INSTRUCTION MANUAL

LS®710

Universal Control Unit

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SAFETY MESSAGES

Your safety and the safety of others is very important. We have provided many important safety messages in this addendum. Please read these messages carefully.

A safety message alerts you to potential hazards that could hurt you or others. Each safety message is associated with a safety alert symbol. These symbols are found in the manual and inside the instrument. The definition of these symbols is described below:

	**GENERAL Safety HAZARD: Refer to the instructions for details on the specific hazard.**
	**CAUTION: Hot Surface Warning**
	**CAUTION: Electrical Shock Hazard**
	**Technician Symbol: All operations marked with this symbol are to be performed by qualified maintenance personnel only.**

CAUTION

The analyzer should only be used for the purpose and in the manner described in this manual. If you use the analyzer in a manner other than that for which it was intended, unpredictable behavior could ensue with possible hazardous consequences.

NOTE

Technical Assistance regarding the use and maintenance of the TML87 UV Fluorescence H_2S Analyzer or any other Teledyne Instruments product can be obtained by:

Contacting Teledyne Instruments' Customer Service Department at 800-846-6062

or

Via the internet at http://www.teledyne-ML.com

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1. OVERVIEW AND INSTALLATION

1.1 Introduction

The LS®710 Universal Control Unit is a microprocessor-based instrument that provides control, monitoring, calculation, and diagnostic functions for up to four of Teledyne Monitor Labs'' in situ instruments. Because of its multiple instrument capabilities, the LS710 can control opacity monitoring systems, SO2/NO analyzers, CO/CO2/H2O analyzers, plus auxiliary inputs from oxygen analyzers, velocity monitors, and other sources. Among the measurements/calculations available from the LS710, depending on the in situ instruments used, are stack-exit opacity; combined opacity for multiple breech applications; SO2, NO, and CO ppm; CO2 percent; H2O percent; O2 percent; #/MBtu SO2; and NO, BWS (calculated stack gas moisture content).

1.2 Communication Link

Two twisted, shielded pairs of wires and one or more J-boxes (junction boxes) provide the serial communication link between the LS710 and process-mounted instruments. A serial data acquisition (SDA) circuit board in each instrument provides an RS422 link that can be networked with up to three other SDA boards. The communication network enables the LS710 to control calibration and monitor instrument status and measurements from any supported instrument.

1.3 Configurations

LS710/instrument configurations vary according to the type and number of instruments being monitored. The following guidelines apply:

- A maximum of four SM8100/SM8175 SO_2/NO analyzers can be monitored with one LS710. If less than four are used, other instruments can be connected, up to the maximum capacity of the LS710.
- Only two EX4700A CO/CO_2/H_2O analyzers can be monitored with one LS710. Two other instruments (opacity and SO_2/NO only) can be monitored with the same LS710, but the EX4700A must be set up for J-box #1 or #2. Where only one EX4700A is installed place it on J-box 1.
- Each J-box accepts one auxiliary terminal input which is scaled and displayed or logged by the LS710. Any linear 4 to 20 mA signal is accepted, including those from oxygen analyzers such as the LS420 and velocity monitors.
- A maximum of four opacity monitors can be controlled with one LS710. If less than four are used, other instruments can be connected, up to the maximum capacity of the LS710. Opacity monitors which are compatible with the LS710 include on the RM4200.
- When two or more opacity monitors are used, individual and combined opacity measurements are available from the same LS710.

Figure 1-1 displays a typical configuration for one instrument and one auxiliary input. Figure 1-2 shows a possible configuration for a total emission monitoring system using multiple instruments and a single LS710.

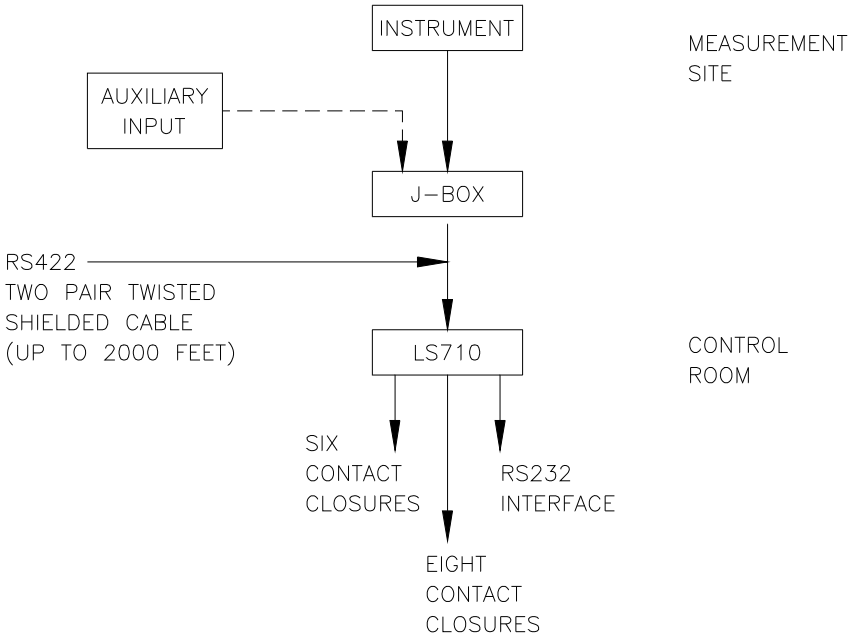


Figure 1-1: Configuration - One Instrument & One Auxiliary Input

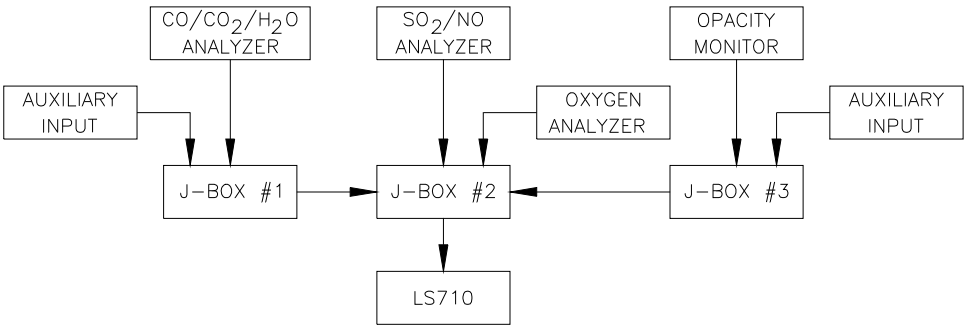


Figure 1-2: Configuration - Total Emission Monitoring System

1.4 Outputs

LS710 outputs include:

- *Six Dry Contact Closures.* There is a contact assigned for zero, span, high alarm, low alarm, process control (calibration), and fault (rated at 28 VDC maximum at 2 amps).

- *Eight 4-20 mA Outputs.* Any parameter measured or calculated by the LS710 can be assigned to these outputs. Four outputs, either 4-20 or 0-20 mA are available as an alternate configuration.

  Analog outputs are operator-assigned and include selectable ranges, averaging, and sample and hold during calibrations. The ranges can be selected for each measurement, limited only by the high/low range of the process-mounted instruments. Averaging can be selected for a period from one to 60 minutes for each instrument.

- *RS232 Interface.* An RS232 interface to transmit ASCII data, using Teledyne Monitor Labs' datalogger protocol, is included. This interface is used to send data to Teledyne Monitor Labs' computer system or other data acquisition/process control systems. Any measurement/calculation such as stack-exit opacity; combined opacity for multiple breech applications; SO_2, NO, and CO ppm; CO_2 percent; #/MBtu SO_2; and NO can be configured for this interface. All system status and calibration results are included in this interface. The interface also drives most serial printers.

- *Analog Output Current Isolators*. Externally mounted current isolators RS232 isolators and/or RS422 isolators are available.

1.5 Front Panel

The front panel of the LS710 displays measurement/calculation data and status messages on a 16-line alphanumeric readout. Control buttons allow you to access any data and to configure operating parameters to suit your needs, including automatic calibration intervals, alarm limits, outputs, averaging periods, alarm reset conditions, etc.

1.6 Calibration

The LS710 provides automatic and manual zero/span calibration checks for each instrument it monitors. Whether manual or automatic, all instruments are calibrated simultaneously. Automatic calibrations are performed at operator-selected intervals from 1 to 24 hours. Manual calibrations can be initiated at any time by selecting `CALIBRATION` from the configuration menu, then selecting `YES` from the `START` entry. Automatic span checks are performed through either the span devices internal to each process-mounted instrument or certified calibration gas. Calibration zero and span values are reported without correction. Calibration corrections are applied to data after calibration. Auto-zero calibrations will occur as required for an instrument. All attached instruments will be zeroed during the auto-zero sequence. The duration of calibration sequence can be altered as required by the application.

For gas calibrations performed on SM8100/SM8175 (SO_2/NO) and EX4700A (CO/CO_2/H_2O) analyzers, span corrections are made by adjusting the gain of each measurement to agree with the value of a specified calibration gas. If the gain correction exceeds a fixed value, the `GAS CAL ERR` message is displayed on the LS710 front panel.

1.7 Diagnostics

The LS710 provides instrument and self-diagnostics to help keep you off the stack. Warnings and alarms alert you to out-of-limit conditions. Fault/Upset messages notify you when LS710 or instrument malfunctions occur or when routine maintenance is required.

1.8 Specifications

1.8.1 Ambient Operating Temperature

40° to 100° F.

1.8.2 Analog Outputs

Standard configuration includes 12 bit eight analog outputs with a common source, 8 bit 4 to 20 mA (400 ohms maximum per channel); four outputs, 0 to 20 or 4 to 20 mA (400 ohms maximum per channel) with a common return, available as an alternate configuration. Any parameter measured or calculated by the LS710 can be assigned to these outputs.

1.8.3 Digital Outputs

RS232 transmits ASCII data in datalogger or Computer Interface formats.

1.8.3.1 Data Logger

The RS232 output drives most serial printers. Any parameter measured or calculated by the LS710 can be assigned to this output. Report format is established through the front panel control.

1.8.3.2 Computer Interface

Offers direct interface with Teledyne Monitor Labs' computer system (data acquisition system) for a variety of data reporting requirements.

1.8.4 Contact Closures

Six dry contacts: zero, span, high alarm, low alarm, calibration sample and hold for process control, and fault; rated at 28 VDC maximum at 2 amps.

1.8.5 Zero/Span Corrections

- Opacity, SO_2, NO, CO, and CO_2 are corrected for zero. SO_2, NO, CO, and CO_2 are corrected for zero and span; H_2O is only converted for zero.
- Calibration: All instruments are calibrated simultaneously, either manually or automatically, at operator-selected intervals.
- Configuration: The LS710 is factory configured for accompanying instrumentation. Information is stored in nonvolatile memory, with startup requiring a minimum of operator intervention. The configuration can be changed for site-specific requirements at any time.
- Installation: The LS710 recognizes the instruments that are connected to it by the data that is transmitted from the J-box and automatically processes all data. Software for all instruments is resident in the LS710 firmware. Additional supported instruments can be added until all channels are in use.
- Interface: Barrier terminal block.

1.8.6 Current Isolator

An optional 4 to 20 mA, stand-alone, single channel current isolator (Part No. 80450031-1) is available. Also, a rack-mount, multi-channel current isolator (Part No. 80450033) with dual isolator cards that can be configured with up to 20 channels (10 cards) is available. See drawing 80450032.

1.8.7 Physical

- 17" (W) x 7" (H) x 25.5" (D); 28 lb
- 19" rack or panel mount available
- Power requirements: 50 watts typical, 90 to 130 VAC, 1 amps; (180 to 260 VAC, 1 amp, optional).

Specifications given are for the LS710 only. Please consult individual technical manuals for instrument specifications.

Specifications are subject to change without notice. Teledyne Monitor Labs, Inc. reserves the right to make product improvements at any time.

1.9 Suggested Spare Parts List

PART NUMBER	DESCRIPTION
80340256	DAC Multimodule - 8
80340178-1	I/O Multimodule
98000057	Front Panel Printed Circuit Board
80610015	CPU Circuit Board Assembly
80610073	Power Supply
80610014	Memory Expansion Board

Table 1-1: Suggested Spare Parts

1.10 Installation

1.10.1 Unpacking the Instrument

The LS710 is shipped separate from other equipment. After removing the LS710 from the shipping box, take off the top cover (two 1/4 turn fasteners are accessible from behind the front panel). Inspect all electrical connections to be sure that all connectors are well seated. Inspect all hardware to be sure that all screws are tight and that there is no loose hardware in the shipping container.

1.10.2 Installation

Drawing 80610001 gives the dimensions for panel mounting and rack mounting. Mounting rails (drawings 98000046 and 98000047) are required to mount the LS710 either into a 19-inch rack or on a panel. Drawing 80610002 shows both internal and external electrical connections for the LS710. The alarm contacts shown in drawing 80610022 are predefined. See drawing 80610022 for contact ratings and assignment.

Each of up to 8 recorder outputs can be configured through the front panel for the measurement to be recorded. The EIA RS232 interface is a connection for printer, CRT, or data acquisition system, such as Teledyne Monitor Labs' computer system. The EIA RS422 interface connects the LS710 to the process-mounted instrument(s).

Instrument to control unit interconnections are shown in drawing 80610023. The termination of the twisted shielded pair must be continuous from the LS710 to each J-box. For example, terminal 32 of the LS710 must go to terminal 32 of the J-box(es). If four J-boxes are to be terminated, terminal 32 must be terminated to all terminal blocks so that continuity exists between all terminal 32's. If a J-box is to be added for the interconnection, as shown in drawing 80610023, then terminal 32 of the interconnecting J-box must have continuity with all other terminals 32. The shields associated with all instruments ***must*** be connected together at both ends (TB1-34), but not tied to facility ground.

1.10.3 Installation Start-Up Service

Teledyne Monitor Labs, Inc. provides an installation start-up service. You will be charged for additional time if our service engineer is required to stay at your site because the installation checklist items listed in the instrument manual have not been completed.

As time allows, after startup is completed, our engineer will give a seminar that includes instrument operation, support, maintenance, and data interpretation. Appropriate plant personnel should be available for this presentation.

2. OPERATING INFORMATION AND CONFIGURATIONS

2.1 Operating Configurations

The LS®710 is designed and configured to be operational after installation and power-up. However, some minor changes in configuration may be required. The front panel controls provides the means to make changes in the instrument configuration as needed for a site. These controls also provide information for maintenance and status messages about calibration settings. A minimum number of entries are required for access to all instrument parameters and selectable functions, making the LS710 easy to use. The controls provide a means of maintaining the process-mounted instruments.

2.2 Front Panel Display

Multi-line (16 lines) alphanumeric readouts provide both measurement and status displays. During normal operation, the readout lines are used to display all measurements available to the unit. If an anomaly is detected the status line will display the anomaly. For example, if an alarm set point is exceeded, the alarm type is displayed on the status line. If, in addition to the alarm, a fault and/or warning occurs, the fault/warning type is also displayed on the status line. The alarm and fault messages are cycled on the status line at a rate of about one second each.

2.3 Configuration Mode

The configuration mode allows you to display and modify instrument parameters. Press the <Select> button on the panel to enter the configuration mode. Parameters can be changed while in the configuration mode, by using the <Select>, <Up> or <Down> buttons. The unit automatically exits the configuration mode and returns to the display mode about five minutes after the last panel button has been pressed or until the <Exit> button is pressed while not in a field entry. The <Exit> button returns to the panel to the display mode.

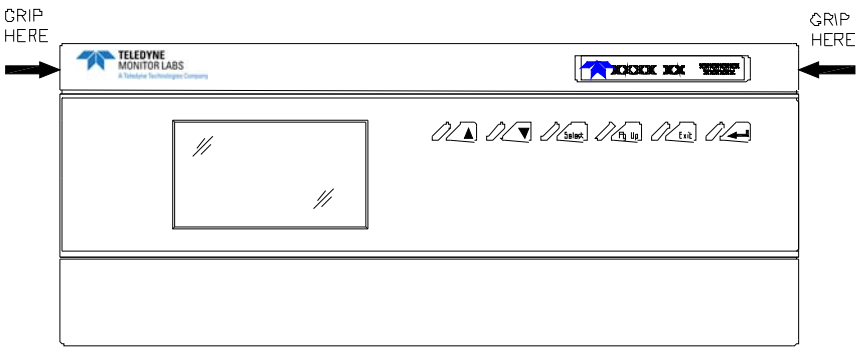


Figure 2-1: Front Panel

2.3.1 Menu Selection

All parameter configurations are entered by accessing the configuration menu and submenu for the desired parameter. Press the <Select> button on the panel to display the configuration menu from the measurement display mode. Press an <Up> or <Down> button to scroll sequentially through a list of all submenus in the configuration menu, one at a time. To select a submenu, press the select button when the cursor is next to the desired entry.

2.3.2 Moving to Entry Fields

Each submenu is unique and contains parameter choice lists or numeric entries related to an instrument or control function. Each time you move to a new submenu, the cursor begins at the top of the menu. Use the <Up> and <Down> buttons to select a parameter and use the <Select> key to move to the entry fields for that parameter.

2.3.3 Numeric Data Entry

The <Up> button is used to change accessible limits, ranges, calibration factors, output assignments, parameters, etc. Numeric data can be entered into the system by incrementing from zero to nine in each of the four available integer digits, using the <Select> button to increment to the next digit. When the desired numeric value is displayed, press the <Enter> button to enter the new value and move to the next entry field if one exists. Pressing the <Exit> or <Pg> button from an entry field without first pressing the <Enter> button will leave the field without changing the entry. Once all fields for a parameter have been changed to the desired values, use the <Pg> button to exit field entry and place the cursor on the next parameter. Pressing <Exit> from a menu selection(not a field entry) returns to the measurement display screen and pressing <Pg> button from a menu selection returns to the configuration menu.

2.3.4 Choice Selection Data Entry

Selecting an entry that is a list of choices is very similar to numeric entry. Once a choice field has been selected the <Up> button will select the next choice in the list. When the desired choice is displayed, press the <Enter> button to finalize the choice. As with numeric entry, pressing the <Exit> or <Pg> button will leave the entry field with the original choice unchanged. Pressing <Exit> from a menu selection (not a field entry) returns to the measurement display screen and pressing <Pg> button from a menu selection returns to the configuration menu.

2.4 J-Box Controls

The J-box (junction box) controls allow monitoring process-mounted instrument analog outputs and the LS710 controls. Test points can be used to measure the approximate transceiver zero and span values. Controls from the LS710 can be overridden by placing the Manual switch on the SDA board in the J-box, to the manual mode. Manual mode also enables the manual switches on the SDA board. In the manual mode, verification that all channels read zero can be made by moving the Zero switch toward the LED and monitoring the measurement test points.

Similarly, move the Span and Zero switches toward the LEDs, to verify span outputs. If a gas bottle is connected to the process-mounted instruments, instrument response can be verified at the SDA board or transceiver test points by activating the Gas switch. To do that, position both the Span and Zero switches away from the LED. See Section 5 for more information about manual gas calibration. When the Manual switch is in auto mode, the LED next to each switch indicates the command from the LS710. The switches have control of the LEDs and resulting command only when the J-box is in the manual mode.

2.5 Calibration Sequence

The calibration sequence is the same whether activated manually or automatically. The automatic calibration system is configured through the front panel under the CALIBRATION menu. Calibration intervals are configured under the INTVL entry. The NEXT entry sets the time until the next calibration, in minutes. NEXT also indicates when the next calibration will occur. Each calibration sequence calculates a zero correction to cancel out any zero drift that might have occurred since the last calibration. Manual calibration is initiated by selecting START from the CALIBRATION menu and entering YES.

Calibration choice E/O (electro/optical) or GAS is selected under CALIBRATION menu. The start of a calibration sequence is indicated by the message CAL PURGE, displayed on the status line. The process control contact closes, zero solenoids are activated, and diagnostics are performed during CAL PURGE.

After the selected duration of purge, ZERO CAL appears on the status line and the zero contact closes. The current loops output the ZERO CAL results unless SH (sample and hold) has been activated. At the completion of ZERO CAL, the zero values averaged over the selected zero period are sent to the RS232 output.

ZERO ERR is displayed on the status line when any of the zero values fall outside their specified milliamp limits. The channel that is out of tolerance can be determined by reviewing the Z values under the individual instrument menu (i.e., EX4700A, SM8100/SM8175, OPACITY) for each instrument installed.

After the selected duration of ZERO CAL, SPAN CAL appears on the status line, the zero contact opens, and the span contact closes. The current loops output the SPAN CAL results unless SH (sample and hold) has been activated. During the entire span cycle, the calculated span is processed through normal routines to be displayed and recorded. All measurement and calculated alarms not pertaining to calibration are disabled. All interference table gains are set to zero. The temperature is set to the selected temperature with 760 mm mercury barometer. At the completion of SPAN CAL, the values averaged over selected SPAN CAL period are sent to the RS232 output. E/O span value uses the temperature in CALIBRATION menu, E/O DEG F.

After the selected duration of SPAN CAL, TEMP CHECK appears on the status line and the span contact opens. During TEMP CHECK, the E/O calibration and zero solenoid commands are removed to allow the process-mounted instruments to return to process sample conditions and process temperature is placed on the strip chart recorder output. During this selected duration the recorder pens reflect temperature readings based on temperature full scale. After the selected duration of TEMP CHECK, the calibration sequence is completed, the status line returns to normal operation, and the process control contact opens and the current gains are outputted through the RS232. All data following calibration will be zero corrected.

2.6 Dynamic Gas Calibration Sequence

The gas calibration sequence is similar to the calibration sequence. The major differences is in the use of standard gases, stack pressure and stack temperature. For process temperatures less than 75° F, the LS710 will use 75° F in all calculations. The process temperature in °C will track the temperature below this limit. The standard gas values are entered under the individual instrument menus (i.e., EX4700A, SM8100/SM8175), XX C entry (where XX denotes the gas concentration, CO, NO, etc.). Gas calibration can be selected instead of calibration by selecting GAS under the CALIBRATION configuration menu, TYPE entry.

ZERO ERR is displayed after calibration whenever any zero is outside the specified tolerance. GAS ERR is displayed, after calibration, any time either measured concentration falls outside the named calibration gas concentration by more than a prescribed value.

If the gas calibration results are within the prescribed value, the gain under the GAS CALIB configuration menu, XX G entry is changed as required to recalibrate the measurement(s). The choices under the CALIBRATION configuration menu, TYPE are E/O and GAS. If GAS is selected, gas calibration is performed instead of calibration, following the same sequence at the interval selected under the CALIBRATION configuration menu. To return to calibration, E/O must be entered under the CALIBRATION configuration menu, TYPE entry.

The Configuration Descriptions and Worksheets list and describe all submenus in the configuration menu. The configuration notes column provides a place for the operator to document site specific configuration. Where there is space for only one entry, the entry is not instrument specific and therefore applies to all instruments, except in systems including an EX4700A. The EX4700A must be on either J-box 1 or 2, therefore, the information is instrument specific to the EX4700A.

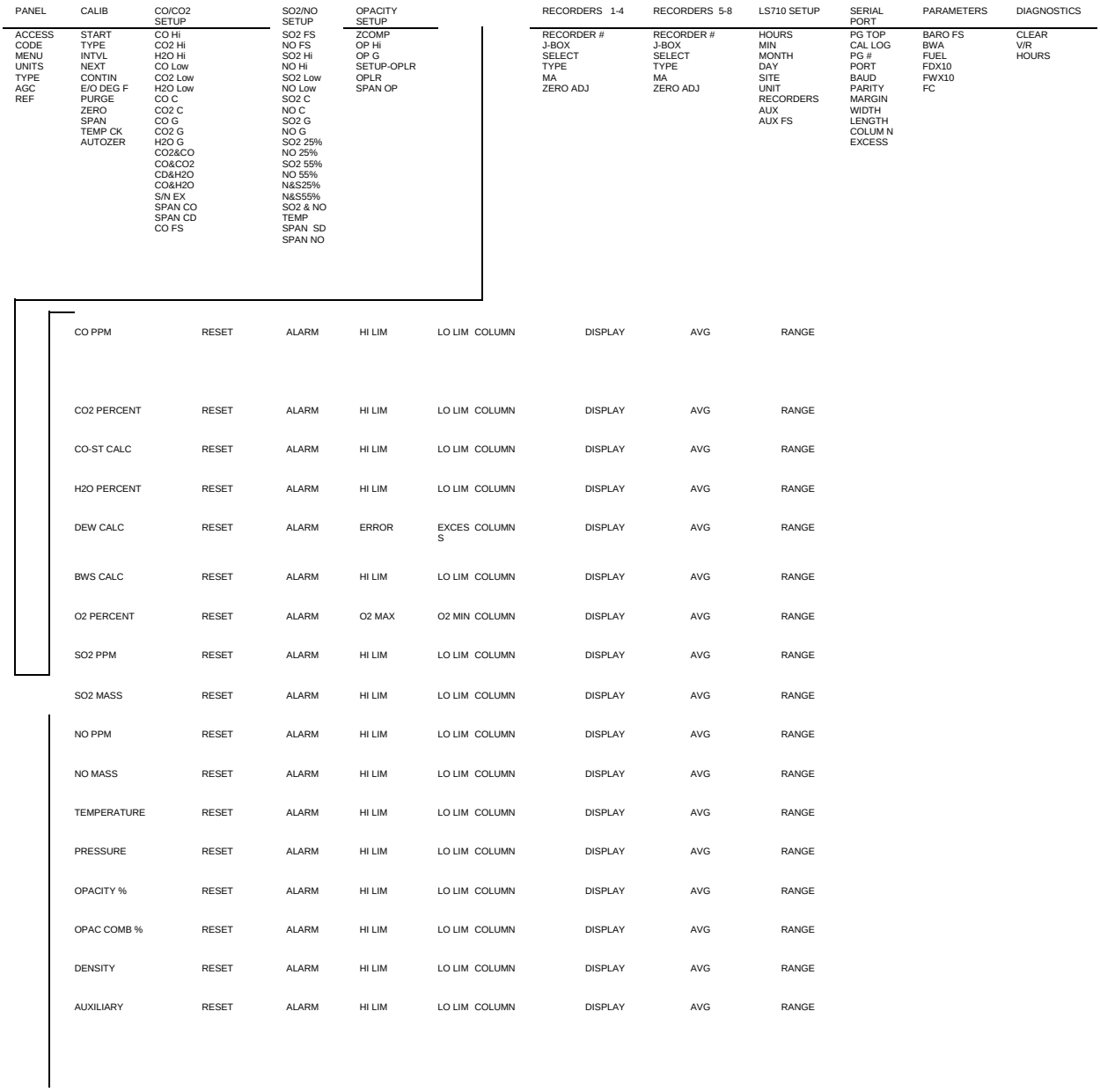


Figure 2-2: LS710 Version 3.03 Software Menus

2.7 Configuration Descriptions and Worksheets

CONFIGURATION MENU: PANEL

Submenu		Increment	Configuration Notes 1	2	3	4
ACCESS	(D.O.)	LOCK/OPEN				
CODE	(E.N.)	0-9999				
MENU	(S)	OPER/SETUP				
UNITS	(S)	ENG/ENGAV/MA/CGS/CGSAV				
TYPE	(D.O.)	EX/MC/SO2/NO				
AGC	(S)	1-30				
REF	(S)	1-30				

(D.O.) = DISPLAY ONLY(S) = SELECT(E.N.) = ENTER NUMBER
(CGS) = Centimeters/Grams/Seconds, indicates metric units

Description:

PANEL Access to any entry under the PANEL menu can be made when the ACCESS entry is set to OPEN.

ACCESS Displays the current status of the front panel, OPEN or LOCK.

CODE A code is used to access certain parameters. Enter 3300 to change ACCESS to OPEN. Enter the code again to change ACCESS to LOCK. Enter 666 to inhibit shutter (see *SM8160 Operation and Maintenance Manual* for functionality).

MENU Controls the display of instrument menus. If OPER is selected, submenus will not display or allow entry of any data for an instrument that is not connected and communicating. If SETUP is selected, all entry fields are available for data entry regardless of the instruments connected. Once the complete system is in place and operating, the most efficient setting is OPER. After five minutes of no activity on the keyboard, the LS710 will automatically revert to the OPER setting.

UNITS Controls the display units. ENG displays 5-second English units; ENGAV displays average English units, averaged over the period selected under each channel. MA displays process-mounted instrument output currents, where applicable. CGS (centimeters/grams/seconds) indicates metric units and CGSAV displays metric 5-second and average data.

TYPE Indicates the instrument type for the selected J-box (EX for EX4700A $CO/CO_2/H_2O$ analyzers, MC for opacity monitors, and SO2 or NO for SM8100/SM8175 SO_2/NO analyzers, depending on the position of the sequential shutter in the SM8100/SM8175 transceiver). If an instrument was connected and communicating but has become unavailable, NA will follow the type to indicate that instrument is not active. (NA

does not appear if there was only one active J-box.)

AGC	AGC is a reading of automatic gain control current used for EX4700A and opacity analyzers only.
REF	REF is an indicator of the electro-optical condition of a process-mounted instrument.

CONFIGURATION MENU: CALIBRATION

START	(S)	YES/NO				
TYPE	(S)	E/O/GAS				
INTVL	(E.N.)	0-24 hours				
NEXT	(E.N.)	1-1440 minutes				
CONTIN	(S)	OFF/Z CAL/H CAL/OUT				
E/O DEG F	(S)	75.0-800.0				
PURGE	(S)	1-3 MINutes				
Z CAL	(S)	2,4 MINutes				
H CAL	(S)	2,4 MINutes				
TEMP CK	(S)	1-3 MINutes				
AUTOZERO	(S)	30-600 MINutes				

(D.O.) = DISPLAY ONLY(S) = SELECT(E.N.) = ENTER NUMBER

Description:

CALIBRATION	To change any item under this menu, the PANEL menu, set ACCESS to OPEN. When CALIBRATION settings are completed, change the ACCESS entry to LOCK.
START	When YES is selected, a manual calibration sequence is initiated.
TYPE	E/O means any automatic interval or manual calibrations will use internal span devices. GAS means any automatic interval or manual calibrations will use externally connected gas bottles and may correct gain values. **Note:** Opacity monitors calibrate regardless of which type of calibration is selected (E/O or GAS), but will always use internal zero and span devices.
INTVL	Allows selection of how often process-mounted instruments are put into automatic calibration. Use the Increment buttons to select an interval from 0 to 24 hours. A zero entry eliminates automatic calibrations.
NEXT	Indicates the time until the next automatic calibration. Synchronize the start of the next calibration with the time of day by manually entering the appropriate time delay. (The intervals between automatic calibrations are determined by the INTVL entry.) The time entered can be from 1 to 1440 minutes (24 hours). This parameter cannot be

	changed during a calibration or when INTVL is set to zero. For example, if you want calibrations to occur each day at 9:00 AM, then enter the value, in minutes, from the current time until 9:00 AM in the NEXT entry.
CONTIN	Selects a continuous Z CAL or H CAL calibration. Once ZERO or SPAN is entered, the calibration continues until OFF is entered to end it. If TYPE in this menu is selected as E/O and CONTIN H CAL is selected, then a continuous E/O span will result. If TYPE in this menu is selected as GAS and CONTIN H CAL is selected, then a continuous GAS span will result. OUT is used to identify an out-of-service instrument. Calibration information does not print if the instrument is OUT of service. Automatically purge cavity with zero gas when process temperature drops at or below 10° F of the dew point. When the process temperature is greater than 20° F, the continuous zero will end. During any continuous condition, the CAL S/H contact will be closed, indicating invalid data, and the continuous condition will be transmitted out the RS232 port.
E/O DEG F	The entered value is the temperature that span and zero will be evaluated. This temperature is provided with the instrument setup data sent from the factory.
PURGE	The entered value establishes the total time of purge prior to zero calibration.
Z CAL	The entered value establishes the total zero time in calibration.
H CAL	The entered value establishes the total span time in calibration.
TEMP CK	The entered value establishes the total time to purge from cal gas to process measurements.
AUTOZERO	The entered value establishes the time that automatic zero will be activated before the activation of a complete calibration cycle. A zero entry will disable the AUTOZERO function. Entry is denied if INTVL above is set to 0.

CONFIGURATION MENU: CO/CO2 SETUP

Submenu		Increment	Configuration Notes 1	2	3	4
CO Hi	(D.O.)					
CO2 Hi	(D.O.)					
H2O Hi	(D.O.)					
CO Low	(E.N.)	0-24.00				
CO2 Low	(E.N.)	0-24.00				
H2O Low	(E.N.)	0-24.00				
CO C	(E.N.)	100-5000				
CO2 C	(E.N.)	1.0-40.0				
CO G	(E.N.)	0-2.000				
CO2 G	(E.N.)	0-2.000				
H2O G	(E.N.)	0-2.000				
CO2 & CO	(E.N.)	0-2.00				
CO & CO2	(E.N.)	0-2.00				
CD & H2O	(E.N.)	0-2.00				
CO & H2O	(E.N.)	0-2.00				
S/N EX	(D.O)	0-999				
SPAN CO		50-5000				
SPAN CD		0.0-100.0				
CO FS	(E.N.)	50-5000				

(E.N.) = ENTER NUMBER (S) = SELECT (D.O.) = DISPLAY ONLY(CD) = CO_2

Description:

CO/CO2	To change items under this menu, the PANEL menu ACCESS entry must be set to OPEN. Set the ACCESS entry to LOCK entry after the settings are completed.
XX S	Displays the last E/O span value for measurement XX, which can be (S values) CO, CO_2, etc.
XX Z	Displays the zero offset value for measurement XX, which can be (Z values) CO, etc.
XX C	Sets the concentration of NBS traceable standard gas (taken from (C values) the supplier's cylinder tag) for gas XX, which can be CO, CO_2, etc.
XX G	Defines the gain factors used to trim out variations from instrument to instrument. The factors can be manipulated manually or are automatically adjusted during gas calibrations. Automatic adjustments are limited to ±10%.

XX & YY	Defines the gain factor for interference between XX and YY (eg, CO_2 & CO, etc).
S/N EX	A display of the EX4700A calibration curve serial number. If there are no tables entered into the firmware for a particular J-box, the display will be -1.
SPAN CO	Sets the CO span value.
SPAN DC	Sets the CO_2 span value.
CO FS	Sets the CO full scale value in ppm.

CONFIGURATION MENU: SO2/NO SETUP

SO2 FS	(E.N.)	20-7500**				
NO FS	(E.N.)	75-7500**				
SO2 Hi	(D.O.)					
NO Hi	(D.O.)					
SO2 Low	(E.N.)	0-24.00				
NO Low	(E.N.)	0-24.00				
SO2 C	(E.N.)	0-7500**				
NO C	(E.N.)	0-7500**				
SO2 G	(E.N.)	0-2.000				
NO G	(E.N.)	0-2.000				
SO2 25%	(E.N.)	0.8-1.20				
NO 25%	(E.N.)	0.8-1.20				
SO2 55%	(E.N.)	0.8-1.20				
NO 55%	(E.N.)	0.8-1.20				
N&S25%	(E.N.)	0.8-1.20				
N&S55%	(E.N.)	0.8-1.20				
NO & SO2	(E.N.)	0-10.000				
TEMP	(S)	RTD/K-TYPE/rtd/ktype				
SPAN NO	(E.N.)	0-7500**				
SPAN SD	(E.N.)	0-7500**				

** Denotes special software for SO_2 and NO cavities that are 750 ppm or less requiring a decimal point. (The value(s) shown are divided by 10; i.e., 1500 ppm will be displayed as 150.0 ppm.)

Description:

The SO2/NO SETUP menu is used to set parameters specific to the SM8100/ SM8175 SO_2/NO analyzer. To change items under this menu, the PANEL menu ACCESS entry must be set to OPEN. Set the ACCESS entry to LOCK entry after the settings have been completed.

XX S	Displays the last E/O span value for measurement XX, which can be NO, SO_2 (S values).
XX Z	Displays the zero offset value for measurement XX, which can be NO, SO_2 (Z values).

XX C	Sets the concentration of NBS traceable standard gas (taken from the supplier's cylinder tag) for gas XX, which can be NO, SO_2 (C values).
XX G	Defines the gain factors used to trim out variations from instrument to instrument. The factors can be manipulated manually or are automatically adjusted during gas calibrations.
NO & SO2	Defines the gain factor for interference between NO and SO_2.
SO2 FS	Sets the SO_2 full scale value in ppm.
XX ?5%	Defines gain factors used to trim out linearity variations (at the 25% and the 55% points) from instrument to instrument. The results will be a slight bending of the response curve in the above specified direction.
NO FS	Sets the NO full scale value in ppm.
TEMP	Selects both the temperature sensor type and the temperature curves. STDR specifies an RTD sensor with standard curves covering 75° to 450° F, and STDK specifies the Type K SM8100 curves used on older probes. Hi 300° to 800° F curves.
SPAN NO	Sets the NO span cell value.
SPAN SD	Sets the SO_2 span cell value.

CONFIGURATION MENU: OPACITY SETUP

Submenu		**Increment**	**Configuration Notes** 1	2	3	4
Z COMP	(D.O.)					
OP Hi	(D.O.)					
OP G	(E.N.)	0 - 2.000				
SETUP	(E.N.)	0.00 - 2.00				
OPLR						
OPLR	(E.N.)	0.20 - 2.00				
SPAN OP	(E.N.)	0 -99.9				

(E.N.) = ENTER NUMBER (S) = SELECT (D.O.) = DISPLAY ONLY

Description:

OPACITY	This menu is used to set parameters specific to the opacity monitor. To change items under this menu, the PANEL menu ACCESS entry must be set to OPEN. Set the ACCESS entry to LOCK entry after the settings have been completed.
Z COMP	Displays the zero compensation value for opacity.

OP Hi	Displays the last E/O span value for opacity (S values).
OP G	The opacity gain factor used to trim out variations from instrument to instrument.
OPLR	Sets the optical path length ratio for an opacity monitor.
SPAN OP	Sets the opacity span cell value.
SETUP OPLR	SETUP OPLR is a factory installed value for the site installation dimensions. This entry can be inserted once. This value is only for the serial port header. The SETUP OPLR along with the working OPLR will be printed at each calibration sequence. The value can be changed either at the factory or by a qualified service person.

CONFIGURATION MENU: RECORDER OUTPUT

Submenu		**Increment**	**Configuration Notes**			
			1	2	3	4
RECORDER#	(D.O.)		1 / 5	2 / 6	3 / 7	4 / 8
J-BOX	(E.N.)	1-4	/	/	/	/
SELECT	(S)	Any channel name (see below)	/	/	/	/
TYPE	(S)	5-SEC/AVG/5S-SH/AV-SH	/	/	/	/
MA	(S)	4-20/0-20	/4-20	/4-20	/4-20	/4-20
ZERO ADJ	(E.N.)	0 -10				

Description:

RECORDERS 1-4	To change items under this menu, the PANEL menu ACCESS entry must be set to OPEN. Set the ACCESS entry to LOCK entry after the settings have been completed. To enable this menu for display, the RECORDER entry under LS710 SETUP must be set to 4 or 8 with a 4 or an 8 analog channel board installed.
RECORDERS 5-8	To change items under this menu, the PANEL menu ACCESS entry must be set to OPEN. Set the ACCESS entry to LOCK entry after the settings have been completed. To enable this menu for display, the RECORDER entry under LS710 SETUP must be set to 8 with an 8 channel analog board installed.
J-BOX	Specifies the J-box or instrument that the above RECORDER # will be connected to.
SELECT	Assigns a measurement channel designation to a particular RECORDER # channel. Enter the desired channel name: CO/CO2/CO-ST/H20/DEW/BWS/O2/SO2/SO2 M/NO/NO M/TEMP/MMGH/OPAC CB-OP(OPAC COMB%)/DENS/AUX/ZERO/ZERO/FS. ZERO and FS (full scale) can be entered here for recorder calibration (see *Chapter 5*).

TYPE	Determines how output data is processed. 5-SEC uses a fundamental 5-second measurement. AVG uses the calculated average measurement. 5S-SH (sample/hold) means the last 5-SEC output is sampled and held through all calibration cycles or any time the instrument is placed in the manual mode. AV-SH means the last averaged output is sampled and held through calibration cycles or any time the instrument is placed in the manual mode.
MA	Sets the current loop output to 0 to 20 mA or 4 to 20 mA. (Reminder: The eight recorder configuration allows only 4 to 20 mA output.)
ZADJ	1% to 10% offset in the recorder current output to accommodate negative data.

CONFIGURATION MENU: LS710 SETUP

Submenu		**Increment**	**Configuration Notes** 1	2	3	4
HOURS	(E.N.)	0-23				
MIN	(E.N.)	0-59				
MONTH	(E.N.)	0-12				
DAY	(E.N.)	1-31				
SITE	(E.N.)	0-9999				
UNIT	(E.N.)	0-9999				
RECORDER	(S)	0, 4, 8				
AUX	(S)	OFF/O2/VEL/AUX				
AUX FS	(E.N.)	0-999.9				

(E.N.) = ENTER NUMBER (S) = SELECT

Description:

LS710 SETUP	To change items under this menu, the PANEL menu ACCESS entry must be set to OPEN. Set the ACCESS entry to LOCK when all changes are completed.
HOURS	Sets the current hour of the day. It must be entered whenever the system is powered up.
MIN	Sets the current minute of the day. It must be entered whenever the system is powered up.
MONTH	Sets the current month. It must be entered whenever the system is powered up.
DAY	Sets the current day. It must be entered whenever the system is powered up.
SITE	The site number to be printed on the top of each page, if an RS232 output is used.

UNIT	The unit number to be printed on the top of each page, if an RS232 output is used.
RECORDER	Sets the type of analog board installed into the LS710 to NONE (no analog board installed), 4 (4 analog board installed), or 8 (8 analog board installed).
AUX	Selects the channel to be assigned to the auxiliary 4 to 20 mA input. A 4 to 20 mA input may be connected to the auxiliary connections of any J-box. This input may be assigned to O2 (O_2 monitor), VEL (velocity monitor), or AUX (any other linear 4 to 20 mA input) to be displayed, printed, or sent to a recorder output.
AUX FS	Sets the full scale value of the auxiliary input. To force a fixed velocity when there is no flow monitor, enter the desired value here and set the AUX entry to OFF.

CONFIGURATION MENU: SERIAL PORT

Submenu		**Increment**	**Configuration Notes** 1	2	3	4
PG TOP	(S)	YES/NO				
CAL LOG	(S)	YES/NO				
PG #	(E.N.)	0-9999				
PORT	(S)	OFF/PRN/DAS				
BAUD	(S)	300/600/1200/2400/4800/9600				
PARITY	(S)	ODD/EVEN/NONE				
MARGIN	(E.N.)	0-20 characters				
WIDTH	(E.N.)	12-233 characters				
LENGTH	(E.N.)	0-99 lines				
COLUMN	(E.N.)	1-28 columns				
EXCESS	(S)	ONLY/INCLD				

Description:

SERIAL PORT	To change items under this menu, the PANEL menu ACCESS entry must be set to OPEN. Set the ACCESS entry to LOCK when changes are completed. These parameters apply to the RS232 port (printer or CRT interface) only.
PG TOP	Sets the condition for advancing the RS232 output to the top of the next page prior to the transmission of the next data output.
CAL LOG	All prior calibration data can be printed with time and date of the last calibration. Current faults are also printed. If there are no prior calibration data to be printed, no log will be printed. The cal log is disabled when a DAS is connected and sending clock sets.
PG#	Sets automatic page numbering. The number specified becomes the current page number.

PORT	Enables/disables the RS232 serial port. The OFF selection disables the port; no serial information will be sent out the RS232 serial port. The DAS selection enables the port for output of serial data for a data acquisition system and disables the internal timing, permitting external clock synchronization through a serial command. The PRN selection enables the port for output of serial information in a form suitable for a printer and enables the internal time of day clock. If the DAS selection is made and no external clock command is sent within approximately 1.5 minutes, the selection will automatically revert to PRN so the LS710 can continue to collect data.
BAUD	Sets the transmission baud for the RS232 output.
PARITY	Determines the transmission of no parity, odd parity, or even parity.
MARGIN	Sets the number of characters to be used for right, left, top, and bottom margins.
WIDTH	Sets the number of characters available across the page, excluding the margins.
LENGTH	Sets the number of rows available in the page length, excluding the margins. A typical page has 66 lines. The page length tells the RS232 when to advance to a new page.
COLUMN	Sets the number of six-character columns to be printed across the page. If more columns are specified than will fit on the page, the printer output will default to datalogger format where all parameters are identified uniquely in one 12-character column.
EXCESS	The selection ONLY prints only those measurements/ calculations that exceed the specified high alarm level. The selection INCLD prints ***all*** measurements/ calculations that are configured in the LS710.

CONFIGURATION MENU: PARAMETERS

Submenu		**Increment**	**Configuration Notes** 1	2	3	4
BARO F.S.	(E.N.)	500 - 999 mm mercury				
BWA	(E.N.)	0.01 - 0.05	_____			
FUEL	(S)	ANTH/BITUM/LIQU/OTHER	_____			
FDX10	(*)	700 - 2000	_____			
FWX10	(*)	700 - 2000	_____			
FC	(*)	500 - 2500	_____			

(S) = SELECT (D.O.) = DISPLAY ONLY (*) = ENTRY MADE ONLY IF FUEL IS OTHER

Description:

PARAMETERS	To change items under this menu, the PANEL menu ACCESS entry must be set to OPEN. Set the ACCESS entry to LOCK after changes are completed.
BARO	Sets the full scale value for the pressure input sensor. If a sensor is not present (output less than 4 mA), the entered value becomes the barometric pressure used in calculations. In calibration the last process barometric value will be used for calibration data correction.
BWA	Sets the ambient moisture in percent H_2O (site average moisture level).
FUEL	Causes calculations to use the fuel factors appropriate for the selected fuel; ANTH = anthracite, BITUM = bituminous, LIQU = liquid, and OTHER = uses fuel factors entered below for any other fuel type.
FDX10	FUEL FACTOR (DRY). When entered, the numerical factor displayed, times ten, should equal fuel FD. FDX10 is entered only if FUEL is selected as OTHER.
FWX10	FUEL FACTOR (WET). When entered, the numerical value displayed, times ten, should equal fuel FW. FWX10 is entered only if FUEL is selected as OTHER.
FC	FUEL FACTOR (CO2). When entered, the numerical value displayed should equal fuel FC. FC is entered only if FUEL is selected as OTHER.

CONFIGURATION MENU: DIAGNOSTICS

Submenu		**Increment**	**Configuration Notes**			
			1	2	3	4
CLEAR	(S)	YES/NO				
V/R	(D.O.)	5.11				
HOURS	(D.O.)					

(S) = SELECT (D.O.) = DISPLAY ONLY

Description:

DIAGNOSTICS	The CLEAR entry can be accessed when the PANEL menu ACCESS entry is set to LOCK or OPEN.
V/R	Displays the firmware version and revision number of your LS710.

HOURS	Displays the total number of hours that the LS710 has been in operation.

CONFIGURATION MENU: Channel Names

CO PPM	CO measurement
CO2 PERCENT	CO_2 measurement
H2O PERCENT	H_2O measurement
O2 PERCENT	O_2 measurement
OPACITY%	Opacity measurement
OPAC COMB%	Combined opacity of all nonzero velocity instruments
DENSITY	Optical density measurement
PRESSURE	Pressure measurement through auxiliary input #2
NO PPM	NO measurement
NO MASS	NO #MBtu (GCM) calculated using measurement and fuel factors
SO2 PPM	SO_2 measurement
SO2 MASS	SO2 #MBut or GCM calculated using measurement and fuel factors
TEMP	Temperature measurement
AUXILIARY	Auxiliary measurement
CO-ST CALC	
DEW CALC	
BWS CALC	

These channels are used as appropriate to the site instruments. Each channel will use entries as described on the worksheets that follow the description.

Submenu		**Increment**
RESET	(S)	-*
ALARM	(S)	OFF/5-SEC/AVG/
HI LIM	(E.N.)	#. # **
LO LIM	(E.N.)	#. # **
O2 MAX	(E.N.)	# # . # (NOTE)
O2 MIN	(E.N.)	# # . # (NOTE)
COLUMN	(E.N.)	0-28
DISPLAY	(S)	0-30
AVG	(E.N.)	1-61 minutes
RANGE	(E.N.)	# # # # **

(E.N.) = ENTER NUMBER (S) = SELECT (D.O.) = DISPLAY ONLY

** Denotes special software for SO_2 and NO cavities that are 750 ppm or less requiring a decimal point. (The value(s) shown are divided by 10; i.e., 1500 ppm will be displayed as 150.0 ppm.)

Note

This entry only appears with the O2 PERCENT menu. BWS CALC menu uses ERROR and EXCESS. All other channel menus use HI LIM and LO LIM.

Description:

CHANNEL	With the exception of RESET, the PANEL menu ACCESS entry must be set to OPEN for channel entries to be changed. Set the ACCESS entry to LOCK entry after the changes are completed.
RESET	Sets alarm handling parameters. LATCH holds an alarm in the active state until YES is entered. YES acknowledges and clears the alarm. AUTO causes the alarm to reset automatically when the value falls below the limit. An alarm is activated any time a value exceeds the high or low limit. In the case of O_2, an alarm is activated when the O_2 value falls below the O_2 minimum.
ALARM	Selects processing for the alarm signal. OFF deactivates the alarm processor. 5-SEC uses 5-second instantaneous values as the alarm variable. AVG uses the average values (averaged over the time period entered for the specific channel menu, AVG entry) as the alarm variable. Both 5-SEC and AVG activate the alarm processor.
HI LIM	Sets the upper alarm limit value. For BWS channel this entry is labeled EXCESS.
LO LIM	Sets the lower alarm limit value. For BWS channel this entry is labeled ERROR.
O2 MAX	Sets the O_2 high alarm limit value. The O2 MAX range is 0% to 30%.
O2 MIN	Sets the O_2 low alarm limit value. The O2 MIN range is 0% to 30%.
COLUMN	Sets the RS232 column at which a channel value is to be printed. An entry of zero omits the measurement from printing. Columns from 1 to 28 can be selected. Each column is six characters long.
DISPLAY	Controls the measurements displayed on the front panel. When 0 is entered, the measurement for the channel is not displayed. The entered number indicates the display position. The positions are numbered in two columns starting in the upper left hand corner of the display. Numbers 1 to 15 are the first column and number 16 starts the second column in the upper middle of the display. The bottom line is reserved as a status line.

AVG	Sets the time over which measurements for a channel are to be averaged. The time can be set for 1 to 60 minutes. AVG also sets the printing rate for a channel. For example, an entry of six averages measurements for a channel over a six-minute time period and prints the average measurement every six minutes.
RANGE	Sets the full scale analog range for trend recording or process control for a channel.

Configuration Notes:

				INSTRUMENT # 1	2	3	4
CO PPM							
	RESET	(S)		*			
	ALARM	(S)	OFF/5-SEC/AVG	*			
	HI LIM	(E.N.)	0-5000	*			
	LO LIM	(E.N.)	0-5000	*			
	COLUMN	(E.N.)	0-28				
	DISPLAY	(S)	0-30				
	AVG	(E.N.)	1-61 minutes				
	RANGE	(E.N.)	200-5000				
CO2 PERCENT							
	RESET	(S)	LATCH/YES/AUTO	*			
	ALARM	(S)	OFF/5-SEC/AVG	*			
	HI LIM	(E.N.)	0-40.0	*			
	LO LIM	(E.N.)	0-40.0	*			
	COLUMN	(E.N.)	0-28				
	DISPLAY	(S)	0-30				
	AVG	(E.N.)	1-61 minutes				
	RANGE	(E.N.)	0-40.0				
H2O PERCENT							
	RESET	(S)	LATCH/YES/AUTO	*			
	ALARM	(S)	OFF/5-SEC/AVG	*			
	HI LIM	(E.N.)	0-60.0	*			
	LO LIM	(E.N.)	0-60.0	*			
	COLUMN	(E.N.)	0-28				
	DISPLAY	(S)	0-30				
	AVG	(E.N.)	1-61 minutes				
	RANGE	(E.N.)	0.0-50.0				

*ENTRY AFFECTS ALL INSTRUMENTS

(S) = SELECT (E.N.) = ENTER NUMBER

Configuration Notes:

				INSTRUMENT # 1	2	3	4
CO-ST CALC							
	RESET	(S)	LATCH/YES/AUTO*				
	ALARM	(S)	OFF/5-SEC/AVG	*			
	HI LIM	(E.N.)	0-9000	*			
	LO LIM	(E.N.)	0-9000	*			
	COLUMN	(E.N.)	0-28				
	DISPLAY	(S)	0-30				
	AVG	(E.N.)	1-61 minutes				
	RANGE	(E.N.)	0-9999				
DEW CALC							
	RESET	(S)	LATCH/YES/AUTO*				
	ALARM	(S)	OFF/5-SEC/AVG	*			
	HI LIM	(E.N.)	0 - 180	*			
	LO LIM	(E.N.)	0 - 180	*			
	COLUMN	(E.N.)	0-28				
	DISPLAY	(S)	0-30				
	AVG	(E.N.)	1-61 minutes				
	RANGE	(E.N.)	0 - 180				
BWS CALC							
	RESET	(S)	LATCH/YES/AUTO*				
	ALARM	(S)	OFF/5-SEC/AVG	*			
	EXCESS	(E.N.)	0-30	*			
	ERROR	(E.N.)	0-30	*			
	COLUMN	(E.N.)	0-28				
	DISPLAY	(S)	0-30				
	AVG	(E.N.)	1-61 minutes				
	RANGE	(E.N.)	0 - 2.00				

*ENTRY AFFECTS ALL INSTRUMENTS
(S) = SELECT (E.N.) = ENTER NUMBER

Configuration Notes:

				INSTRUMENT # 1	2	3	4
O2 PERCENT							
	RESET	(S)	LATCH/YES/AUTO*				
	ALARM	(S)	OFF/5-SEC/AVG	*			
	O2 MAX	(E.N.)	0-30.0	*			
	O2 MIN	(E.N.)	0-30.0	*			
	COLUMN	(E.N.)	0-28				
	DISPLAY	(S)	0-30				
	AVG	(E.N.)	1-61 minutes				
	RANGE	(E.N.)	0.0-25.0				

SO2 PPM

RESET	(S)	LATCH/YES/AUTO*				
ALARM	(S)	OFF/5-SEC/AVG	*			
HI LIM	(E.N.)	0-7500	*			
LO LIM	(E.N.)	0-7500	*			
COLUMN	(E.N.)	0-28				
DISPLAY	(S)	0-30				
AVG	(E.N.)	1-61 minutes				
RANGE	(E.N.)	0-7500				

SO2 MASS

RESET	(S)	LATCH/YES/AUTO*				
ALARM	(S)	OFF/5-SEC/AVG	*			
HI LIM	(E.N.)	0-9.000	*			
LO LIM	(E.N.)	0-9.000	*			
COLUMN	(E.N.)	0-28				
DISPLAY	(S)	0-30				
AVG	(E.N.)	1-61 minutes				
RANGE	(E.N.)	0-9.000				

Note

Mass calculations are based upon O_2 measurement. If O_2 measurement is not available for the specified J-box then a calculation based upon CO_2 is used. J-box 1 CO_2 is used unless the mass measurement is on J-box 1. In this case J-box 2 CO_2 is used. When GCS units are selected GCM is calculated. Refer to *Chapter 4* for calculations.

*ENTRY AFFECTS ALL INSTRUMENTS

(S) = SELECT (E.N.) = ENTER NUMBER

Configuration Notes:

				INSTRUMENT # 1	2	3	4
NO PPM							
RESET	(S)	LATCH/YES/AUTO*					
ALARM	(S)	OFF/5-SEC/AVG	*				
HI LIM	(E.N.)	0-7500	*				
LO LIM	(E.N.)	0-7500	*				
COLUMN	(E.N.)	0-28					
DISPLAY	(S)	0-30					
AVG	(E.N.)	1-61 minutes					
RANGE	(E.N.)	0-7500					
NO MASS							
RESET	(S)	LATCH/YES/AUTO*					
ALARM	(S)	OFF/5-SEC/AVG	*				
HI LIM	(E.N.)	0-9.000	*				

	LO LIM	(E.N.)	0-9.000	*			
	COLUMN	(E.N.)	0-28				
	DISPLAY	(S)	0-30				
	AVG	(E.N.)	1-61 minutes				
	RANGE	(E.N.)	0-9.000				
TEMP							
	RESET	(S)	LATCH/YES/AUTO	*			
	ALARM	(S)	OFF/5-SEC/AVG	*			
	HI LIM	(E.N.)	0-800	*			
	LO LIM	(E.N.)	0-800	*			
	COLUMN	(E.N.)	0-28				
	DISPLAY	(S)	0-30				
	AVG	(E.N.)	1-61 minutes				
	RANGE	(E.N.)	500-800				

Note

Mass calculations are based upon O_2 measurement. If O_2 measurement is not available for the specified J-box then a calculation based upon CO_2 is used. J-box 1 CO_2 is used unless the mass measurement is on J-box 1. In this case J-box 2 CO_2 is used. When CGS (Centimeters/Grams/Seconds) units are selected GCM (Grams per Cubic Meter) is calculated. Refer to *Chapter 4* for calculations.

*ENTRY AFFECTS ALL INSTRUMENTS

(S) = SELECT (E.N.) = ENTER NUMBER

Configuration Notes:

				INSTRUMENT # 1	2	3	4
OPACITY %							
	RESET	(S)	LATCH/YES/AUTO*				
	ALARM	(S)	OFF/5-SEC/AVG	*			
	HI LIM	(E.N.)	0-100.0	*			
	LO LIM	(E.N.)	0-100.0	*			
	COLUMN	(E.N.)	0-28				
	DISPLAY	(S)	0-30				
	AVG	(E.N.)	1-6 minutes				
	RANGE	(E.N.)	0-100.0				
OPACITY COMB %							
	RESET	(S)	LATCH/YES/AUTO*				
	ALARM	(S)	OFF/5-SEC/AVG	*			
	HI LIM	(E.N.)	0-100.0	*			
	LO LIM	(E.N.)	0-100.0	*			
	COLUMN	(E.N.)	0-28				
	DISPLAY	(S)	0-30				
	AVG	(E.N.)	1-6 minutes				
	RANGE	(E.N.)	0-100.0				
DENSITY %							
	RESET	(S)	LATCH/YES/AUTO*				

ALARM	(S)	OFF/5-SEC/AVG	*			
HI LIM	(E.N.)	0-2.0	*			
LO LIM	(E.N.)	0-2.0	*			
COLUMN	(E.N.)	0-28				
DISPLAY	(S)	0-30				
AVG	(E.N.)	1-6 minutes				
RANGE	(E.N.)	0.00-1.80				

*ENTRY AFFECTS ALL INSTRUMENTS
(S) = SELECT (E.N.) = ENTER NUMBER

Configuration Notes:

AUXILIARY

			INSTRUMENT # 1	2	3	4
RESET	(S)	LATCH/YES/AUTO*				
ALARM	(S)	OFF/5-SEC/AVG	*			
HI LIM	(E.N.)	0-999.9	*			
LO LIM	(E.N.)	0-999.9	*			
COLUMN	(E.N.)	0-28				
DISPLAY	(S)	0-30				
AVG	(E.N.)	1-60 minutes				
RANGE	(E.N.)	0-999.9				

*ENTRY AFFECTS ALL INSTRUMENTS
(S) = SELECT (E.N.) = ENTER NUMBER

USER NOTES

3. OPERATING PROCEDURES

3.1 Setup Procedures

The following procedures are required to set up the LS710 menus. Use them when the LS710 is powered up for the first time or whenever there is a change in the process-mounted instruments.

Note

You should be familiar with the front panel controls, menus and entries described in *Chapter 2* before attempting the setup procedure.

3.1.1 Unlock the Front Panel

1. Access the PANEL menu. If ACCESS OPEN is displayed, skip to 3.1.2.

2. If ACCESS LOCKED is displayed, access the CODE entry and use the <Select> and <Up> buttons to enter the correct access code as shown in Chapter 2.7 *Configuration Descriptions and Worksheets*.

3.1.2 Initiate a Calibration Check

1. Be sure that the `CALIBRATION` menu `TYPE` entry is set to the desired calibration type (`E-O` or `GAS`).

2. Set purge and temperature check to 1. Set zero and span to 2.

Note

These entries can be increased in applications requiring increased response time.

3. Select `CALIBRATION` under the `CONFIGURATION` menu, and the `START` entry, for `YES` to calibrate all measurements.

4. If a span or gas error occurs, refer to the span error correction procedure in section 3.3.9. Correct all span errors.

3.1.3 Set Up the Channel Menus

This procedure establishes the displays and alarms for your specific application.

1. Push the <Pg Up> button to display the configuration menu.

2. Using the <Up> or <Down> button select the channel name for the measurement that is to be added/changed.

3. Select the `DISPLAY` entry and use the <Up> button to enter the display position on which the measurement is to appear.

Note

If a displayed measurement is no longer desired, enter `0` to remove it from the display.

4. If alarms are not required for this measurement, skip to step 5. If alarms are required, use the <Pg Up> button to enter the desired RESET parameter. See Chapter 2.7 *Configuration Descriptions and Worksheets* for a description of the RESET parameters.

Note

Alarms are not specific to each J-box, so the values for `RESET`, `ALARM`, `HI LIM`, and `LO LIM` apply to all instruments related to a specific measurement.

5. Select the `ALARM` entry and use the <Up> button to enter the desired alarm handling parameter. Refer to Chapter 2.7 *Configuration Descriptions and Worksheets* for a list of `ALARM` parameters and the notes on Alarm/Fault Processing. If alarms are not required for this channel, enter `OFF` and skip to step 9.

6. Access the `HI LIM` entry and use the <Select> and <Up> buttons to enter the desired high alarm limit.

7. Access the `LO LIM` submenu and use the <Select> and <Up> buttons to enter the desired low alarm limit.

8. If either the alarm or the display is conditioned by the average measurement value, set up the average period for the J-box. See the averaging periods procedure in section 3.2.1.

9. Repeat steps 1 through 4 for each J-box.

Note

Paragraphs 5 through 9 are set only once.

3.1.4 Notes on Alarm/Fault Processing

1. Alarms are processed as soon as measurement or calculated data is available. If you set the channel name in the `CONFIGURATION` menu `ALARM` entry to `5-SEC` a detected alarm will activate within 5 to 10 seconds after the measurement is taken. If you set the `ALARM` entry to `AVG`, the calculated average is compared to the alarm limit and individual measurements included in the average will not activate the alarm even if they exceed the alarm limit.

Note

The alarm processor is disabled during calibration.

2. When an alarm is activated, an alarm message is displayed on the lower readout.

3. Alarms are reset according to the channel name menu, RESET entry. If RESET is set to AUTO, the alarm resets automatically when the measurement falls back within the limits. If RESET is set to LATCH, you must reset the alarm by changing the RESET entry to YES.

Note

When you enter YES to reset an alarm, the alarms for all instruments related to that alarm condition are reset and the RESET entry returns to LATCH.

4. If an instrument fault is detected during the diagnostic phase of the calibration sequence, !FAILURE is displayed on the status line. Chapter 6 provides more information about faults.

3.1.5 Perform the Analog Output Procedure

The procedure assumes that the measurement/calculation to be placed on the analog output is displayed. If that is not true, perform the data display and incorrect data procedures in sections 3.3.5 and 3.3.7.

Note

An analog board must be installed in the LS710 and the type of board must be entered under the LS710 SETUP menu RECORDERS entry, for the analog output to be functional.

1. Select the RECORDER menu.

2. Select the J-BOX entry and use the <Up> button to enter the desired J-box number.

3. Choose the SELECT entry and use the <Up> button to enter the measurement or calculation that is to be output.

4. Next select the TYPE entry and use the up button to enter the type of conditioning that is required. Refer to Chapter 2.7 *Configuration Descriptions and Worksheets* for a list of TYPE parameters.

5. Choose the MA entry and use the <Up> button to enter the desired mA output.

6. Select the zero adjust entry and change to allow for negative data.

7. Repeat 1 through 5 for all analog outputs needed for your application.

8. Set up the recorder range using the analog range procedure in section 3.2.3.

3.1.6 Set Up the Serial Port

Note

This procedure is required only if the RS232 printer/CRT interface is being used. It assumes that the serial RS232 is connected as specified in *Appendix A*. The RS232 must be selected for 8 bit data, one stop bit.

1. Select the SERIAL PORT menu. The first entry under that menu is PG TOP; select YES to send a new page top prior to the next data to be printed.
2. The next entry is PG#; set to 1 or the page number you wish the next page to be numbered.
3. If a printer is attached, the CAL Log will send data from the last calibration cycle to the RS232 port. If DAS is connected, selection of YES will have no effect.
4. Set the RS232 ON or PRN to activate or deactivate the RS232 port.

Note

If DAS is sending clock sets, this entry will be DAS.

5. At the entry BAUD, use the <Select> and <Up> buttons to enter the RS232 baud.
6. At the entry PARITY, use the <Up> button to enter the RS232 parity.

Note

The RS232 device will not print legible information if the RS232 device baud and parity, and the LS710 baud and parity do not match.

7. Select the MARGIN entry and use the <Up> button to enter the number of characters you want for the top, bottom, left and right margins.

Note

The same margin is used for the top, bottom, left and right margins of the page. For a data acquisition system, set the MARGIN to zero.

8. Select the WIDTH entry and use the <Select> and <Up> button to enter the paper width in characters (8.5" x 11" paper has an 80-character page width). For data acquisition systems, set the WIDTH to 12.

9. Select the LENGTH entry and use the <Select> and <Up> button to enter the paper length in characters (8.5" x 11" paper has a 66-character page length).

Note

A minimum of seven lines is required to print headers. For a data acquisition system, a page length of 99 is recommended.

10. Select the COLUMN entry and use the <Select> and <Up> buttons to enter the number of columns to be printed.

Note

To select each column to be printed, use the RS232 column procedure in section 3.3.8.

Note

Each column requires six characters. If the number of columns entered does not fit the width of the page, the format is automatically reduced to allow the information to be printed.

11. Select the EXCESS entry. To print only excess data (data that exceeds an alarm level that is set to AVG), enter ONLY, using the <Up> button. If all the measurements set up to be printed, are to be printed, enter INCLD.

3.1.7 Set Up Channels Calculated with Outputs

Note

This procedure is required only if your application uses calculated values such as combined opacity or mass concentration.

3.1.7.1 Setting the Calculations

Refer to the general procedures list in section 3.2 to find instructions for setting up the calculations you need.

3.2 General Procedures

These are the basic procedures needed for updating and maintaining LS710 parameters. The list in not sequential, choose only the procedure needed.

3.2.1 Averaging the Periods

Average periods can be set up for each measurement and calculation (channel) in each of the four possible J-boxes. The averaged value can be used in several ways: for display (PANEL CONFIGURATION menu UNITS entry), analog output (ANALOG CONFIGURATION menu, TYPE entry), alarms (Channel name CONFIGURATION menu ALARM entry), and printing.

When the RS232 is activated, data is printed after every average computational period from the time the average was selected. Averages are synchronized at the top of each minute.

1. Access the channel name (measurement) that is to be averaged.

2. Access the AVERAGE entry and use the <Up> and <Select> buttons to enter the average period in minutes (from 1 to 61).

3. Repeat 1 to 2 for all measurements that require averaging in the selected J-box.

4. Repeat 1 to 3 for all J-boxes with measurements that require averaging.

5. Select the PANEL menu and set the UNITS entry to ENGAVG or CGSAVG to enable averaging for the desired type of units.

3.2.2 Analog Output

The following procedure assumes that the measurement or calculation that is to be placed on the analog output can be displayed. If it cannot, perform both the data display and the incorrect data procedures in sections 3.3.5 and 3.3.7. Then perform the following.

1. Choose the recorder output to be configured. Select the RECORDER# entry field for the recorder output desired and use the <Up> button to enter the number of the recorder output to be configured.

2. Choose which J-box is to be configured. Select the J-box entry and use the <Up> button to enter the number of the J-box that includes the measurement that is to be placed on the analog output.

3. Then select the SELECT entry and use the <Up> button to enter the measurement that is to be placed on the selected recorder output.

4. Next select the TYPE entry and use the <Up> button to enter the conditioning that is required for the measurement. Refer to *Chapter 2, Configuration Description and Worksheet* for the TYPE parameters.

5. Select the MA entry and use the <Up> button to enter either 4-20 or 0-20 output.

Note

Using the 8 analog output board, only 4-20 mA can be entered.

6. Select zero adjust and change to allow for negative data to be displayed.

7. Repeat 1 through 5 for all analog outputs required for your application.

8. Set up the recorder range using the analog range procedure in section 3.2.3.

3.2.3 Analog Range

Set up the analog range for each channel.

1. Access the channel name to be placed on the analog output.

2. Then access the RANGE entry and use the <Up> button to enter the range required to represent the recorder full scale output.

3. Repeat 1 and 2 for all measurements that require assignment to an analog recorder.

3.2.4 BWA Factor

BWA (entered under the PARAMETERS menu), a measure of the ambient moisture at the measurement site, can be determined by any of the following methods.

- BWA = This factor can be used as a constant value at any location.

- BWA = the highest monthly average of BWA that occurred within a calendar year at the nearest weather bureau station, calculated using data for the past three years.

- BWA = the highest daily average of BWA that occurred within a calendar month at the nearest weather bureau station, calculated from data for the past three years.

  This factor should be calculated for each month and can be used as an estimating factor for that calendar month.

- 40CFR60 allows BWA = 0.027

3.3 Calculations

3.3.1 #/MBtu Calculations

The following procedure assumes that accurate measured values for O_2 or CO_2, and SO_2 and/or NO can be displayed. If that is not true, perform the data display procedure in section 3.3.5 or the incorrect data procedure in section 3.3.7 to display the required values then perform this procedure.

1. Perform the fuel factors procedure in section 3.3.6 to ensure an accurate FD for the #/MBTU calculation.

2. Enter the correct BWA factor in the PARAMETERS CONFIGURATION menu BWA entry

3. To obtain a recorder output, perform the analog output procedure in section 3.2.2 .

GCM (Grams per Cubic Meter): No special setup is required, simply select CGS or CGSAVG under the PANEL menu.

3.3.2 Combined Opacity Calculations

The following procedure assumes that accurate values for the measured variables OP and VEL can be displayed for all combined instruments. If that is not true, perform the data display procedure in section 3.3.5 and the incorrect data procedure in section 3.3.7 to display the required variables.

3.3.2.1 The Optical Path Length Ratio

The optical path length ratio for each breech must be entered in the OPACITY CONFIGURATION menu OPLR entry, using the incorrect data procedure in section 3.3.7.

Note

SETUP OPLR is factory set and can only be changed by a qualifying factory service person.

Note

When all breech cross sectional areas are equal, the velocity units are feet/second. When any one breech differs, velocity units in cubic feet/second must be used. See other computed values for the equation used.

3.3.2.2 Setting the Recorder Output

Refer to the analog output procedure in section 3.2.2 to set the recorder output.

3.3.3 O_2 Calculation

The following calculation assumes that accurate values for CO and CO_2 can be displayed. If that is not true, perform the data display procedure in section 3.3.5 and the incorrect data procedure in section 3.3.7. Then perform the following steps.

1. Perform the fuel factors procedure in section 3.3.6.
2. Enter the BWA factor in the PARAMETERS CONFIGURATION menu BWA entry.
3. Ensure that the entry for AUX under LS710 SETUP menu is not selected for O_2 for the J-box that O_2 is to be calculated.

3.3.4 J-Box Communications

The following points assume that the wrong instrument TYPE was viewed when the J-box selection procedure was last performed. If the TYPE is EX, but should be MC or SM, there is no communication to the J-box.

Note

An SM system will show SO_2 or NO depending on the position of the sequential shutter.

- If the correct TYPE is displayed, but followed by NA, communications were interrupted after they were initially established and you should check the MANUAL switch in the J-box to be sure it is in the auto mode and ensure power is available to the J-box.

- If the TYPE is still wrong, check the jumpers on the J-box serial data acquisition (SDA) board. They should be set according to the following table:

	MC, EX, SM Instruments	
	SW6-1*	**SW6-2***
For instrument 1	IN	IN
For instrument 2	OUT	IN
For instrument 3	IN	OUT
For instrument 4	OUT	OUT

Table 3-1: J-box Serial Data Acquisition Board Jumpers

*Older SDA boards are JP1 and JP2 respectively.

Refer to *drawing 81750011* (*80340181* on older SDA boards) in the EX4700A, SM8100/SM8175, or RM opacity monitor instruction manuals for the configuration of other jumpers on the SDA board.

If the TYPE is still wrong, check the wiring from the LS710 to all installed J-boxes. Wire terminating on terminal 32 in the LS710 must be terminated on terminal 32 in all of the installed J-boxes. The same must be true for terminals 33, 34, 35, and 36. This means that the ***shields of all J-boxes and the LS710 are tied together, but not to facility ground***.

3.3.5 Display Data

This is a diagnostic procedure that can be used to determine why data is ***not*** displayed on the front panel. If the expected data is a basic measurement (TEMP, SO2, NO, OP, DEN, CO, CO2, H2O, AUX), use the following procedure:

1. If the instrument TYPE is wrong for any J-box, perform the communication procedure in section 3.3.4.

Note

EX is a default type if no communication has taken place as well as the type when an EX4700A is connected.

2. Access the CALIBRATION menu CONTIN entry and enter OFF. If OUT was entered, verify that the data has returned.

3. If OUT in 2 was selected, select the CALIBRATION menu START entry and enter YES to start a calibration and obtain new zeros for the instrument.

4. If ZERO ERROR appears after completion of the calibration, perform the incorrect data procedure in section 3.3.7.

5. Access the individual instrument (CO/CO2, SO2/NO, OPACITY) menu, XX G entry (where XX denotes the desired measurement) to verify that the value is not zero. If it is zero, change it to 1.00 and verify that the data has returned.

Note

The proper gains have been recorded in the gas calibration procedure for the required instrument.

6. Access the PANEL menu UNITS entry to verify that ENG is entered. If AVG is entered, enter ENG and verify that the data has returned. A long average period for the gas could be delaying the data update.

7. If SO_2 or NO is the problem, access the SO2/NO menu SO2 FS and NO FS entries to verify that a non zero value is displayed. If zero is displayed, enter the required full scale value.

8. If O2, VEL, or AUX is the problem, access the SETUP menu AUX entry to verify that O_2 is selected for O2, VEL (or OFF) is selected for VEL, and AUX is selected for AUX measurement. Then, set up the full scale value in the LS710 SETUP menu AUX FS entry.

Note

If a velocity value is required, but there is no flow instrument, enter OFF in the AUX entry (rather than VEL) and enter the actual velocity value in the LS710 SETUP menu AUX FS entry.

9. Verify that no other parameter is displayed on the same line (i.e. no channel menu, DISPLAY entry may contain the same number).

3.3.6 Fuel Factors

Fuel factors (entered in the PARAMETERS menu) are used in the calculation of #/MBtu and O_2 percent. To calculate the values from ultimate fuel analysis, see *Calculated Values* in *Chapter 4*. To use the preprogrammed values, use the following procedure:

1. Select the PARAMETERS menu FUEL entry and use the <Up> button to enter the fuel being used.

2. If OTHER is entered as the fuel, specific fuel factors must be entered also.
   Select the FDX 10 entry and enter one tenth of the FD factor. Next select the FWX 10 entry and enter one tenth of the FW factor. Then access the FC entry and enter the FC factor.

Note

X 10 denotes the displayed value is to be multiplied by 10.

3.3.7 Incorrect Data

3.3.7.1 Measurement Is SO2, NO, CO, CO2, or H2O

If the measurement is SO2, NO, CO, CO2, or H2O, initiate a calibration check or a manual gas calibration. For more information on CO, CO_2, and H_2O calibration, see the *EX4700A Operation and Maintenance Manual* and for SO_2 or NO, refer to the *SM8100/SM8175 Operation and Maintenance Manual*.

Note

Gas calibration sets the gains. See the data display procedure in section 3.3.5.

3.3.7.2 Measurement Is Opacity

If the measurement is OPACITY, enter the optical path length ratio under the OPACITY menu OPLR entry.

EX measurements available are CO, CO2, H2O, TEMP, AUX, and O2; and the calculation available is O2.

MC measurements available are OPACITY, DENSITY, AUX, and VEL; calculation of OP COMB is available.

SO2/NO measurements available are SO2, NO, TEMP, AUX, or O2 and the calculations available are SO2 MASS, NO MASS.

3.3.8 RS232 Column

The following procedure assumes that the RS232 procedure is complete.

1. Select the desired channel name.
2. Enter the column in which the measurement is to be printed in the field entry for the desired J-box.

Note

In the 12-character format, the number entered determines the order in which the measurement is printed. If two or more measurements are assigned the same number, only the first measurement found will be printed. When zero is entered, the measurement will not be printed.

3. Repeat steps 1 and 2 for all measurements that are to be printed or for measurements that are to be removed from the format.

3.3.9 E/O Span Error Corrections

Correct a span error as follows:

1. Display the CONFIGURATION menu using the configuration menu display/access procedure.

Note

The E/O DEG F displayed under the CALIBRATION menu should agree with the factory setup value.

2. Select the menu for the specific instrument (CO/CO2, SO2/NO, etc.) XX S entry (where XX denotes a measurement of the desired instrument (i.e., SO2 Hi, NO Hi, OP Hi) and write down the span value. If the value is zero, perform the span display procedure.

Note

The span display data is not retained through power outages.

Note

SO_2 and NO entries for 25% and 50% must agree with that required for each SO_2/NO instrument.

Note

SO_2 and NO entries for gains (XXG) will only affect gas calibration.

3. Repeat step 3 for each instrument measurement that is associated with the span error.

4. Select the menu for the specific instrument (CO/CO2, SO2/NO, OPACITY) SPAN XX entry (i.e.,. SPAN NO, SPAN SD, SPAN OP) and verify the span value. If this value differs from the value recorded in step 3 by more than 2.5% of the full scale range, depending on the instrument, refer to the appropriate instrument manual for complete calibration procedures.

5. Repeat 2 through 4 for each J-box that displays a span error.

6. Access the DIAGNOSTICS menu CLEAR entry and enter YES to clear all of the span errors.

7. Start a calibration to verify the corrections.

8. Unlock front panel access.

9. Whenever power is reapplied to the LS710, ACCESS entry will be LOCKED. To change most parameters, the front panel must be opened, using the following procedure:

10. Verify that the panel is locked.

11. If you attempt to open the panel when it is already open, you will, in fact, lock the panel. Select the PANEL menu. If the ACCESS entry is OPEN, no further action is required.

12. If the ACCESS entry is LOCKED, select the CODE entry under the PANEL menu. Then, use the <Select> and <Up> buttons to enter the code shown in *Chapter 2*, *Configuration Description and Worksheets*. This unlocks the front panel.

3.4 Spare LS710 Setup Procedures

The following procedures are required to replace the LS710 with a spare or unit used on another site. ***This procedure will also be required when an updated firmware set has changed the configuration of the menu.***

Note

Refer to the front panel controls, menus and entries described in *Chapter 2* before attempting setup procedures that are unfamiliar.

To change any item under this procedure, the PANEL menu ACCESS entry must be set to OPEN (refer to the unlock the front panel procedure in section 3.1.1). When settings are completed, change the ACCESS entry to LOCK.

1. Access the PANEL menu and change the menu selection to SETUP. In the SETUP menu all entry fields are available for data entry regardless of the instruments connected. Hence, the LS710 can be setup prior to interfacing with stack equipment. The setup menu also provides a training base when the LS710 is not installed.

2. For all unused J-boxes within each channel task, and for all unused channel tasks:

    - Select the ALARM signal to OFF (deactivate the alarm processor for that channel).
    - Set the column entry to 0.
    - Set the display entry to 0.
    - Set the full scale analog range to 0.

3. Copy all entries as recorded in *Chapter 2* for the LS710 to be replaced to the proper entries in this unit.

4. If an EX4700A is to interface with the LS710, the PROM located on the memory expansion board will have to be removed from the unit being replaced and inserted into this unit when the units are interchanged.

After the unit is properly set up, all menu setup information is stored in U1 EEPROM on the I/O multimodule. Thus this U1 can be removed from the unit being replaced and inserted into this unit when the units are interchanged without having to perform steps 1 through 3 above.

USER NOTES

4. TECHNICAL DESCRIPTION

4.1 Introduction

This section provides information to help you maintain and, in general, troubleshoot anomalies that might occur in the operation of the LS710.

4.2 Front Panel Controls

These items define access, display rates, and the location and type of measurement displays.

4.2.1 Access to Variables

Accidental changes to protected variables is prevented by setting the variable under the PANEL menu ACCESS entry to LOCK. To permit access to all variables, enter the code shown in *Configuration Description and Worksheet*, *Chapter 2*, into the CODE entry of the PANEL menu. The value of this variable is not preserved across power outages.

4.2.2 Selection of Displayed Measurement

This item, in any channel name menu, DISPLAY entry, governs where each measurement/channel will be displayed when the LS710 is in the display mode. Each measurement/channel can be set to one of 31 states:

- 0: The measurement is not displayed.
- Configuration 1-30: The line number that the measurement is displayed on when in display mode.

4.2.3 Units of Measure

This item, in the PANEL menu UNITS entry, allows the displayed units of a measurement to be changed. The selection applies to ***all*** measurements/channels and the choices are:

- ENG: Displays linearized and corrected 5-second English measurements. The units can be percent, ppm, milliamps, or dimensionless, depending on the measurement. The REF and AGC signals are displayed in milliamps, without any corrections.
- ENGAV: Displays linearized and corrected English units that are averaged for the time period selected for each measurement. The REF and AGC signals are displayed in 5-second averaged milliamps.
- MA: Displays unconditioned milliamp (mA) signals from the transceiver such as 5-second measurements for CO, CO2, H2O, TEMP, REF, etc from an EX4700A. These signals may not be scaled as typical 4-20 mA outputs.
- CGS -CGS (Centimeters/Grams/Seconds) indicates metric units will be display measurements in linearized and corrected 5-second metric units. The units can be percent, ppm, GCM (Grams per Cubic Meter), milliamps, or dimensionless, depending on the measurement. The REF and AGC signals are displayed in milliamps, without any corrections.
- CGSAV: Displays linearized and corrected metric units that are averaged for the time period selected for each measurement. The REF and AGC signals are displayed in 5-second averaged milliamps.

4.2.4 Type

Can indicate when the LS710 is not communicating with a J-box. NA will appear after the type if not active.

4.3 Calibration Controls

These items control the time and function of automatic calibrations. To change many of these items, the PANEL menu ACCESS entry must be set to OPEN.

4.3.1 Manually Activated Calibration

The CALIBRATION menu START entry is used to start a calibration or gas calibration (as selected under TYPE below). Calibrations will be performed when YES is entered into the START entry.

4.3.2 Calibration Type

The CALIBRATION menu TYPE entry is used to select whether calibration or gas calibration will be performed when a calibration cycle is started. Calibrations can be started at automatic intervals as described below.

4.3.3 Calibration Interval

The CALIBRATION menu INTVL entry, is used to set the time between automatic calibrations. It is a numeric variable with a range of zero through 24 hours. Setting this variable to zero means that ***no*** automatic calibrations will occur.

4.3.4 Synchronizing with the Time of Day

The CALIBRATION menu NEXT entry, allows automatic calibrations to be synchronized to the time of day. Enter the number of minutes from the current time until the next automatic calibration is to begin. This is a numeric variable with a range of 1 through 1440 minutes, in 1-minute increments. This variable cannot be changed during a calibration or when the interval between calibrations is set to zero.

4.3.5 Zero Corrections

The individual instrument menus (EX4700A, SM8100/SM8175, OPACITY) and CO LOW, CO2 LOW, H2O LOW etc. entries, represent a zero correction to the fundamental measurements. These corrections are established by the instrument E-O or gas calibration, but can be altered if no calibration is in progress.

4.3.6 Calibration Linearity SO2/NO

1. Set the SO2(G) and NO(G) so that the gases read correctly using the approximate 85% span gases.

2. Connect a 20% to 0% of instrument full scale mixed SO_2 cal gas to the *Cal to Probe* line (through the heat exchanger where provided) and adjust SO_2 25% such that the LS710 display is the same as the named gas. Verify that the predetermined flow is maintained.

3. Connect a 20% to 30% of instrument full scale mixed NO cal gas to the *Cal to Probe* line (through the heat exchanger where provided) and adjust NO 25% such that the LS710 display is the same as the named gas. Verify that the predetermined flow is maintained.

4. Connect a 50% to 60% of instrument full scale mixed SO_2 cal gas to the *Cal to Probe* line (through the heat exchanger where provided) and adjust SO_2 55% such that the LS710 display is the same as the named gas. Verify that the predetermined flow is maintained.

5. Connect a 50% to 60% of instrument full scale mixed NO cal gas to the *Cal to Probe* line (through the heat exchanger where provided) and adjust NO 55% such that the LS710 display is the same as the named gas. Verify that the predetermined flow is maintained.

6. Repeat this procedure for verification and trimming.

4.3.7 Span Adjustments

The individual instrument menus (CO/CO2, SO2/NO, OPACITY), NO Hi, SO2 Hi, OP Hi, etc. entries represent a span adjustment to the fundamental measurements. Each item has an associated engineering value representing each span , which is the averaged during the last span calibration. The value is updated at the end of SPAN CAL in the gas calibration sequence. The individual instrument menus (CO/CO2, SO2/NO, OPACITY), NO G, SO2 G, OP G, etc. entries represent a gain adjustment to the fundamental measurements. Each item has an associated value from 0 to 2.00 representing an adjustment made to measurement value. Each G displayed has been calculated at the end of the last gas calibration sequence to trim the measurement to equal the gas standard used for each measurement. The value is updated at the end of SPAN CAL in the gas calibration sequence. The individual instrument menus NO C, SO2 C, OP C, etc. entries, represent gas standards used for gas calibration. All Gs and Cs can be manually altered and are preserved through power outages. All Ss can not be manually altered and are not preserved through power outages. The SO_2/NO instrument allows linearity trim at 25% and 55% (Refer to the *SM8100/SM8175 Operation and Maintenance Manual* for procedure).

4.3.8 Continuous Calibration

The CALIBRATION menu CONTIN entry allows you to select continuous zero or span calibration. This variable cannot be selected during a calibration. The selections are:

- OFF allows normal operation and calibration.
- Z CAL forces continuous zero calibration for the selected J-box.
- H CAL forces continuous span calibration for the selected J-box when CALIBRATION, TYPE = E-O and continuous gas calibration when CALIBRATION, TYPE = GAS.
- OUT forces the selected J-box out of service.

During continuous zero calibration, the zero contact is closed and the message CONTIN ZERO is displayed on the status line. Temperature is set to the E/O DEG F entry and barometric pressure set to 760 mm mercury for the selected J-box.

Note

LS710 firmware forces continuous zero for the EX4700 when the process temperature is less than the water dew point temperature +20° F. The forced continuous zero will be released when the process temperature exceeds the above modified dew point temperature by 10° F. This function is disabled either when the E/O calibration sequence is selected or when the EX4700 junction box Manual switch is activated.

During continuous span calibration, the zero and span contacts are closed and the message CONTIN SPAN is displayed on the status line. The temperature is set to E/O DEG F entry and barometric pressure set to 760 mm mercury for the selected J-box. During continuous gas calibration, the zero and span contacts are closed and the message CONTIN GAS is displayed on the status line. The temperature is set to process measurement and barometric pressure for the selected J-box.

A request for a manual calibration is denied if a calibration is already in progress. If a manual calibration is in progress at the time an automatic calibration is scheduled to start, the automatic calibration is deferred until its next regularly scheduled time.

4.3.9 Auto-Zero

Auto-zero calibrations will occur as required for an instrument. All attached instruments will be zeroed during the auto-zero sequence. The duration of calibration sequence can be altered as required by the application. Averages and alarms are inhibited. Recorder outputs are placed on sample and hold. The calibration contact is energized and all J-boxes are set to zero. After the selected purge time the zero contact is energized and all zero data is averaged through the selected zero time. At the end of the zero sequence the zero contact is opened and J-boxes are set back to operate for the duration of the selected TEMP CK. During the TEMP CK delay all zeroes are updated for zero correction and results are sent out the RS232 port. At the end of the sequence the calibration contact is opened. All recorders are set back to their selected operation and the averages and alarms are enabled. Finally the auto-zero message is removed from the panel.

The value selected under the SO2/NO menu and AUTOZERO selection establishes the time that automatic zero will be activated before the activation of a complete calibration cycle. A zero entry will disable the AUTOZERO function. The last auto-zero will occur at the minutes selected under the SO2/NO menu and autozero selection, before an automatic calibration. To manually activate an auto-zero set the time to NEXT cal to the selected minutes, then immediately start a calibration. If an AUTO-ZERO message does not appear at the bottom of the screen, then the clock has decremented the NEXT time before the calibration was started. In this case a normal calibration will be initiated.

4.4 Manual Operation

The Manual switch in the J-box allows process-mounted instruments to be controlled from that location. The differences from normal operation when in the manual mode are:

4.4.1 Calibration

All solenoids are disabled. Calibration is abandoned, if in progress, and further automatic calibrations are inhibited until the next regularly-scheduled calibration following exit from the manual mode.

4.4.2 Chart Recorders

If averaged or sample-and-hold operation is selected, the last value written, prior to entry to the manual mode, is preserved.

4.4.3 Alarms

Existing alarms remain active, but no new alarms are declared for the duration of the manual mode. All alarms are removed on exit from the manual mode.

4.4.4 Averages

Averaging is halted on entry to the manual mode. All measurements contributing to an unfinished average are discarded. Averaging resumes, with no prior history, on exit from the manual mode.

4.4.5 Display Mode

The status message MANUAL is displayed on the status line while you are in the manual mode.

4.5 Averages

The channel name menus AVG entry is used to define the averages available for periods beyond the fundamental 5-second response time which is dictated by the hardware. Averages are available for the fundamental measurements and calculated values. The reference signals are not averaged for reporting purposes.

The averaging period can be individually selected for each measurement/channel, from 1 to 60 minutes, in 1-minute increments.

4.5.1 Computing the Average

At the end of the 5-second measurement period, that measurement is summed into an accumulator and a count is incremented. Measurements taken during calibration or manual mode do not contribute to averages.

At the end of the averaging period, the sum in the accumulator is divided by the count to form the average. The accumulator and count are then reset to zero.

4.5.2 Resetting the Average

Changing the averaging period causes the accumulating average to be abandoned and restarted from the top of the next minute. The previously computed average is available for strip chart recorders and the front panel display until updated at the end of the new averaging period. Averages start at the top of the minute after the time of the last manual change.

4.6 Output Configuration

Alarms are established for each channel name menu.

4.6.1 Alarm Limits

Alarm limits can be entered through the front panel to determine what measurement value will cause an alarm. The choices for the alarm entry are OFF, 5-SEC, and AVG. OFF disables the reporting of alarms for the selected channel. 5-SEC compares the alarm limits to the fundamental 5-second measurement. AVG compares the alarm limits to the calculated average. A high alarm exists if the measured value equals or exceeds the established high alarm limit in engineering units (i.e., concentration). A low alarm exists if the measured value equals or exceeds the established low alarm limit in engineering units.

Note

02 MIN exists if the measured value falls below the established alarm limit.

Alarm limits can be checked against the fundamental 5-second measurement or the currently selected average for a channel. The check is made at the conclusion of the computation.

4.6.2 Alarm Reporting

Relay. A relay contact for HIGH alarm and a separate contact for LOW alarm is closed as long as that alarm is active on any channel.

Messages In Display Mode. A message, unique to each alarm, appears on the status line as long as an individual alarm is active. The message for fundamental measurements includes the measurement abbreviation, followed by a space, and HIGH or LOW; or, in the case of O2, MAX or MIN.

RS232. If you are using the RS232 output, alarm messages are printed with identification of the measurement or calculation that is in alarm and indicates which limit (HI LIM, LO LIM, MAX, or MIN) was exceeded.

4.6.3 Resetting Alarms

Typically, the channel name menus RESET entry is set to LATCH. In this way, an alarm will remain active until you manually change that entry to YES. After you enter YES, the entry automatically changes back to LATCH in preparation for the next alarm occurrence. This method ensures that the operator sees the alarm before it is reset.

You can also set the channel name menus RESET entry to AUTO. This resets the alarm automatically as soon as the measurement/calculation no longer violates the limit.

Change The Averaging Period. Changing the averaging period will reset alarms for a channel. Use the channel name menus AVG entry to change the averaging period.

Change The Alarm Limits. Changing a limit will reset the alarm until the new limit is exceeded. Use the channel name menus HI LIM and LO LIM entries to change the alarm limits.

4.6.4 Analog Reporting

Eight recorder outputs (or four recorder outputs in the alternate configuration) provide continuous analog outputs of selected measurements. Each operates independently and each is configured independently at run-time through front panel commands. The available choices are:

4.6.4.1 Measurement

Any fundamental or computed measurement, except for the reference and AGC signals, can be routed to the recorder. Engineering units are used.

4.6.4.2 Reporting Period

The selections for reporting period are:

- *5-Second (*5-SEC*) Measurement.* The fundamental 5-second measurement is reported. Data taken during calibration will be visible.

- *Averaged (*AVG*) Measurements.* The currently selected average for the channel is reported. Data taken during calibration will be visible.

- *5-SEC Sample and Hold (*5S-SH*).* This selection is intended for process control applications. It is the same as a 5-second measurement, but the last measurement made before a calibration is preserved across calibrations.

- *Averaged Sample and Hold (*AV-SH*).* This is the same as an averaged measurement, except the last measurement made before a calibration is preserved across calibrations.

- *Current Loop (mA).* The type of current loop can be selected as 0 to 20 mA or 4 to 20 mA.

Note

Only 4 to 20 mA is available on the eight DAC configuration. For adjustments, refer to *Chapter 5*.

- *OFFSET*: 1% to 10% offset can be selected to accommodate negative data.

- *Full Scale Range (RANGE).* The full scale range can be selected for each channel. (During E-O span calibration, the instrument full scale range is used.) For adjustments, refer to *Chapter 5*.

The DACs are updated every five seconds, asynchronously with any other process. Changes in configuration made during operation may be deferred until the next 5-second update.

4.6.5 Serial Port

A new page is formatted any time the system is placed (either automatically or manually) into calibration, or when commanded through the front panel. The page is formatted starting with automatic page numbering PAGE-XXXX followed by copyright, then Teledyne Monitor Labs. The next line identifies the site followed by the unit; e.g., UNIT #15. The next line is derived from the channel database and defines the data that is to be printed in each column.

The print format assigns a measurement/calculation to a column of the printer page. Column, as selected under each channel, indicates where the measurement/calculation will print. If zero is entered, nothing is printed for the specified channel. Column selected under the RS232 configuration menu selects how many columns will be printed. Column number selected under a channel that exceed the number to be printed will not be printed. If more columns are specified than will fit on the page, the printer output will default to data logger format where all parameters are identified uniquely in one 12 character column. If two or more identical numbers are selected under any channel(s), only one will be sent out the RS232 port.

The print rate can also establish for each measurement. The value entered in channel AVG not only represents the average period, but also sets the print rate for a channel. For example, if six is selected for opacity, the six-minute average of the opacity measurements is printed every six minutes. If 60 is selected for SO2, SO_2 hourly averages are printed every hour. Column zero on the printed page is dedicated to the time of day. Time is volatile; hence, any time the power is interrupted the correct time must be reentered.

There are two page formats. In the standard format, data is arranged in columns. In the data acquisition systems format, data is placed in single column. In the DAS format the channel COLUMN indicates the order in which the data will print.

Calibration data is printed in the short data acquisition systems format. Page, copyright, Site, and Unit are printed as headers. ZERO is printed, followed by all applicable zero data. SPAN is printed followed by all span data. The last data to be printed is all the applicable gain data. All prior calibration data can be printed by selecting CAL LOG as YES. The time and date of the last calibration will be printed. Current

faults are also printed. If there are no prior calibration data to be printed, no log will be printed. The cal log is disabled when a DAS is connected and sending clock sets.

The PORT-DAS selection enables the port for output of serial data for a Data Acquisition System and disables the internal timing, permitting external clock synchronization through a serial command. The PRN selection enables the port for output of serial information in a form suitable for a printer and enables the internal time of day clock. If the DAS selection is made and no external clock command is sent within approximately 1.5 minutes, the selection will automatically revert to PRN so the LS710 can continue to collect data. If the PORT-DAS selection is set to OFF and DAS sends clock sets the entry will revert to DAS.

The BAUD and PARITY entries set up the LS710 transmission to match the printer/DAS. The top, bottom, and left margin of the page can be sets up with the MARGIN entry. WIDTH and LENGTH sets up the page format excluding margins. When EXCESS ONLY is entered, only the measurements/calculations that exceed alarm limits are printed. When EXCESS INCLD is entered, all data is printed, as configured.

4.7 Calculated Values

Using the entered values for known fuel factors or fuel type, the following concentrations can be calculated by the LS710:

Note

All in-situ measurements are wet basis.

4.7.1 O_2

The predicted value of O_2 using measured CO_2 and entered BWA using the formula:

$$\%O_2 = 20.95[(1 - BWA) - \frac{F_W}{F_C}\frac{\%CO_2}{100}]$$

4.7.2 #/MBtu

Converts ppm to #/MBtu in calculating the NO #/MBtu and SO_2 #/MBtu.

- When in-situ wet basis O_2 measurement is available #MBtu is calculated using the formula:

$$\#/MBtu = (ppm\ avg)\frac{20.9}{(1 - BWA)20.9 - O_2}F_W(2.59 \times 10^{-9})(MW)$$

where MW = molecular weight of the measured gas and O_2 = percent oxygen (wet basis).

- When O_2 measurement is unavailable but CO_2 is, #MBtu is calculated using the formula:

$$\#/\text{Mbtu} = (\text{ppm avg})\ \frac{100}{\%CO_2} F_C (2.59\times10^{-9})(MW)$$

- When CGS (Centimeters/Grams/Seconds, used to indicate metric units) is selected GCM (Grams per cubic meter) is calculated using the formula:

GCM = (ppm avg) MW 0.04087

where MW is the molecular weight of the measured gas.

Note

The molecular wt of SO_2 = 64.06, and NO = 30. However, under EPA regulations NO is reported as NO_2, so that the molecular wt of NO_2 = 46.1 is used to report lbs of NO_X per MBtu.

4.7.3 Fuel Factors

The fuel factors are:

Fuel	F_d	F_w	F_c
Anthracite	10100	10540	1970
Bituminous	9780	10640	1800
Liquid	9190	10320	1420

Table 4-1: Fuel Factors

Fuel factors can be calculated from an ultimate fuel analysis and entered in the PARAMETERS menu, FDX 10, FWX 10, and FC entries (when the PARAMETERS menu FUEL entry is set to OTHER), using the formulas:

$$F_d = (10^6)\frac{(5.57\%H + 1.53\%C + 0.57\%S + 0.14\%N - 0.46\%O)}{GCV}$$

$$F_w = (10^6)\frac{(5.57\%H + 1.53\%C + 0.57\%S + 0.14\%N - 0.46\%O + 0.21\%H_2O)}{GCV}$$

$$F_C = (10^6)\frac{(0.321\%C)}{GCV}$$

Where

- GCV = gross calorific value in Btu/LB and H, C, S, N, O and H_2O are the content by weight of hydrogen, carbon, sulfur, nitrogen, oxygen, and water. For mixed fuels, use the formula:
- F = XF1 + YF2 + ZF3

  where X, Y, Z are the fractions of total heat input derived from each fuel factors (F1, F2, F3).

4.7.4 Other Computed Values

Combined opacity is derived from the volumetric average of the optical density of each stack/duct as:

$$OD = \frac{V_1 OD_1 OPLR_1 + V_2 OD_2 OPLR + V_3 OD_3 OPLR_3 + V_4 OD_4 OPLR_4}{V_1 + V_2 + V_3 + V_4}$$

Exit opacity is then a look-up solution of:

$$OP = 1 - 10^{(-OPLR)(OLD)}$$

where V = velocity in ft/sec (m/s) for equal volume breeches (ft^3/sec for unequal volume breeches), OD = optical density, OP = opacity, and OPLR = exit path length (2 * measurement path length).

5. CALIBRATION

5.1 Panel Adjustments

The panel contrast adjustment is located behind the front panel. Simply hinge open the panel and locate two panel adjustments. One adjustment is for the panel back light and the second is the panel contrast adjustment. The contrast needs to be adjusted, when the ambient lighting conditions change, for the best visibility. The back light is normally adjusted full on; however, with high ambient lighting conditions, visibility may be improved with no back light. Small corrections will be required after the panel establishes operating temperatures.

5.2 Calibration

5.2.1 Analog Outputs for the 8 Recorder Board

The analog output adjustment requires a precision 3-1/2 digit DMM (digital multimeter) that can read 20 ±0.1 mA. The DMM return is connected to TB1 Terminal 29. Only one analog output needs to be adjusted. The adjustment that can be made using any one of the eight analog outputs is also good for the other seven analog outputs.

5.2.2 Zero Adjust

In the ANALOG menu, RECORDER# entry, the entries are for reference only. They will be numbered 1, 2, 3, 4 in the ANALOG 1- 4 menu and 5, 6, 7, 8 in the ANALOG 5 - 8 menu. This line is used to identify which recorder output is being operated on in subsequent entries to avoid confusion with the typical menu where the columns indicate which J-box is being operated on. Use the UP or DOWN button to place the cursor on the SELECT parameter. Push the SELECT button to access the entry field and use the UP button to select the ZERO choice. With the DVM connected to the appropriate terminal for the recorder number selected (see list below), adjust R3 for 4 mA.

The following terminals of TB1 correspond to the eight recorder outputs (see drawing 80340213-2):

TB1-19	Analog 1
TB1-21	Analog 2
TB1-22	Analog 3
TB1-24	Analog 4
TB1-25	Analog 5
TB1-27	Analog 6
TB1-28	Analog 7
TB1-30	Analog 8

Table 5-1: TB1 Terminals And Recorder Outputs

5.2.3 Span Adjust

In the ANALOG menu, RECORDER# entry, the entries are for reference only. They will be numbered 1, 2, 3, 4 in the ANALOG 1- 4 menu and 5, 6, 7, 8 in the ANALOG 5 - 8 menu. This line is used to identify

which recorder output is being operated on in subsequent entries to avoid confusion with the typical menu where the columns indicate which J-box is being operated on. Use the UP or DOWN button to place the cursor on the SELECT parameter. Push the SELECT button to access the entry field and use the UP button to select the F.S. (full scale) choice. With the DVM connected to the appropriate terminal for the recorder number selected (see list below), adjust R2 for 20 mA.

Note

This single adjustment calibrates all eight channels.

5.2.4 Gas Calibration

Calibration of the LS710 to an external standard gas enhances the accuracy of the measurements. LS710 systems can be calibrated using standard gas concentrations plumbed to the J-box. The gas concentrations should be close to the normal concentrations expected in the monitored process, but should not be less than 30% of the full scale instrument capability. Prior to calibration verify:

- If the J-box does not have an operating pressure transducer, enter the site barometric pressure in the LS710 under the PARAMETER menu and the BARO FS entry for the required J-box. If the pressure transducer is installed in the J-box then the entry will be the full scale transducer value. Typically this value will be 780 mmhg; however, the value should be adjusted such that the front panel indicates the proper site barometric value.

- Enter the calibration gas gains for each gas. Access the SO2/NO SETUP heading, SO2 G subheading and enter 1.00. Access the NO G subheading and enter 1.00. If a blended gas is available enter 1.00 for NO and SO_2 interference gain. Otherwise leave it at its previous section. Access the NO 25% subheading and enter 1.00. Access the SO2 25% subheading and enter 1.00. Access the 55% subheading and enter 1.00. Access the SO2 55% subheading and enter 1.00.

- Enter the full range of the instrument (i.e., 188, 208, 375, 750) in the SO2/NO SETUP heading SO2 FS and NO FS subheadings. NO FS is determined by the measurement cavity size. SO_2 may be 25% of 100% of NO FS.

Refer to the instrument manual for a complete calibration procedure.

Instrument calibration can be manually changed through the front panel. For example, to calibrate for 1000 ppm, obtain a standard gas near 1000 ppm and perform the following steps.

1. Position the J-box MANUAL switch to the manual mode and move the ZERO switch toward the LED. While measuring the largest process gas (TP6 for SO_2, TP8 for CO_2 in the J-box), increase the external pressure regulator until the measurement will not reduce to a lower value. (This insures that the measurement cavity is clear of process gas.) Record the pressure gauge value. Return the MANUAL switch to auto mode.

2. Select the CALIBRATION menu. Type and select gas.

3. Select the CALIBRATION menu START entry and set the choice to YES. Wait for the calibration sequence to complete and verify that there are no calibration faults.

4. Connect the standard gas to the dynamic calibration connection on the probe.

5. Access the individual instrument menu (EX4700A, SM8100/SM8175, OPACITY) CC S entry (where CC denotes the gas being calibrated, SO_2, CO, etc.) and record the value displayed. Divide the actual standard gas bottle concentration (CC C entry) by the displayed value. Select the CC G entry and set the value to agree with the above ratio. For example, if the instrument (CC S) reads the gas at 1000 pp. and the gas bottle concentration (CC C) is 980 ppm., the CC G must be set to 0.98.

If it is necessary to set the CC G value below 0.9 or above 1.1, contact the factory for assistance.

USER NOTES

6. TROUBLESHOOTING

6.1 Circuit Theory of Operation

The LS®710 is designed as an intelligent control unit. The configuration of the unit can be changed without entering the electronics to change switches, adjust potentiometers, or move jumpers.

Note

See Figure 6-1 for a block diagram of major components.

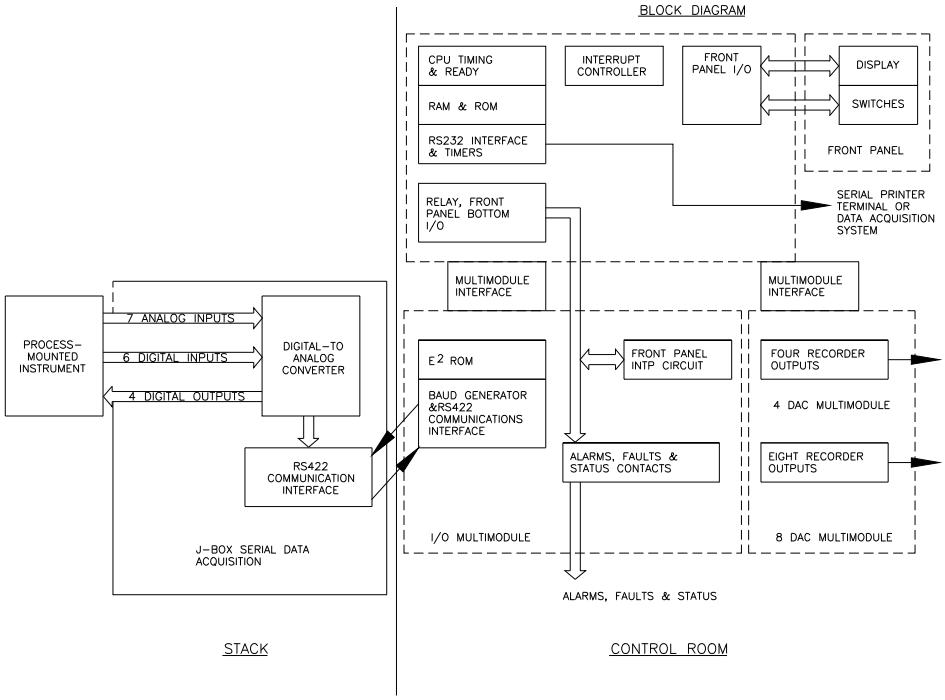


Figure 6-1: Block Diagram

6.1.1 CPU Circuit Board

The CPU circuit board provides intelligence for the LS710. The main program is stored in nonvolatile EPROM (*erasable programmable read only memory*). The scratch pad memory is placed into RAM (*random access memory*). There are no diagnostics for the processor itself.

The watchdog timer, U39, monitors the processor for inactivity. Any time the processor is held up waiting for a device to respond, the watchdog timer interrupts the processor and forces a response from the processor so it can proceed with the error routine.

The watchdog timer is checked during the diagnostic portion of the calibration sequence, and if found to be faulty will flag fault code WDOG. If, during normal operation, the watchdog

finds the processor inactive, the processor will flag error TRAP. TRAP is not a watchdog fault, but a faulty or nonresponding device.

The I/O decoder decodes the address for the timers, input/output interface, and the interrupt controller.

The CPU board is divided into sections: the microprocessor, the memory, the input/output interface, the timers and serial transmission, and the interrupt controller.

6.1.1.1 Memory

The RAM chip is U51. The EPROM chips are U52-U55. The RAM and EPROM diagnostics are performed during the calibration sequence. The RAM test is a nondestructive test that sets and verifies that all bits can be set to zeros and ones, then returns each bit to its initial state. Any error detected is flagged as fault code RAM.

The diagnostic EPROM test (performed at calibration time) verifies the EPROM by comparing a specific bit pattern to the sum of the ROM data. Any error detected is flagged as fault code ROM. Some of the support chips that are verified are U28 for the RAM test and U42 and U49 for EPROM. The SEQ error is generated when attempting to execute all ones, indicating ROM error.

6.1.1.2 Input/Output Interface

The processor can both read and write data through the U15 and U17 I/O chips. The processor sets and resets all 24 bits and verifies both operations during the diagnostic portion of the calibration sequence. The diagnostic only checks U15 and U17 and not the output drivers.

The output drivers drive the front panel readout and the relays on the I/O board. If the drivers are not operating, you will see errors on the display. A fault on U15 or U17 is flagged as fault code PIO.

6.1.1.3 Timer and Serial Transmission

The fault code for the timer, U18, is TIMR.

The 8251 PCI (U19) provides RS232 (serial) compatibility with a printer/CRT or data acquisition system. The firmware allows an asynchronous serial interface with 8 bit data, one stop bit, and baud rate and parity programmed through the front panel.

6.1.1.4 Interrupt Controller

The interrupt controller provides eight interrupts. This diagnostic tests U16. If a fault is detected, PIC (*peripheral interrupt controller*) is displayed.

6.1.2 DAC Multimodule

(For the four recorder output circuit board, *drawing 80340174*.)

The DACs used (U3, U10) are 8 bit. The processor can simply store the digital value into the DAC chip. The DACs use the associate amplifier (U2, U7, U9, U13) to obtain a 0 to 10 volt output. DAC1 is further conditioned for 0 to 20 mA output by U1, U6, U8, U12. DAC1 is calibrated so that the output is offset 10% of full scale when the processor asserts zero. The 0 to 20 and 4 to 20 mA scaling are set up on the front panel.

The DAC outputs are routed through U5 for diagnostic testing. During diagnostic testing, the processor tests the DACs at two levels determined by comparator U5. If one of the DACs has failed, it is possible

that the processor will not be able to determine which one has failed. In this case, the fault code is DAC. If it is possible to determine the faulty DAC, the fault code is DACn, where *n* is the number of the DAC.

6.1.3 I/O Multimodule

The LS710 architecture places all functions interfacing to all J-boxes on the I/O multimodule board, *drawing 80340177*. In this way, the simplest board is subject to the highest abuse from the process-mounted instrument interface. Also, all configuration parameters are stored on this board; therefore, the I/O multimodule board can be broken down into two areas, the memory and the I/O. The memory, baud generator, and UART are checked by the diagnostics. A fault in the memory is flagged EEPR. This test checks the address/data buffer, the 8255 (U2), and the EEPROM 2817 (U1). A problem with the 8251 (U3) or lack of serial communication with the J-box is flagged UART. *Schematic 80610043* is the same as above, except with optical isolation on RS422.

6.1.4 Expansion Circuit Board

The RAM chip is U6. The EPROM chip is U3. The RAM and EPROM diagnostics are performed during the calibration sequence. Any error detected is flagged as fault code RAM.

The diagnostic EPROM test (performed at calibration time) verifies the EPROM. Any error detected is flagged as fault code ROM. Some of the support chips that are verified are U1, U2, and U4. The SEQ error is generated when attempting to execute all ones, indicating ROM error.

6.2 Diagnostic Faults

A '!FAILURE' message is displayed any time a diagnostic fault is detected. To correct the fault, identify and replace the faulty circuit board(s) in the LS710. Failure messages are displayed on the status line.

Table 6-1 lists all of the LS710 diagnostic fault codes. The *FAULT* is the name of the fault displayed under the DIAGNOSTIC configuration menu, FAULT submenu. The *MODULE* indicates the circuit board that is at fault. The CPU board is the largest board, the I/O board has six relays in a row, and the DAC board and expansion PCA are the only boards with potentiometer adjustments. The *DESCRIPTION* column gives a description of the test that failed and caused the fault.

The codes in Table 6-1 are listed in a specific order. Replace circuit boards in the same sequence. For example, if you have identified a fault on the CPU board and one on the I/O board, replace the CPU board first and check to see if that also clears the I/O board fault before replacing the I/O board.

Table 6-2 describes the calibration diagnostics, including the status message that is displayed on the front panel and a description. With these messages the J-box number precedes the status message, except for J-box 1.

Table 6-3 is a list of possible instrument failures, including the failure message that is displayed and a description.

6.3 Fault Descriptions

Table 6-1: Fault Descriptions

Fault: RAM (Random Access Memory)

Module: CPU

Description: An error was detected when the diagnostic RAM test was performed (during the last calibration sequence). The RAM is essential to proper instrument operation. A RAM problem could result

in the instrument recording a constant output and failing to respond to operator commands, and other faults can be caused by a RAM error. No other fault should be resolved until the RAM error has been corrected.

More Information: See the CPU Circuit Board - Memory section.

Fault: ROM (Read Only Memory)

Module: CPU

Description: This is a checksum error that was detected during the diagnostic EPROM test (performed during the last calibration sequence). The ROM is as essential to instrument operation as the RAM (see the RAM fault description). Other faults can be caused by a ROM error. No other fault should be resolved until the ROM error has been corrected.

More Information: See section 6.1.1.

Fault: TIMR

Module: CPU

Description: This error indicates that timer chip durations are in error. The timer test is only performed on application of power to the LS710. Faulty timer symptoms are fixed strip chart recorder output, or the time to the next calibration is not timing out.

More Information: See section 6.1.1.3.

Fault: SEQ (Sequence)

Module: CPU

Description: This indicates a control circuit failure. The unit will restart automatically.

Fault: PIC (Peripheral Interrupt Controller)

Module: CPU

Description: This error indicates that data read from the interrupt mask was not the same as data written into the mask. Symptoms of a faulty PIC are: fixed strip chart recorder output, no control of the front panel, or the time to the next calibration is not timing out.

More Information: See section 6.1.1.4.

Fault: WDOG (Watchdog)

Module: CPU

Description: This error indicates that either an existing device failed to respond when queried or a nonexisting device was queried when the unit was in the calibration sequence diagnostic mode. When the WDOG fault is displayed, either the I/O board or (less likely) the DAC board could be at fault.

More Information: See section 6.1.1.

Fault: TRAP

Module: CPU

Description: This error indicates a failure in the watchdog circuitry when a faulty or nonexisting device has been queried to test the watchdog during the normal operating mode.

More Information: See section 6.1.1.

Fault: DAC (Digital-to-Analog Converter), DAC1, DAC2, DAC3, DAC4

Module: DAC

Description: An error was detected when the DAC output was checked against a fixed reference. The error might have been caused when the output was adjusted to compensate for an uncalibrated recorder. These diagnostics do not check the output drive circuitry on the DAC multimodule board.

More Information: See section 6.1.2 and *drawing 80340174* in *Chapter 5*.

Fault: PIO

Module: I/O

Description: This is an output device error related to the peripheral interface chip, which drives the front panel readout. There are no diagnostics performed on the front panel other than manual operator interaction.

More Information: See section 6.1.1.2.

Fault: EEPR

Module: I/O

Description: This fault indicates that the interrupt from the EEPROM support circuitry did not occur within the specified amount of time, an erroneous interrupt from the EEPROM circuitry occurred, or the power supply voltage is low.

More Information: See section 6.1.3 and *drawing 80340177* in *Chapter 5*.

6.4 Calibration Status

Note

More information about the calibration sequence and diagnostics can be found in *Chapter 2*.

Table 6-2: Calibration Diagnostics

Calibration Status: `REF TRANS` (transceiver)

Description: An error due to an out-of-tolerance reference signal. Refer to individual instrument manuals for more information.

Calibration Status: `AGC TRANS` (transceiver)

Description: (Applies to the EX4700A only.) An error that occurs when the EX4700A AGC (*automatic gain control*) is not within ±8 mA of 16 mA. See the *EX4700A Operation and Maintenance Manual* for more information.

Calibration Status: `CALIB STARTED`

Description: Appears only when manual calibration has been selected and if the system was not in calibration mode prior to selecting manual calibration.

Calibration Status: `CALIB IN PROG`

Description: Appears only when manual calibration has been selected and the system is in the calibration mode.

Calibration Status: `CAL PURGE`

Description: Appears while the process-mounted instrument measurement cavity is being purged of process gases.

Calibration Status: `ZERO CAL`

Description: Appears during the zero portion of an E-O or gas calibration sequence.

Calibration Status: `H CAL CAL`

Description: Appears during the span portion of the calibration sequence.

Calibration Status: GAS CAL

Description: Appears during the span portion of the gas calibration sequence.

Calibration Status: AUTO-ZERO

Description: Appears during the ENTIRE AUTO ZERO sequence.

Calibration Status: TEMP CHECK

Description: Appears when the calibration sequence is complete and waiting for valid data. During this period, the LS710 displays process temperature on all strip chart recorders not configured for SH (sample and hold).

Calibration Status: XX MANUAL

Description: Appears when the Auto/Manual switch in the J-box is set to the manual mode. XX = EX (EX4700A), SM (SM8100/SM8175), or MC (opacity monitors).

Calibration Status: CONTIN ZERO

Description: Appears if the continuous Z CAL parameter is entered in the CALIBRATION configuration menu, CONTIN submenu.

Calibration Status: CONTIN SPAN

Description: Appears if the continuous H CAL parameter is entered in the CALIBRATION configuration menu, CONTIN submenu.

Calibration Status: CONTIN GAS

Description: Appears if the continuous GAS parameter is entered in the CALIBRATION configuration menu, CONTIN submenu.

Calibration Status: ZERO ERR

Description: Appears if the zeros fall outside 4 ±3 mA. This also activates the status on the front panel.

Calibration Status: H CAL ERR

Description: Appears when the internal span is outside the limits specified for a process-mounted instrument. This also activates the status on the front panel.

Calibration Status: GAS ERR

Description: Appears, with a J-box number (except J-box 1), when a gas calibration has determined that gain adjustments, in excess of +10% must be made to correct the measurement to agree with the gas value entered.

6.5 Instrument Status

Note

EX status messages apply to EX4700A instruments, SM applies to SM8100/SM8175's, and MC applies to opacity monitors.

Table 6-3: Instrument Failures and Messages

Instrument Status: J-BOX UART

Description: Appears, with a J-box number, when the J-box transmission is faulty.

Instrument Status: EX IR SOURCE

Description: Appears when the source in the process-mounted instrument needs voltage adjustment or replacement.

Instrument Status: EX TEMP

Description: Appears when the detector temperature, filter temperature, or optic plate temperature of the process-mounted instrument is out of tolerance. This fault indicates that there is a failure in the process-mounted instrument's electro-optical system, potentially resulting in erroneous output.

Instrument Status: EX POWER

Description: Appears when a failure is detected in the process-mounted instrument power supply system.

Instrument Status: WINDOWS

Description: Appears, with a J-box number, when the zero compensation of an opacity monitor exceeds 4% opacity. All instrument glass exposed to the process should be cleaned during the next scheduled maintenance.

Instrument Status: !FAILURE

Description: Appears when the LS710 diagnostics detect a fault. See Table 6-1.

Instrument Status: OUT SERVICE

Description: Appears, with a J-box number, when a J-box and instrument have been taken out of service.

Instrument Status: MANUAL

Description: Appears, with a J-box number and an instrument type (SM, MC, or EX), when the J-box Manual switch is in the manual mode.

Instrument Status: SM TEMP

Description: Appears, with a J-box number, when the optic plate temperature of the process-mounted instrument is out of limits.

Instrument Status: SM SCANNER

Description: Appears, with a J-box number, when the scanner amplitude of the process-mounted instrument is out of tolerance.

Instrument Status: J-BOX UART

Description: Appears, with a J-box number, when the J-box transmission is faulty.

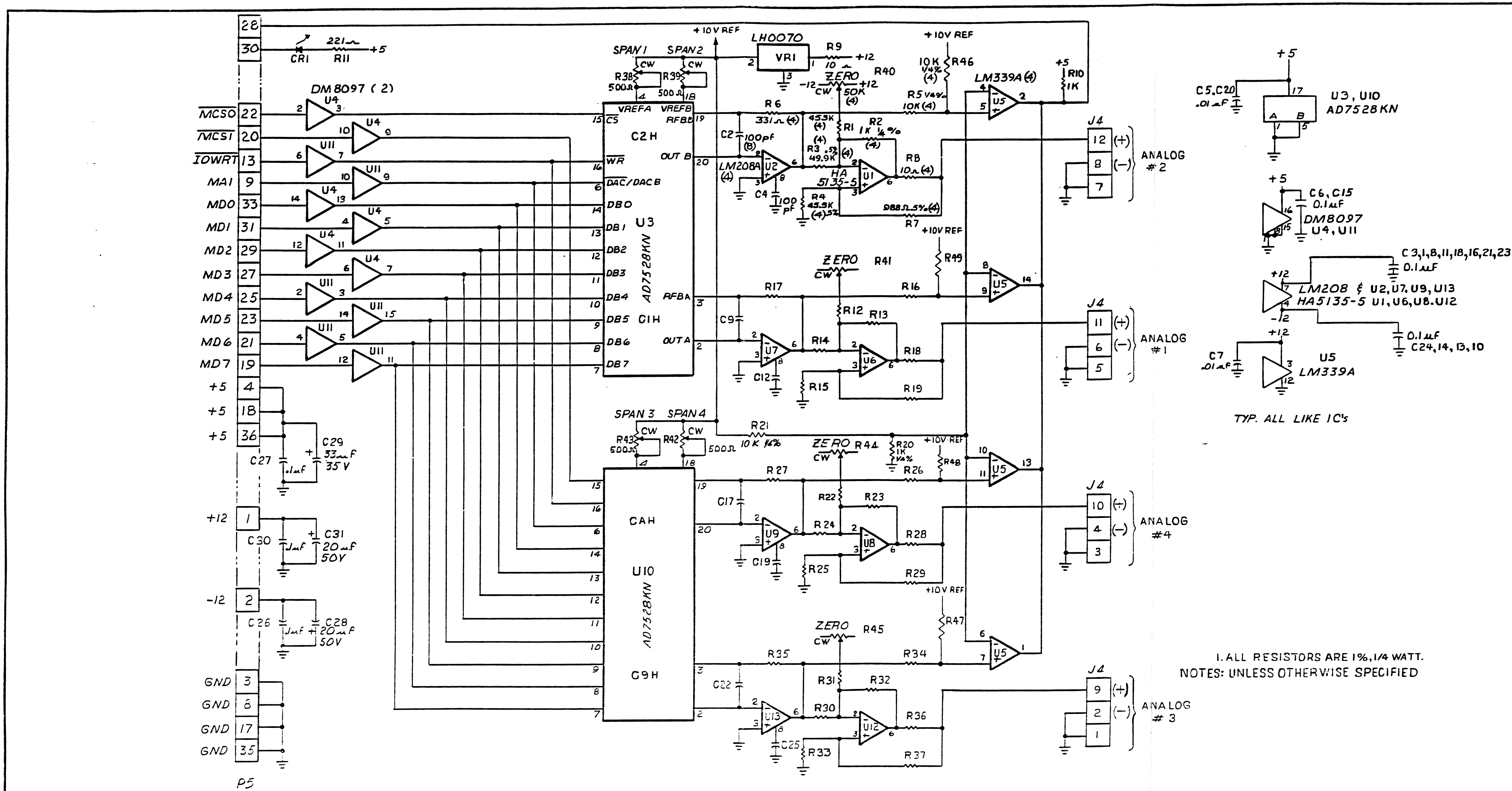
USER NOTES

7. ENGINEERING DRAWINGS

Part Number	Description
80340174	Schematic, DAC Multimodule
80340177	Schematic, I/O Multimodule
80610013	Schematic, LS710 Expansion Board
80610019-1	Wiring Diagram, 8 Analog LS710 Control Unit
80610019-2	Wiring Diagram, 4 Analog LS710 Control Unit
80610019-3	Wiring Diagram, 0 Analog LS710 Control Unit
80610020	Assembly, LS710 Control Unit
80610023-1	Wiring Diagram, LS710 to System J-Box(s)
80610024	LS710 Calibration Timing Diagram
80610032-1	Wiring Diagram, Interconnection, LS710 8 Analog
80610032-2	Wiring Diagram, Interconnection, LS710 4 Analog
80610035	LS710 Control Unit
80610037	Panel Mount Kit for LS710 Control Unit
80610058	Schematic, SRAM Adaptor Board

Table 7-1: Engineering Drawings

USER NOTES



NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTORS ARE 1%, 1/4 WATT.

PATENT NO. 4,560,873
DATE OF PAT. DEC. 24, 1985

LTR	DESCRIPTION	DATE	DRW	APPR
B	ECO 2507	11-11-85	DAC	
A	ER 125	6-6-85	FM²	
1	ENGINEERING REVISIONS	7-10-84	D.C	
0	PROTO-TYPE RELEASE	4-84	WAP	

REVISIONS

ITEM	PART NO	DESCRIPTION	QTY	MATERIAL

MATERIAL LIST

NEXT ASSEMBLY	USED ON
80340175	EX4700

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE THIS DRAWING

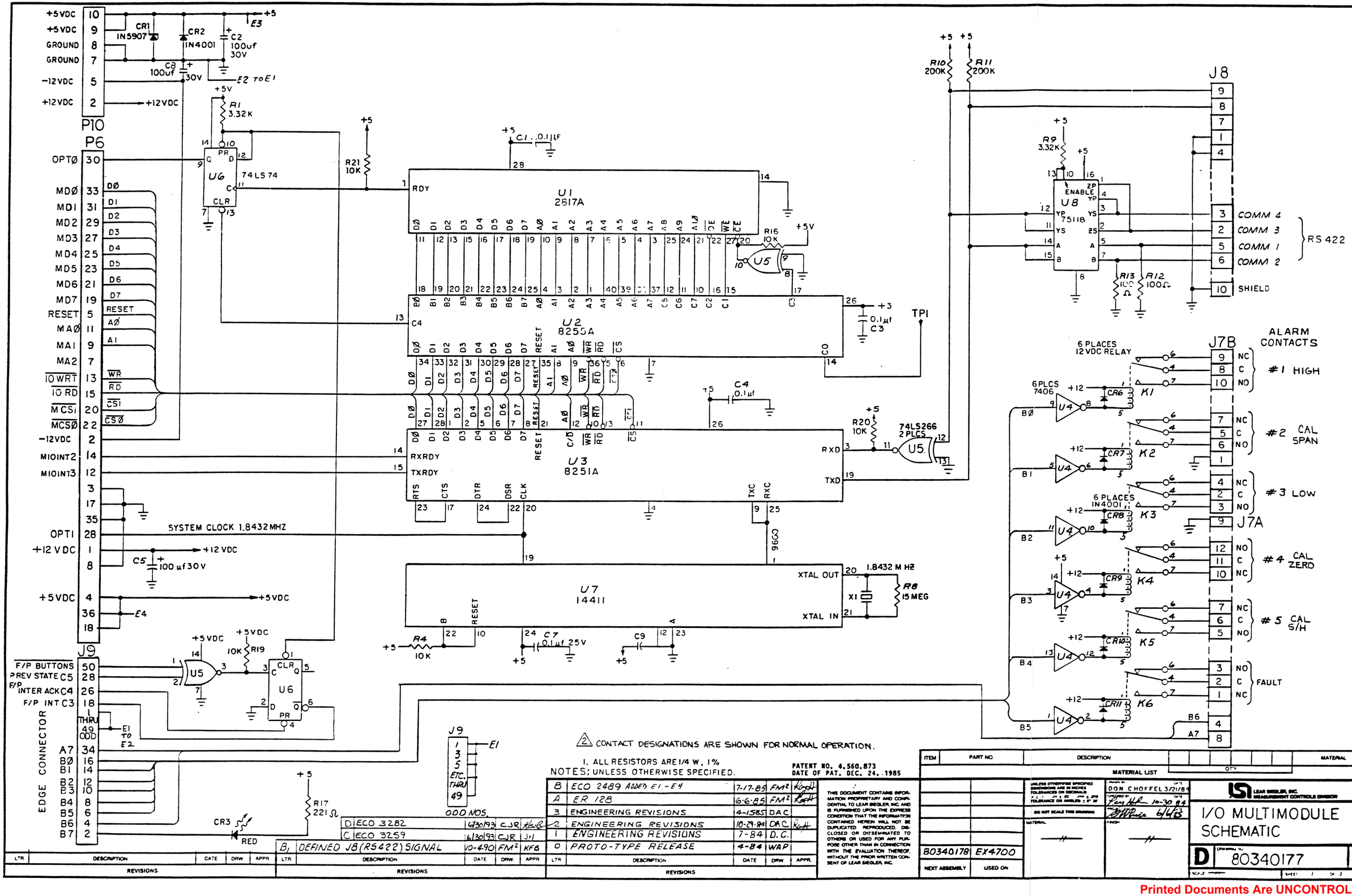
A. PIERCE 4-84

LEAR SIEGLER INC
MEASUREMENT CONTROLS DIVISION

DAC MULTIMODULE SCHEMATIC

D 80340174 B

SHEET 1 OF 1



2 CONTACT DESIGNATIONS ARE SHOWN FOR NORMAL OPERATION.

1. ALL RESISTORS ARE 1/4 W, 1%

NOTES: UNLESS OTHERWISE SPECIFIED.

PATENT NO. 4,560,873
DATE OF PAT. DEC. 24, 1985

LTR	DESCRIPTION	DATE	DRW	APPR
B	ECO 2489 ADDED E1 - E4	7-17-85	FM²	
A	ER 128	6-6-85	FM²	
3	ENGINEERING REVISIONS	4-1585	DAC	
2	ENGINEERING REVISIONS	10-29-84	DAC	
1	ENGINEERING REVISIONS	7-84	D.C.	
0	PROTO-TYPE RELEASE	4-84	WAP	
D	ECO 3282	6/30/93	CJR	
C	ECO 3259	6/30/93	CJR	JH
B1	DEFINED J8 (RS422) SIGNAL	10-4-90	FM²	KFB

REVISIONS

ITEM	PART NO.	DESCRIPTION	QTY	MATERIAL

MATERIAL LIST

80340178 | EX4700
NEXT ASSEMBLY | USED ON

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ON DECIMALS: .XX ± .02 .XXX ± .010. TOLERANCE ON ANGLES: ± 0° 30'

DO NOT SCALE THIS DRAWING

MATERIAL

FINISH

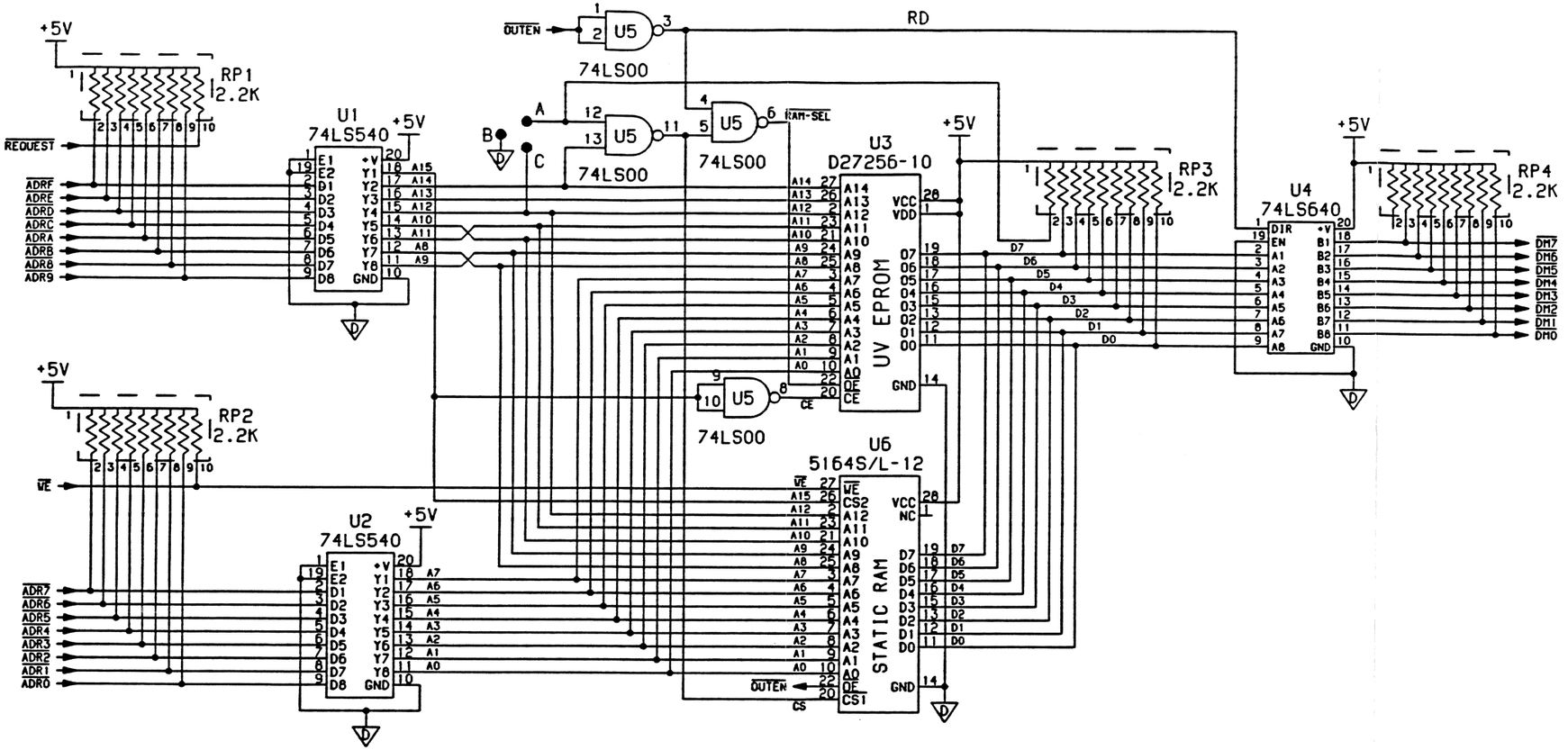
DRAWN BY DON CHOFFEL 3/21/84
CHECKED BY Ray Hl 10-30 84
APPROVED BY 6/4/93

LEAR SIEGLER, INC. MEASUREMENT CONTROLS DIVISION

I/O MULTIMODULE SCHEMATIC

D | 80340177 | D

SHEET 1 OF 1



I.C. POWER NOT SHOWN AT SYMBOLS				
REFERENCE DESIGNATOR	TYPE	PIN=PWR	PIN=PWR	PIN=PWR
U7	74LS05	14=+5V	7=DGND	
U8	74LS11	14=+5V	7=DGND	
U9	74LS27	14=+5V	7=DGND	
U11	LF347	4=+15V	11=-20V	

ASSEMBLY TABULATION			
ASSY No.	RAM	EPROM	JUMPER
80610014-1	0K	24K	A-B
80610014-2	4K	20K	A-C
80610014-3	8K	16K	NOT INSTALLED

U6 NOT USED ON -1 ASSEMBLY

3. USED FOR P.C.B. No. 80610012
2. CAPACITOR VALUES ARE IN uF.
1. RESISTOR VALUES ARE IN OHMS.

NOTES: UNLESS OTHERWISE SPECIFIED.

Printed Documents Are UNCONTROLLED

FILENAME= MP001301.SCH

LTR	DESCRIPTION	DATE	DRV	APPR
A	ENGINEERING RELEASE 3749		JDP	

REVISIONS

80610014

NEXT ASSEMBLY | USED BY

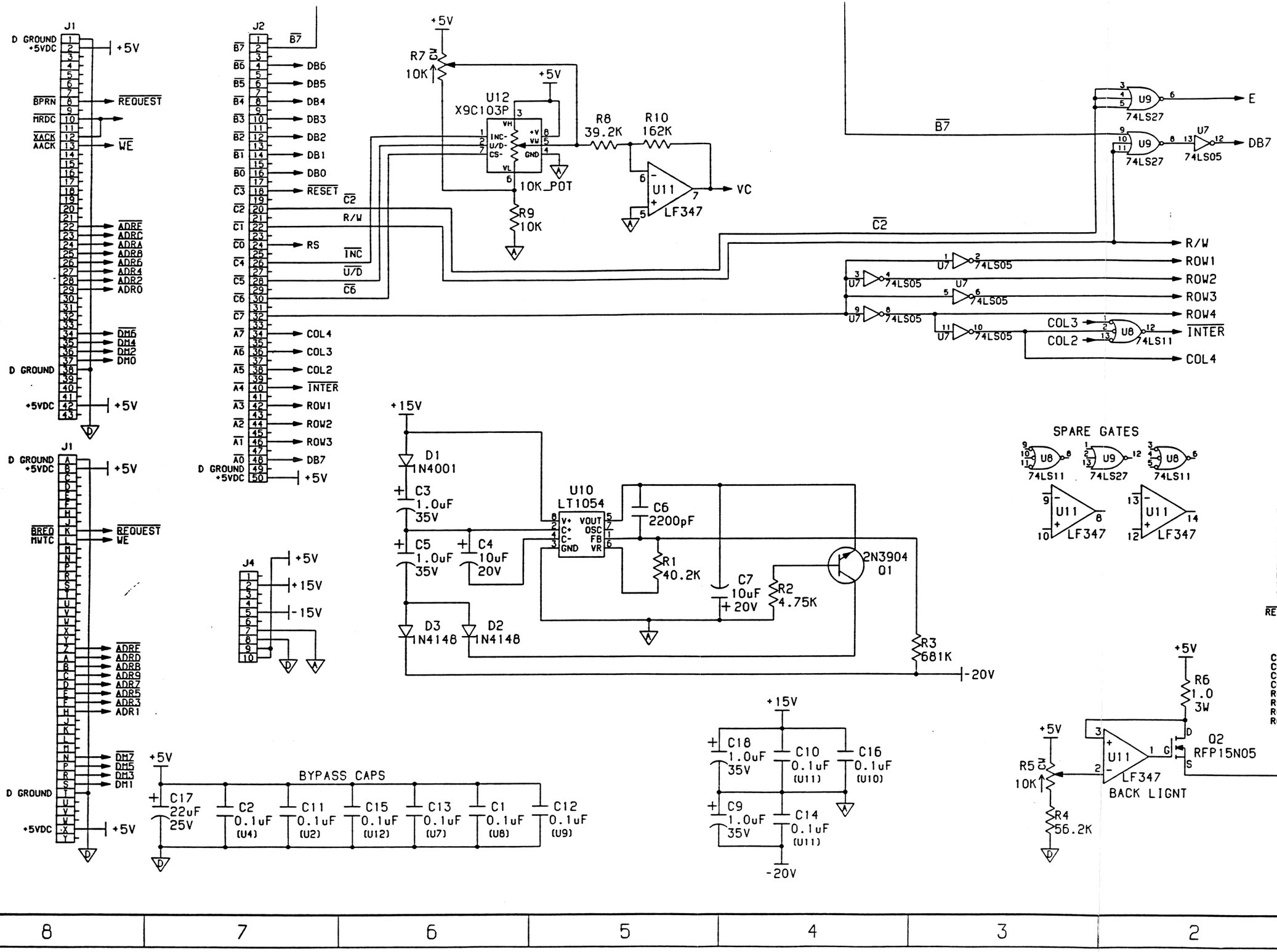
DRAWN BY PHILLIPS DATE 02/17/93
CHECKED BY DATE
PROJ ENG BY DATE 2/17/93
FINISH

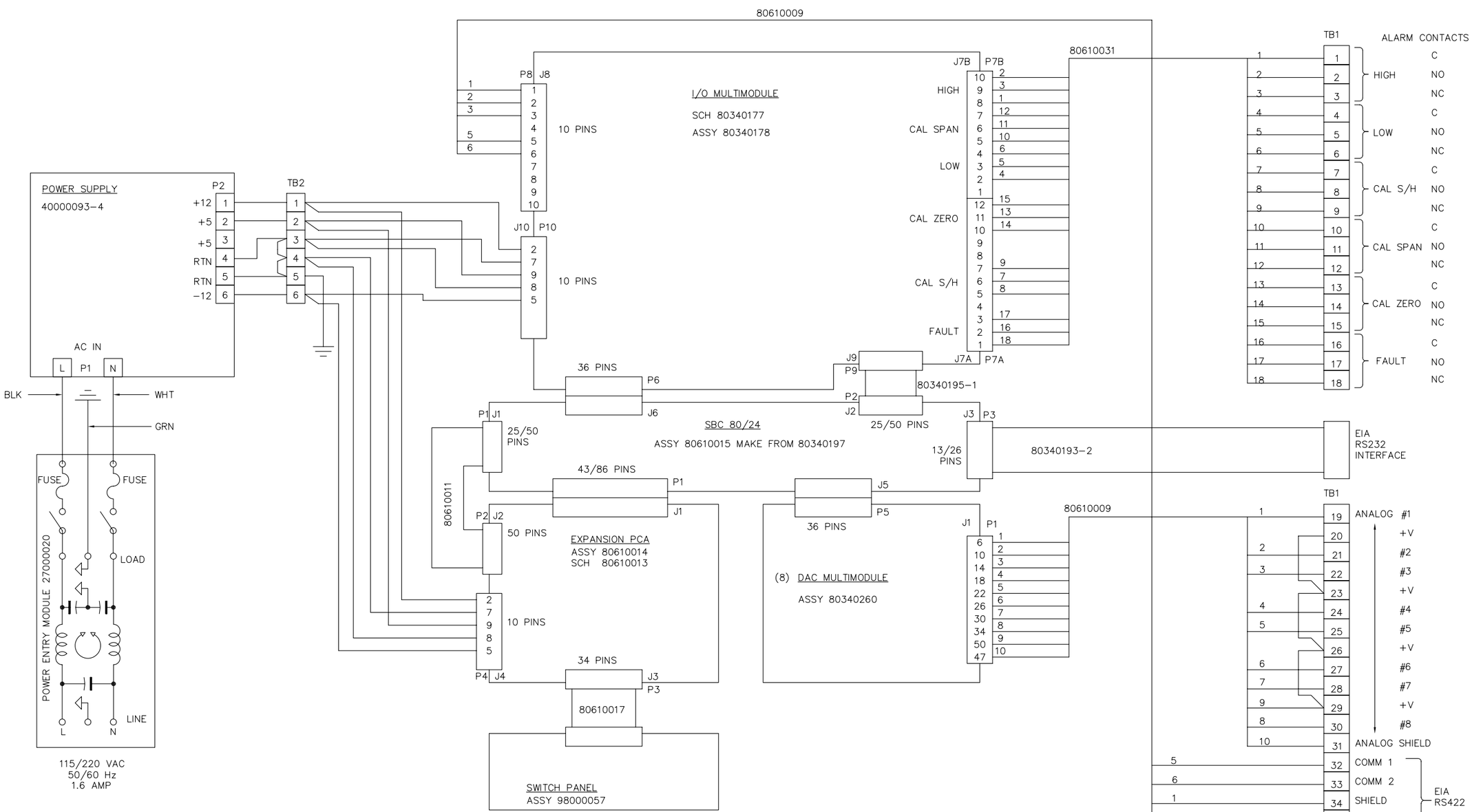
LEAR SIEGLER MEASUREMENT CONTROLS CORPORATION

SCHEMATIC
LS710
EXPANSION BD.

D | Drawing no. 80610013 | Rev. A

Scale | Sheet 1 Of 2





Printed Documents Are UNCONTROLLED

FILENAME= MP001911

LTR.	DESCRIPTION	DATE	DRAWN	APVD
E	ECO 6439- CHG POWER SUPPLY & WIRING	3/24/04	CJR	
D	REVISE PER ECO 4515	10/17/94	CJR	
C	REVISE PER ECO 4321	6/16/94	CJR	GWP
B	REVISE PER ECO 3982	8/12/93	CJR	GWP
A	RELEASE TO MFG PER ECO 3834	4/26/93	CJR	GWP

REVISIONS

NEXT ASSEMBLY	USED ON
80610019	LS710

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES
TOLERANCE ON DECIMALS .X±.1 .XX±.02 .XXX±.010
TOLERANCE ON ANGLES ±0°30'

DO NOT SCALE DRAWING

MATERIAL

FINISH

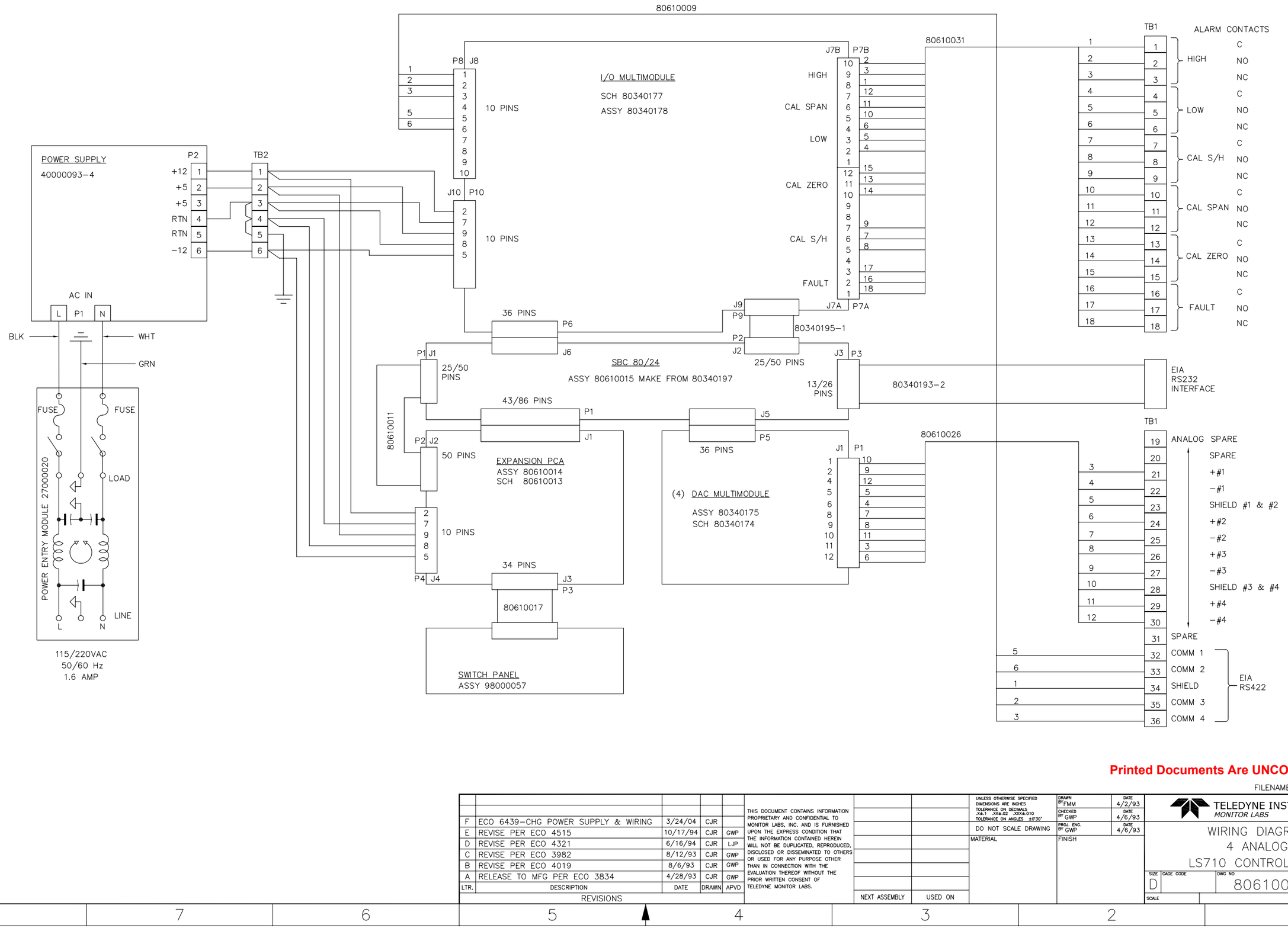
	BY	DATE
DRAWN	FMM	4/2/93
CHECKED	GWP	4/6/93
PROJ. ENG.	GWP	4/6/93

TELEDYNE INSTRUMENTS
MONITOR LABS

WIRING DIAGRAM- 8 ANALOG LS710 CONTROL UNIT

SIZE	CAGE CODE	DWG NO	REV
D		80610019-1	E

SCALE N/A SHEET 1 OF 1



Printed Documents Are UNCONTROLLED

FILENAME= MP001921

LTR.	DESCRIPTION	DATE	DRAWN	APVD
F	ECO 6439-CHG POWER SUPPLY & WIRING	3/24/04	CJR	
E	REVISE PER ECO 4515	10/17/94	CJR	GWP
D	REVISE PER ECO 4321	6/16/94	CJR	LJP
C	REVISE PER ECO 3982	8/12/93	CJR	GWP
B	REVISE PER ECO 4019	8/6/93	CJR	GWP
A	RELEASE TO MFG PER ECO 3834	4/28/93	CJR	GWP

REVISIONS

NEXT ASSEMBLY | USED ON

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES
TOLERANCE ON DECIMALS .X±.1 .XX±.02 .XXX±.010
TOLERANCE ON ANGLES ±0°30'

DO NOT SCALE DRAWING

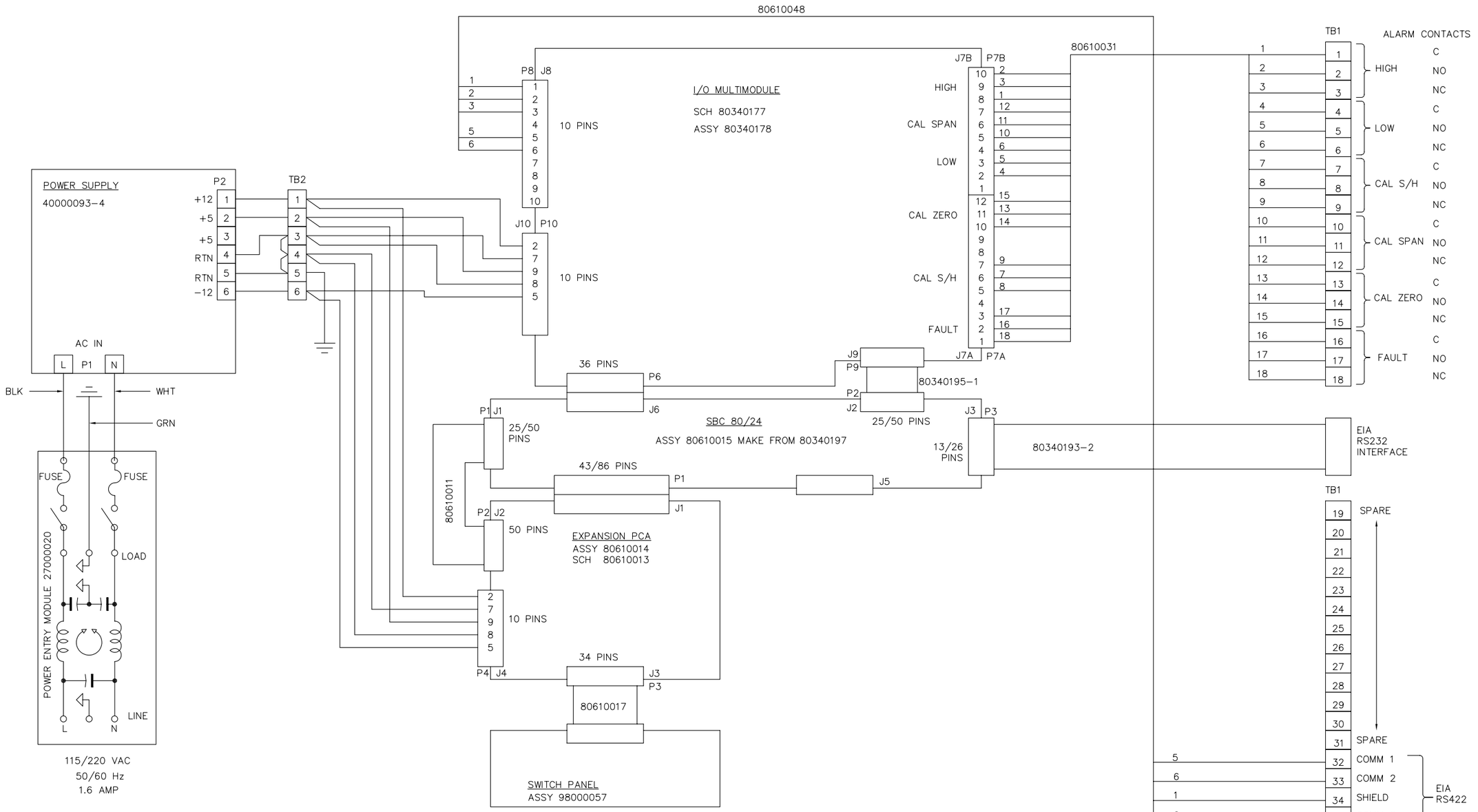
MATERIAL | FINISH

DRAWN BY FMM 4/2/93
CHECKED BY GWP 4/6/93
PROJ. ENG. BY GWP 4/6/93

TELEDYNE INSTRUMENTS
MONITOR LABS

WIRING DIAGRAM
4 ANALOG
LS710 CONTROL UNIT

SIZE D | CAGE CODE | DWG NO 80610019-2 | REV F
SCALE | SHEET 1 OF 1



Printed Documents Are UNCONTROLLED

FILENAME= MP001931

LTR.	DESCRIPTION	DATE	DRAWN	APVD
	REVISIONS			
C	ECO 6439-CHG POWER SUPPLY & WIRING	3/24/04	CJR	
B	REVISE PER ECO 4515	10/17/94	CJR	
A	RELEASE TO MFG ECO 4321	6/16/94	CJR	

NEXT ASSEMBLY	USED ON
80610019	LS710

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES
TOLERANCE ON DECIMALS .X±.1 .XX±.02 .XXX±.010
TOLERANCE ON ANGLES ±0°30'

DO NOT SCALE DRAWING

MATERIAL

FINISH

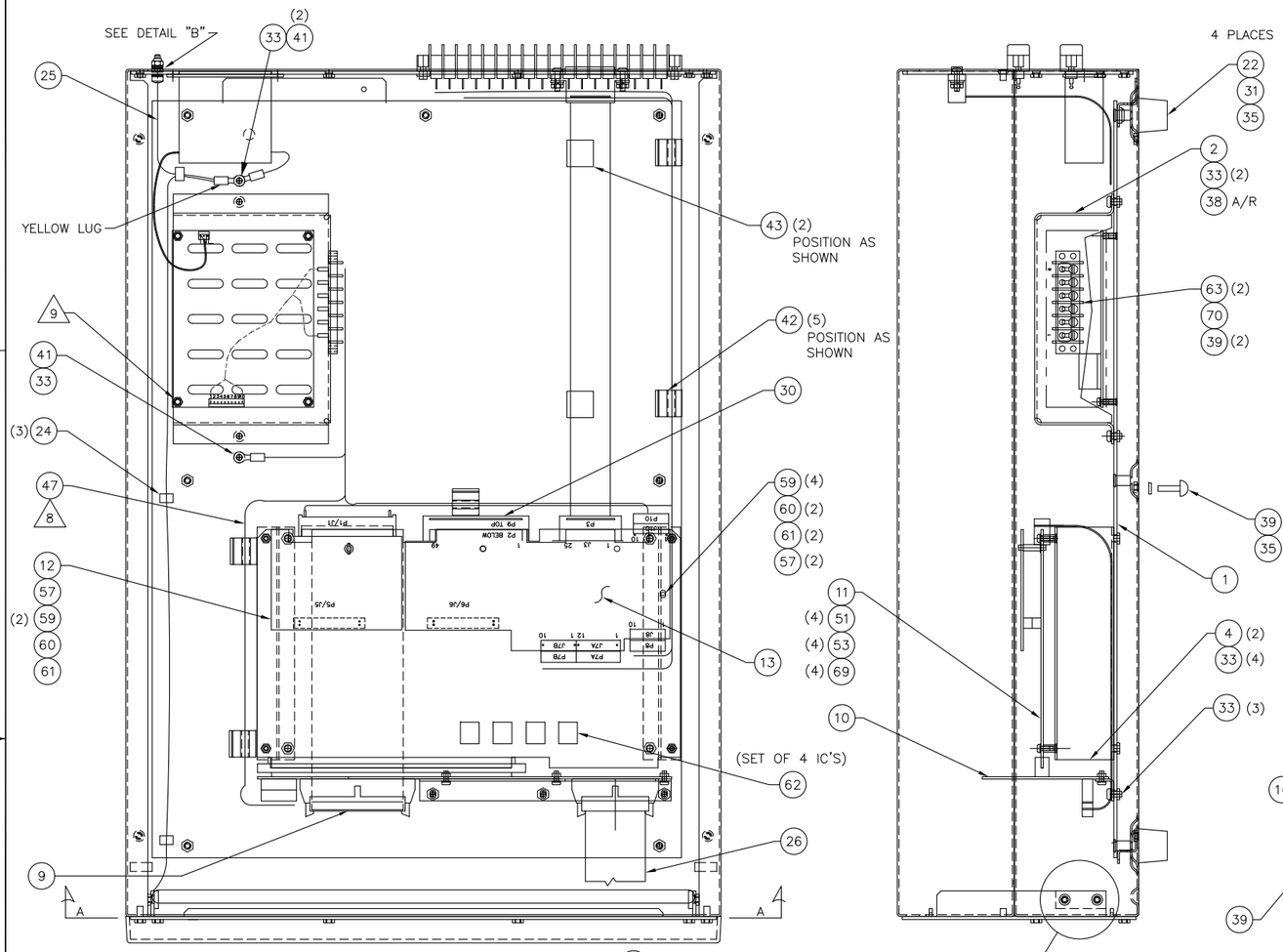
		DATE
DRAWN BY	RMM	4/2/93
CHECKED BY		DATE
PROJ. ENG. BY		DATE

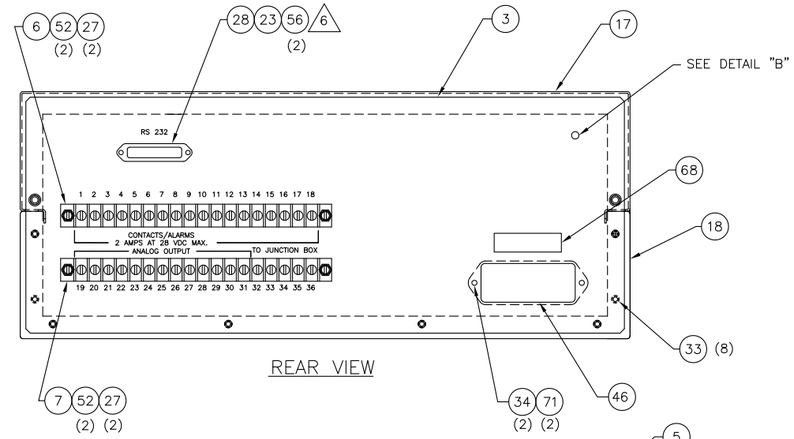
TELEDYNE INSTRUMENTS
MONITOR LABS

WIRING DIAGRAM
0 ANALOG
LS710 CONTROL UNIT

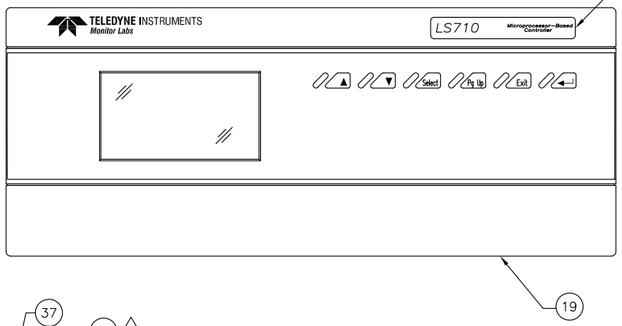
SIZE	CAGE CODE	DWG NO	REV
D		80610019-3	C

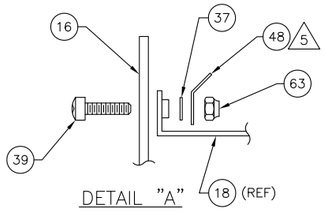
SCALE N/A SHEET 1 OF 1



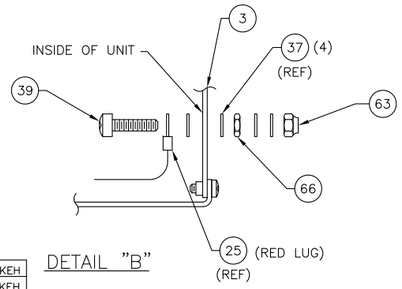


REAR VIEW

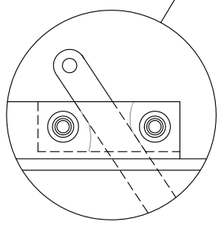




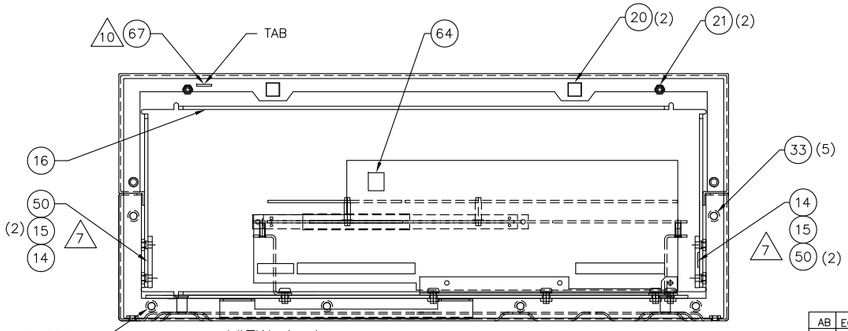
DETAIL "A"



DETAIL "B"



DETAIL "C"



VIEW A–A

NOTES:

1. WIRING DIAGRAM 80610019–1 (8 DAC).
2. WIRING DIAGRAM 80610019–2 (4 DAC).
3. DELETED
4. WIRING DIAGRAM 80610019–3 (W/O DAC)

5 CONNECT CABLE (25) TO THIS QUICK CONNECT (48), USING THE YELLOW FEMALE QUICK CONNECT IN THE MIDDLE OF THE CABLE.

6 MUST BE SMALL PATTERN TO ALLOW MATING CONNECTOR ADEQUATE ENGAGEMENT.

7 "SANDWICH" HINGE ARMS (FROM ITEM (19)) WITH RETAINERS, ITEMS (14) & (15). ORIENT AS SHOWN IN DETAIL "C".

8 CONNECT P4, J10–7 TO TB2–4
CONNECT P4, J10–8 TO TB2–3

9 MOUNT POWER SUPPLY ASSY TO PLATE (1) WITH SCREWS ATTACHED. REFERENCE M4 X 12MM KEPS (TML # 28001188–43).

10 CONNECT GROUNDING CABLE (FOR TOP COVER) (67) TO END OF CABLE (25) AND "TAB" AS SHOWN ON COVER (FRONT INSIDE).

PARTS NOT SHOWN:

(32) 80610054 SPEC CHANGE (–7 ONLY)(1)
(49) 80610049 MANUAL (2)
(62) 80610045–1 PROMSET (–21)(1)
(62) 80610052–1 PROMSET (–7 ONLY)(1)
(64) 80610047 CONSTANTS PROM (–21)(1)
(64) 80610053 CONSTANTS PROM (–7 ONLY)(1)
(65) 980036–2 RACK MOUNT KIT (1)

ASSEMBLY NUMBER TABULATION CHART	
ASSEMBLY NUMBER	DESCRIPTION
80610020–7	8 DAC 110/230 VAC (HI–CO_2 ONLY)
80610020–21	8 DAC 110/230 VAC

LTR.	DESCRIPTION	DATE	DRAWN	APPR
AB	ECO 6482–REPLACE 25000032 LABEL W/009–004000	10/18/04	CR	KEH
AA	ECO 6439– MULTIPLE CHANGES	3/24/04	CR	KEH
Y	ECO 6382– MULTIPLE CHANGES	8/18/03	CR	KEH
W	ECO 6244– MULTIPLE CHANGES	3/12/02	CR	KEH
V	ECO 6070– REVISE QTY OF ITEM 35 & 39	2/8/00	CR	KEH
U	REVISE PER ECO 5722	4/27/98	CR	KEH
T	REVISED PER ECO 5557	1/16/98	CR	KEH
S	REVISED PER ECO 5147	02JAN97	JDP	KEH
R	REVISED PER ECO 4945	3/1/96	JDP	KEH
P	REVISED PER ECO 4792	6/27/95	JDP	KEH
N	REVISED PER ECO 4764	4/17/95	CJR	KEH

REVISIONS

LTR.	DESCRIPTION	DATE	DRAWN	APPR
AE	SEE DCN 80610020AE FOR CHANGE; REF ECO 6695	3/13/08	CAD	JR
AD	SEE DCN 80610020AD FOR CHANGE; REF ECO 6690	3/7/08	CAD	JN
AC	SEE DCN 80610020AC FOR CHANGE; REF ECO 6607	9/27/06	CAD	JN

NEXT ASSEMBLY	USED ON
	SM8100A
	SM8175
	RM4200
	EX4700A

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES
TOLERANCE ON DECIMALS .X±.1 .XX±.02 .XXX±.010
TOLERANCE ON ANGLES ±0°30'

DO NOT SCALE DRAWING

MATERIAL

DRAWN BY FMM DATE 4/6/93
CHECKED BY GW PRICE 4–12–93
PROJ. ENG. BY GW PRICE 4–12–93
FINISH

TELEDYNE INSTRUMENTS
Monitor Labs
A Teledyne Technologies Company

ASSEMBLY
LS710
CONTROL UNIT

SIZE D | CAGE CODE | DWG NO 80610020 | REV AE
SCALE 1/2 | SHEET 1 OF 5

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	UNIT QTY						REFERENCE	TOTAL REQ.	STOCK ISSUED	SHORT QTY
			-7			-21						
1	80610003	MOUNTING PLATE	1			1						
2	80610028	COVER, PWR SUPPLY	1			1						
3	80610034	REAR PANEL	1			1						
4	80610006	BRACKET, SBC BOARD	2			2						
5	80610007	LABEL, MODEL NO.	1			1						
6	80610031	CABLE ASSY P7A/B-TB1/18	1			1						
7	80610009	CABLE ASSY P1/P8-TB19/36	1			1						
9	80610011	CABLE ASSY CPU-EXP BOARD	1			1						
10	80610014	PC ASSY - EXPANSION	1			1						
11	80610015	SBC ASSY - MODIFIED	1			1						
12	80340260-1	MULTI-MODULE ASSY 8 DAC	1			1						
13	80340178-1	I/O ASSY	1			1						
14	98000037	HINGE RETAINER RT.	2			2						
15	98000038	HINGE RETAINER LF	2			2						
16	98000049	FRONT PANEL	1			1						
17	98000051-2	COVER, STD ENCLOSURE	1			1						
18	98000052-2	BASE, STD ENCLOSURE	1			1						
19	98000058	BEZEL ASSY	1			1						
20	28001136	RETAINER 1/4 TURN	2			2						
21	28001137	STUD	2			2						

DRAWN BY	DATE	CHECKED BY	DATE	PROJ. ENG. BY	DATE
FMM	02JAN97	RE SNYDER	11-10-93	GW PRICE	4-12-93

TELEDYNE INSTRUMENTS
Monitor Labs
A Teledyne Technologies Company

LS710 CONTROL UNIT ASSY

SIZE	CAGE CODE	DWG NO	REV
A		80610020	AE

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	UNIT QTY						REFERENCE	TOTAL REQ.	STOCK ISSUED	SHORT QTY
			-7			-21						
22	014-070030	BUMPER (FOOT)	4			4						
23	21000539-6	JACK SOCKET ASSY (PAIR)	1			1						
24	98000106-1	CLAMP W/FOAM .50	3			3						
25	80610064	CABLE, GROUNDING	1			1						
-												
26	80610017	CABLE ASSY KEYBOARD TO EXPANSION BD	1			1						
27	28001324-03	M3 SPLIT LOCKWASHER SS	4			4						
28	80340193-2	CABLE ASSY RS232	1			1						
29												
30	80340195-1	CABLE ASSY CPU TO I/O	1			1						
31	28001197-47	SCREW PAN HD M4 X 25mm	4			4						
32	80610054	HI-RANGE CO_2 0-40% SPEC CHANGE	1			-						
33	28001188-41	SCREW PAN HD (M4 X 8mm) KEP	24			24						
34	28001188-33	SCREW, PAN HD (M3 X 10) KEP	2			2						
35	28001324-04	SPLIT LOCKWASHER M4 SS	7			7						
36												
37	28001296-108	LOCK WASHER, INT.EXT #8	5			5						
38	28001153-3	GROMMET	A/R			A/R						
39	28001197-45	SCREW, M4 X 16mm	7			7						
40												
41	28001266-108	LOCK WASHER, INTERNAL STAR ST ST #8	3			3						
42	028-080020	CLAMP FOR WIRE BUNDLES	5			5						
43	028-080150	CLAMP FOR RIBBON CABLE	2			2						
44												

DRAWN BY	DATE	CHECKED BY	DATE	PROJ. ENG. BY	DATE
FMM	02JAN97	RE SNYDER	11-10-93	GW PRICE	4-12-93

TELEDYNE INSTRUMENTS
Monitor Labs
A Teledyne Technologies Company

LS710 CONTROL UNIT ASSY

SIZE	CAGE CODE	DWG NO	REV
A		80610020	AE

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	UNIT QTY −7			UNIT QTY −21			REFERENCE	TOTAL REQ.	STOCK ISSUED	SHORT QTY
45												
46	80610030	POWER ENTRY ASSY	1			1						
47	80610033	CABLE ASSY TB2 TO P4/J10	1			1						
48	21000839	QUICK CONNECT	1			1						
49	80610049	MANUAL, LS710 FOR SM8175	2			2						
50	28001188−43	SCREW PN HD W/LOCK WASHER M4 X 12mm	4			4						
51	28001280−0416	SCREW, PN HD, 4−40 X 1/2, ZINC	4			4						
52	28001197−37	SCREW PN HD M3 X 20mm	4			4						
53	28001324−04	SPLIT LOCK WASHER, #4, S.S.	4			4						
54												
55												
56	028−000810	SMALL PATTERN #6 WASHER	2			2						
57	28001259−306	6−32 NYLON NUT	3			3						
58												
59	28001306−6	#6 FLAT NYLON WASHER	6			6						
60	28000982−1	6−32 X 1/2" NYLON SPACER MALE/FEMALE	3			3						
61	28001267−605S	SCREW PN HD (NYLON) 6−32 X 5/16 SLOT	3			3						
62	80610052−1	PROM SET PRGM U−52−U55	1			−						
63	28001190−3	LOCK NUT, M4	4			4						
64	80610047	CONSTANTS PROM	−			1						
64	80610053	CONSTANTS PROM	1			−						
		NOTE: POWER CORD TO BE IDENTIFIED BY S/O.										

DRAWN BY FMM DATE 02JAN97 | CHECKED BY RE SNYDER DATE 11−10−93 | PROJ. ENG. BY GW PRICE DATE 4−12−93

LS710 CONTROL UNIT ASSY

TELEDYNE INSTRUMENTS
Monitor Labs
A Teledyne Technologies Company

SIZE	CAGE CODE	DWG NO	REV
A		80610020	AE

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	UNIT QTY						REFERENCE	TOTAL REQ.	STOCK ISSUED	SHORT QTY
			7			21						
65	98000036-2	RACK MOUNT KIT	1			1						
66	28001195-7	HEX NUT, M4	1			1						
67	98000226	COVER GROUND M/F CABLE	1			1						
68	009-004000	LABEL, S/N (SERIAL NUMBER) TML BLUE	1			1						
69	28001304-04	FLAT WASHER, #4, S.S.	4			4						
70	80610073	POWER SUPPLY W/PLATE AND TERM BLOCK	1			1						
71	28001190-1	STOP NUT M3	2			2						

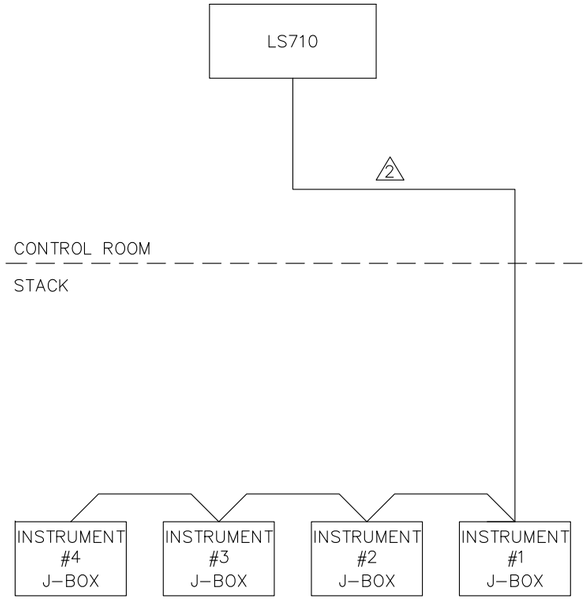
DRAWN BY	DATE	CHECKED BY	DATE	PROJ. ENG. BY	DATE
CJR	02JAN97				

TELEDYNE INSTRUMENTS
Monitor Labs
A Teledyne Technologies Company

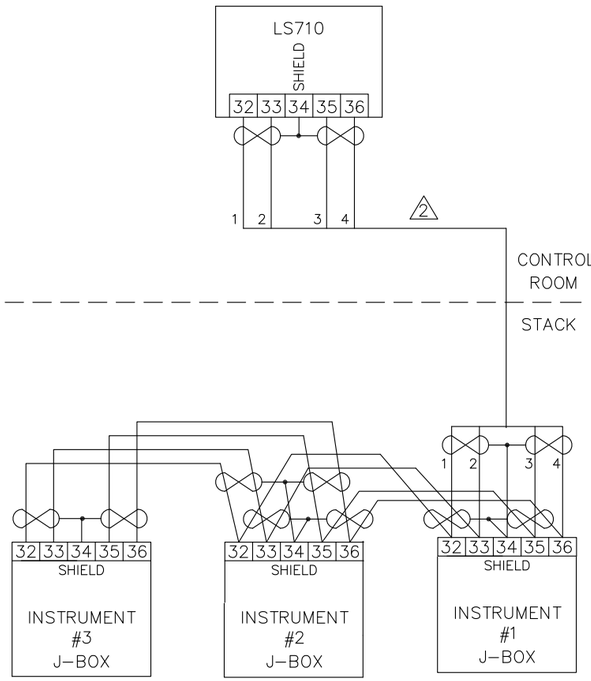
LS710 CONTROL UNIT

SIZE	CAGE CODE	DWG NO	REV
A		80610020	AE

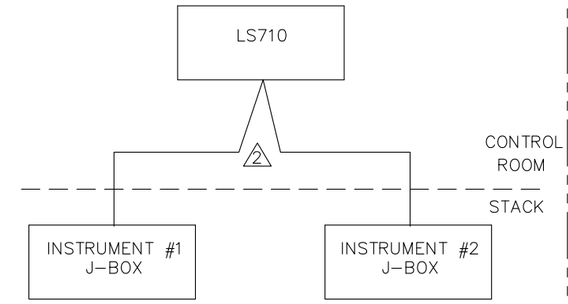
SHEET 5 OF 5



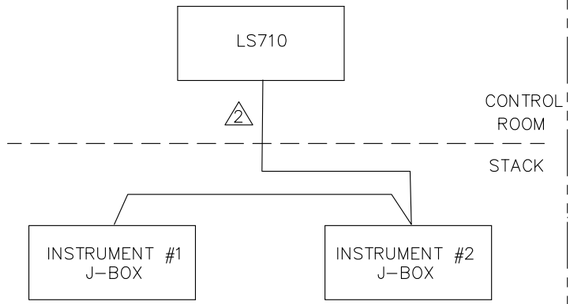
FOUR INSTRUMENT CONFIGURATION



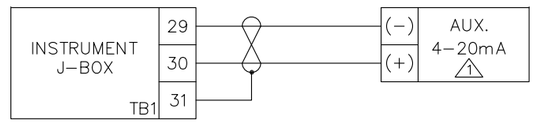
THREE INSTRUMENT CONFIGURATION



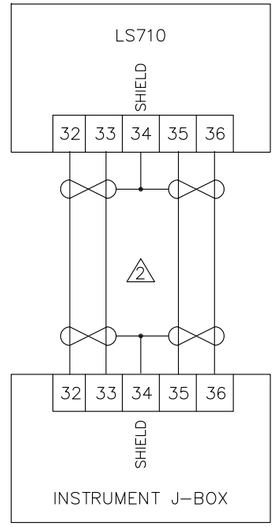
DUAL STACK CONFIGURATION



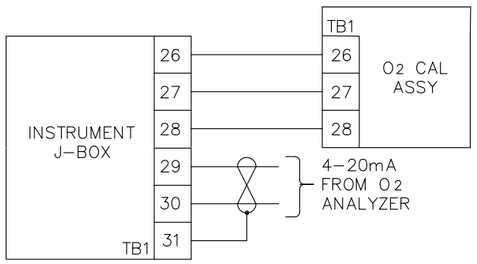
DUAL INSTRUMENT CONFIGURATION



TYPICAL J–BOX CONNECTION
AUXILIARY INPUT



SINGLE INSTRUMENT CONFIGURATION
DATA TRANSMISSION LINE
CONNECTIONS



TYPICAL J–BOX CONNECTION
O2 CALIBRATION OPTION

NOTES:

1. ALL INSTRUMENT J–BOXES HAVE PROVISION FOR ONE LINEAR 4–20mA DC AUXILIARY INPUT. TYPICALLY: O2 AUX. INPUTS ARE ASSOCIATED WITH CO, CO2, SO2 & NO MEASUREMENTS; VELOCITY AUX. INPUTS ARE ASSOCIATED WITH OPACITY/O.D. MEASUREMENTS.
   NOTE: POLARITY FOR SM8100A/B: "+" CONNECTS TO TERMINAL 30, "–" CONNECTS TO TERMINAL 29.
   POLARITY FOR SM8160/8175: "+" CONNECTS TO TERMINAL 29, "–" CONNECTS TO TERMINAL 30.

2. CAUTION
   THIS COMMUNICATION CABLE MUST BE ROUTED AWAY FROM RFI/EMI INTERFERENCE AND SHIELD WIRE CONNECTED AT TERMINAL 34 ON BOTH ENDS

3. INSURE LS710 & ASSOCIATED J–BOXES GROUNDS ARE CONNECTED TO EARTH GROUND WITH NO GROUND FAULT, & COMMUNICATION CABLE SHIELD IS CONNECTED TO BOTH ENDS BUT NOT TO EARTH GROUND.

LTR.	DESCRIPTION	DATE	DRAWN	APPR
D	SEE DCN 80610023–1D; REF ECO 6801	4/17/09	CAD	GFW
C	ADD MANUAL #'S TO TITLE BLK– ECO 5762	7/14/98	CJR	LS
B	ECO 5730–ADD MANUAL # TO TITLE BLK	5/8/98	CJR	GWP
A	RELEASE PER ECO 3749	2/19/93	FMM	GWP

REVISIONS

NEXT ASSEMBLY	USED ON
	81600002 SM8160 MANUAL
	81750003 SM8175 MANUAL
	80250257–1 EX4700A MANUAL

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES
TOLERANCE ON DECIMALS .X±.1 .XX±.02 .XXX±.010
TOLERANCE ON ANGLES ±0°30'

DO NOT SCALE DRAWING

MATERIAL

FINISH

DRAWN BY FMM 2/11/93
CHECKED BY
PROJ. ENG. BY

TELEDYNE MONITOR LABS
A Teledyne Technologies Company

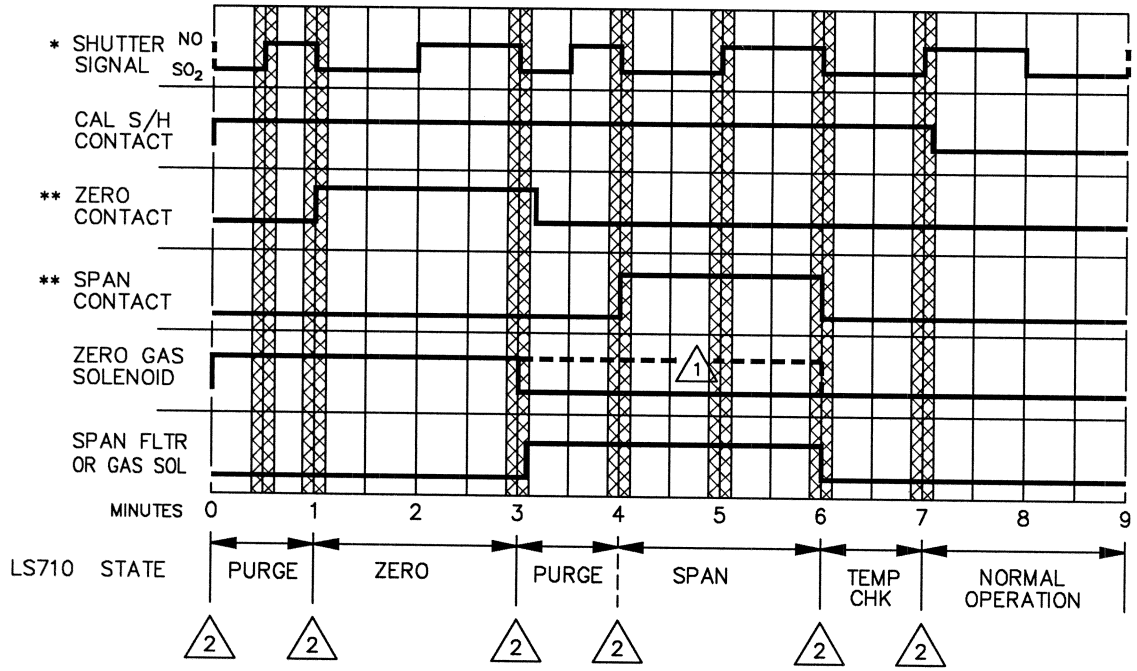
WIRING DIAGRAM LS710 TO SYSTEM J–BOX(s)

SIZE D | CAGE CODE | DWG NO 80610023–1 | REV D

SCALE | SHEET 1 OF 1

DWG NO 80610024 SH

REVISIONS				
LTR.	DESCRIPTION	DATE	DWN	APVD
A	MANUFACTURING RELEASE	2/10/93	FMM	GWP
B	REVISED PER ECO 5109	25SEP96	JDP	GWP



* APPLICABLE FOR SM8100 ONLY.

** VALID DATA PEROID.

2 0 TO 5 SECOND DELAY.

1 TRUE DURING E/O CALIBRATION ONLY.

FILENAME= MP002401.--B

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES
TOLERANCE ON DECIMALS .X±.1 .XX±.02 .XXX±.010
TOLERANCE ON ANGLES ±0°30'

DO NOT SCALE DRAWING

MATERIAL

FINISH

DRAWN BY FMM	DATE 2/10/93
CHECKED BY GW PRICE	DATE 2/12/93
PROJ. ENG. BY	DATE 9/26/96

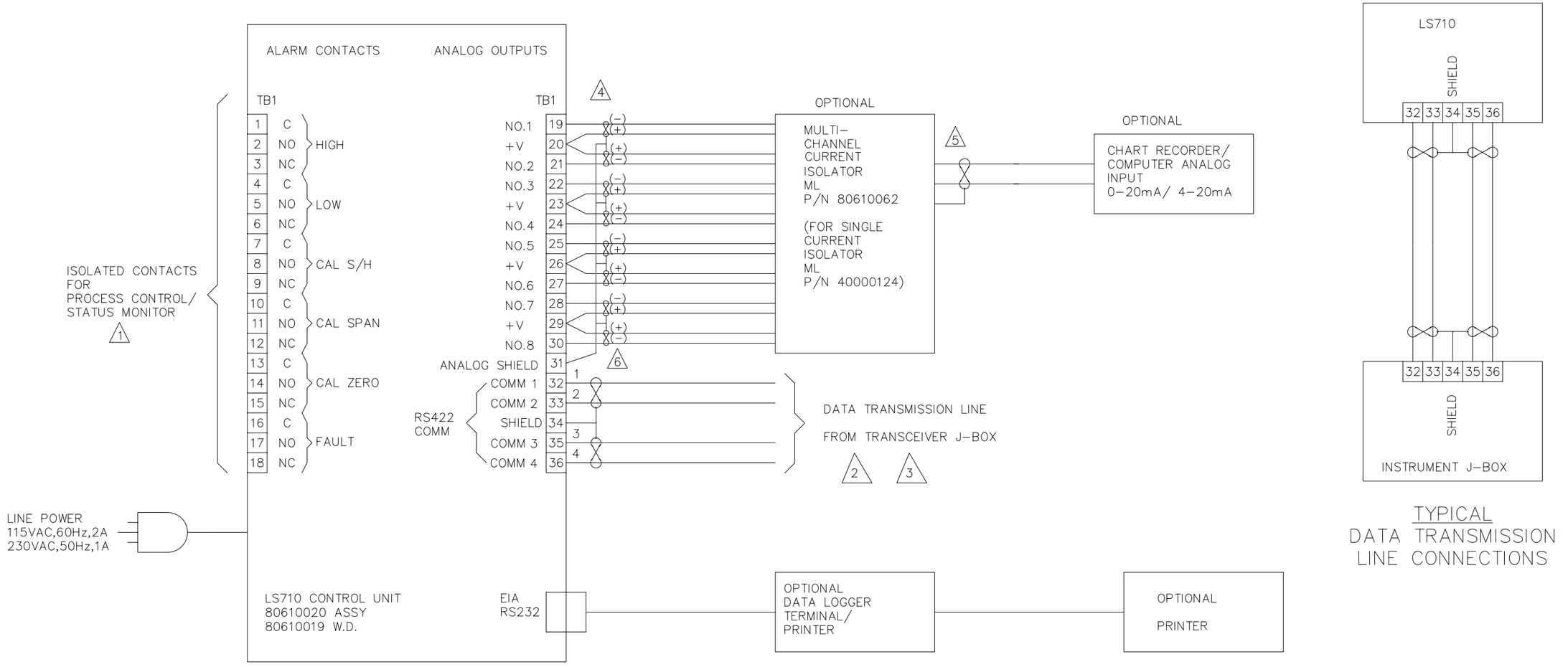
MONITOR LABS, INC.
74 INVERNESS DRIVE EAST
ENGLEWOOD, COLORADO 80112

LS710 CALIBRATION TIMING DIAGRAM

SIZE	CAGE CODE	DWG NO	REV
A		80610024	B

SCALE NONE SHEET 1 OF 1

PLOTTED 09/26/1996 14:39:18



TYPICAL
DATA TRANSMISSION
LINE CONNECTIONS

NOTES

1. 2 AMP @ 28VDC RESISTIVE.
2. FOR MULTI–INSTRUMENT CONFIGURATION SEE DWG. 80610023.
3. MAXIMUM LENGTH 2000 FEET.
4. MAXIMUM RESISTANCE 500 OHMS.
5. MAXIMUM RESISTANCE 600 OHMS.
6. TWISTED SHIELDED PAIRS ARE RECOMMENDED AND SHOULD BE WIRED AS SHOWN. SHIELDING MAY BE OMITTED IF THE WIRING IS KEPT ISOLATED FROM POWER WIRING AND OTHER ELECTRICAL NOISE PRODUCING DEVICES.

FILENAME=MP003211

LTR.	DESCRIPTION	DATE	DRAWN	APPR
D	ECO 5762–ADD MANUAL #'S TO TITLE BLK	7/14/98	CJR	
C	REVISE PER ECO 5730	5/13/98	CJR	GWP
B	REVISED PER ECO 5116	10/11/96	DAC	GWP
A	RELEASE PER ECO 3834	4/7/93	FM2	GWP

REVISIONS

NEXT ASSEMBLY	USED ON
	81600002 SM8160 MANUAL
	81750003 SM8175 MANUAL
	80250257–1 EX4700A MANUAL

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE INCHES
TOLERANCE ON DECIMALS
X±.1 XX±.02 XXX±.010
TOLERANCE ON ANGLES ±0°30'

DO NOT SCALE DRAWING

MATERIAL

FINISH

DRAWN BY FMM 4/5/93
CHECKED BY
PROJ. ENG. BY GWP 4/12/93

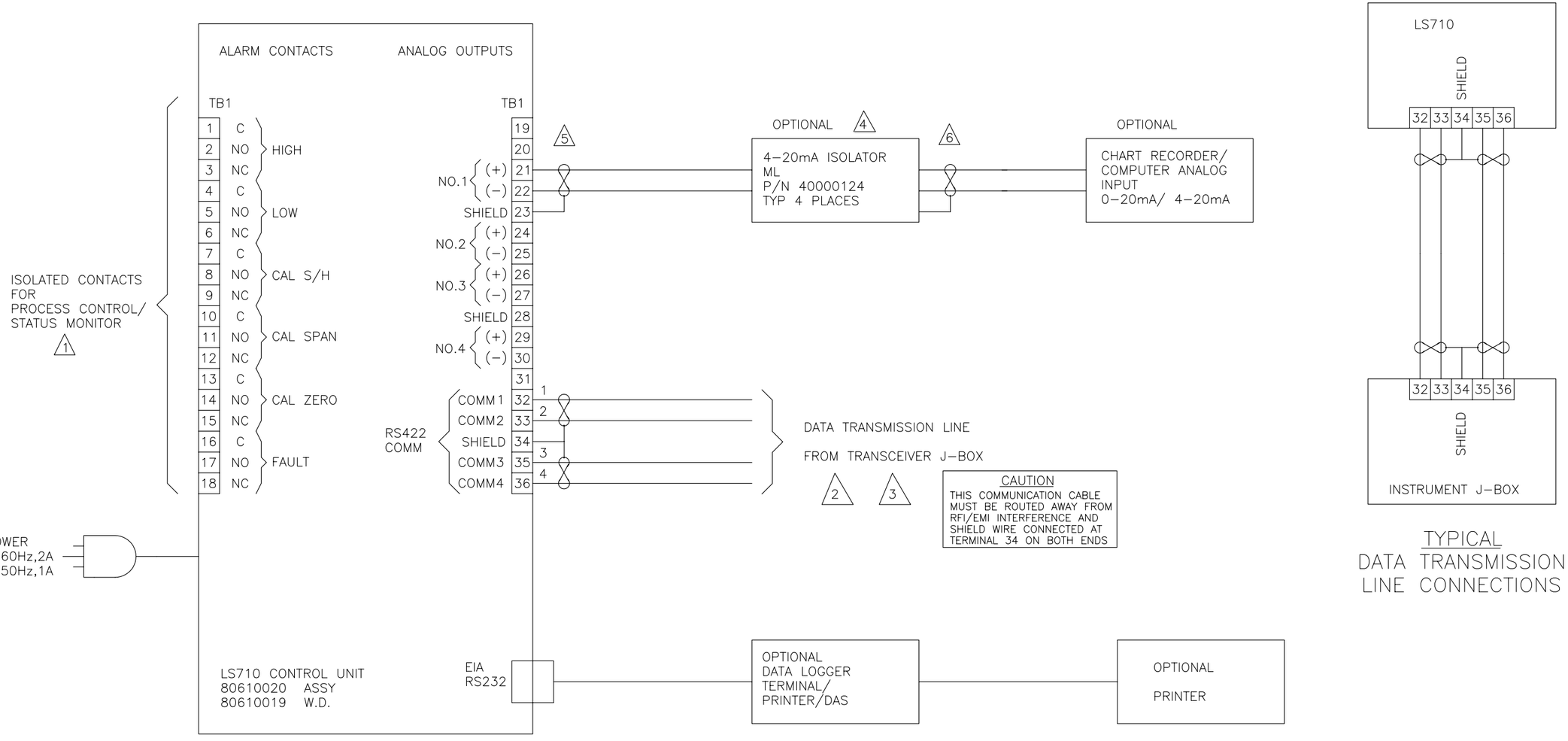
MONITOR LABS, INC.
74 INVERNESS DRIVE EAST
ENGLEWOOD, COLORADO 80112

WIRING DIAGRAM
INTERCONNECTION
LS710 8 ANALOG

SIZE D | CAGE CODE | DWG NO 80610032–1 | REV D

SCALE | SHEET 1 OF 1

PLOTTED 10/11/1996 14:40:15



TYPICAL DATA TRANSMISSION LINE CONNECTIONS

NOTES

1. 2 AMPS @ 28VAC RESISTIVE.
2. FOR MULTI−INSTRUMENT CONFIGURATION SEE DWG. 80610023.
3. MAXIMUM LENGTH 2000 FEET.
4. SINGLE CURRENT ISOLATOR FOR MULTI−CHANNEL CURRENT ISOLATOR ORDER 80610062.
5. MAXIMUM RESISTANCE 400 OHMS.
6. MAXIMUM RESISTANCE 600 OHMS.

Printed Documents Are UNCONTROLLED

FILENAME= MP003221

LTR.	DESCRIPTION	DATE	DRAWN	APPR
	REVISIONS			
D	ECO 5762−ADD MANUAL #'S TO TITLE BLK	7/14/98	CJR	
C	ECO 5730−ADD MANUAL # TO TITLE BLK	5/8/98	CJR	GWP
B	REVISED PER ECO 5116	10/11/96	DAC	GWP
A	RELEASE PER ECO 3834	4/7/93	FM2	GWP

NEXT ASSEMBLY	USED ON
	81750003 SM8175 MANUAL
	80250257−1 EX4700A MANUAL

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE INCHES
TOLERANCE ON DECIMALS
.X±.1 .XX±.02 .XXX±.010
TOLERANCE ON ANGLES ±7'30"

DO NOT SCALE DRAWING

MATERIAL

FINISH

	BY	DATE
DRAWN	FMM	4/5/93
CHECKED		
PROJ. ENG.	GW PRICE	4/12/93

MONITOR LABS, INC.
74 INVERNESS DRIVE EAST
ENGLEWOOD, COLORADO 80112

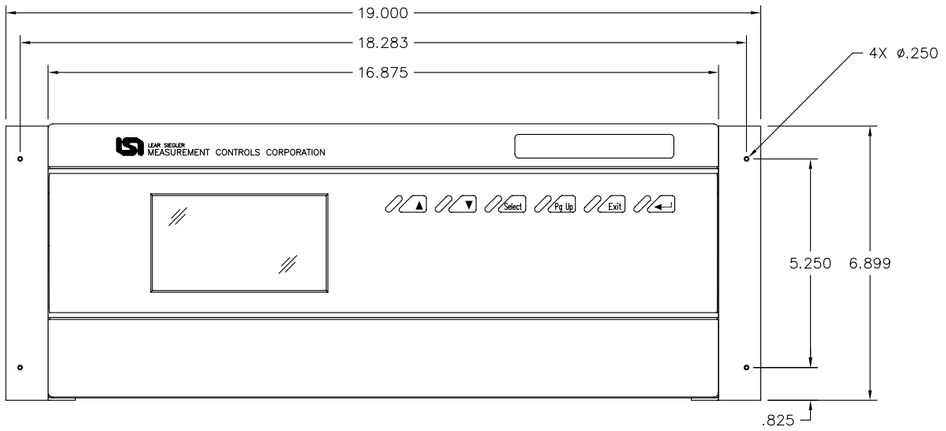
WIRING DIAGRAM
INTERCONNECTION−
LS710 4 ANALOG

SIZE	CAGE CODE	DWG NO	REV
D		80610032−2	D

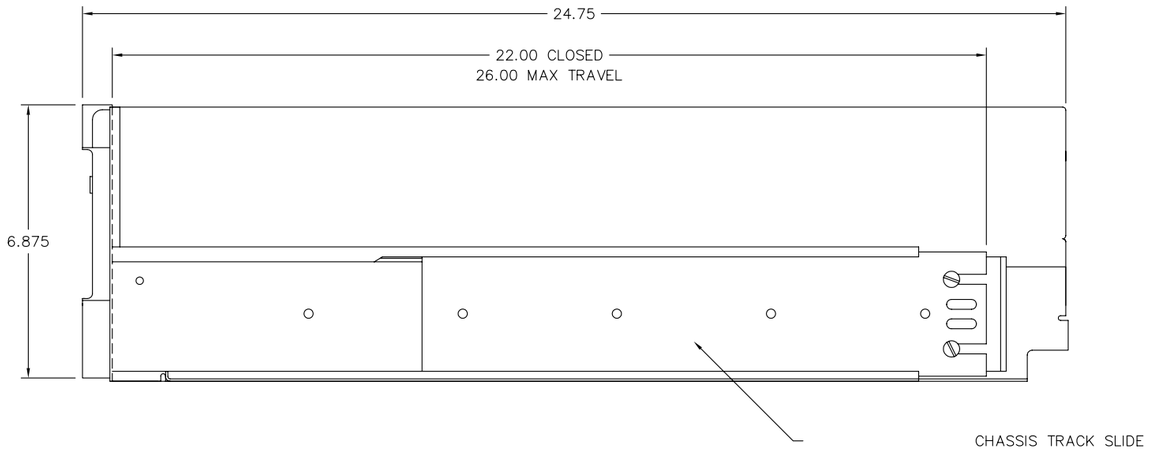
SCALE

SHEET 1 OF 1

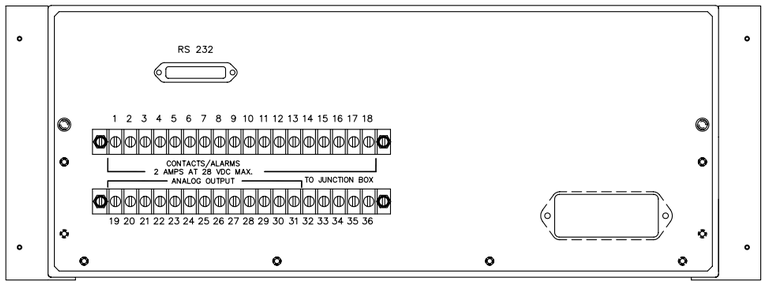
PLOTTED
10/11/1996 14:51:15



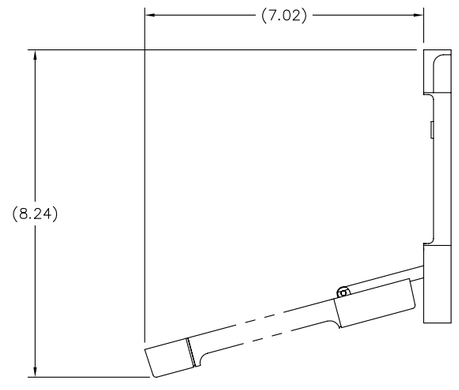
FRONT VIEW



SIDE VIEW



REAR VIEW



DETAIL OF OPEN BEZEL

Printed Documents Are UNCONTROLLED

MP003501

LTR.	DESCRIPTION	DATE	DRW	APPR
A	INITIAL RELEASE PER ECO	4-93	MLS	

REVISIONS

NEXT ASSEMBLY: LS710

USED ON:

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES
TOLERANCE ON DECIMALS
.X±.1 .XX±.02 .XXX±.010
TOLERANCE ON ANGLES ±0°30 '

DO NOT SCALE DRAWING

MATERIAL

FINISH

DRAWN BY SHARP DATE 4-15-93

CHECKED BY DATE

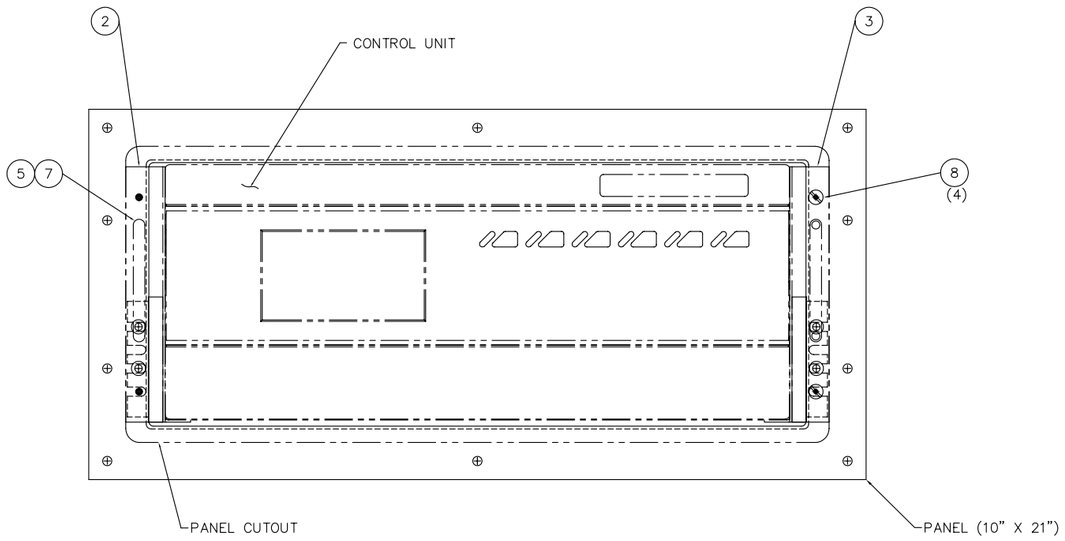
PROJ. ENG. BY DATE

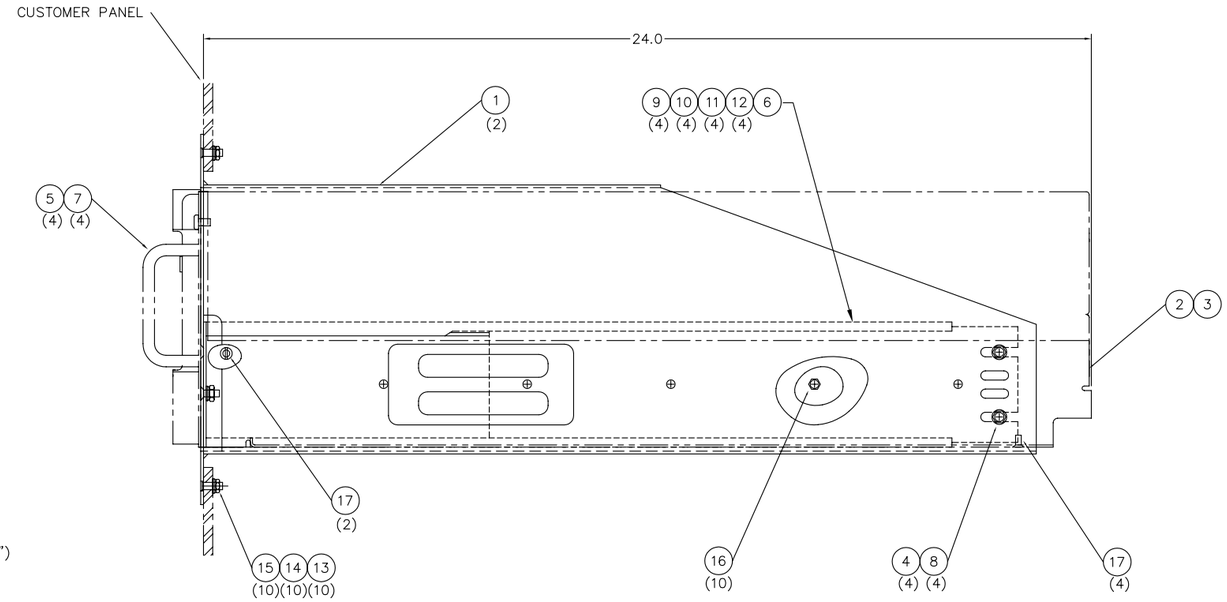
LEAR SIEGLER MEASUREMENT CONTROLS CORPORATION

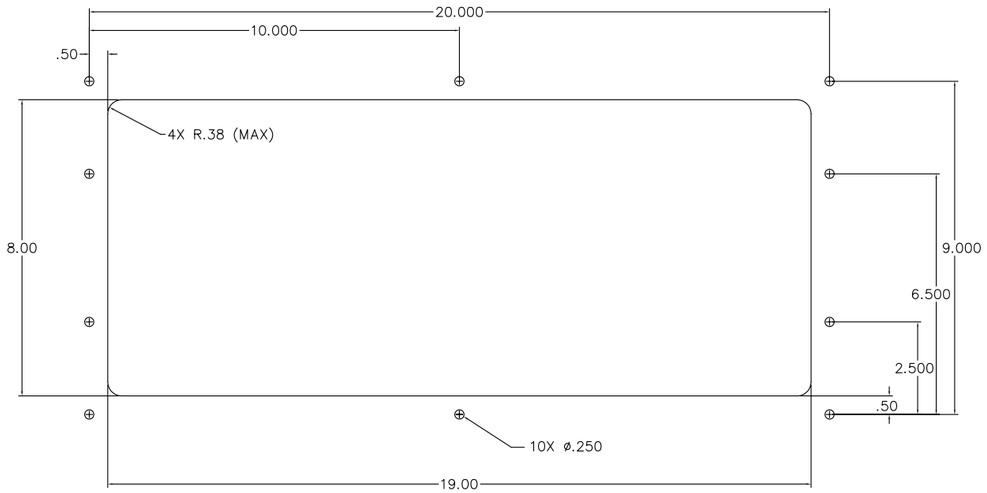
LS710
CONTROL UNIT

D | DRAWING NO. 80610035 | REV. A

SCALE 1:2 | SHEET 1 OF 1

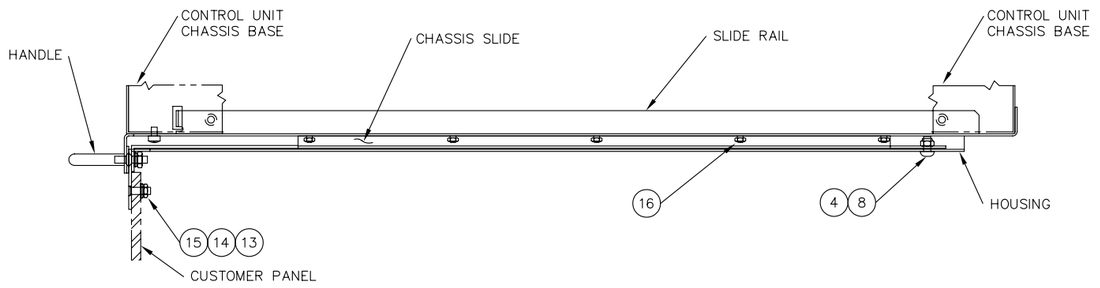






PANEL CUTOUT

NOTE: REMOVE (4) FEET & INSTALL M4 X 12 SCREWS W/LKWASHER (19)
DO NOT REINSTALL SCREWS USED TO ATTACH FEET.



SEE SEPARATE PARTS LIST ON "A" SIZE

FILENAME=MP003701

LTR.	DESCRIPTION	DATE	DRAWN	APPR
C	ECO 6326 – CHG ITEM NUMBER	2/21/03	CJR	
B	REVISED PER ECO 4792	06/26/95	JDP	
A	RELEASE PER ECO 4383	8/29/94	NLN	

REVISIONS

NEXT ASSEMBLY	USED ON
	LS710

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE INCHES
TOLERANCE ON DECIMALS
.X±.1 .XX±.02 .XXX±.010
TOLERANCE ON ANGLES ±0'30'

DO NOT SCALE DRAWING

MATERIAL

FINISH

DRAWN BY FMM — DATE 7/30/93
CHECKED BY
PROJ. ENG. BY

MONITOR LABS, INC.
74 INVERNESS DRIVE EAST
ENGLEWOOD, COLORADO 80112

PANEL MOUNT KIT FOR LS710 CONTROL UNIT

SIZE	CAGE CODE	DWG NO	REV
D		80610037	C

SCALE 1: 2 — SHEET 1 OF 2

Printed Documents Are UNCONTROLLED

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	UNIT QTY				REFERENCE	TOTAL REQ.	STOCK ISSUED	SHORT QTY
1	80610038	HOUSING, PANEL MOUNT	1							
2	98000046-2	SLIDE RAIL, LEFT	1							
3	98000047-2	SLIDE RAIL, RIGHT	1							
4	M5	NUT, HEX LOCK	4							
5	14000223	HANDLE	2							
6	14000222	SLIDE, PAIR	1							
7	10-32 X 3/8	SCREW 100° FL HD STL ZN PLT	4							
8	M5 X 8	SCREW PAN HD STL ZN PLT	8							
9	10-32 X 1/2	SCREW, 100° FL HD ZN PL	4							
10	10-32	NUT, HEX	4							
11	#10	WASHER, LK	4							
12	#10	WASHER, FLAT	4							
13	M5	NUT HEX	10							
14	M5	WASHER LOCK	10							
15	M5	WASHER FLAT	10							
16	M4	NUT, HEX	10							
17	M4 X 8mm	SCREW 90° FL HD STL ZN PLT	6							
18										
19	M4 X 12	SCREW W/LKWASHER PAN HD	4							

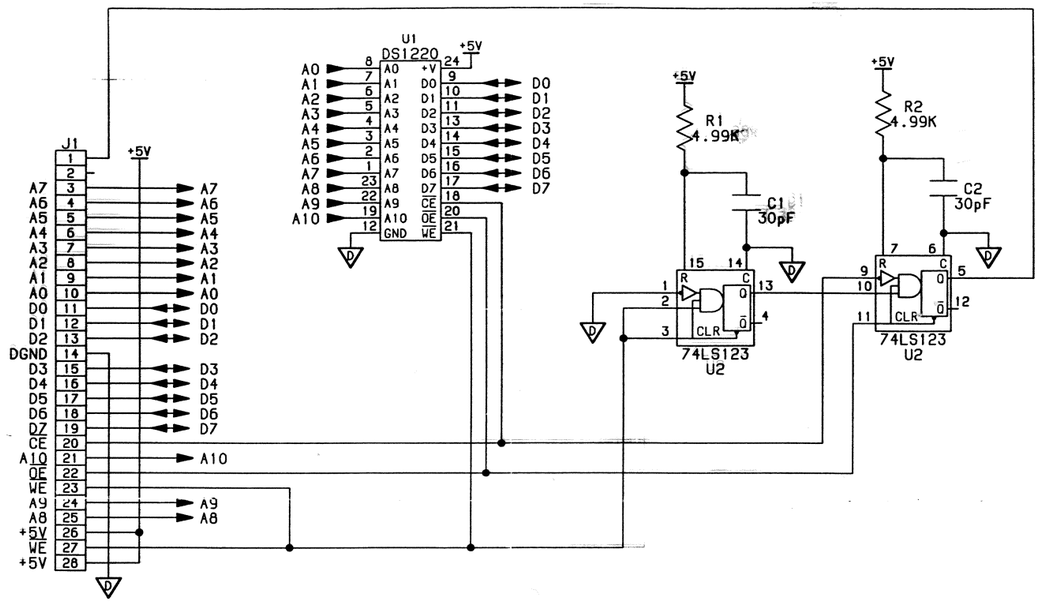
DRAWN BY	DATE	CHECKED BY	DATE	PROJ. ENG. BY	DATE
FMM	7/30/93				

MONITOR LABS, INC.
74 INVERNESS DRIVE EAST
ENGLEWOOD, COLORADO 80112

PANEL MOUNT KIT
FOR LS710 CONTROL UNIT

SIZE	CAGE CODE	DWG NO	REV
A		80610037	C

FILENAME= MP003702 SHEET 2 OF 2



I.C. POWER NOT SHOWN AT SYMBOLS			
REFERENCE DESIGNATOR	TYPE	PIN=PWR	PIN=PWR
U2	74LS123	16=+5V	8=DGND

3. USED FOR P.C.B. No. 80610057-1
2. CAPACITOR VALUES ARE IN uF.
1. RESISTOR VALUES ARE IN OHMS.

NOTES: UNLESS OTHERWISE SPECIFIED.

Printed Documents Are UNCONTROLLED

FILENAME=MP005801.S-A

LTR	DESCRIPTION	DATE	DRW	APPR
A	RELEASE TO MFG PER ECO 4831 REV A	07/21/95	JDP	

REVISIONS

DRAWN BY PHILLIPS DATE 06/09/95
CHECKED BY DATE
PROJ ENG BY DATE

80340176 LS710
NEXT ASSEMBLY USED ON

MONITOR LABS INC.
74 INVERNESS DRIVE EAST
ENGLEWOOD, COLORADO 80112

SCHEMATIC
SRAM ADAPTOR
BOARD

SIZE D | CAGE CODE | DWG. NO. 80610058 | REV A
SCALE = NONE | SHEET 1 OF 1

APPENDIX A. RS232 SERIAL OUTPUT

1.1 Print Format

The print format assigns a measurement/calculation to a column of the printer page. You can also establish the print rate for each measurement.

1.2 Column

This is a variable entry with a range of zero to 28. For standard printers, it indicates on which column the measurement/calculation will print. If zero is entered, nothing is printed for the specified channel. When an optional 13-character printer is used (yielding only one column of print), the COLUMN indicates the order in which the data will print.

1.3 Avg

This is a variable entry denoting the average calculation period, in minutes. The value entered not only represents the average period, but also sets the print rate for a channel. For example, if six is selected for opacity, the six-minute average of the opacity measurements is printed every six minutes. If 60 is selected for SO_2, SO_2 hourly averages are printed every hour. Cycle the LS710 power off and on or start the calibration cycle to synchronize all channels that are selected to print.

1.4 Printer Format

The printer output is in ASCII format. The operating parameters for the printing device connected to the LS710 RS232 port are entered in the PRINTER heading. The parameters required to configure the printer are:

- PG TOP. The choices for this entry are YES and NO. YES advances the paper to the top of the next page.

- PG #. This entry specifies the page number to be printed on the bottom of the current page in the printer. Up to 9999 pages are allowed.

- PORT. Enables/disables the RS232 serial port. The OFF selection disables the port; no serial information will be sent out to the RS232 serial port. The DAS selection enables the port for output of serial data for a Data Acquisition System and disables the internal timing, permitting external clock synchronization through a serial command. The PRN selection enables the port for output of serial information in a form suitable for a printer and enables the internal time of day clock. If the DAS selection is made and no external clock command is sent within approximately 1.5 minutes, the selection will automatically revert to PRN so the LS710 can continue to collect data.

- BAUD. Sets up the LS710 transmission baud to match the baud of the printer. Values from 300 to 9600 are allowed.

- PARITY. Sets up the RS232 transmission error checking.

- MARGIN. Sets up the top, bottom, and left margins of the page. Zero to 20 characters are allowed.

- WIDTH. Sets up the width of the page, excluding the margin. Twelve to 233 characters are allowed.

- LENGTH. Sets up the length of the page, excluding margins. Up to 99 lines are allowed. A typical page length has 66 lines. The length determines when the page will advance.

- COLUMN. Specifies the number of six-character columns that appear across a page. Up to 28 columns are allowed. When more columns are specified than the width will accommodate, the number of columns is reduced to a printable number.

- EXCESS. The choices are ONLY and INCLD. When ONLY is entered, only the measurements/calculations that exceed alarm limits are printed. When INCLD is entered, all data is printed, as configured.

1.5 LS710 Setup

Column zero on the printed page is dedicated to the time of day. The time is volatile, so any time the power is interrupted, the correct time must be reentered. The parameters used to enter time are:

- HOURS. This parameter permits entry of zero to 23 hours. The clock is a 24-hour clock; e.g., 2:00 p.m. is 1400 hours.

- MIN. This parameter permits entry of zero to 59 minutes.

1.6 Page Format

There are two page formats. In the standard format, data is arranged in columns. In the short format, data is placed on single lines. The short format is designed for a small, 13-character printer or for interfaces to data acquisition systems.

1.7 Normal Format

A twelve-character alphanumeric line prints on each new page to identify the site. The second line identifies a unit; e.g., Unit #15. The next line is derived from the channel database and defines the data that is to be printed in each column (see Figure 1). At the top of each page, a page number is printed. A new page is formatted any time the system is placed (either automatically or manually) into calibration, or when commanded through the front panel or through a data acquisition system.

1.8 Short Format

Site and unit are printed prior to calibration data. Data is grouped by time of day. Figure 2 shows the short format of the same data shown in Figure 1.

1.9 Calibration Format

Calibration data is printed in the short format. Site and unit are printed as headers. ZERO is printed, followed by all applicable zero data, then zero drift data. SPAN is printed, followed by span drift data, then by all span data. The last data to be printed is all of the applicable gain data.

1.10 Printer Specifications (Impact Dot Matrix Printer)

Width	132 characters, normal; 233 characters, condensed
Interface	RS232C
Ribbon	Black cartridge
Power	120 Vac, 70 watts
Size	5.2" x 23.3" x 15.5"
Weight	20 lb.
Setup	Parity selectable (ODD/EVEN/NONE); 8 bit data, 1 stop bit

Figure 1. Normal Format (with one EX4700A, one SM8100/SM8175, and two opacity monitors)

PAGE 0001

Copyright

ML 1994

SITE: 3

UNIT: 1

TIME 2S02 #2NO #OP CMB CO PPM 2O2 %AUX 3VEL

1:00.4.3102505.535087

1:06 11 88

1:12 9 87

1:18 12 87.5

1:24 15 87.9

1:30 21 88.5

1:36 17 88.1

1:42 15 87.6

2:00 102455.335187.2

3:001.8.4151506.134986.9

Figure 2. Short Format

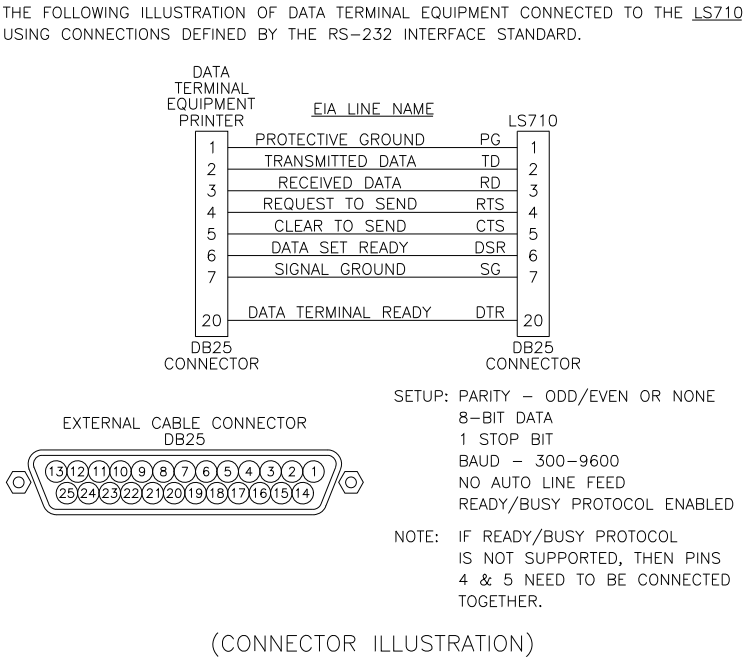


Figure 3. DTE Connector

PAGE: 0001
Copyright

Teledyne Monitor Labs, Inc. 1991

SITE: 3

UNIT: 1

1:00

$2SO_2$ # 0.40

2NO # 0.30

OP CMB 10

CO PPM 250

$2O_2$ % 5.5

AUX 350

3VEL 87

1:06

OP CMB 11

3VEL 88

1:12

OP CMB 9

3VEL 87

1:18

USER NOTES

APPENDIX B. CALIBRATION RECORDER OUTPUTS

The analog output adjustment requires a precision 3-1/2 digit DMM (digital multimeter) that can read 20 mA ±0.01 mA. The DMM return is connected to TB1 terminal 25 (see drawing 80610019-2). Make a note of the current entries before you change the SELECT subheading so the entries can be reentered when the zero and span adjustments are completed.

1.1 Zero Adjustments

To adjust zero, set up the ANALOG headings as follows:

HEADING	SUBHEADING	ENTER
ANALOG 1	SELECT	ZERO
ANALOG 2	SELECT	ZERO
ANALOG 3	SELECT	ZERO
ANALOG 4	SELECT	ZERO

- *Recorder Output 1.* Adjust R41 on the DAC multimodule board (drawing 80340174) for 0 or 4 ±0.01 mA on the rear panel TB1 terminal 21.
- *Recorder Output 2.* Adjust R40 on the DAC multimodule board for 0 or 4 ±0.01 mA on the rear panel TB1 terminal 24.
- *Recorder Output 3.* Adjust R45 on the DAC multimodule board for 0 or 4 ±0.01 mA on the rear panel TB1 terminal 26.
- *Recorder Output 4.* Adjust R44 on the DAC multimodule board for 0 or 4 ±0.01 mA on the rear panel TB1 terminal 29.

1.2 Span Adjustments

The above zero adjustments must be verified prior to adjusting span. To adjust span, set up the ANALOG headings as follows:

HEADING	SUBHEADING	ENTER
ANALOG 1	SELECT	FS
ANALOG 2	SELECT	FS
ANALOG 3	SELECT	FS
ANALOG 4	SELECT	FS

- *Recorder Output 1.* Adjust R38 on the DAC multimodule board for 20 ±0.01 mA on the rear panel TB1 terminal 21.
- *Recorder Output 2.* Adjust R39 on the DAC multimodule board for 20 ±0.01 mA on the rear panel TB1 terminal 24.
- *Recorder Output 3.* Adjust R43 on the DAC multimodule board for 20 ±0.01 mA on the rear panel TB1 terminal 26.
- *Recorder Output 4.* Adjust R42 on the DAC multimodule board for 20 ±0.01 mA on the rear panel TB1 terminal 29.

Return the ANALOG 1-4 headings, SELECT subheadings to their original entries.

1.3 Eight DAC Recorder Output

1.3.1 Configuration

The eight DAC circuit board contains 36 jumpers which perform the functions delineated in Table 1 below. All eight outputs are factory-configured as 4-20 mA current loop outputs. Jumpers E1-E2 and E7-E9 are used only in a current loop output mode. When E1 to E2 is connected, the 4 mA offset current is user-adjustable via potentiometer R3. The jumper is not required if operating in a voltage mode. The connection E7-E9 scales the DAC for a 4-20 mA output. When E3-E4 and E5-E6 are connected, the output is configured for 0 to 5 VDC. When E3-E4 and E5-E6 are not connected but E4-E5 is connected, the output is configured for -5 to 5 VDC. E10, E11, and E12 are factory-installed and should not be modified.

Table 1. Configuration Jumpers

JUMPERS	FUNCTION	COMMENTS
E1, E2	Offset	See text above.
E7, E8, E9	Output V/I	E7-E8 voltage output or E7-E9 current output.
E3, E4, E5, E6	Output Scale	See text above.
E13, E21, E29	Channel 8 Output	E13-E21 voltage output or E21-E29 current output.
E14, E22, E30	Channel 7 Output	E14-E22 voltage output or E22-E30 current output.
E15, E23, E31	Channel 6 Output	E15-E23 voltage output or E23-E31 current output.
E16, E24, E32	Channel 5 Output	E16-E24 voltage output or E24-E32 current output.
E17, E25, E33	Channel 4 Output	E17-E25 voltage output or E25-E33 current output.
E18, E26, E34	Channel 3 Output	E18-E26 voltage output or E26-E34 current output.
E19, E27, E35	Channel 2 Output	E19-E27 voltage output or E27-E35 current output.
E20, E28, E36	Channel 1 Output	E20-E28 voltage output or E28-E36 current output.

1.3.2 Span Adjustments

The analog output adjustment requires a precision digital multimeter (DMM) that can read with an accuracy of ±0.005% or better. Make a note of the current entries before you change the SELECT subheading so the entries can be reentered when the zero and span adjustments are completed. All adjustments have been set at the factory; however, readjustments are required when the DAC has been reconfigured.

When performing the adjustments for a board containing a mixed configuration or voltage and current, or for an all-voltage configuration, follow the procedure outlined for voltage output. When all channels are configured as current, follow the procedure outlined for current output. Connect the return of the DVM to J1 pin 3. For voltage mode, connect the positive DVM lead to J1 pin 4, and for current mode, E36.

1.3.2.1 Adjustments

To adjust zero, set up the RECORDER headings as follows:

HEADING	SUBHEADING	ENTER
ANALOG 1	SELECT	ZERO
ANALOG 2	SELECT	ZERO
ANALOG 3	SELECT	ZERO
ANALOG 4	SELECT	ZERO
ANALOG 5	SELECT	ZERO
ANALOG 6	SELECT	ZERO
ANALOG 7	SELECT	ZERO
ANALOG 8	SELECT	ZERO

Adjust R1 for:

0.0000 volts voltage mode

-5.0000 bipolar

0.6250 current mode.

If the voltage can't be obtained in the current mode, trim R3 to complete the adjustment.

To adjust span, set up the RECORDER headings as follows:

HEADING	SUBHEADING	ENTER
ANALOG 1	SELECT	FS
ANALOG 2	SELECT	FS
ANALOG 3	SELECT	FS
ANALOG 4	SELECT	FS
ANALOG 5	SELECT	FS
ANALOG 6	SELECT	FS
ANALOG 7	SELECT	FS
ANALOG 8	SELECT	FS

Adjust R2 for:

4.9967 volts voltage mode

-4.9988 bipolar

3.1244 current mode.

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APPENDIX C. METRIC MEASUREMENTS

The metric measurements permit the display of SO_2 and NO in grams per cubic meter and temperature in degrees Celsius. The display indications appear as `SO2 M` and `NO M` to replace `SO2 #/MBtu` and `NO #/MBtu`, while the temperature appears in degrees C. The values of `SO2 M` and `NO M` are calculated from the SO_2 ppm and NO ppm respectively. The basic instrument is based on ppm so all full scale and calibration information is entered in ppm.

The grams per cubic meter outputs may be averaged and limits in M (meters) may be set for a high and low alarm. They may output to chart recorders, the front panel display, or an RS232 port. The grams per cubic meter outputs are setup and behave essentially the same as the #/MBtu outputs described in the manual. The only difference is that the equation used to calculate the results from the ppm inputs has been changed and the limits and range values have been appropriately changed.

The metric conversions are accomplished with the following formulas:

`SO2 M` = [(SO_2 ppm)(SO_2 molecular weight)(0.04087)]

`NO M` = [(NO ppm)(NO molecular weight)(0.04087)]

Where SO_2 molecular weight = 64.0628
NO molecular weight = 30.0061
and NO_2 molecular weight = 46.1

Temperature in Celsius = (Temperature in Fahrenheit -32)(5.0) / (9.0)

The alarm ranges are:

- `SO2 M 0.00` - 19.64M
- `NO M 0.00` - 9.20 M
- `TEMP 0` - 427 C.

The analog output ranges are:

- `SO2 M 0.00` - 19.64 M
- `NO M 0.00` - 9.20 M
- `TEMP 250` - 427 C.

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APPENDIX D. GLOSSARY OF TERMS AND ABBREVIATIONS

AGC (Automatic Gain Control). A process by which gain is automatically adjusted as a function of input or other specified parameter.

Alphanumeric. All characters used by a processor or device, including letters (alpha), numbers, and punctuation marks.

ASCII (American Standard Code for Information Interchange). A standard code used to transmit data between computers and/or devices such as a printer.

BAR0. An LS710 subheading (**PARAMETERS** heading) used to enter the average barometric pressure at the measurement site (site absolute pressure).

Baud rate. The signaling speed or unit pulse used by a device such as a printer or modem.

BWA. An LS710 subheading (**PARAMETERS** heading) used to enter the ambient moisture in percent H_2O at the mesurement site (site average moisture level).

CD. Carbon dioxide (CO_2).

CO-ST. A calculated value representing the concentration of carbon monoxide and carbon dioxide that is insensitive to excess air variations, except as it affects burner efficiency.

Configuration menu. The basic menu that includes all headings and subheadings programmed into the LS710 which is used primarily during initial setup and reconfiguration of a system.

CPU (Central Processing Unit). A circuit board in the LS710 and a fault code used to indicate a faulty CPU board.

Current isolator. An option with the LS710 that isolates the ground on the 4 to 20 mA output lines from the LS710 to the ground at a strip chart recorder or computer system. Single channel and multichannel options are available.

DAC (Digital-to-Analog Converter). One of four (or eight) channels used to drive strip chart recorders or other devices from the LS710.

DMM. Digital multimeter.

EEPROM (Electrically Erasable Programmable Read Only Memory). A read only memory in the LS710 that can be regrogrammed electrically; also, an LS710 fault code that indicates a problem with the I/O ciruit board.

E-O calibration (electro-optical calibration). The basic calibration cycle used to verify instrument readings, using the same optics and electronics used in normal process measurement. E-O calibration consists of a zero and span check. E-O calibration differs from gas calibration in that a zero reflector and span filters are placed into the measurement path rather than using NBS-traceable gases injected into the measurement cavity.

E-O span value (XX S). The span measurement read by the process-mounted instrument during the last E-O calibration cycle.

EPROM (Erasable Programmable Read Only Memory). A read only memory used to store basic LS710 program data.

FC. A carbon fuel factor used in the calculation of #/MBtu and O_2 CAL. See *Calculated Values*, *Chapter 4* for the FC formula.

FD. Fuel factor, dry. See *Calculated Values*, *Chapter 4* for the FD formula.

FDX. A numerical value entered in the **PARAMETERS** heading to specify the fuel factor, dry for a monitored process.

FW. Fuel factor, wet. See *Chapter 4* for the FW formula.

FWX. A numerical value entered in the **PARAMETERS** heading to specify the fuel factor, wet for a monitored process.

Gain factors (XX G). Gain factors used to trim out variations from instrument to instrument that can be manipulated automatically during gas calibration.

Gas (dynamic) calibration. A sequence of zero and span checks used to verify instrument readings using NBS-traceable standard gases injected into the measurement cavity. Gas calibrations differ from E-O calibrations in that E-O calibrations use span filters placed in the measurement path rather than standard gases for span.

I-O. Input/output.

J-box (junction box). A separate component of a monitoring system that houses test points, circuit boards, manual switches, and interface points or terminal strips. J-boxes vary from instrument to instrument, but typically provide for manual initiation of calibration cycles, an interface between the process-mounted instrument and the LS710, and various control/diagnostic circuit boards and electronics. J-boxes are located near the process-mounted instruments or, in some cases, in the same protective cover as the instruments.

Multiple breech. More than one duct or breech feeding a common stack.

Operator's (short) menu. An abbreviated version of the configuration menu used for daily operation. The operator's menu can be set up to exclude unused headings and subheadings or limit access to certain parameters. For example, if the LS710 is monitoring opacity instruments only, all subheadings related only to gas monitoring can be excluded in the operator's menu.

PIC (Peripheral Interrupt Controller). An LS710 fault code that occurs when data read from the interrupt mask is not the same as data written into the mask.

PIO (Peripheral Input and Output). An LS710 fault code that occurs when reading back all zeros or all ones that were written to the peripheral interface chip.

RAM (Random Access Memory). A computer data storage device; also, an LS710 fault code that indicates a problem with the CPU circuit board.

REF (Reference). An LS710 fault code that occurs when there is a problem with individual reference signals.

ROM (Read Only Memory). A computer device for storing data in permanent or unerasable form; also, an LS710 fault message that indicates a problem with the CPU circuit board.

Scroll. A repeating list or display of the LS710 headings and subheadings. The scroll steps through each heading in order and returns to the first heading when the sequence is finished. The subheadings within each heading are also arranged in a repeating list. In this way, if you scroll past the desired item you can simply continue through the scroll until it appears again.

SD. Sulfur dioxide (SO_2).

SEQ (Sequence). An LS710 fault code that indicates a control circuit failure on the CPU circuit board.

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