LUDLUM MODEL 329-32
64-CHANNEL LAUNDRY MONITOR

Operator's Manual

November 2015

Serial Number 107800 and Succeeding

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STATEMENT OF WARRANTY

Ludlum Measurements, Inc. warrants the products covered in this manual to be free of defects due to workmanship, material, and design for a period of twelve months from the date of delivery. The calibration of a product is warranted to be within its specified accuracy limits at the time of shipment. In the event of instrument failure, notify Ludlum Measurements to determine if repair, recalibration, or replacement is required.

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LUDLUM MEASUREMENTS, INC.
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Section 1

Introduction

The Ludlum Model 329-32 Laundry Monitor is intended for automatic monitoring of both alpha and beta-gamma contamination on clothing or other light articles presumed to be free of radioactivity, or within release or ruse limits. A conveyor belt carries articles between two gas-proportional detector arrays. An audible alarm will sound when contamination exceeds the given proportional detector arrays. An audible alarm will sound when contamination exceeds the given alarm setpoint. A light emitting diode (LED) array spans the width of each end of the laundry monitor. The LEDs show the position of the alarm on the conveyor and provide the operator with the status of the machine. A dual liquid crystal display (LCD) shows the counts and the current operating conditions, such as conveyor speed and gas flow. A 20-key keypad also allows the changing of alarm setpoints, operating parameters, and other system information.

Changing any parameter requires the use of a security code. The entire system is mobile, having casters that lock to prevent movement of the monitor. Power required is 95 to 135 Vac at 2 amps; 220 Vac available.

Each lower and upper detector array has 16 individual gas-proportional probes. The two arrays provide 32 alpha channels and 32 beta-gamma channels for a total of 64 counting channels. A spare detector array (supplied with each system) allows for easy replacement, reducing down time. Each probe in the array has an active open area of approximately 94 cm^2, and the staggering of these probes provide an even response across the conveyor. The useable detection width is 86.4 cm (34 in.) with an overall belt width of 91.4 cm (36 in.). The spare array has its own gas circuit allowing it to be maintained in a purged state for immediate replacement of the upper or lower detector. All three detectors slide out of the conveyor bed for cleaning and repair.

The ^{10}P gas lines connect to a separate vented flow control box located underneath the conveyor. A dual gas bottle input allows automatic changeover operation when a bottle becomes empty. The gas control box also checks the output from the upper and lower detectors to ensure continuous gas flow

purging and automatically detects gas output loss. Rotameters with needle valves accessible on the front of the gas flow box, control the input flow.

The electronics is microprocessor based and housed in two slide-out drawers. There are two alarm levels, each fully adjustable. The first alarm level (ALERT) can pause the conveyor, stop the conveyor, allow the conveyor to continue, or rescan. Rescanning reverses the belt to clear the probe that caused the alert and then passes the article through the monitor again. A master yellow alert lamp will light for the duration of the ALERT. The second alarm level (ALARM) can either stop the conveyor and light the red master lamp and audio, rescan once, twice, always, or it may continue conveyor operation and latch all alarms. Fail detection features include high-voltage failure, low count, and high background.

The high voltage, conveyor belt speed, and output gas flows are monitored by the central processor. Pressing the BACKGROUND UPDATE button manually enters the background mode. Automatic background updates allow updating after the conveyor has become free of articles.

The conveyor drive system consists of a one-eighth hp gear motor driving both upper and lower conveyors. An infrared sensor detects articles approaching the detectors. A safety "bump" bar surrounds the perimeter of the conveyor bed, stopping the conveyor belt if bumped. The upper-to-lower conveyor spacing adjusts between 0 and 17.8 cm (0 and 7 in.).

Section 2

Specifications

Readout/Data Output: The monitor has a digital LCD readout (see Figure 7) that presents the regular counts or background counts. The count readout is in counts per second (cps) or counts per minute (cpm), regardless of count time. Each channel reads out on the LCD in units from 0000-9999.

Background Update: Background updates may be made either manually or automatically. In the automatic mode a switch-over occurs if the belt has run clear long enough to clear all articles from underneath the detectors. The infrared light and belt speed are both used to determine and time required to do this. The operator can manually request BACKGROUND UPDATE at any time. Defeating the automatic switch-over to background mode requires manually pushing the BACKGROUND UPDATE to enter the background mode. The software allows the user to enter a maximum time limit between updates.

Count Time: The count time is keypad adjustable from 1 to 12 seconds.

Alarm Output: The monitor has visual and audible indicators of an alarm. The first-level alarm (ALERT) is shown by a yellow LED for each detector. The second-level alarm (ALARM) is shown by a red LED. The array of LEDs spans the width of the conveyor, showing an affected channel. A master yellow and red lamp also light if any of the detectors alert or alarm.

Alarm Setpoints: Counts per second is the base for counting alarm setpoints in CPS mode and counts per minute is the base for alarms in the CPM mode. The alarm range from 0000 to 9999 cps or cpm, including beta alert, beta alarm, alpha alert, alpha alarm, high alpha background, and high beta-gamma background. The low gas output alert is adjustable from 0-200 cc/min.

Ease of Decontamination: Construction of the monitor consists of anodized or painted aluminum and stainless steel. PVC covers the LED array and wipes clean with a moist cloth.

Model 43-77 Gas Proportional Detector: There are 16 probes in each detector array, having an individual open active area of 94 cm^2. The gas proportional probes are staggered across the width of the belt, ending undetected zones. This arrangement provides nearly constant efficiency across the conveyor width. Three metal bars cover the active area of each probe to limit face curvature. The three bars and the conveyor belt yields about 94 cm^2 of open area (see Figure 8).

Accessibility of Detectors: The detectors are easily accessible on the side of the laundry monitor. Changing a detector array takes about five minutes. The spare detector array is located underneath the lower detector and has its own gas supply, providing rapid replacement and return to service. After changing a detector array, take a few minutes to verify its operation by passing the test source array through the monitor. A non-purged array may take up to 1.5 hours to purge.

Note:

Each array weighs about 22.7 kg (50 lb), and due to its awkward size, it is recommended that two persons perform an array change-out.

Counting Gas Input: The system is designed for ^{10}P (10% methane, 90% argon) gas, and other mixtures are possible. The operating gas consumption is about 30 cc/min for each detector. Total consumption is less than 100 cc/min, or about one bottle per month in a standard 223 scf (standard cubic foot) bottle.

Detector Window: 0.4 mg/cm^2 aluminized Mylar

Active Area (each array): approximately 2000 cm^2 (310 in^2)

Open Area (each array): approximately 1600 cm^2 (248 in^2)

Minimum Detector Efficiency (4π): approximately 22% for $^{90}Sr/^{90}Y$ (beta); 15% for ^{230}Th (alpha)

High Voltage: adjustable from 200 to 2500 volts

Design Threshold Sensitivities: The threshold sensitivity refers to the voltage from the detector. A pulse height from 2.5 to 50 mV from the detector will register a beta count. Any pulse from the detector greater than 125 mV registers as an alpha count. In summary:

Beta Threshold: 2.5 mV

Beta Window: 50 mV

Alpha Threshold: 125 mV

Reliably Detected (RDA): RDA is the amount of radioactivity that has 90% chance of detection. The RDA ranges from 0.40 to 2.0 nCi (800 to 4440 dpm) for belt speeds from 0.25 to 8.1 cm (0.10 to 3.2 in.) per second. At 4.9 m (16 ft) per minute the RDA for the beta-gamma channels is about 2 nCi. Detection of the lowest activity is shown in Figure 2. The graph shown in Figure 2 shows the activity (picocuries) versus belt speed. Slowing the belt makes the monitor more sensitive. Slowing the belt to a speed of 0.25 cm (0.10 in.) per second allows the monitor to detect down to 400 pCi.

Conveyor Speed: The conveyor belt speed is keypad-adjustable from 0.25 to 14 cm (0.10 to 5.5 in.) per second. Figure 2 shows the relationship between belt speed and (PC) personal clothing throughput. The upper horizontal axis shows the maximum PC throughput of 250 PCs per hour.

Conveyor Belt Maintenance: The stainless steel belt will not absorb contaminants. Replacement of the upper or lower belt takes about one hour. The belt requires weaving together when replaced. However, splicing the belt using special splicing links speeds the weaving time.

Article Size: maximum 17.8 x 86.4 cm (7 x 34 in.) (W x H), upper conveyor adjustable from 0.64 to 17.8 cm (0.25 to 7 in.) above lower conveyor

Power: 95-135 Vac at 2 amps maximum; 220 Vac available

Temperature Range: -15 to 50 °C (5 to 122 °F)

Construction: steel frame and aluminum electronics housing

Size: 150 x 116 x 282 cm (59 x 45.8 x 111 in.) (H x W x L)

Shipping Size: 152 x 122 x 301 cm (60 x 48 x 119 in.) (H x W x L)

Shipping Weight: 568 kg (1250 lb)

Section 3

Description of Controls and Functions

Initialization

When the Model 329-32 powers up, a start sequence begins. All lights on each end-pane (operator and input ends) will turn on. The audio will sound, and the dual LCD will darken. This routine tests all lights and pixels on the LCD screens. Use this time to verify the operation of all lights, LEDs, and audio devices. Pressing any keypad button, the BACKGROUND UPDATE button, or AUDIO ACKNOWLEDGE button concludes the power-up test. All lights and audio will turn off. The LCD displays a logo while the start routine finishes, and then the dual LCD shows the default screens. The left-hand screen displays the current beta background counts and probes A through P, upper, and lower detectors. The right-hand screen shows the current operating conditions screen. If all the alarm setpoints and setup parameters are correct, the Model 329-32 Laundry Monitor is ready to begin operation.

Warning!

Ensure the castors are locked before operating.

Keypad Functions

Entering the alarm setpoints and setup parameters entails use of the keyboard to navigate through the menus. See MENU DIAGRAMS in back of manual for the menu structure of the monitor. See also Figure 4 for the keypad diagram. The keypad has the numerals 0-9, a backspace key, an enter key, and several special function keys. Figure 7 shows the layout of the keypad in relation to the LCDs.

Count/Background Key, "CNT/BKGD": This key changes the left-hand LCD between showing the 32 channels of counts and showing the 32 channels of background counts. When used with the ALPHA/BETA-GAMMA key (below), viewing all four count windows is possible. The four windows are ALPHA COUNT, BETA-GAMMA COUNT,

ALPHA BACKGROUND COUNT, and BETA-GAMMA BACKGROUND COUNT.

Alpha/Beta-Gamma Key, "A/B-G": This key changes the left-hand LCD between showing the 32 channels of alpha and showing the 32 channels of beta-gamma. When used with the COUNT/BACKGROUND key (above), viewing all four count windows is possible. The four count windows are the ALPHA COUNT, BETA-GAMMA COUNT, ALPHA BACKGROUND COUNT, and BETA-GAMMA BACKGROUND COUNT.

Main Menu Key, "MAIN MENU": This key shows the read menu, bypassing the need to go through the main menu. Reading all alarm and alert setpoints is possible from here. In addition, viewing all current operating conditions is possible.

Operating Conditions Key, "OPER COND": This key presents the current operating conditions, such as conveyor belt speed, high voltage, and output gas flow. The count time is shown with a countdown time, showing the time left in the current count time.

Print Screen Key, "PRNT SCRN": This key provides a hard copy of the counting window (the left-hand LCD). The convenience panel has a dedicated printer port. While a print screen is spooling information to the printer, new counts will not appear in the counting window. If a printer is not attached, is off-line, or is not ready to print, a warning message will flash. The print buffer in the monitor will clear after the warning message. The menu system also allows automatic dumping of count information for each count time and allows the format to change from ASCII (human readable) to hex (more compact). Use these functions with care since it is possible to send information to the printer faster than the printer can print.

Alarm Setpoints Key, "ALRM PNTS": This key displays all the current alarm points on the right-hand LCD. It is useful for showing at a glance all the present alarm setpoints (ALARM and ALERT).

Hold Key, 'HOLD": This key "freezes" the counts shown. The HOLD key will also cancel (halt) the parameter configuration process while in the setup mode.

Backspace Key, "BKSP": This key returns the screen to a previous menu. Changing a parameter that has been entered incorrectly is possible with the backspace key.

Enter Key, "ENT": This key enters a parameter in the setup mode. The enter key also progresses to the next menu if available.

Operator Controls and Functions

See Figures 1 and 5.

Pilot Light: A green lamp located on the left side of the conveyor outfeed turns on whenever the ON/OFF switch is in the ON position.

Run Button: Two green buttons on the inlet end and one green button on the outlet end start the conveyor and reset any alarm conditions. Releasing the RUN button starts the count cycle. Holding the RUN button down for more than three seconds, accelerates the belt to 12.7 cm (5 in.) per second. Releasing the RUN button returns the conveyor to normal speed.

Stop Button: Stopping the conveyor is possible by:

1. Two red "mushroom" buttons on the inlet end.

2. One red "mushroom" button on the operator end.

3. A safety cable pull that surrounds the monitor.

4. Microprocessor command.

The monitor continues to count or update background after hitting a STOP button. The only way to restart the conveyor after a stop button has been depressed, is by pressing a RUN button. A conveyor "pause" may be asserted by an ALERT condition, and the conveyor may restart after a time.

Update Background Button: The white button located on the operator and forces the system into the background updating mode. To start this mode, push the button until hearing a short beep. The counting LED will turn off, and the updating background LED will turn on. The background counting window may be used to show the current background counts. Pressing UPDATE BACKGROUND does not affect the conveyor operation. Sensing an article while the system is updating the background will force the system to switch from the UPDATING BACKGROUND mode to the COUNTING mode if the conveyor is running.

Audio Acknowledge Button: This black button located on the operator end-panel turns off the audio. Pressing the RUN or UPDATE BACKGROUND button re-enables audio.

Alert Lamp: This master red lamp signals that an ALARM condition exists for one or more channels

Alarm Lamp: This mater red lamp signals that an ALERT condition exists for one or more channels.

Audio Annunciator: Located on each end, it will sound continuously if a second-level ALARM condition exists or an operating error exists, such as high-voltage failure.

Pressing the AUDIO ACKNOWLEDGE turns the AUDIO off until pressing the RUN or UPDATE BACKGROUND button. Pressing the AUDIO ACKNOWLEDGE button when hearing no audio will disable the next audio output. A required background is heard by a beep every second.

Upper Conveyor Crank: The hand crank located on the upper right-hand side of the operator end-panel adjusts the height between the upper and lower conveyor. The height is adjustable between 0.64 and 17.8 cm (0.25 and 7 in.).

Conveyor Belt Tightener: This adjustment is located on the inlet end of the upper and lower conveyors.

Description of Status Lights

The Model 329-32 has a row of status lights that are visible from either end of the conveyor. There are 16 LED status lights located in a row beneath the channel-by-channel alarm/alert LED array (see Figure 5). These status lights show the present system mode and can show some failure in the count process. The subtitles show the markings found on the monitor.

Counting: This green LED shows that the system is in counting mode. Updated counts appear in the beta count or alpha count windows on the LCD display. This light turns on after pressing the RUN button, unless the UPDATE REQUIRED LED is on.

Article Sensed: This green LED shows that an article is passing the infrared sensor located about 45.7 cm (18 in.) ahead of the detectors. If sensing an article while the conveyor is running, the system will switch

out of the BACKGROUND UPDATE mode and into COUNTING mode.

Detectors OK: This green LED shows that all detectors are working properly. This status light will turn off if the LOW COUNT or HV FAIL status light turns on.

Speed OK: This green LED shows that the conveyor is not over-running the probe active length. For best operation, a point source of radiation must spend at least one full count time over the probe, which requires a speed slow enough to allow two full count times across the probe. When a single count time is allowed, the worst case occurs when a point source is halfway across the active length of the probe and the count time ends. When two count times are allowed, the point source worst case is when the count time ends at one quarter of the active length, a new count begins, and a full count has taken place at the three-quarters position.

Equation 1 shows the relationship between the count time and the belt speed for a point source and a given probe size. Finding the number to enter into the monitor requires solving Equation 1. Round the result down to the nearest tenth of an inch per second. For example, with a probe length of 6.592 inches and a three-second count time, the maximum speed setting is 1 inch per second.

Equation 1:

$$\textit{Belt Speed}\ \frac{\text{(inches)}}{\text{second}} = 6.592\ \text{(inches)} \times \frac{2}{\text{CT (seconds)}} \times \frac{1}{2}$$

For maximum performance, the equation above should be used; however, the counting algorithm used allows faster belt speeds to be selected with good results on distributed contamination.

Motor On: This greed LED shows that the speed sensor is receiving pulses.

Updating Background: This green LED shows that the system is in the background update mode. This light turns on by pressing the BACKGROUND UPDATE button.

Bottle In Use -- Main: This green LED shows that the main gas bottle supply is in use.

Bottle in Use -- Aux: This green LED shows the auxiliary gas bottle supply is now in use.

Bottle Empty – Main: When this red LED is lit, it shows that the main gas bottle is empty. Adjust the bottle pressure to 1 psi above the point where this LED turns OFF (about 5 psi). Do not exceed 15 psi.

Bottle Empty – Aux: When this red LED is lit, it shows that the auxiliary gas bottle is empty. Adjust the bottle pressure to 1 psi above the point where this LED turns OFF (about 5 psi). Do not exceed 15 psi.

Low Output: This red LED shows that the gas output from either the upper or lower detector is below the minimum gas output parameter. This LED does not set off an alarm or cease conveyor operation.

Update Required: This red LED shows that the background information needs updating. It will start flashing one minute before reaching the actual time limit. This allows the conveyor time to clear articles. Press the UPDATE button as soon as the monitor is clear. After flashing for one minute, the conveyor will stop, and all RUN buttons will be ignored.

Low Count: This red LED shows that a count for any beta-gamma channel has not been received within the last 10 seconds. The offending channel is indicated by a red alarm LED. Low count is checked only in COUNTING mode.

High Background: This red LED shows that a background count channel is greater than the high alpha or beta-gamma background parameters. Checking for this alarm occurs only when in the BACKGROUND mode. The belt will not operate during a HIGH BACKGROUND condition, even if switched to the COUNTING mode. The audio will be continuous to say an alarm condition exists. The offending channel is shown by a red alarm LED.

HV Fail: This red LED shows that the measured high voltage on either upper or lower detector is not within 10% of the high-voltage setpoint. The belt will not operate during an HV FAIL condition. Audio will be continuous.

Trouble: This red LED is a catch-all error indicator. Possible errors include an internal communication error, LCDs not operating properly, and others not yet defined. All operation halts. The audio will be continuous to say an alarm condition exists.

Section 4

Operating Procedures

Preparing Monitor for Use

The primary requirement for operation is to have the upper and lower detectors purged with ^{10}P gas. If the system has not run on gas for 24 hours at a minimum of 30 cc/min output flow, then purge the system as described in the following paragraphs.

Warning!

This equipment has been investigated with regard to safety from electrical fire and shock hazard only. The gas/mechanical features have not been investigated and are subject to approval by the inspection authority having jurisdiction.

Connecting the Gas Supply

The monitor has dual gas bottle inputs with automatic change-over. Normal operation requires two gas bottles and two regulators. The supplied 0.64 cm (0.25 in.) female pipe to 0.32 cm (0.13 in.) I.D. hose nipple (LMI part # 13-7836) connects to the regulator. The supplied inserts (LMI # 22-9639) go inside the end of the interconnecting 0.64 cm (0.25 in.) O.D. hose. Adjust the regulators while watching the corresponding bottle empty LEDs and add 1 psi to the point where the LED just turns off. The gas box contains in-line flow restrictors that limit the maximum flow to about 200 cc/min with input pressures between 5 and 10 psi. Do not exceed 15 psi on either input to the gas box.

The monitor selects the main gas bottle up power-up. If in automatic bottle change-over and the main bottle is empty or not present, and an auxiliary bottle is present, then the monitor switches to the auxiliary bottle. When power is off, the monitor selects the main bottle. Therefore, be sure that the main bottle has enough gas to maintain at least 30 cc/min during power-off conditions. The standby detector gas

flow should be at least 10 cc/min. Leave the monitor on with conveyor stopped when left unattended.

To achieve quick purging of the detectors, turn the proper knob on the flowmeter one full turn counter-clockwise. The flowmeter is located on the front of the gas box. After 1.5 hours, adjust the input flow via the flow meter to 50 cc/min and maintain an output of at least 30 cc/min.

Check the detector for a completely purged state. Use a check source placed over the input and output probes on each detector. The 16 individual probes are in a series so gas flows from one detector to the next. Regardless of the input and output lines, the input and output probes on a detector will be channel A or channel B, upper or lower detector. It is only necessary to check these two probes for similar counts from a check source to make sure purging is complete.

The monitor constantly checks the exhaust gas output of each detector array. The low gas flow warning will normally be set at around 10 cc/min through SETUP MENU II. The low gas warning is an alarm that only lights the low gas output indicator. This indicator is valid for the upper and lower detectors (not the spare). The monitor will operate during a low gas flow condition. However, when resuming the counting mode, the counts will begin to drop off. Eventually a low count alarm will halt operation.

Parameter Setup Before Operation

A discussion of necessary parameters follows in this section. View all parameters of interest out of the READ MUNUs. The following parameters must be set up or checked before article inspection:

a. Whether low count is armed or not.

b. High beta-gamma background setpoint.

c. High alpha background setpoint.

d. Count alarm setpoints.

e. Upper and lower high voltage.

f. Count time.

g. Conveyor belt speed and action.

h. Low gas flow limit and gas bottle mode.

i. Background update status (automatic or manual).

j. Maximum background update interval.

k. Background subtract status (active or inactive).

Low Count Alarm Setup: Checking for a low count alarm occurs in the COUNT mode and on the beta channels. Ideally, alpha background is zero; therefore, no checking occurs on the alpha channels. An alarm will occur if the last 10 seconds of count yields zero.

High Background Alarm Setup: Background fluctuations become important when looking for an alarm close to the lower limit of detection for the monitor. The counts displayed in the background window are the average of the last 12 one-half-second count intervals. The high alpha background alarm follows this same discussion. The high background alarms may be set from 0 to 9998 cps.

Setting Maximum Sensitivity Alarm Levels: The lowest that an alpha or beta-gamma count alarm may be set is based on the current background counts. The following equation may be solved by iteration:

Equation 2:

$$TC = 3.15\sqrt{BC} + BC - P[AF]\sqrt{TC}$$

Where, $P[AF] = -1.28$

At a 90% confidence level.

The factor 3.15 in the equation above yields 1 out of 1000 false alarms per count time for one detector.

Example 1: Find the maximum beta-gamma sensitivity setting.

The beta-gamma background is 4 counts. False alarm rate is set to 1 out of 1000. Discuss how the alarm frequency changes the total count.

Set the maximum sensitivity based on the background count. Therefore, by iteratively solving Equation 4, the total count is found to be:

(Confidence Level) Alarm Frequency)	**P[AF]**	**TC**
5%	1.645	6.2
10%	1.280	7.0
20%	0.840	8.0
30%	0.525	8.8

40%	0.252	9.6
50%	0.000	10.3
60%	-0.252	11.2
70%	-0.525	12.2
80%	-0.840	13.4
90%	-1.280	15.3

The alarm frequency is the confidence level that particular alarm will sound for a give source size. Normal operation uses the 90% confidence level that yields a total count of 15.3 counts.

Program the alarm setpoint into the monitor as 16 cps. The detector efficiency determines the smallest source activity seen by the monitor. The detector efficiency depends on the belt speed. The belt speed depends on the count time.

The equation below determines the value of the setpoint in curies.

Equation 3:

$$RDA_{90\%} = \frac{TC - BC}{k \times DE \times IT}$$

where,
$RDA_{90\%}$ is the reliably detected activity at a 90% confidence level,
TC is the total count,
BC is the background count,
DE is the detector efficiency,
IT is the interrogation time,

$$k = 37 \frac{dps}{nCi}$$

For example, if the count time is set to be 1 second with the belt speed at 3.2 ips and the background is 4, then the total count is 15. The detector efficiency is 23% for ^{137}Cs. Use Equation 5 to calculate the maximum sensitivity value in curies. The result is 1.29 nCi.

Examples 2 and 3 listed below use the typical efficiencies for the Ludlum Model 329-32 – beta efficiencies of no less than 20% (4π geometry) and alpha efficiency of no less than 15%. The count alarms and alert levels may be set from 0 to 9998 cps.

Example 2: Find beta-gamma alarm for known source size.

It is desired to set the monitor for 10,000 dpm and a belt speed of 3.2 ips or greater, with a confidence level of 90%, (P[AF] = -1.280), and a background count of 4 cps.

Equation 4:

$$\text{TOTAL COUNT (TC)} = \text{ALARM LEVEL x EFFIENCICY}$$
$$= \frac{10{,}000 \text{ dpm}}{60 \text{ seconds}} \times 0.20(\text{efficiency})$$

From Equation 1, the belt speed should be set at 3.2 inches per second; however, the count algorithm allows use of a belt speed of 5.0 ips.

Since the TC is much larger than the background count (BC), the alarm is set to:

Equation 5:

$$\text{ALARM POINT (AP)} = TC + P[AF] \times \sqrt{TC}$$
$$= 33 + (-1.280) \times \sqrt{33} = 26 \text{ cps}$$

Round the AP down to the nearest integer.

A three-second count requires the conveyor to slow down to 1.0 ips. Using Equation 6, the alarm point is set to:

Equation 6:

$$AP = \frac{100 - 1.280\sqrt{100}}{3}$$
$$= 29 \text{ cps}$$

In summary, a longer count time allows for a higher alarm setting, due to the TC being higher in number. As the TC becomes higher in value, so does the percent deviation from the mean or average value. Therefore, the AP may be set higher for higher count times.

Example 3: Find alpha alarm for known source size.

Set the alpha alarm level and belt speed for 1000 dpm per 100 cm^2. The alarm chance for a false alarm is 99%, P[AF] = -2.58. The count time is 1 second. Discuss how the alarm point changes for 2, 5, and 10-second count times.

Equation 7:

$$\text{TOTAL COUNT (TC)} = \text{ALARM LEVEL x EFFICIENCY}$$
$$= \frac{1000 \text{ dpm}}{600 \text{ seconds}} \times 0.15 = 2.5 \text{ cps}$$

Equation 8:

ALARM POINT (AP) = TC + P[AF] X √TC
= 2.5 – 2.58 x √2.5 = -1.6 cps

A 1-second count time produces ±4.1 counts from 2.5 cps at 3 standard deviations. This fluctuation is too large for a value so close to zero. Therefore, the large fluctuation in possible counts provides a less than adequate alarm chance. A count time increase up to 9 or 10 seconds yields an alarm setpoint of statistical stability.

Count time (seconds)	belt speed (ips)	alarm setpoint (cps)
1	3.2	-1.6
2	1.6	-0.4
5	0.6	0.7
10	0.3	1.2

Detector High-Voltage Setup: The upper and lower high-voltage value may differ. A "peak" of each detector should be performed to determine the operating voltage. If detecting alpha, then a plateau with al alpha source should be run to ensure proper voltage. The high voltage on either detector may be set independently of each other in the voltage range from 250 to 2500 Vdc.

Count Time and Belt Speed Setup: The count time, conveyor belt speed, and alarm setpoints are all related. It is best to choose a desired throughput or conveyor speed and then calculate your count time and alarm levels. If the levels can't be achieved, then slow the speed down. Configuring the alarm setpoints requires two variables/parameters – detector efficiency and maximum radioactivity levels. The count time (CT) is inversely proportional to the maximum speed:

Equation 9:

$$\text{COUNT TIME} = \frac{5.0}{\text{BELT SPEED}} \text{ SECOND}$$

The belt speed may be set from 0.1 to 5.5 inches per second in tenth-inch intervals. Therefore, round equations 10 down to the nearest tenth.
The count time may be set from 1 to 12 seconds in integer intervals.

Gas Parameter Setup: Set the low gas flow to 20 cc/min when the operating gas flow is at 50 cc/min. The low gas flow alert may be set from 0 to 200 cc/min.

The gas bottle mode determines how the monitor switches between the main gas bottle or forced to the auxiliary gas bottle.

Background Update Interval Setup: The maximum background update interval forces the monitor to update the background values stored in the system electronics. The annunciator on each end of the monitor will begin to beep one minute before a required background update takes place. After one minute, the belt will stop and the RUN button will not work. When detecting small sources, perform the background update more frequently than when working with sources where the background is negligible. The background update time interval may be set from 2 to 998 minutes. If background subtract is inactive, set the update interval to 999 (no update).

Background Subtract Status Setup: The background subtract status may be active or inactive. The value used to subtract from the current count is an average of the last four background readings. Beta-gamma and alpha backgrounds are separate.

Parameter Defeat Values: Table 1 lists the defeat or override setpoints. The setpoints should not be overridden for normal operation. These defeat values aid in troubleshooting the monitor.

Table 1. Alarm Overrides

Defeat Parameter	Range	Value	Action on Defeat
High Voltage	251-2500 V		250 disables HV alarm and turns HV off.
Low Gas Output Alert	0-199 cc/min		200 disables low gas alert.
Background Update Interval	1-998 min	999	Interval set to infinity.
Count Type Alarm/Alert	0-9998 cps	9999	No alarm/alert checking for all count channels.

Suggested Checks Before and After Use: This section lists checks that are suggested before and after each shift when using the Ludlum Model 329-32 Laundry Monitor.

LUDLUM MODEL 329-32 LAUNDRY MONITOR
OPERATOR CHECK AND VERIFICATION

1. Check all LEDs and lights by turning power switch off and then on.

2. Press the AUDIO ACKNOWLEDGE button.

3. After the count screen appears on the left-hand LCD, press the RUN button.

4. Check status lights for correct indication.

5. Press READ MENU, then "1" to check the following:
   Low Count Alarm: _____.
   High Beta Bkgnd Alarm: _____.
   Beta-Gamma Alarm: _____.
   Beta-Gamma Alert: _____.
   Alpha Alarm: _____.
   Alpha Alert: _____.
   High Alpha Bkgnd Alarm: _____.

6. Press ENT, then "2" to view:
   High Voltage (upper): _____.
   High Voltage (lower): _____.

7. Press ENT, then "3" to view:
   Count Time: _____.
   Update Interval: _____.
   Date: _____.
   Time: _____.

8. Press ENT, then "4" to view:
   Belt Speed Setpoint (inches/sec): _____.
   Conveyor action on ALERT: _____.
   Conveyor action on ALARM: _____.

9. Press ENT, then "5" to view:
   Low Gas Flow Alarm Setpoint: _____.
   Upper Gas Flow Output (cc/min): _____.
   Lower Gas Flow Output (cc/min): _____.
   Spare Gas Flow Output (cc/min): _____.

10. Press ENT, then "7", then "1" to view:
    Background Update Automatic/Manual: _____.
    Current Update Time Limit: _____.
    Background Subtract Status: _____.

11. Press ENT, then "7", then "6", then "2" to view:
    Automatic/Manual Bottle Chang-over: _____.

Parameter Descriptions and Setup

This section describes how to set optional parameters for operation.

Setting the Real Time Clock

The real-time clock is standard military format. The time and the year may be set via the SETUP MENU (see MENU diagrams in the back of this manual).

Setting the Security Code

A four-key security code allows access to the setup menus. The security code consists of any of the 20 keys on the 20-key keypad. The security code may be temporarily reset "0000" by calling up READ MENU II and pushing the #9 key.

Setting Alarms Using Automatic Alarm Setup Feature

Automatic alarm setpoint is possible for the beta-gamma or alpha counts. The source size to alarm on, detector efficiency, and confidence level must be known.

Setting the Auto-Rescan Mode

The conveyor can reverse and rescan an area if an alarm condition (ALARM or ALERT) exists for a channel. The belt will reverse to clear the alarm area from underneath the detectors.

Normal setup uses only rescan on alarm or alert, but not on both. If both rescan on alert and rescan on alarm are set to 1 or 2, then the monitor only counts the number of rescans, regardless of alarm.

There are four choices for the rescan mode:

1. No rescan defeats this mode.

2. Rescanning once will reverse the belt if an alarm exists for any one channel. Catching an alarm on the second pass will force the belt to stop.

3. Rescanning twice will reverse the belt if an alarm exists for any channel. Catching an alarm on the second pass will reverse the belt. If on the third pass an alarm exists for any channel, the belt will stop.

4. Rescanning always will keep the article on the belt until no alarm condition exists.

Setting Up the Printer Port

The serial port is RS-232 compatible, using RTS/CTS hardware handshaking and is located on the rear of the monitor. See Appendix A for pin-out description.

The ASCII output dumps the contents of the count display (left-hand LCD), plus the high-voltage setpoints, date, and time. Ten lines of 40 characters each make up the ASCII data dump. Each 40-character line ends with a carriage return and line feed. The end-of-screen transmission characters are an additional carriage return and line feed. The hex dump data is in the form of 2-byte integers. Table II shows the byte declarations of the hexadecimal data stream that is output every count time.

Setting Up Efficiency Mode

1. Turn on Efficiency Mode.
2. Raise beta/alpha alarms to 9999 (to prevent nuisance audio alarms).
3. Set LOCOUNT ON.
4. Set background update interval to 999 m.
5. Set high background alarm to 9999.
6. Set the conveyor action on alarm to continue and to latch maximum numbers.
7. Set conveyor speed to 2.0 ips (or the site required speed).
8. Set count time to 1 second.

Note: Peaking routine sets the count time to 6 seconds. Be sure to set count time to 1 second when running efficiencies (or adjust the belt speed accordingly).

Raise the cables in spare detector compartment interference.

Set printer to 32-second timeout, 52 lines per page.

The OKIDATA B4400 required a 9-pin female to 25-pin. See following pinout. The upper cabinet assembly cable 7-pin MTA converts to 9-pin D sub.

9-pin D		**MTA 7-pin**	
Blue	Pin 2	Pin 6	TX (alarm output)
Yellow	Pin 3	Pin 4	RX (alarm input)
Violet	Pin 5	Pin 7	ground
Green	Pin 7	Pin 5	CTS (alarm output)
Orange	Pin 8	Pin 3	RTS (alarm output)

Table II. Hexadecimal Output Byte Declarations

Data Byte	Value
1 & 2	1 = Regular Counts 0 = Background Counts
2 & 3	Upper High Voltage
4 & 5	Lower High Voltage
6 & 7	Upper Gas Output
8 & 9	Lower Gas Output
10 & 11	Count Time
12 & 13	Month
14 & 15	Day
16 & 17	Year
18 & 19	Hours
20 & 21	Minutes
22 & 23	Seconds
24 to 87	32 Alpha Channels (A through P)
88 to 151	32 Beta Channels (A though P)
152	End of Transmission Character (Decimal 32)

All values are composed of two data bytes. The first data byte sent is the most significant byte of the value. The second data byte sent is the least significant byte of the value.

Functional Check-Out and Operation

If the monitor has had the gas supply connected (see page 5-1), and the parameters set up (starting on page 5-2), then the functional check may begin.

a. Turn on power switch located on the out-feed end of conveyor.

b. Walk around the instrument to confirm that nothing is touching the safety stop bar and that all lights are working on both in-feed and out-feed panels. Ensure both annunciators are sounding and that the LCD screens are darkened.

c. Press any key on the keypad, the UPDATE BACKGROUND button, or the AUDIO ACKNOWLEDGE button. Check that both the in-feed and out-feed panels have the same lights turned, which include DETECTOR OK, SPEED OK, MAIN OR AUXILIARY gas BATTLE IN USE, and MAIN and/or AUXILIARY gas BOTTLE EMPTY. The UPDATE REQUIRED LED should be flashing for 45 seconds after initialization. If any other lights on these panels are on, then refer to the troubleshooting section of this manual for the light(s) in question.

   View the LCD screens. The right-hand screen should show the current operating conditions. The left-hand LCD should show all zeros for the 32 beta-gamma count channels. Press the ALRM PTS key on the 20-key keypad and check that the alarm and alert levels are correct. Check any other parameters of interest. A security code must be entered before changing any parameter.

d. Clear the immediate area of any radiation sources. To stop the conveyor at any time, press any red stop button or the red cable pull surrounding the conveyor. Press the UPDATE BACKGROUND button. Check that the UPDATING BACKGROUND LED came on. Make sure the background counts on the LCD screen are within normal background levels. The LCD screen should update every count time.

e. Press one of the green RUN conveyor buttons to change the mode of the monitor from updating background to counting mode. Check that the COUNTING LED is on and the UPDATING BACKGROUND LED is off. Make sure the regular counts on the LCD screen are within normal background levels. The LCD screen should update each count time.

f. The conveyor torque is factory set at a minimum to pull articles through the monitor. With the conveyor belt moving, use the crank handle to raise or lower the upper detector assembly. The upper conveyor should be within 1.3 cm (0.5 in.) of the expected object height. Certain articles may allow the upper conveyor to be lowered onto them for maximum sensitivity.

g. Perform the daily response check for beta-gamma and/or alpha using a proper source for the given alarm setpoints. To examine the upper detector alpha response, use a piece of foam to raise the check source to within an acceptable distance.

h. Place articles on conveyor in a manner so as to lessen self-shielding. Press one of the green RUN buttons to start the conveyor.

Warning!

Ensure the castors are locked before operating.

Section 5

Safety Considerations

Environmental Conditions for Normal Use

Indoor use only

No maximum altitude

Temperature range of -15 to 50 °C (5 to 122 °F)

Maximum relative humidity 10% to 95% (non-condensing)

Mains supply voltage range of 95-135 Vac (178-240 VAC available), 50/60Hz single phase (less than 100mA)

Maximum transient voltage of 2500 VAC

Installation Category II (Overvoltage Category as defined by IEC 1010-1)

Pollution Degree 2 (as defined by IEC 664)

Cleaning Instructions and Precautions

The Model 329-32 may be cleaned externally with a damp cloth, using only water as the wetting agent. Do not immerse the instrument in any liquid. Observe the following precautions when cleaning or servicing:

1. Turn the instrument OFF and disconnect the instrument power cord.

2. Allow the instrument to sit for one minute before cleaning.

Warning Markings and Symbols

Caution!

The operator or responsible body is cautioned that the protection provided by the equipment may be impaired if the equipment is used in a manner not specified by Ludlum Measurements, Inc.

Warning!

This equipment has been investigated with regard to safety from electrical fire and shock hazard only. The gas/mechanical features have not been investigated and are subject to approval by the inspection authority having jurisdiction.

The Model 329-32 is marked with the following symbols:

PROTECTIVE CONDUCTOR TERMINAL (per IEC 417, No. 5019) – designates the central grounding point for the safety ground. This symbol is visible inside the chassis.

CAUTION, RISK OF ELECTRIC SHOCK (per ISO 3864, No. B.3.6) – designates a terminal (connector) that allows connection to a voltage exceeding 1 kV. Contact with the subject connector while the instrument is on or shortly after turning off may result in electric shock. This symbol appears on the front panel.

Warning!

The operator is strongly cautioned to take the following precautions to avoid contact with internal hazardous live parts that are accessible using a tool:

1. Turn the instrument power OFF and disconnect the power cord.
2. Allow the instrument to sit for one minute before accessing internal components.

Warning!

Ensure the castors are locked before operating.

Replacement of Main Fuse (Back Panel)

Warning!

For continued protection against risk of fire, replace only with fuse of the specified type and current rating.

Section 6

Calibration

Note:

Local procedures may supersede the following.

Perform a yearly verification to guarantee accurate operation. Verification will include the following (in order of procedure):

1. Checking the high voltage.
2. Checking gas flow sensor setup.
3. Checking window levels on the quad-amplifier boards.
4. Finding a beta-gamma peak on each detector.
5. Running a plateau (alpha) on each detector (optional).
6. Running an efficiency using the Efficiency Mode (optional).

An operational check should follow calibration of the monitor. Review Section 3 of this manual to check for proper operation of the external readouts. Select a check source (alpha and/or beta-gamma) and an established alarm point (see "Parameter Setup Before Operation" starting on page 5-2). Finally, pass the check source over every channel to be sure the calibration process is accurate.

High-Voltage Power Supply (HVPS) Board Calibration

Turn monitor OFF and insert an LMI Model T-1034 (part # 48-2515) in series with the upper detector power connector (left rear of main chassis). Turn monitor to ON and allow to initialize. Set the high voltage via the keypad so each high voltage is set to 1750 Vdc.

Note:

The readout does not need to read 1750 Vdc at this time. The background update interval should be set to 999 minutes. The background mode should be set to manual. All underlined words are the exact letters found on the circuit board.

Find the HVPS board #5323-746 located in the extreme left (see Figure 6) of the main electronics chassis. Install an extender board (LMI #5323-631) so the potentiometers on the high-voltage board are accessible. The potentiometers called CAL, labeled UH (R183) and LH (R81) set the upper and lower high voltages respectively. Measure the actual high voltage using a digital voltmeter attached to the T-1034. Measure the voltage on pin 1 on the TLC27M7 amplifier (U155 upper, U77 lower) while adjusting the potentiometer called READOUT, labeled UR (R178, upper) and LR (R82, lower) to 1.750 Vdc ±0.003 Vdc.

Use the keypad to call up the high-voltage read screen. Adjust the potentiometer called VFC CAL, labeled HV CAL (R78) until the high voltage reads out on the LCD display at 1750 Vdc ±3 V. The lower high voltage should read 1750 Vdc ±3 V.

Use the 4-pin header to P8 to set the beta-gamma threshold (BT), beta-gamma window (BW), and the alpha threshold (AT).Use pin 1 labeled GND of P8 as a reference for the following measurements. Adjust the potentiometer labeled BT (R85) so the voltage from BT-GND (pins 4 to 1) on connector P8 is 50 mV ±1 mVdc. Adjust the potentiometer labeled BW (R84) so the voltage from BW-GND (pins 3 to 1) on P8 is 1.00 Vdc ±0.01 Vdc. Adjust the potentiometer labeled AT (R83) so the voltage from AT-GND (pins 2 to 1) on P8 is 2.500 Vdc ±0.025 Vdc.

Sample HVPS Calibration Worksheet

HVPS BOARD CALIBRATION
UPPER AND LOWER HIGH VOLTAGE SETTINGS

a. Turn the monitor off. Slide out main electronic chassis until it clicks into place. Disconnect both upper and lower detector high-voltage D connectors located on the rear of the main electronics chassis and install a Ludlum Model T-1034 high-voltage divider in series with the upper detector. Plug high-voltage extender board (part #5323-631) into HVPS slot. Plug HVPS onto extender board. Figure 6 shows the location of the HVPS board on the extreme left of the main electronic chassis.

b. Turn monitor on. Press a key on the keypad. After initialization, push the main menu key. Once the main menu is displayed on the right-hand LCD, push:

   #2 key to select SETUP MENU;
   #1 key to select Standard Setup, enter security code;
   #7 key to select OTHERS;
   #2 key to select BACKGROUND UPDATE MODE;
   #1 to select MANUAL UPDATE, [ENT key to accept value];
   #3 key to select BACKGROUND UPDATE INTERVAL;
   #9, #9, #9, ENT key enter value;
   ENT key to accept value;
   BKSP key to return to setup I menu;
   #2 key to select HIGH VOLTAGE setup;
   #1 key #7 key, #5 key, #0 key, ENT key, ENT key, MAIN MENU key, #3 key to select READ MENU;
   #2 key to select HIGH VOLTAGE read.

c. Measure voltage on the test points of the T-1034 with a digital voltmeter.

d. The upper high voltage should be 1750 Vdc ±3 Vdc. If necessary, adjust potentiometer labeled UH (R183 so voltmeter reads 1750 ±3 Vdc.

   Upper high voltage is set to: _____.

e. Test voltage on pin 1 of TLC27M7 opamp (U155). It should be 1750 Vdc ±5 mV. Adjust potentiometer labeled UR (R178), if necessary.

Upper reference set to: _____.

f. Turn monitor OFF and move the T-1034 HV tester to the lower detector connector and plug the lower detector connector into T-1034. Reconnect upper detector connector. Turn monitor back ON and allow initialization.

g. Measure the actual high voltage using the test points of the T-1034. If necessary, adjust potentiometer labeled LH (R81) so that a reading of 1750 Vdc ±3 Vdc is obtained.

Lower high voltage is set to: _____.

h. Measure pin 1 of TLC27M7 opamp (U155). If necessary, adjust potentiometer labeled UR (R178) to obtain a reading of 1750 Vdc ±0.003 Vdc.

Lower reference set to: _____.

i. Check the lower high-voltage readout for 1750 V. If necessary, adjust potentiometer labeled HV CAL (R78) so that the lower high voltage reads 1750 Vdc ±5 Vdc.

Lower high voltage LCD readout: _____.

j. Check the upper high voltage on the LCD is 1750 Vdc ±5 Vdc.

Upper high voltage LCD readout: _____.

k. Remove voltmeter and T-1034 from circuit and reconnect lower detector.

l. Place digital voltmeter negative lead on pin 1 of connector P8, labeled GND.

m. Place digital voltmeter positive lead on pin 4 of connector P8, labeled BT.

n. Adjust potentiometer labeled BT (R85) so voltmeter reads 50 mVdc ±1 mVdc.

Beta threshold reference set to: _____.

o. Place digital voltmeter positive lead on pin 3 of connector P8, labeled BW.

p. Adjust potentiometer labeled BW (R84) so voltmeter reads 1.00 Vdc ±0.01 Vdc.

   Beta window reference set to: _____.

q. Place digital voltmeter positive lead on pin 2 of connector P8, labeled AT.

r. Adjust potentiometer labeled AT (R83) so voltmeter reads 2.500 Vdc ±0.025 Vedc.

   Alpha threshold reference set to: _____.

s. Remove voltmeter circuit. Turn power off. Remove extender board. Replace HVPS board into main electronic chassis.

t. Make sure to return all parameters to the original settings.

Gas/Motor Board Calibration

(Boards #5323-747 and #5323-771 only)

the board in place with power on to verify. The background update interval should be set to 999 minutes. The background mode should be set to manual. (All underlined are exact letters found on the circuit board. All bold letters are on the gas flow box located underneath the conveyor.)

Disconnect and plug the gas return lines at all three detectors. If you wish to save the purge on any detector, unplug the incoming gas line and place a short hose across the detector IN and OUT hose barbs.

Use the gas motor board layout (Drawing 323 x 458, attached) to identify test points and components. Check the zero setting of the AD625 amplifier (U80). Turn the system OFF, and then back to ON. Do not push the Update Background button. Leave the unit in the test mode. Use a digital voltmeter to measure the voltage from pins 10 or 11 on chip AD625 (U80) to pin 7 of the same chip. If necessary, adjust the potentiometer labeled NULL (R94), such that the voltage is 0.000 Vdc ±0.050 Vdc. Press either Background Update or any keypad key to clear the test mode when done.

When zeroing the gas flow sensors, make sure that the return lines are plugged. Slight air movement through the sensor lines will cause errors in reading.

Adjust, if necessary, the ZERO3 (SPR) potentiometer, such that the voltage across pins 2 and 6 of the 18-pin flow connector is 0.0 mVdc ±2 mVdc. Adjust, if necessary, the ZERO2 (LOR) potentiometer, such that the voltage across pins 8 and 12 of the 18-pin flow connector is 0.0 mVdc ±2 mVdc. Adjust, if necessary, the ZERO1 (UPR) potentiometer, such that the voltage across pins 14 and 18 of the 18-pin flow connector is 0.0 mVdc ±2 mVdc.

Set the rotameter for the spare circuit located on the front of the gas flow control box to read near 50 cm^3/min. Insert a jumper between the upper detector return gas flow sensor and the spare gas output hose. Adjust the upper gas flow readout by rotating potentiometer labeled VFC (R93) so the LCD gas flow output readout is 5 cm^3/min ±2 cm^3/min. If necessary, tweak ZERO1 slightly to reach 50.

Switch the spare output flow to the lower return gas flow sensor. The lower gas flow readout should be 50 cm^3/min ±5, as viewed on the LCD.

Switch the spare output flow to the spare return gas flow sensor. The spare gas flow readout should be 50 cm^3/min ±5, as viewed on the LCD.

If any of the LCD readings are out of tolerance, try bringing them in by re-adjusting the respective sensor zero trimmer (ZERO1 for UPR, ZERO2 for LOR, and ZERO3 for SPR).

Return all hoses to the original position. adjust all flow meters to near 50 cm^3/min.

Sample Gas/Motor Calibration Worksheet

GAS/MOTOR BOARD CALIBRATION
GAS OUTPUT FLOW SETTINGS
(BOARDS #5323-747 AND 5323-771 ONLY)

a. Turn monitor on. Press a key on the keypad. After initialization, push the main menu key. Once the main menu is displayed on the right-hand LCD, push:

   #2 key to select SETUP menus;
   #1 key to select Standard Setup, enter security code;
   #7 key to select OTHERS …;
   #2 key to select BACKGROUND UPDATE MODE;
   #1 key to select MANUAL UPDATE, [ENT key to accept value];
   #3 key to select BACKGROUND UPDATE INTERVAL;
   #9, #9, #9, ENT key enter value;
   ENT key to accept value;
   Select MAIN MENU key to return to main I menu;

#3 key to select READ MENU;
#5 key to select GAS PARAMETERS.

b. Disconnect and plug the gas return lines at all three detectors. If you wish to save the purge on any detector, unplug the incoming gas line and place a short hose across the detector IN and OUT hose barbs.

c. Turn the monitor OFF and then ON and leave in the Test mode during steps d and e below.

d. Attach the positive lead of a digital voltmeter to pin 10 or 11 on chip AD625 (U80). Attach the negative lead to pin 7.

e. Check for 0.00 mVDC ±0.5 mVDC. If necessary, rotate potentiometer labeled NULL (R94) until a reading of 0.0 mVDC ±0.5 mVDC is obtained.

Gas flow amplifier null voltage: _____.

f. Press the Update button or any key on the keypad to clear Test.

g. Remove voltmeter from circuit.

h. Attach the positive lead of a digital voltmeter to pin 6 on connector labeled UPPER LOWER SPARE. Attach the negative lead to pin 2 of the same connector.

i. Check for a reading of 0.0 mVDC ±2 mVDC. If necessary, rotate potentiometer labeled ZERO3 (R95) until a reading of 0.0 VDC ±1 mVDC is obtained.

Gas flow amplifier #3 zero voltage: _____.

j. Attach the positive lead of a digital voltmeter to pin12 on connector labeled UPPER LOWER SPARE. Attach the negative lead pin 8 of the same connector.

k. Rotate potentiometer labeled ZERO2 (R92) until the voltmeter reads 0.0 mVDC ±1 mVDC.

Gas flow amplifier #2 zero voltage: _____.

l. Attach the positive lead of a digital voltmeter to pin 18 on connector labeled UPPER LOWER SPARE. Attach the negative lead to pin 14 of the same connector.

m. Rotate potentiometer labeled ZERO1 (R96) until the voltmeter reads 0.0 mVDC ±1 mVDC.

   Gas flow amplifier #1 zero voltage: _____.

n. Connect a hose adapter between the gas inlet and spare detector to the upper return hose at the upper detector connector.

o. Adjust the spare input flow meter located on the front of the gas flow control box to read about 50 cm3/min.

   Spare gas flow: _____ cm3/min.

p. Rotate potentiometer labeled VFC (R93) until the right-hand LCD shows the spare gas flow at 50 cm3/min. If not, adjust zero 1.

   Upper gas flow: _____.

q. Move the bypass hose from the upper return to the lower return hose fitting and verify a lower gas flow output reading of 50 cm3/min ±2 cm3/min on LCD. If not, adjust zero Z.

   Lower gas flow: _____.

r. Move the bypass hose from the lower return to the spare return fitting and verify a spare gas flow output reading of 50 cm^3/min ±2 cm^3/min on LCD. If not, adjust zero 3.

   Spare gas flow: _____.

s. If any of the LCD readings are out of tolerance, try bringing them in by re-adjusting the respective sensor zero trimmer (ZERO1 for UPR, ZERO2 for LOR, and ZERO3 for SPR).

t. Remove bypass hose adapter and connect all gas line hoses to their original positions.

u. Make sure to reset all alarm parameters before putting unit back into service.

Gas/Motor Board Calibration (Boards #5323-891 and #5323-909 only)

Find the gas/motor board located in the smaller slide-out electronic chassis (see Figure 9) with the LCDs. The left side of the chassis houses the slide-out gas/motor boards. Leave the boards in place with power onto calibrate.

The background update interval should be set to 999 minutes. The background mode should be set to manual. (All underline words are the exact letters found on the circuit board. All bold letters are on the gas flow box located underneath the conveyor.)

Calibrate the upper detector output gas flow by inserting a jumper hose between the input and output detector gas liens located at the detector. Adjust the spare flowmeter located on the front of the gas flow control box to read near 50 cc/min. Calibrate the upper gas flow readout by rotating potentiometer labeled VFC (R93) so the LCD gas flow output readout is 50 cc/min ±2 cc/min. Move the jumper hose line from spare gas input hose to the lower gas return hose fitting. The lower gas flow should read within 5 cc/min as views on the LCD.

The spare detector output gas flow verification follows the same procedure as for the lower detector. Move the adapter hose line from the lower to the spare return hose. The spare gas flow should read within 5 cc/min as viewed on the LCD.

Return all hoses to their original positions.

Sample Gas/Motor Calibration Worksheet

GAS/MOTOR BOARD CALIBRATION
GAS OUTPUT FLOW SETTINGS
(Boards #5323-891 and #5323-909 ONLY)

a. Turn monitor on. Press a key on the keypad. After initialization, push the main menu key. Once the main menu is displayed on the right-hand LCD, push:

   #2 key to select SETUP menus;
   #1 key to select Standard Setup, enter security code;
   #7 key to select OTHERS …;
   #2 key to select BACKGROUND UPDATE MODE;
   #1 key to select MANUAL UPDATE, [ENT key to accept value];
   #3 key to select BACKGROUND UPDATE INTERVAL;
   #9, #9, #9, ENT key enter value;
   ENT key to accept value;
   Select MAIN MENU key to return to main I menu;
   #3 key to select READ MENU;
   #5 key to select GAS PARAMETERS.

b. Connect a hose adapter between the gas inlet and spare detector to the upper return hose at the upper detector connector.

c. Adjust the spare input flow meter located on the front of the gas flow control box to read about 50 cc/min.

   Spare gas flow: _____ cc/min.

d. Rotate potentiometer labeled VFC (R93) until the right-hand LCD shows the spare gas flow at 50 cc/min.

   Upper gas flow: _____.

e. Move the bypass hose from the upper return to the lower hose fitting and verify a lower gas flow output reading of 50 cc/min ±5 cc/min on LCD.

   Lower gas flow: _____.

f. Move the bypass hose from the lower return to the spare return fitting and verify a spare gas flow output reading of 50 cc/min on LCD.

   Lower gas flow:_____.

g. Remove bypass hose adapter and connect all gas line hoses to their original positions.

h. Make sure to reset all alarm parameters before putting unit back into service.

Quad Amplifier Board Calibration

The high-voltage power supply board provides the reference voltages for beta-gamma threshold, beta-gamma window, and alpha threshold. Calibrate the HVPS board before proceeding.

Locate the potentiometers – four each – on the top of each of the eight amplifier boards. Figure 6 shows the location of the potentiometers. Use a pulser (Ludlum Model 500 or equivalent) with a Positronics FS4101D (LMI #13-8304) connector for applying a signal to each detector input on the back of the main electronics chassis. View all counts on the left-hand LCD with the monitor displaying the regular counts in cps mode and with a one-second count time. The background update interval should be set to 999 minutes.

Confirm proper window setting by varying the pulser amplitude around the 50 mV level. The beta counts should go to near zero between 47 and 53 mV. If necessary, adjust the gain potentiometer to stop beta counts with 50 mV in. As seen in Figure 10, the amplifier gain adjustment will move the amplifier output pulse up or down. Moving the pulse up will result in the top of the pulse being out of the beta-gamma window. Moving the pulse too low will result in registered beta-gamma counts. Adjust the pulse amplitude so the top of the pulse is just as the beta-gamma window.

Check the lower threshold setting with the pulser on the 5-mV, full-scale range. Sweep the pulser across the 2 to 3-mV range while checking where counts cease. Any input below the range of 2.5 mV, should produce near zero counts. The box in Figure 10 shows the different pulse heights that appear on the amplifier output when sweeping the pulser through various voltage amplitude ranges.

Table III. Pin Numbers for Channel Inputs

Detector	Beta Output Pin #	Alpha Output Pin #	Pin on Amplifier Board
Board #1 or Board #5			
A	2	1	1
B	4	3	2
C	6	5	4
D	8	7	4
Board #2 or Board #6			
E	2	1	1
F	4	3	2
G	6	5	3
H	8	7	4
Board #3 or Board #7			
I	2	1	1
J	4	3	2
K	6	5	3
L	8	7	4
Board #4 or Board #8			
M	2	1	1
N	4	3	2
O	6	5	3
P	8	7	4

Boards #1, #2, #3, #4 are upper channels.
Boards #5, #6, #7, and #8 are lower channels.

Sample Quad Amplifier Calibration Worksheet

QUAD AMPLIFIER BOARD CALIBRATION
AMPLIFIER AMPLITUDE OUTPUT SETTING

a. Turn monitor on. Press a key on the keypad. After initialization, push the main menu key. Once the main menu is displayed on the right-hand LCD, push:

   #2 key to select SETUP menus;
   #1 key to select Standard Setup, enter security code;
   #3 key to select COUNT TIME;
   #1, ENT key to enter value;
   Press ENT twice;
   Press #5 to change count mode;
   Press #1 to set CPS mode;
   Set all alarms and high backgrounds to 9999;
   Set the LOCOUNT to OFF;
   BKSP to the SETUP MENU II;
   Press #2 and make BACKGROUND UPDATE MODE manual;
   Press #3 and set the UPDATE TIME LIMIT to 9999;
   Press #4 and set BACKGROUND SUBTRACT OFF;
   Press OPER COND key.

b. Push the run button to start counting mode. Push any red button or the cable pull to stop the conveyor.

c. Remove the 8 pin, D-type connector situated on the back of the main electronics chassis labeled:

UPPER RIGHT BANK	UPPER LEFT BANK
A C E G I K M O	B D F H J L N P

d. Adjust pulser for a 50-mV amplitude pulse height.

e. Connect pulser to channel A at the back of the main chassis.

f. Rotate potentiometer (R83) labeled SIGI on board #1 until counts cease as viewed on the left-hand LCD. Table IV and Figure 6 show the board numbers for the respective channels.

g. Connect pulser to channel B at the back of main chassis.

h. Rotate potentiometer (R257), labeled SIG2 on board #1 until counts cease as viewed on the left-hand LCD. Board numbers for the respective channels are in Table IV and Figure 6.

i. Repeat for all upper and lower channels.

j. Adjust pulser to the 5-mV scale.

k. For each upper and lower channel (A-O), sweep the pulser from 0 to 3 mV. The counts should cease around 2.5 mV. Make note of where the counts begin. See Figure 12 for a sample worksheet used to calibrate a quad amp.

l. Adjust pulser to 500-mV scale.

m. For each upper and lower channel (A-O), sweep the pulser from 50 to 500 mV. The counts should register on the left-hand LCD between 2.5 and 50 mV. The counts should cease around 50 mV. Note where the counts go to zero. See Figure 12 for a sample worksheet used to calibrate the quad amps.

n. Switch to view alpha counts by pressing the Alpha/Beta-Gamma key on the keypad.

o. For each upper and lower channel (A-O), sweep the pulser from 50 to 150 mV. Note where the counts begin. The typical alpha threshold is 125 mV.

p. Replace the 8-in , D-type connectors labeled UPPER RIGHT BANK and UPPER LEFT BANK.

q. Remove the 8-pin, D-type connector situated on the back of the main electronics chassis labeled:

LOWER RIGHT BANK	LOWER LEFT BANK
A C E G I K M O	B D F H J L N P

r. Repeat steps d through o for all lower channels.

s. Replace the 8-pin, D-type connectors labeled LOWER RIGHT BANK and LOWER LEFT BANK.

Note that the boards in the cassis are grouped as:
(A B C D),
(E F G H),
(I J K L),
(M N O P).
Whereas, the grouping of the connectors on the back of the electronics is:
(A C E G I K M O),
(B D F H J L N P).
Labels for the potentiometers are:
SIG1 (R3),
SIG2 (R257),
SIG3 (R272), and
SIG4 (R227) on the board.

Running a Beta-Gamma Peak on Detectors

An automatic peaking method (Selection #3 in SETUP MENU III) finds the operating voltage for each detector. Place the beta-gamma source array over the detectors and lower the upper conveyor to within 1.3 cm (0.5 in.). The high voltage is set below the typical operating voltage. The high voltage increases from some low voltage to a voltage where the counts begin to drop off. The Model 329-32 typically operates around 1700 Vdc; therefore, a range of 1600 to 1800 Vdc is enough to find the voltage where the peak counts occur. This peak routine includes background counts.

The peak voltage for the 16 probes in each array (upper or lower) is found by averaging them together. Check the printout and ensure that each detector is peaking near the expected voltage. The count time is fixed at six seconds for this procedure.

Sample Calibration Worksheet to Peak Detectors

DETECTOR CALIBRATION PEAK VOLTAGE SETTINGS

a. Make sure the printer is connected and online for the following procedure. Turn monitor on and press a key on the keypad. Place the source array (32 beta-gamma check sources) over the lower detector. Lower the upper detector to 1.3 cm (0.5 in.) spacing.

Push MAIN MENU, #2 key to select SETUP menus,

enter security code;
#1 to get to SETUP MENU I;
Press ENT once to SETUP MENU II;
Press #1 and set LOCOUNT ON, HIGH BKGND to 999;
Go to SETUP MENU III;
#3 for AUTO BETA PEAKING;
Set start high voltage to 1600;
Set end high voltage to 1900;
Use the default increment of 25 volts;
Allow time for completion, then check all detector peak voltages.

Running an Alpha Plateau on the Detectors

An alpha plateau may be run to check that the peak voltage found above is satisfactory for alpha. This procedure must be done manually. Increment the voltage on each detector through the same or narrower range as was run in the peaking procedure (see the previous page). The alpha plateau counts should remain near constant around the "peak" operating voltage found using the procedure discussed on the previous page. Set the background update interval to 999 minutes and the background mode to manual mode before starting the procedure.

Section 7

Troubleshooting and Maintenance

Instrument maintenance consists of keeping the instrument clean and periodically checking the battery and calibration.

An instrument operational check should be performed prior to each use by exposing the detector to a known source and confirming the proper reading on each scale.

Recalibration should be accomplished after any maintenance or adjustment has been performed on the instrument. Ludlum Measurements recommends recalibration at intervals no greater than one year. Local regulations may have precedence over this recommendation.

Changing a Detector

All three detector arrays are the same. The connector on each detector connects with four screws. To remove the gas hoses that come out of the connector housing, pull the tubing off each nipple. The connector houses three D type connectors. Pull the D connectors gently away by working each side out slowly. A small square {4.4 x 4.4 cm (1.8 x 1.8 in.)} bracket holds the detector in place on the front side (side with LCDs). The hex socket head bolts may stay in the detector when removing the detector. The back side (side away from LCDs) may have two square brackets (not required). Remove the hex head bolts on the back side from the detector when sliding the detector out. Pull the detector out of the main housing by sliding the detector perpendicular to the conveyor.

Finding a Small Detector Gas Leak

When one of the 16 probes has a leak too small to see, use the output gas flow readout in either the OPER COND window or the gas parameters window to locate the leak by dividing the detector into banks. Remove the detector array in question and place it on the input side of the conveyor. Connect each 1.2 m (4 ft) or longer pieces of tubing to the spare detector fittings at the flow box. Adjust the spare gas flow to approximately 100

kk cc/min and connect the input to the output directly. Note the reading of the spare gas out in the LCD display OPER COND. Now apply this to one-half of the detector array in question by breaking the gas connections. Allow time for the pressure to stabilize, and then check the output flow reading in the LCD. It should be within a few cc/min of the bypass flow reading. Finding the malfunctioning probe quickly requires elimination of groups of probes.

Quick Purging Technique for Detectors

To achieve quick purging of the detectors, turn the knob on the flowmeter, located on the front of the gas box, one full turn. After 0.5 hours, adjust the input flow via the flowmeter to 50 cc/min and maintain an output of at least 40 cc/min. Check the detector for a completely purged state by using a check source placed over the input and output probes on each detector. The 16 individual probes are in series, so gas flows from one detector to the next. The input probe is first in line. The output probe is the last probe to receive gas. Regardless of the input and output (exhaust) lines, the input and output probes on a detector will be channel A and channel B, upper or lower detector. It is only necessary to check that the input and output probes have the same counts per second for the same source. The detector is considered purged when the counts are about the same.

Changing Fuses

The AC panel on the rear of the unit and the motor control chassis contain all the fuses in the monitor. The main line electronics fuse, motor line fuse, and motor armature fuse are the four fuses in the system as listed in Table IV. Figure 9 shows the location of the four fuses in the motor control chassis. Consult the Bodine[1] booklet as to fuse placement within the Bodine[1] interface board.

Fuse Type	Description	Location
ABC-6	Line to Main Electronics	Motor Control
AGC-1	Electronics	Motor Control
ABC-6	Line to Motor	Bodine Module
MDA-1.25	Motor Armature	Bodine Module
ABC-10	Line to Monitor	AC Rear Panel
ABC-5	Line to Accessory Receptacle	AC Rear Panel

Belt Tensioning Procedures

Stop the conveyor belt. Raise the upper conveyor to a separation of about 10.2 cm (4 in.) from the lower conveyor belt. Measure the upper belt sag at the center of the upper detector. The sag should be 6.4 cm (2.5 in.) ±1.3 cm (0.5 in.) nominal. If necessary, loosen the hold-down bolts and adjust the tensioning screws. Each mark on the tensioning device equals about 1.3 cm (0.5 in.) sag adjustment. Adjust each tensioner equally.

For the lower conveyor, remove the belt guards on the inlet end of the conveyor. Using leather gloves, grasp the lower belt on each side about 38.1 cm (15 in.) from the in-feed edge (there are matching holes on the conveyor at this 38.1 cm (15 in.) point). Lift the belt off the conveyor bed with moderate tension and measure the height of the belt off the table. The height should be 15.2 cm ±2.5 cm (6 in. ±1 in.).

Conveyor Belt Drive System Maintenance

The motor located on the out-feed end of the monitor drives the upper and lower conveyor belts. A metal housing located on the back of the monitor on the out-feed end covers the drive system. The motor drives a chain and two right-angle drives that operate the upper and lower belts. Figure 11 shows the locations to be greased or oiled once a year.

Setting the Contrast on the Displays

Control of the LCDs (Liquid Crystal Displays) is by the LCD interface board (LMI #5323-635). The board is located on the back of the main electronic chassis (see Figure 6). The contrast controls are located in the center of the board. The two potentiometers on the board are used to adjust the contrast on each display.

Rotate each control in either direction while watching the LCDs on the front of the main electronic chassis to get the desired contrast.

Troubleshooting the HVPS Board

The high-voltage power supply board (LMI (5323-746) located on the extreme left of the main electronic chassis (see Figure 6) has an LED array on the board. In reference to Figure 13, from left to right, the 10 lights have the following meaning:

1) Left light --- +5 V REFERENCE
2) +5 V POWER
3) +15 V GENERAL
4) +5 V DIGITAL
5) UPPER HIGH VOLTAGE FIAL
6) No connection
7) LOWER HIGH VOLTAGE FAIL
8) TALKER
9) LOWER HIGH VOLTAGE READ
10) Right light --- UPPER HIGH VOLTAGE READ

Lights 1 through 4 should always be on. Upon power-up, the TALKER light should blink, the POWER light and the UPPER HIGH VOLTAGE READ light should be on. After initialization, the TALKER light will turn off and LEDs 9 and 10 will alternate on and off.

Lights 5 or 7 will light if the high-voltage read is more than 10% of the high-voltage setpoint. However, setting either high voltage to 250 disables high-voltage fail detection.

If the LEDs show a properly working board and the counts are low, then the high voltage is not getting to the detector. Measure the high voltage at the detector C connector.

Troubleshooting the Counter Boards

The eight counter boards (LMI# 5323-440) located in the main chassis in the main electronic chassis (see Figure 6) have LED arrays also. Refer to Figure 14 from left to right. The 10 lights have the following meaning:

1) Left light --- No connection
2) No connection
3) No connection
4) No connection
5) +5 V DIGITAL
6) LOW COUNT (COUNTER 4)
7) LOW COUNT (COUNTER 3)
8) LOW COUNT (COUNTER 2)
9) LOW COUNT (COUNTER 1
10) Right light --- TALKER

Light 5 should always be on. Upon pre-initialization, the four LOW COUNT lights will be on and the TALKER LED will blink at a rate faster than once a second. After initialization, the LOW COUNT lights should turn off. The TALKER light will blink once every count time.

Troubleshooting the Central Processor Board

The central processor board (LMI# 5323-441) has one LED. This LED shows communication errors. Every time the LED lights, a communication error occurred with the central processor. The software on each board can overcome certain communication errors. However, if the LED stays on, then a serious communication error has occurred.

Troubleshooting the Gas/Motor Controller Board

Locate the gas/motor controller board by unscrewing and sliding the motor control chassis out until the chassis clicks into its extended position. Find the board on the left side of the chassis (see Figure 9). Viewing the LED array is possible without removing the gas/motor controller board. The 10 lights have the following meaning:

1) Left light --- -15 V
2) +15 V
3) +5 V
4) ASTOP, Processor issued STOP.

5) SAFE, If no STOP button is pushed, this LED will Activate when cable pull is touched. If ASTOP is active, then LED will be on.
6) PSW2, Auxiliary bottle empty.
7) PSW1, Main bottle empty.
8) START, Run mode.
9) STOP, Stop mode.
10) Right light --- TALKER, Blinking during normal operation.

Lights 1, 2, and 3 should always be on. The ASTOP LED is lit when the central processor board sends the stop command to the gas/motor controller board. The START LED turns on when pressing the run button. The light stays on while in the run mode.

The STOP LED turns on when pressing the stop button. The light stays on while in the stop mode.

The TALKER LED turns on when the gas/motor controller board communicates to the central processor board. This communication is very fast, and during normal operation the talker light will look like it is in the off state. However, when the gas/motor controller board is reset, the TALKER LED will blink on and off.

When the gas/motor controller board is reset, check the LED array to see that the following list of lights in satisfied:

1) ON
2) ON
3) ON
4) ON
5) OFF
6) DON'T CARE
7) DON'T CARE
8) OFF
9) ON
10) BLINKING ON AND OFF

Reasons Conveyor Will Not Run

The following provides help to determine the cause of a conveyor halt condition. For safety, the monitor has all stop buttons, safety cable pull, and the chain drive cover switch wired in series. This arrangement requires installation of the stop buttons, safety cable pull, and the chain drive cover. The conveyor will not run if any STOP button is pushed, if the safety

switches are inoperative, or if the cable pull is pulled. The safety cable pull stops the conveyor when pressed.

If the conveyor will not run when pressing the RUN button, then check:

1) Is Update required?
2) Is monitor in SETUP MODE?
3) that nothing is leaning on the safety cable pull.
4) that the chain drive cover is properly installed.
5) that all fuses are not blows.
6) all cabling between RUN/STOP buttons.

If the conveyor operates only when holding the RUN button down, then the central processor board (#5323-441) is either sending the alarm stop command to the gas/motor controller board, or the gas/motor controller board is not responding to the central processor board, in which case the gas/motor controller has most probably been reset and not ready for communications. To clear a gas/motor controller board reset, turn the power off to the monitor and back on after a few seconds. This on/off procedure causes a system wide reset. Initialization (see Section 3) should be followed after the monitor is turned back on. The conveyor should run at the setpoint speed, as instructed by the central processor.

Section

8

Recycling

Ludlum Measurements, Inc. supports the recycling of the electronics products it produces for the purpose of protecting the environment and to comply with all regional, national, and international agencies that promote economically and environmentally sustainable recycling systems. To this end, Ludlum Measurements, Inc. strives to supply the consumer of its goods with information regarding reuse and recycling of the many different types of materials used in its products. With many different agencies – public and private – involved in this pursuit it becomes evident that a myriad of methods can be used in the process of recycling. Therefore, Ludlum Measurements, Inc. does not suggest one particular method over another, but simply desires to inform its consumers of the range of recyclable materials present in its products, so that the user will have flexibility in following all local and federal laws.

The following types of recyclable materials are present in Ludlum Measurements, Inc. electronics products, and should be recycled separately. The list is not all-inclusive, nor does it suggest that all materials are present in each piece of equipment:

Batteries	Glass	Aluminum and Stainless Steel
Circuit Boards	Plastics	Liquid Crystal Display (LCD)

Ludlum Measurements, Inc. products, which have been placed on the market after August 13, 2005, have been labeled with a symbol recognized internationally as the "crossed-out wheelie bin." This notifies the consumer that the product is not to be mixed with unsorted municipal waste when discarding; each material must be separated. The symbol will be placed near the AC receptacle, except for portable equipment where it will be placed on the battery lid.

The symbol appears as such: 

Section 9

Appendix

Motor Controller Information

The motor and controller referred to in this section is manufactured by Bodine[1] Electric Company (BEC). Documents printed by BEC have been included with the monitor and are not reprinted in this manual. For the most part, the end user of the monitor need not be concerned with these documents:

a. Motor/Gearmotor Safety, Installation, Use, and Maintenance Information

b. Instructions for Installation and Operation TYPE-FPM PM Motor/ Adjustable Speed Controls.

c. Instructions for Installation and Operation FPM Digital Interface Board Supplement.

The Bondine[1] gear motor is grease lubricated and should not need re-lubrication for the design life of the motor. The Bodine type FFM PM Motor/Adjustable Speed Control, Mode 832, has the piggyback integral digital board installed.

The only user serviceable parts on the Bodine controller are fuses and the torque control. However, the torque control is set at the factory and should not need re-adjustment. The armature fuse and lien fuse on the driver board Model 832 may need replacement. The only control that should be moved is the TORQUE adjustment potentiometer. The torque should be calibrated so that the articles are pulled through without motor slippage.

Serial Port Pin Descriptions

The serial port is located underneath the conveyor. The connectors are the 7-pin MS type.

Pin Letter	Direction	Description
A	From Model 329-32	DSR (+10 Vdc)
B	From Model 329-32	DCD (+10 Vdc)
C	From Model 329-32	RTS (Request to send)
D	To Model 329-32	RD (Receive data)
E	To Model 329-32	CTS (Clear to Send)
F	From Model 329-32	TD (Transmit Data)
G	N/A	GND (Ground)

Section

10

References and Acknowledgements

1. Bodine is a registered name by the Bodine Electric Company.

R1. Draft INPO document REN/EPN-04 called, "Performance Testing of Portal Monitors for Personnel Contamination Contro," (revision 0, April 1983.)

R2. Glenn F. Knoll, Radiation Detection and Measurement, John Wiley and Sons, New York, 1979.

Section

11

Figures and Diagrams

Belt Splicing Instructions (2 pages)

Menu Diagrams (8 pages)

Figures 1-3 (Drawing 323 x 571)

Figure 4, Keypad Layout

Figure 5, Operator Panel Layout

Figure 6, Main Chassis Board Placement

Figure 7, Control Panel

Figure 8, Detector Layout

Figure 9, Motor Control Chassis Layout

Figure 10, Quad Amplifier Calibration and Adjustments

Figure 11, Model 329-32 Yearly Lubrication Points

Figure 12, Quad Amplifier Sample Calibration Sheet

Figure 13, High Voltage Troubleshooting LED Array on Board # 5323-746

Figure 14, Quad Counter Troubleshooting LED Array on Board #5323-440

Figure 15, Model 329-32 Floor Space Requirements

Figure 16, Model 329-32 Recommended End Lifting Procedure

Figure 17, Model 329-32 AC Panel

TAPESWITCH Connecting Suggestions

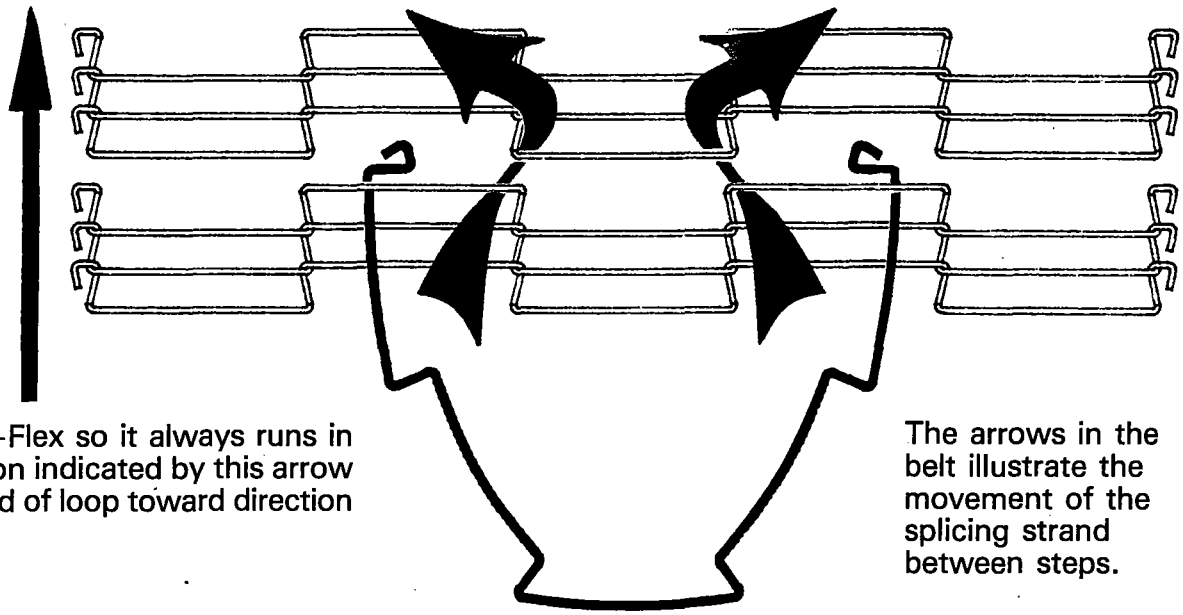
WIRE BELT COMPANY of AMERICA

19 RIVER STREET, WINCHESTER, MA 01890
Tel. 617/729-5200 Telex: 948273 Fax: 617/729-1543

wire BELT company of america

FLAT-FLEX® SPLICING INSTRUCTIONS

1

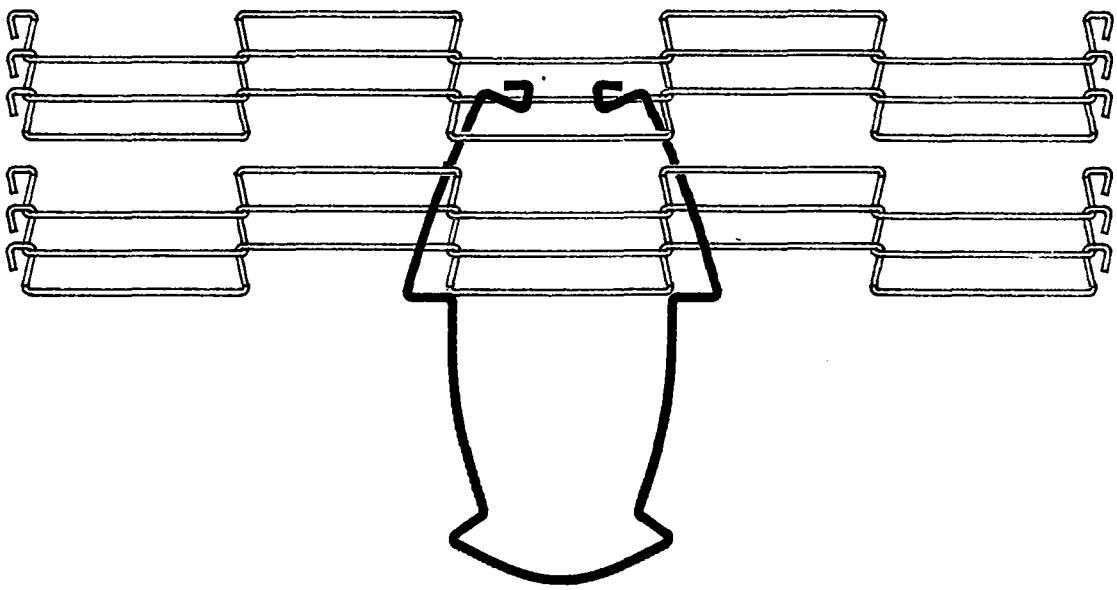


Install Flat-Flex so it always runs in the direction indicated by this arrow - closed end of loop toward direction of travel.

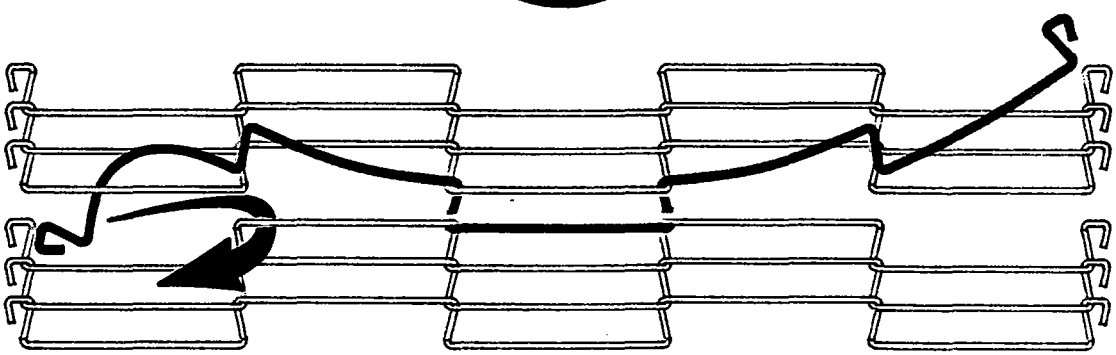
The arrows in the belt illustrate the movement of the splicing strand between steps.

When bending the splicing strand, try to limit bending to straight portions of the strand rather than in the "Z" bend area.

2

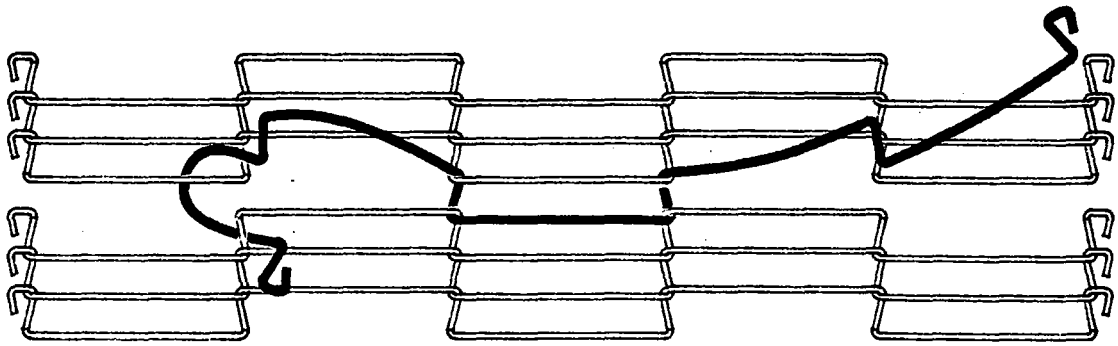


3



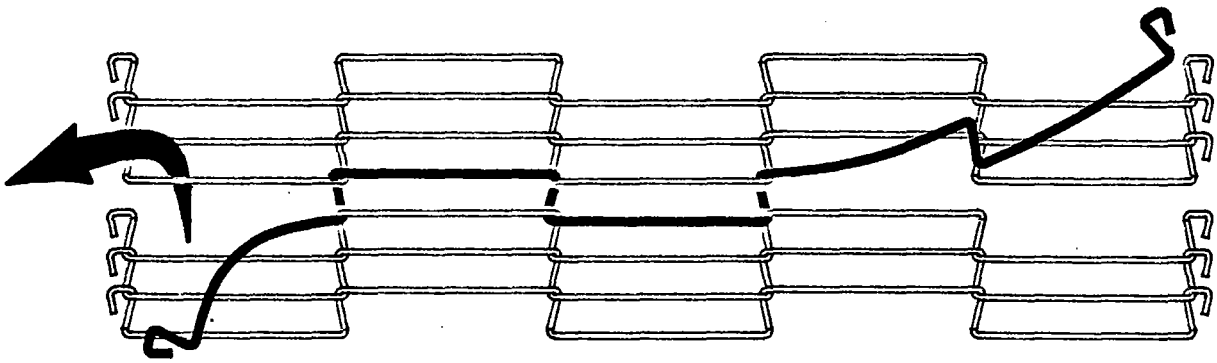
Continued on other side

4

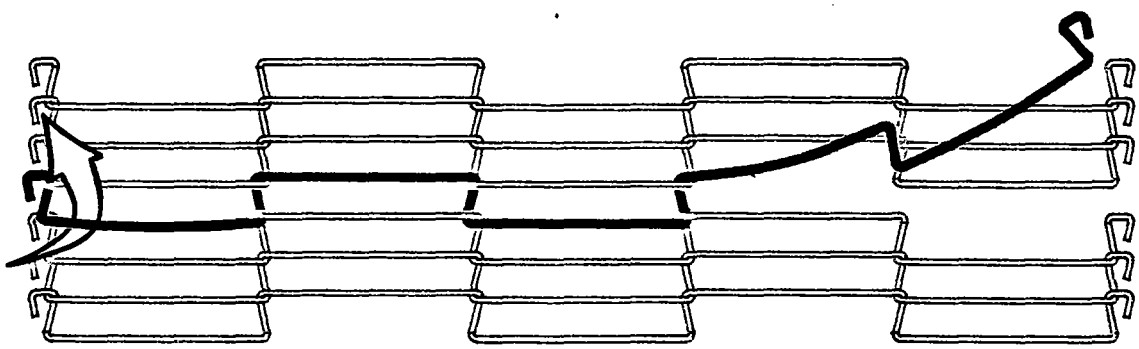


Splice one side completely before starting the other side.

5

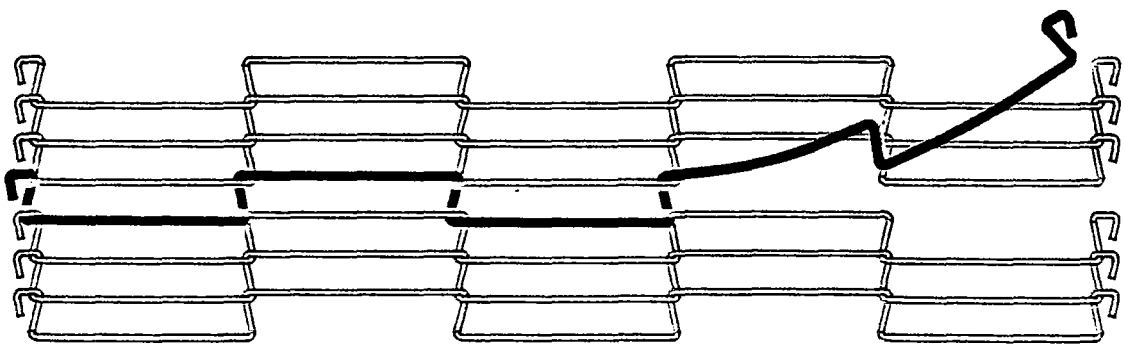


6

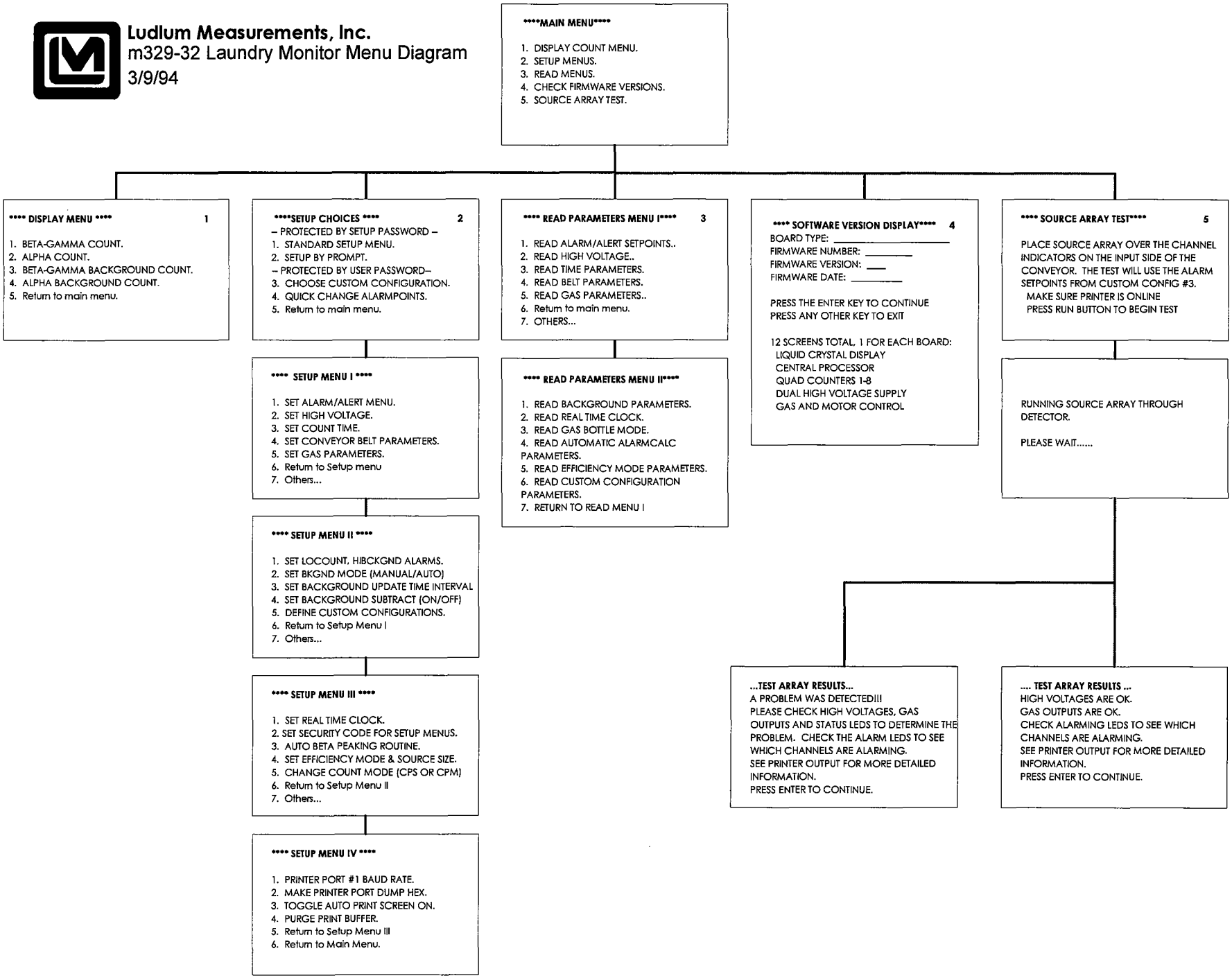


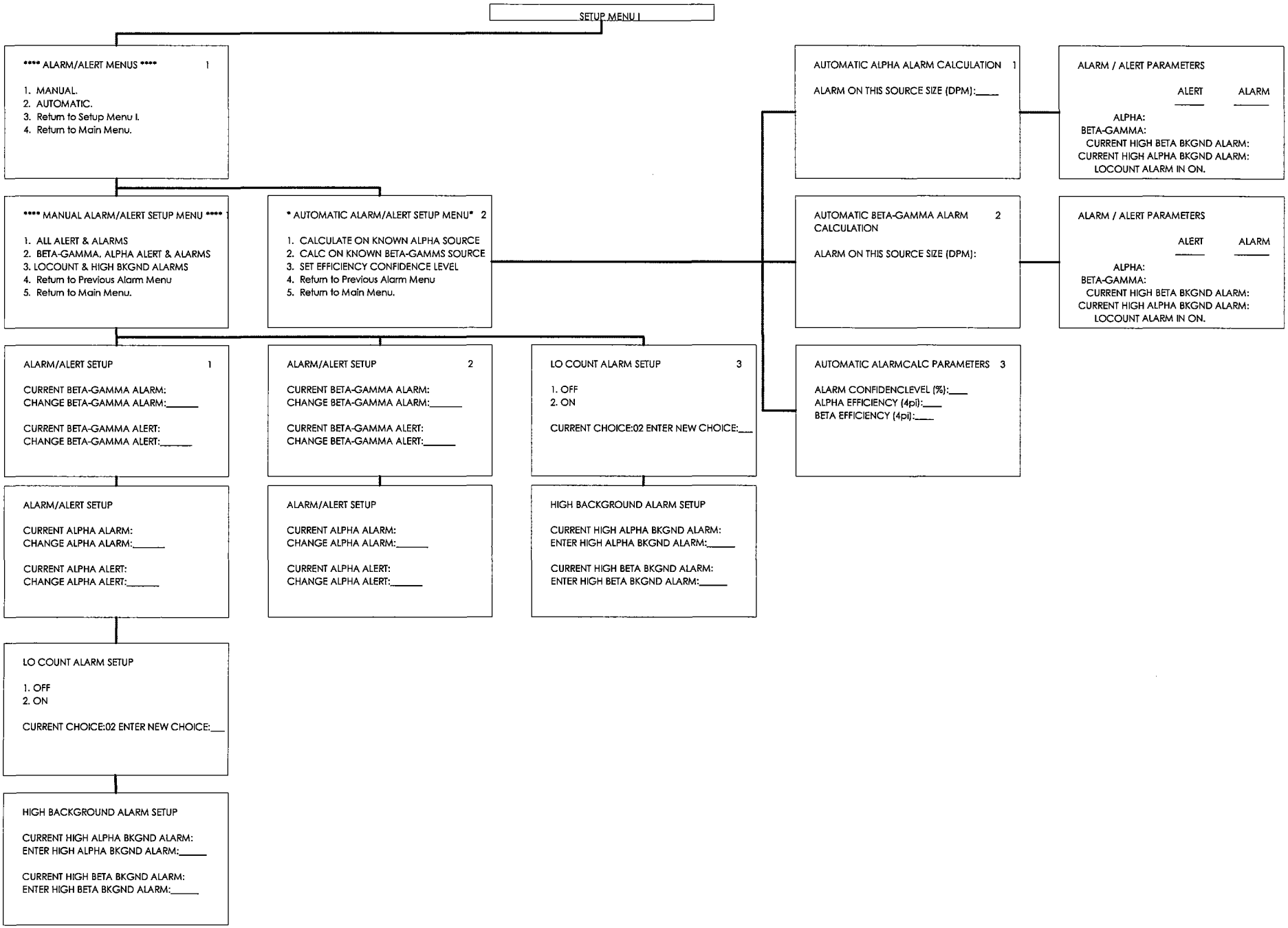
After completely splicing the belt, it is advisable to go along the width of the belt straightening the spliced-in strand.

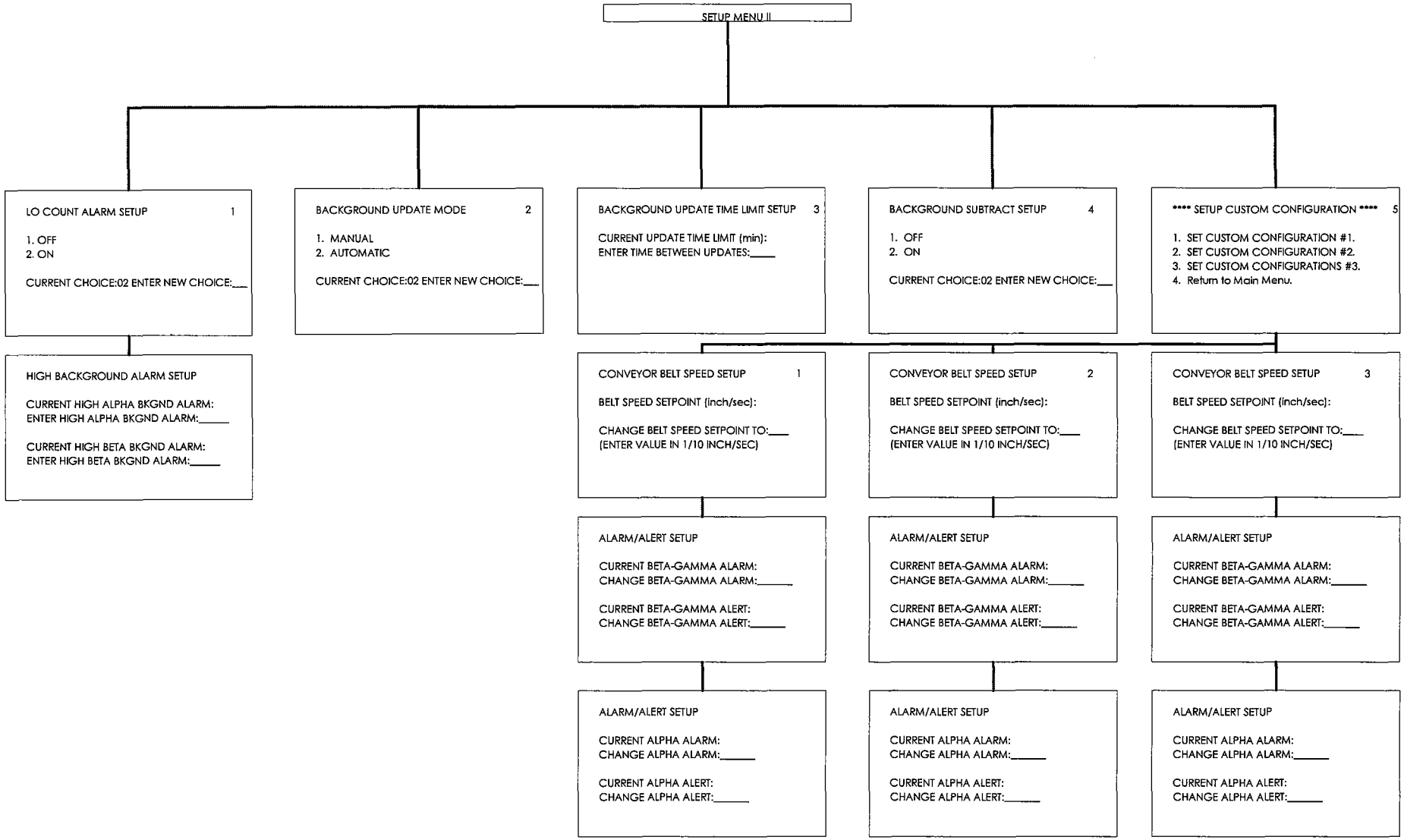
7

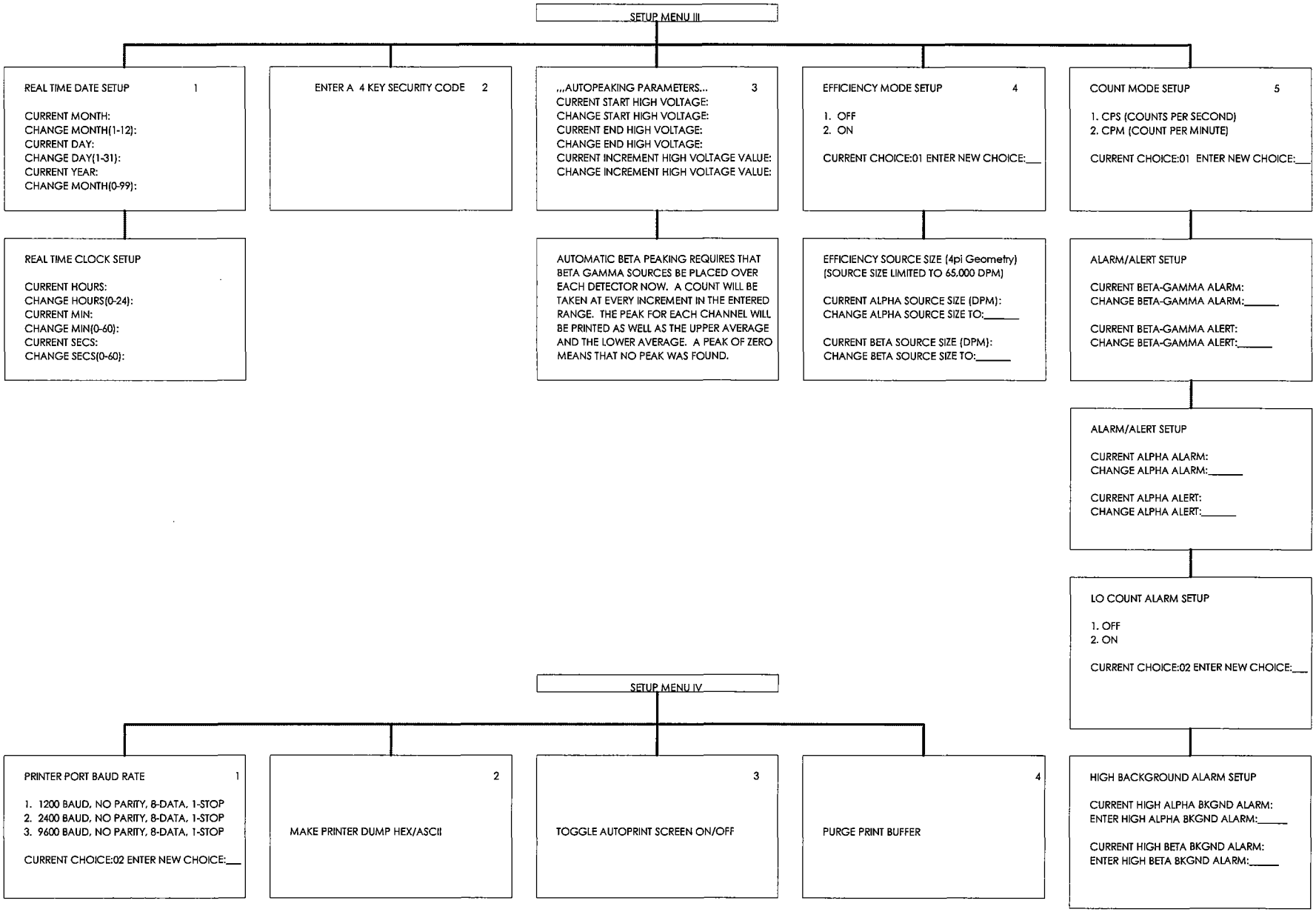


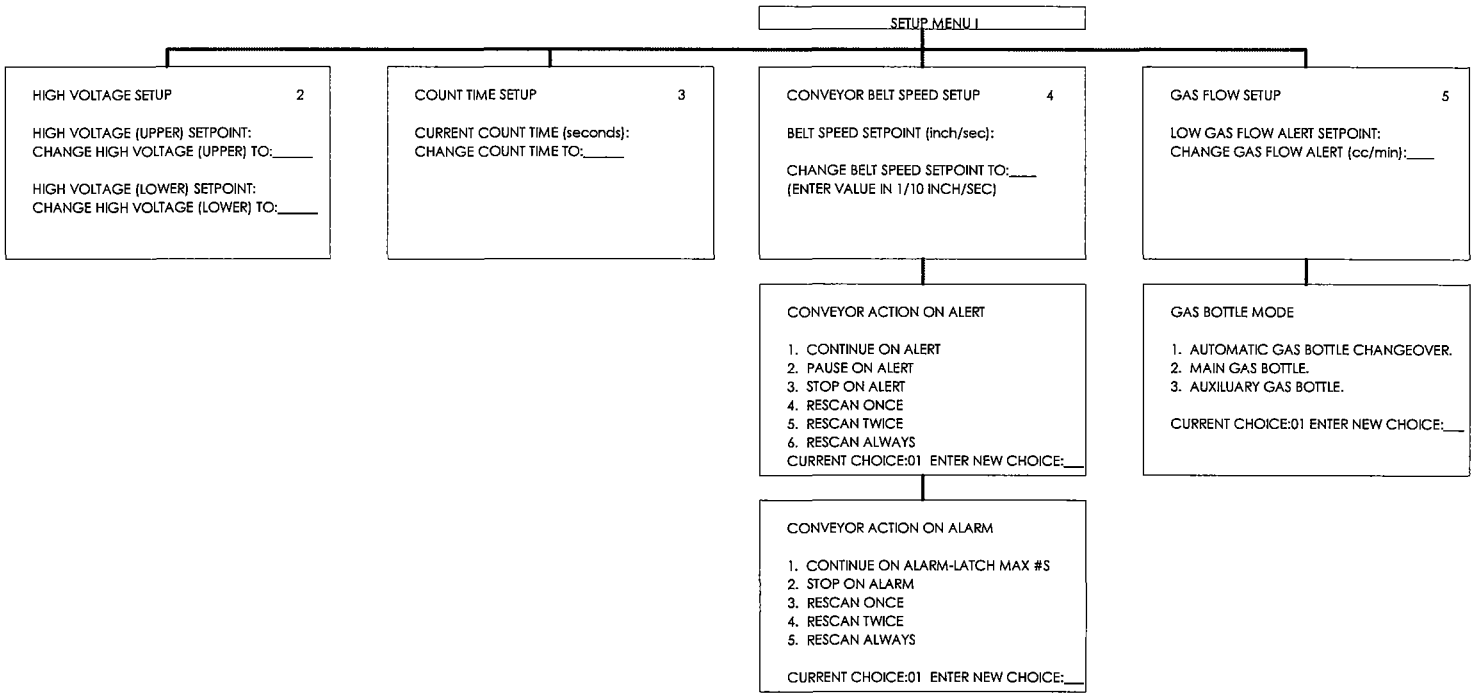
Ludlum Measurements, Inc.
m329-32 Laundry Monitor Menu Diagram
3/9/94

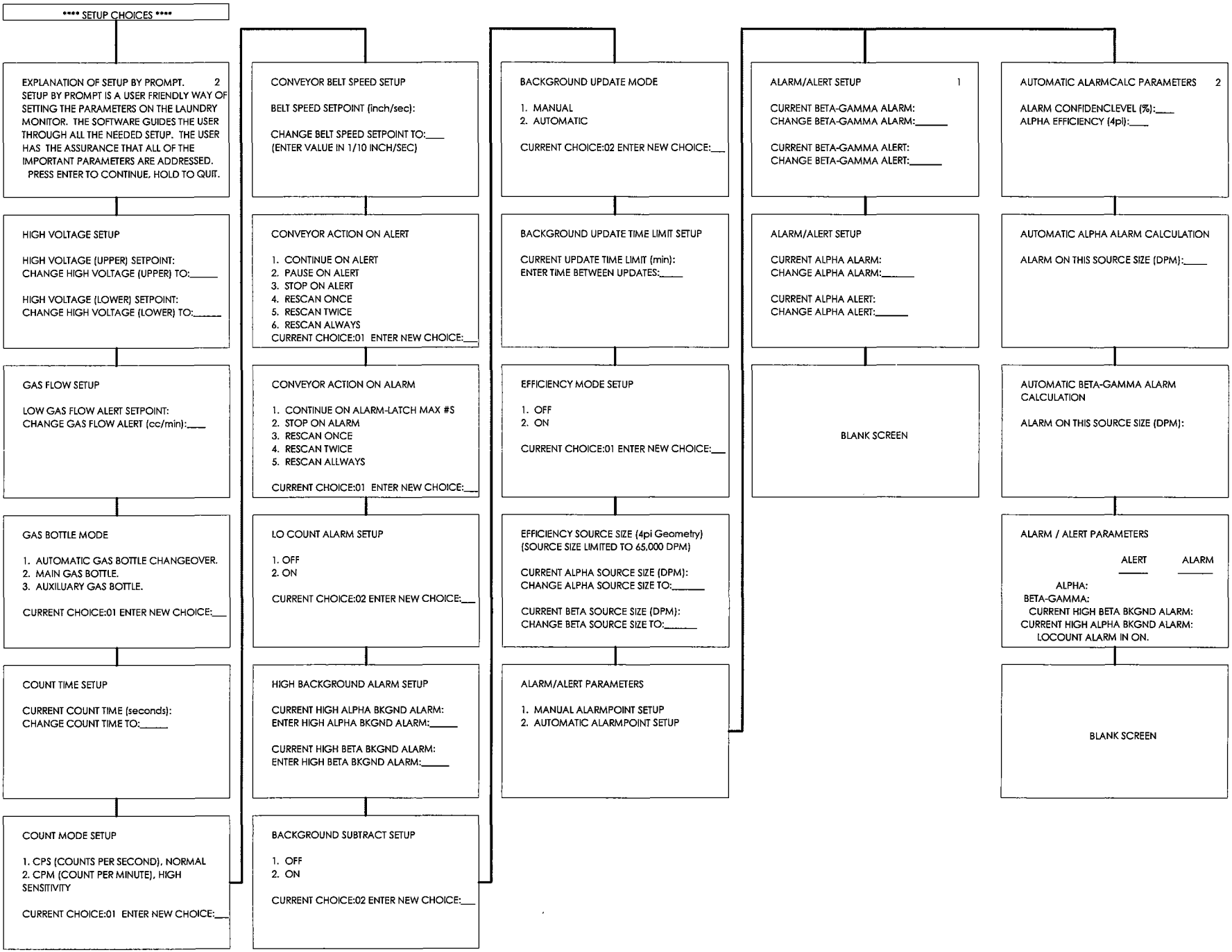


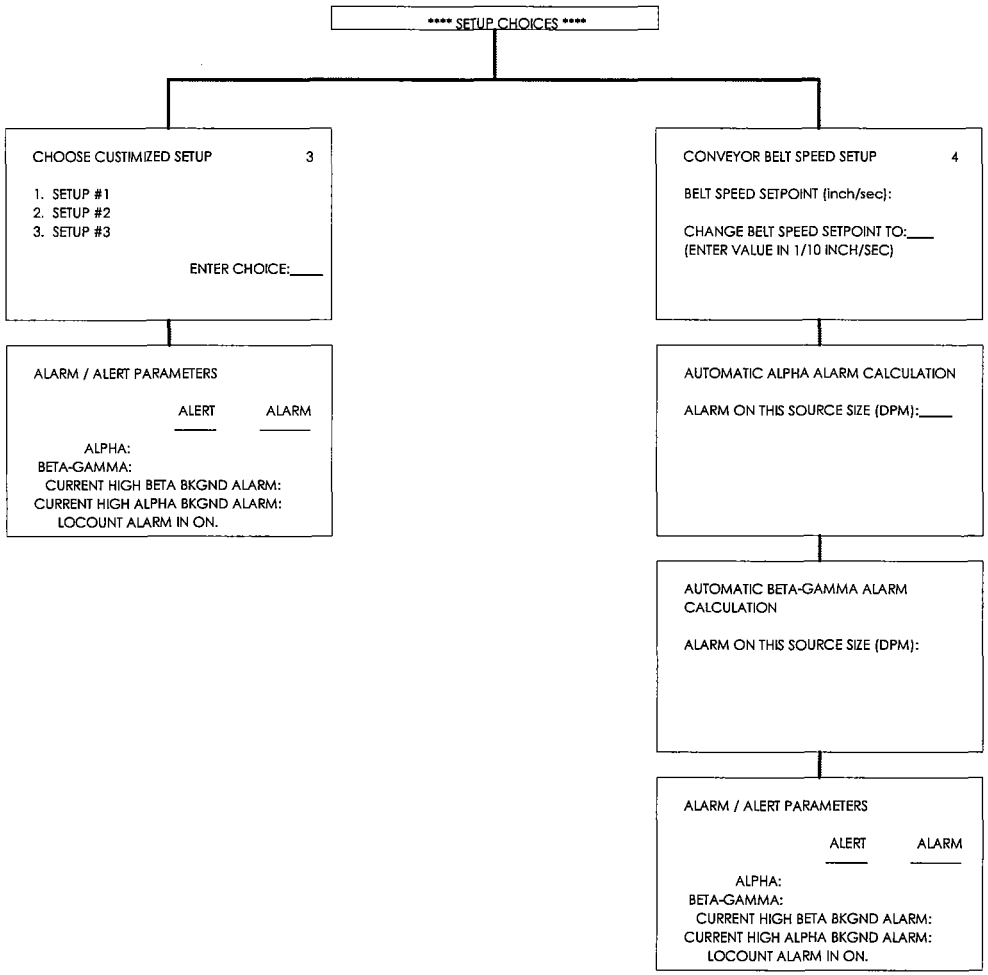

SETUP MENU I
**** ALARM/ALERT MENUS **** 1
1. MANUAL.
2. AUTOMATIC.
3. Return to Setup Menu I.
4. Return to Main Menu.
**** MANUAL ALARM/ALERT SETUP MENU **** 1
1. ALL ALERT & ALARMS
2. BETA-GAMMA, ALPHA ALERT & ALARMS
3. LOCOUNT & HIGH BKGND ALARMS
4. Return to Previous Alarm Menu
5. Return to Main Menu.
* AUTOMATIC ALARM/ALERT SETUP MENU* 2
1. CALCULATE ON KNOWN ALPHA SOURCE
2. CALC ON KNOWN BETA-GAMMS SOURCE
3. SET EFFICIENCY CONFIDENCE LEVEL
4. Return to Previous Alarm Menu
5. Return to Main Menu.
ALARM/ALERT SETUP 1
CURRENT BETA-GAMMA ALARM:
CHANGE BETA-GAMMA ALARM:_____
CURRENT BETA-GAMMA ALERT:
CHANGE BETA-GAMMA ALERT:_____
ALARM/ALERT SETUP 2
CURRENT BETA-GAMMA ALARM:
CHANGE BETA-GAMMA ALARM:_____
CURRENT BETA-GAMMA ALERT:
CHANGE BETA-GAMMA ALERT:_____
LO COUNT ALARM SETUP 3
1. OFF
2. ON
CURRENT CHOICE:02 ENTER NEW CHOICE:__
ALARM/ALERT SETUP
CURRENT ALPHA ALARM:
CHANGE ALPHA ALARM:_____
CURRENT ALPHA ALERT:
CHANGE ALPHA ALERT:_____
ALARM/ALERT SETUP
CURRENT ALPHA ALARM:
CHANGE ALPHA ALARM:_____
CURRENT ALPHA ALERT:
CHANGE ALPHA ALERT:_____
HIGH BACKGROUND ALARM SETUP
CURRENT HIGH ALPHA BKGND ALARM:
ENTER HIGH ALPHA BKGND ALARM:_____
CURRENT HIGH BETA BKGND ALARM:
ENTER HIGH BETA BKGND ALARM:_____
LO COUNT ALARM SETUP
1. OFF
2. ON
CURRENT CHOICE:02 ENTER NEW CHOICE:__
HIGH BACKGROUND ALARM SETUP
CURRENT HIGH ALPHA BKGND ALARM:
ENTER HIGH ALPHA BKGND ALARM:_____
CURRENT HIGH BETA BKGND ALARM:
ENTER HIGH BETA BKGND ALARM:_____
AUTOMATIC ALPHA ALARM CALCULATION 1
ALARM ON THIS SOURCE SIZE (DPM):____
ALARM / ALERT PARAMETERS
ALERT ALARM
ALPHA:
BETA-GAMMA:
CURRENT HIGH BETA BKGND ALARM:
CURRENT HIGH ALPHA BKGND ALARM:
LOCOUNT ALARM IN ON.
AUTOMATIC BETA-GAMMA ALARM CALCULATION 2
ALARM ON THIS SOURCE SIZE (DPM):
ALARM / ALERT PARAMETERS
ALERT ALARM
ALPHA:
BETA-GAMMA:
CURRENT HIGH BETA BKGND ALARM:
CURRENT HIGH ALPHA BKGND ALARM:
LOCOUNT ALARM IN ON.
AUTOMATIC ALARMCALC PARAMETERS 3
ALARM CONFIDENCLEVEL (%):___
ALPHA EFFICIENCY (4pi):___
BETA EFFICIENCY (4pi):___

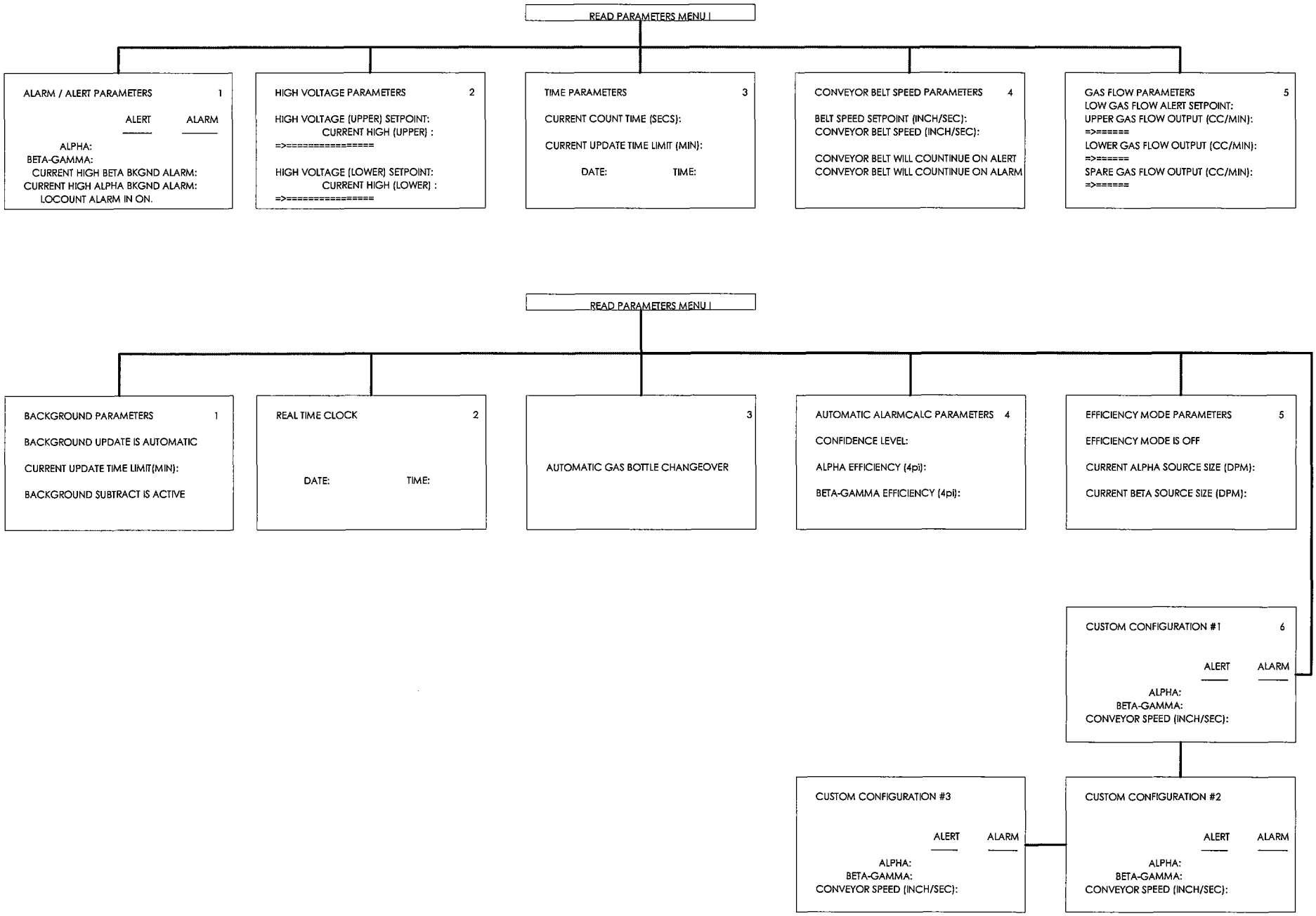

SETUP MENU II
LO COUNT ALARM SETUP 1
1. OFF
2. ON
CURRENT CHOICE:02 ENTER NEW CHOICE:___
HIGH BACKGROUND ALARM SETUP
CURRENT HIGH ALPHA BKGND ALARM:
ENTER HIGH ALPHA BKGND ALARM:_____
CURRENT HIGH BETA BKGND ALARM:
ENTER HIGH BETA BKGND ALARM:_____
BACKGROUND UPDATE MODE 2
1. MANUAL
2. AUTOMATIC
CURRENT CHOICE:02 ENTER NEW CHOICE:___
BACKGROUND UPDATE TIME LIMIT SETUP 3
CURRENT UPDATE TIME LIMIT (min):
ENTER TIME BETWEEN UPDATES:____
BACKGROUND SUBTRACT SETUP 4
1. OFF
2. ON
CURRENT CHOICE:02 ENTER NEW CHOICE:___
**** SETUP CUSTOM CONFIGURATION **** 5
1. SET CUSTOM CONFIGURATION #1.
2. SET CUSTOM CONFIGURATION #2.
3. SET CUSTOM CONFIGURATIONS #3.
4. Return to Main Menu.
CONVEYOR BELT SPEED SETUP 1
BELT SPEED SETPOINT (inch/sec):
CHANGE BELT SPEED SETPOINT TO:___
(ENTER VALUE IN 1/10 INCH/SEC)
CONVEYOR BELT SPEED SETUP 2
BELT SPEED SETPOINT (inch/sec):
CHANGE BELT SPEED SETPOINT TO:___
(ENTER VALUE IN 1/10 INCH/SEC)
CONVEYOR BELT SPEED SETUP 3
BELT SPEED SETPOINT (inch/sec):
CHANGE BELT SPEED SETPOINT TO:___
(ENTER VALUE IN 1/10 INCH/SEC)
ALARM/ALERT SETUP
CURRENT BETA-GAMMA ALARM:
CHANGE BETA-GAMMA ALARM:_____
CURRENT BETA-GAMMA ALERT:
CHANGE BETA-GAMMA ALERT:_____
ALARM/ALERT SETUP
CURRENT BETA-GAMMA ALARM:
CHANGE BETA-GAMMA ALARM:_____
CURRENT BETA-GAMMA ALERT:
CHANGE BETA-GAMMA ALERT:_____
ALARM/ALERT SETUP
CURRENT BETA-GAMMA ALARM:
CHANGE BETA-GAMMA ALARM:_____
CURRENT BETA-GAMMA ALERT:
CHANGE BETA-GAMMA ALERT:_____
ALARM/ALERT SETUP
CURRENT ALPHA ALARM:
CHANGE ALPHA ALARM:_____
CURRENT ALPHA ALERT:
CHANGE ALPHA ALERT:_____
ALARM/ALERT SETUP
CURRENT ALPHA ALARM:
CHANGE ALPHA ALARM:_____
CURRENT ALPHA ALERT:
CHANGE ALPHA ALERT:_____
ALARM/ALERT SETUP
CURRENT ALPHA ALARM:
CHANGE ALPHA ALARM:_____
CURRENT ALPHA ALERT:
CHANGE ALPHA ALERT:_____

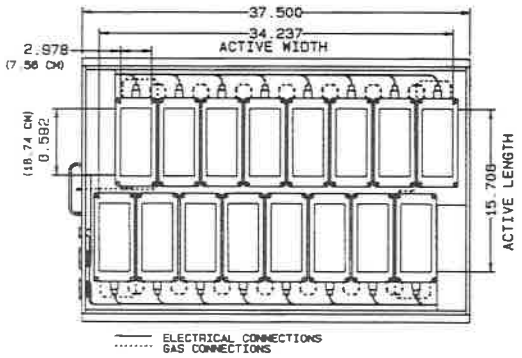

SETUP MENU III
REAL TIME DATE SETUP 1
CURRENT MONTH:
CHANGE MONTH(1-12):
CURRENT DAY:
CHANGE DAY(1-31):
CURRENT YEAR:
CHANGE MONTH(0-99):
ENTER A 4 KEY SECURITY CODE 2
,,,AUTOPEAKING PARAMETERS... 3
CURRENT START HIGH VOLTAGE:
CHANGE START HIGH VOLTAGE:
CURRENT END HIGH VOLTAGE:
CHANGE END HIGH VOLTAGE:
CURRENT INCREMENT HIGH VOLTAGE VALUE:
CHANGE INCREMENT HIGH VOLTAGE VALUE:
EFFICIENCY MODE SETUP 4
1. OFF
2. ON
CURRENT CHOICE:01 ENTER NEW CHOICE:__
COUNT MODE SETUP 5
1. CPS (COUNTS PER SECOND)
2. CPM (COUNT PER MINUTE)
CURRENT CHOICE:01 ENTER NEW CHOICE:__
REAL TIME CLOCK SETUP
CURRENT HOURS:
CHANGE HOURS(0-24):
CURRENT MIN:
CHANGE MIN(0-60):
CURRENT SECS:
CHANGE SECS(0-60):
AUTOMATIC BETA PEAKING REQUIRES THAT BETA GAMMA SOURCES BE PLACED OVER EACH DETECTOR NOW. A COUNT WILL BE TAKEN AT EVERY INCREMENT IN THE ENTERED RANGE. THE PEAK FOR EACH CHANNEL WILL BE PRINTED AS WELL AS THE UPPER AVERAGE AND THE LOWER AVERAGE. A PEAK OF ZERO MEANS THAT NO PEAK WAS FOUND.
EFFICIENCY SOURCE SIZE (4pi Geometry)
(SOURCE SIZE LIMITED TO 65.000 DPM)
CURRENT ALPHA SOURCE SIZE (DPM):
CHANGE ALPHA SOURCE SIZE TO:_____
CURRENT BETA SOURCE SIZE (DPM):
CHANGE BETA SOURCE SIZE TO:_____
ALARM/ALERT SETUP
CURRENT BETA-GAMMA ALARM:
CHANGE BETA-GAMMA ALARM:_____
CURRENT BETA-GAMMA ALERT:
CHANGE BETA-GAMMA ALERT:_____
ALARM/ALERT SETUP
CURRENT ALPHA ALARM:
CHANGE ALPHA ALARM:_____
CURRENT ALPHA ALERT:
CHANGE ALPHA ALERT:_____
LO COUNT ALARM SETUP
1. OFF
2. ON
CURRENT CHOICE:02 ENTER NEW CHOICE:__
SETUP MENU IV
PRINTER PORT BAUD RATE 1
1. 1200 BAUD, NO PARITY, 8-DATA, 1-STOP
2. 2400 BAUD, NO PARITY, 8-DATA, 1-STOP
3. 9600 BAUD, NO PARITY, 8-DATA, 1-STOP
CURRENT CHOICE:02 ENTER NEW CHOICE:__
2
MAKE PRINTER DUMP HEX/ASCII
3
TOGGLE AUTOPRINT SCREEN ON/OFF
4
PURGE PRINT BUFFER
HIGH BACKGROUND ALARM SETUP
CURRENT HIGH ALPHA BKGND ALARM:
ENTER HIGH ALPHA BKGND ALARM:_____
CURRENT HIGH BETA BKGND ALARM:
ENTER HIGH BETA BKGND ALARM:_____


SETUP MENU 1
HIGH VOLTAGE SETUP 2
HIGH VOLTAGE (UPPER) SETPOINT:
CHANGE HIGH VOLTAGE (UPPER) TO:_____
HIGH VOLTAGE (LOWER) SETPOINT:
CHANGE HIGH VOLTAGE (LOWER) TO:_____
COUNT TIME SETUP 3
CURRENT COUNT TIME (seconds):
CHANGE COUNT TIME TO:_____
CONVEYOR BELT SPEED SETUP 4
BELT SPEED SETPOINT (inch/sec):
CHANGE BELT SPEED SETPOINT TO:___
(ENTER VALUE IN 1/10 INCH/SEC)
CONVEYOR ACTION ON ALERT
1. CONTINUE ON ALERT
2. PAUSE ON ALERT
3. STOP ON ALERT
4. RESCAN ONCE
5. RESCAN TWICE
6. RESCAN ALWAYS
CURRENT CHOICE:01 ENTER NEW CHOICE:__
CONVEYOR ACTION ON ALARM
1. CONTINUE ON ALARM-LATCH MAX #S
2. STOP ON ALARM
3. RESCAN ONCE
4. RESCAN TWICE
5. RESCAN ALWAYS
CURRENT CHOICE:01 ENTER NEW CHOICE:__
GAS FLOW SETUP 5
LOW GAS FLOW ALERT SETPOINT:
CHANGE GAS FLOW ALERT (cc/min):___
GAS BOTTLE MODE
1. AUTOMATIC GAS BOTTLE CHANGEOVER.
2. MAIN GAS BOTTLE.
3. AUXILUARY GAS BOTTLE.
CURRENT CHOICE:01 ENTER NEW CHOICE:__


**** SETUP CHOICES ****
EXPLANATION OF SETUP BY PROMPT. 2
SETUP BY PROMPT IS A USER FRIENDLY WAY OF SETTING THE PARAMETERS ON THE LAUNDRY MONITOR. THE SOFTWARE GUIDES THE USER THROUGH ALL THE NEEDED SETUP. THE USER HAS THE ASSURANCE THAT ALL OF THE IMPORTANT PARAMETERS ARE ADDRESSED.
PRESS ENTER TO CONTINUE, HOLD TO QUIT.
HIGH VOLTAGE SETUP
HIGH VOLTAGE (UPPER) SETPOINT:
CHANGE HIGH VOLTAGE (UPPER) TO:_____
HIGH VOLTAGE (LOWER) SETPOINT:
CHANGE HIGH VOLTAGE (LOWER) TO:_____
GAS FLOW SETUP
LOW GAS FLOW ALERT SETPOINT:
CHANGE GAS FLOW ALERT (cc/min):___
GAS BOTTLE MODE
1. AUTOMATIC GAS BOTTLE CHANGEOVER.
2. MAIN GAS BOTTLE.
3. AUXILUARY GAS BOTTLE.
CURRENT CHOICE:01 ENTER NEW CHOICE:__
COUNT TIME SETUP
CURRENT COUNT TIME (seconds):
CHANGE COUNT TIME TO:_____
COUNT MODE SETUP
1. CPS (COUNTS PER SECOND), NORMAL
2. CPM (COUNT PER MINUTE), HIGH SENSITIVITY
CURRENT CHOICE:01 ENTER NEW CHOICE:__
CONVEYOR BELT SPEED SETUP
BELT SPEED SETPOINT (inch/sec):
CHANGE BELT SPEED SETPOINT TO:___
(ENTER VALUE IN 1/10 INCH/SEC)
CONVEYOR ACTION ON ALERT
1. CONTINUE ON ALERT
2. PAUSE ON ALERT
3. STOP ON ALERT
4. RESCAN ONCE
5. RESCAN TWICE
6. RESCAN ALWAYS
CURRENT CHOICE:01 ENTER NEW CHOICE:__
CONVEYOR ACTION ON ALARM
1. CONTINUE ON ALARM-LATCH MAX #S
2. STOP ON ALARM
3. RESCAN ONCE
4. RESCAN TWICE
5. RESCAN ALLWAYS
CURRENT CHOICE:01 ENTER NEW CHOICE:__
LO COUNT ALARM SETUP
1. OFF
2. ON
CURRENT CHOICE:02 ENTER NEW CHOICE:__
HIGH BACKGROUND ALARM SETUP
CURRENT HIGH ALPHA BKGND ALARM:
ENTER HIGH ALPHA BKGND ALARM:_____
CURRENT HIGH BETA BKGND ALARM:
ENTER HIGH BETA BKGND ALARM:_____
BACKGROUND SUBTRACT SETUP
1. OFF
2. ON
CURRENT CHOICE:02 ENTER NEW CHOICE:__
BACKGROUND UPDATE MODE
1. MANUAL
2. AUTOMATIC
CURRENT CHOICE:02 ENTER NEW CHOICE:__
BACKGROUND UPDATE TIME LIMIT SETUP
CURRENT UPDATE TIME LIMIT (min):
ENTER TIME BETWEEN UPDATES:____
EFFICIENCY MODE SETUP
1. OFF
2. ON
CURRENT CHOICE:01 ENTER NEW CHOICE:__
EFFICIENCY SOURCE SIZE (4pi Geometry)
(SOURCE SIZE LIMITED TO 65,000 DPM)
CURRENT ALPHA SOURCE SIZE (DPM):
CHANGE ALPHA SOURCE SIZE TO:_____
CURRENT BETA SOURCE SIZE (DPM):
CHANGE BETA SOURCE SIZE TO:_____
ALARM/ALERT PARAMETERS
1. MANUAL ALARMPOINT SETUP
2. AUTOMATIC ALARMPOINT SETUP
ALARM/ALERT SETUP 1
CURRENT BETA-GAMMA ALARM:
CHANGE BETA-GAMMA ALARM:_____
CURRENT BETA-GAMMA ALERT:
CHANGE BETA-GAMMA ALERT:_____
ALARM/ALERT SETUP
CURRENT ALPHA ALARM:
CHANGE ALPHA ALARM:_____
CURRENT ALPHA ALERT:
CHANGE ALPHA ALERT:_____
BLANK SCREEN
AUTOMATIC ALARMCALC PARAMETERS 2
ALARM CONFIDENCLEVEL (%):___
ALPHA EFFICIENCY (4pi):____
AUTOMATIC ALPHA ALARM CALCULATION
ALARM ON THIS SOURCE SIZE (DPM):____
AUTOMATIC BETA-GAMMA ALARM CALCULATION
ALARM ON THIS SOURCE SIZE (DPM):
ALARM / ALERT PARAMETERS
ALERT ALARM
ALPHA:
BETA-GAMMA:
CURRENT HIGH BETA BKGND ALARM:
CURRENT HIGH ALPHA BKGND ALARM:
LOCOUNT ALARM IN ON.
BLANK SCREEN


**** SETUP CHOICES ****
CHOOSE CUSTIMIZED SETUP 3
1. SETUP #1
2. SETUP #2
3. SETUP #3
ENTER CHOICE:____
ALARM / ALERT PARAMETERS
ALERT ALARM
ALPHA:
BETA-GAMMA:
CURRENT HIGH BETA BKGND ALARM:
CURRENT HIGH ALPHA BKGND ALARM:
LOCOUNT ALARM IN ON.
CONVEYOR BELT SPEED SETUP 4
BELT SPEED SETPOINT (inch/sec):
CHANGE BELT SPEED SETPOINT TO:___
(ENTER VALUE IN 1/10 INCH/SEC)
AUTOMATIC ALPHA ALARM CALCULATION
ALARM ON THIS SOURCE SIZE (DPM):____
AUTOMATIC BETA-GAMMA ALARM CALCULATION
ALARM ON THIS SOURCE SIZE (DPM):
ALARM / ALERT PARAMETERS
ALERT ALARM
ALPHA:
BETA-GAMMA:
CURRENT HIGH BETA BKGND ALARM:
CURRENT HIGH ALPHA BKGND ALARM:
LOCOUNT ALARM IN ON.


READ PARAMETERS MENU I
ALARM / ALERT PARAMETERS 1
ALERT ALARM
ALPHA:
BETA-GAMMA:
CURRENT HIGH BETA BKGND ALARM:
CURRENT HIGH ALPHA BKGND ALARM:
LOCOUNT ALARM IN ON.
HIGH VOLTAGE PARAMETERS 2
HIGH VOLTAGE (UPPER) SETPOINT:
CURRENT HIGH (UPPER) :
=>==========
HIGH VOLTAGE (LOWER) SETPOINT:
CURRENT HIGH (LOWER) :
=>==========
TIME PARAMETERS 3
CURRENT COUNT TIME (SECS):
CURRENT UPDATE TIME LIMIT (MIN):
DATE: TIME:
CONVEYOR BELT SPEED PARAMETERS 4
BELT SPEED SETPOINT (INCH/SEC):
CONVEYOR BELT SPEED (INCH/SEC):
CONVEYOR BELT WILL COUNTINUE ON ALERT
CONVEYOR BELT WILL COUNTINUE ON ALARM
GAS FLOW PARAMETERS 5
LOW GAS FLOW ALERT SETPOINT:
UPPER GAS FLOW OUTPUT (CC/MIN):
=>======
LOWER GAS FLOW OUTPUT (CC/MIN):
=>======
SPARE GAS FLOW OUTPUT (CC/MIN):
=>======
READ PARAMETERS MENU I
BACKGROUND PARAMETERS 1
BACKGROUND UPDATE IS AUTOMATIC
CURRENT UPDATE TIME LIMIT(MIN):
BACKGROUND SUBTRACT IS ACTIVE
REAL TIME CLOCK 2
DATE: TIME:
3
AUTOMATIC GAS BOTTLE CHANGEOVER
AUTOMATIC ALARMCALC PARAMETERS 4
CONFIDENCE LEVEL:
ALPHA EFFICIENCY (4pi):
BETA-GAMMA EFFICIENCY (4pi):
EFFICIENCY MODE PARAMETERS 5
EFFICIENCY MODE IS OFF
CURRENT ALPHA SOURCE SIZE (DPM):
CURRENT BETA SOURCE SIZE (DPM):
CUSTOM CONFIGURATION #1 6
ALERT ALARM
ALPHA:
BETA-GAMMA:
CONVEYOR SPEED (INCH/SEC):
CUSTOM CONFIGURATION #3
ALERT ALARM
ALPHA:
BETA-GAMMA:
CONVEYOR SPEED (INCH/SEC):
CUSTOM CONFIGURATION #2
ALERT ALARM
ALPHA:
BETA-GAMMA:
CONVEYOR SPEED (INCH/SEC):



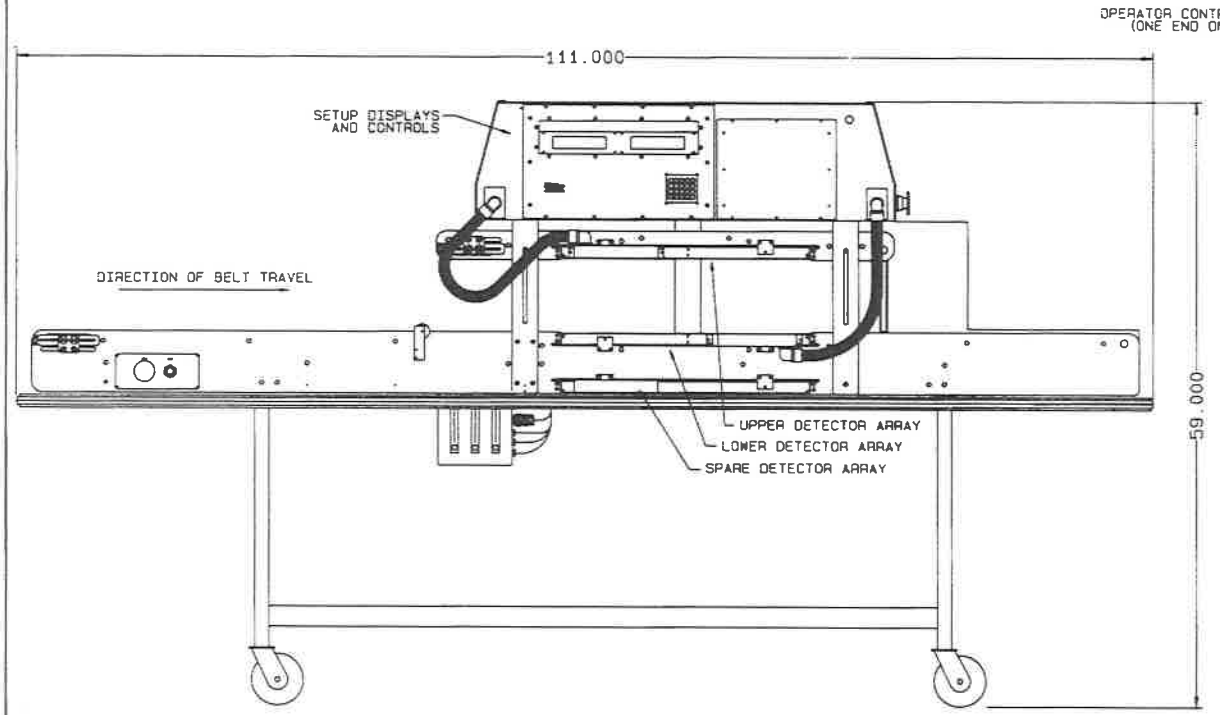
M 329-32 DETECTOR ARRAY

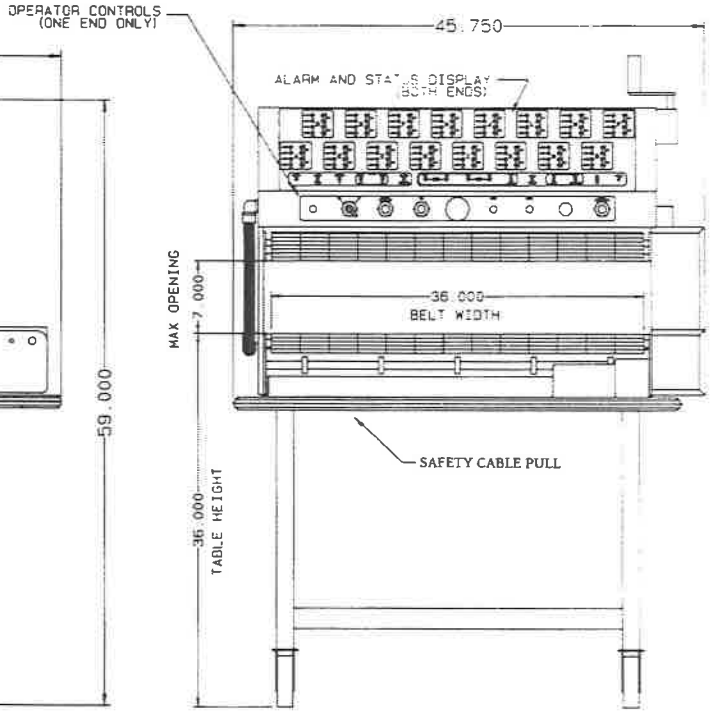
CONVEYOR BELT IS
81% OPEN

DETECTOR COVER OBSTRUCTS
1.27 SQI PER SECTION

LUDLUM

MODEL 329-32
32 CHANNEL LAUNDRY MONITOR





CHG	NO.				DWN	CHK	APP
DWN	DATE	CHK	DATE	APP	DATE		
BG	1-20-93			Jbw	9-7-15		

TOL: SHOP STD ☐ OTHER

SCALE: FULL ☐ OTHER

TITLE MODEL 329-32R LAUNDRY MONITOR

LUDLUM MEASUREMENTS, INC
501 OAK STREET
SWEETWATER, TEXAS 79556

SERIES 329

SHEET 501

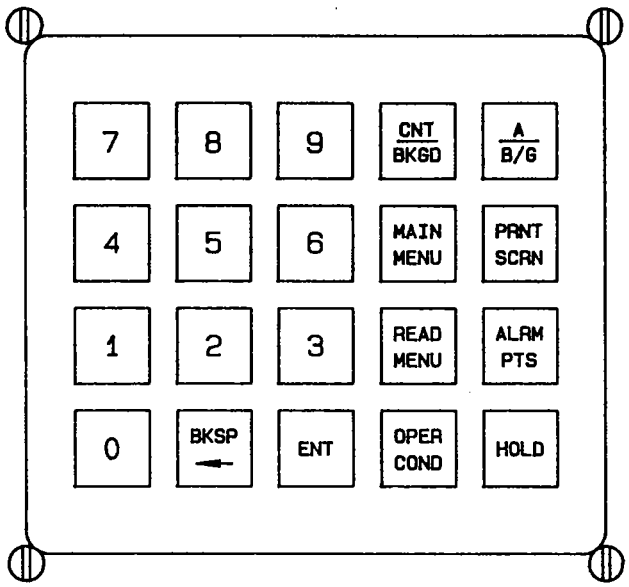


FIGURE 4 - KEYPAD LAYOUT

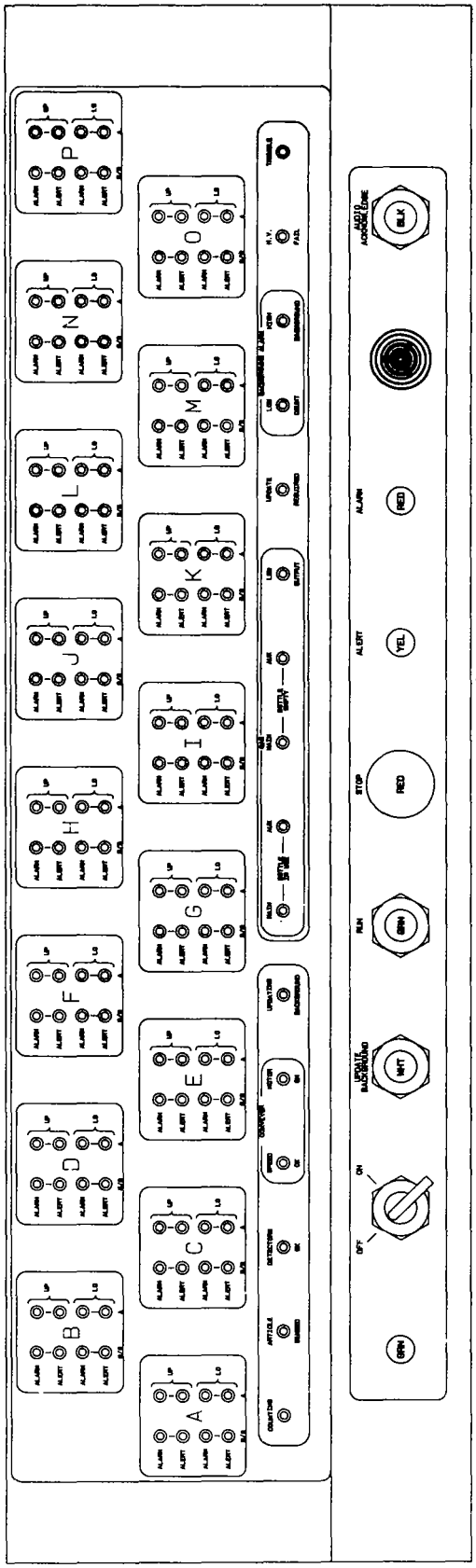
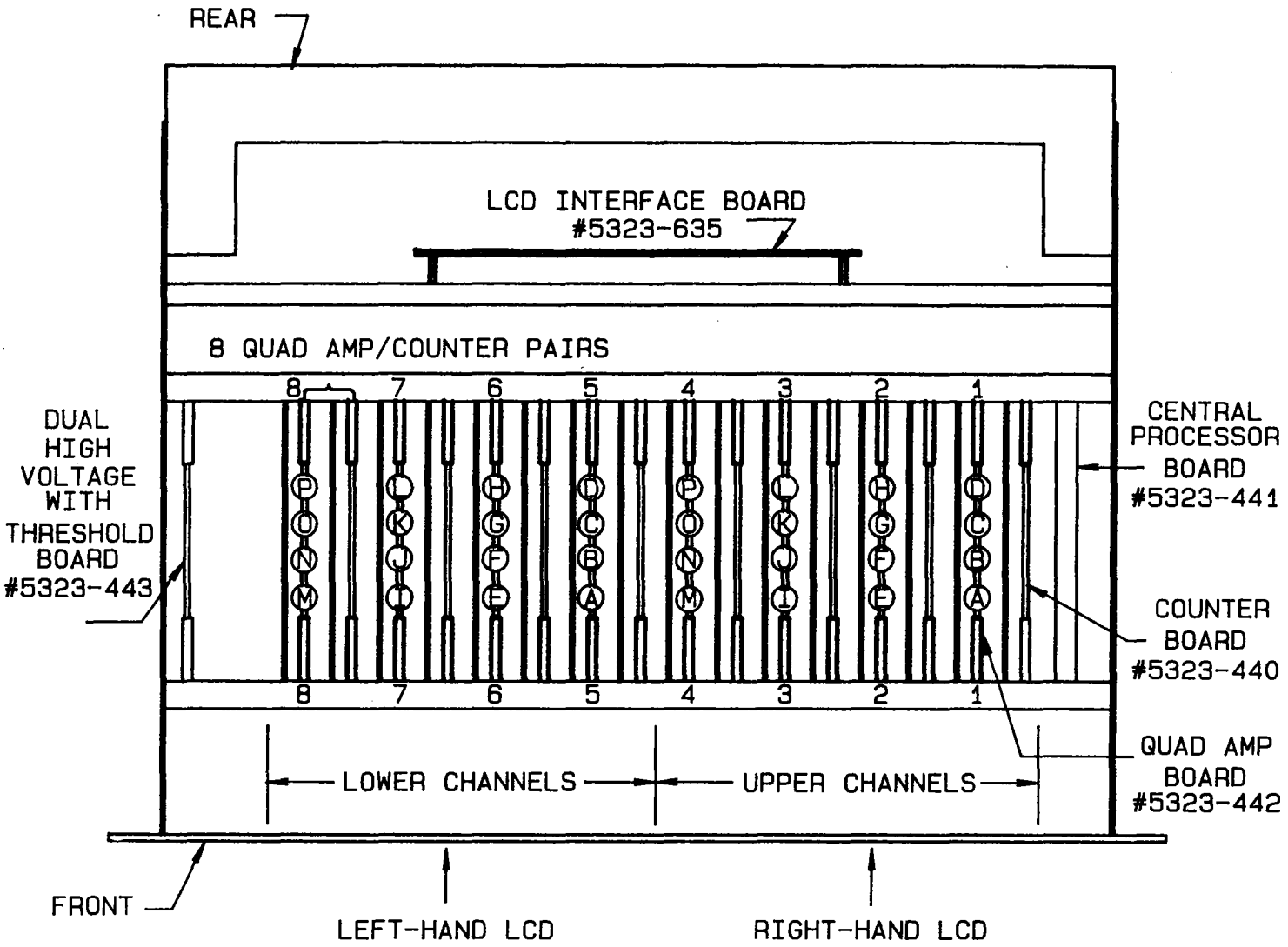


FIGURE 5 - OPERATOR PANEL LAYOUT



NOTE: CIRCLED LETTERS INDICATE POTENTIOMETER
USED TO ADJUST THE RESPECTIVE AMPLIFIER

ALL BOARDS HAVE COMPONENTS
FACING TO RIGHT

FIGURE 6 MAIN CHASSIS BOARD PLACEMENT

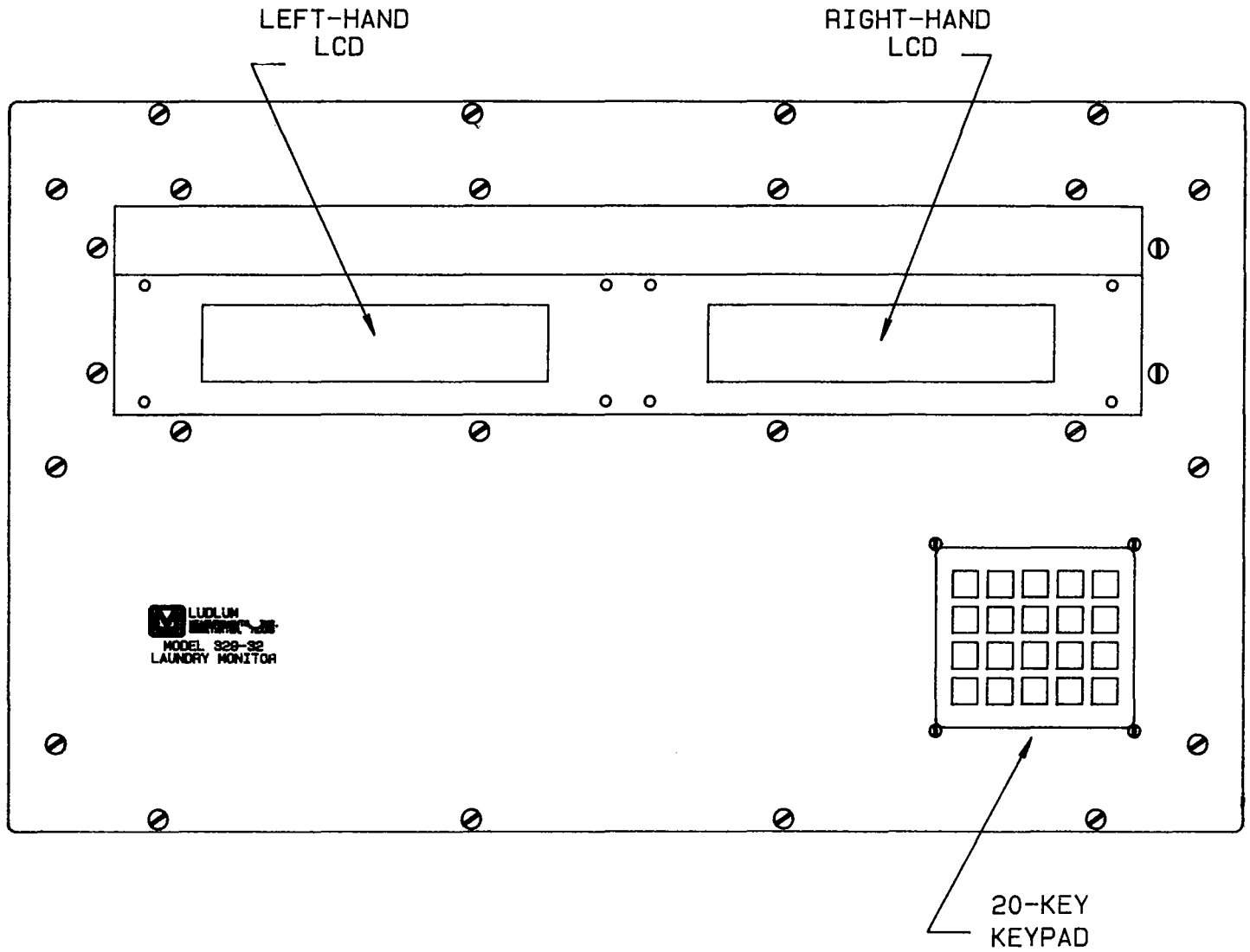
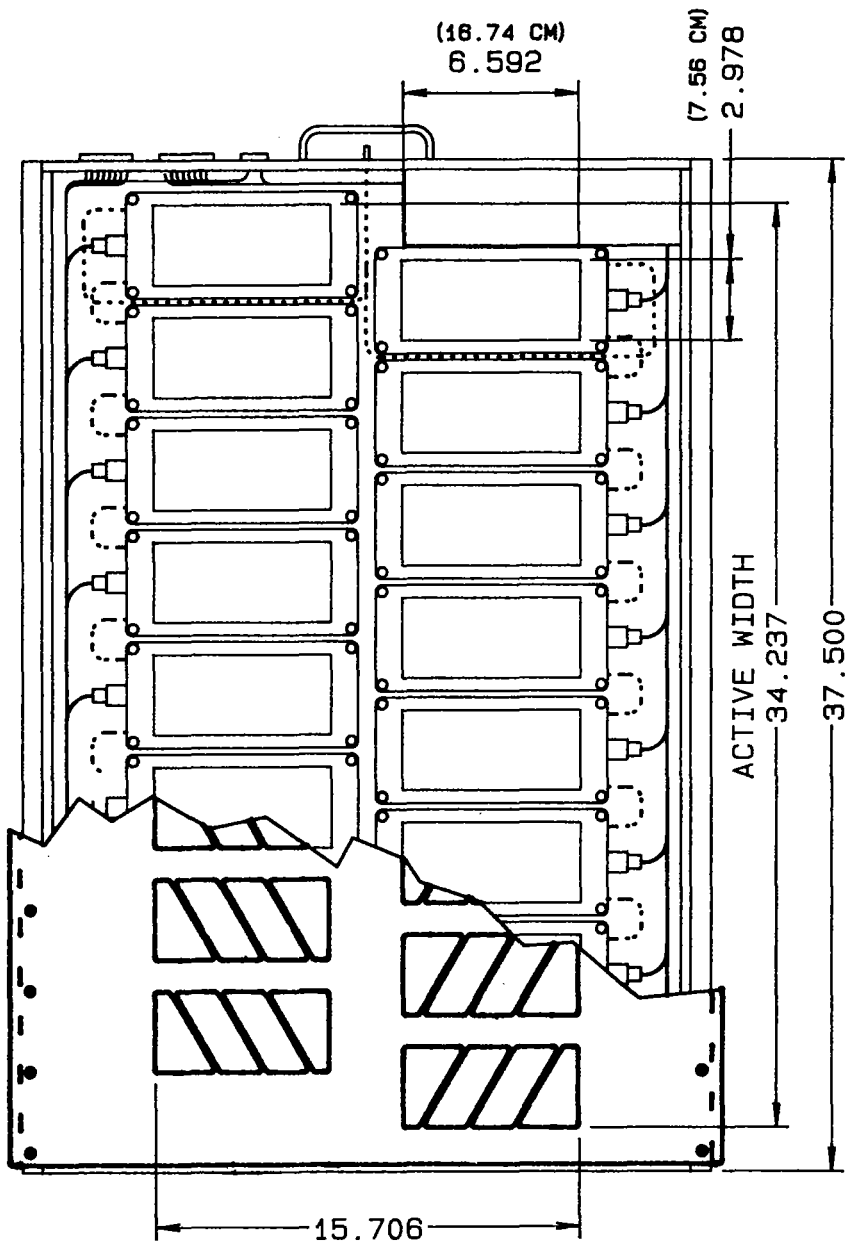


FIGURE 7 CONTROL PANEL

M 329-32 DETECTOR ARRAY



——— ELECTRICAL CONNECTIONS
····· GAS CONNECTIONS

CONVEYOR BELT IS
81% OPEN

DETECTOR COVER OBSTRUCTS
1.27 SQI PER SECTION

FIGURE 8 DETECTOR LAYOUT

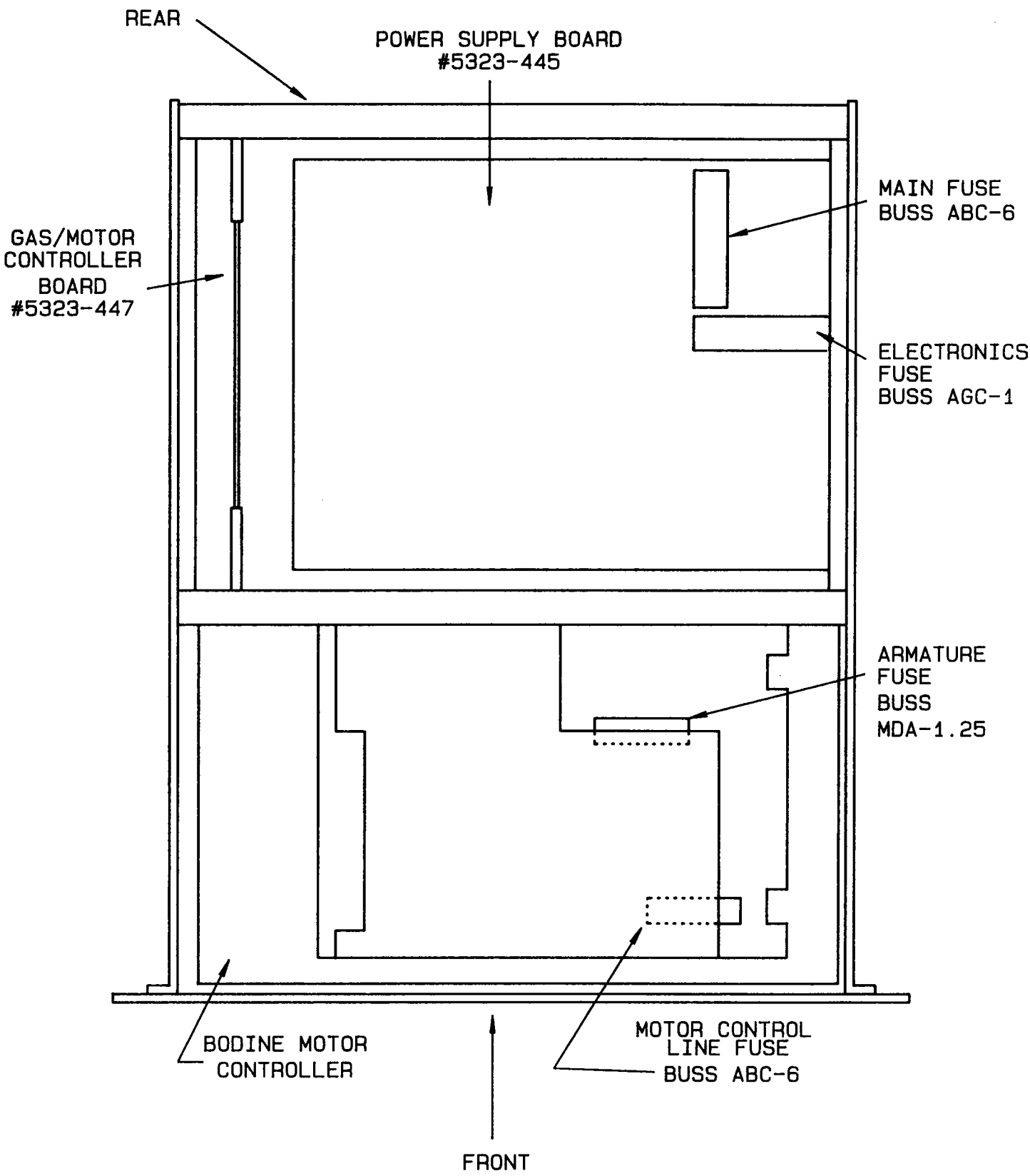


FIGURE 9 MOTOR CONTROL CHASSIS LAYOUT

QUAD AMPLIFIER CALIBRATION

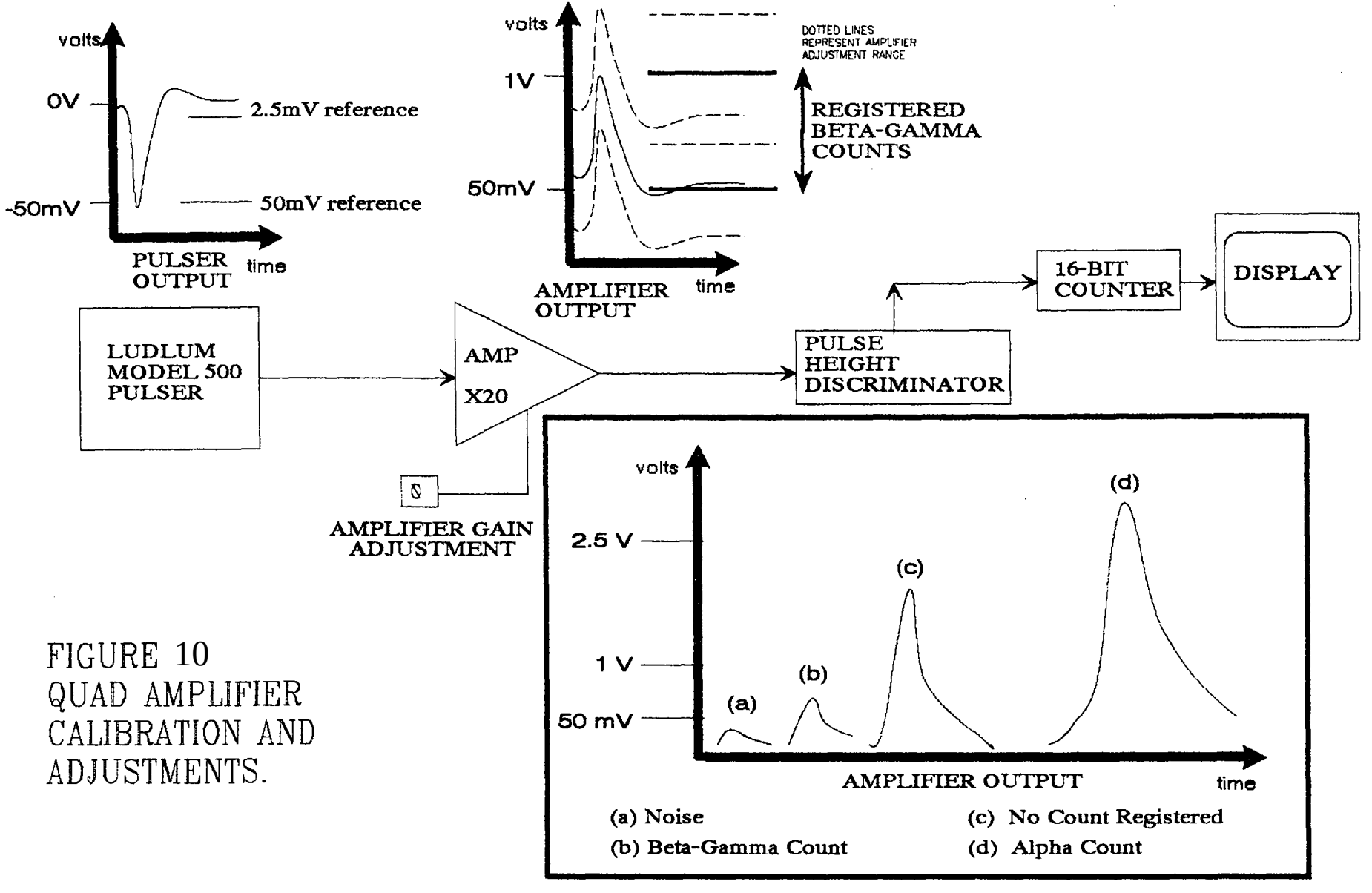


FIGURE 10
QUAD AMPLIFIER CALIBRATION AND ADJUSTMENTS.

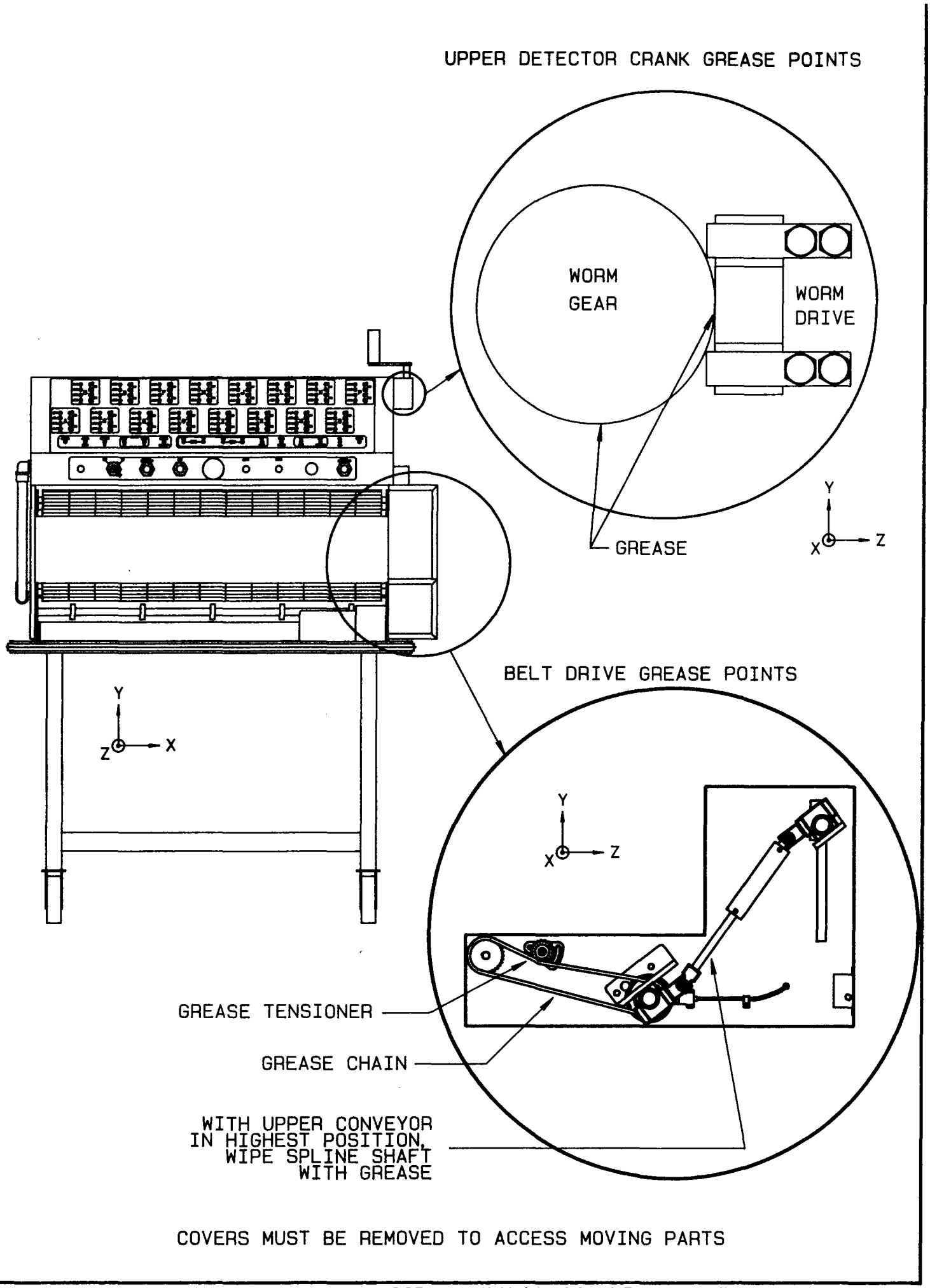


FIGURE 11 M 329-32B YEARLY LUBRICATION POINTS

BETA COUNTS	BETA COUNTS	BETA COUNTS	BETA COUNTS	BETA COUNTS	ALPHA COUNTS
Set scaler on 50mV setting Adjust pot so channel read ~50 cps. Record value below.	50mV scale	5mV scale	500mV scale	500mV scale	500mV scale
	Do cps drop to 0 above 50mV. (Y/N)	Find point where cps drop to 0. ~2.5mV	Find point where cps drop to 0. ~50mV	Are cps registered from ~50mV to 500mV. (Y/N)	Find point where cps drop to 0. ~125mV
UPPER/LOWER	UPPER/LOWER	UPPER/LOWER	UPPER/LOWER	UPPER/LOWER	UPPER/LOWER
A					
B					
C					
D					
E					
F					
G					
H					
I					
J					
K					
L					
M					
N					
O					
P					

NOTES:

QUADAMP.FRM	QUAD AMPLIFIER CALIBRATION SHEET	TESTER:

FIGURE 12 QUAD AMPLIFIER SAMPLE CALIBRATION SHEET.

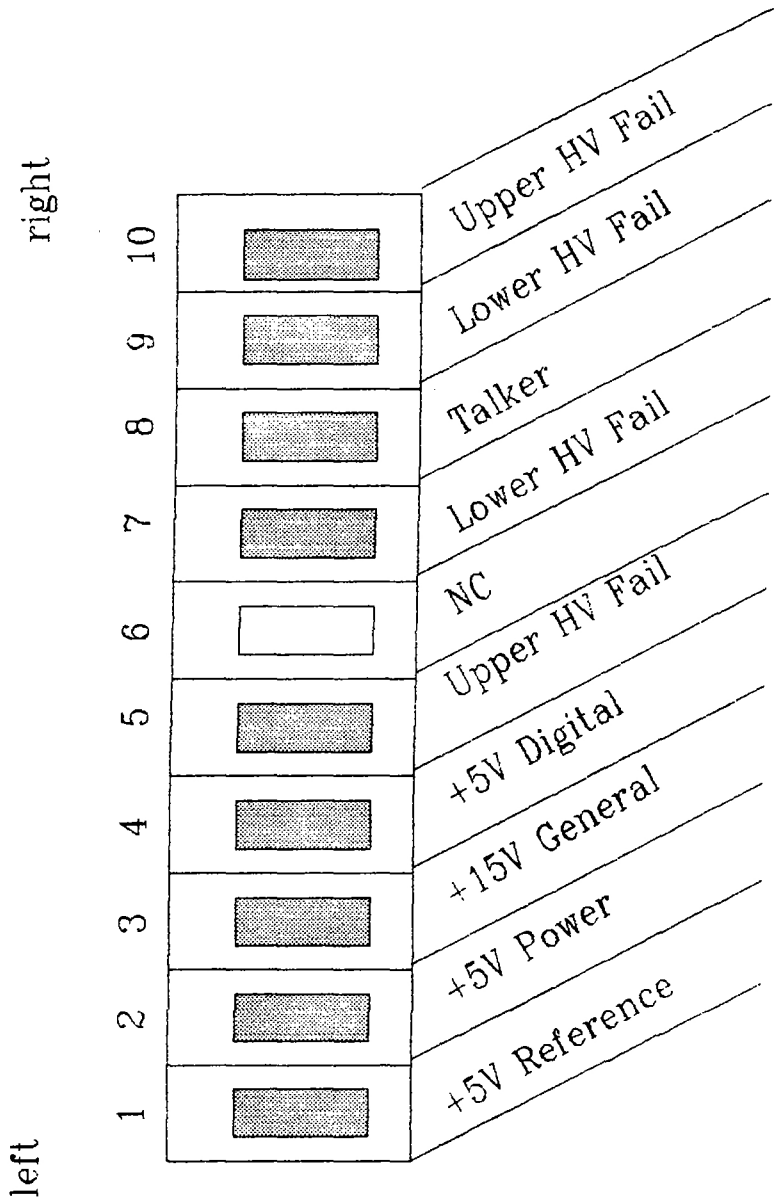


FIGURE 13 HIGH VOLTAGE TROUBLESHOOTING LED ARRAY ON BOARD #5323-443.

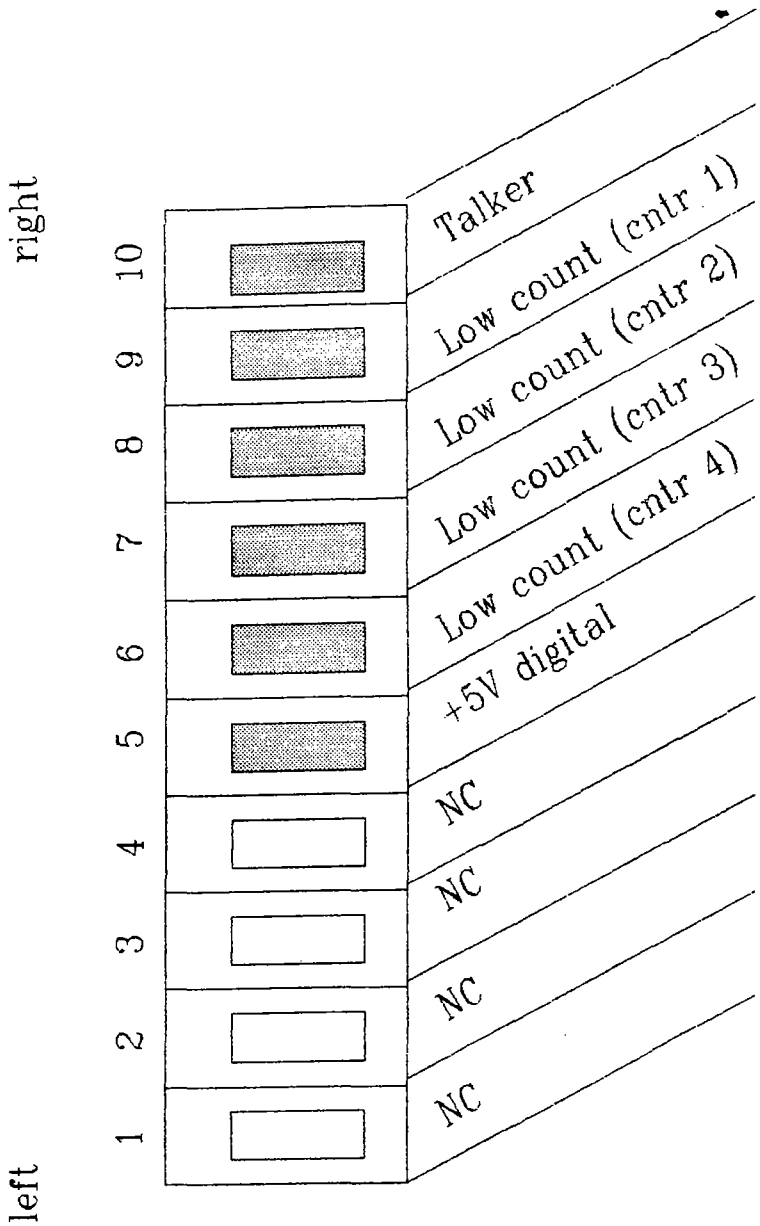


FIGURE 14 QUAD COUNTER TROUBLESHOOTING LED ARRAY ON BOARD #5323-440.

Figure 15

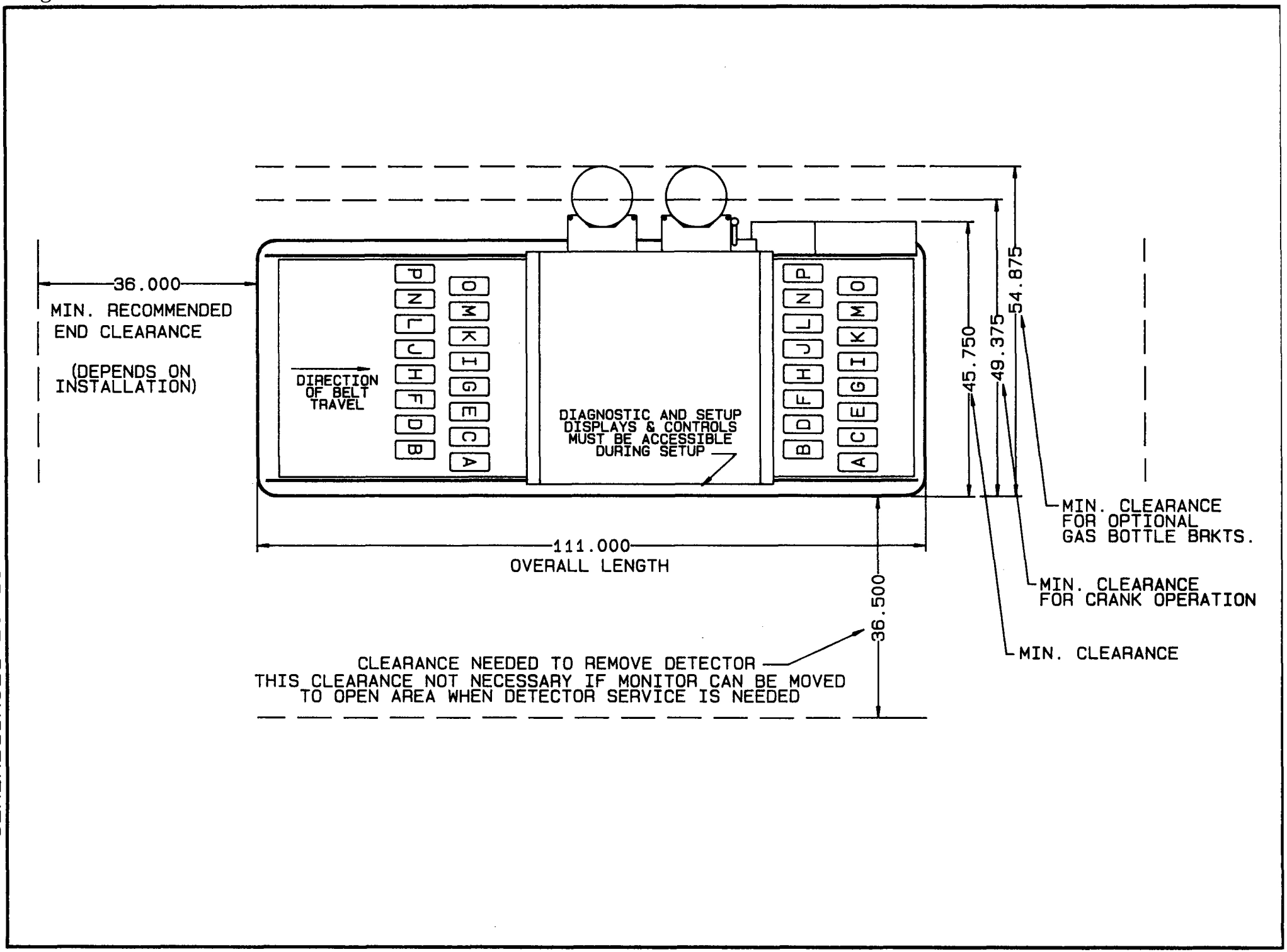
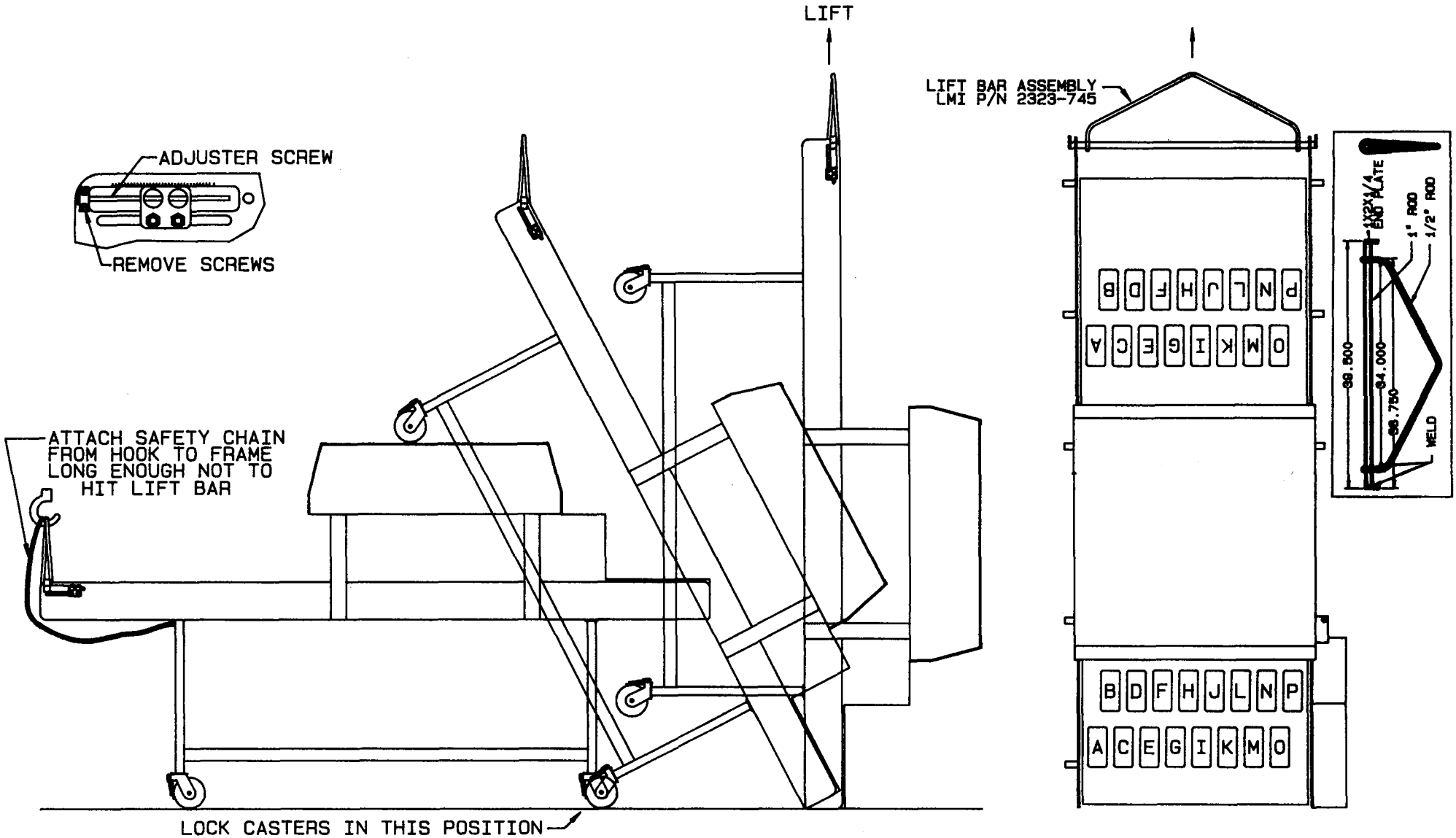

36.000
MIN. RECOMMENDED
END CLEARANCE
(DEPENDS ON
INSTALLATION)
DIRECTION
OF BELT
TRAVEL
P N L J H F D B
O M K I G E C A
DIAGNOSTIC AND SETUP
DISPLAYS & CONTROLS
MUST BE ACCESSIBLE
DURING SETUP
B D F H J L N P
A C E G I K M O
45.750
49.375
54.875
MIN. CLEARANCE
FOR OPTIONAL
GAS BOTTLE BRKTS.
MIN. CLEARANCE
FOR CRANK OPERATION
MIN. CLEARANCE
111.000
OVERALL LENGTH
36.500
CLEARANCE NEEDED TO REMOVE DETECTOR
THIS CLEARANCE NOT NECESSARY IF MONITOR CAN BE MOVED
TO OPEN AREA WHEN DETECTOR SERVICE IS NEEDED

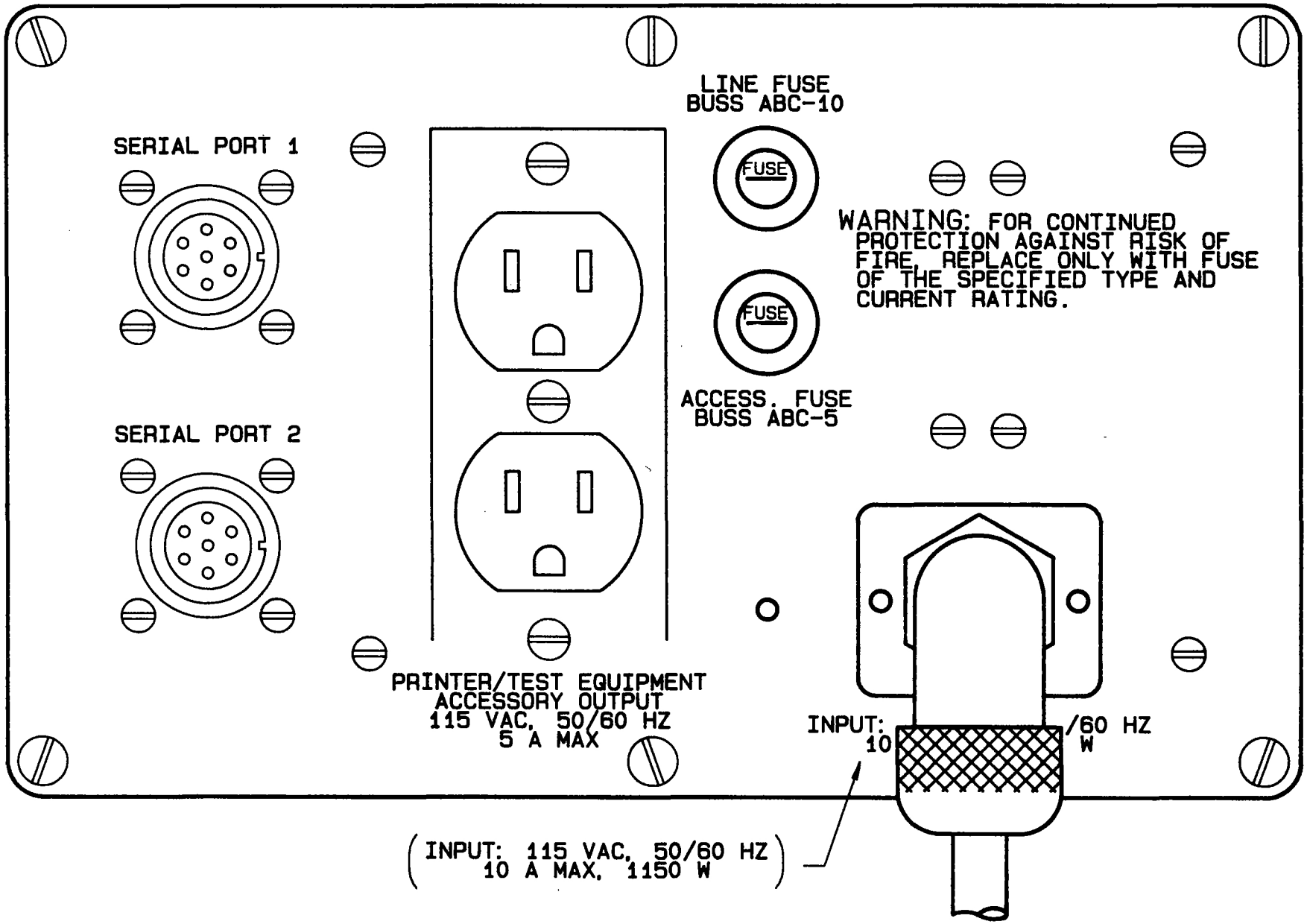
Figure 16



M 329-32 RECOMMENDED END LIFTING PROCEDURE

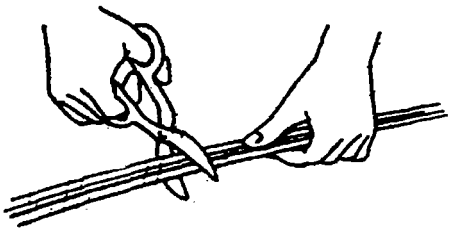
Step 1: Make sure upper conveyor is locked into place in lowest position.
Step 2: Remove cable pull.
Step 3: Remove lower conveyor belt tensioner adjuster screws by removing the two small screws and unscrewing the adjuster screws (both sides). Slide tensioner toward motor end as far as possible.
Step 4: Place lift bar into tensioner slots as shown.
Step 5: Move monitor into position to be lifted. Then lock casters into position as shown.
Step 6: Attach safety chain as shown.
Step 7: Lift monitor being careful not to allow motor end to strike floor as it swings down during lifting and during lowering.

Figure 17

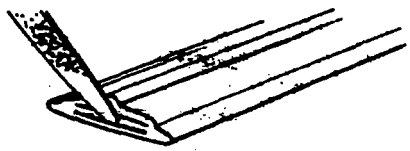


M 329-32 AC PANEL

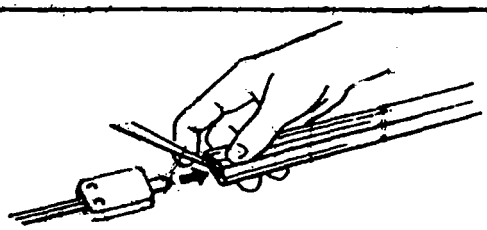
TAPESWITCH Connecting Suggestions



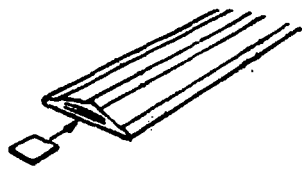
1. Cut Controflex Switch with a plain shears as cleanly as possible. See that no chip has slipped inside switch.



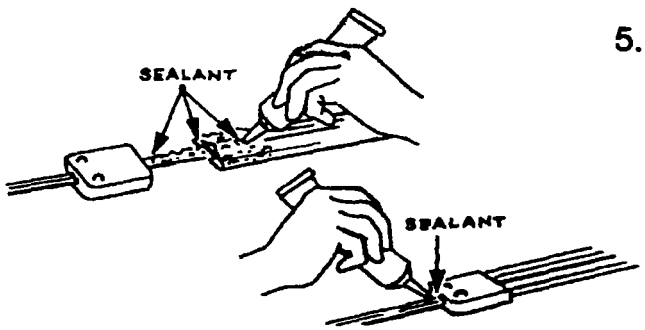
2. Spread switch conductors with a nail file or knife. Note that bottom conductor of Controflex Type "A" is made up of overlapping segments,—so that the bottom conductors might be doubled.



3. Insert connector blade of live end terminal between top and bottom conductors.



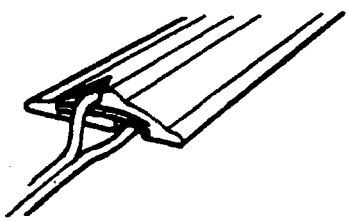
4. Insulate dead end of switch with piece of folded electrical tape or other insulating material 3/8 x 3/8 x .010 thk. *Test switch with ohmeter or buzzer.*



5. Apply Tapeswitch 105 Sealant generously, wetting about 1/2" of the switch end as well as at cut of switch and along wire. Push on terminal fittings. Wipe excess Sealant into a bead. At live end fitting apply additional sealant around wire exit. Allow to dry. (Alternate sealant: PVC Pipe Solvent Sealer from local hardware).

6. Switch is now ready for use.

ALTERNATIVE IMPROVISED CONNECTIONS



Soldering leads directly to switch conductors.

- V-notch plastic jacket to expose top and bottom conductors.
- Insert piece of insulating material 3/8 x 3/8 x .010 thick between top and bottom conductors.
- Solder wire which has been pre-tinned to the conductors.

TAPESWITCH CORPORATION OF AMERICA
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