LUDLUM MODEL 52
PORTABLE PORTAL MONITOR

August 2002
Serial No. 175872 and Succeeding
Serial Numbers

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August 2002

1. GENERAL

The Model 52 Portal Monitor is used for Beta/Gamma personnel contamination monitoring and meets the FEMA standard for Emergency Response Portal Monitoring (FEMA-REP-14). It is designed to be disassembled for ease of transportation and storage, and can be assembled in 5 minutes or less without tools. All parameters are stored in non-volatile memory which requires no battery backup. These parameters allow easy operation with minimal setup by minimally trained personnel. The parameters are pre-set at the factory to detect a 1.0 μCi Cs^{137} beta window source in a 10 μR/hr background field, in accordance with the FEMA standard. The Model 52 can be powered by 120 VAC or 6 "D" cell batteries. 220 VAC-powered units are available as a special order.

The instrument has a "person-counter" integrated into the electronics that increments by 1 every time a count is completed. It is a 4-digit number normally displayed on the LCD display, next to the "READY" message. It also has an RS-232 port that can be used to print out parameter setpoints, background counts, and counts above background.

The portal frame incorporates an array of 18 Geiger-Mueller (G-M) detectors positioned around the frame and base. Fourteen G-M pancake detectors are located in the frame for monitoring the head and body. Four cylindrical G-M detectors are utilized in the base for monitoring the feet.

The electronics are microprocessor-based for ease of setup and reliability. Individual LEDs (Light Emitting Diodes) mounted in the frame and also on the electronics front panel indicate the specific alarm location. LEDs in the front panel indicate count cycle status. Audible signals accompany the LEDs for additional indication. Detector counts, background, and all parameters may be viewed on the LCD display. All setup is accomplished via pushbuttons on the electronics assembly.

The Model 52 incorporates a summing alarm in addition to the individual channel alarms. This increases the system sensitivity to widespread contamination. If 2 or more channels had a noticeable increase in counts but did not exceed their alarm threshold, the sum of their counts could exceed the summing alarm.

The Model 52 also has background update and subtract capabilities. The instrument will take a background count and subtract it from the current count. This function helps compensate for fluctuations in background. Background subtract can be turned on or off, the background count time is adjustable, and the background interval time is adjustable. The operator can force the instrument to stop and take a background count at a different interval if desired.

The alarm volume is adjustable via the keypad on the front panel. For further explanation of parameters and their functions, see section 6.

2. ASSEMBLY INSTRUCTIONS

SEE FIGURE 1 - M52 ASSEMBLY DRAWING ON PAGE 2

This section gives instructions on how to assemble the Model 52 and get it ready for use.

The Model 52 comes in a container that can be used for shipping and storage. The pieces and quantities that make up the system are:

1 - Base
1 - R1 (Right #1) Section
1 - R2 Section
1 - R3 Section
1 - L1 Section
1 - L2 Section
1 - L3 Section
1 - Top Section
1 - Electronics Section
1 - Power Cord
1 - Remote electronics extension cable (optional).

Unpack the container and inventory to ensure that all pieces are present.

The Model 52 can be assembled without tools. All connections are made with latches. To connect a latch, lift up the bottom tab, hook the top cross bar into the hook on the piece that you are attaching, and push tab back down until it snaps into place.

CAUTION!

Exercise care when unlatching pieces, as the latches can spring open violently.

To unlatch, lift up the tab and unhook the top cross bar.

- ☐ Set the **Base** on the ground with the screens over the foot detectors facing up.

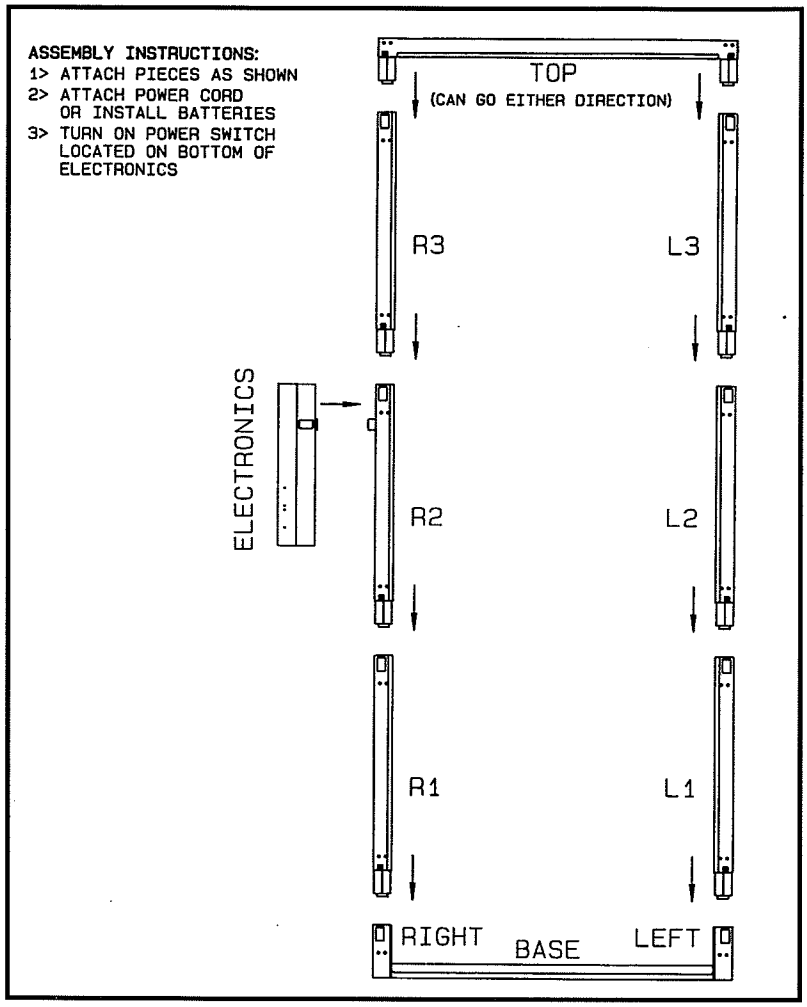


Figure 1 - M52 Assembly Drawing

❑ Insert the male end of section **R1** into the female side bracket of the base marked **RIGHT** and attach the latches. The detector screens must be facing toward the middle of the portal.

❑ Insert the male end of section **R2** into female end of section **R1** and attach the latches.

❑ Repeat the process for the rest of the side sections (**R3** through **L3**).

❑ Insert the **TOP** into the tops of the side sections and attach the latches. The top can be installed in either direction. It does not matter which end goes to the right.

❑ Plug the **ELECTRONICS** section onto the back of section **R2** with the LEDs facing up. Make sure that the pin in the back of R2 goes into the hole on the electronics. Then attach the latches. If you are using the optional Remote Electronics Extension Cable, plug it between R2 and the Electronics. Place the Electronics wherever necessary.

❑ If you have line voltage available, plug the **POWER CORD** into the connector on the bottom of the Electronics marked INPUT. If not, install 6 "D" Cell batteries into the battery compartment. The Power cord and batteries may both be installed at the same time, but the Model 52 does not charge the batteries.

❑ **Turn on** the **POWER** switch located on the bottom of the electronics and allow the instrument to finish updating. If the preprogrammed settings are acceptable, it is ready for use. Proceed to User Operation, Section 3. If the settings need to be changed or checked, proceed to Parameter Setup, Section 7.

2.1 Packing Instructions

1. LAY THE 3/8" THICK FOAM AGAINST THE INNER SIDES OF THE CASE.
2. LAY TOP INTO CASE ON ITS SIDE AS SHOWN.
3. PLACE A SECTION BESIDE THE TOP WITH 1/4" FOAM IN BETWEEN.
4. PLACE OTHER SECTIONS IN PLACE WITH FOAM IN BETWEEN.
5. LEAVE ELECTRONICS ATTACHED TO SECTION R2 AND PLACE INTO CASE.
6. LAY 1" THICK PIECE OF FOAM WITH NOTCHES IN END ON TOP OF SECTIONS.
7. TURN BASE ASSEMBLY UPSIDE DOWN AND PLACE IN CASE.

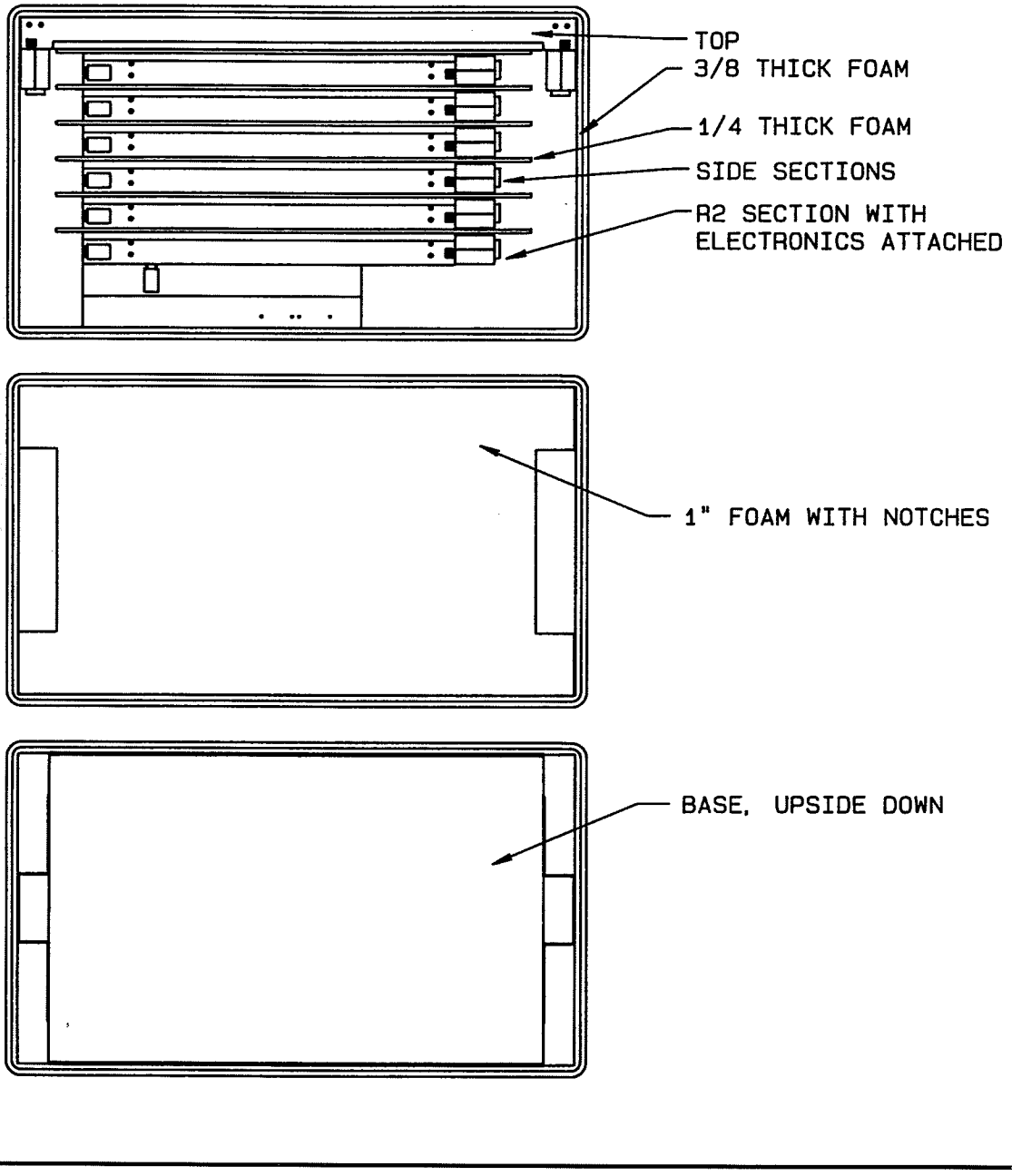


Figure 2 - M52 Packing Instructions

3. USER OPERATION

This section gives instructions on how to use the instrument to monitor a person for radiation contamination. It assumes that the unit has been assembled and turned on. If this is not the case, refer to Assembly Instructions, Section 2. For information on Parameter Setup, see Section 7. The front panel and top and bottom views are on pages 5 and 6.

3.1 Operational Check

To ensure that the Model 52 is functioning correctly, an operational check should be performed on a routine basis. This check verifies that the instrument is turned on, that the settings are appropriate, and that the system alarms when the detectors are exposed to excess radiation (above background level). Ludlum Measurements suggests that this operational check be performed once per day or at the beginning of each work period. As long as the system passes the operational check, no calibration or other checks are necessary. If the response or any function of the Model 52 should change, the instrument should be checked and brought in compliance with manufacturer's original specifications.

❑ Check each of the 8 sections for sensitivity to radiation. There are 3 sections on each side, 1 at the top, and 1 on the floor (base plate). Using the check source supplied with the instrument (Cs-137, approximately 1 μCi), hold the source as described on the instrument's Certificate of Calibration, with the active side of the source turned toward the panel to be tested.

❑ Activate the counter by pressing on the base plate. When the audible beep sounds, the 6-second count time commences. Keep the source in place with pressure on the base plate until the alarm sounds. The visual alarms on the frame and control panel relevant to that panel should also illuminate. Remove the source and the pressure on the base plate to allow the unit to reset. If any of the appropriate alarms do not activate before the end of the 6-second count (indicated by another audible beep), the instrument requires a check to manufacturer's specifications and possible repair.

❑ Repeat alarm checks for all sections. For the base plate, perform the check on each side, holding the source as described on the instrument's Certificate of Calibration.

3.2 Personnel Monitoring

A count starts when someone steps onto the base plate. A count can only be started when the system is in the **READY** mode. **You must exit out of any setup menus before a count can be taken.**

Prior to operation, the monitor must be allowed to update the background count if background time is not set to zero. This mandatory update occurs just after power-up and then after expiration of the background update interval timer. New background count data is compared to the low and high background setpoints that have been programmed into the unit. If the setpoints have been exceeded, a HI BACKGROUND or LO BACKGROUND alarm is given and the unit returns to updating background. The instrument will continue to update the background until the alarm condition has been corrected, i.e. the background goes down, failed detectors are repaired, or the parameters have been changed.

To check someone for radiation contamination, follow the steps below:

❑ The green **READY** light must be lit in order to use the instrument. An orange **UPDATING** light may be on, indicating that a standby update is taking place. When the **UPDATING** light is on, the system should not be used and all people to be checked should remain at least 3 feet away until the **READY** light comes back on.

❑ The subject steps onto the base plate and positions feet on the foot detector screens. The green **COUNTING** light will come on.

❑ The yellow **INCOMPLETE** light will turn on if the subject steps off of the base plate before the count is complete.

❑ When the count is complete, the green **CHECK OK** light or one or more of the red alarm lights will turn on. If there is an alarm, the alarm LEDs on the top of the electronics and the LEDs on the portal frame will indicate the location of the alarm.

❑ The subject then steps off the instrument.

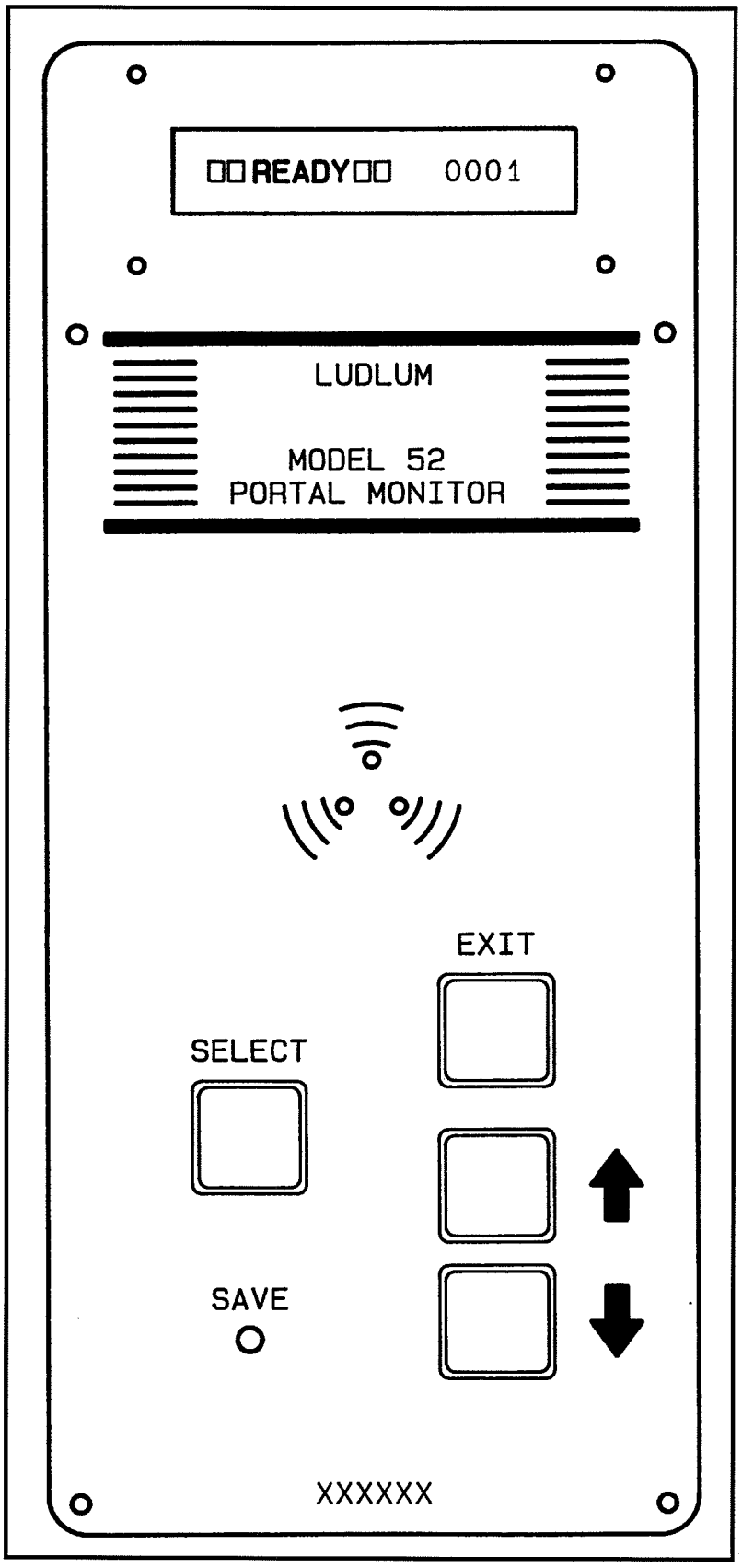


Figure 3 - M52 Front Panel Drawing

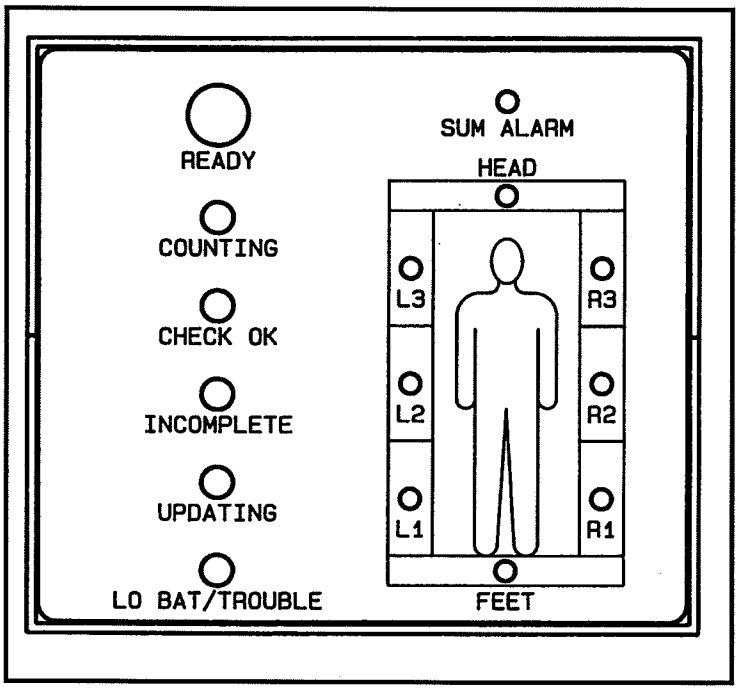


Figure 4 - M52 Electronics Top View

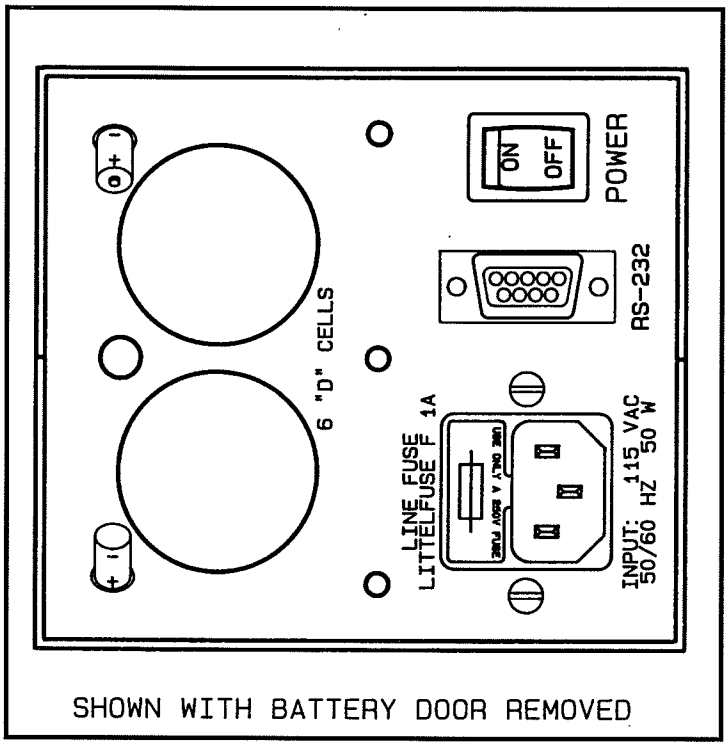


Figure 5 - M52 Electronics Bottom View

4. SPECIFICATIONS

- **WEIGHT**: 65 lbs. (85 lbs including case)
- **OUTSIDE DIMENSIONS**: 81" tall x 40.3" wide x 24.8" deep
- **INSIDE DIMENSIONS**: 76.5" tall x 32" wide
- **POWER**: 102-132 VAC, 50/60 Hz, 50 watts maximum or six (6) "D" cell batteries. Battery life is approximately 80 hours in a non-alarm condition. 220 VAC operation optional.
- **FUSE**: Littelfuse F-1A, 1 amp, 5 x 20mm, 250 volt
- **COUNTING CAPACITY**: 9999 counts per minute.
- **SENSITIVITY**: 80 millivolts (mV)
- **COUNT TIME**: Adjustable from 1 to 60 seconds
- **ALARM HOLD TIME**: Adjustable from 1 to 99 seconds
- **AUDIO**: Unimorph speaker with keypad adjustable volume
- **BACKGROUND UPDATE INTERVAL**: Automatic. Adjustable from 0 - 99 minutes. 0 = OFF
- **BACKGROUND COUNT TIME**: Adjustable from 0 - 99 seconds. 0 = OFF.
- **FORCE BACKGROUND UPDATE INTERVAL TIME:** Adjustable from 0 to 99 minutes. 0 = OFF.
- **PERSON COUNTING CAPACITY**: 9999 people before rolling back to zero.
- **SETUP PASSWORD**: 4-digit numeric password that, if enabled, must be entered before having access to the setup menu.

5. DESCRIPTION OF CONTROLS AND FUNCTIONS

FRONT PANEL - (See Figure 3 on page 5)

- **READOUT**: LCD, 1-line, 16-character alphanumeric display. It normally displays "☐ ☐ READY ☐ ☐ XXXX," with the "XXXX" being the number of people who have been checked by the instrument. It will display other messages, depending upon the operational status of the instrument. Counts, alarms, and other information can be displayed by following the instructions in Section 7.
- **EXIT Key**: Moves back one menu selection.
- **Increment (Up Arrow "↑") Button**: Moves up one line in the current menu.

WITHIN PARAMETER SETUP: A digit increments by 1. An on/off parameter toggles to the other state.

- **Decrement (Down Arrow "↓") Button**: Moves down 1 line in the current menu.

WITHIN PARAMETER SETUP: A digit decrements by 1. An on/off parameter toggles to the other state.

- **SELECT Key**: Selects the current menu displayed on the Readout. When setting parameters, it activates the digits so that they can be changed.

SAVE Key: Recessed push button that saves all parameters to non-volatile memory. This button can only be operated by inserting a small screwdriver or pin through the hole. All of the microprocessor RAM is transferred to EEPROM memory when this button is pushed. Any changes made to variables only change the current microprocessor RAM. If the Model 52 is turned off prior to saving changes, the changes are lost. To save parameter changes, press the **SAVE** button before turning the Model 52 off. Upon power-up, the EEPROM memory is loaded into the microprocessor. If the **SAVE** key is pressed while turning the instrument on, the M52 is loaded with a set of default parameters.

The parameters that are set are :

Default Value	
Count time	6 sec
Background Count Time	60 sec
Update Interval	5 min
Force Background	30 min
Hold Time	6 sec
Alarm Volume	255
Password On/Off	OFF
Password	0000
Alarms	
Left	200
Right	200
Head	200
Feet	250
Sum	450
Background Alarms	
Left Low/High	25/1000
Right Low/High	25/1000
Head Low/High	25/1000
Feet Low/High	50/1000

LEDs (top of electronics) - (See Figure 4 on page 6 for LED layout)

- **READY** LED: Normally lit prior to any interrogation. System is ready to take a count.

- **COUNTING** LED: Indicates that a count is in progress. Stepping off of the base plate prior to expiration of the count time will cause this light to go off and the **INCOMPLETE** LED to come on. When the count is complete the **CHECK OK** or one of the alarm LEDs will activate.

- **CHECK OK** LED: Indicates that a count has been completed and no alarms were sensed. This LED will stay on until the subject steps off of the base plate or for 2 seconds, whichever is longest.

- **INCOMPLETE** LED: Indicates that a count was in progress and the subject stepped off of the base plate before the count was complete. The **Incomplete** LED stays on for the alarm hold time or until the subject steps back onto the base plate. An incomplete resets the count time. If no one steps back onto the base plate during the incomplete time, then the Model 52 goes back to the ready state lighting the **READY** LED.

- **LO BAT / TROUBLE** LED: Indicates that the batteries are weak and must be replaced. It can also indicate that the system has detected a high or low background condition. If there is a background problem, the **UPDATING** LED will also be lit and the LCD display will have a message displayed. If the batteries are weak, the **LO BAT/TROUBLE** LED will be the only LED illuminated. Battery condition will not be indicated when the system is connected to line voltage.

- **SUM ALARM, HEAD, etc.** LEDs: Indicate which channel has alarmed during a count. These light as soon as an alarm is sensed; when the count is complete, the **CHECK OK** will not light, the audio will stay on for the alarm hold time, and then the Model 52 goes back to the ready state, lighting the **READY** LED. The SUM ALARM is an alarm that adds all the channels together to determine if there is widespread contamination. If several channels have a high count but not high enough to exceed their individual alarm threshold, then the sum of the channels could exceed the sum alarm threshold.

BOTTOM OF ELECTRONICS - (See Figure 5 on page 6)

- **Power On/Off**: Switch to turn instrument on and off. Switches both line voltage and batteries.

- **Line Fuse**: Fuse to limit current from AC outlet. The fuse is a Littelfuse F 1A or equivalent.

- **INPUT**: Line Voltage input. 115 VAC, 50/60 Hz, 50 W.

- **6 "D" CELLS (underneath door)**: Compartment for batteries. Holds 3 "D" cell batteries per side. Install batteries as shown by diagram above holes.

- **RS-232**: RS-232 port so that instrument can be connected to a printer or a computer.

6. PARAMETERS AND FUNCTIONS

This section lists the different parameters of the Model 52 and their functions.

All counts, alarms, and other settings are in **COUNTS PER MINUTE.** The instrument makes the necessary calculations to convert the count time setting into **counts per minute.**

The **READ** menu accesses the same parameters and in the same way as the **SETUP** menu. **However, no parameters may be changed in the READ menu.**

The **COUNTS** menu shows the accumulated counts in each channel.

6.1 Alarm Menu Parameters

❑ **ALARMS** - This parameter sets the number of **counts per minute** that it takes to set off an alarm. If background subtract is turned on, the alarm will be the number of counts above background. If it is turned off, the alarm will be the number of gross counts. All channels must have their alarms individually set. An alarm can be turned off by setting it to zero.

❑ **LO BACKGROUND ALARM** - This parameter sets the number of **counts per minute** that the background should not fall below in normal operation. If background falls below this level, a LO BACKGROUND alarm will be signified by a message on the LCD and illumination of the UPDATING light and the LO BAT/TROUBLE light. This alarm indicates if a detector has failed or is not connected. This alarm will also indicate if the ambient background has gone down. All channels must have their LO BKGND Alarms individually set and each can be turned off by setting it to zero.

❑ **HI BACKGROUND ALARM** - This alarm is the opposite of the LO BACKGROUND Alarm. This alarm will indicate if background radiation has increased or if a detector has failed. All channels must be set individually and each can be turned off by setting to zero.

6.2 Time Menu Parameters

❑ **COUNT TIME** - This parameter sets the length of time in **seconds** that the instrument will accumulate counts before determining if a subject is contaminated. Its range is 1 to 60 seconds.

❑ **ALARM HOLD TIME** - This sets the length of time in seconds that visual and audible alarm signals will stay on before the instrument goes back to the READY mode. All alarms and INCOMPLETE are controlled by this timer.

6.3 Volume Menu Parameters

❑ **ALARM VOLUME** - This sets the volume of the audible alarm signal. Setting range is from 1 (lowest) to 255 (loudest). Audio can be turned off by setting to zero.

6.4 Background Menu Parameters

❑ **BACKGROUND SUBTRACT ON/OFF** - This allows you to turn the background subtract function on or off.

❑ **BACKGROUND COUNT TIME** - This sets the length of time in seconds the instrument will accumulate counts to determine background. The instrument takes the last 3 background counts and averages them to determine background. The setting range is from 0 to 99 seconds.

If BACKGROUND COUNT TIME is set to zero, no background will ever be taken. This includes the initial background taken at startup.

❑ **BACKGROUND INTERVAL** - This sets the length of time in minutes that the instrument will wait before taking another background count. After the time has elapsed, the instrument will attempt to take a background count. The setting range is from 0 to 99 minutes. Zero is off. If something interrupts it during the count (someone steps on the base plate, changes a parameter, etc.), the count is aborted and the instrument will try again as soon as it returns to the READY mode. During heavy usage, it is possible that the instrument may never be able to complete a background count. After a background count has been taken, the INTERVAL and FORCE INTERVAL timers are reset.

If BACKGROUND INTERVAL is set to zero, the background will never be updated after the initial startup background.

❑ **FORCE BACKGROUND INTERVAL** - This sets the length of time in minutes the instrument will wait before it shuts down operation and forces you to allow it to take a new background count. The setting range is from 0 to 99 minutes. During heavy usage, the normal background interval may not be able to take a background count. The FORCE interval will cause the instrument to shut down until it has had a chance to update background. This time interval must always be larger than the

BACKGROUND INTERVAL or the COUNT TIME. After a background count has been taken, the INTERVAL and FORCE INTERVAL timers are reset.

6.5 Person Counter

The Person Counter is built into the Model 52 electronics so that the operator can keep track of the number of people who have been surveyed by the instrument. It is also printed out with the counts to help keep track of which person was contaminated. The counter is displayed on the LCD along with the READY message. The counter can be reset by turning the instrument off and then back on.

6.6 RS-232 Port

The RS-232 port allows the instrument to be connected to a printer or a computer so that a record can be kept of the activity of the instrument.

When connected to a printer - When the instrument is first turned on, the printer will print the parameter settings. From then on, when a count is complete, the printer will print out the person number, the background counts, and the number of counts above background for all channels. Check OK or Alarm will be printed with an asterisk beside any channel that has exceeded its alarm setpoint. See the examples below.

When connected to a computer - The instrument will send the same data to a computer that it sends to a printer (see above). The optional computer software will display the data on the screen and allow it to be saved to a file.

The model 52 RS-232 port operates at 9600 baud, 8 data bits, 1 stop bit, no parity (9600,8,N,1).
Example print-out from the RS-232 port after power-on.

```
            LUDLUM MEASUREMENTS, INC.
             MODEL 52 PORTAL MONITOR
                PARAMETER LIST

          COUNT TIME = 006 SEC
BACKGROUND COUNT TIME = 060 SEC
     UPDATE INTERVAL = 005 MIN
     FORCE BACKGROUND = 060 MIN
           HOLD TIME = 006 SEC
       ALARM VOLUME = 255

SECTION     ALARM POINT     LO COUNT     HI BKGND
L1              0200           0000         1000
L2              0200           0000         1000
L3              0200           0000         1000
R1              0200           0000         1000
R2              0200           0000         1000
R3              0200           0000         1000
FEET            0250           0000         1000
HEAD            0200           0000         1000
SUM             0450
     ALL COUNTS IN CPM.
```

Example print-out from the RS-232 port after a complete count.

```
PERSON # 0001
CHECK OK

SECTION     BACKGROUND     COUNT ABOVE BKGND     ALARM
L1              0079              0000             NO
L2              0087              0000             NO
L3              0071              0009             NO
R1              0085              0000             NO
R2              0089              0051             NO
R3              0072              0000             NO
FEET            0252              0000             NO
HEAD            0072              0000             NO
SUM             0807              0060             NO
     ALL COUNTS IN CPM.
```

7. SETUP OPERATION

SEE FIGURE 6 on page 12 for menu diagram.

This section gives instructions on how to use the keys to setup the instrument. Examples of keystroke sequences are given for several parameters. Use the menu tree diagram and similar keystrokes to access other parameters. For information on using the instrument to make a radiation check, see section 3.

To move from one level of the menu tree to a sub-level, press the SELECT key. To move up one level, press the EXIT key. To step through the different items on one level, use the UP or DOWN ARROW KEYS. The SELECT key also moves from one digit to the next when setting parameters. To reset all parameters to their default settings, hold down the SAVE key while turning on the instrument.

All parameters are listed in the following order: L1, L2, L3, R1, R2, R3, FEET, HEAD, and SUM.

When you press the SELECT key from READY Mode, you have the following selections.

1 - Setup Menu
2 - Read Menu
3 - View Counts Menu

7.1 Setup Menu

The setup menu has four choices:

1- Setup ALARMS MENU
2- Setup BACKGROUND MENU
3- Setup TIME MENU
4- Setup VOLUME MENU
5- Setup PASSWORD MENU

To change a parameter, access the variable of interest through the setup menus using the SELECT and increment/decrement "↑/↓" keys. Press the SELECT key to change the parameter. The cursor becomes visible and blinks on the variable to change. On multiple digit variables, press the SELECT key to access the next digit.

7.1.1 Setup Alarms Menu

The SETUP ALARMS menu allows changes to be made to the count alarms for each of the Individual Alarm channels.

To access the SETUP ALARM menu:

- ❑ Turn the instrument ON. Wait for READY to display on the LCD.
- ❑ Press SELECT once to select the setup menu. SETUP menu appears.
- ❑ Press SELECT once to execute the setup menu. ALARMS menu appears.
- ❑ Press SELECT once to execute the alarms menu. L1 ALARM XXXX appears where XXXX is a 4 digit number between 0 and 9999. To access other alarm channels, use the increment ("↑" or decrement "↓") keys.
- ❑ To change the current setting press SELECT to activate the first digit. Use increment/decrement "↑/↓" to change first digit as desired. Press SELECT to activate the second digit. Use increment/decrement "↑/↓" to change second digit as needed. Repeat for the other digits. Press SELECT to temporarily save the settings.
- ❑ Repeat the above step to change the other alarm channels as desired.
- ❑ Press the EXIT key to exit back to the ALARMS menu.

NOTE: Press the SAVE key in order to put parameters in non-volatile memory before power down.

7.1.2 Setup Background Menu

Access the SETUP menu:

- ❑ With READY displayed on LCD.
- ❑ Press SELECT once to select the setup menu. SETUP menu appears.
- ❑ Press SELECT once to execute the setup menu. ALARMS menu appears.
- ❑ Press decrement "↓" once to advance to the BACKGROUND MENU.

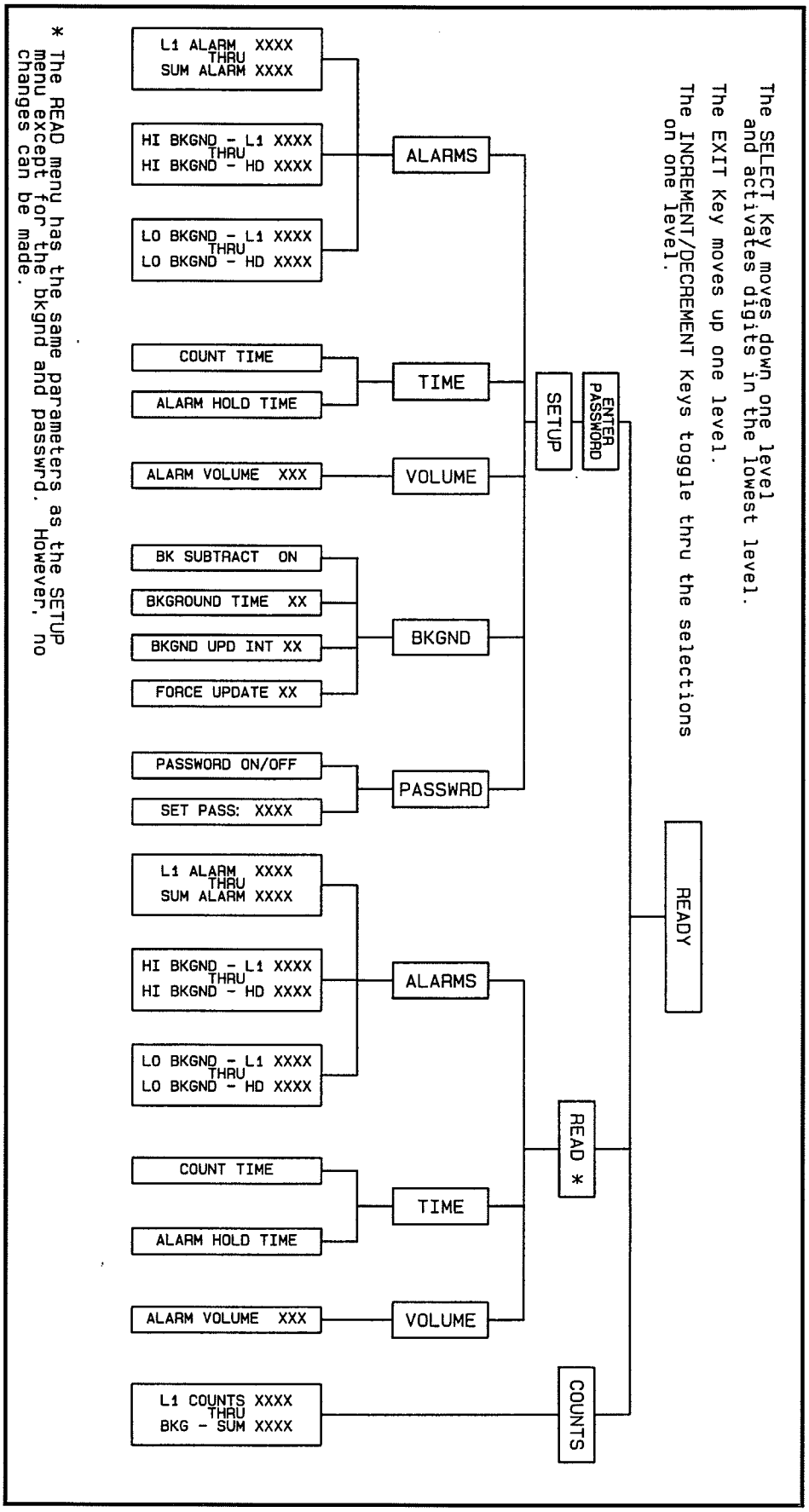


Figure 6 - M52 Menu Tree Diagram

❑ Press SELECT once to activate the BACKGROUND menu.

❑ Press SELECT and use either increment or decrement ("↑" or "↓") key to toggle the background subtract feature ON or OFF as desired. This will normally be left in the ON position. Activate and exit the ON/OFF prompt by pressing the SELECT key one last time.

❑ Press the decrement "↓" key to select the BKGROUND TIME. **Note:** This number must be less than or equal to the FORCE UPDATE and BKGND UPD INT parameter as set above.

❑ Press the decrement "↓" key to select the BKGND UPD INT timer. Save and exit this item by pressing the SELECT key one time. **Note:** This parameter must be greater than or equal to the BKGROUND TIME parameter and less than or equal to the FORCE UPDATE parameter.

❑ Press the decrement "↓" key to move to the FORCE UPDATE interval timer. Press the SELECT key to edit this timer as desired. The FORCE INTERVAL must always be larger than the BKGND UPD INT and the BKGND TIME. Save and exit this menu item by pressing the SELECT key one last time.

7.1.3 Setup Time Menu

This menu sets the count time and alarm hold time. The alarm hold time also applies to the Incomplete LED.

To access the SETUP TIME menu:

❑ With READY displayed on the LCD.

❑ Press SELECT once to select the setup menu. SETUP menu appears.

❑ Press SELECT once to execute the setup menu. ALARMS menu appears.

❑ Press the decrement "↓" key twice. TIME menu appears.

❑ Press SELECT once to execute the setup time menu. "COUNT TIME XX" appears. The "XX" is a number between 1 and 60.

❑ Press SELECT to activate the first digit. Use increment/decrement "↑/↓" keys to change the first digit. Press SELECT to activate the second digit. Use increment/decrement "↑/↓" to change the second digit. Press SELECT to temporarily save parameter.

❑ Use increment/decrement "↑/↓" to change to the next setting.

❑ Press the EXIT key to exit back to the TIME menu.

NOTE: Press the SAVE key in order to store parameters in non-volatile memory prior to power down.

7.1.4 Setup Volume Menu

The volume menu sets the alarm volume. The Model 52 emits a beeping sound after various events (mode change, parameter change, etc.). This beeping volume is always at the maximum and is not adjustable.

To access the SETUP VOLUME menu:

❑ Ensure "READY" is displayed on LCD.

❑ Press SELECT once to select the setup menu. SETUP menu appears.

❑ Press decrement "↓" 3 times to get to the VOLUME MENU.

❑ Press SELECT once to execute the setup volume menu. "ALARM VOLUME XXX" appears. The "XXX" is a number between 1 and 255. This variable sets from 001 (lowest) to 255 (loudest). A value of 000 mutes the audio alarm volume. Any audio alarm uses this volume set point. The beep audio is not affected by this setting.

❑ Press SELECT to activate the first digit. Use increment/decrement "↑/↓" to change the first digit. Press SELECT to activate the second digit. Use increment/decrement "↑/↓" to change the second digit. Repeat for third digit. Press SELECT to save.

❑ Press the EXIT key to exit back to the VOLUME menu.

NOTE: Press the SAVE key in order to store parameters in non-volatile memory prior to power down.

7.1.5 Password Menu

This menu sets the password and whether the password is ON or OFF.

To access the PASSWORD menu:

- Ensure "READY" is displayed on LCD.
- Press SELECT once to select the setup menu. SETUP menu appears.
- Press SELECT once to execute the setup menu. ALARMS menu appears.
- Press the increment or decrement ("↑" or "↓") keys until the PASSWORD menu appears.
- Press SELECT once to execute the password on/off menu. "PASSWORD: XXX" appears. The "XXX" is either ON or OFF.
- Press SELECT to change the password status. Use increment/decrement "↑/↓" to change to either ON or OFF. Press SELECT to temporarily save parameter.
- Use increment/decrement "↑/↓" to change to the next setting. "ENTER PASS: XXXX" appears.
- To reset the PASSWORD to 0000, hold down the SAVE key while turning on the instrument.
- Press SELECT to activate the first digit. Use increment/decrement "↑/↓" to change the first digit. Press SELECT to activate the second digit. Use increment/decrement "↑/↓" to change the second digit. Repeat for third and fourth digit. Press SELECT to save.
- Press the EXIT key to exit back to the TIME menu.

NOTE: Press the SAVE key in order to store parameters in non-volatile memory prior to power down.

7.2. Read Menu

The read menu has 3 choices:

1- Read Alarms Menu
2- Read Time Menu
3- Read Volume Menu

The read menu accesses the same menu structure as the Setup Menu. However, no variables may be changed from the read menu.

7.2.1 Read Alarms Menu

To access the READ ALARMS menu:

- Turn the instrument ON. Wait for "READY" to display on the LCD.
- Press SELECT once to select the setup menu. SETUP menu appears.
- Press increment "↑" key once. READ menu appears.
- Press SELECT once to execute the read menu. ALARMS menu appears.
- Press SELECT once to execute the alarms menu. "L1 ALARM XXXX" appears.
- Use the increment/decrement "↑/↓" keys to change to the next alarm channel.
- Press the EXIT key to exit back to the ALARMS menu.

7.2.2 Read Time Menu

This menu reads all of the time parameters of the Model 52. The user cannot change these values from this menu.

To access the READ TIME menu:

- Turn instrument ON. Wait for "READY" to display on LCD.
- Press SELECT once to select the setup menu. SETUP menu appears.
- Press decrement "↓" key once. READ menu appears.
- Press SELECT once to execute the read menu. ALARMS menu appears.
- Press decrement "↓" key once. TIME menu appears.
- Press SELECT once to execute the time menu. "COUNT TIME XX" appears. The "XX" is a number between 0 and 99.
- Use the increment/decrement "↑/↓" keys to change to other time parameters.
- Press the EXIT key to exit back to the TIME menu.

7.2.3 Read Volume Menu

This menu reads all of the volume parameters of the Model 52. The user cannot change these values from this menu.

To access the READ VOLUME menu:

❑ Turn the instrument ON. Wait for "READY" to display on LCD.

❑ Press SELECT once to select the setup menu. SETUP menu appears.

❑ Press decrement "↓" key once. READ menu appears.

❑ Press SELECT once to execute the read menu. ALARMS menu appears.

❑ Press decrement "↓" key twice. VOLUME menu appears.

❑ Press SELECT once to execute the time menu. "ALARM VOLUME XXX" appears. The "XXX" is a number between 0 and 255.

❑ Use the increment/decrement "↑/↓" keys to change to other parameters.

❑ Press the EXIT key to exit back to the VOLUME menu.

7.3 Counts Menu

The counts menu will display the counts for each channel, one channel at a time.

Use the increment/decrement "↑/↓" keys to change to the next channel.

8. CALIBRATION PROCEDURE

8.1 General

The Model 52 is set for 80 mV sensitivity and 900 Vdc operation for G-M type detectors.

8.2 Equipment Required

1- Ludlum Model 500 Pulser or equal

2- High Impedance voltmeter for high voltage measurements (1000 megohm)

3- 8 to 15 volt DC power supply

4- Digital counter or oscilloscope for negative going 5 Vdc pulses.

8.3 Calibration Procedure

Calibration of the Model 52 is accomplished by adjustments to the amplifier board located inside each detector section of the portal frame. Adjustments include threshold voltage level and the high voltage power supply setting. The design threshold level is 45 mV and operating high voltage is approximately 900 Vdc.

The amplifier board has two 8-position DIP switches. The switch in line with the 10 pin MTA is used to select the LED connection, and the switch in line with the 14-pin MTA is used to select the signal connection. To set the switches for the section that the board will be used in, close the corresponding channel as listed below and open all others:

L1 - SWITCH 1
L2 - SWITCH 2
L3 - SWITCH 3
R1 - SWITCH 4
R2 - SWITCH 5
R3 - SWITCH 6
FOOT - SWITCH 7
HEAD - SWITCH 8

❑ Connect the center conductor of a cable from the Model 500 Pulser to one of the Teflon-insulated connector jacks and ground to the metal sockets. Apply power to the board by supplying +12 Vdc to Pin 13 of one of the 14 pin MTA connectors and ground to pin 14.

You may use a voltage from 8 to 15 volts on pin 13. Pin 1 of the connector is defined as the pin on the right as you face the pins with the white tab on the other side of the pins. Pin 1 goes to switch 1 on the dip switches.

❑ Attach the counter or oscilloscope to one of pins 1 through 8 of the 14-pin MTA connectors, connected to a closed switch. Adjust pulser amplitude to negative 45 mV and vary R1123 (THS) until pulses just appear.

❑ Adjust R194 (HV ADJUST) for 900 Vdc at the Teflon-insulated connector jack.

PARTS LIST

Ref. No.	Description	Part No.
	Model 52 Portable Portal Monitor	
UNIT	Completely Assembled Model 52 Portable Portal Monitor	48-2471
	Main Board, Drawing 215 x 60	
BOARD	Completely Assembled Main Board	5215-087
	• **CAPACITORS**	
C101	68µF 6.3V	04-5654
C201	68µF 6.3V	04-5654
C211	0.1µF 50V	04-5663
C231	0.01µF 50V	04-5664
C301	2700µF 35V	04-5621
C311,C312	27pF 100V	04-5658
C501	68µF 6.3V	04-5654
C502	0.1µF 50V	04-5663
C503	10µF 20V	04-5655
C504-C506	0.1µF 50V	04-5663
C601	10µF 20V	04-5655
C602	4.7µF 20V	04-5653
C603	10µF 20V	04-5655
C611	4.7µF 20V	04-5653
C701	0.1µF 50V	04-5663
C711	0.1µF 50V	04-5663
	• **DIODES**	
CR101-CR103	CXSH-4 EB33	07-6358
	• **TRANSISTORS**	
Q211	MMBT4403LT1	05-5842
Q401	2N7002L	05-5840
Q402	MMBT4403LT1	05-5842
Q501	MMBT3904T	05-5841
	• **RESISTORS**	
R031	4.75k	12-7858
R111	100k	12-7834
R131-R139	2.21k	12-7835
R211,R212	10k	12-7839
R231	100k	12-7834
R331	22.1k	12-7843
R401	10k	12-7839
R402	10 OHM	12-7836
Ref. No.	**Description**	**Part No.**
R403	10k	12-7839
R431	10k	12-7839
R501	10k	12-7839
R502	10 MEG	12-7955
R503	73.2k	12-7895
R504	10k	12-7839
R505	82.5k	12-7849
R506	1M	12-7844
R507	8.25k	12-7838
R508	10k	12-7839
R701	5 k TRIMMER	09-6918
R1310	100k	12-7834
	• **RESISTOR NETWORK**	
RN031	NETWORK-4.7 K	12-7918
RN121	NETWORK-4.7K 8P SIP	12-7706
RN331	NETWORK-4.7 K	12-7918
RN421	NETWORK-22 K	12-7917
	• **SWITCHES**	
S111	92-851.342 ELEMENT	08-6726
S121	92-851.342 ELEMENT	08-6726
S211	92-851.342 ELEMENT	08-6726
S221	92-851.342 ELEMENT	08-6726
S321	92-851.342 ELEMENT	08-6726
	• **TRANSFORMERS**	
T401	XFMR- M 177 AUDIO	4275-083
	• **INTEGRATED CIRCUITS**	
U121	22K DIP 14 PIN	12-7577
U122	LTC1045CN	06-6371
U131	TLC372ID	06-6290
U211	X24C02S8I	06-6299
U231-U233	TLC372ID	06-6290
U311	N87C51FA	06-6286
U331	TLC372ID	06-6290
U421	CD74HC573M	06-6298
U431	N82C54	06-6309
U501	LM358D	06-6312
U502	LM285M-2.5	06-6291
U511	CXK581000AM-70LL	06-6385
U531	N82C54	06-6309
U601	MAX232CSE	06-6382
U611	CD74HC138M	06-6339
U612	CD74HC00M	06-6308
U631	N82C54	06-6309
U711	CD74HC08M	06-6313
	• **VOLTAGE REGULATOR**	

VR201	LT1129CQ-5	06-6372

- **CRYSTALS**

Y311	6.144MHZ	01-5262

- **MISCELLANEOUS**

SOCKET	822276-1 44P	06-6293
5 EA.	92-960-0 MTG FLNGE	08-6727
P14	CONN-640456-2	13-8073
P15	CONN-640456-6	13-8095
P16	CONN-640456-3	13-8081
P17	CONN-640456-5	13-8057
P18	CONN-640456-3	13-8081
P19	CONN-1-540456-1	13-8059
P20	CONN-1-640456-4	13-8141

AMP/HVPS Board, Drawing 215 x 82

BOARD	Completely Assembled AMP/HVPS Board	5215-130

- **CAPICITORS**

C111	10µF	04-5592
C119	1µF	04-5575
C125	0.1µF	04-5521
C129	100µF	04-5576
C131	100pF	04-5532
C132	0.001µF	04-5519
C140	100pF	04-5532
C142	0.0056µF	04-5522
C143	0.0047µF	04-5547
C151,C152	0.0047µF	04-5547
C153	0.01µF	04-5523
C163	0.001µF	04-5519
C166	0.01µF	04-5523
C167	100µF	04-5576
C171	1µF	04-5607
C172	0.0047µF	04-5570
C174	0.0047µF	04-5547
C177	0.0047µF	04-5547
C187	10µF	04-5592
C231	0.01µF	04-5523
C233	22µF	04-5594

- **DIODES**

CR118	1N4007	07-6274
CR134	1N4148	07-6272
CR173	1N4007	07-6274
CR175,CR176	1N4007	07-6274
CR225	1N4001	07-6268

- **TRANSISTORS**

Q123	2N3904	05-5755
Q133	MPSW01	05-5778
Q230	2N3904	05-5755
Q256	MPS6534	05-5763

- **RESISTORS**

R110	1 M	10-7028
R113,R114	1 M	10-7028
R115	10k	10-7016
R116	8.2k	10-7015
R141	200 OHM	10-7006
R144	1 G	12-7686
R145	10k	10-7016
R146	22k	10-7070
R159	10k	10-7016
R160	1k	10-7009
R161	4.7k	10-7014
R162	1k	10-7009
R164,R165	100k	10-7023
R170	1k	10-7009
R178	432k	12-7689
R179	100k	10-7023
R180	10k	10-7016
R217	22k	10-7070
R218	100 OHM	10-7004
R219	10k	12-7540
R220	7.15k	12-7620
R222	33k	10-7019
R223	47k	10-7020
R224	100k	10-7023
R229	470k	10-7026
R241	1 M	10-7028
R242	100k TRIMMER	09-6829
R244	1 M TRIMMER	09-6778
R245	4.7k	10-7014
R247	56 OHM	10-7096

- **SWITCHES**

S252,S253	76SB08S DIP	08-6549

- **INTEGRATED CIRCUITS**

U181	TLC372I	06-6265
U186	CA3096	06-6023
U211	LM358	06-6024
U235	LM385Z-1.2	05-5808

- **VOLTAGE REGULATOR**

VR236	LM78L05	05-5815

- **TRANSFORMERS**

T2	L8050	40-0902

- **MISCELLANEOUS**

DS257	E176 RED JUMBO	07-6362
P13-P15	CONN-1-640456-4 MTA-100	13-8141
P16-P18	CONN-1-640456-0 MTA-100	13-8066
P-19	CONN-640456-2 MTA-100	13-8073
*	RECEPTACLE (7 ea) Cloverleaf 011-6809	18-8771

LED Display, Drawing 215 X 63

BOARD	Completely Assembled LED Display Board	5215-090

- **LEDS**

DS110	E118-RED	07-6308
DS111	E119-ORANGE	07-6343
DS112	E120-YELLOW	07-6309
DS113,DS114	E121-GREEN	07-6310
DS115	E178-GRN JUMBO	07-6364
DS116-DS124	E112-RED	07-6390

- **CONNECTORS**

P8	CONN-CJ50-36B-10	13-8730
P9	CONN-640456-7 MTA-100	13-8115

LED Display Driver, Drawing 420 X 4

BOARD	Completely Assembled Display Driver Board	5420-005

- **RESISTORS**

R148	200 OHM	10-7006
R149-R151	10k	10-7016

RESISTOR NETWORK

RN142-R144	150 OHM DIP 16P	12-7741

- **INTEGRATED CIRCUITS**

U140,U141	SN75512	06-6369

Wiring Diagram, Drawing 215 X 116

- **SWITCHES**

S1	DM62J12S205PQ W/LE	08-6715

- **TRANSFORMER**

T1	CFP302 115/230V	22-9908

- **CONNECTORS**

J1	CONN-640440-6 MTA100	13-8047
J2	CONN-640442-3 MTA100	13-8135
J3	CONN-640442-2 MTA100	13-8178
J4,J11	CONN-640442-5 MTA100	13-8140
J5	CONN-1-640442-4 MTA100	13-8173
J6	CONN-640441-3 MTA100	13-8160
J7	CONN-1-640442-1 MTA100	13-8137
J9	CONN-640442-7 MTA100	13-8172
J14	D RECPT-9 PIN	13-8003
J15	CONN-1-640442-4 MTA100	13-8173

- **MISCELLANEOUS**

DSO1	UNIMORPH	21-9251
J13	AC RECEPTACLE	13-8427

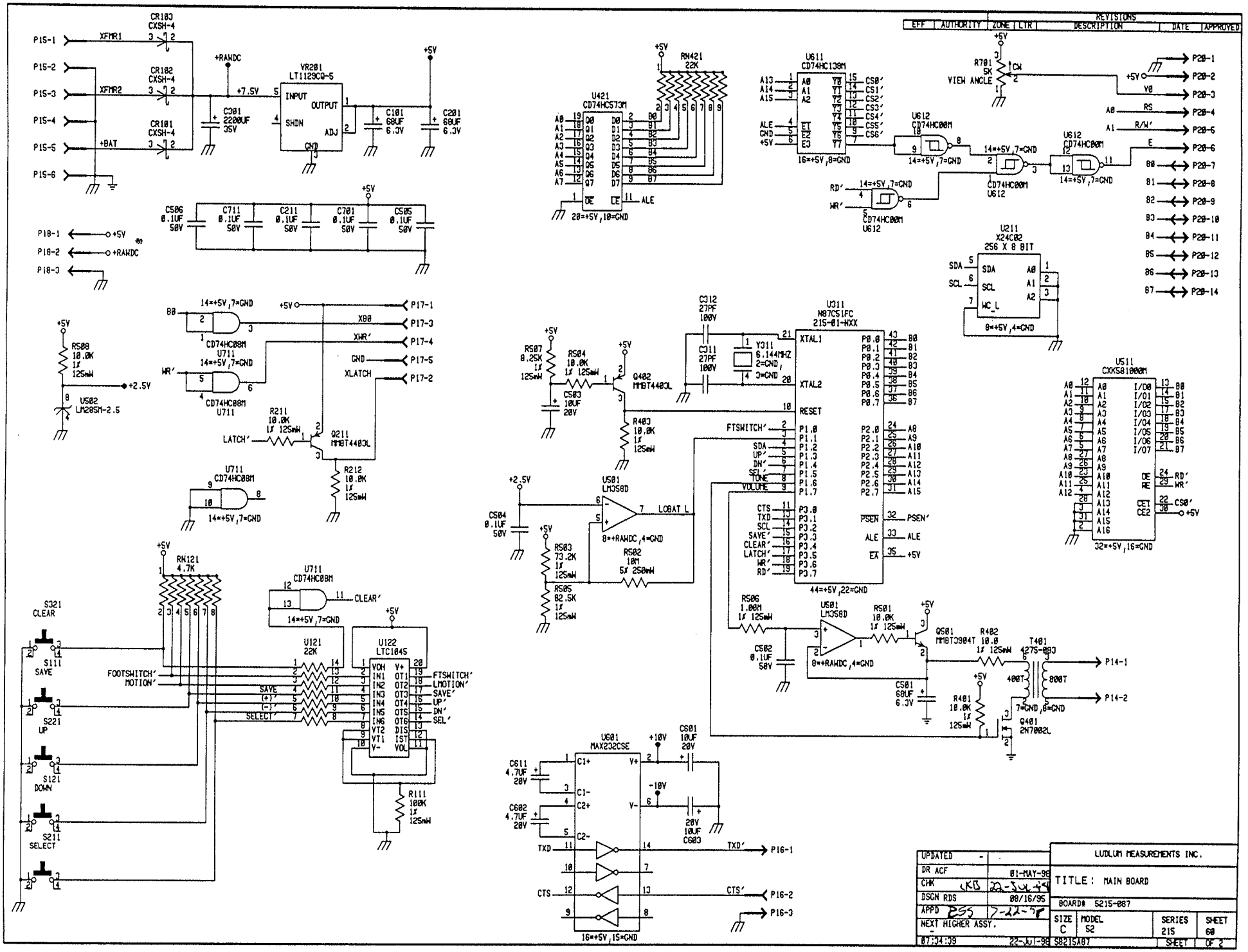
DRAWINGS AND DIAGRAMS

Main Board, Drawing (2 sheets), 215 X 60
Main Board Layout, Drawing 215 X 103

AMP/HVPS Board, Drawing 215 X 82
AMP/HVPS Board Layout, Drawing 215 X 83

LED Display, Drawing 215 X 63
LED Display Board Layout, Drawing (2 sheets), 215 X 104
LED Display Driver, Drawing 420 X 4
LED Driver Layout, Drawing 420 X 89

Wiring Diagram-Electronics, Drawing 215 X 116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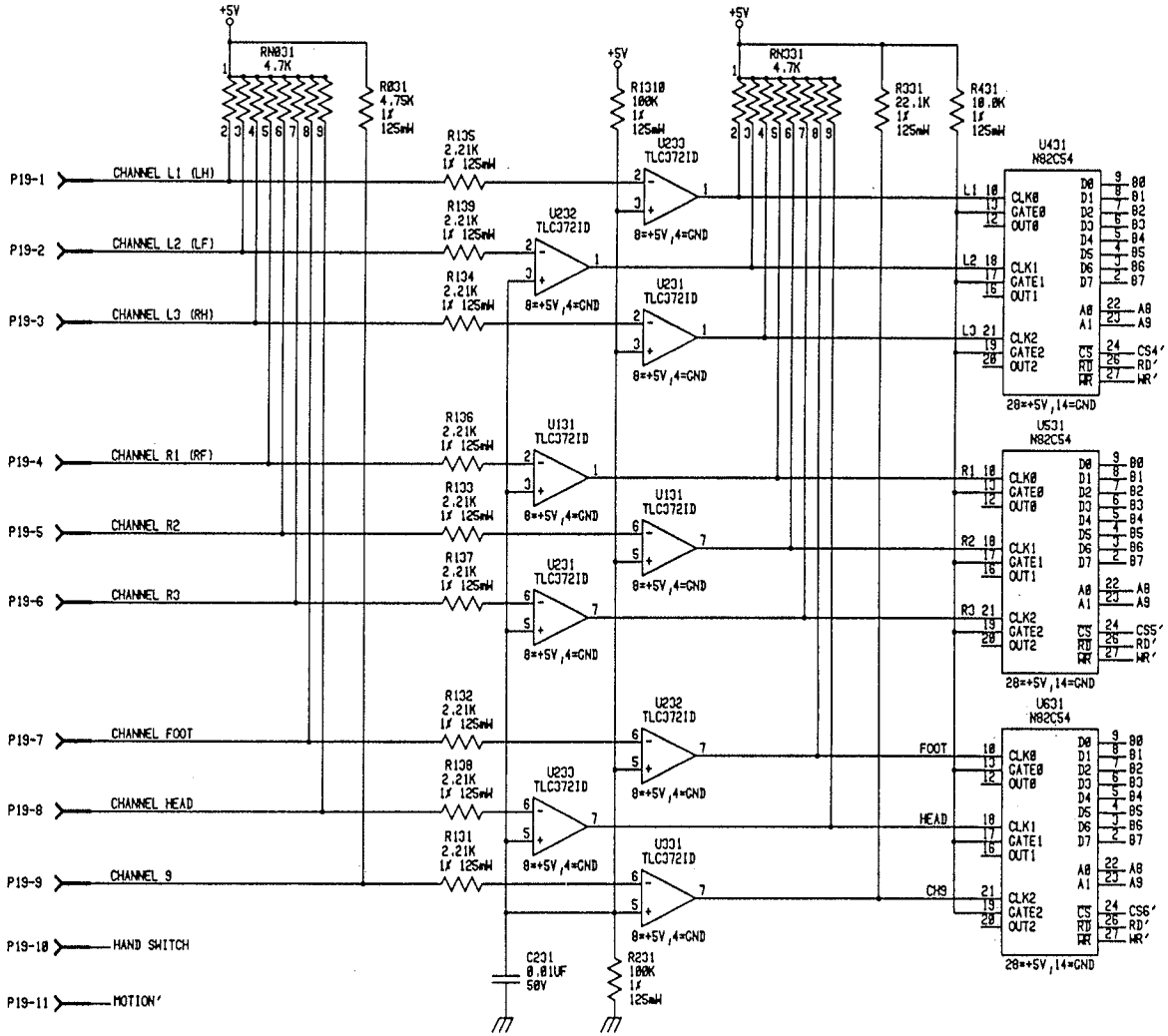
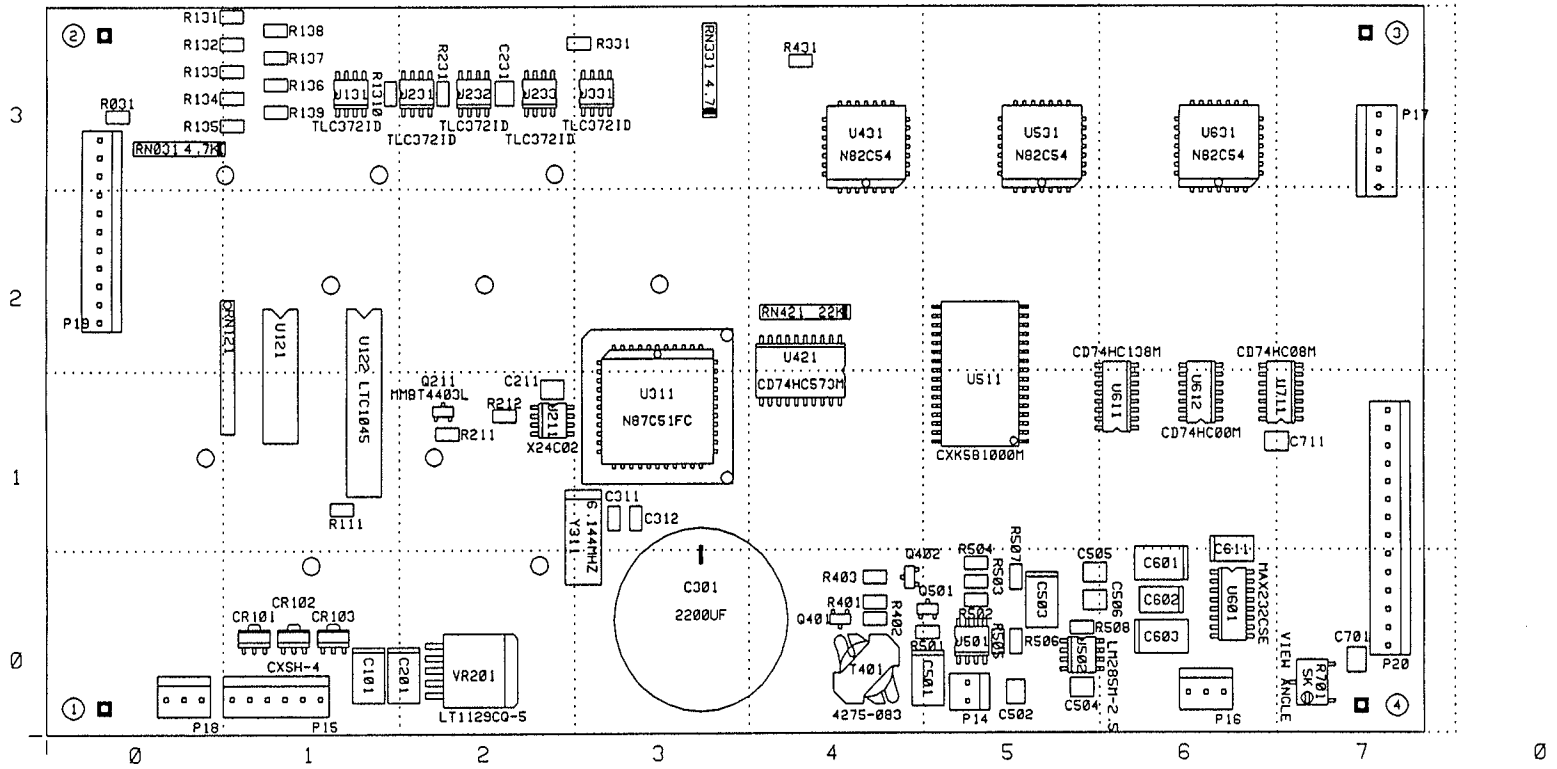
P15-1
P15-2
P15-3
P15-4
P15-5
P15-6
XFMR1
XFMR2
+BAT
CR103 CXSH-4
CR102 CXSH-4
CR101 CXSH-4
+RAWDC
+7.5V
VR201 LT1129CQ-5
INPUT
OUTPUT
SHDN
ADJ
GND
C301 2200UF 35V
C101 68UF 6.3V
C201 68UF 6.3V
+5V
P18-1
P18-2
P18-3
C506 0.1UF 50V
C711 0.1UF 50V
C211 0.1UF 50V
C701 0.1UF 50V
C505 0.1UF 50V
RN421 22K
U421 CD74HC573M
U611 CD74HC138M
U612 CD74HC00M
R701 5K VIEW ANGLE
P20-1
P20-2
P20-3
P20-4
P20-5
P20-6
P20-7
P20-8
P20-9
P20-10
P20-11
P20-12
P20-13
P20-14
U211 X24C02 256 X 8 BIT
SDA
SCL
WC_L
R508 10.0K 1% 125mW
+2.5V
U502 LM285M-2.5
U711 CD74HC08M
R211 10.0K 1% 125mW
Q211 MMBT4403L
R212 10.0K 1% 125mW
LATCH'
P17-1
P17-3
P17-4
P17-5
P17-2
X00
XHR'
XLATCH
C312 27PF 100V
C311 27PF 100V
Y311 6.144MHZ
U311 N87C51FC 215-01-NXX
XTAL1
XTAL2
RESET
R507 8.25K 1% 125mW
R504 10.0K 1% 125mW
C503 10UF 20V
Q402 MMBT4403L
R403 10.0K 1% 125mW
FTSWITCH'
SDA
UP'
DN'
SCL'
TONE
VOLUME
CTS
TXD
SCL
SAVE'
CLEAR'
LATCH'
WR'
RD'
PSEN'
ALE
EA
U501 LM358D
LOBAT_L
C504 0.1UF 50V
R503 73.2K 1% 125mW
R505 82.5K 1% 125mW
R502 10M 5% 250mW
U511 CXK581000M
R506 1.00M 1% 125mW
R501 10.0K 1% 125mW
C502 0.1UF 50V
C501 68UF 6.3V
Q501 MMBT3904T
R402 10.0 1% 125mW
T401 4275-003
400T
800T
P14-1
P14-2
R401 10.0K 1% 125mW
Q401 2N7002L
S321 CLEAR
S111 SAVE
S221 UP
S121 DOWN
S211 SELECT
RN121 4.7K
U711 CD74HC08M
CLEAR'
U121 22K
U122 LTC1045
FOOTSWITCH'
MOTION'
SAVE
(+)'
(-)'
SELECT'
FTSWITCH'
LMOTION'
SAVE'
UP'
DN'
SEL'
R111 100K 1% 125mW
U601 MAX232CSE
C611 4.7UF 20V
C602 4.7UF 20V
C601 10UF 20V
C603 10UF 20V
+10V
-10V
TXD
CTS
TXD'
CTS'
P16-1
P16-2
P16-3
LUDLUM MEASUREMENTS INC.
TITLE: MAIN BOARD
BOARD# 5215-007
UPDATED -
DR ACF 01-MAY-98
CHK KB 22-JUL-98
DSGN RDS 08/16/95
APPD ESS 7-22-98
NEXT HIGHER ASSY. -
07:04:39 22-JUL-98
SIZE C
MODEL S2
SERIES 215
SHEET 60
S8215A07
SHEET OF 2

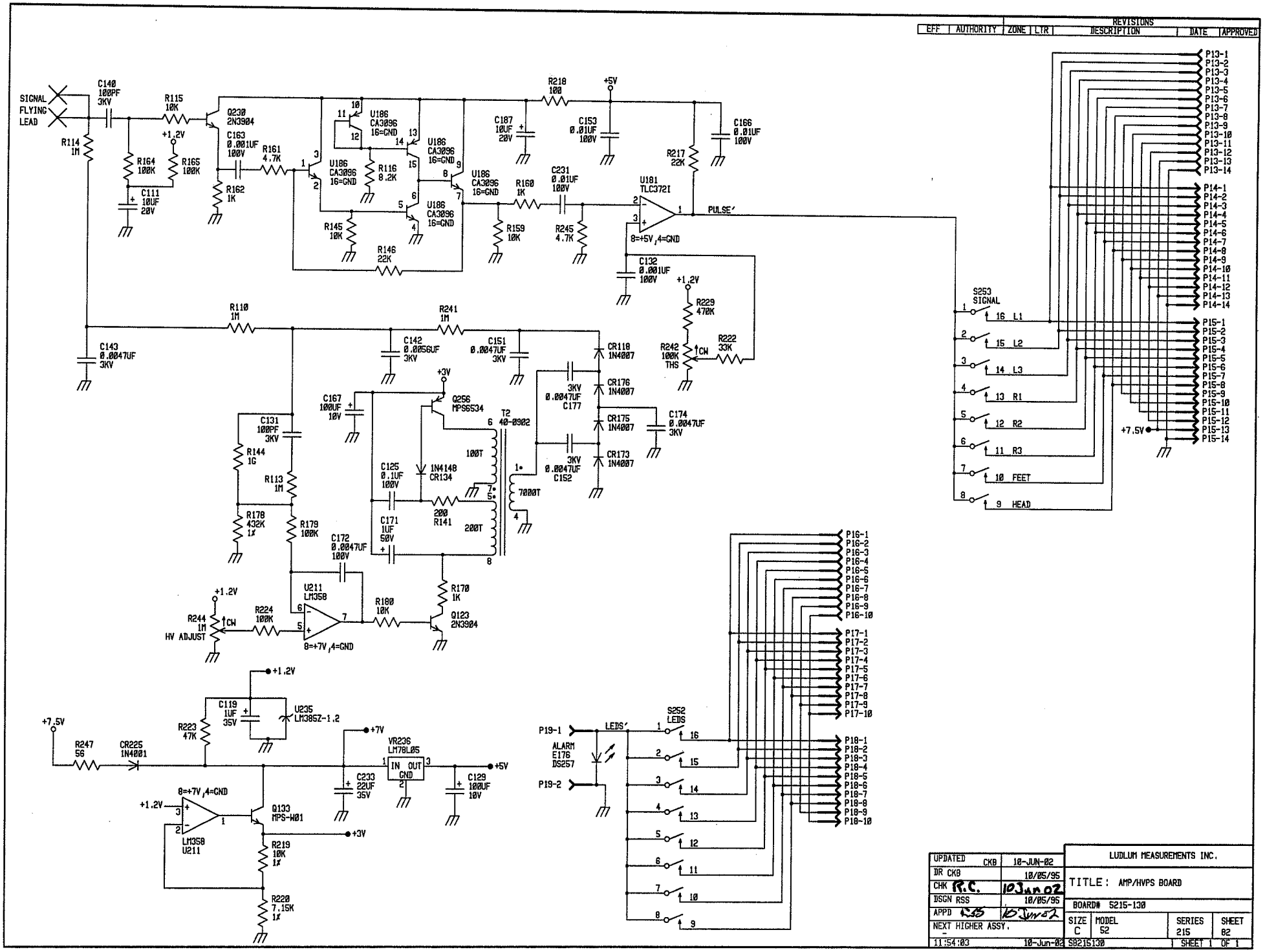
REVISIONS						
EFF	AUTHORITY	ZONE	LTR	DESCRIPTION	DATE	APPROVED

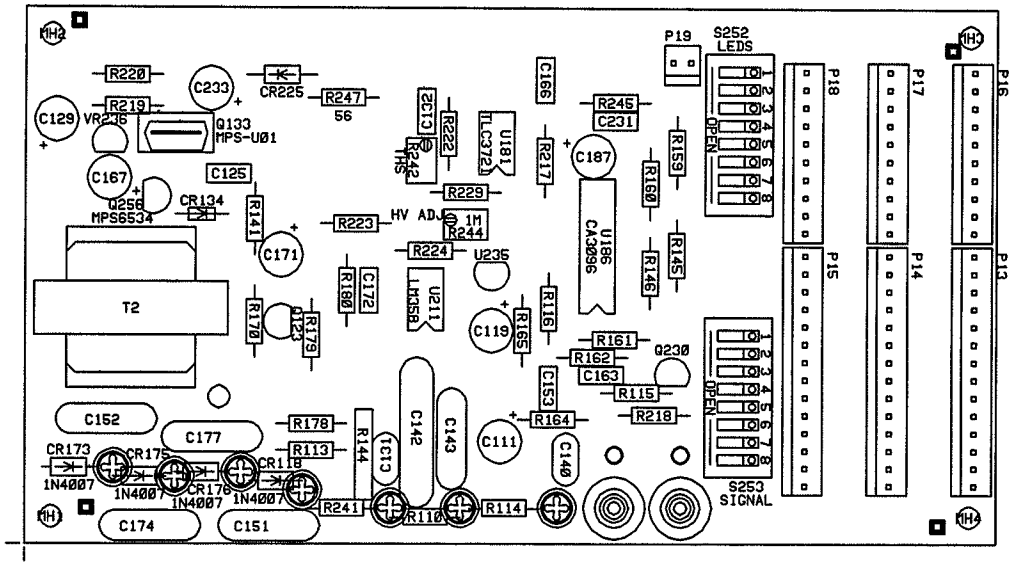


UPDATED	-	LUDLUM MEASUREMENTS INC.	
DR CK'D	08/19/95	TITLE: MAIN BOARD	
CHK P.W.	7-22-96		
DSGN RDS	08/16/95	BOARD# 5215-087	
APP'D [illegible]	7-22-96	SIZE C / MODEL 52 / SERIES 215 / SHEET 60	
NEXT HIGHER ASSY. -			
07:36:32	22-JUL-96	58215087	SHEET 2 OF 2



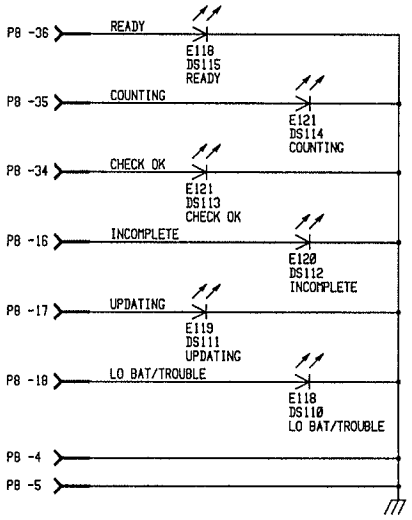
LUDLUM MEASUREMENTS INC. SWEETWATER, TX.			
DR CKB	08/20/95	TITLE: MAIN BOARDC	
CHK	7-22-98	BOARD# 5215-087	BS215087
DSGN RSS	08/18/95	MODEL 52	SERIES 215 SHEET 100
APP RSS	7-20-98	COMP ARTWORK ☐	SLDR ARTWORK ☐
07:38:48	22-Jul-98	COMP OUTLINE ☐	SLDR OUTLINE ☐
COMP PASTE ☐	COMP MASK ☐	SLDR PASTE ☐	SLDR MASK ☐

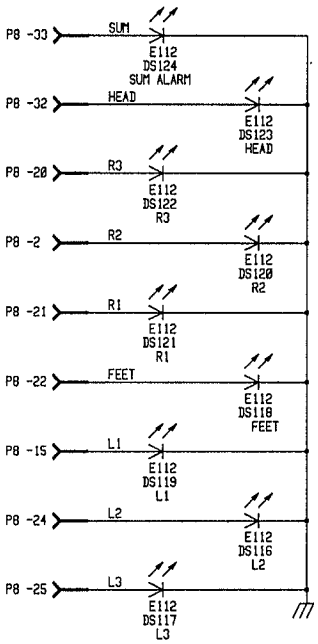

REVISIONS
EFF | AUTHORITY | ZONE | LTR | DESCRIPTION | DATE | APPROVED
SIGNAL FLYING LEAD
C140 100PF 3KV
R115 10K
R114 1M
R164 100K
R165 100K
C111 10UF 20V
+1.2V
Q230 2N3904
C163 0.001UF 100V
R162 1K
R161 4.7K
U186 CA3096 16=GND
R116 8.2K
R145 10K
R146 22K
R218 100
+5V
C187 10UF 20V
C153 0.01UF 100V
C166 0.01UF 100V
R217 22K
R160 1K
C231 0.01UF 100V
U181 TLC372I
8=+5V,4=GND
PULSE'
R159 10K
R245 4.7K
C132 0.001UF 100V
+1.2V
R229 470K
R242 100K THS
CW
R222 33K
S253 SIGNAL
16 L1
15 L2
14 L3
13 R1
12 R2
11 R3
10 FEET
9 HEAD
+7.5V
P13-1 P13-2 P13-3 P13-4 P13-5 P13-6 P13-7 P13-8 P13-9 P13-10 P13-11 P13-12 P13-13 P13-14
P14-1 P14-2 P14-3 P14-4 P14-5 P14-6 P14-7 P14-8 P14-9 P14-10 P14-11 P14-12 P14-13 P14-14
P15-1 P15-2 P15-3 P15-4 P15-5 P15-6 P15-7 P15-8 P15-9 P15-10 P15-11 P15-12 P15-13 P15-14
R110 1M
R241 1M
C143 0.0047UF 3KV
C142 0.0056UF 3KV
C151 0.0047UF 3KV
CR118 1N4007
CR176 1N4007
CR175 1N4007
CR173 1N4007
3KV 0.0047UF C177
3KV 0.0047UF C152
C174 0.0047UF 3KV
+3V
C167 100UF 10V
Q256 MPS6534
T2 40-0902
100T
200T
7000T
C131 100PF 3KV
R144 1G
R113 1M
R178 432K 1%
R179 100K
C125 0.1UF 100V
1N4148 CR134
200 R141
C171 1UF 50V
C172 0.0047UF 100V
U211 LM358
R224 100K
R244 1M HV ADJUST
CW
R180 10K
R170 1K
Q123 2N3904
P16-1 P16-2 P16-3 P16-4 P16-5 P16-6 P16-7 P16-8 P16-9 P16-10
P17-1 P17-2 P17-3 P17-4 P17-5 P17-6 P17-7 P17-8 P17-9 P17-10
P18-1 P18-2 P18-3 P18-4 P18-5 P18-6 P18-7 P18-8 P18-9 P18-10
P19-1
P19-2
ALARM E176 DS257
LEDS'
S252 LEDS
16 15 14 13 12 11 10 9
+1.2V
C119 1UF 35V
U235 LM385Z-1.2
R223 47K
+7.5V
R247 56
CR225 1N4001
+7V
VR236 LM78L05
IN OUT GND
+5V
C233 22UF 35V
C129 100UF 10V
8=+7V,4=GND
LM358 U211
Q133 MPS-W01
R219 10K 1%
R220 7.15K 1%
UPDATED CKB 10-JUN-02
DR CKB 10/05/95
CHK R.C. 10Jun02
DSGN RSS 10/05/95
APPD 10 Jun02
NEXT HIGHER ASSY.
11:54:03 10-Jun-02
LUDLUM MEASUREMENTS INC.
TITLE: AMP/HVPS BOARD
BOARD# 5215-130
SIZE C | MODEL 52 | SERIES 215 | SHEET 82
S5215130 | SHEET 1 OF 1

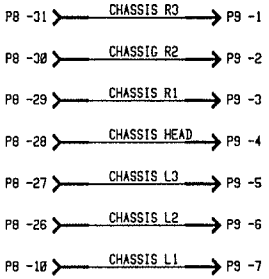


LUDLUM MEASUREMENTS INC. SWEETWATER, TX.					
DR ACF	16-JUL-99	TITLE: AMP/HVPS BOARD			
CHK RC July 16, 99		BOARD: 5215-130			
DSGN RSS	05-OCT-95	MODEL: 52			
APP BS 7-16-99		FILENAME: BS215130			
COMPONENT	SOLDER	14:12:37	16-Jul-99		
		REVISION	SERIES	SHEET	
OUTLINE	OUTLINE	1.0	215	83	

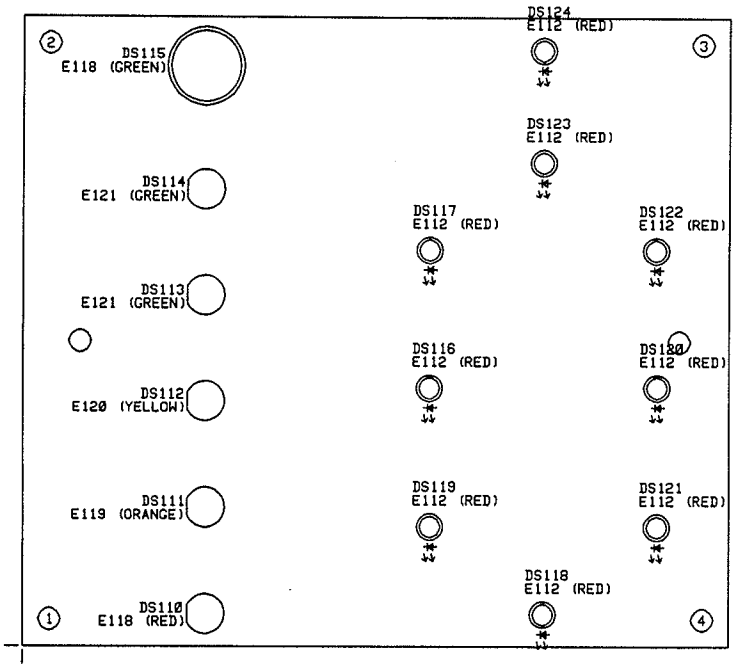
REVISIONS						
EFF	AUTHORITY	ZONE	LTR	DESCRIPTION	DATE	APPROVED



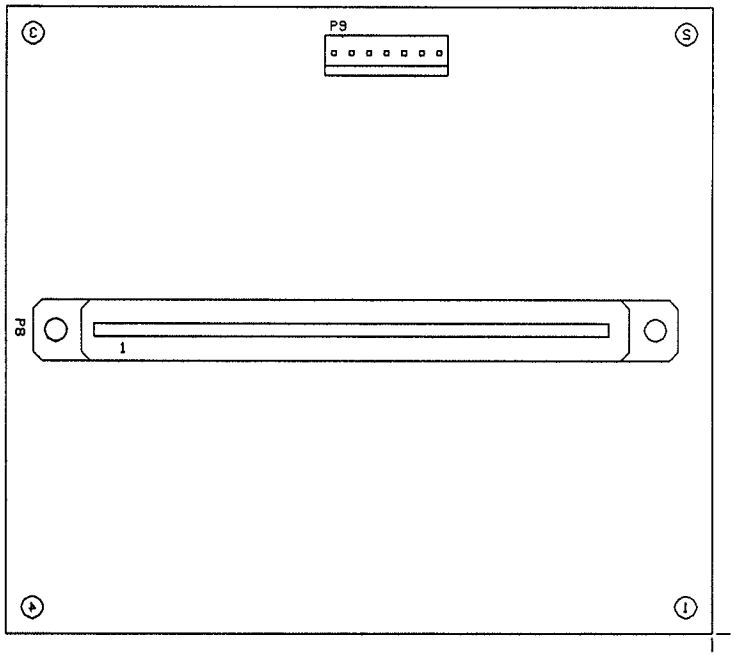




UPDATED -		LUDLUM MEASUREMENTS INC.	
DR ACF	21-JUL-99	TITLE: LED DISPLAY	
CHK CKB	21-JUL-99		
DSGN RDS	16-JUN-95	BOARD# S215-090	
APPD RDS	21JuL99	SIZE C / MODEL S2 / SERIES 215 / SHEET 63	
NEXT HIGHER ASSY. -			
16:36:12	21-Jul-99	S9215090	SHEET 1 OF 1

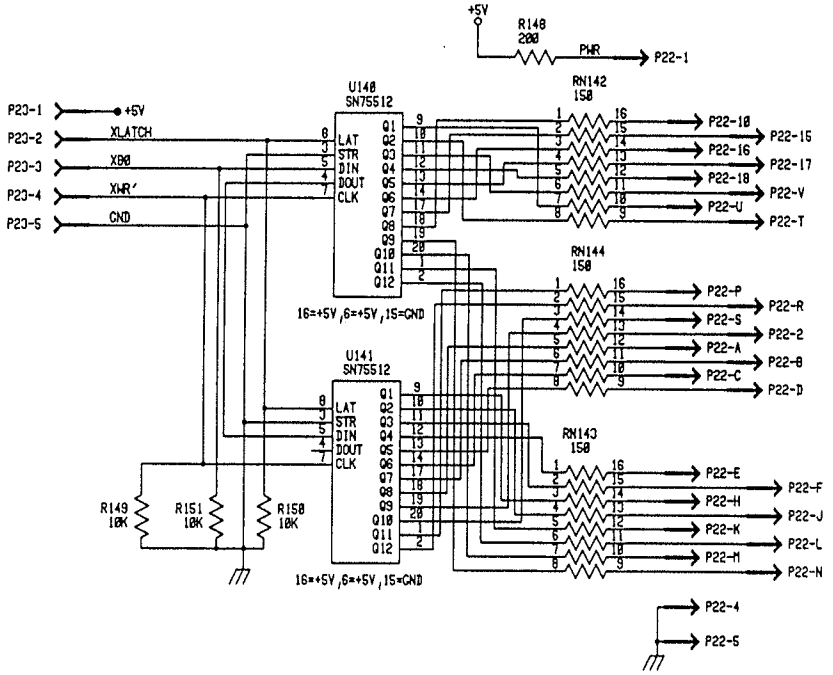


LUDLUM MEASUREMENTS INC. SWEETWATER, TX.			
DR ACF	21-JUL-99	TITLE: LED DISPLAY BOARD	
CHK CKJ	21-JUL-99	BOARD: 5215-090	
DSGN RDS	16-AUG-95	MODEL: 52	
APP RDS	21JuL99	FILENAME: BS215090	
COMPONENT	SOLDER	16:29:12	21-Jul-99
OUTLINE	OUTLINE	REVISION 1.0	SERIES 215 / SHEET 104

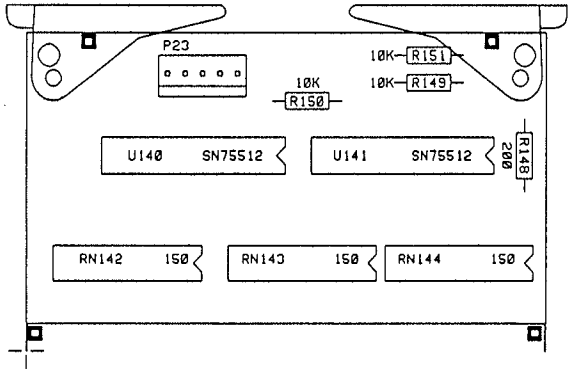


LUDLUM MEASUREMENTS INC. SWEETWATER, TX.					
DR ACF	21-JUL-99	TITLE: LED DISPLAY BOARD			
CHK CKB	21-JUL-99	BOARD# 5215-090		BS215090	
DSGN RDS	16-AUG-95	MODEL 52	SERIES 215	SHEET 104	
APP RDS	21 JUL 99	COMP ARTWORK ☐		SLDR ARTWORK ☐	
15:23:50	29-Nov-95	COMP OUTLINE ☐		SLDR OUTLINE ☒	
COMP PASTE ☐	COMP MASK ☐	SLDR PASTE ☐		SLDR MASK ☐	

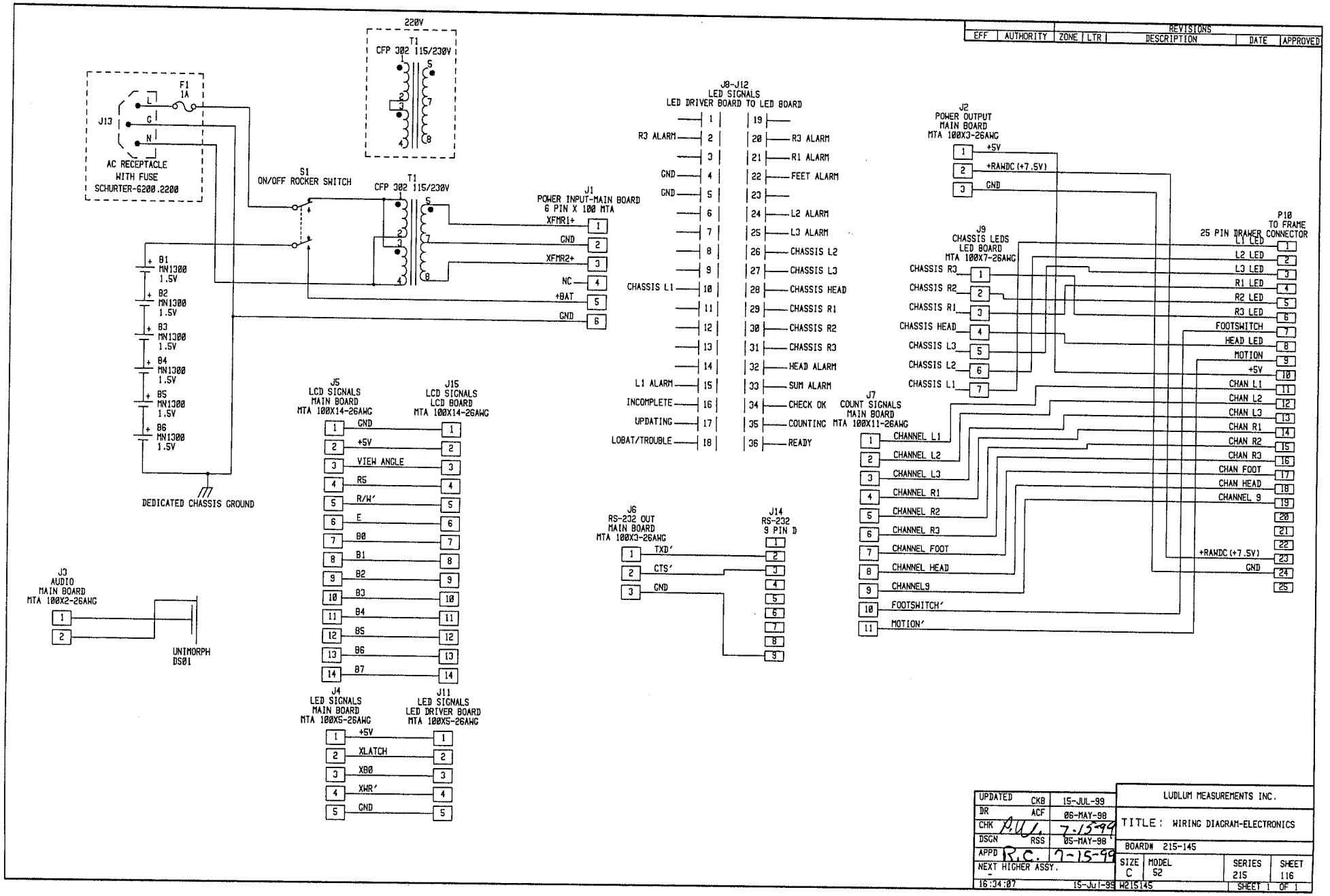
REVISIONS						
EFF	AUTHORITY	ZONE	LTR	DESCRIPTION	DATE	APPROVED



UPDATED -		LUDLUM MEASUREMENTS INC.	
DR RDS	06APR94	TITLE: LED DISPLAY DRIVER	
CHK CKB	22-JUL-98		
DSGN RDS	06APR94	BOARD# 5420-005	
APPD [illegible]	7-22-98	SIZE C / MODEL 4901/4901-1/52 / SERIES 420 / SHEET 4	
NEXT HIGHER ASSY. -			
07:42:57	22-JUL-98	58420005	SHEET OF



LUDLUM MEASUREMENTS INC. SWEETWATER, TX.					
DR RDS 07JUN94	TITLE: LED DRIVER				
CHK CKD 22JUN94					
DSGN RDS 07JUN94	BOARD# 5420-005				BS420005
APP BS 7-22-98	MODEL 4901/52		SERIES 420		SHEET 89
07:44:11 22-JUL-98	COMP SIDE ☐	SLDR SIDE ☐	OUTLINE ☒		
COMP PASTE ☐	COMP MASK ☐	SLDR PASTE ☐	SLDR MASK ☐		



REVISIONS						
EFF	AUTHORITY	ZONE	LTR	DESCRIPTION	DATE	APPROVED

UPDATED	CKB	15-JUL-99
DR	ACF	06-MAY-98
CHK	P.W.	7-15-99
DSGN	RSS	05-MAY-98
APPD	R.C.	7-15-99
NEXT HIGHER ASSY.	-	
16:34:07		15-Jul-99

LUDLUM MEASUREMENTS INC.

TITLE: WIRING DIAGRAM-ELECTRONICS

BOARD# 215-145

SIZE	MODEL	SERIES	SHEET
C	52	215	116

W215145 SHEET 1 OF 1