>
<td>ENTER</td>
<td></td>
</tr>
</tbody>
</table>

Page 3-22
### Option A1
**Programmable Level Mode (continued)**

<table>
<thead>
<tr>
<th>Step</th>
<th>Display Before Next Key Is Pressed</th>
<th>Next, Press</th>
<th>Result:</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>LL</td>
<td>0 0 2 5</td>
<td>Select the lower limit of the span in vertical units.</td>
</tr>
<tr>
<td></td>
<td>00 25</td>
<td>Enter</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>L 01</td>
<td>0 0 4 0</td>
<td>Select the lowest sampling level. It must be greater than LL.</td>
</tr>
<tr>
<td></td>
<td>00 40</td>
<td>Enter</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>L 02</td>
<td>0 1 2 5</td>
<td>Select up to 49 more sampling levels in increasing sequence. If the highest sampling level is to be equal to HL, it must be entered again here.</td>
</tr>
<tr>
<td></td>
<td>. . .</td>
<td>. . .</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>L 07</td>
<td>0 3 7 0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0370</td>
<td>Enter</td>
<td></td>
</tr>
</tbody>
</table>

START the sequence.
OPTION A1

PROGRAMMABLE HYDROLOGIC
STAGE MODE

This mode samples a hydrologic event as the water level rises and then falls.

Following are the required and optional hydrologic stage parameters, in the order in which they are prompted for by the display. Up to 6 levels may be programmed.

REQUIRED:

HH Level corresponding to maximum analog signal.
HL Level corresponding to minimum analog signal.
EH Differential rising level which causes a sample to be taken.
EL Differential falling level which causes a sample to be taken.
L 01 The level above which sampling begins and below which sampling stops.
P 01 The default time associated with L 01.

OPTIONAL:

L 02 A level greater than L 01 above which default time P 02 between samples is used.
P 02 Default time associated with L 02.

L 06 The highest stage level.
P 06 Default time associated with L 06.

The following is an example of how to program the * 09 mode. For simplicity, only two of the six possible stage levels are used. (See Figure 1-7).
(Note that any height unit may be used, but time is always in hours and minutes.)

HH 65 FEET
HL 4 FEET
EH 4 FEET
EL 6 FEET
L 01 10 FEET
P 01 5 HOURS
L 02 25 FEET
P 02 2 HOURS
## PROGRAMMABLE HYDROLOGIC STAGE MODE

### OPTION A1

**Display Before Next Key Is Pressed**

<table>
<thead>
<tr>
<th>NEXT PRESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>09</td>
</tr>
</tbody>
</table>

**Result:**

- LED’s identifying current mode, if any, come on for 30 seconds.
- Cancels current mode. Displays real time clock.

<table>
<thead>
<tr>
<th>0650 ENTER</th>
</tr>
</thead>
</table>

1. Select the *09 function.

2. **HH:** 0650

   Select HH = 65.0 FEET

3. **HL** 0040

   Select HL = 4.0 FEET
<table>
<thead>
<tr>
<th>STEP</th>
<th>DISPLAY BEFORE NEXT KEY IS PRESSED</th>
<th>NEXT, PRESS</th>
<th>RESULT:</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>0040</td>
<td>ENTER</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>EH 0040</td>
<td>0040</td>
<td>Select EH = 4.0 FEET</td>
</tr>
<tr>
<td></td>
<td>EL 0060</td>
<td>ENTER</td>
<td>Select EL = 6.0 FEET</td>
</tr>
<tr>
<td>6</td>
<td>L 01 01 01 00</td>
<td>ENTER</td>
<td>Select L 01 = 10.0 FEET</td>
</tr>
<tr>
<td></td>
<td>PAUSE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>P:01 05:00</td>
<td>0500</td>
<td>Select P 01 = 5 hours</td>
</tr>
</tbody>
</table>

Controller corrects L 01 to the nearest N/256 of the span.
**OPTION A1**

**PROGRAMMABLE HYDROLOGIC STAGE MODE**

<table>
<thead>
<tr>
<th>STEP</th>
<th>DISPLAY BEFORE NEXT KEY IS PRESSED</th>
<th>NEXT, PRESS</th>
<th>RESULT:</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>L 02</td>
<td>0250</td>
<td>Select L 02 = 25.0 FEET</td>
</tr>
<tr>
<td></td>
<td>0250</td>
<td>ENTER</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>PAUSE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0249</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>P :02</td>
<td>0200</td>
<td>Select P 02 = 2 HOURS</td>
</tr>
<tr>
<td></td>
<td>02:00</td>
<td>ENTER</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>L 02</td>
<td>* START</td>
<td>Start the sequence.</td>
</tr>
</tbody>
</table>

Controller corrects L 02 to nearest N/256 of the span.

No sample will be taken until the water level rises to, or above L 01.
**OPTION A2**

**ADJUSTABLE PURGE & DRAW**

This function may be appended to any time or flow function.

* 03

<table>
<thead>
<tr>
<th>STEP</th>
<th>DISPLAY BEFORE NEXT KEY IS Pressed</th>
<th>NEXT, PRESS</th>
<th>RESULT:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>0 *</td>
<td>ENTER any mode and sequence but do not press START yet. Select and ENTER * 03 function.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>03</td>
<td>ENTER</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>P _</td>
<td>0 0 9</td>
<td>Select purge time seconds—3 digits. Minimum = 5 seconds Maximum = 25 seconds</td>
</tr>
<tr>
<td></td>
<td>P009</td>
<td>ENTER</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>D _</td>
<td>0 0 7</td>
<td>Select draw time seconds—3 digits. Minimum = 5 seconds Maximum = 125 seconds</td>
</tr>
<tr>
<td></td>
<td>0007</td>
<td>ENTER</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>START</td>
<td>START the sequence.</td>
</tr>
</tbody>
</table>

Page 3-28
OPTION A2
PROGRAMMABLE MULTIPLE
TIME INTERVALS
(MAXIMUM OF 12 DIFFERENT INTERVALS)

EXAMPLE: OF 2 DIFFERENT INTERVALS:
IMMEDIATE START:

10 events 1 hours intervals
7 events at 2 hours intervals

RESULT:

1

RESET

2

RESET

Cancels current mode. Displays real
time clock.

3

09:16

*

Select * 04 function. TIME LED comes
on.

- 0 4

04

ENTER

Select 1 hour intervals.

0001

01:00

ENTER

0001

ENTER

0002

ENTER

Press ENTER ten (10) times to pro-
gram ten 1 hour intervals.
## OPTION A2

**PROGRAMMABLE MULTIPLE TIME INTERVALS**

<table>
<thead>
<tr>
<th>S</th>
<th>T</th>
<th>DISPLAY BEFORE</th>
<th>E</th>
<th>NEXT KEY</th>
<th>PISPRESSED</th>
<th>NEXT, PRESS</th>
<th>RESULT:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4</td>
<td></td>
<td>5</td>
<td>0010</td>
<td>02:00</td>
<td>ENTER</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td></td>
<td>6</td>
<td>0001</td>
<td>0002</td>
<td>ENTER</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0</td>
<td></td>
<td>6</td>
<td>0007</td>
<td>01:00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Select and ENTER 2 hour interval.

Press ENTER seven (7) times to program seven 2 hour intervals.

Exits from * 04 mode and permits DELAY START, MULT. SAMPLE or MULT. BOTTLE to be programmed before STARTing if desired.

Start the sequence. The first time interval begins counting down.
INDEPENDENTLY TIMED SPOUT ADVANCE

The *01 function allows the spout to advance at a selected time interval regardless of the flow. Samples are triggered only by a flow contact closure while bottle advance is triggered only by the timer. The result is a sample volume in each bottle proportional to the volume of flow during that time period.

NOTE: When using this option, be sure the sample volume is small enough compared to the flow rate to avoid overfilling a sample bottle. There is no overflow protection in this mode.

To activate the *01 mode, proceed as follows:

<table>
<thead>
<tr>
<th>STE P IS PRESSED</th>
<th>NEXT, PRESS</th>
<th>RESULT:</th>
</tr>
</thead>
<tbody>
<tr>
<td>O RES E T</td>
<td>O RES E T</td>
<td>Display continues as before. LED's identifying current mode come on for 30 seconds.</td>
</tr>
<tr>
<td>O RES E T</td>
<td>O RES E T</td>
<td>Cancels current mode. Displays real time clock.</td>
</tr>
<tr>
<td>4400</td>
<td>O T I M E</td>
<td>Select TIME mode. TIME LED comes on.</td>
</tr>
<tr>
<td>--</td>
<td>0 1 0 0</td>
<td>Select override time: Hours; Minutes.</td>
</tr>
<tr>
<td>01:00</td>
<td>E N T E R</td>
<td>ENTER the override time.</td>
</tr>
<tr>
<td>O 101</td>
<td>E N T E R</td>
<td>Select the *01 mode.</td>
</tr>
<tr>
<td>01</td>
<td>O F L O W</td>
<td>ENTER the *01 mode.</td>
</tr>
<tr>
<td></td>
<td>O F L O W</td>
<td>Select FLOW.</td>
</tr>
</tbody>
</table>
INDEPENDENTLY TIMED SPOUT ADVANCE

<table>
<thead>
<tr>
<th>STEP</th>
<th>DISPLAY BEFORE NEXT KEY IS Pressed</th>
<th>NEXT, PRESS</th>
<th>RESULT:</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td></td>
<td>START</td>
<td>START the sequence.</td>
</tr>
<tr>
<td>0000</td>
<td></td>
<td></td>
<td>Display counts the total number of external flow contact closures.</td>
</tr>
<tr>
<td>0001</td>
<td></td>
<td></td>
<td>First sample is taken on first external closure.</td>
</tr>
</tbody>
</table>

* * *

* * *

* * *

0123

Sequence stops after 24 time periods/bottles.
4.0 MAINTENANCE AND TROUBLESHOOTING

4.1 Maintenance

4.1.1 Preface

The S-4401 Portable Discrete Sampler requires only minimal maintenance to assure proper and reliable operation. Figure 4-1 is an exploded view of the sampler with callouts and accompanying parts list.

4.1.2 Inspection

The following procedures are recommended after each 300 hours of sampler operation or more frequently in very dirty installations.

a. Separate the equipment chassis subassembly from the top cap and bottle case.

b. Remove the battery.

c. Using a hose, thoroughly spray the splash shield on the underside of the equipment chassis with water.

d. Remove the moisture with a rag or blow dry with compressed air.

4.1.3 Cleaning Sampler Interior

a. Rinse the intake strainer using methylene chloride or other non-ketone solvent that will not affect the next sample collections.

b. Place the equipment chassis on the bottle case, immerse the intake hose in clean water, connect the battery and press TEST CYCLE. Repeat the TEST CYCLE several times.

4.1.4 Cleaning the Measuring Chamber

a. Unscrew the top of the chamber.

b. Loosen the two hold-down knobs on each side of the chamber and remove the chamber.

c. Wash with methylene chloride or solvent and water. Maximum temperature of water 140°F for soaking, 212°F for short rinse.
Figure 4-1. Exploded View
4.1.5 Cleaning the Chamber Top

a. Remove the compressor and fill sense lines.

   **CAUTION:** This step is important to prevent water from getting into the tubing and causing the sampler to malfunction.

b. Wash the underside and top of the chamber top. Dry thoroughly with a soft, lint-free cloth.

c. Apply a light coating of grease to the O-ring on the underside of the chamber top.

d. Replace the chamber top on the chamber. Screw the locking ring down tight.

e. Reconnect the compressor and fill sense lines.

4.1.6 Cleaning the Control Panel

Use a mild cleaning solution such as Windex and wipe with a soft, lint-free cloth.

   **Avoid harsh cleaners such as detergents, solvents, etc., which can damage the panel. Do not use abrasives; they will scratch the panel surface. NEVER USE ACETONE!**

4.1.7 Removal and Replacement of Controller and PC Boards

To remove the controller, remove the eight round-head Phillips screws from the keyboard. Lift the controller assembly out of the equipment chassis. Loosen the 15 terminal screws and cast off the wiring harness.

The three or four printed circuit boards making up the electronics portion of the sampler are individually removable for repair or replacement. To remove a particular circuit board, see Figure 4-2.

Immediately before replacing the controller back in its housing, remove and replace the zerust sponge (Part number 60033).

4.1.8 Cleaning the Sampler Exterior

Assemble the equipment chassis to the bottle case, install the cover, and latch it securely. Rinse exterior with water. Remove clinging dirt or sludge with a cloth or a soft brush while washing down.
4.1.9 Fuse Access

The 3 AG fuses rated 10 amp, 32 volts are located in the fuse holders on the underside of the equipment chassis. See Figure 1-4 for fuse locations.

4.2 Troubleshooting (See Table 4-1)

Troubleshooting instructions are based on analyses which follow a logical sequence of events leading to a malfunction. When a trouble occurs, look for the obvious possibilities first. Is the power supply connected? Are connections loose or wires broken? Is the sample bottle full? Review the malfunction, review normal operation, then check one possibility at a time starting with the easiest to verify.
Figure 4-2. S-4401 Controller Connection Diagram
Figure 4-3. Disassembling the Controller
<table>
<thead>
<tr>
<th>TRouble</th>
<th>Probable Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Nothing works</td>
<td>1. Loose connection</td>
<td>Tighten connectors.</td>
</tr>
<tr>
<td></td>
<td>2. Fuse blown</td>
<td>Replace fuse.</td>
</tr>
<tr>
<td></td>
<td>3. Controller problem</td>
<td>Repair/Replace controller.</td>
</tr>
<tr>
<td>B. Weak draw</td>
<td>1. Air leaks</td>
<td>Be sure hold-down knobs of chamber are tight.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check tubing and fittings.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check seals in chamber.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Replace parts.</td>
</tr>
<tr>
<td></td>
<td>2. Pinched intake hose</td>
<td>Relieve pinching.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Replace damaged hose.</td>
</tr>
<tr>
<td></td>
<td>3. Clogging</td>
<td>Clean hose and lines.</td>
</tr>
<tr>
<td></td>
<td>1. Intake hose drawing air</td>
<td>Reposition intake strainer to avoid taking air.</td>
</tr>
<tr>
<td>Short samples:</td>
<td>a. Sample spurts into chamber intermittently,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>triggering fill sensor with approx. ¼ sample</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. See “Weak Draw”</td>
<td></td>
</tr>
<tr>
<td>D. Compressor runs,</td>
<td>1. Leaks</td>
<td>With the chamber top off, check to see if compressed air is coming out through hole inside chamber top. If not, fault is in compressor or valves or tubing. If air is getting into the chamber, then pinch valve is not closing. Repair pinch valve.</td>
</tr>
<tr>
<td>but no purge</td>
<td>2. Pinch valve not closing</td>
<td>a. Check voltage at solenoid; if 12 VDC, then pinch solenoid needs to be replaced. If no voltage, replace controller.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. Check battery.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>c. Check pinch tube; replace if damaged.</td>
</tr>
<tr>
<td></td>
<td>3. Controller not giving signal</td>
<td>With a Battery Voltmeter check for 12VDC at solenoid valve. If no voltage, replace controller.</td>
</tr>
<tr>
<td>TROUBLE</td>
<td>PROBABLE CAUSE</td>
<td>REMEDY</td>
</tr>
<tr>
<td>---------</td>
<td>----------------</td>
<td>--------</td>
</tr>
<tr>
<td>E. Sample drains slowly or not at all from chamber to bottle</td>
<td>1. Clogged spout 2. Controller not functioning 3. Inoperative pinch valve</td>
<td>Clean spout. 12 VDC to pinch valve stays up. Replace controller. Check pinch hose for clogging and pinch valve for operation during cycle.</td>
</tr>
<tr>
<td>Chamber overfilling, cycling double at fill</td>
<td>1. Fill sensor inoperative 2. Fill sensor tubes leak or full of water</td>
<td>Replace fill sensor. Replace tubing.</td>
</tr>
<tr>
<td>G. Sampler will not start cycle</td>
<td>1. Bottle-full sensor activated</td>
<td>Replace full bottle with empty bottle.</td>
</tr>
<tr>
<td>H. Compressor runs half-heartedly</td>
<td>1. Connections loose 2. Battery voltage below 10.8 VDC</td>
<td>Tighten connectors, check wires, resolder any loose wires. Charge or replace battery.</td>
</tr>
<tr>
<td>I. Runs and appears to constantly purge</td>
<td>1. Fill sensor failed</td>
<td>Check by removing sensor wires. Start sample cycle. When draw starts, touch wires together. If draw stops and purge begins, the sensor is bad. Replace sensor. If not replace controller.</td>
</tr>
<tr>
<td>L. Sampler works part of the time</td>
<td>1. Check bottle full condition 2. Battery voltage low 3. Control panel component failure or faulty PC board</td>
<td>Install empty sample bottle. Charge or replace battery. Replace control panel or PC board.</td>
</tr>
</tbody>
</table>
5.0 CONNECTING THE A1 ANALOG OPTION INPUT

The analog input may take any one of the four different forms: 4-20 mA, 0-20 mA, 1-5 Volts DC, or 0-1 Volt DC. All samplers are connected for 4-20 mA when shipped unless specified otherwise on the purchase order. To reconnect for a different current or voltage input, simply RE-SOLDER the W1 and W2 jumpers on the analog option PCB (shown in Figures 4-3 and 5-1) to the appropriate new positions shown in Figure 5-1.

IMPORTANT: THE WORK SHOULD BE DONE IN AN ATMOSPHERE OF LOW HUMIDITY. REPLACE THE ZERUST CAPSULE BEFORE CLOSING UP THE CONTROLLER.
A. 4-20 ma INPUT
All samplers equipped with the A1 ANALOG INPUT option are shipped with this 4-20 ma connection unless specified differently on the purchase order.

B. 4-20 ma
1.5 VDC
0-20 ma

C. 1.5 VOLT INPUT

D. 0.1 VOLT INPUT

FIGURE 5.1 Detail view of the A1 ANALOG OPTION PC Board 05830-000, showing how to connect the W1 and W2 jumpers to select any one of the 4 analog input current or voltage ranges.