

LIQUID SOLIDS CONTROL



INSTRUCTION MANUAL

MODEL 1022 AUTOMATIC DIVERT SYSTEM

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LSC Model 1022

AUTOMATIC LIQUOR DIVERT SYSTEM

INSTRUCTION MANUAL

May 26, 2015

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- Wiring in Figures 6A & 6B was corrected May 26, 2015

TABLE OF CONTENTS

1. INTRODUCTION AND OVERVIEW	1
2. HARDWARE INFORMATION	4
2.1 C.P.U. BOARD	4
2.1.1 REPLACING THE C.P.U. BOARD	5
2.2 POWER SUPPLY BOARDS: PC-3.....	5
2.3 RELAY BOARDS: PC-2	5
2.4 REFRACTOMETER BOARD PC-4 (PG. 49 JUMPER CONFIGURATION)	6
2.4.1 TRIM POT ADJUSTMENTS	6
2.4.2 POTENTIOMETER DIALS.....	6
2.5 SIGNAL DISTRIBUTION BOARD (PC-5)	6
2.6 PROGRAMMING DIAGNOSTIC INFORMATION MODULE.....	8
2.7 THE OPERATOR'S PANEL.....	8
2.7.1 LED INDICATORS.....	8
2.7.2 RESET KEY AND EMERGENCY DIVERT PUSH BUTTON	9
3. INSTALLATION	9
3.1 SENSING HEAD INSTALLATION	9
3.2 STEAM REQUIREMENTS.....	9
3.3 ELECTRICAL INSTALLATION	9
3.4 INITIAL START-UP	9
3.4.1 INITIAL SYSTEM SETTINGS	13
4. DIVERT OPERATION.....	15
4.1 GENERAL DESCRIPTION	15
4.2 THE OPERATOR'S PANEL.....	15
4.2.1 LED INDICATORS.....	16
4.2.2 RESET KEY AND EMERGENCY DIVERT PUSH BUTTON	16
4.3 PRISM WASH	16
4.3.1 STANDARD PRISM WASH.....	16
4.3.2 SMART PRISM WASH.....	17
5. DIVERT MAINTENANCE.....	17

6. REFRACTOMETER.....	38
6.1 THEORY OF OPERATION	38
6.2 INTERNAL COMPONENTS OF SENSING HEAD.....	38
6.2.1 LAMP ASSY.	38
6.2.2 DETECTOR ASSY.	38
6.2.3 TEMPERATURE SENSOR ASSY.....	38
6.2.4 PRISM ASSY.	39
6.3 REFRACTOMETER CALIBRATION	39
6.3.1 CALIBRATION PROCEDURE.....	39
6.4 REFRACTOMETER MAINTENANCE	41
6.4.1 PRISM REPLACEMENT	41
6.5 PRISM WASH CHECK VALVE REPLACEMENT.....	41
7. GATE ADAPTOR	42
7.1 GATE ADAPTOR MAINTENANCE.....	42
7.1.1 REMOVAL AND ANNUAL REBUILD OF GATE ADAPTORS	42
7.1.2 GATE ADAPTOR REASSEMBLY	43
8. SPARE PARTS.....	46
9. APPENDIX A: GLOSSARY OF TERMS.....	47
9.1 ALARMS AND EVENT MESSAGE	47

1. INTRODUCTION

The LSC Automatic Black Liquor Divert System monitors the refractive index and hence the “percent dissolved solids” of black liquor being fired in a Kraft Recovery Boiler, and signals the presence of dangerous low-solids liquor. The object of this manual is to familiarize maintenance and the operating personnel with the functions and technical aspects of the system.

The Automatic Black Liquor Divert System is comprised of several principal components:

- The 1022 Processor
- Dual Refractometers
- Operator Interface Panel
- The Pipe Section
- Gate Adaptor with Limit Switches
- Prism Wash Ball Valves with Solenoids
- Hard copy / printer (optional)

A typical installation is illustrated in Figure 1 (next page).

The 1022 “Automatic Divert Processor” monitors the signals from the sensing heads. The unit can be wired in many configurations, allowing the system to stand alone (power the divert valve) or to be integrated with a DCS or Burner Management System through discrete contact outputs. User friendly software with on screen prompting allows for easy access to all information on the programming and diagnostic module in the processor enclosure.

The system will also divert for several other reasons, such as:

- AUX DIVERT
- MANUAL DIVERT
- LOSS OF POWER
- LOSS OF CPU CONTROL

The Model 1022 system is designed to operate by the following rule: “if for any reason, BOTH refractometers are out of service, the System will immediately divert the liquor.”

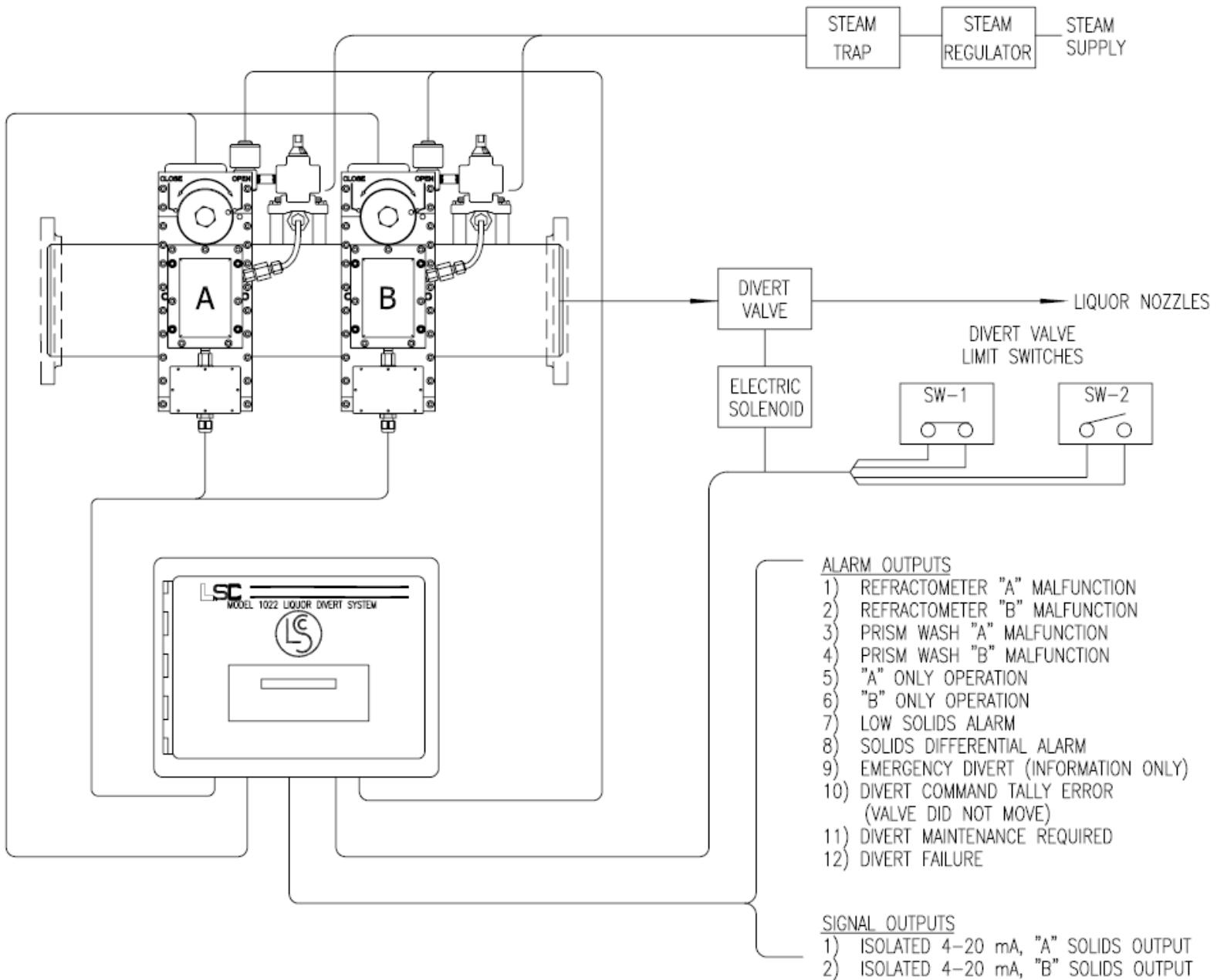
All causes for a divert will be logged to generate a “First out” report. This information will be available from the Maintenance Screen inside the 1022 enclosure.

Once a Divert has occurred, for any reason, there will be a two (2) minute lock out restriction prohibiting reset of the system.

In order to “reset,” the two minute lock out time must pass and the liquor solids as indicated by at least one of the refractometers must be higher than the “emergency trip” set point.

* NOTE: “Aux divert” input must be satisfied.

Figure 1
Model 1022 Schematic



The Sensing Heads read the dissolved solids and signal to the Refractometer electronics. Automatic temperature compensation of the dissolved solid reading is provided within. An automatic prism wash cycle is provided every 20 minutes, alternating between heads. Indication of the prism wash can be seen on the operator interface panel. It is impossible to wash both refractometers simultaneously, either manually or automatically. The prism wash cycle also proves the sensing head is responding to liquor changes.

The CPU is responsible for:

- Monitoring the Refractometers
- Providing outputs to the Divert Valve
- Burner Management System Inputs
- Alarm status indication
- Troubleshooting
- Self - diagnostic
- Deciding dual or single Refractometer Operation
- Prism wash cycle
- Historical event memory
- Divert logic

A redundant power supply provides a secure voltage to the central processing unit, assuring maximum up-time for the system. When in the power supply backup mode, a system malfunction alarm is given, alerting the operator of its condition. The CPU does multiple checks of the data and programming integrity of all information in the system.

*** CPU failure in all cases will result in a failsafe situation (DIVERT).**

The Pipe Section, as its name implies, becomes a part of the black liquor feed line. Incorporated into it are:

- Two mounting plates for the gate adaptors
- Two flow deflection baffles
- Two ball valves for controlling wash steam to the sensing heads
- Check valves on the sensing heads

The gate adaptor is a thin-profile gate valve between the sensing head and pipe section so that the sensing head can be easily isolated from the active liquor line. A limit switch on the gate adaptor indicates to the CPU a closed position. The CPU will remove service any refractometer with a closed gate adaptor. Closing both gate adaptors will initiate a DIVERT. Between the opening of one gate, to the closing of the other be sure to wait 30 seconds --- failure to do so will cause a DIVERT.

2. HARDWARE INFORMATION

The 1022 processor is comprised of seven (7) main components	PART #	QTY
1) C.P.U Board (PC-1)	1022401	1
2) Relay Board (PC-2)	1022402	2
3) Power Supply Board (PC-3)	1022403	2
4) Refractometer Board (PC-4)	1022404	2
5) Signal Distribution Board (PC-5)	1022405	1
6) Programming Diagnostic Information Module	1022412	1
7) Operator Interface Panel	1022408	1

2.1 C.P.U. Board

The C.P.U. is responsible for:

- | | |
|---|---|
| ■ Monitoring the Refractometers | ■ Trouble shooting & Self-diagnostics |
| ■ Divert Logic | ■ Decide dual or single refractometer operation |
| ■ Providing outputs to the divert valve | ■ Prism wash cycle |
| ■ Burner Management system inputs | ■ Historical event memory |
| ■ Alarm status information | |

The C.P.U. board is located in the center of the unit, and has five indicator lights on it. These function lights indicate the status of the unit at all times. There are three red lights and two green lights.

From top to bottom as you look at the C.P.U.:

- **Red Top Light** - Indicates a power failure
- **Red middle Light** -Indicates a run fail error.
- **Red Bottom Light** - Indicates a check sum error or a EPROM malfunction
- **Top Green Light** - C.P.U. running
- **Bottom Green Light** - Power good

If for any reason the system is malfunctioning, one or both of the green indicators will be off, and one, two, or three of the red indicators will be illuminated. The system may be reset by pushing and holding the black switch located below the two green indicators for 10 seconds.

*** NOTE: When resetting the unit the system will divert if it has not already diverted, and the system should reset in approximately 10 seconds.**

2.1.1 Replacing the C.P.U. card

When replacing the C.P.U. board the system will divert. This is one of three cards you cannot change while the system is operating without causing a divert. When booting up the replaced card and the set points on the new card differ from those programmed into the previous C.P.U. card, the configuration mismatch screen will appear, the display panel will indicate "Display Link IDLE" and the top red light and the bottom green light will be illuminated.

There are three possibilities when at this screen:

1. DFLT

(Use default settings)

2. SITE

(Use site settings)

3. CPU

(Use CPU settings)

Choosing DFLT will use these settings:

Divert set point 58%
 Low solids set point..... 60%
 Refractometer set points
 Scale factor 4mA: 55%
 20mA 75%
 Divert valve travel 5 sec
 Brightness set to the Medium setting

Choosing the **SITE** option will result in the settings being the same as those used previously.

Choosing the CPU option results in the settings of that CPU to be used, whatever they are.

Any one of these selections will clear the CPU board malfunction, and will allow you to clear the divert condition if all other parameters are met.

2.2 Power Supply Boards: PC-3 (Two)

These boards supply the +5 Volts and +15 Volts to the CPU simultaneously. Failure of either board will initiate the "SysMaint" (System Maintenance) alarm. Failure of both boards will cause a divert. Either board can be replaced without interruption of service (One at a time).

2.3 Relay Boards: PC-2 (Two)

The PC-2 Relay Boards provide alarm contacts for the various alarms, as well as the divert contact. The divert contacts are "normally closed," and wired in series for redundancy. Opening (or removing) either of these contacts will cause a DIVERT. When a divert condition occurs, if there is a failure in the system, if one of the Relay boards is removed, or if there is a power failure, at least one of the contacts will open, causing a DIVERT. This redundancy is an important aspect of the fail safe system.

NOTE: Neither Relay Board can be removed during operation without causing a DIVERT.

2.4 Refractometer Board

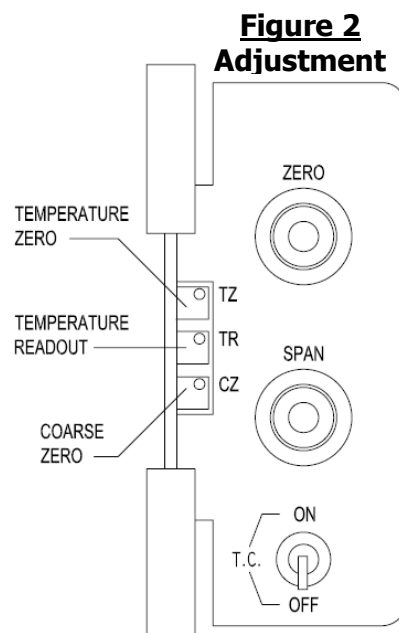
The refractometer board sends appropriate power to the L.E.D. light source and temperature sensor. With the aid of calibration set points, it transforms the return temperature signals into outputs proportional to concentrations (percent Solids).

2.4.1 Trim Pot Adjustments

- **TZ - Temperature Zero:** Adjust to approximately zero volts when the sensing head is at the process temperature. Refer to the refractometer screen for the TC voltage display, under the temperature Section. Voltage will then vary with process temperature.
- **TR - Temperature Read out:** Adjust the temperature trim pot to the process temperature in degrees C when the sensing head is at process temperature. Outlined in more detail in the calibration section. Refer to the refractometer screen under the temp section.
- **CZ - Coarse Zero:** This is the coarse adjustment for the low end of the scale factor.

2.4.2 Potentiometer Dials

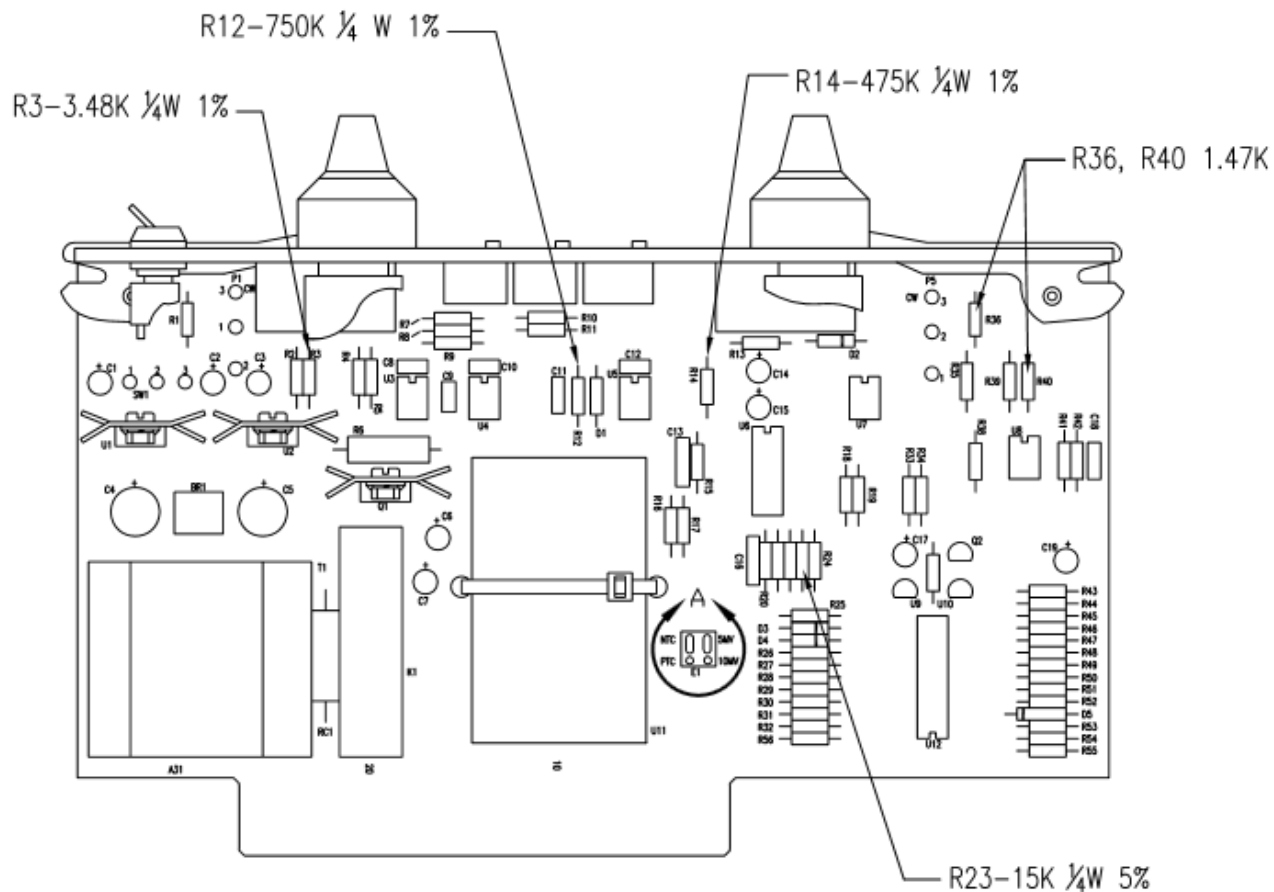
- **ZERO** - This provides the fine adjustment of the low end scale factor.
- **SPAN** - This provides the fine adjustment of the high end scale factor.
- **T.C.** - (On/Off Switch) Turns automatic temperature compensation on or off.
Set to "ON" for normal operation, "OFF" for "off-line" calibration.



2.5 Signal Distribution Board: PC-5 (Refer to Figure 6A. Page 10)

This board connects all other boards in the system, and is often referred to as the "motherboard." All internal and external wiring and signals are connected on this board. These connections include:

- Sensing Heads A and B. hooked up to TB5 and TB14 respectively.
- 4-20 mA, A and B, TB3 and TB12 respectively.
- AC signal to Prism wash solenoid A and B, TB1 and TB15 respectively.
- AC power input TB2 refractometer A, TB10 C.P.U. power, and TB16 refractometer B.
- Divert signal output to divert valve: either hot 110 or 220 AC, or a dry contact signal depending on your application. See Figure 6b, page 11, for proper wiring contacts on TB7
- Operator port outlet, TB9, this port is used if the operator panel is to be mounted remotely from the 1022 processor.
- Gate position sense A and B TB4 and TB13 respectively.
- Dry contact alarm outputs A-Only operation, A Refractometer Malfunction, A Prism Wash Fail, Low Solids Differential, Divert Fail and System Maintenance alarms on TB11.
- Dry contact alarm outputs B-Only operation, B Refractometer Malfunction, B-Prism Wash Fail, Solids Differential, Divert Fail and System Malfunction alarms on TB11.
- Dry contact divert valve position sense either divert position or non-divert position on TB7, position 1,2,3, and 4.
- Printer interface outlet TB8

**Jumper shown for**

M-725 sensing head with the #829114 temperature sensor. (Orange and brown wires)

Jumpers shown for

M-614 sensing head with the #614300 temperature sensor. (Green with white stripe and brown wires)

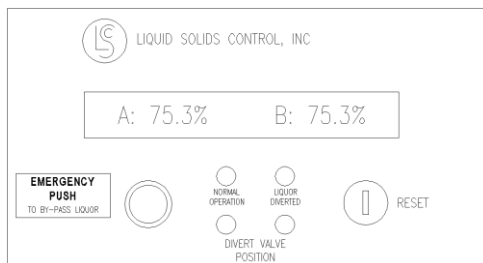
2.6 Programming Diagnostic Information Module

This touch pad screen control allows you to view and input the operating parameters of the system. See screen display panels for more in-depth information about the operation of the module.

2.7 The Operator's Panel

From the operator's panel the Boiler Operator will know the Black Liquor solids level as well as the status of the system.

Figure 3
Operator's Panel



The operator's panel will indicate when a refractometer is being washed by replacing the unit letter and colon with a "WH" for wash and hold. A single "H" indicates the continuing hold time.

If for any reason a refractometer is out of service, the solids indication will read "-OUT-". This will result in an alarm as well as automatic switch over to the remaining in-service refractometer.

A refractometer will be taken out of service for the following reasons:

- Gate adaptor closed for calibration or servicing of the unit
- Component failure within the refractometer
- Individual refractometer power shut off
- Failing the SMART WASH criteria

If BOTH Refractometers are out of service for any reason, the System will

Immediately divert the liquor. All causes for a refractometer being taken out of service will be logged and will be available from the Maintenance Screen inside the 1022 enclosure.

2.7.1 Led Indicators

WH 75.3 %	B: 75.3 %
-----------	-----------

An additional indication of a refractometer being out of service will be the Green "NORMAL OPERATION" LED flashing at a one-second interval. If the LED goes out completely it means one of the Divert power supplies needs servicing.

A: -OUT-	B: 75.3 %
----------	-----------

The Red "LIQUOR DIVERTED" LED is not only an indication of the Divert command, but also the divert valve(s) status. When a divert is initiated the LED will flash at a fast rate (several times a second) until the divert valve(s) move to the liquor diverted position. This will be indicated by the "DIVERT VALVE POSITION" LEDs. The Red LED indicates that the liquor is diverted and the Green LED indicates that the divert valve(s) is (are) in the firing liquor position. When a reset is initiated, the "LIQUOR DIVERTED" LED will flash slowly (once per second) until the divert valve(s) return to the firing liquor position.

2.7.2 Reset key and Emergency Divert Push Button

Reset - WAIT 119 Sec

The "EMERGENCY PUSH" manual divert button is available to the boiler operator at all times. Once the button has been pushed, there is a 10 second grace period that will allow an immediate reset in case of an accidental divert. After that there will be a 2 minute lock-out of a reset. Trying to use the "RESET KEY" before the 2 minutes has elapsed will result in a message being displayed indicating the remaining time, as illustrated above.

After the two minute lock out time has expired, and the percent solids indicated by at least one of the refractometers is higher than the "emergency trip" set point, then a reset is permitted.

3. INSTALLATION

3.1 Sensing Head Installation

A typical sensing head installation is illustrated in Figure 5 on the next page.

3.2 Steam Requirements

To achieve an effective prism wash, in most black liquor applications, the steam requirements are:

- * 80 to 85 psi of saturated steam over and above the process line pressure.
- * Tubing arrangement as shown in Figure 4 below.

This tubing arrangement allows two to three seconds of steam/condensate mixture to precede the full steam pressure.

3.3 Electrical Installation

The basic system wiring is illustrated in Figure 6 (Pages 10 & 11). All wiring must be performed by a qualified industrial electrician, per local electrical codes.

3.4 Initial Startup

Before powering up the system check once more to see that all the external wiring to the unit is connected as shown in Figure 6. The programming and diagnostic module should now be illuminated. If not, adjust the intensity of the screen with the dial on the bottom right hand corner of the module. The main menu should now be visible on the screen. Proceed to set the alarm position, time and operating conditions for the mill requirement.

Figure 4
Prism Wash Tubing Installation

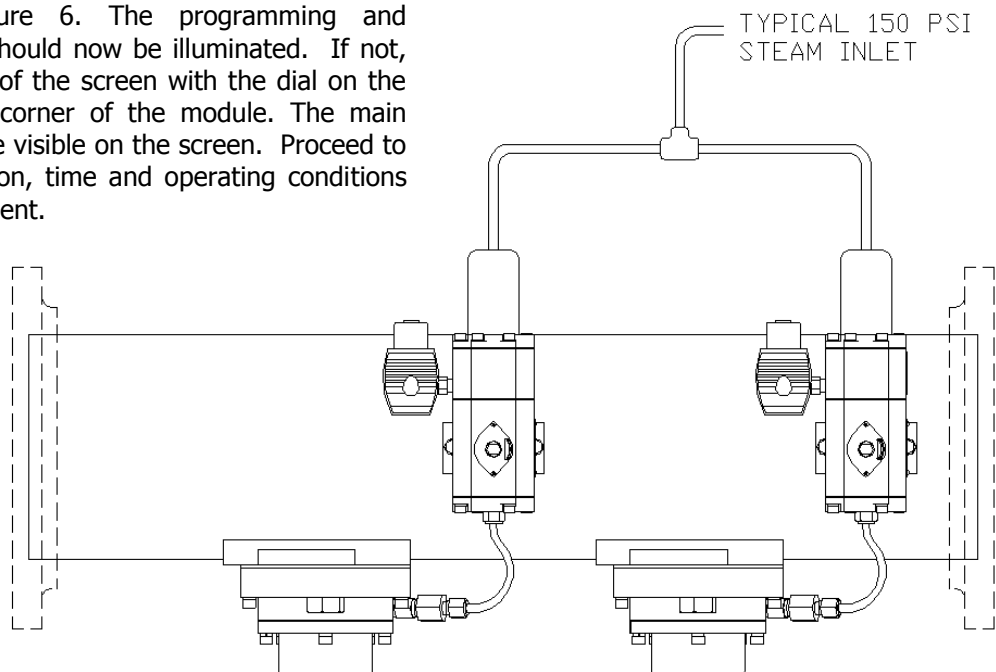


Figure 5
Installation using Gate Adaptors

LSC P/N 190302 (Air to open / Spring to close)
LSC P/N 190305 (Air to open / Air to close)
Complete Prism Wash Ball Valve with
Actuator and solenoid.

If necessary, the 1/4" Ball
Valve can be ordered by
itself LSC P/N 190310

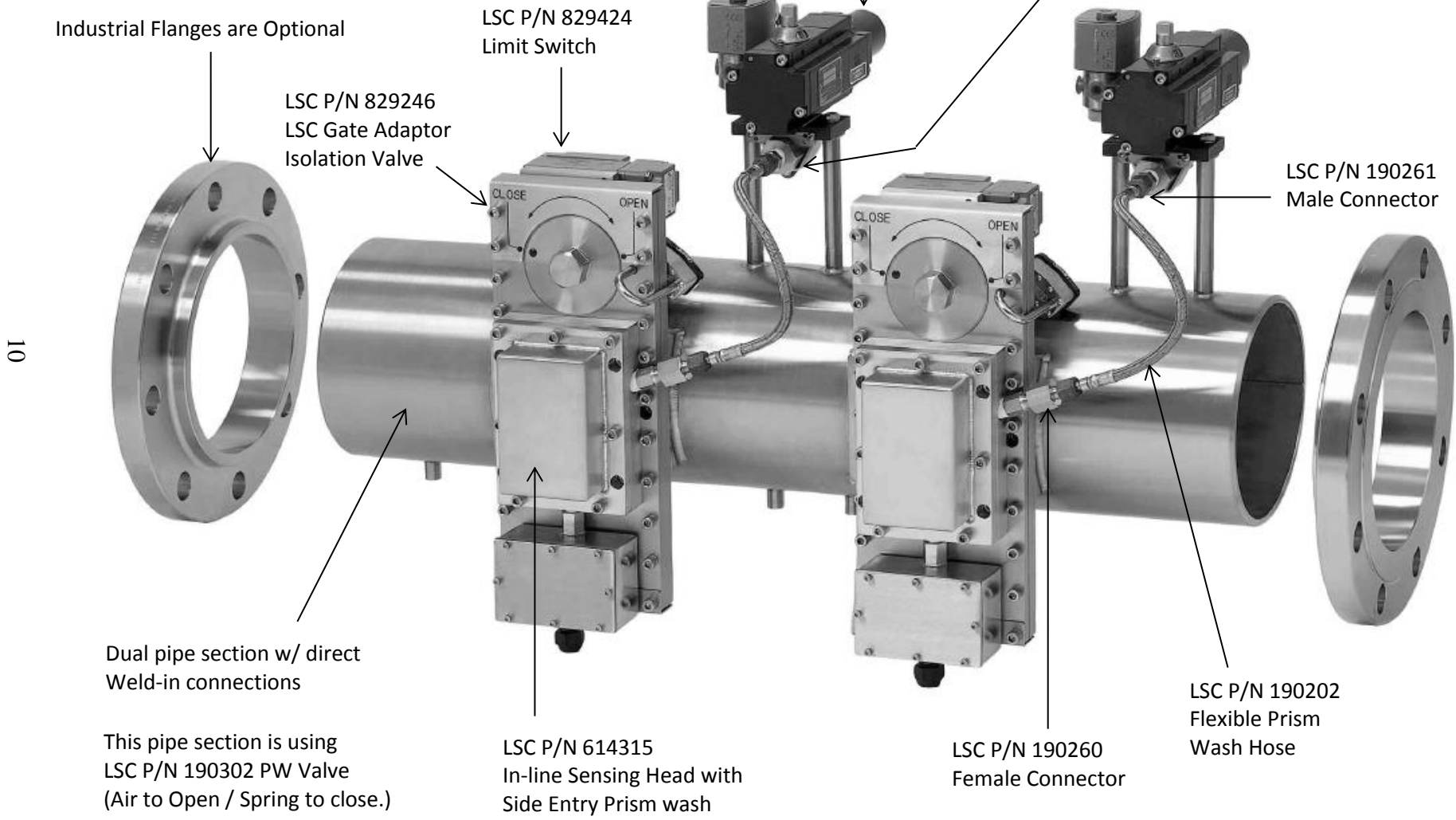


Figure 6A
Model 1022 Wiring Diagram
(Motherboard)

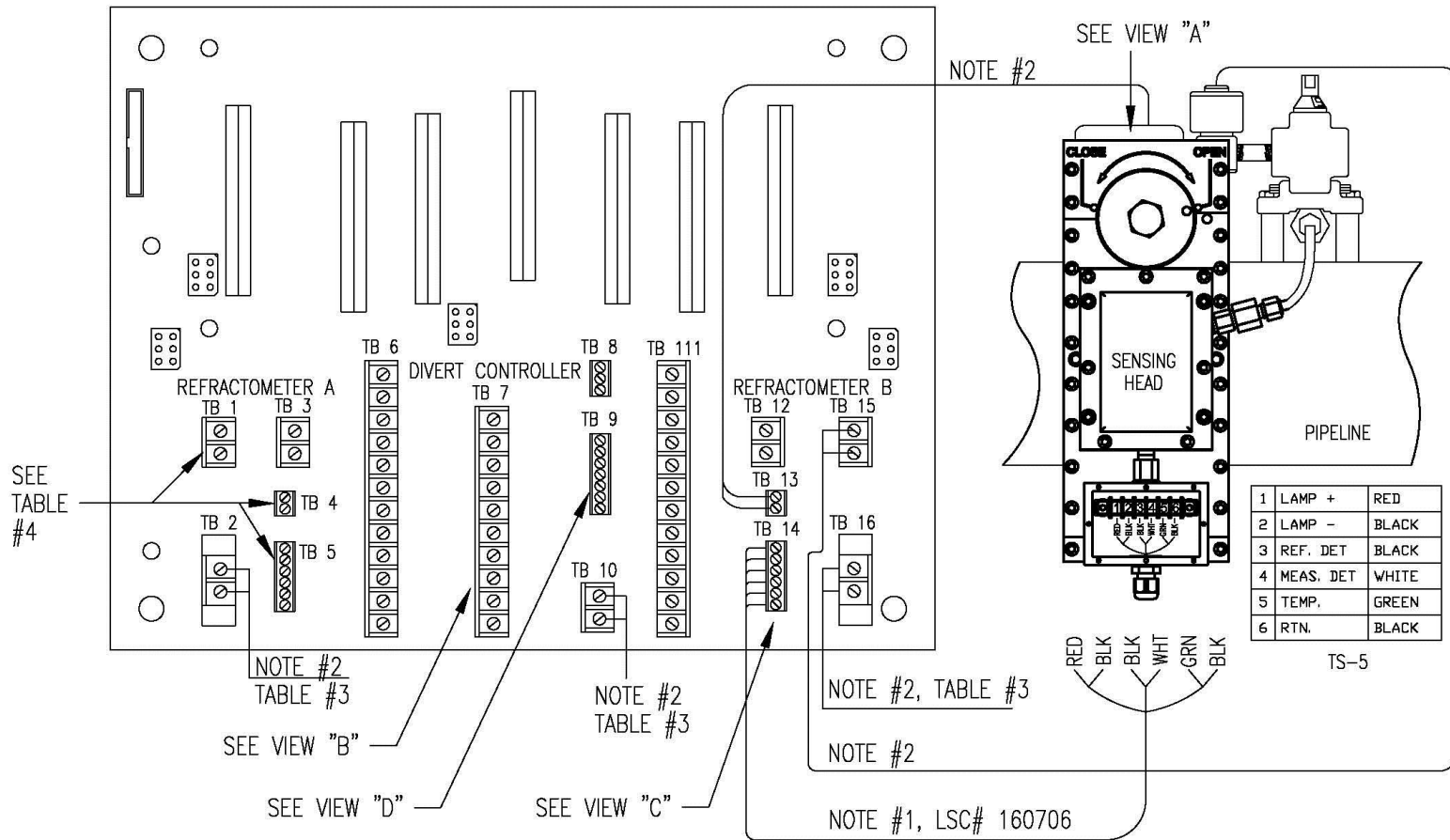


Figure 6B
Model 1022 Wiring Diagram (Detail views)

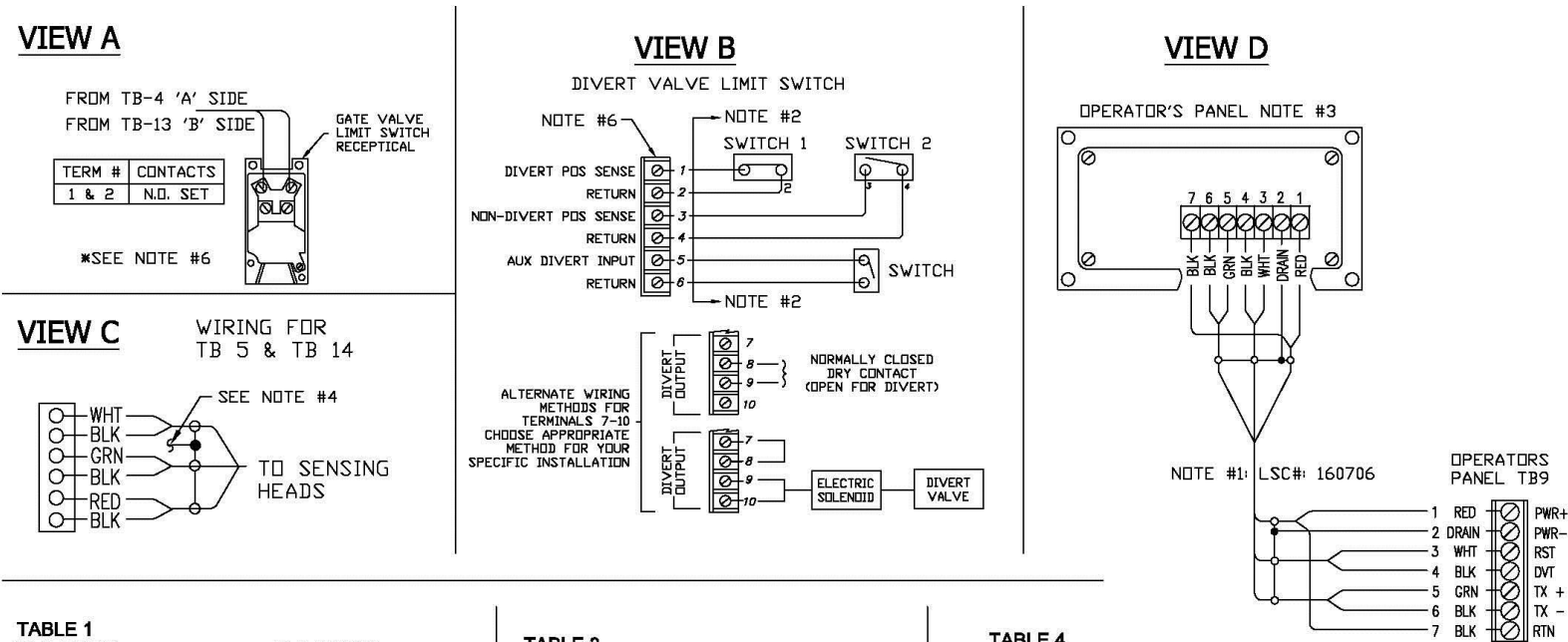


TABLE 1
TB-6, ALARMS 1

TERM #	DESCRIPTION
1	A-ONLY OPERATION
2	OPERATION
3	REFRACT MalfuCTION
4	REFRACT MalfuCTION
5	PRISM WASH FAIL
6	PRISM WASH FAIL
7	LOW SOLIDS
8	LOW SOLIDS
9	DIVERT
10	DIVERT
11	SYSTEM MAINTENANCE
12	SYSTEM MAINTENANCE

TABLE 11, ALARMS 2

TERM #	DESCRIPTION
1	B-ONLY OPERATION
2	OPERATION
3	REFRACT MalfuCTION
4	REFRACT MalfuCTION
5	PRISM WASH FAIL
6	PRISM WASH FAIL
7	SOLIDS DIFFERENTIAL
8	SOLIDS DIFFERENTIAL
9	DIVERT FAIL
10	DIVERT FAIL
11	SYSTEM MalfuCTION
12	SYSTEM MalfuCTION

NOTE: IN OPERATION NO ALARM CONDITION, RELAY COILS ARE ENERGIZED, PROVIDING AN OPEN CONTACT. CONTACTS CLOSE TO ALARM

TABLE 2
ISOLATED CURRENT OUTPUT

TERM #	REFRACT. A
1	+
2	- 4-20mA

TERM #	REFRACT. B
1	+
2	- 4-20mA

TABLE 3

POWER REQUIREMENTS		
TB-2	REFRACTOMETER 'A'	20 WATTS
TB-16	REFRACTOMETER 'B'	20 WATTS
TB-10	DIVERT CONTROLLER	45 WATTS

TABLE 4

TYPICAL WIRING A SIDE / B SIDE			
A SIDE		B SIDE	
TB-1	TYP	TB-15	PRISM WASH SOLENOID
TB-4	TYP	TB-13	GATE LIMIT SWITCH
TB-5	TYP	TB-14	SENSING HEAD CABLE

NOTES:

1. SUPPLIED BY LSC
2. CUSTOMER SUPPLIED
3. MAY BE LOCATED UP TO 500' AWAY FROM ENCLOSURE, WIRING IS NOT NECESSARY WHEN LOCATED ON ENCLOSURE DOOR.
4. CONNECT SHIELD TO GROUND STUD IN 1022 CABINET
5. SEE DWG# 1022604 FOR PRINTER INTERFACE WIRING (OPTIONAL)
6. DRY CONTACT SWITCHES. DO NOT SUPPLY ANY EXTERNAL VOLTAGE TO TB4, TB13, TB7 - TERMINALS 1,2,3,4,5, & 6

The 1022 has a battery backup and will retain all preset values in the event of a power failure. In order to set the appropriate set points, leave the main menu by selecting "MENU", then "SET". Notice the screen has changed to the "SET PARAMETERS" menu. This menu will be the starting point for the following settings. To return to this menu after each setting, press "EXIT" the appropriate number of times. See the illustrations in Section 5, Divert Maintenance, for a full description of each screen.

In each menu that requires settings, the screen will display: ++, >, --, and <.

- (++) Increases the digit at the cursor
- (>) Moves the cursor to the right one digit
- (--) Decreases the digit at the cursor
- (<) Moves the cursor to the left one digit.

3.4.1 Initial System Settings

A. Setting the Time and Date

Press "TIME", then adjust the appropriate time and date. Time is displayed in a 24 hour format, and must be adjusted for the bi-annual time change if recognized. The CPU has a built in calendar that is pre-programmed for leap years, so that once the date is set it should not have to be adjusted again.

B. Setting the Divert/alarm Set Points:

- For DIVERT/ALARM SET POINTS: Press "SETP"
- For DIVERT POINT: press "TRIP"

Adjust to mill specifications, as determined by mill management.
This is the point at which the 1022 will initiate a divert command.

***NOTE:** This set point cannot be adjusted below 58%, as specified by B.L.R.B.A.C. guidelines. If the percent solids drops to or below this setting, the unit will initiate a *DIVERT* signal. This signal is sent through a dry contact configuration or by removal of a 110/220 VAC output. These signals can be used to directly control equipment or provided to other management, control or safety systems for their divert decision making purposes.

C. Low % Alarm: Press "LOW %"

Adjust to mill specifications, as determined by mill management. The Low Solids alarm is intended to alert the boiler operator to the fact that the liquor solids content is approaching dangerously low values.

D. DIFF. Alarm:

This is a non-adjustable alarm pre-determined at 2% by B.L.R.B.A.C. 2% is the maximum difference in refractometer readings before the "%Diff" alarm is initiated ("set"). The solids differential alarm is intended to alert the boiler operator that the instrument requires technical attention.

E. Refractometer Scale Factor: Press “SF”

This is the setting of the 4-20 mA output which corresponds to the high & low % solids ranges. Prior to settings of the “Scale Factor” the appropriate gate adaptor must be closed and this is indicated by “CLOSED” beside A or B refractometers. The CPU will only allow you to proceed to the next step under this condition. Closure of both gate adaptors will initiate a divert.

1. Press “A” or “B”
2. Press 4 m A
3. Set the low end of the scale as per the scale factor. (I.e. 55%)
4. Exit back one menu to set the high end of the scale factor
5. Press 20 mA
6. Set the high end of the scale as per the scale factor. (I.e. 75%)
7. Exit back two menus, open the gate, wait 45 seconds and close the other gate. Follow the above procedure again.

F. Miscellaneous Parameters: Press “MISC”**Operator interface panel brightness:**

There are three possible settings for the brightness of the operator interface panel. Press “BRIT” to set at the desired light intensity.

Divert Valve Travel - Press “TRAV”:

This value is to be set at the period of time it takes for the divert to cycle. If the valve fails to complete its cycle in this allotted time a divert failure alarm will be initiated.

4. DIVERT OPERATION

4.1 General Description

The Model 1022 Automatic Divert System will provide a significant advancement in reliable divert system operation.

This system is designed to operate as "normal" with both refractometers in service. With both in service, Both must indicate low solids to initiate automatic liquor diversion. If one refractometer is "out of service," the other "in service" refractometer alone indicating low solids will initiate automatic liquor diversion.

The Model 1022 system is designed to divert according to the following conditions: "if for any reason BOTH refractometers are out of service, the System will immediately divert the liquor."

The system will divert for several other reasons, such as:

- AUX DIVERT
- LOSS OF POWER
- MANUAL DIVERT
- LOSS OF CPU CONTROL

All cases for divert will be logged to generate a "First out" report. This information will be available from the Maintenance Screen inside the 1022 enclosure.

Once a divert has occurred, for any reason, there will be a two (2) minute lock out restriction prohibiting reset of the system.

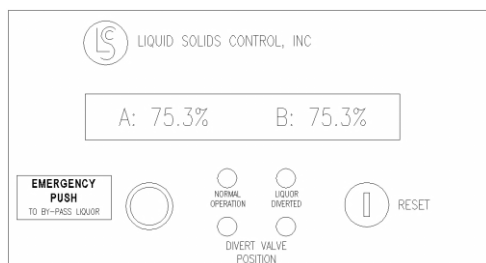
In order to "reset," the two minute lock out time must pass and the liquor solids as indicated by at least one of the refractometers must be higher than the "emergency trip" set point.

*** NOTE: "Aux divert" input must be satisfied.**

4.2 The Operator's Panel

From the operator's panel the Boiler Operator will know the Black Liquor solids level as well as the status of the system.

Figure 3
Operator's Panel



The operator's panel will indicate when a refractometer is being washed by replacing the unit letter and colon with a "WH" for wash and hold. A single "H" indicates the continuing hold time.

WH 75.3 %	B: 75.3 %
-----------	-----------

If for any reason a refractometer is out of service, the solids indication will read "-OUT-". This will result in an alarm as well as automatic switch over to the remaining in-service refractometer.

A: -OUT-	B: 75.3 %
----------	-----------

A refractometer will be taken out of service for the following reasons:

- Gate adaptor closed for calibration/servicing of the unit.
- Failing the SMART WASH criteria.
- Component failure within the refractometer.
- Individual refractometer power shut off.

NOTE: If BOTH Refractometers are out of service for any reason, the System will Immediately divert the liquor. All causes for a refractometer being taken out of service will be logged and will be available from the Maintenance Screen inside the 1022 enclosure.

4.2.1 Led Indicators

An additional indication of a refractometer being out of service will be the Green "NORMAL OPERATION" LED flashing at a one-second interval. If the LED goes out completely it means one of the Divert power supplies needs servicing.

The Red "LIQUOR DIVERTED" LED is not only an indication of the Divert command, but also the divert valve(s) status. When a divert is initiated the LED will flash at a fast rate (several times a second) until the divert valve(s) move to the liquor diverted position. This will be indicated by the "DIVERT VALVE POSITION" LEDs. The Red LED indicates that the liquor is diverted and the Green LED indicates that the divert valve(s) is (are) in the firing liquor position. When a reset is initiated, the "LIQUOR DIVERTED" LED will flash slowly (once per second) until the divert valve(s) return to the firing liquor position.

4.2.2 Reset key and Emergency Divert Push Button

Reset - WAIT 119 Sec

The "EMERGENCY PUSH" manual divert button is available to the boiler operator at all times. Once the button has been pushed, there is a 10 second grace period that will allow an immediate reset in case of an accidental divert. After that there will be a 2 minute lock-out of a reset. Trying to use the "RESET KEY" before the 2 minutes has elapsed will result in a message being displayed indicating the remaining time, as illustrated above.

***NOTE: "Aux Divert" input must be satisfied**

4.3 Prism Wash

Version 1.2 firmware for the Model 1022 incorporates enhanced Prism Wash control features. For those customers that find a fixed duration of wash is preferable, we now support that feature. Also prism wash interval time can be adjusted even with "Smart Wash" enabled.

Smart wash functions as before, however it does use the "Interval Parameter" setting. If the 1022 detects a failed prism wash it will retry at half the Interval Time no matter what mode the prism wash system is in.

4.3.1 Standard Prism Wash

Access to these parameters is done through the maintenance menu. Press the "MENU" button. This brings you to the "SET PARAMETERS" button and the "MISC PARAMETERS" button. From the MISCELLANEOUS PARAMETERS screen the "WASH PARAMETERS" appears as a new option.

The "PRISM WASH PARAMETERS" screen allows the setting of the wash parameters.

INTERVAL: The interval can be set from a minimum of 300 seconds to a maximum of 900 seconds between the wash of one refractometer and the wash of the second refractometer. The interval setting will be used by Smart Wash when enabled. Typical setting is 600 sec.

DURATION: The duration can be set between 5 seconds to a maximum of 60 seconds. The 1022 considers a wash successful if at any time during the wash the refractometers output falls to zero volts.

SMART WASH: This setting is used to toggle smart wash on or off.

4.3.2 Smart Prism Wash

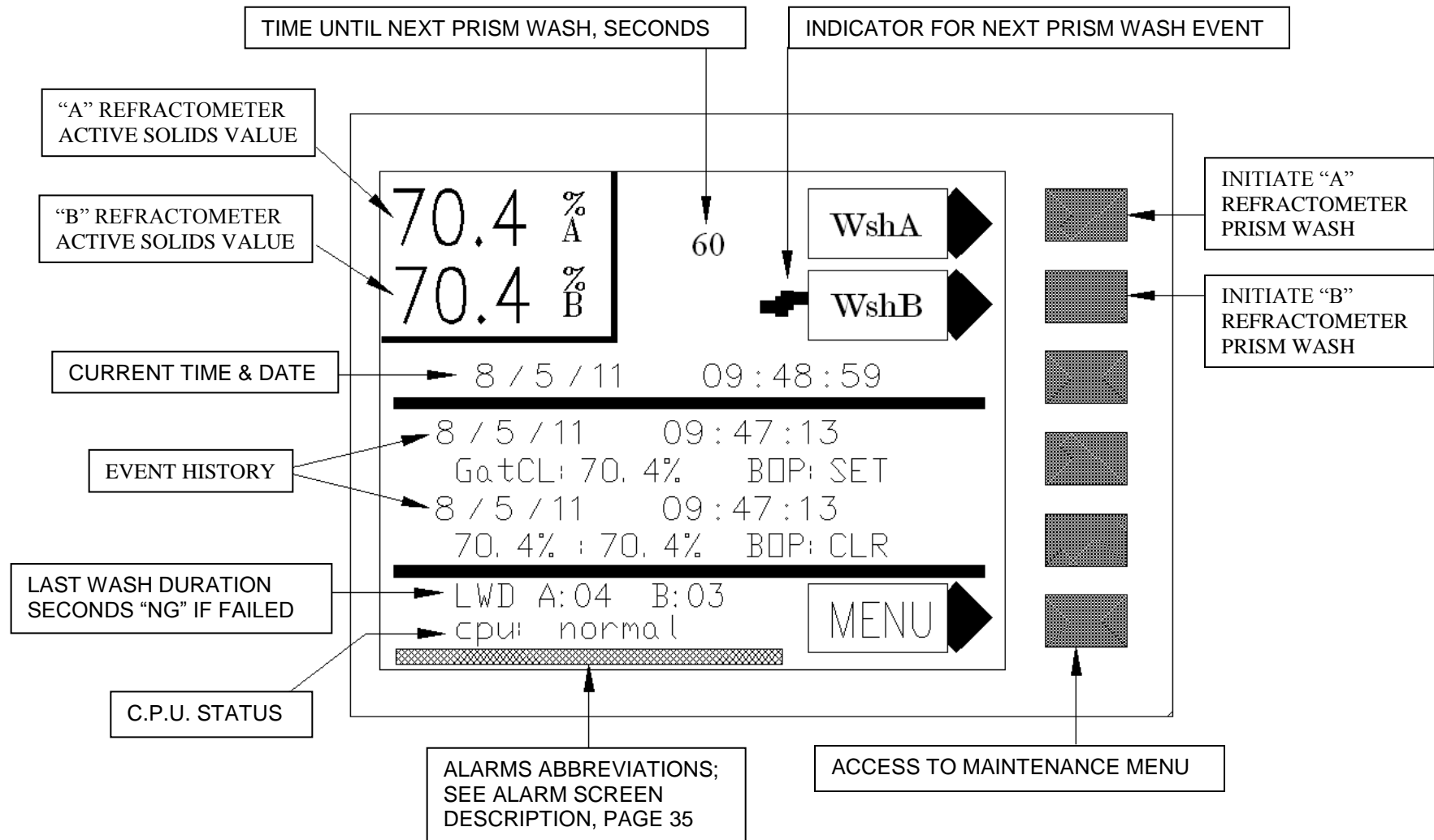
The 1022 CPU controls the refractometer prism wash timing and monitors the response. The timing for normal washing consists of a wash every twenty minutes. The CPU staggers the wash so that a wash is initiated every ten minutes alternating between refractometers. It is impossible to wash both refractometers simultaneously, either manually or automatically. The wash system is called "SMART WASH" because it is controlled by the CPU, which is programmed to make decisions based on the wash performance. The CPU starts a wash with a maximum time limit of 30 seconds. However, as soon as the refractometer satisfies the wash criteria, the wash will halt and the 40 second signal hold will start.

If for any reason the refractometer fails the first wash, a second wash attempt will result in the refractometer being taken "out of service" and full control will be passed to the remaining "in service" refractometer.

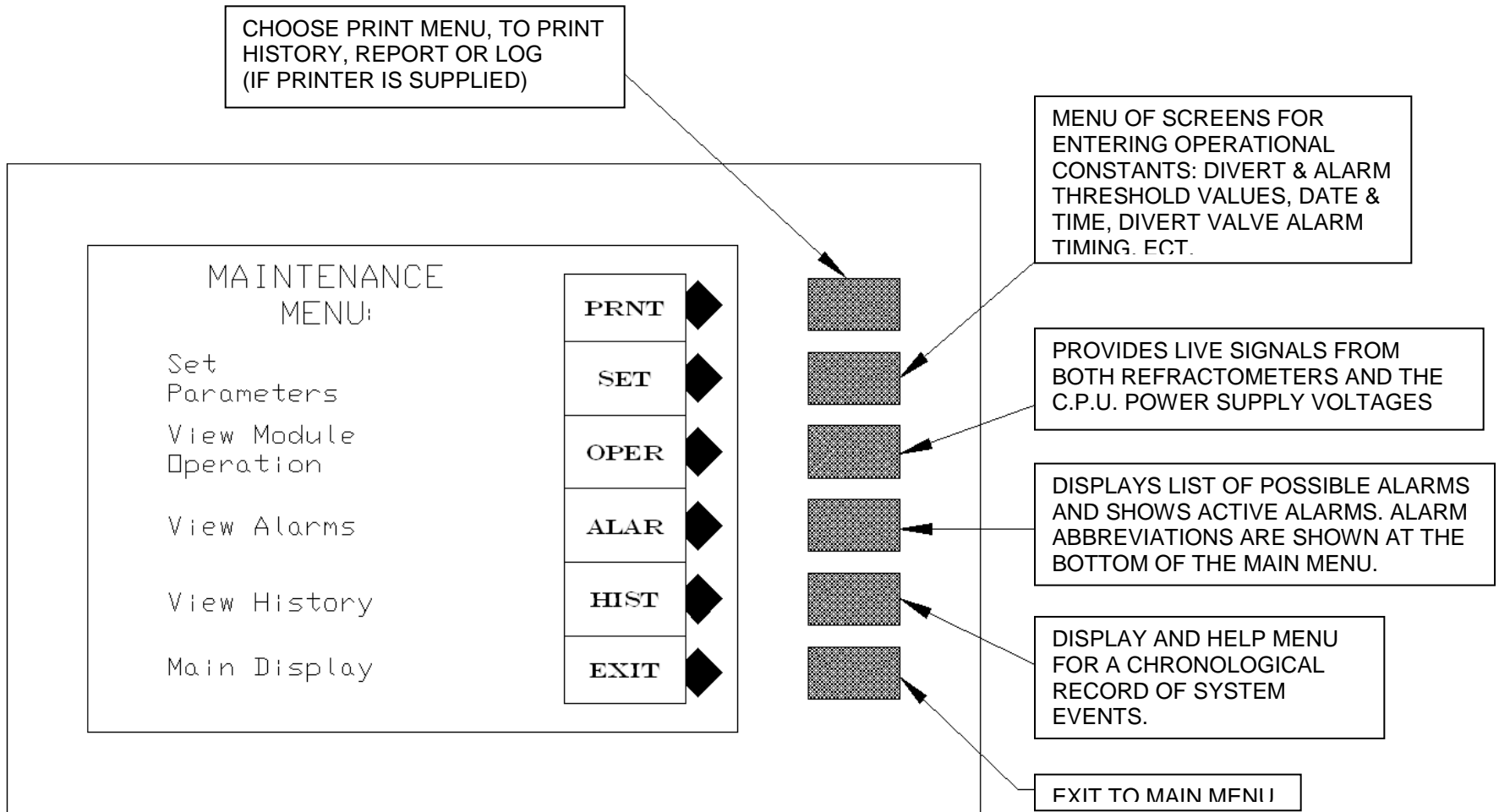
The SMART WASH system also eliminates excessive and abusive prism washing during an empty pipeline

5. DIVERT MAINTENANCE

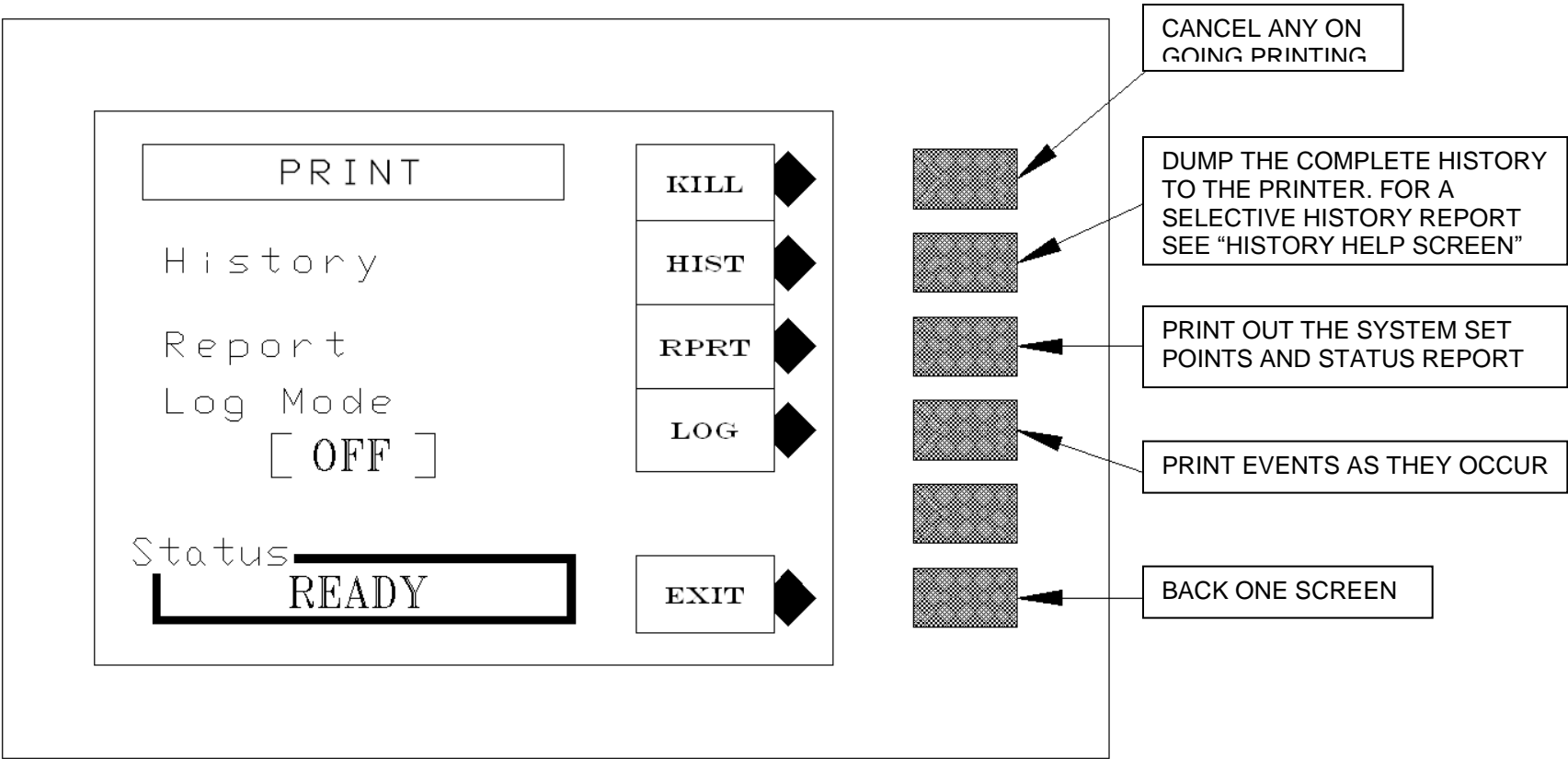
All information needed to maintain the 1022 Divert System is shown on the diagnostic screens accessible through the computer control panel. These screens are illustrated and explained on the following pages.



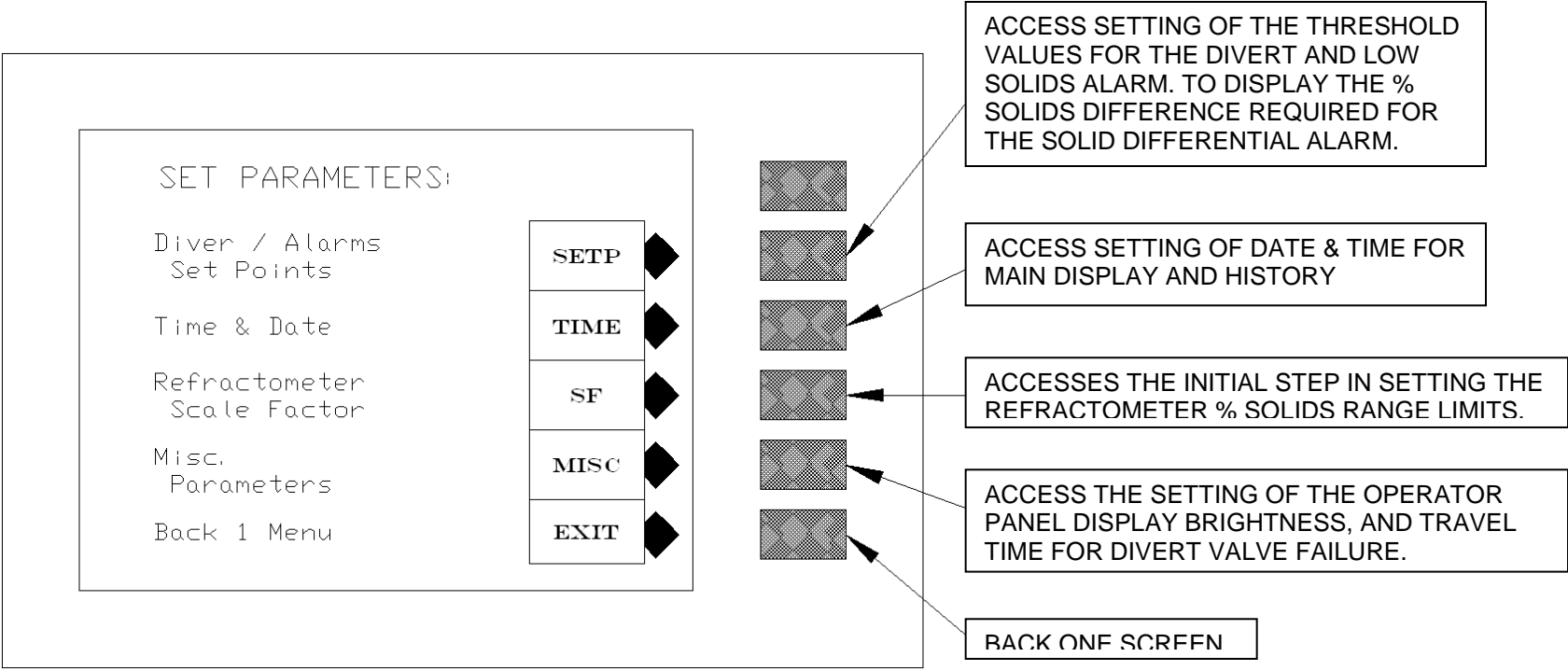
MAIN DISPLAY



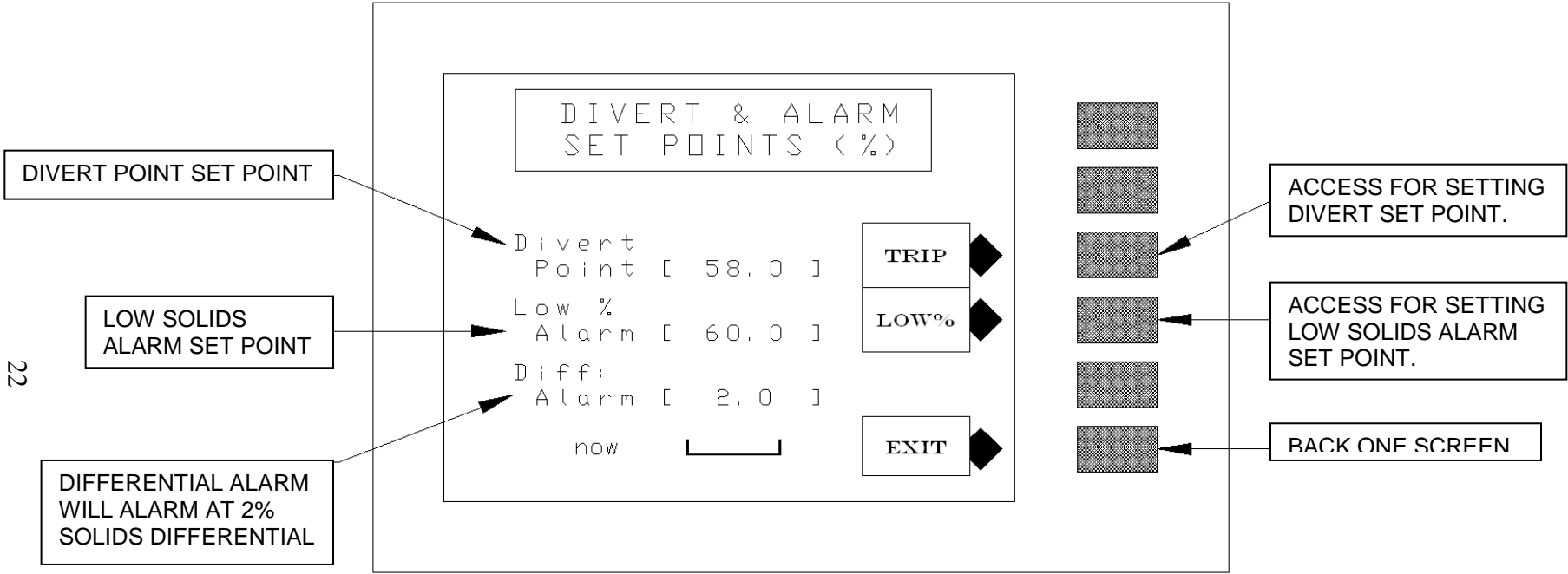
MAINTENANCE MENU



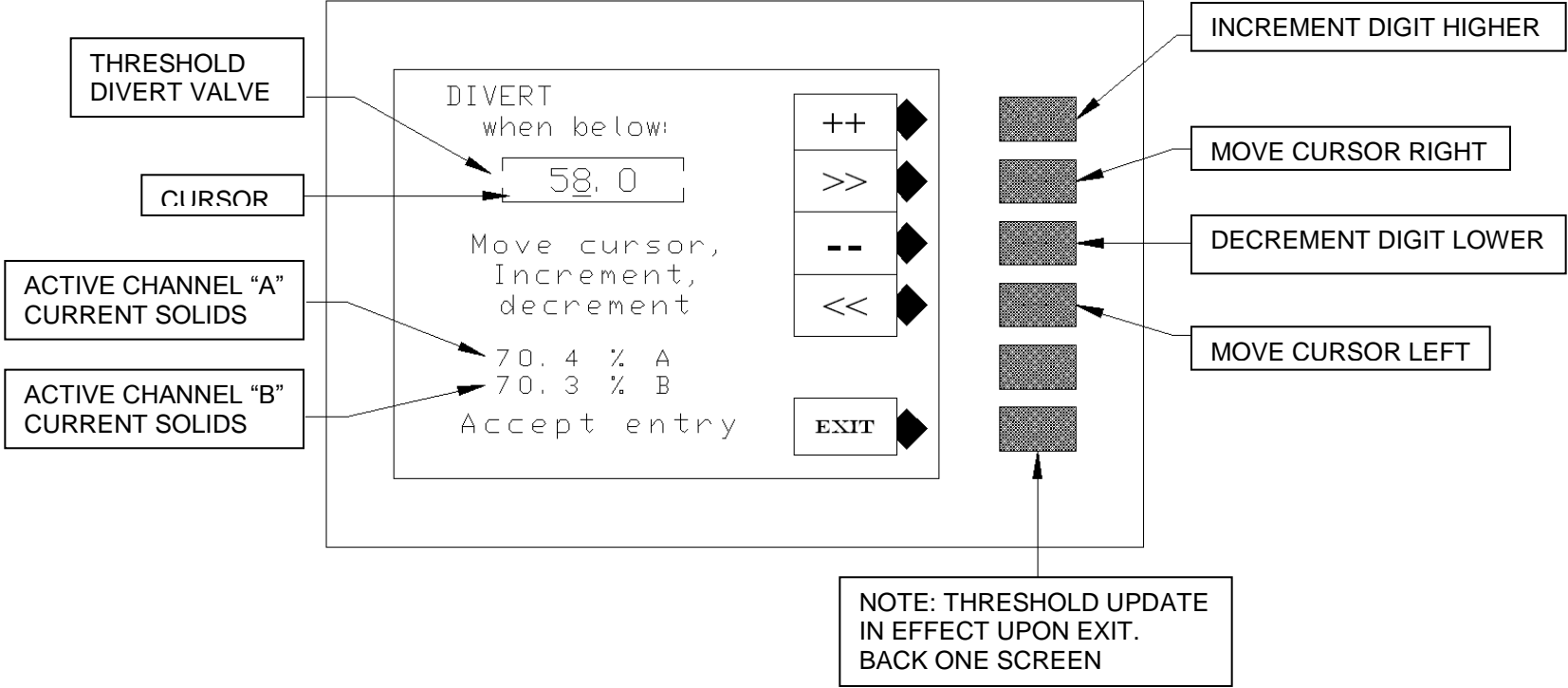
PRINT SCREEN



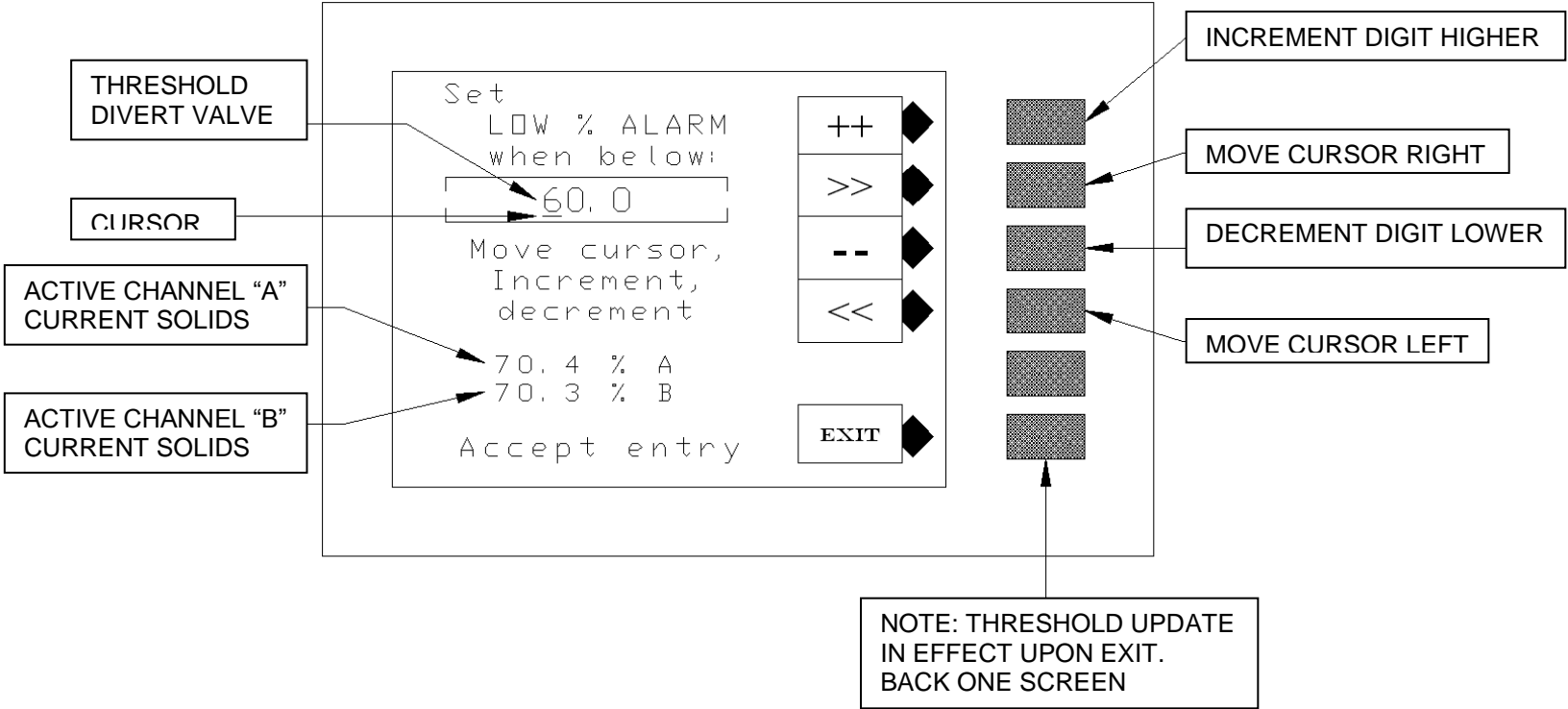
MISCELLANEOUS PARAMETERS



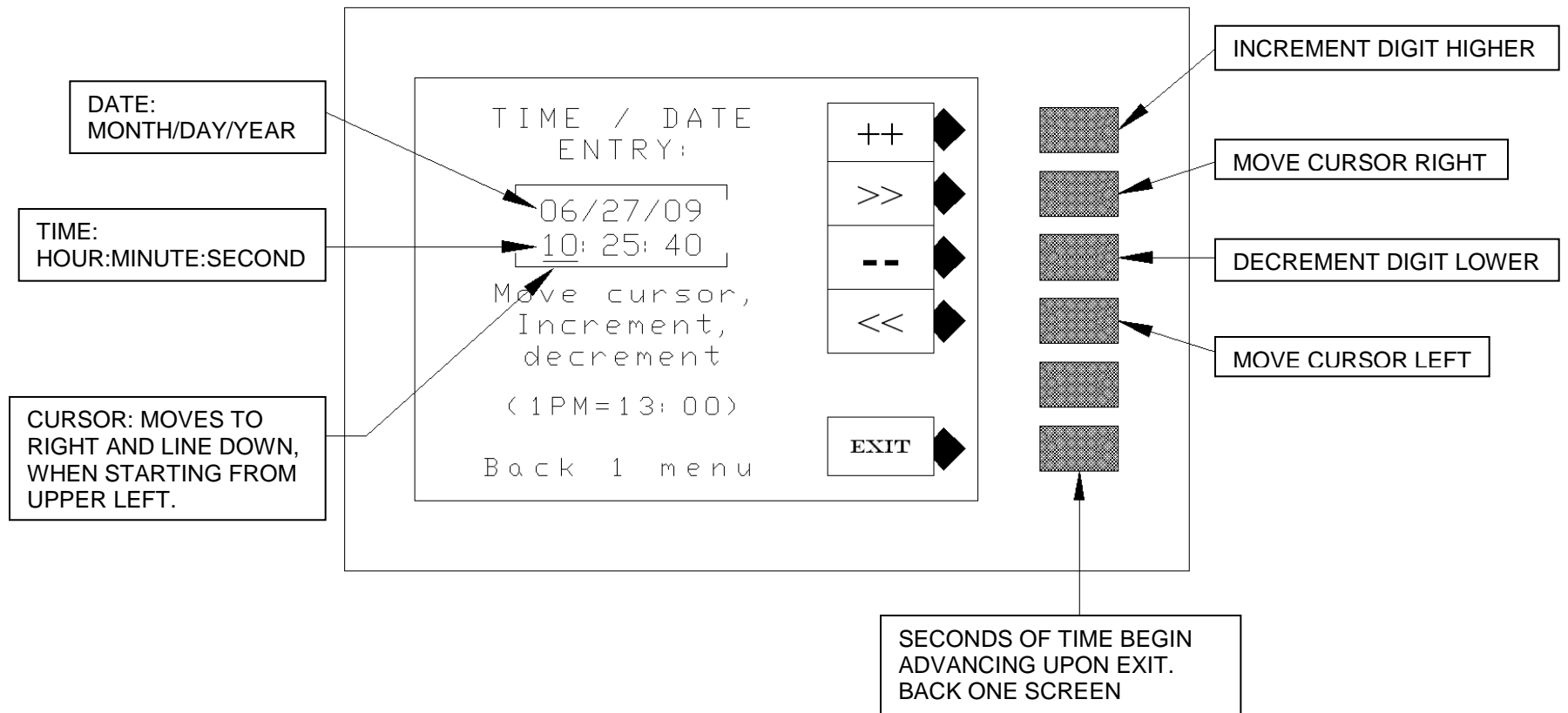
DIVERT & ALARM SET POINTS (%)



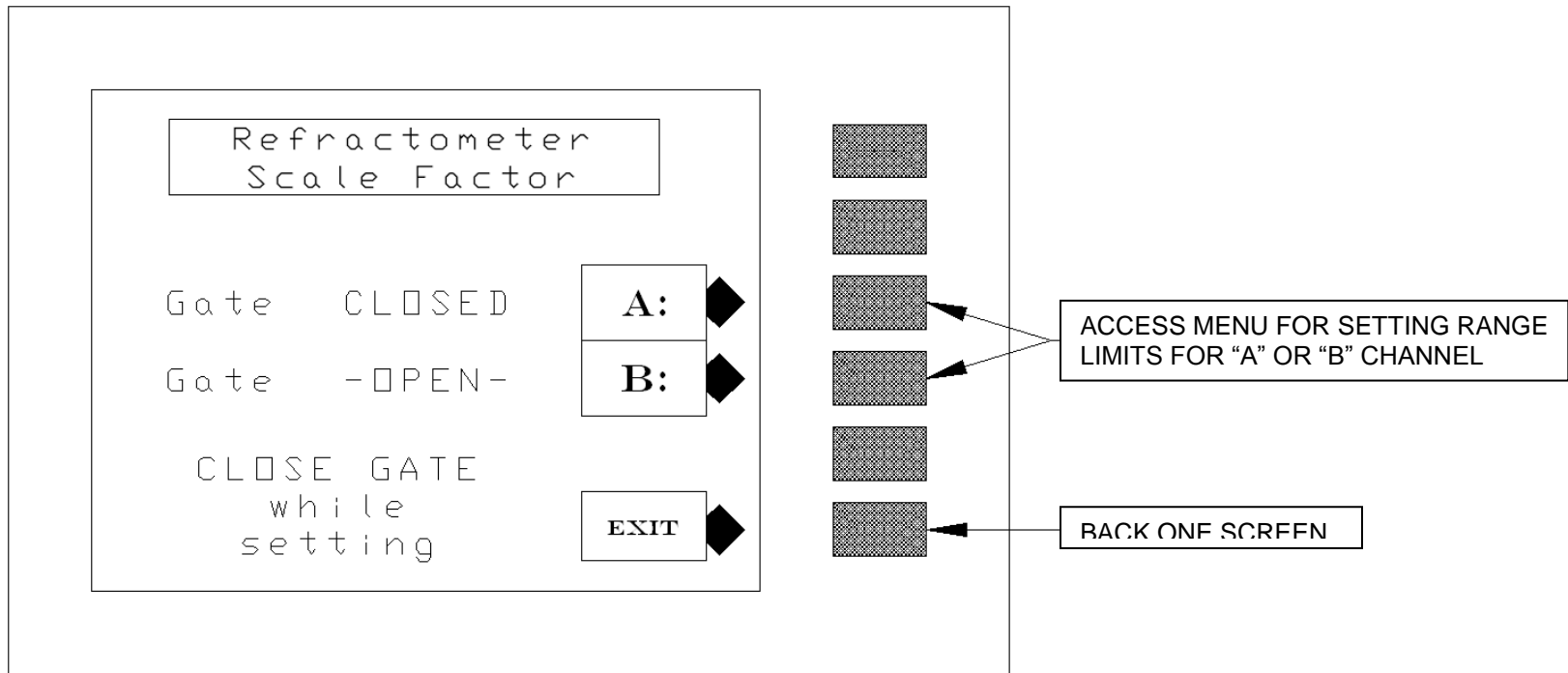
SETTING DIVERT



LOW % ALARM



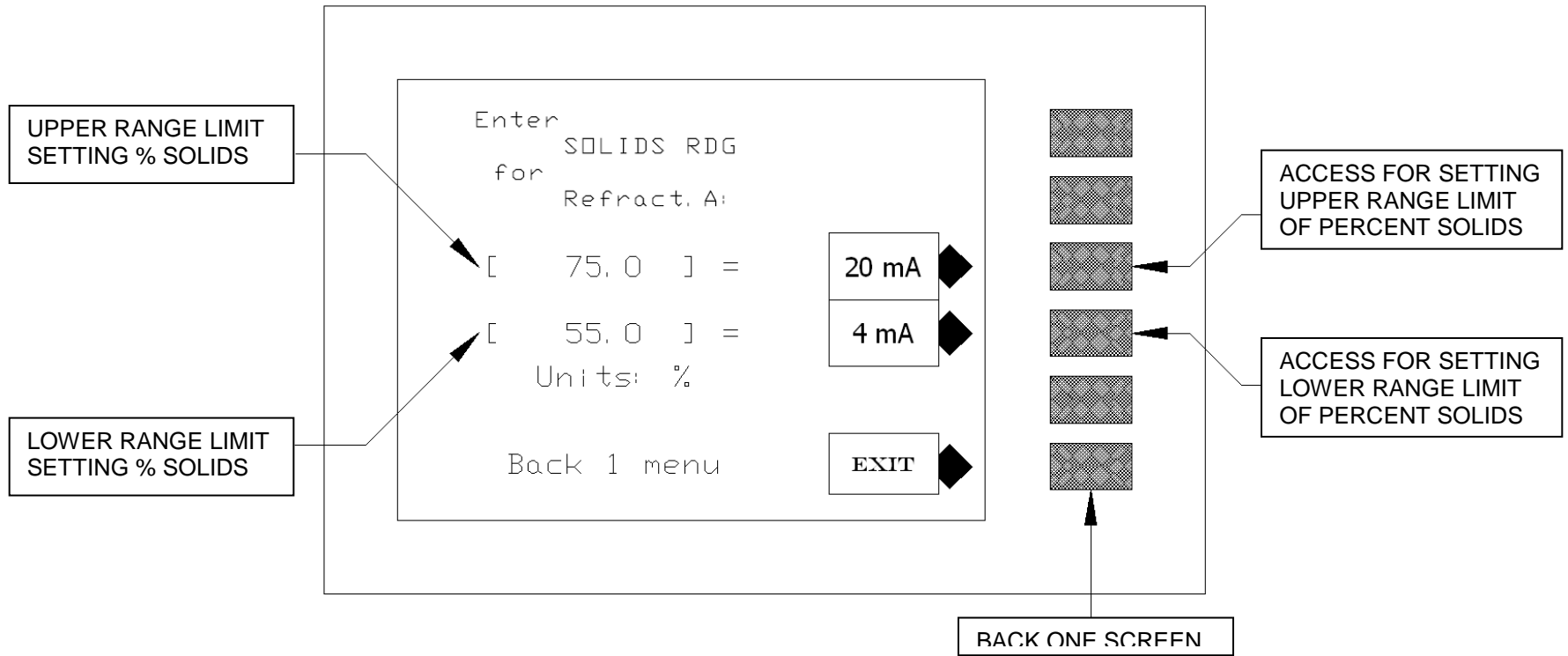
TIME / DATE ENTRY



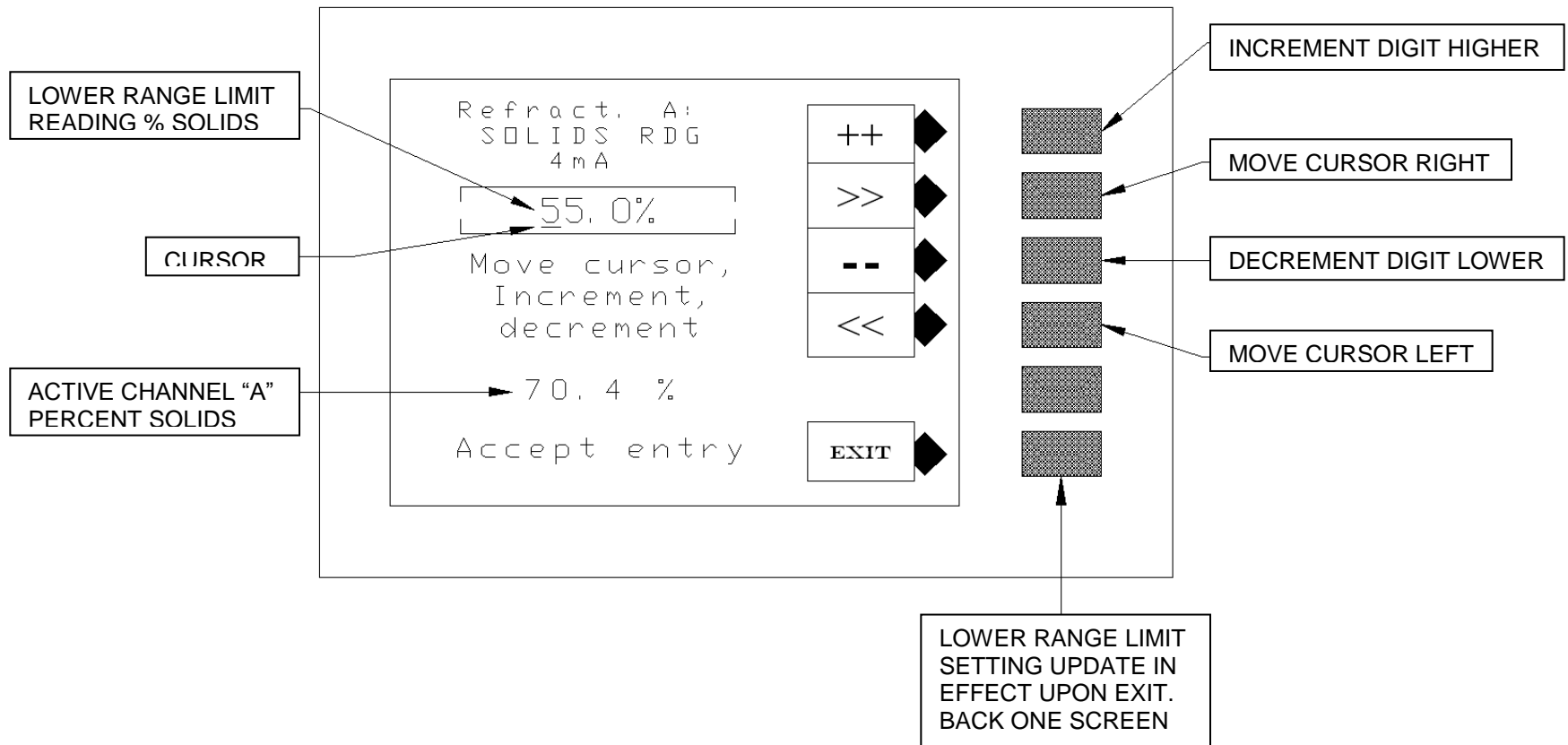
NOTE:
BEFORE EITHER CHANNEL'S RANGE LIMITS CAN BE
SET, ITS CORRESPONDING GATE MUST BE CLOSED

IMPORTANT:
CLOSE ONLY ONE GATE AT A TIME

REFRACTOMETER SCALE FACTOR "SF"

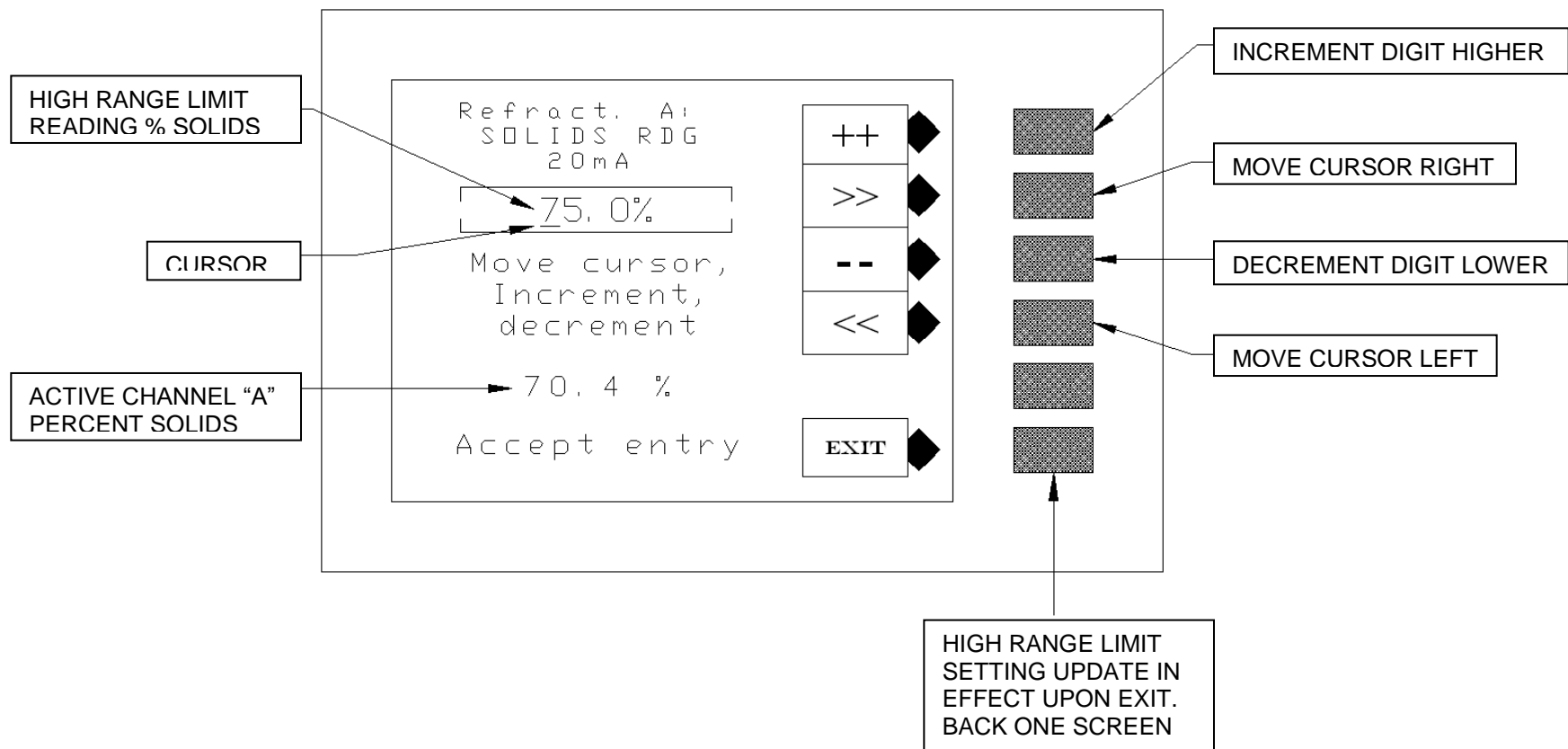


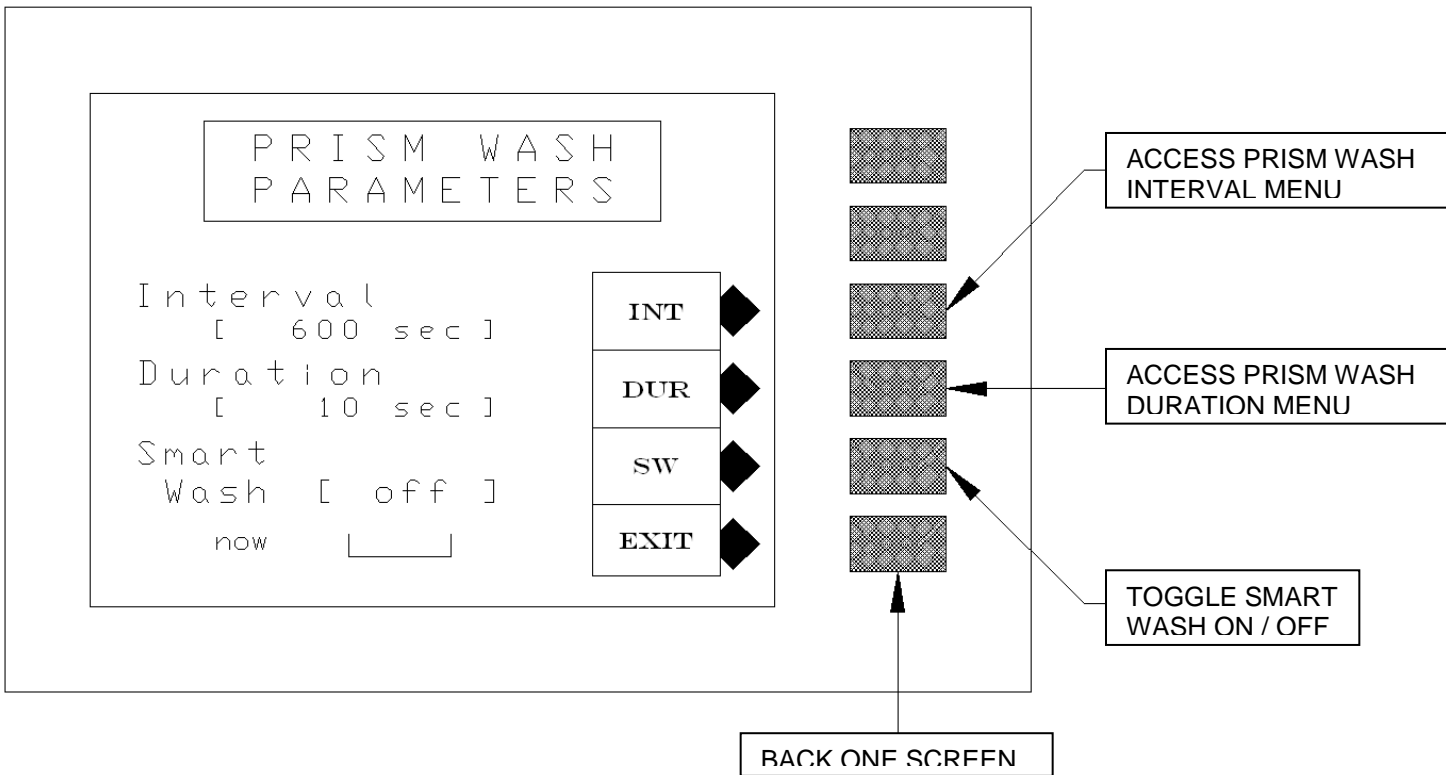
SOLIDS RDG: FOR REFRACTOMETER "A" OR "B"



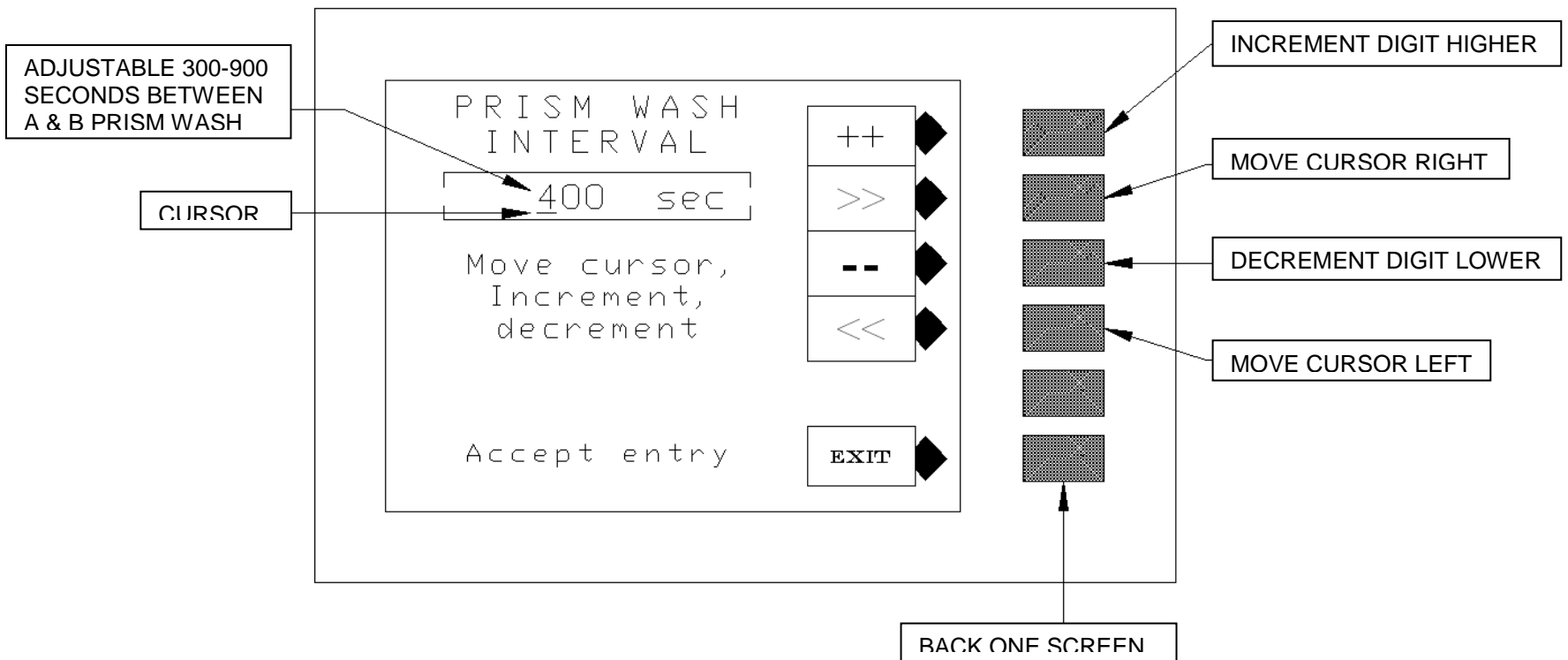
REFRACTOMETER "A" OR "B" SOLIDS RDG 4 mA

29

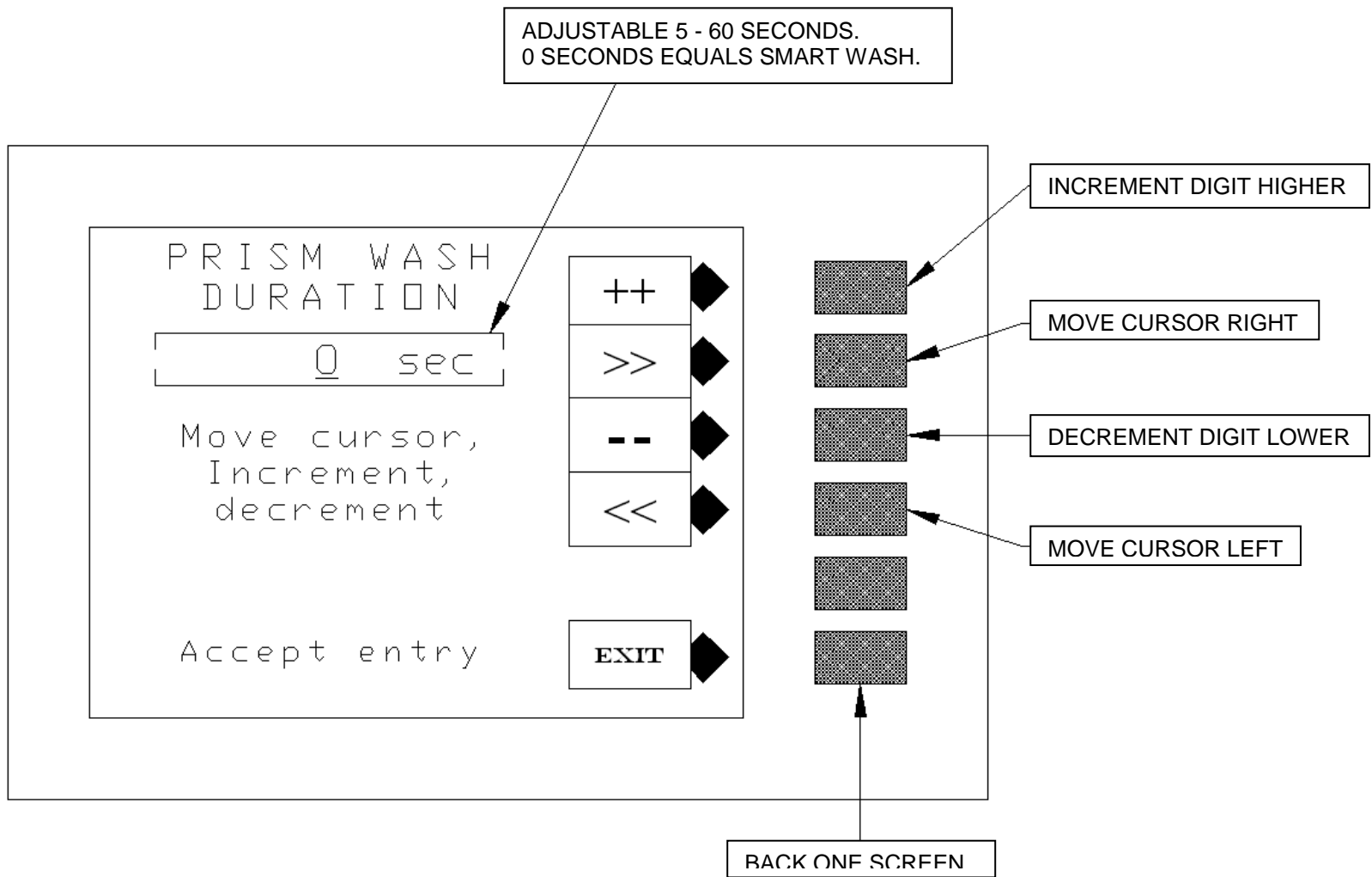
**REFRACTOMETER "A" OR "B" SOLIDS RDG 20 mA**

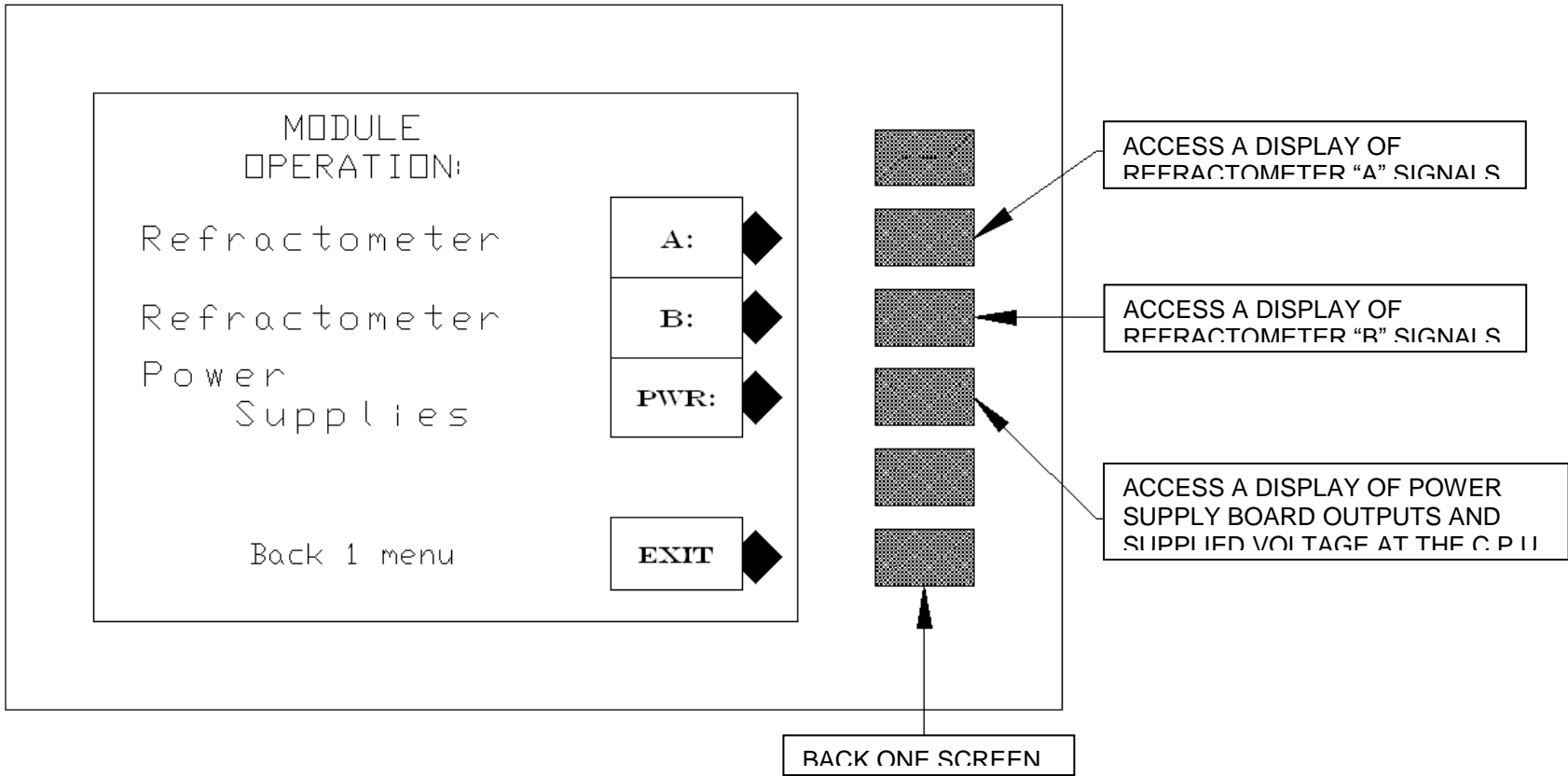


PRISM WASH PARAMETERS

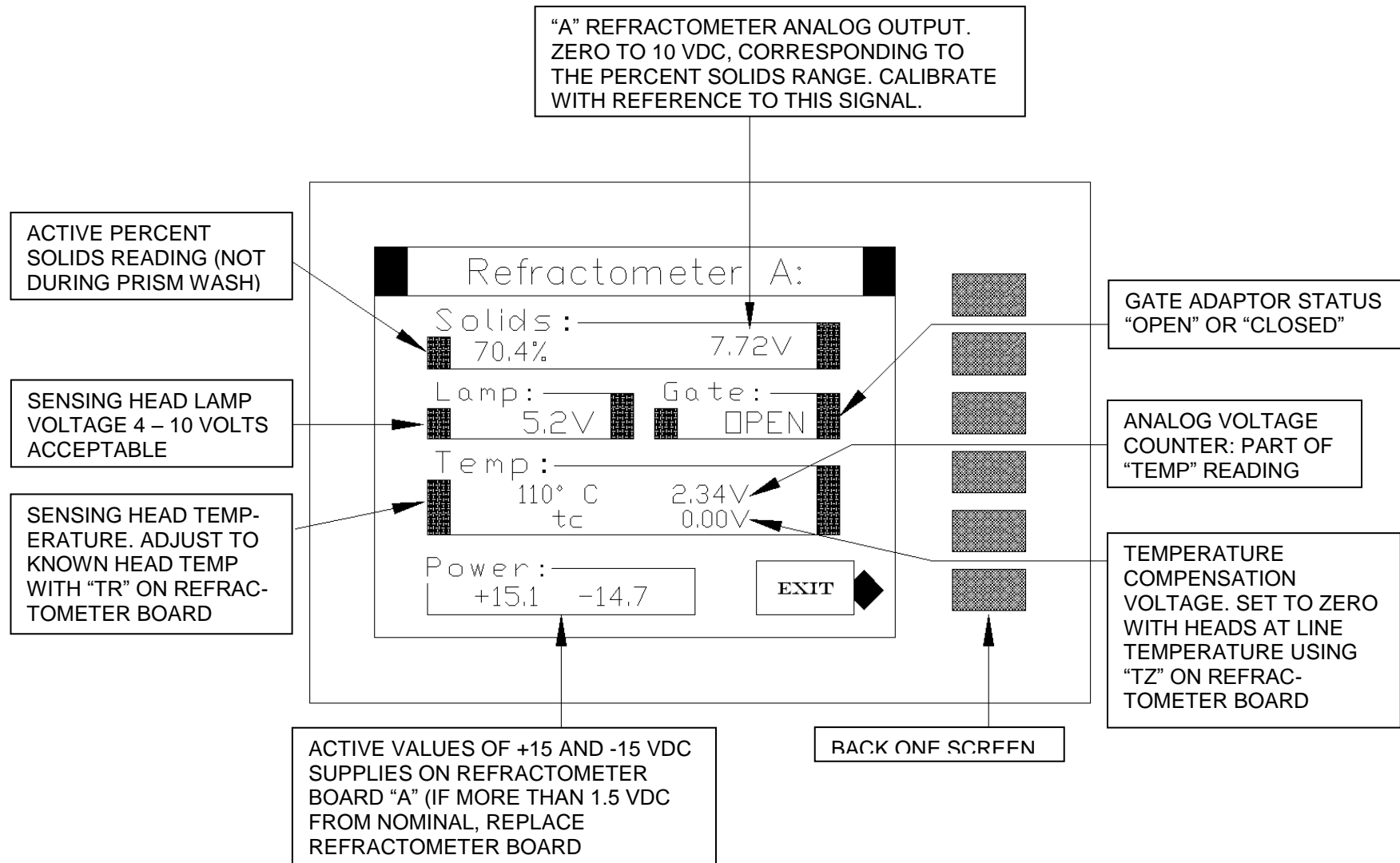


PRISM WASH INTERVAL

**PRISM WASH DURATION**

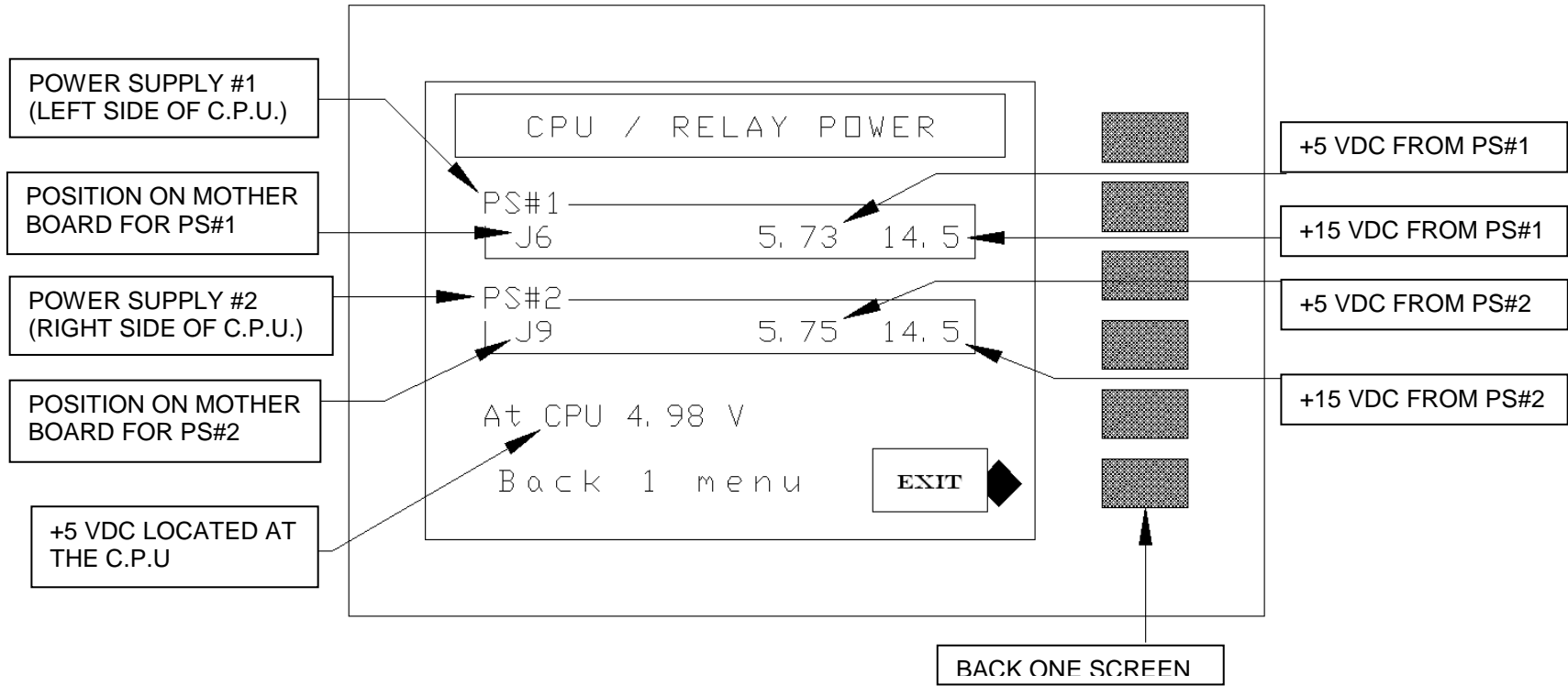


MODULE OPERATION



REFRACTOMETER "A" OR "B" DIAGNOSTIC SCREEN

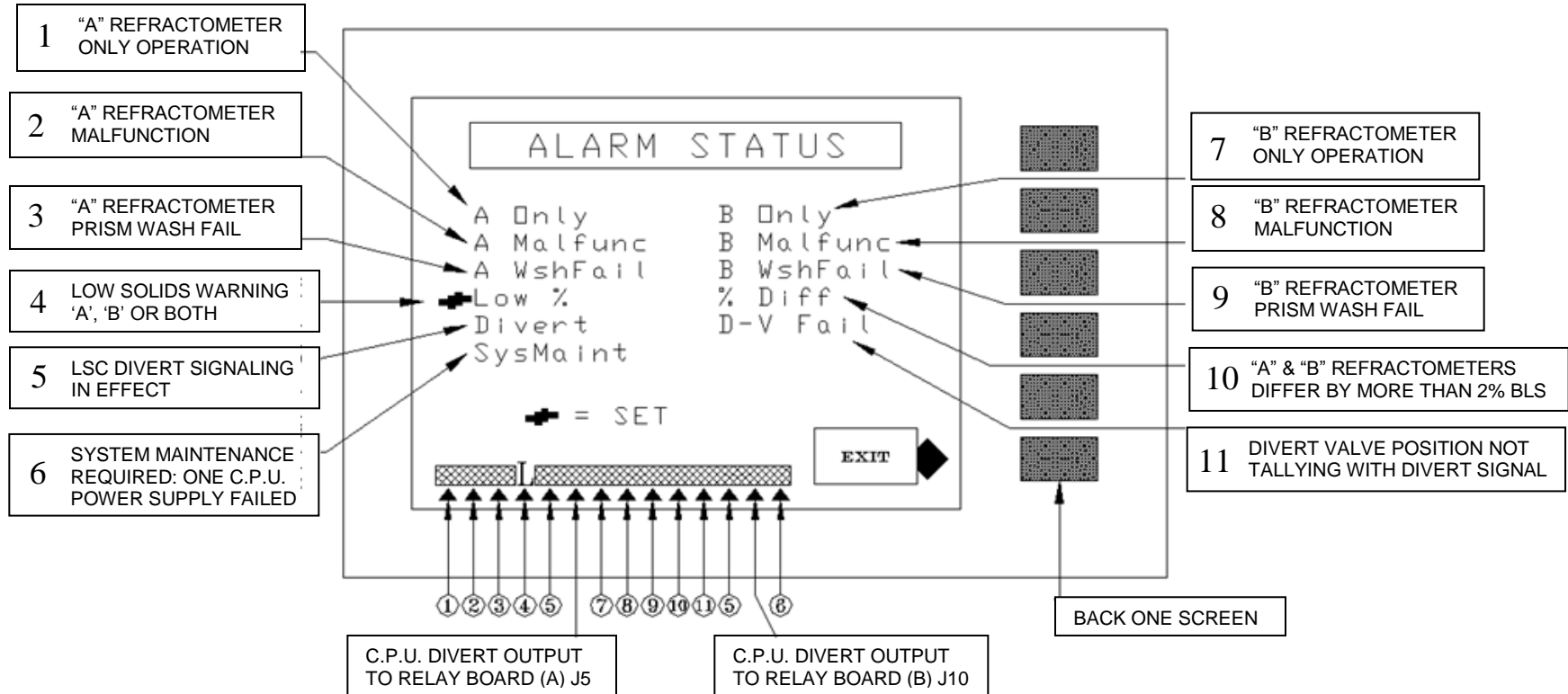
35



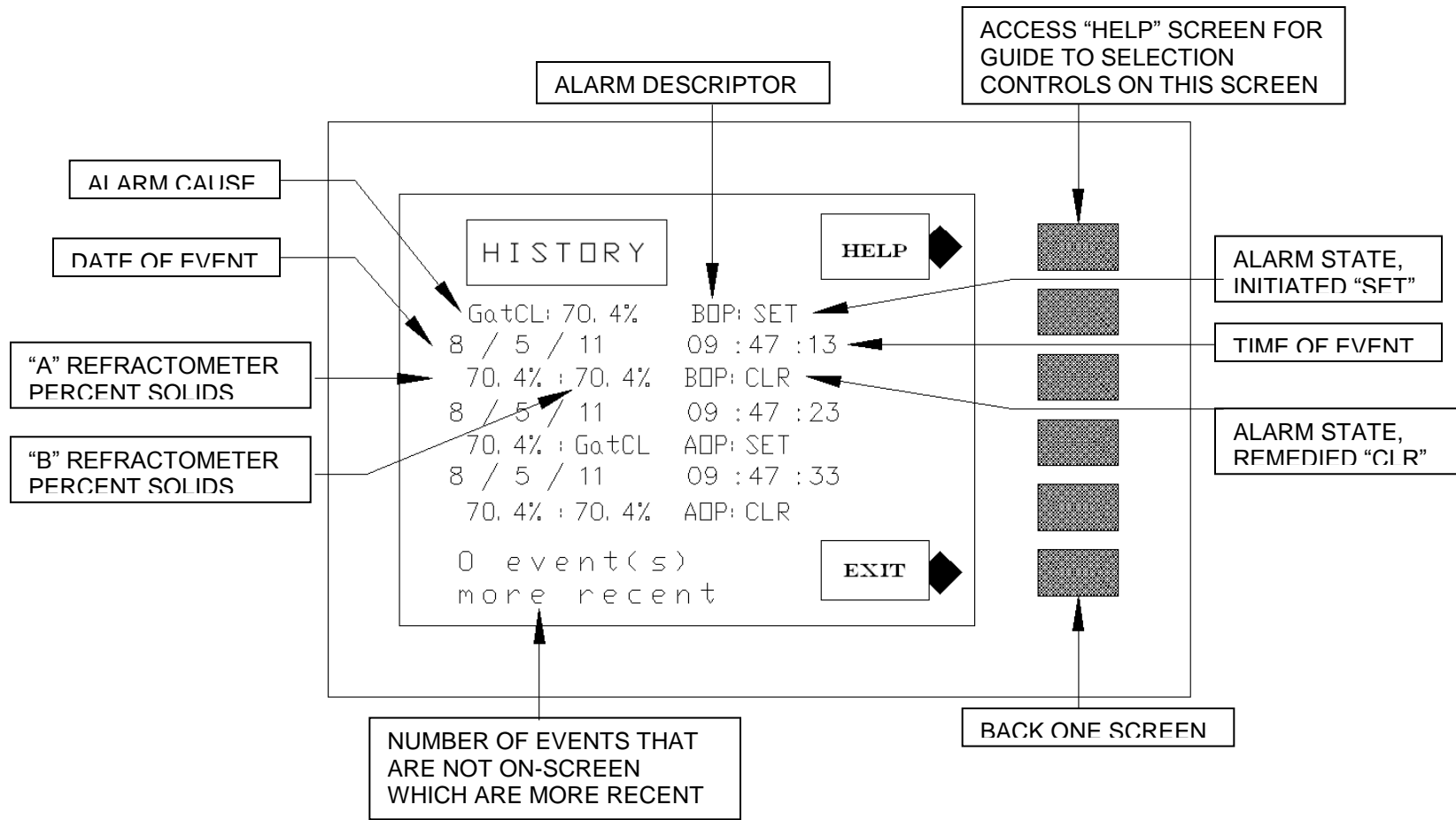
C.P.U. / RELAY POWER

NOTE:
ALARM STATUS BAR ILLUMINATES ABBREVIATIONS FOR
ALARM INDICATED BELOW, REFERENCED BY NUMBER.

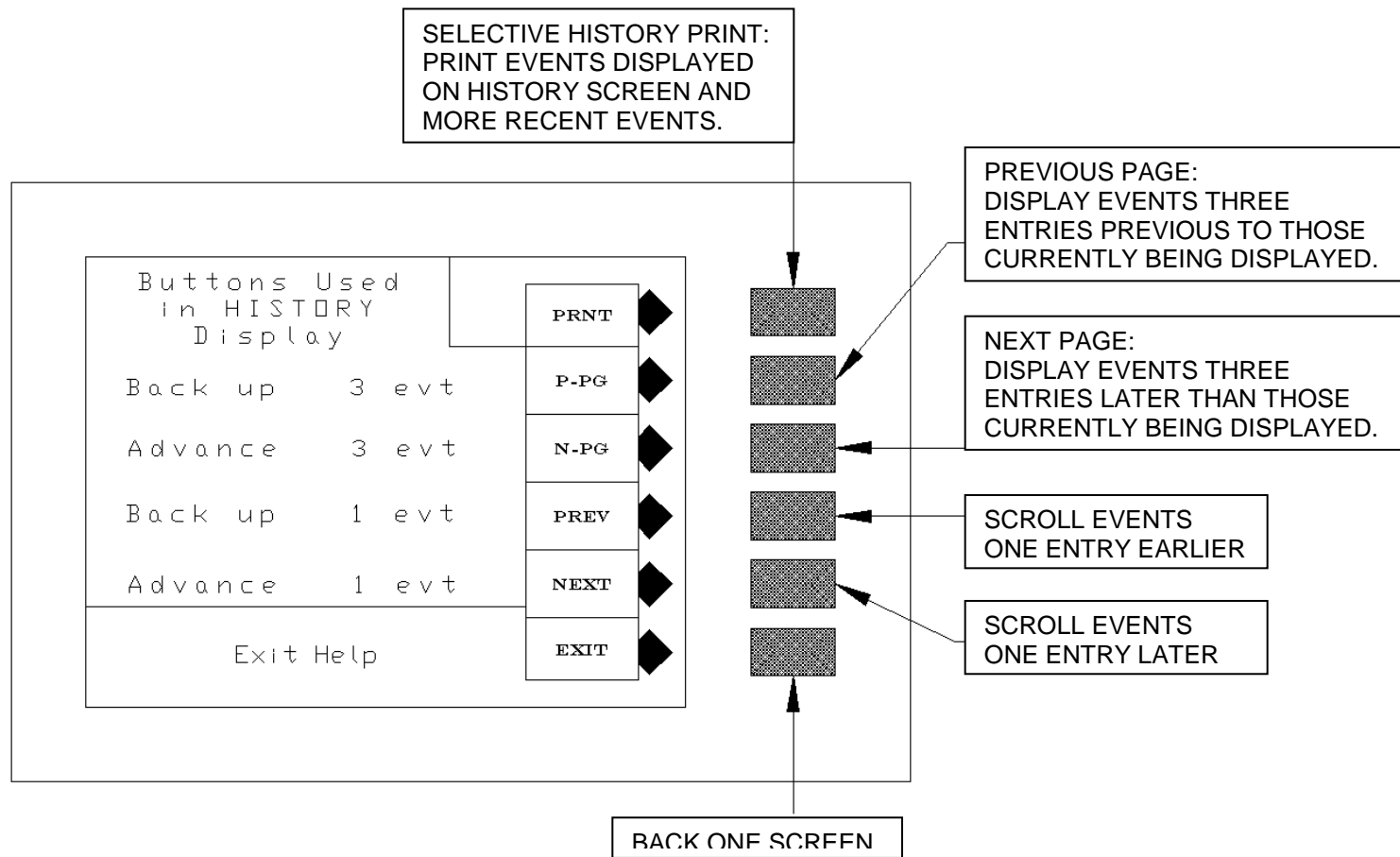
36



ALARM STATUS



HISTORY



NOTE:
SELECTIONS DO NOT REGISTER WHEN THE SCREEN IS IN THE "HELP" MODE. THE SCREEN IS A GUIDE TO THE SELECTION CONTROLS WHEN THE HISTORY SCREEN IS BEING VIEWED.

HISTORY HELP SCREEN

6. REFRACTOMETER

6.1 Theory of Operation

The sensing head detects changes in the refractive index of the process fluid. The sensing window is actually the flat base of a sapphire hemisphere (prism) which sets up a sapphire/ liquor interface. The internal components are located in fixed self-aligning positions to achieve an optimum critical angle. The "critical angle" is the angle at which refraction stops and reflection starts, and is directly related to the refractive index of the process fluid.

6.2 Internal Components of Sensing Head

Various components of the sensing head are shown in Figure 7 (next page).

6.2.1 Lamp Assembly

- Infrared LED: a diode in a Resin case with epoxy.
- Collimating lens: creates a uniform beam, mounted in the end of a collar into which fits the LED. The LED is secured with a set screw.
- Focusing lens/source mounting block: the lens creates the converging beam, and is epoxied into the mounting block. The block anchors the collimating assembly with a retaining screw.

6.2.2 Detector Assembly

- Detector: dual silicon solar cell; measure and reference.
- Terminal strip: the junction point for internal wiring.
- Detector mounting block with detector locator

6.2.3 Temperature Sensor Assembly

- Temperature sensing diode sealed in aluminum casing with epoxy.
- Heat sink compound: ensures efficient heat transfer between the diode and the sensing head base block.
- Insulating retaining collar and retaining screw.

6.2.4 Prism Assembly

- Prism gasket: made from Teflon, must be baked to seal.
- Prism: high quality industrial sapphire hemisphere.
- Prism hold down assembly

6.3 Refractometer Calibration

The refractometer measures refractive index and is not affected by the make-up or materials contained in the liquid. On that basis, synthetic samples can be prepared to simulate actual process samples when actual process line conditions and liquids are not practical.

Two samples are needed, one for the low and one for the high end of anticipated refractive index. Avoid highly volatile materials or mixtures that are not miscible. Be sure that samples are allowed to equilibrate at ambient temperature. Samples at ambient temperature should simulate the refractive index of the process material at its nominal operating temperature.

6.3.1 Calibration Procedure

Note: Before Proceeding:

- 1) Close ONLY ONE GATE ADAPTOR AT A TIME so that one refractometer remains active.
- 2) Shut off the steam supply ONLY to the refractometer being calibrated.

Calibration is performed using the adjustment controls illustrated below.

- 1) Remove the sensing head from the gate adaptor and rinse off the gate and sensing head with hot water in order to remove the black liquor without thermally shocking the prism.
- 2) Allow approximately 20 - 30 minutes for the sensing head to reach room temperature.
- 3) Place the sensing head on its cover and remove the wash nozzle by removing the two straight slot screws located on the prism wash nozzle.
- 4) From the main screen in the 1022 box, press the "MENU" button, then press the "VIEW MODULE OPERATION" button. From there press the corresponding "REFRACTOMETER" button (A or B). From this screen all refractometer parameters are viewed.
- 5) Apply several drops of low refractive index sample onto the prism of the sensing head. Cover the prism to prevent from stray light sources.
- 6) Turn the zero dial to 500 and flip the temperature compensation switch to "OFF".
- 7) Adjust the course zero trim potentiometer (labeled "CZ") to achieve 0 volts as displayed on the screen.
- 8) Clean the sensing head window well and apply the high end sample. Cover the prism to prevent interference from stray light sources. The output will go up to a high value.
- 9) With the span control knob, set the output to read 10.0 VDC. Re-check both low and high end samples making sure indications are exact and correct, and that the output indication is below scale when the sensing window is clean and dry.
- 10) Flip the TC switch to ON.
- 11) Replace the wash nozzle.
- 12) Reinstall the Sensing Head on the Gate Adaptor.
- 13) Open the gate and turn on the steam supply.
- 14) After the head has reached the process temperature, approximately 30 minutes, set the temperature read out and the temperature compensation for the Sensing Head calibrated. (A or B)
- 15) Set the temperature read out to the process temperature by adjusting "TR".
- 16) Adjust the temperature compensation voltage to 0 by adjusting "TZ".
- 17) Press the exit button twice to return to the main operating screen.
- 18) Any fine zero adjustments can now be made using the ZERO counting dial to correlate to off line testing.

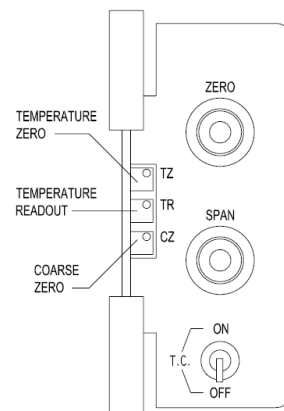
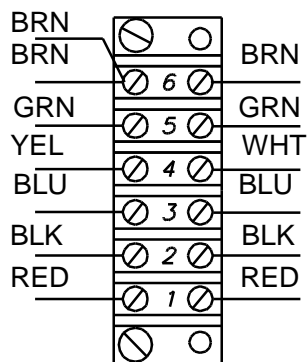
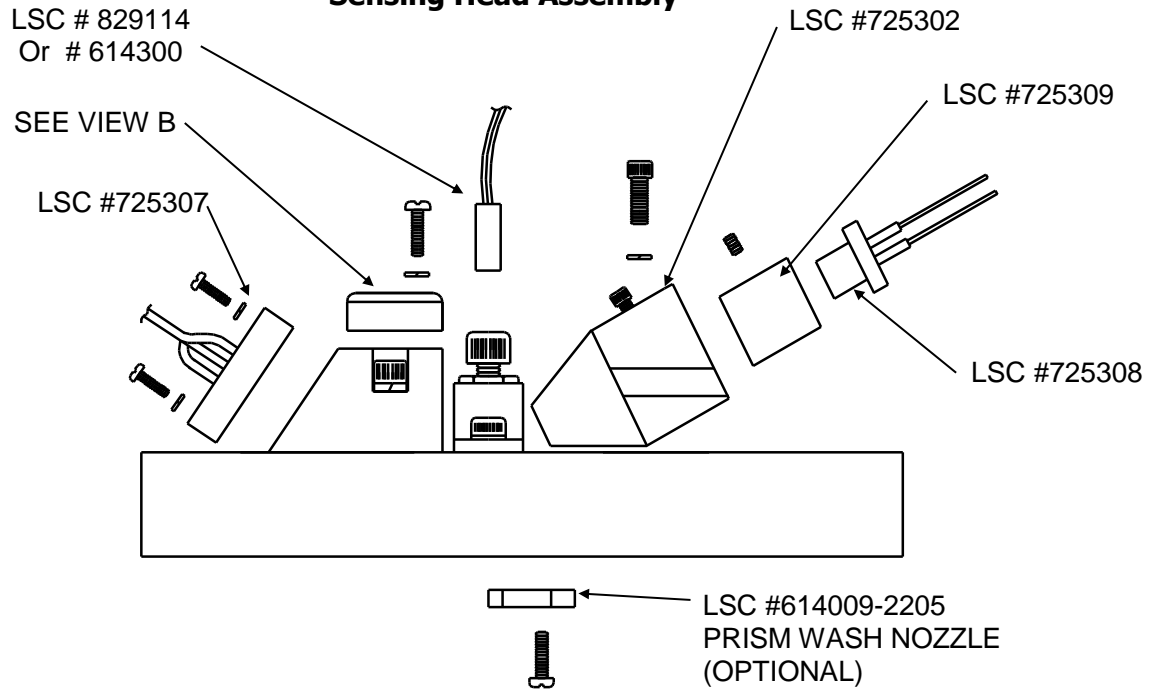
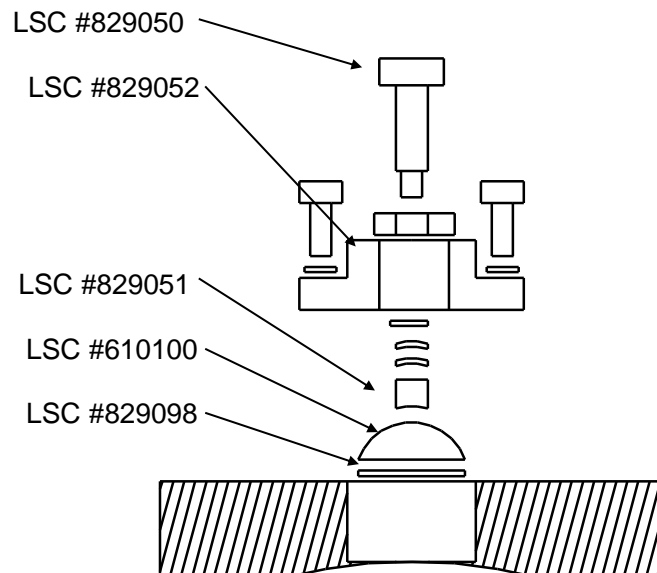


Figure 7
Sensing Head Assembly



VIEW B



6.4 Refractometer Maintenance

6.4.1 Prism Replacement

Replacement of the prism or prism gasket is required when the prism becomes etched, foggy or damaged visibly. See Figure 7 View A (page 40) for an exploded view of the prism assembly.

- 1) Remove all internal components
- 2) Assemble all parts as shown in Figure 7, View A
- 3) Torque the hold down screw to 25 inch-lbs.
- 4) Bake assembly at 400 degrees Fahrenheit for 4 hrs.
- 5) Upon completion of baking remove and tighten the hold-down screw to 35 inch-lbs.
- 6) Allow the assembly to cool.
- 7) With a sharp knife point, remove any gasket material extruded over the prism window on the underside of the baseplate.
- 8) Tighten the hold down screw lock- nut.
- 9) Replace remaining parts. Install cover along with O-ring.

6.5 Prism Wash Check Valve Replacement

One of the most common causes of prism wash failure is the seizure of the check valve at the steam line inlet to the sensing head. The usual remedy is replacement of the check valve by the following procedure:

- 1) Close Gate Adaptor
- 2) Shut-off steam to sensing head and or
- 3) Shut off air to solenoid which activates steam ball valve.
- 4) Remove the steam line and the check valve.
- 5) Apply Teflon tape or a suitable thread sealing compound to the threads of the new check valve.
- 6) Install the new check valve, matching the valve's flow direction to that of the prism wash system.
- 7) Return all line and valves to their operational positions.

*NOTE: Closing the gate will automatically place the 1022 in single head operation. The CPU acknowledges the closure of the gate adaptor and the unit will not send a signal to the prism wash solenoid. However, please follow the above procedure for safety precautions.

7. GATE ADAPTOR

The LSC gate adaptor provides a means for simple and quick removal of a LSC In-line Refractometer Sensing head from an active process pipeline. The Gate adaptor employs a completely captivated slide plate, mechanically sure, operated by an eccentric cam. Operation of the Gate adaptor is accomplished by turning a 25mm hex cam just under ½ turn. Double Teflon seals are provided against both sides of the slide plate. The Gate adaptor provides for an external lock "fully open" or "fully closed" with positive visual and physical indication of "fully open" or "fully closed"

The components of the Gate Adaptor assembly are illustrated in Figure 8 (page 42).

7.1 Gate Adaptor Maintenance

Before maintenance can be done the sensing head must first be safely removed;

- 1) Turn off the steam and air supply to the Prism Wash Valve.
- 2) Rotate the 25mm hex cam counter clockwise to align the closed indication with the cam reference point. Insert the LSC lock (PN # 670350) through the ¼ hole located next to the open indication. (See illustration) If our lock is not available a 2" x .250" dia. pin may be used.
NOTE: The lock will go through *only* when the gate slide is 100% fully closed, or 100% fully open.
- 3) Break the steam line connection between the prism wash valve and the Sensing Head check valve, and remove (free) one end of the line. Note: Be very cautious of steam pressure that may be trapped within this short piece of line.
- 4) Note: When closing the Gate Adaptor, some Black Liquor will be trapped (or captivated) between the Sensing Head and the closed Gate slide plate. This area is a 3/8 inch X 2 inch dia.
- 5) Loosen the four (4) mounting bolts (1/4 x 20) sequentially, and in small increments. Never remove one of the bolts completely at one time. Loosen the four bolts in a manner that you understand and except some small amount of black liquor to "ooze" out from between the Sensing Head and Gate Adaptor. Always be fully prepared, and be protected! (hands arms and face!)

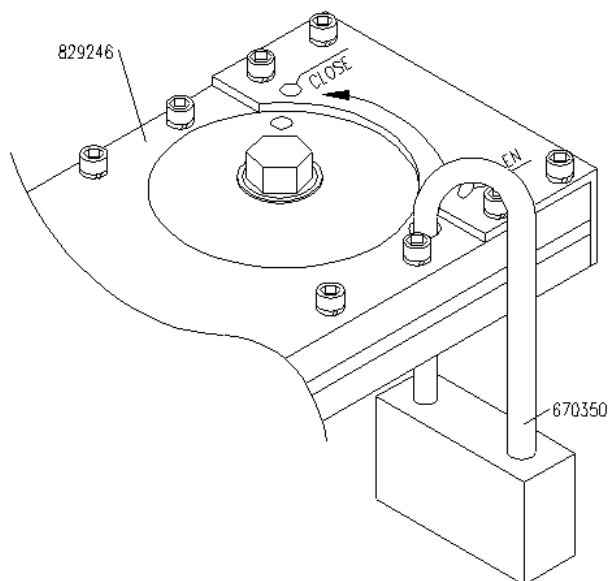
7.1.1 Removal and Annual Rebuild of Gate Adaptors

- 1) Once the sensing head has been removed and all liquids drained from the process line, gate adaptor removal can begin.
- 2) Remove the four threaded inserts from the sensing head mounting holes, allowing access to four of the gate adaptor mounting bolts.
- 3) Unscrew the six mounting bolts that hold the gate onto the pipe section. Note that the four corner bolts are captive and must be unscrewed in successive increments to avoid jamming.
- 4) Dismantle the gate adaptor by removing twenty-two socket head cap screws.
- 5) Remove O-rings and clean all liquor from O-ring grooves.
- 6) Inspect all parts for visual damage and replace or repair as necessary.

7.1.2 Gate Reassembly

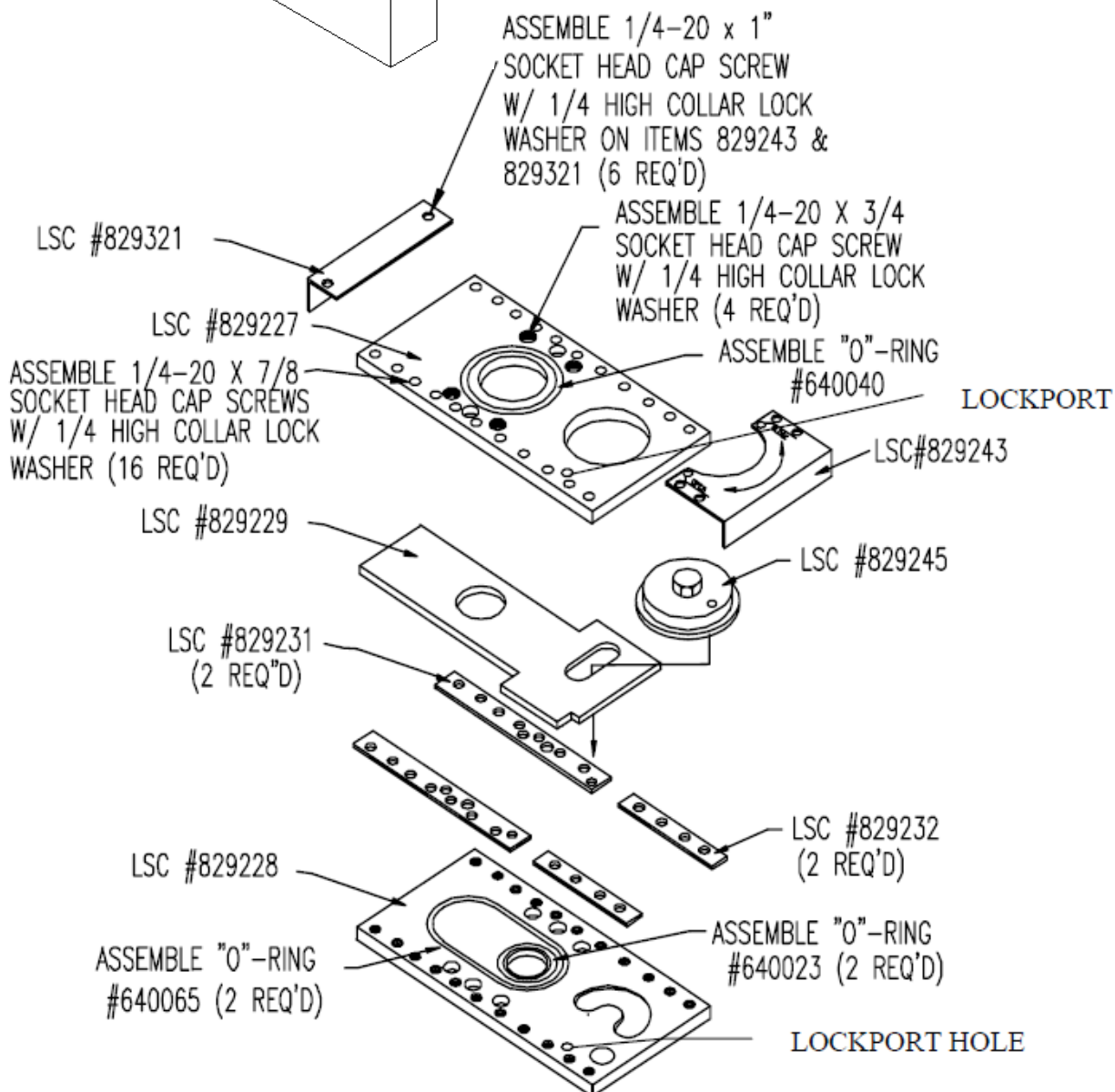
- 1) Apply a thin layer of High-Temperature Teflon Grease, LSC part no. 829487 to all four internal sliding surfaces and O-ring grooves. (See Figure 8.) This lubricant protects the O-rings and moving parts during operation. Use of other lubricants could lead to leaking and eventual seizing.
- 2) For ease of assembly, set bottom plate on a set of riser blocks at least 1/2" thick.
- 3) Place the four, 5/8" captive gate mounting bolts, with their high collar lock washers, into the counter-bored holes in the bottom plate.
- 4) Press the O-rings (LSC #640065 & 640023) into the appropriate grooves of the top and bottom plates and smooth any excess lubricant.
- 5) Position the slide gate on the bottom plate aligning the oval hole over the C-shaped cutout in the bottom plate.
- 6) Place the greased cam actuator assembly onto the slide gate with the small bearing in the oval hole.
- 7) Position the side rails on the bottom plate.
- 8) Situate the top plate onto the previously arranged assembly, guiding the cam actuator to seat it in the opening of the top plate.
- 9) Position the end plates and install the twenty-two socket head cap screws (complete with lock washers and anti-seize compound).
- 10) Tighten the bolts in progressive succession, starting in the center and alternately progressing to the ends.
- 11) Slowly cycle the actuator (using a 1" box wrench) to seat the O-rings and evenly distribute the excess grease.
- 12) Before mounting the Gate Adaptor to the pipe, make sure the pipe mounting plate surface and O-ring groove are clean.
- 13) Install a new Teflon O-ring (LSC part no. 640040) into the pipe mounting plate O-ring groove.
- 14) Position the gate adaptor on the pipe and fasten with the four captive bolts (be sure to use an anti-seize compound on the threads), then install the remaining two 7/16" bolts with lock washers.
- 15) Screw the threaded inserts into the four captive bolt holes.
- 16) **Make sure each insert is screwed below the top plate surface, bottomed and tight!**
- 17) Seat a new Teflon O-ring (P/N 640040) into the groove on the gate and re-attach the sensing head, steam fittings, and gate adaptor limit switch (if removed).
- 18) The gate should be cycled open.
- 19) Re-establish the steam and air supply to the prism wash system.

NOTE: Due to close tolerances in all locations where socket head cap screws are used a high collar lock washer must be used.



NOTE:

1. GATE ADAPTOR SHOWN IN CLOSED POSITION WITH LOCK.
2. ASSEMBLE LOCK (LSC #670350) THRU HOLE IN GATE ADAPTOR TO LOCK IN OPEN OR CLOSED POSITION
3. LOCK HOLE (WITHOUT LOCK ASSEMBLED) TO BE USED AS A VISUAL INDICATOR TO DETERMINE POSITIVE FULLY OPEN OR POSITIVE FULLY CLOSED POSITION OF VALVE



8. SPARE PARTS**614903 : IN-LINE SENSING HEAD SPARE PARTS KIT**

QTY	DESCRIPTION	PART #
4	SCREW, PH #2-56 X 3/8 LONG	102006
4	LOCK WASHER, # 2	102820
3	SCREW, SH/CS #6-32 X 3/8 LONG	106206
2	LOCK WASHER, # 6 HC	106830
7	SCREW, SH/CS 1/4-20 X 7/8 LONG	125214
7	LOCK WASHER, 1/4 HC	125830
1	PRISM SAPPHIRE	610100
1	TEMPERATURE SENSOR ASSEMBLY	614300
1	O-RING, 3-5/8 OD X 3-3/8 ID	640040
1	O-RING, 4-7/16 OD X 4-1/4 ID	640066
1	GASKET T – BOX	725010
1	DETECTOR HOLDER ASSEMBLY	725307
1	LIGHT SOURCE ASSEMBLY	725308
1	GASKET PRISM SEAL	829098

829254 : GATE ADAPTOR SPARE PARTS KIT

QTY	DESCRIPTION	PART #
1	CAM ASSEMBLY	829245
4	THREADED INSERTS	829233
2	O-RING (SMALL) TEFLON ENCAPSULATED	640023
2	O-RING (LARGE) TEFLON ENCAPSULATED	640065
2	O-RING (WHITE)	640040
1	STICK FREE LUBE	829487

1022915 : 1022 GENERAL SPARE PARTS KIT

QTY	DESCRIPTION	PART #
1	1022 PC – 1, CPU BOARD	1022401
1	1022 PC – 2, RELAY CIRCUIT BOARD	1022402
1	1022 PC – 3, POWER SUPPLY CIRCUIT BOARD	1022403
1	1022 PC – 4, REFRACTOMETER CIRCUIT BOARD	1022404
1	MAINTENANCE PANEL	1022412

1022920 : EXTENDED SPARE PARTS KIT

QTY	DESCRIPTION	PART #
1	1022 PC – 5, MOTHER BOARD	1022405
1	OPERATOR PANEL ASSEMBLY	1022408ND

9. APPENDIX A: Alarms and Event Messages

SET	An alarm has been activated
CLR	An alarm has been cleared
AOP	“A” refractometer only operation
BOP	“B” refractometer only operation
LO%	Low solids alarm
DIF	Differential solids (2%) alarm
D-V	Divert valve limit switch input a failure means the divert valve has not followed the Divert signal within the predetermined amount of time.
Wfail	The corresponding refractometer has failed the “Smart Wash”
MALFUNC	The corresponding refractometer is malfunctioning. REF: “History” screen for reason.
GatCL	The corresponding Gate Adaptor has been closed.