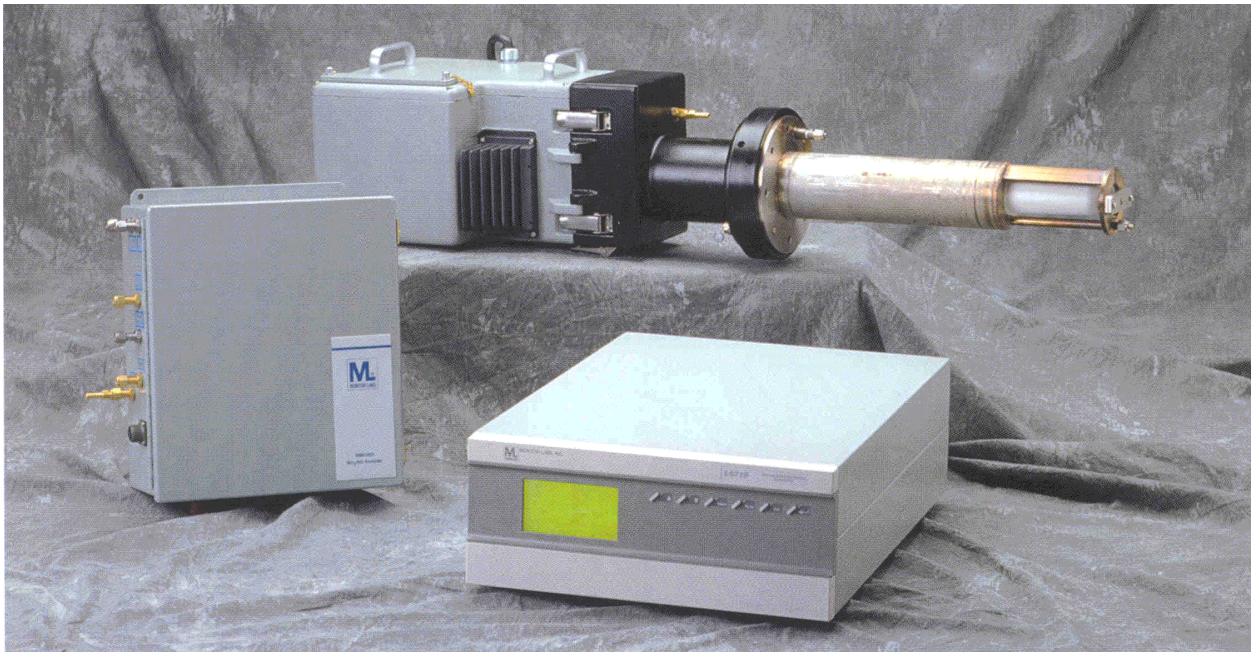
INSTRUCTION MANUAL

SM8160
SO_2 AND NO ANALYZER



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Revision History

Rev	Date	Summary	Affected Pages
B4	Oct 96	Updated *2.3.4*, *Process Gas Conditions*, *Temperature*, to agree with Technical Specification.	2-13
B5	Nov 96	Updated reference designators on Transceiver PCB.	8-1 to 8-3, drawing *81750045*
B6	Nov 96	Updated drawings *81750044* and *81750045*.	*Chapter 9*, drawings *81750044* and *81750045*.
B7	Dec 96	Added drawing *81001240* to *Chapter 9*.	9-1
B8	Jan 97	Added drawings *81750006-3*, *81750006-4*, *81750007-3*, and *81750007-4* to *Chapter 9*.	9-1
C	Feb 97	Revised drawing *81750001-2*, *SM8175 Wiring Diagram System Interconnect Without Heat Exchanger*.	*Chapter 9*, drawing *81750001-2*
D	Feb 97	Increased spare parts quantities for UV lamp. Changed UV lamp maintenance interval to 6 months.	2-17, 4-5
E	Sept 97	Revised drawings *81750004, J-Box Mounting Plate Assembly*, and *81750006, J-Box Assembly*.	*Chapter 9*
F	Nov 97	Revised *6.1, UV Lamp Replacement*, and *6.11.1, PMT Base Plate Replacement*.	6-1, 6-8 to 6-9
G	Nov 97	Updated drawing *81750027*, *Optic Plate Assembly*.	*Chapter 9*
H	Nov 97	Revised format of *Spare Parts List*; applied new styles to entire manual.	2-15 to 2-17
J	Jul 98	Updated drawing package.	*Chapter 9*
K	Aug 98	Updated *2.3.3*, *Measurement Ranges*.	2-9
		Revised *Figure 3-1*, *LS710 Version 3.03 Software Menus*.	3-10
		Updated *4.5.7.1*, *Manual Gas Calibration Using a Flowmeter* and *Figure 4-2*, *Controller Configuration Menu*.	4-14 to 4-16, 4-22
L	Feb 99	Revised drawing *94200018, Typical Installation – LS420 W/A Cal (SM/EX Interface), Standard Detector*	*Chapter 9*
M	May 99	Revised drawings *81750044* and *81750045*.	*Chapter 9*
N	July 99	Corrected part numbers for 18 inch and 6 foot probes in *Spare Parts Requirements* list.	2-14
P	February 01	Update drawing 81750007-X	*Chapter 9*
R	May 02	Update drawings 81750011 and 81750012	*Chapter 9*
S	May 03	Update drawing 81750002-2	*Chapter 9*
T	July 04	Update drawings	*Chapter 9*
W	July 04	Update drawings	*Chapter 9*

Y	Dec 05	Update drawings	*Chapter 9*
Z	Sept 06	Update drawings	*Chapter 9*
AA	Dec 07	Updated Schematic Drawing (UV Lamp Drive Circuit)	*Chapter 9*
AB	APR 09	Update Cover and Drawings	*Cover & Chapter 9*

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4. The part number of each item
5. The model number or a description of each item
6. The serial number of each item, if applicable
7. A description of the problem you are experiencing if factory repair is needed, or the reason you are returning the equipment (eg, sales return, warranty return, etc)
8. The original sales order number or invoice number related to the equipment
9. Whether repair work is under warranty or is to be billed, and a purchase order number for any work to be billed.

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2. The following documents are necessary to support claims:

    a. Original freight bill and bill of lading
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    c. Copy of packing list
    d. Photographs of damaged equipment and container

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1.0 Introduction

1.1 Purpose of the Manual

This manual is written for the control room operator, maintenance technician, and plant personnel who use the SM8160. It provides system description, function, theory, installation, operation, and maintenance information.

Note

This manual is intended to be used in conjunction with the LS710 Control Unit Operation and Maintenance Manual, which provides detailed information on the configuration and setup of the analyzer within the menu structure.

1.2 Purpose of the SM8160

The SM8160 SO_2 and NO process gas analyzer is a combined optical and electronic system that detects and measures sulfur dioxide (SO_2) and nitric oxide (NO) gas concentrations and temperatures in stack emissions.

By means of a fixed probe that protrudes through a stack wall into the gas/particle (effluent) stream, the SM8160 directly measures SO_2 and NO without disturbing or modifying the effluent. Gas concentration measurement is independent of the effluent flow rate.

Note

NO_X is the sum of NO and NO_2 in the gas stream. However, due to high temperatures, combustion processes produce 95% to 99% NO out of the total NO_X emission. The 1% to 5% difference is well within US EPA relative accuracy requirements and can be corrected using a 1.01 to 1.05 multiplier.

The instrument uses an UV (ultraviolet) analytical technique known as *second-derivative spectroscopy*. Use of this technique results in high measurement sensitivity to low SO_2 and NO concentrations and rejection of other stack gases that may cause interference with less sophisticated systems. The second derivative signal is further unaffected by changes in light level which may result from light source aging or the slow buildup of dust on the optical surface exposed to the stack gas.

1.3 Theory of Second-Derivative Spectroscopy

Two definitions basically describe the second-derivative spectroscopic measurement technique. Spectroscopy is the empirical observation of changes in light

absorption caused by molecules absorbing light energy in specific wavelength regions (λ) around and including discrete wavelengths that are called peak absorption wavelengths (λ_o). Second-derivative spectroscopy is the measurement of the amount of curvature in a narrow wavelength band around λ_o.

1.3.1 General Explanation

The spectrum of interest is a continuous distribution of light wavelengths that is part of the total electromagnetic wave spectrum. The light spectrum extends from infrared through visible to the far ultraviolet, a wavelength range of about 5×10^{-2} cm (0.05 centimeter) to 5×10^{-7} cm (0.0000005 centimeter). Figure 1-1 below shows the light spectrum.

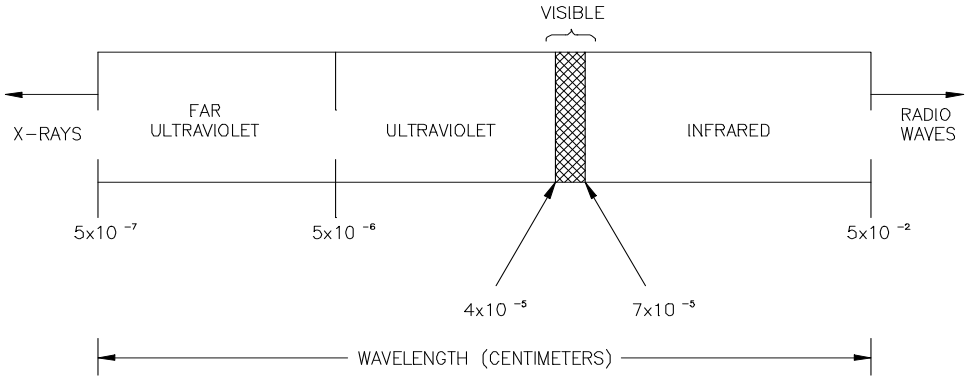
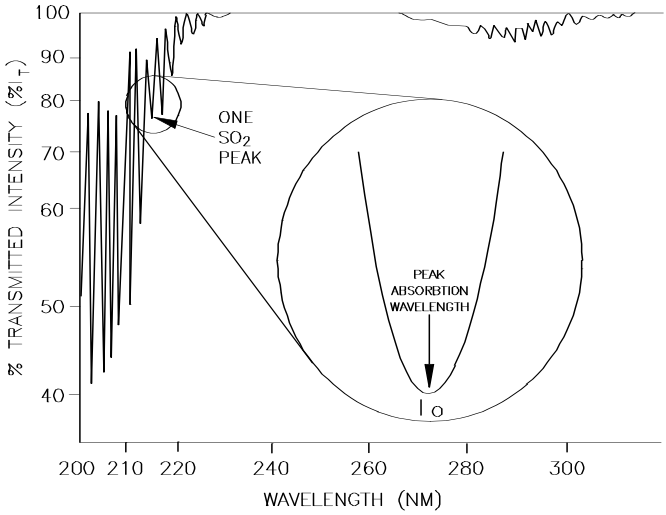


Figure 1-1. Light Spectrum

All atoms and molecules absorb incident light energy in many narrow wavelength regions throughout the light spectrum. The distribution of these regions of absorption wavelengths is called an absorption spectrum. Figure 1-2 below shows a partial SO_2 absorption spectrum. Transmitted light intensity is less at wavelengths around and including peak absorption wavelengths than in the spectrum between them. Each atom or molecule has a unique absorption spectrum that distinguishes it from others.

The SM8160 is *optically tuned* to detect two specific peak absorption wavelengths, one of them unique to SO_2 and the other unique to NO. Note that the

SM8160 measures the *second derivative* of the absorption spectrum. A peak absorption wavelength (minimum transmitted intensity) is also a peak second-derivative wavelength (maximum curvature). The NO and SO_2 peak absorption wavelengths monitored are 2.265 x 10^{-5} cm (226.5 nanometers) for NO and 2.185 x 10^{-5} cm (218.5 nanometers) for SO_2. These values appear within the ultraviolet NO and SO_2 *second-derivative* spectrums shown in Figure 1-3 below.



$$\%I_T = \left(\frac{I_0 - I_A}{I_0}\right) * 100\%$$

WHERE: I_0 = incident UV light intensity on SO_2
I_A = absorbed UV light intensity on SO_2
I_T = transmitted UV light intensity through SO_2

Figure 1-2. SO_2 Absorption Spectrum

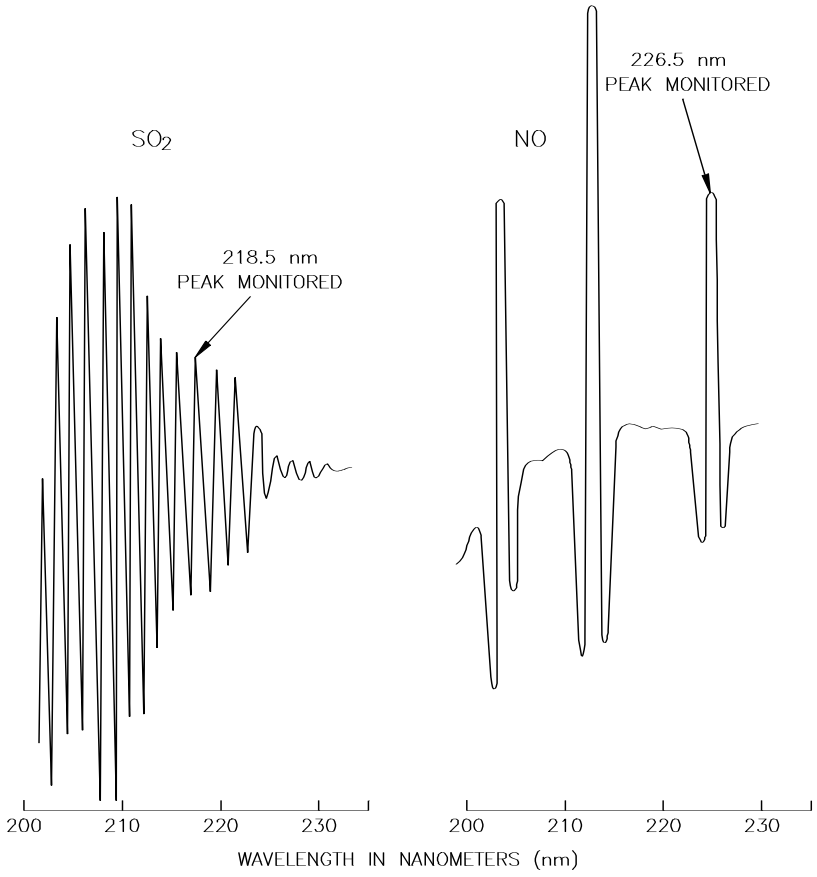


Figure 1-3. SO_2 and NO Second-Derivative Spectrums

Maximum curvature, maximum light absorption, and minimum transmitted light intensity all occur at peak absorption wavelength λ_o (see Figure 1-4 below). The

amount of curvature (or second derivative) is directly proportional to gas concentration. See Appendix B for mathematical theory.

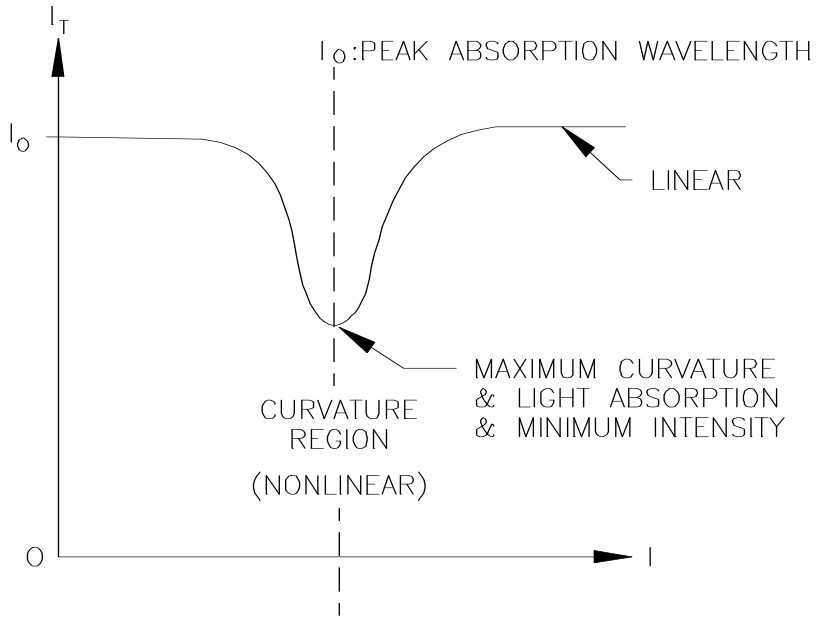


Figure 1-4. Absorption Spectrum Around Peak Absorption Wavelength (λ_0)

The SM8160 detects an AC signal corresponding to the second derivative of the absorption spectrum around a specific peak absorption wavelength. This signal is generated by wavelength modulation. In this process, the measured wavelength varies over time in accordance with a sinusoidal modulating waveform (F). The measurement signal induced by (F) is the second derivative, which varies at twice the modulating signal frequency (2F). The amplitude of the second-derivative signal is directly proportional the gas concentration (see Appendix B).

Figure 1-5 through Figure 1-8 below illustrate the generation of the AC second-derivative signal. A linear absorption curve showing light intensity (I) versus wavelength (λ) without peak absorption wavelengths present is illustrated in Figure 1-5. This type of response appears when there is neither NO nor SO_2, or at some

band of wavelengths apart from any absorption wavelengths. The curve has a (negative) constant slope: a straight line without curvature. Because of this constant slope (absence of absorption curvature), the induced and modulating signal frequencies are equal.

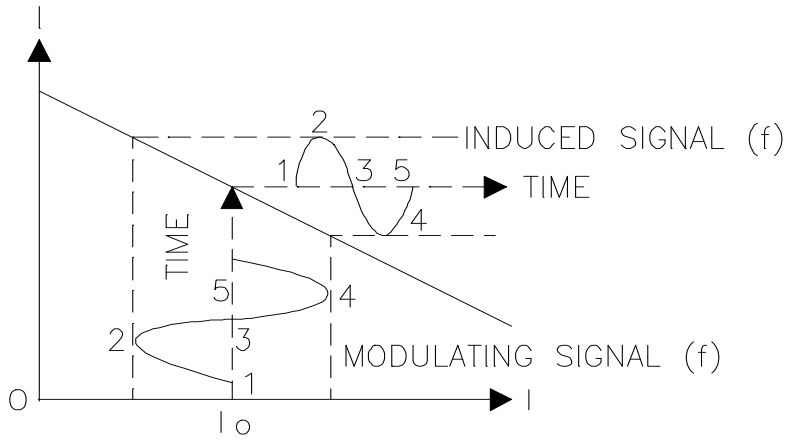


Figure 1-5. Absorption Curve: Modulated Without Curvature

In contrast, an absorption curve with a peak absorption wavelength (λ_o) and thus with curvature is shown in Figure 1-6. As the wavelength is modulated with frequency (F) about λ_o, the induced second-derivative signal (2F) can be traced point-by-point on the graph. Each identically-numbered point corresponds to simultaneous time between the two signals. By contrast, look at Figure 1-5 and Figure 1-6 and notice the difference in location of the induced signal points (1 through 5) for an identical (F) signal. Superimposing (2F) on (F) demonstrates that (2F) is twice (F) in frequency and is out of phase, except at 90° (see Figure 1-7).

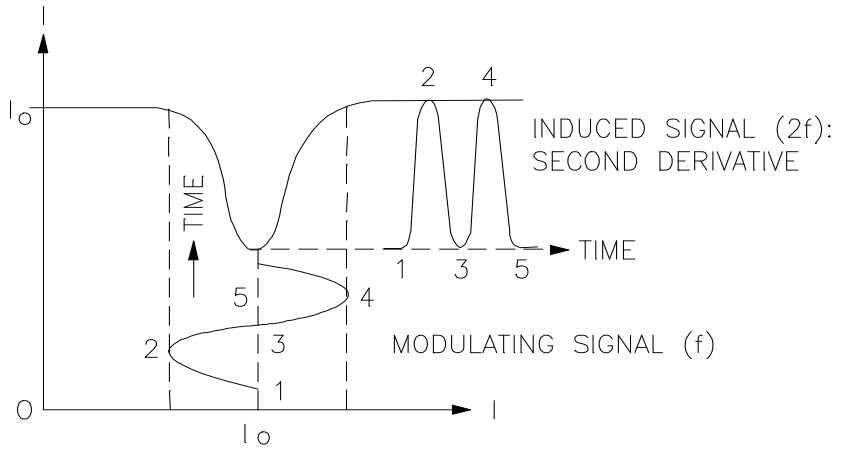


Figure 1-6. Absorption Curve Modulated with Curvature

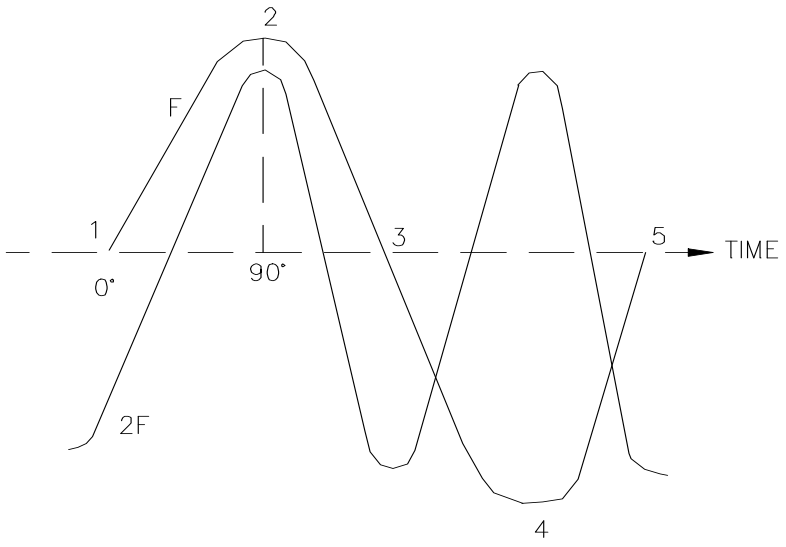


Figure 1-7. Induced Signal Superimposed on Modulation Signal

Figure 1-8 shows two absorption curves where curve 2 indicates greater light absorption and curvature caused by higher gas concentration than curve 1. This results in ($2F_2$) having greater light intensity amplitude than ($2F_1$).

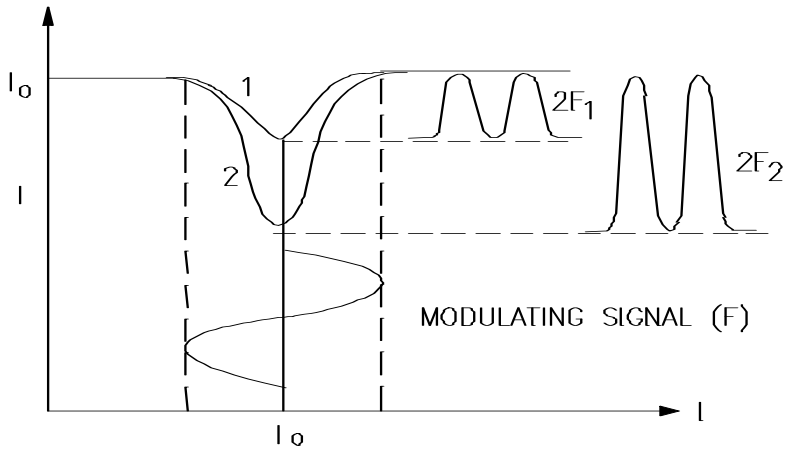


Figure 1-8. Two Absorption Curves with Different Curvatures (Curve 2 Curvature Is Greater Than Curve 1 Curvature)

Once the 2F second-derivative signal is established, it is processed using a ratiometric technique which ensures that measurement accuracy is unaffected by light level.

In summary, the second-derivative signal exists only when an absorption is present. The second-derivative signal amplitude increases or decreases relatively linearly with respect to increasing or decreasing gas concentration. The frequency of the second-derivative signal is twice the modulating frequency.

2.0 System Description

This section describes the SM8160 from a system point of view, relating to the System Block Diagram in Figure 2-9. Attention is focused on signal flow and functional blocks that can be used with the wiring diagrams included in Chapter 9.

2.1 Basic Components

The SM8160 includes four basic components: probe, transceiver, J-box, and control unit (see Figure 2-1). The probe is physically joined to the transceiver. Signals flowing between the J-box and the transceiver are connected by the interconnect cable provided with the transceiver. The probe includes part of the optical system, the measurement cavity, the ceramic filter, and the thermal probe (see Figure 2-2). The interconnect cable to the controller is a variable-length RS422 communication link that transports signals between the J-box and the remote control unit.

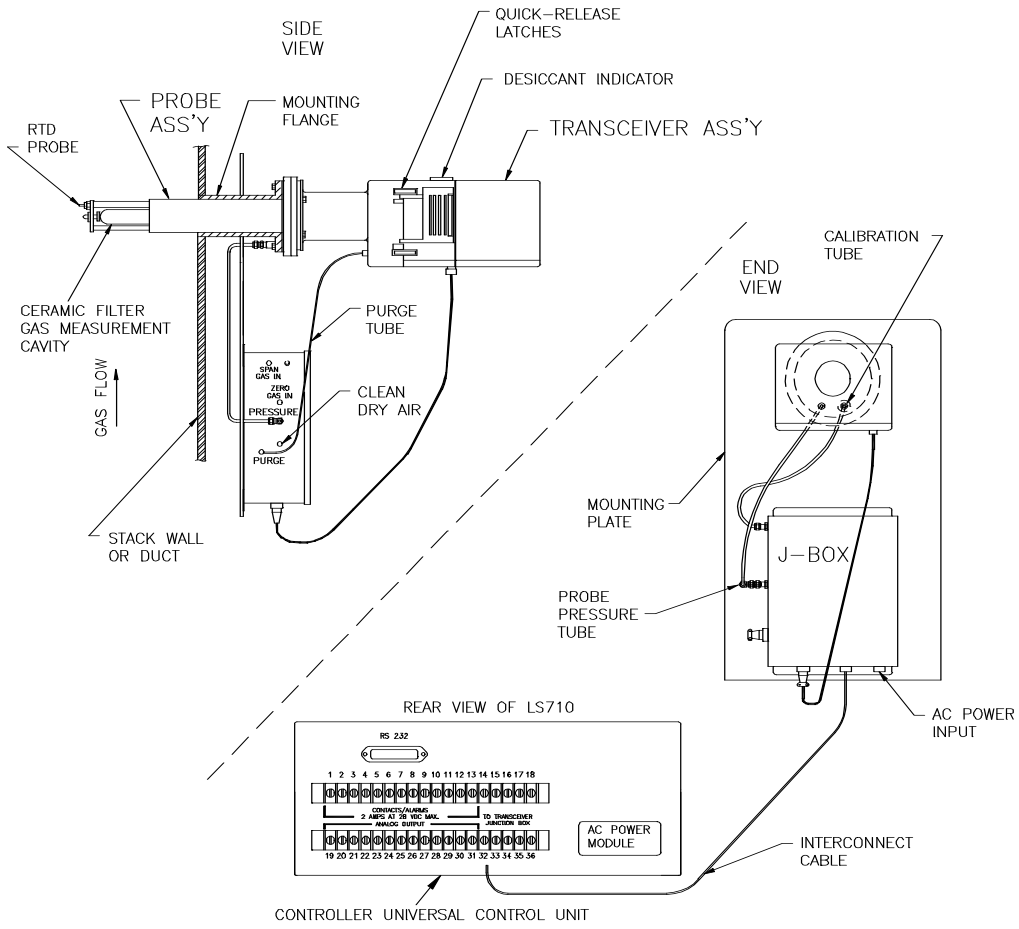


Figure 2-1. Basic Components, Side and Rear Views

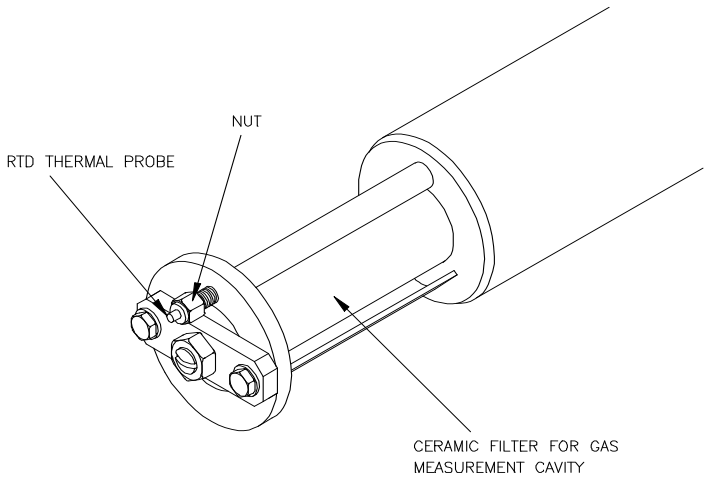


Figure 2-2. Standard SM8160 Probe for Measurement Cavities of 20 cm or Less

The transceiver contains part of the optical system (UV lamp, monochromator, and PMT detector) and the electronics system (see Figure 2-3). The calibration access slot makes all electrical adjustments easily accessible so the cover does not have to be removed during a calibration adjustment. The electronics system is located on the transceiver printed circuit board (PCB) shown in Figure 2-4.

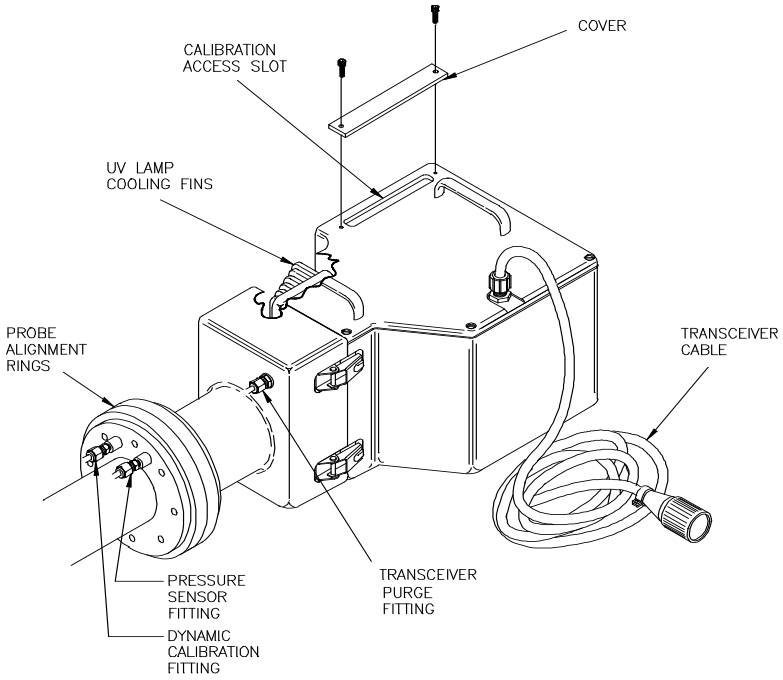


Figure 2-3. SM8160 Transceiver, External View

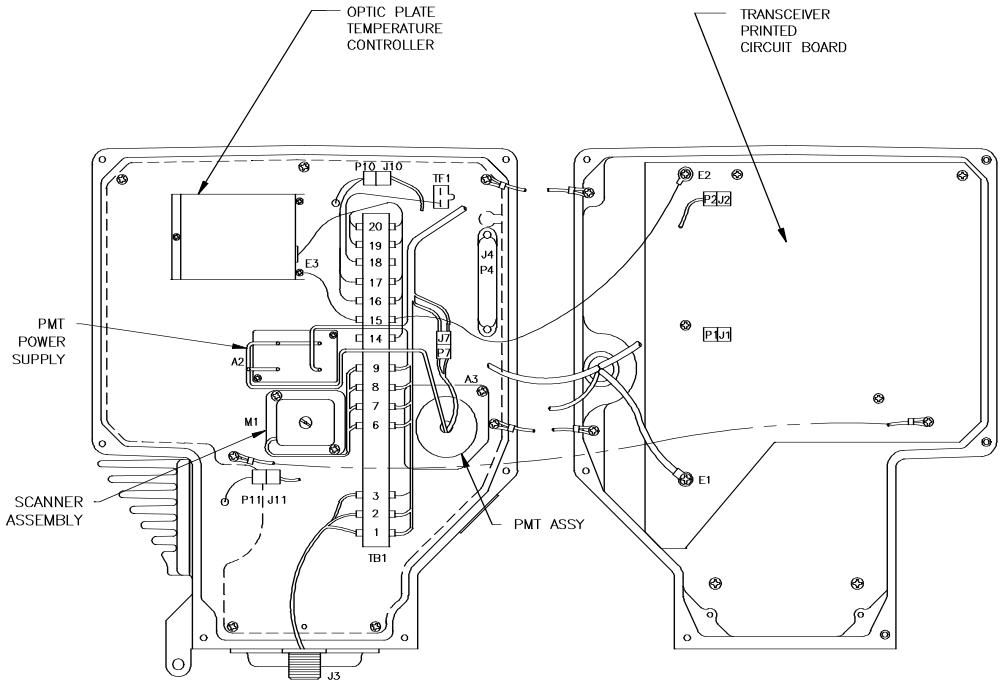


Figure 2-4. SM8160 Transceiver, Internal View

Figure 2-5 shows the front of the transceiver. The desiccant indicator shows the amount of moisture inside the transceiver. An external span cell can be inserted in the desiccant opening for performing a functional check. The purge tube passes air into the transceiver housing and exits through a hole in the lamp housing to expel ozone gases generated by the lamp. The thermal probe cable and purge tube connect to the transceiver. The thermal probe cable originates near the probe measurement cavity, and the purge tube comes from the J-box (see Figure 2-6).

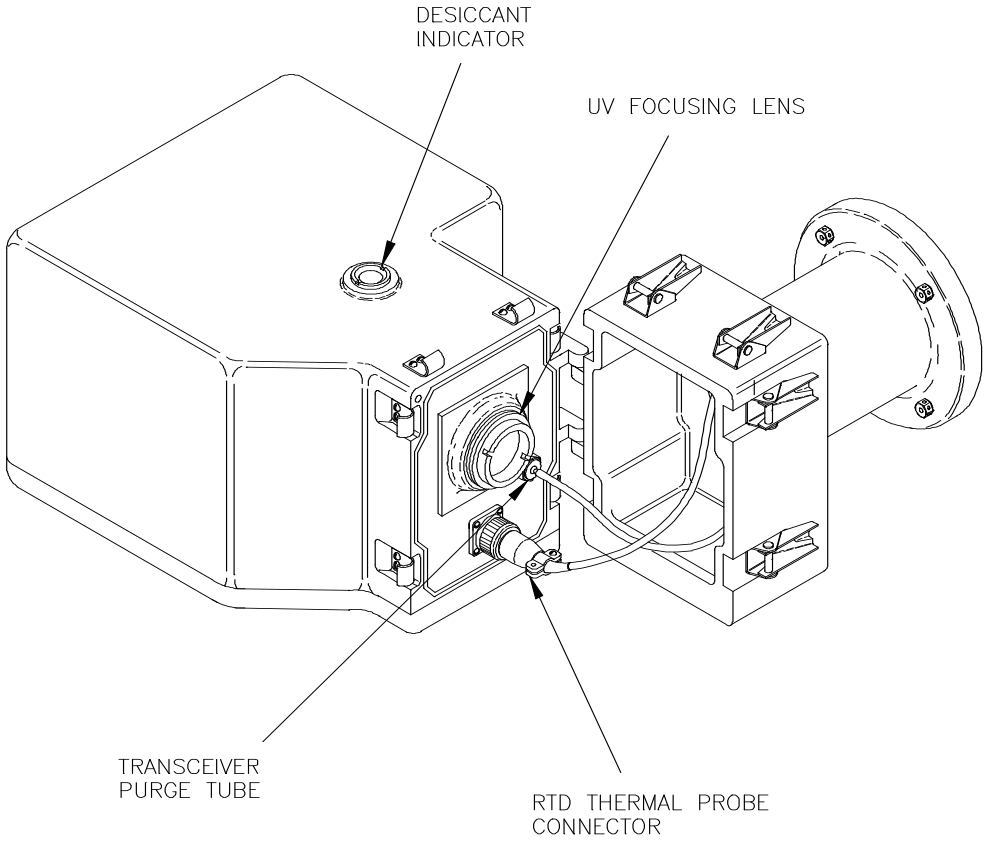


Figure 2-5. SM8160 Transceiver, Front View

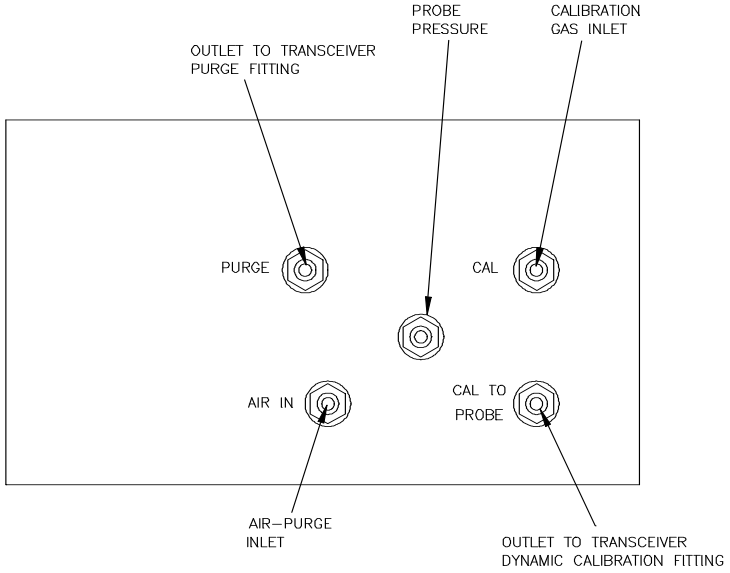


Figure 2-6. SM8160 J-Box, External View

The J-box is a terminal interface unit located between the transceiver and the controller. The J-box houses the serial data acquisition (SDA) board, pressure gauge and regulator, and lamp power supply board (see Figure 2-7). External AC power is connected to the transceiver at the J-box.

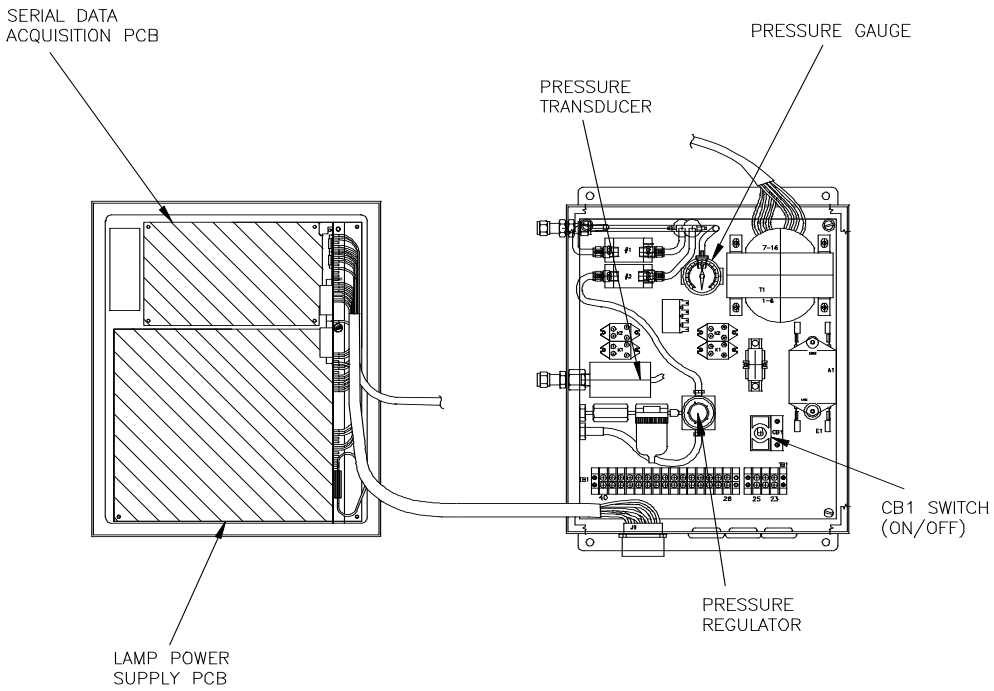


Figure 2-7. SM8160 J-Box, Internal View

The controller is typically located in a control room away from the transceiver and J-box (see Figure 2-8). It produces all of the system outputs (also displayed on the front panel of the unit). Chart recorders and other customer-supplied instruments can be connected to the back of the controller.

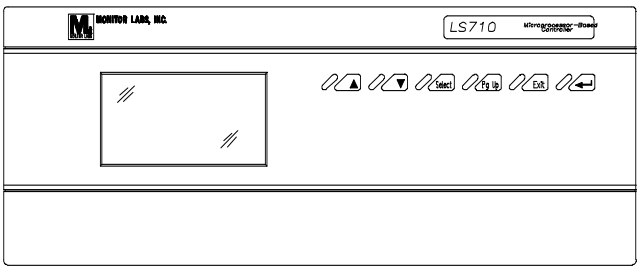


Figure 2-8. Controller

2.2 System Overview

This section describes the system in general with a discussion of major signal paths as shown in Figure 2-9. Reference is made to the functional blocks in conjunction with signal paths. The major signals and signal groups are:

- second-derivative (d^2)
- gas temperature
- reference
- system timing and control
- alarms and faults.

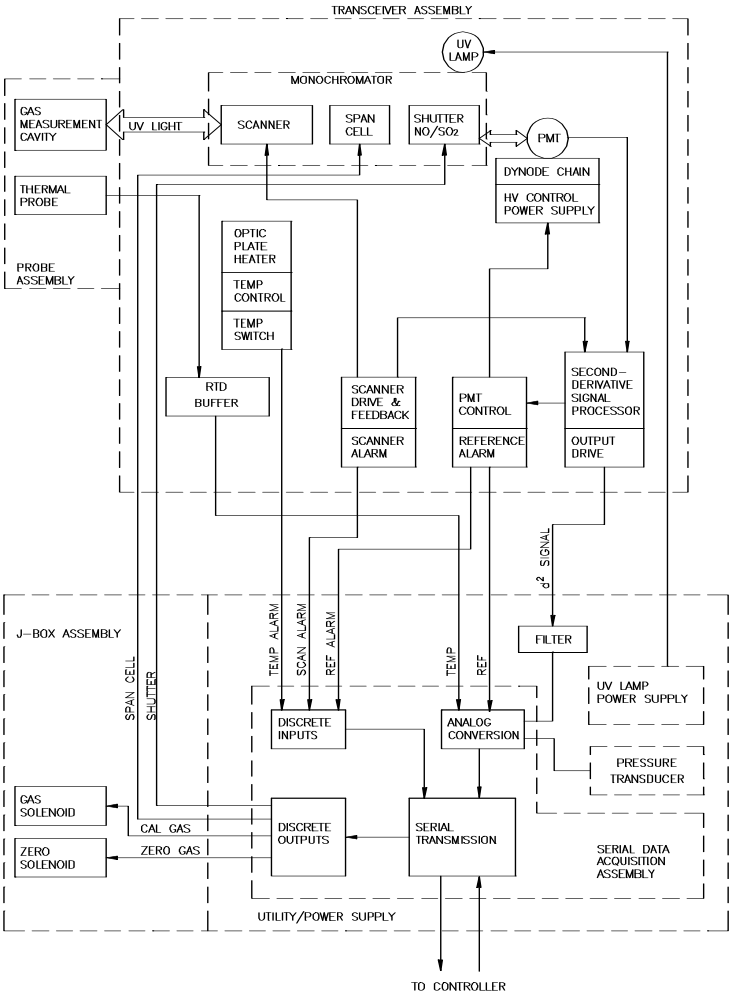


Figure 2-9. System Block Diagram

2.2.1 Transceiver Signals

Light from the UV lamp travels along the probe to the gas measurement cavity where wavelengths unique to the gas are absorbed. The light is then reflected back through the monochromator inside the transceiver. The monochromator spatially separates the wavelengths of interest. A scanner within the monochromator modulates the wavelength around the absorption peak of interest. This absorption signature appears at the monochromator exit slit and is measured through a photomultiplier tube (PMT) detector. A second exit slit is present so that both SO_2 and NO signatures can be measured. For signal separation a two-position shutter blocks one of the exit slits and allows either the SO_2 or NO UV light signal to be projected onto the detector, depending on the logic state of the shutter control signal.

The photomultiplier tube (PMT) transforms UV light into an electrical signal current proportional to the high voltage applied across the tube. Operating voltage for the photomultiplier tube is controlled by a DC feedback through a high voltage (HV) power supply. This DC feedback representing available light forms an automatic gain control (AGC) which constant amplified (Io) signal levels with the deterioration of the UV light source or contamination buildup on exposed probe optics. The second-derivative signal (d^2) is extracted from the PMT signal in the second-derivative signal circuitry. It then goes to the output drive where d^2 is normalized by dividing by the DC level of PMT OUT.

2.2.2 J-Box Signals

The second-derivative signal, temperature, and PMT light level reference analog signals are converted to digital format for transmission to the control unit. Serial transmission to the controller also includes the transceiver status, which is:

- optic plate over/under TEMPerature alarm (optical plate temperature not within specification)
- SCANner alarm (the wavelength modulation device is not operating properly)
- light level REFerence alarm (detected light level is inadequate to maintain specified performance)
- pressure in mmHg (used to correct measurements to standard pressure conditions).

Communication from the controller to an SM8160 J-box includes selection of the analog measurement and sequencing of discrete outputs, which are:

- shutter control for either NO or SO_2 measurements
- span cell control for automatic calibration checks

- zero solenoid control for automatic zero correction
- calibration gas solenoid control for gas calibration corrections.

2.3 Specifications and Operating Envelope

2.3.1 System Measurement Accuracy

The SM8160 provides SO_2 and NO measurements that meet or exceed the US EPA requirements defined in 40 CFR Part 60, Appendix B, Performance Specification 2, and the QA/QC requirements of 40 CFR Part 60, Appendix F. Performance specifications are only applicable within the operating conditions listed below.

Calibration error (linearity): Within 5% of calibration gas value or 2 ppm, whichever is greater, for values greater than 20% of measurement cavity range after calibration at process temperature.

Zero calibration drift (24 hours): Within 2.5% of span.

Span calibration drift (24 hours): Within 2.5% of span or 2 ppm, whichever is greater.

Response time: Less than 4 minutes, typical.

Operational period: 3 to 6 months without maintenance, typical.

Relative accuracy: Within 20% of US EPA 40 CFR Part 60, Appendix A reference method values, and typically within 10% in applications where measurement values are at least 20% of the measurement cavity range. Consult the factory for guaranteed performance at lower measurement levels.

2.3.2 Span Values

That full scale concentration for which the analog outputs are set to provide full scale output. Specified performance is available for SO_2 span values between 75% and 150%, or NO span values between 75% and 125% of the measurement cavity range (see 2.3.3 below). In regulatory compliance applications, the span value is an EPA-defined value which is used as the basis for defining calibration gas values, drift limits, etc. This regulation-based span value is not necessarily the same as the range of the analyzer.

2.3.3 Measurement Ranges

Measurement capabilities of the SM8160 are determined by the physical length of the optical measurement cavity. A selection of standard measurement cavities

provides for nominal full scale concentrations (measurement cavity ranges) of 3000, 1500, 750, 500, 375, 208, and 100 ppm. Consult the factory for applicability of special cavities and ranges of 75000 (7.5%), 12000 (1.2%), 6000, and 1000 ppm for specific process conditions. Other ranges are available on request.

Optional PROM set 80610067 is available for SM cavities below 750 ppm, adding a decimal point to the full scale, alarms ranges, gas concentrations, etc. The LS710 will print and display SO_2 and NO to the nearest 0.1 ppm.

2.3.4 Process Gas Conditions

Temperature: Specified performance is available after calibration at quasistatic nominal process temperature and within a range of normal process temperature variations of ±24° C (75° F) from nominal. Specified performance is available at process temperatures up to 232° C (450° F). Performance at higher temperatures or over larger temperature variations is dependent on specific application conditions; consult the factory. Temperature is measured over the range of 52° to 426° C (125° to 800° F). The probe can withstand operation over this temperature range without damage.

Pressure: Measurements are continuously corrected for the effects of ambient barometric pressure. Stack gas pressure must be restricted to atmospheric pressure ±101 cm (40 inches) of water column. Consult the factory for higher pressures.

Other: Standard configuration is not recommended for applications with substantial entrained water droplets. Consult the factory for special configurations.

Note

Guaranteed performance in any specific application is subject to factory review and approval of site-specific gas measurement conditions.

2.3.5 Calibration

Automatic on-stack zero and span calibration at selectable intervals up to 24 hours with manual activation at any time. Gas calibrations incorporate automatic correction of zero and span values at the completion of the calibration cycle. Electro-optical calibrations using zero gas and span cell only provide automatic zero correction. Calibration cycle length is selectable; typical length is 7 minutes.

2.3.6 Outputs

Controller: Eight 4-20 mA current sources that can be user-assigned to any selected variable. These current source outputs can be spanned to any integer value between 25 and 75,000 ppm (7.5%) for SO_2, or between 75 ppm and 7.5% for NO

as long as that value is within the span capabilities of the analyzer described above. External current loop isolators are optional. Process temperature signal is linear with process gas temperatures from 52° to 426° C (125° to 800° F). RS232 serial printer and data communication port are also available.

Junction box: Provides electrically isolated RS422 communication link between the transceiver and controller via a cable containing two individually twisted, shielded pairs. Accepts one additional 4-20 mA input for transmission to the controller over RS422.

2.3.7 Optical System

Light source: Deuterium lamp, hollow cathode discharge, typical lifetime up to six months.

Measurement technique: Second derivative signal detection and processing, with SO_2 monitored at 218.5 nm and NO monitored at 226.5 nm.

2.3.8 Operating Temperature

Instrument ambient: -35° to 52° C (-30° to 125° F).

Controller ambient: 5° to 38° C (40° to 100° F).

2.3.9 Physical

Transceiver: (lxwxh) 38.1 cm x 30.5 cm x 25.4 cm (15 in x 12 in x 10 in); 22.7 kg (50 lb).

Junction box: (hxwxd) 35.6 cm x 30.5 cm x 15.2 cm (14 in x 12 in x 6 in); 15 kg (33 lb).

Probe assembly: 8.9 cm (3.5 in) OD x 1.8 m (6 ft) overall length; adapter flange, standard; 13.6 kg (30 lb).

LS710 controller: (wxhxd) 43.2 cm x 17.8 cm x 64.8 cm (17 in x 7 in x 25.5 in); 12.7 kg (28 lb). Rack or panel mount option.

Weatherproof protective housing: (lxwxh) 80 cm x 50.8 cm x 45.7 cm (31.5 in x 20 in x 18 in); 5.4 kg (12 lb) plus 3.6 kg (8 lb) for mounting plate.

2.3.10 Utility Requirements

Transceiver/junction box: 115/220/240 VAC ±10%, 50/60 Hz, 220 watts nominal, 500 watts maximum.

Controller: 115/220/240 VAC ±10%, 50/60 Hz, 30 watts nominal, 50 watts maximum.

Instrument air: Junction box and transceiver purge with transceiver gas calibration requires 2.8 to 20 lpm (6 to 42 SCFH) of clean, oil-free, dry air or N_2 at 70 to 100 psig.

2.3.11 Construction

Probe: 316L stainless steel. Hastelloy is available for special applications. Standard length 6 feet; also available 1.5, 4, and 8 feet lengths.

Transceiver: Cast aluminum alloy-NEMA 4.

Alignment: Alignment of in situ probe and transceiver is adjustable, and probe is factory-prealigned. Test points and alignment procedures are provided for field maintenance needs.

Weatherproof protective housing: Factory-supplied housing hinges to top of mounting plate; lock-open/lock-closed mechanism.

2.3.12 Installation Interfaces

Mounting flanges: Factory-supplied mounting flange is welded to pipe barrel for customer installation; 4 in (ID) schedule 40 pipe barrel cut to length by factory for standard applications. Larger flanges available for wet scrubber FGDs and other wet gas applications as required. Transceiver unit attaches to flange with four factory-supplied 3/8" NC bolts.

Mounting plate: Required for attachment of weatherproof housing and junction box. Attaches to stack/duct with 4 anchor bolts.

Note

Consult the LS710 Operation and Maintenance Manual for specifications related to the controller.

2.3.13 Compatibility with Previous Models

The difference between the SM8160 and the previously supplied SM8100 is the transceiver printed circuit board and constants ROM U3 located in the controller. If the SM8160 is to be used in sequence with other SM equipment on the same controller, consult your service representative for information on upgrading the existing equipment (or other alternatives).

If an EX4700A ($CO/CO_2/H_2O$ in situ analyzer) is used on the same controller with the SM8160, the EX4700A must be specified (with optics plate S/N) at the time the order is placed so that specific EX4700A table information can be included in the constants ROM.

2.4 Suggested Spare Parts List

81000450-4	Maintenance Kit including: 81000161-1 UV lamp assembly 80030213 lens cloth 81000205 filter gasket 16000053 desiccant 81000790-2 Grafoil rings [4] 53000093-2 thermal fuses [2].

There are three levels of recommended spare parts.

Level 1: General maintenance supplies and expendable such as fuses, filters, gaskets, lamp, etc.

Level 2: Critical items that are known from experience to have a higher failure rate such as motors, fragile optics, power supplies, and circuit boards.

Level 3: Other miscellaneous items not included in Level 1 or 2. This level includes other spare parts which are not expected to fail over a given time frame.

SM8160 SO_2/NO Analyzer Spare Parts Requirements
Junction Box Assembly

Description	Part Number	Level
Printed Circuit Assembly, Serial Data Acquisition	81750012SP-1	2
Printed Circuit Assembly, Utility/Power Supply	81750015-2	2
Gauge, Pressure, 0 to 30 psi	28000344-1	3
Relay, Solid State, DC/AC	45000168	3
Transducer Assembly, Pressure	81001227-2	3
Transformer Assembly	81750016	3
Valve, Brass, NC, 115 VAC	22000096-3*	3
Valve, Solenoid, Stainless Steel, 115 VAC	22000096-5*	3

SM8160 SO_2/NO Analyzer Spare Parts Requirements Transceiver Assembly		
Description	**Part Number**	**Level**
Cartridge, Desiccant	16000053	1
Fuse, Thermal	53000093-2	1
Lamp Assembly, Ultraviolet	81000161-1	1
Beam Splitter Assembly	81000160-2	2
Controller Assembly, Temperature	81000623-3	2
Dynode Chain Assembly	81000883-2	2
Printed Circuit Assembly, Transceiver	81750045-2	2
Scanner Assembly	81000164-4	2
Lens Assembly, Focusing	81000157-3	3
Photomultiplier Tube Assembly	81000284-1	3
Sensor Assembly, Temperature	81000908-2	3
Sensor, Thermal, Close 120° F, Open 130° F	53000027	3
Sensor, Thermal, Close 170° F, Open 155° F	53000028	3
Shutter, Sequential, Kit	81000165SP	3
Span Cell Assembly, Internal	81000409-1	3

SM8160 SO_2/NO Analyzer Spare Parts Requirements Probe Assembly		
Description	**Part Number**	**Level**
Filter Assembly, Ceramic, 15 to 20 cm Cavity	81000935-1	1
Filter Assembly, Ceramic, 1.25 to 100 cm Cavity	28000262	1
Filter Assembly, Ceramic, 36 cm Cavity	80340018-1	1
Filter Assembly, Ceramic, 75 cm Cavity	81001130	1
Gasket, Ceramic Filter (except 36 and 75 cm Cavity)	81000205	1
Gasket, Ceramic Filter, 75 cm Cavity	81001137	1
Gasket, Ceramic Filter, 36 cm Cavity	81001176	1
Gasket, Probe Mount	81750564	1
Ring, Grafoil (except 36 cm cavity)	81000790-2	1
Seal, Grafoil (36 cm cavity only)	81000790-3	1
Cube, Corner, for 18 Inch Probe	20400-5007-2	3
Cube, Corner, for 4 Foot Probe	20400-5007-3	3
Cube, Corner, for 6 Foot Probe	20400-5007-4	3

SM8160 SO_2/NO Analyzer Spare Parts Requirements Probe Assembly		
Description	**Part Number**	**Level**
Cube, Corner, for 8 Foot Probe	20400-5007-5	3
Probe, Thermal, RTD, 316SS, for 18 Inch Probe	53000188-7*	3
Probe, Thermal, RTD, 316SS, for 4 Foot Probe	53000188-8*	3
Probe, Thermal, RTD, 304SS, for 4 Foot Probe with 36 cm Cavity	53000188-2	3
Probe, Thermal, RTD, 304SS, for 4 Foot Probe with 75 cm Cavity	53000188-5	3
Probe, Thermal, RTD, 316SS, for 6 Foot Probe	53000188-9*	3
Probe, Thermal, RTD, 304SS, for 6 Foot Probe with 36 cm Cavity	53000188-3	3
Probe, Thermal, RTD, 304SS, for 6 Foot Probe with 75 cm Cavity	53000188-6	3
Probe, Thermal, RTD, 316SS, for 8 Foot Probe	53000188-10*	3
Probe, Thermal, RTD, 304SS, for 8 Foot Probe with 36 cm Cavity	53000188-4	3
Window Assembly, 316SS	81000789-2*	3
Window Assembly, 316SS, 36 cm	81001007-1*	3

SM8160 SO_2/NO Analyzer Spare Parts Requirements Maintenance Kit		
Description	**Part Number**	**Level**
Cloth, Polishing, Lint-Free (for transceiver lens)	25000393	1

For 115 volt 316L stainless instruments only, call the factory for availability for 220 volt or Hastelloy instruments.

3.0 Installation

3.1 Site Preparation

3.1.1 Stack Site Selection and Preparation

Select the transceiver/probe site according to procedures established by the appropriate regulatory agencies. The location should be selected where measurements of SO_2 and NO are representative of the SO_2 and NO concentrations at the stack exit (refer to 40 CFR Part 60, Appendix B, PS-2, paragraph 3). If the instrument will be exposed to weather conditions, a protective housing is required. Each SM8160 is typically supplied with a fiberglass weather cover.

Clean, dry instrument air must be supplied with the following specifications:

- 70 psi minimum to 100 psi maximum air pressure
- -40° F maximum dew point
- less than 40 ppm hydrocarbon concentration.

The instrument air tube must be installed near the mounting plate for connection to the J-box.

3.1.2 Controller Site Preparation

Refer to the LS710 Operation and Maintenance Manual for information.

3.1.3 Electrical Site Preparation

Refer to drawings 81750001-2, 80610023-1, and 80610023-2.

AC power to the transceiver and controller must be wired in compliance with local electrical codes. The power line carrying 115 VAC ±10%, 60 Hz AC power must be capable of supplying the following input powers:

- transceiver and J-box: 220 watts typical to 500 watts warmup
- controller: 30 watts typical to 100 watts startup.

3.2 System Installation

After completion of site preparation, install the transceiver and probe as described in the following steps.

Note

Cover the probe opening and transceiver lens when transporting the system to the stack.

3.2.1 Installing the Mounting Flanges and Pipe

1. If installation is on a metal stack, go to step 2.

   If installation is on a masonry stack, bolt the stack plate (customer-supplied) to the stack wall using six 0.5-diameter anchor bolts.

2. Perform this step ***only*** when a protective housing for the SM8160 is being installed. If no housing is to be installed, go to step 3.

   If installation is on a metal stack, fillet weld four mounting brackets to the stack, with dimensions as shown in drawing 81750002-2.

   If installation is on a masonry stack, fillet weld four mounting brackets to the stack plate, with dimensions as shown in view AA of drawing 81750002-2.

3. Cut a 4½" diameter hole in the stack wall for insertion of the mounting flange pipe (4 inch Schedule 40 pipe).

4. Insert the mounting flange pipe into the hole and position the face of the mounting flange not less than six inches away from the stack wall. One hole of the largest bolt circle ***must be*** in the twelve o'clock position.

5. Fillet weld the mounting flange pipe where it meets the stack wall (metal stacks) or stack plate (masonry stacks).

3.2.2 Installing the Protective Housing

If no protective housing is being used, install the J-box as described in 3.2.3 below.

Bolt the mounting plate assembly (including the housing and J-box) to the four mounting brackets welded to the stack by inserting four 1/2-13 UNC bolts with flat washers and lockwashers. Use the four 0.68-diameter clearance holes in the mounting plate.

Secure the cover in the raised position.

3.2.3 Installing the J-Box

Position the J-box with the three cable inlet holes facing downward. Bolt the J-box in place on the enclosure mounting plate. Inside the J-box, check for an orifice in the plumbing to the probe Cal port. When the probe is configured with a

1-meter cavity, this orifice is not used, and in some cases the orifice is not required with the 36 cm cavity.

3.2.3.1 Cable Installation

1. Open the J-box cover.

2. Push an external AC power cable (three wires) through one of the cable inlet holes at the bottom of the J-box. The holes allow for the use of ¾-inch conduit fittings. Make connections as listed below.

   - from AC high power line to TB1 pin 23
   - from AC low power line to TB1 pin 24
   - from ground line to TB1 pin 25.

   See Figure 2-7 and drawing 81750001.

3. Push the two twisted-pair 22 AWG cables with overall shields through another inlet hole at the bottom of the J-box.

   Note

   If conduit is not used, replace the supplied fittings with glands that maintain the NEMA 4 rating of the J-box. Terminate this interconnect cable so that terminal 32 of the controller connects to terminal 32 of the J-box. Similarly, terminal 33 of the controller connects to terminal 33 of the J-box. Connect the shield on both ends to terminal 34. Terminals 35 and 36 must also be terminated to like terminal numbers.

4. When applicable, install and connect the O_2 calibration J-box per drawing 80390072. Refer to drawing 94200019 if YEW O_2 calibration J-box is used. Both O_2 J-box assemblies interface with the SM8160 J-box as indicated in drawing 81750001. Refer to drawing 80390010-6 when the LS420 O_2 calibration J-box is used.

5. Close the J-box cover.

3.2.3.2 Plumbing Installation

1. Connect a purge tube from the J-box Purge fitting to the transceiver Purge fitting located on the bottom of the probe air flush housing. Connect instrument air to the J-box Air In fitting.

2. If the probe has a pressure-sensing port, connect a tube from the J-box Pressure fitting to the left Calibration fitting on the probe flange. If the probe port is not installed, point the elbow on the J-box pressure bulkhead downward.

3. Connect a cylinder of mixed NO and SO_2 calibration gas to the J-box Gas Cal fitting. Concentrations should be near that expected in the process, but not less than 20% of the instrument full scale.

Note

A pressure regulation adjustment of approximately 5 to 20 psi is required.

4. If the optional heat exchanger is used, connect the J-box Cal to Probe fitting to the left side of the heat exchanger. Using the insulated tubing provided, connect the right side of the heat exchanger to the probe Cal fitting (right Calibration fitting on the probe flange). Without a heat exchanger, connect the J-box Cal port to the probe Cal fitting.

3.2.4 Installing the Probe

1. Slide the probe (without the transceiver) through the hole at the top of the mounting plate until the probe flange meets the mounting flange.

Note

Be sure the dynamic calibration fitting slides through the large hole used for zero and gas calibration (in the five o'clock position). One hole in the probe flange must be at the twelve o'clock position.

2. From the stack side, insert five 3/8-16 x 1-inch LG hex bolts with split lockwashers through the mounting flange into the five threaded holes in the probe flange. Tighten the bolts.

3.2.5 Installing the Transceiver

1. Lower the transceiver onto the hinge pins of the probe.

2. Attach the thermal probe connector from the probe to the bulkhead connector just below the transceiver lens. Also, connect the purge tube.

Note

Ensure that the thermal probe connector and purge tube are not in the light path when making the connection, and when closing the transceiver against the probe.

3. Remove the lens cover and clamp the transceiver to the probe, ensuring that the pilot pins are properly aligned.

Note

The pilot pins ensure correct optical alignment between the transceiver and probe.

Do not:

- Connect the cable between the transceiver and the J-box. This will be done during checkout and startup by a Teledyne Monitor Labs service engineer.
- Attempt to extend the length of this cable. The junction box must be mounted within the factory fabricated distance.

3.2.6 Installing the Controller

Refer to the LS710 Operation and Maintenance Manual for installation information.

3.3 Purge

High gas concentrations can exist in the ambient air surrounding the transceiver and low levels of ozone are produced by the UV lamp, so instrument air is circulated through the transceiver and probe body. The resulting positive pressure keeps gases, dust, and other contaminants from entering the optical path and prevents ozone accumulation inside the transceiver.

Note

Ozone is highly corrosive. Always operate the transceiver with purge air.

3.4 Checkout and Startup Service

Teledyne Monitor Labs provides a checkout and startup service at additional cost. This includes a seminar on instrument operation, support, maintenance, and data interpretation. All personnel who will operate or maintain the SM8160 should attend this presentation.

Note

Startup cannot begin until the steps under section 3.2, System Installation, have been completed. Customers are charged at an hourly rate for additional time that Teledyne Monitor Labs' service engineer is required to spend at the site waiting for completion of the installation.

At startup, the Transceiver Checklist and Installation/Startup Checklist are completed by Teledyne Monitor Labs' service representative. Sample checklists are provided at the end of this chapter for your information.

The complete field test and calibration procedure used at startup and whenever instrument test or verification is needed can be found in Chapter 4.

3.5 Transceiver Checklist (Sample)

1. Visually inspect the unit for any apparent damage and record below.

_____
_____
_____
_____
_____

2. Check the mounting interface bolts for tightness. _____

3. Open the transceiver and visually inspect the lens and probe reflector. _____

4. Apply power to the instrument and wait one minute for the lamp to fire. _____

5. Verify that the lamp has fired (Ref LED on the SDA board in the J-box is not lit). _____

3.6 Installation/Startup Checklist

1. Factory setup values:

   SO_2 and NO gain from factory _____

   SO_2 range _____

   NO range _____

2. LS710 setup:

   Under the CALIBRATION MENU:

   - INTVL _____ calibration interval

   - E/O DEG TEMP_____Factory setup for the recorded Span Values.

   Under the SO2/NO SETUP MENU:

   - SO2 FS and NO FS agree with SO_2 and NO ranges in 1 above

   - SO2 C and NO C agree with the calibration gas value plumbed into the J-box

   - SO2 G and NO G agree with the factory setup or set to 1 for initial calibration

   - NO&SO2 agrees with the factory setup

   - TEMP is set to RTD (rtd, KTYPE, and ktype are for older models).

   Under both the SO2 PPM and the NO PPM MENUS:

   - ALARM OFF unless HI LIMIT and LOW LIMIT values are inserted

   - COLUMN 0 unless required for RS232 output

   - DISPLAY ___ a value of 1 - 30 for position on display (must not duplicate another display position)

   - AVG____Typically 1 min is selected for recorder and RS232 outputs

   - RANGE____Typically set to agree with SO_2 and NO ranges in 1 above.

3. Verify that the transceiver has been on for at least three hours before continuing checkout (warmup and settling time).

   Select START as YES under the CALIBRATION MENU on the controller and wait for the calibration to finish. Verify that E/O is selected under CALIBRATION MENU and Type submenu.

4. Verify that system fault alarms are off:

   Heater _____ Scanner _____ Reference _____

5. Verify that SO_2 and NO zero and span readings are correct:

   SO_2 zero _____ma

   NO zero _____ma

   SO_2 span cell value _____ppm

   SO_2 front panel span reading _____ppm

   NO span cell value _____ppm

   NO front panel span reading _____ppm

   SO_2 S _____

   NO S _____

   Pressure _____

   SPAN SO_2 _____ ppm reading, _____bottle concentration

   SPAN NO _____ ppm reading, _____bottle concentration.

6. Verify SO_2 and NO current loop output:

   If the ZERO ADJ (Recorder Menu) is selected as 0, then:

   Io(mA) = 20 mA (Front Panel Readings)/(Range Setting) for 0-20 mA output

   = 16 mA (Front Panel Readings)/(Range Setting) +4 mA for 4-20 mA output

   Repeat for all analog outputs.

7. Verify alarm levels according to the application requirements:

   SO_2 LOW level _____ ppm SO_2 high level _____ ppm

   NO LOW level _____ ppm NO high level _____ ppm

8. Verify contact closure outputs to any external devices.

9. Verify RS232 communication to the DAS or printer, as appropriate.

3.7 LS710 Menu Reference

PANEL	CALIB	CO/CO2 SETUP	SO2/NO SETUP	OPACITY SETUP
ACCESS	START	CO Hi	SO2 FS	ZCOMP
CODE	TYPE	CO2 Hi	NO FS	OP Hi
MENU	INTVL	H2O Hi	SO2 Hi	OP G
UNITS	NEXT	CO Low	NO Hi	SETUP-OPLR
TYPE	CONTIN	CO2 Low	SO2 Low	OPLR
AGC	E/O DEG F	H2O Low	NO Low	SPAN OP
REF	PURGE	CO C	SO2 C	
	ZERO	CO2 C	NO C	
	SPAN	CO G	SO2 G	
	TEMP CK	CO2 G	NO G	
	AUTOZER	H2O G	SO2 25%	
		CO2&CO	NO 25%	
		CO&CO2	SO2 55%	
		CD&H2O	NO 55%	
		CO&H2O	N&S25%	
		S/N EX	N&S55%	
		SPAN CO	SO2 & NO	
		SPAN CD	TEMP	
		CO FS	SPAN SD	
			SPAN NO	

RECORDERS 1-4	RECORDERS 5-8	LS710 SETUP	SERIAL PORT	PARAMETERS	DIAGNOSTICS
RECORDER #	RECORDER #	HOURS	PG TOP	BARO FS	CLEAR
J-BOX	J-BOX	MIN	CAL LOG	BWA	V/R
SELECT	SELECT	MONTH	PG #	FUEL	HOURS
TYPE	TYPE	DAY	PORT	FDX10	
MA	MA	SITE	BAUD	FWX10	
ZERO ADJ	ZERO ADJ	UNIT	PARITY	FC	
		RECORDERS	MARGIN		
		AUX	WIDTH		
		AUX FS	LENGTH		
			COLUM N		
			EXCESS		

CO PPM	RESET	ALARM	HI LIM	LO LIM	COLUMN	DISPLAY	AVG	RANGE
CO2 PERCENT	RESET	ALARM	HI LIM	LO LIM	COLUMN	DISPLAY	AVG	RANGE
CO-ST CALC	RESET	ALARM	HI LIM	LO LIM	COLUMN	DISPLAY	AVG	RANGE
H2O PERCENT	RESET	ALARM	HI LIM	LO LIM	COLUMN	DISPLAY	AVG	RANGE
DEW CALC	RESET	ALARM	ERROR	EXCESS	COLUMN	DISPLAY	AVG	RANGE
BWS CALC	RESET	ALARM	HI LIM	LO LIM	COLUMN	DISPLAY	AVG	RANGE
O2 PERCENT	RESET	ALARM	O2 MAX	O2 MIN	COLUMN	DISPLAY	AVG	RANGE
SO2 PPM	RESET	ALARM	HI LIM	LO LIM	COLUMN	DISPLAY	AVG	RANGE
SO2 MASS	RESET	ALARM	HI LIM	LO LIM	COLUMN	DISPLAY	AVG	RANGE
NO PPM	RESET	ALARM	HI LIM	LO LIM	COLUMN	DISPLAY	AVG	RANGE
NO MASS	RESET	ALARM	HI LIM	LO LIM	COLUMN	DISPLAY	AVG	RANGE
TEMPERATURE	RESET	ALARM	HI LIM	LO LIM	COLUMN	DISPLAY	AVG	RANGE
PRESSURE	RESET	ALARM	HI LIM	LO LIM	COLUMN	DISPLAY	AVG	RANGE
OPACITY %	RESET	ALARM	HI LIM	LO LIM	COLUMN	DISPLAY	AVG	RANGE
OPAC COMB %	RESET	ALARM	HI LIM	LO LIM	COLUMN	DISPLAY	AVG	RANGE
DENSITY	RESET	ALARM	HI LIM	LO LIM	COLUMN	DISPLAY	AVG	RANGE
AUXILIARY	RESET	ALARM	HI LIM	LO LIM	COLUMN	DISPLAY	AVG	RANGE

Figure 3-1. LS710 Version 3.03 Software Menus

CONFIGURATION MENU: PANEL

ACCESS	Displays access to the front panel, OPEN or LOCK. Select LOCK to lock in data.
CODE	Code to access and alter parameters. Enter 3300 to change ACCESS to OPEN. Enter 666 to inhibit the current position of the shutter. Disabled next calibration cycle.
MENU	If OPER is selected, submenus will allow data entry to connected J-boxes. If SETUP is selected, all entry fields are available. After five minutes of no keyboard activity, MENU will 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. CGS (centimeters/grams/seconds) indicates metric units and CGSAV displays metric 5-second and average data.
TYPE	Indicates EX for $CO/CO_2/H_2O$ analyzers, MC for opacity monitors, and SO_2 or NO for SO_2/NO analyzers, depending on the transceiver sequential shutter. Loss of J-box communication results in displaying NA, indicating Not Active.
AGC	AGC is a reading of automatic gain control current used for EX4700A and opacity analyzers only. See *Channel* and *Display* for setup.
REF	An indicator of the electro-optical condition. See *Display* under *Channel* for setup.

CONFIGURATION MENU: CALIBRATION

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. Opacity monitors will always use internal zero and span devices, regardless of type.

INTVL	Allows selection of automatic calibration over interval, from 0 to 24 hours. A zero entry eliminates automatic calibrations.
NEXT	Indicates the hours until the next automatic calibration. This parameter cannot be changed during a calibration or when INTVL is set to zero.
CONTIN	Selects a continuous ZERO or SPAN calibration. Once ZERO or SPAN is entered, the calibration continues until OFF is entered. If TYPE in this menu is selected as E-O and CONTIN SPAN is selected, then a continuous E-O span will result. Otherwise, a continuous gas span will result. OUT is used to identify an out-of-service instrument.
E/O DEG F	The entered factory value is the temperature where E-O span and zero will be evaluated.
PURGE	The entered value establishes the total time of purge before zero calibration.
ZERO	The entered value establishes the zero time in calibration.
SPAN	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 gas.
AUTO ZERO	Entered minutes for auto zero before cal sequence. 0 = disable.

CONFIGURATION MENU: GAS

XXS	Displays the last E-O span value for measurement XX, where XX = CO, CO_2, SO_2, NO.
XXZ	Displays the zero offset value for measurement XX, where XX = CO, etc.
XXC	Sets the concentration of NBS traceable standard gas (taken from C values from the supplier's cylinder tag) for gas XX, which can be CO, CO_2, etc.

XXG	A measurement gain to read XXC within 1%. Can be manipulated manually or 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 and CO, etc).

CONFIGURATION MENU: CO/CO2 SETUP

S/N EX	A display of the EX4700A calibration curve serial number. Set to -1 if none are available.
SPAN CO	Sets the CO E-O span value.
SPAN CD	Sets the CO_2 E-O span value.
CO FS	Sets the CO full E-O scale value in ppm.

CONFIGURATION MENU: SO2/NO SETUP

NO & SO2	Defines the gain factor for interference between NO and SO_2.
TEMP	Selects both the temperature sensor type and the temperature curves. SMxxxxR specifies an RTD sensor, and SMxxxxK specifies type K sensor used on older probes. SM8175 specifies 125° to 450° F curves. SM8160 specifies 300° to 800° F curves.
XX ?5%	Defines gain factors used to trim out linearity variations (at the 25% and 55% points).
SO2 FS	Sets the SO_2 full scale value in ppm.
NO FS	Sets the NO full scale value in ppm.
SPAN NO	Sets the NO E-O span cell value.
SPAN SD	Sets the SO_2 E-O span cell value.

CONFIGURATION MENU: OPACITY SETUP

Z COMP	Displays the zero compensation value for opacity.
OP S	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	A nonalterable factory installed value for the site installation dimensions. The SETUP OPLR along with the working OPLR will be printed at each calibration sequence.

CONFIGURATION MENU: RECORDER OUTPUT

RECORDERS 1-4	To enable display of this menu, the RECORDER entry under LS710 SETUP must be set to 4 or 8 to agree with the analog channel board installed.
RECORDERS 6-8	The above entry must be set to 8 with an 8 channel analog board installed.
J-BOX	Specifies the J-box that the above RECORDER # will be connected to.
SELECT	Assigns a measurement channel designation to a particular RECORDER # channel. ZERO and FS (full scale) can be entered here for recorder calibration.
TYPE	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 likewise means the last averaged output is sampled and held.
MA	Sets the current loop output to 0-20 mA. (Reminder: The 8 recorder configuration allows only 4-20 mA output.)
ZADJ	1% to 10% offset in the recorder current output to accommodate negative data.

CONFIGURATION MENU: LS710 SETUP

Note

Time and day must be entered whenever the system is powered up. DAS can set the current time and day through the RS232 port.

HOURS	Sets the current hour of the day.
MIN	Sets the current minute of the day.
MONTH	Sets the current month.
DAY	Sets the current day.
SITE	The site number to be printed on the top of each page.
UNIT	The unit number to be printed on the top of each page.
RECORDER	Sets the type of analog board installed into the LS710 to NONE (no analog board installed), 4, or 8 (8 analog board installed).
AUX	Selects the channel to be assigned to the auxiliary 4-20 mA input. A 4-20 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 4-20 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

PG TOP	Sets the condition for advancing the RS232 output to the top of the next page before transmission of the next data output.
CAL LOG	All previous calibration data can be printed with time and date of the last calibration. Current faults are also printed. If there are no previous 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 or disables the RS232 serial port. The OFF selection disables the port. The DAS selection is automatically selected when the time of day clock is controlled by the DAS. The PRN selection sets the port 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.
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 data logger format, where all parameters are identified uniquely in one 12 character column.
EXCESS	The selection ONLY prints only those measurements and calculations that exceed the specified high alarm level. The selection INCLD prints *all* measurements and calculations that are configured in the LS710.

CONFIGURATION MENU: PARAMETERS

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.
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 (CO_2). When entered, the numerical value displayed should equal fuel FC. FC is entered only if FUEL is selected as OTHER.

CONFIGURATION MENU: DIAGNOSTICS

CLEAR	YES clears all LS710 faults.
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 or 20.9*((1-BWA)-((FW/FC)*(CO_2/100)))
OPACITY %	Opacity measurement.
OPAC COMB %	Combined opacity of all non-zero velocity instruments.
DENSITY	Optical density measurement.
PRESSURE	Pressure measurement through auxiliary input #2.
NO PPM	NO measurement.
NO MASS	NO #/MBtu (GCM).

Note

Mass calculations are based on O_2 measurement. If O_2 measurement is not available for the specified J-box, then the calculation is based on J-box 1 CO_2.

If metric selected, computes grams per cubic meter: (CONCEN)(MOL WT)(0.04087) Else if O_2 selected, computes lb/Mbtu: (CONCEN)(20.9/(20.9(1-BWA)-O_2))(FW)(2.59E-9)(MOLECULAR WEIGHT) Else if CO_2 selected, computes lb/Mbtu: (CONCEN)*FC*2.59E-9*(100/%CO_2)*MOL WT

SO2 PPM	SO_2 measurement.
SO2 MASS	SO_2 #/MBtu or GCM TEMP temperature measurement.
AUXILIARY	Auxiliary measurement.
CO-ST CALC	CO-stoichiometric concentration (CO/CO_2)*(FC/FW)*100.
DEW CALC	Calculate dew point.
BWS CALC	BWS = [(CO_2/100)(FW-FD)/FC]+BWA.

CHANNEL:

RESET	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 (averages 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.
O2 MIN	Sets the O_2 low alarm limit value.
COLUMN	Sets the RS232 column at which a channel value is to be printed. An entry of zero omits the measurement from printing. Each column is six characters long.
DISPLAY	When 0 is entered, the measurement for the channel is not displayed. The entered number indicates the display position. Numbers 1 to 15 are the first column and number 16 starts the second column in the upper middle of the display.
AVG	Sets the time over which measurements for a channel are to be averaged, from 1 to 60 minutes. AVG also sets the printing rate for this channel.
RANGE	Sets the full scale analog recorder range for a channel.

Teledyne Monitor Labs reserves the right to modify, alter, or enhance its software at its own discretion.

Periodically, software upgrades are made available for sale; call for standard upgrade price.

Customers who request upgrades accept all responsibility for installation and configuration of the upgrade, including costs and real or consequential damages related to the installation or use of the upgrade.

Factory service software upgrades performed by Teledyne Monitor Labs employees will include a charge for software installation.

In the event of a software upgrade covered by warranty, Teledyne Monitor Labs' liability is limited to provision of the software or firmware component in question on electronic media. Labor, travel costs, incidentals, and all other expenses resulting from the software upgrade are the sole responsibility of the customer.

4.0 Operation, Calibration, Maintenance

4.1 Operation

This section describes the basic operating steps for the SM8160. Operators must understand the operating procedure for the controller before attempting to operate the SM8160. Refer to the LS710 Operation and Maintenance Manual for details on headings and setup parameters pertaining to SM8160 operation and reporting. Refer also to section 4.3, System Parameter Setup.

The SM8160 has two control modes, manual and automatic. The manual mode is used during installation, maintenance, calibration, and servicing, and is controlled by the switches located on the Serial Data Acquisition (SDA) board in the J-box. These switches control the automatic and manual modes, zero cal solenoid, gas cal solenoid, internal span cell, and NO/SO_2 shutter position.

The automatic mode is used for normal operation and data collection of the SM8160, and is controlled by the controller.

In general, the following controller parameters and menu headings need to be taken into consideration for proper operation (see Figure 4-1).

Basic SM8160 setup with results displayed on controller front panel:

- `J-BOX` selection (1-4 corresponding to the SDA board switches)
- `SO2/NO SETUP` full scale (NO must be cavity full scale; SO_2 can be 20% to 125% of cavity full scale)
- `SO2/NO SETUP TEMP`erature (RTD, or K type used on older units)
- `CALIB` menu `E/O DEG F`
- `SO2/NO SETUP` gains for NO, SO_2, NO/SD interference
- `PANEL UNITS` (mA, eng=ppm)
- `PARAMETERS` menu `BARO`metric pressure (mm Hg)
- `SO2/NO SETUP Z`(ero) for NO and SO_2.

Calibration verification and diagnostics:

- `PANEL TYPE` (`NO` or `SO2` for SM8160)
- `PANEL REF`
- `CALIB`ration menu `TYPE`
- `CALIB`ration menu `INTVL`, `NEXT`

- ρ CALIBration menu CONT
- ρ SO2/NO SETUP NO S and SO2 S (reported value used in E/O cal)
- ρ SO2/NO SETUP S(pan) for NO and SO_2 (reference value used in E/O cal)
- ρ SO2/NO SETUP C(oncentration) for NO and SO_2 (reference values used in gas cal).

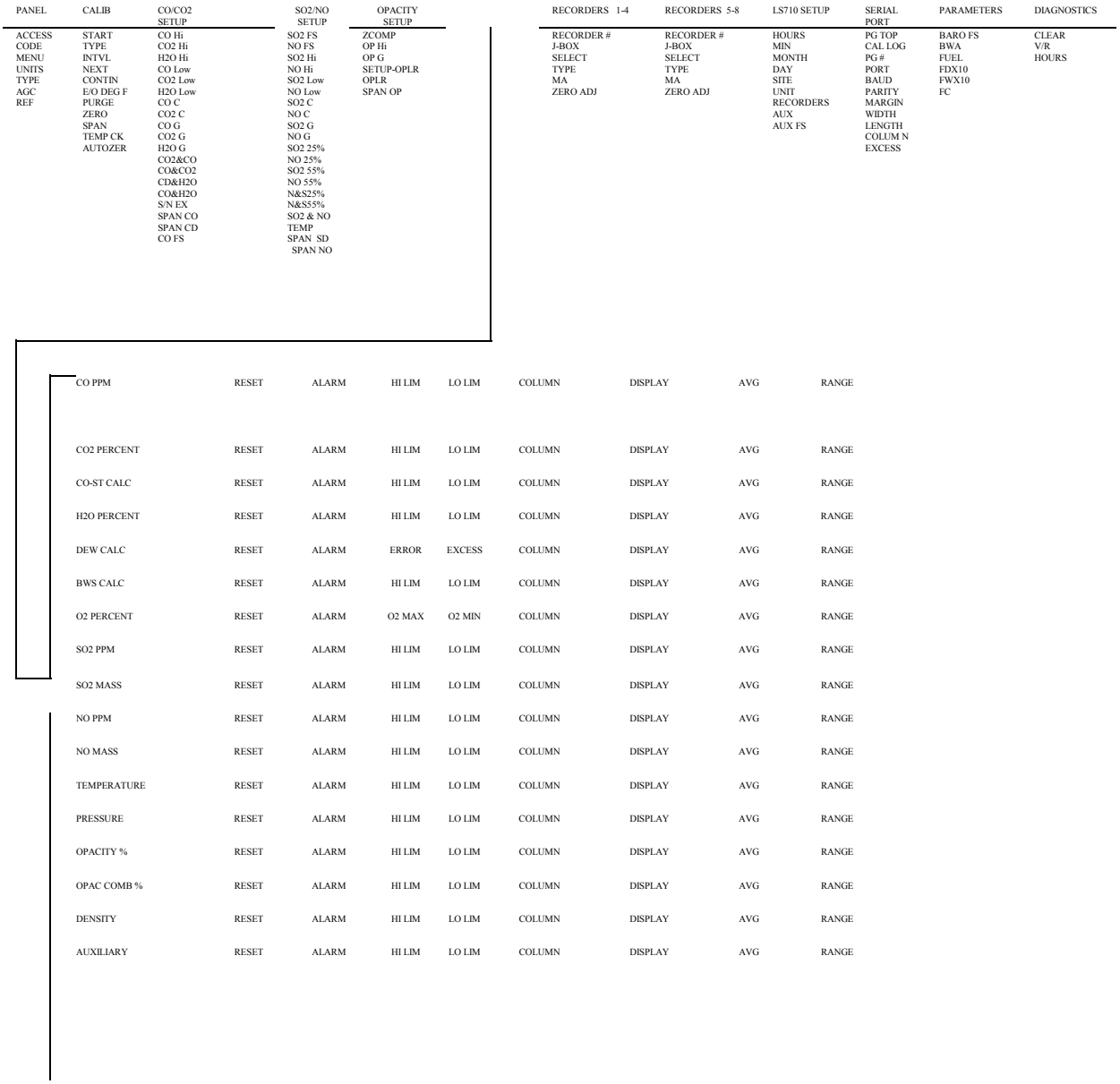


Figure 4-1. Controller Configuration Menu

Process monitoring and reporting:

- SERIAL PORT heading and subheadings
- LS710 SETUP HOURS, MIN, SITE, UNIT, and RECORDER
- SO2 PPM heading and subheadings (alarms, limits, recorder)
- SO2 #/MBTU heading and subheadings (alarms, limits, recorder)
- NO PPM heading and subheadings (alarms, limits, recorder)
- NO #/MBTU heading and subheadings (alarms, limits, recorder)
- TEMPERATURE heading and subheading (alarms, limits, recorder).

4.2 Controller Configuration

The configuration menu includes all possible headings and subheadings, including headings and subheadings for all of the measurements and calculations the controller can process (see Figure 4-1). The controller can monitor up to four instruments and up to four auxiliary inputs, including opacity, SO_2, NO, O_2, and velocity. The configuration menu is generally used during instrument setup and when new instruments are added to the controller.

4.3 System Parameter Setup

This section contains setup instructions for the system operation parameters that do not affect or are not essential for calibration. Menu parameters pertinent to calibration are discussed in the calibration section of the manual.

1. Enter the calibration intervals and desired time of day for automatic calibrations. Access the CALIBration menu INTVL subheading and increment to the desired calibration interval (eg, 24 hours). Access the NEXT subheading and enter the number of ***minutes*** from the present time to the desired time of day for the next automatic calibration.

2. Set up the measurement channels. Enter values for all appropriate subheadings (eg, ALARM, HI LIM, LO LIM) for each measurement channel (eg, SO2 CHAN, NO CHAN).

   Verify that each channel has a ***different*** column number if the controller uses the RS232 port for a printer or data acquisition system. No two channels can have the same column.

3. Set up the analog outputs under the RECORDERS 1-4 and RECORDERS 5-8 menus. Set each DAC number for a specific J-box number, channel (eg, SO2, NO, TEMPERATURE), type, and mA (ie, 4-20 or 0-20).

Note

The 8 DAC board offers 4-20 mA only. Go to step 6 if no oxygen analyzer is used with your installation.

4. Enter O2 under the INSTRUMENT heading, AUX subheading to identify the O_2 analyzer, if used.

5. Enter the O_2 analyzer full scale value (normally 25.0) under the INSTRUMENT heading, AUX FS subheading.

Note

If the controller ***is not*** connected to the printer, go to step 8.

6. Enter HOURS and MIN under the LS710 SETUP menu.

7. Enter the printer parameters under the PRINTER heading.

Note

(a) If you are using a data acquisition system, set the MARGIN to zero and the WIDTH to 12. (b) Set EXCESS to INCLUD. (c) The number of columns must match the number of measurement channels. Each COLUMN is equal to a measurement output (eg, SO_2 ppm, O_2).

8. Make the following entries under the PARAMETERS heading.

   a. Obtain barometric pressure for the day in mmHg. Call up the PARAMETERS heading, BARO subheading. Increment to the correct full scale number, typically 780. If BARO is not displayed, go to the PRESSURE heading, DISPLAY subheading and increment to 9 (or an unused position on the front panel). This pressure must agree with the barometric pressure for the day. Adjust the above BARO FS (full scale value) as required until the displayed BARO value agrees with the correct ambient or stack pressure.

   b. If using BWS CALC, O_2 derived from CO_2, or SO_2/NO with O_2 and a diluent, enter the percent of ambient moisture under the PARAMETERS heading, BWA subheading.

   c. If using BWS CALC, O_2 derived from CO_2, or SO_2/NO MASS, enter the type of fuel (ie, ANTH, BITUM) under the PARAMETERS heading, FUEL subheading. Select OTHER if the desired fuel factor is different than the fuel factors listed in the LS710 Operation and Maintenance Manual. Enter the correct fuel factors under the FDX10 or FWX10 subheading. Keep in mind that the value you enter is automatically multiplied by 10.

9. Enter SITE and UNIT numbers under the LS710 SETUP heading if you want these numbers to be printed with printer output.

4.4 Maintenance

This section provides a guide to scheduled maintenance procedures such as inspection, cleaning, and adjustments. The calibration section includes procedures for the adjustment of parameters used to maintain system operation within desired specifications.

4.4.1 Routine Maintenance

After initial installation, the SM8160 typically provides three months of low-maintenance operation. The table below summarizes the routine maintenance recommended to ensure ongoing trouble-free operation.

Refer to Chapter 6 for component replacement procedures.

Recommended Interval	Description	Materials Required
12 months*	Clean probe.	Ceramic filter and filter gasket (these are probe-dependent). Refer to appropriate probe list of materials for correct part numbers.
6 months	Replace UV lamp.	UV lamp assembly (P/N 81000161-1).
12 months	Perform field calibration procedure, section 4.5.	Refer to 4.5.1.
6 months*	Replace transceiver desiccant cartridge.	Desiccant cartridge (P/N 16000053).
6 months	Replace desiccant capsules in J-box air filter.	Desiccant capsules (P/N 80180305-2).

* If the transceiver desiccant cartridge requires more frequent replacement, the instrument air system may require more thorough drying.

Note

The transceiver optics are sealed from the electronics to prevent optical contamination during checkout, servicing, or calibration.

4.4.2 Junction Box

4.4.2.1 Serial Data Acquisition (SDA) Board Test Points

The following test points on the SDA are referenced throughout the maintenance procedures in this manual.

1 SO_2 Measurement
2 NO Measurement
3 Temperature Measurement
4 Reference Input
5 [not used]
6 [not used]
7 Auxiliary Input (typically O_2 measurement)
8 Pressure
9 Ground
10 Vref
11 A/D Status Pin
12 Isolated 5 VDC Return
13 Isolated 5 VDC
14 +5 VDC
15 -5 VDC

4.4.2.2 SDA Board Setup Switches

The SDA board dipswitches select the J-box associated with the instrument. Up to four J-boxes can be connected to a control unit. Switches S6-1 and S6-2 determine which J-box the control unit is addressing (see Table 4-1 below). Only one J-box address can be configured for a given J-box number. Communication conflict will result if two J-boxes have the same number. The socket that the SDA board is plugged into indicates the instrument type (EX4700A, SM8100A, or opacity). Switches S6-3 through S6-5 determine whether the source is a current loop or voltage measurement. For the SO_2/NO instrument, these are voltage inputs and should be switched off. All other instruments are current inputs and have these three switches positioned on.

Table 4-1. Serial Data Acquisition (SDA) Board Dipswitches

Switch	J-Box Number 1	J-Box Number 2	J-Box Number 3	J-Box Number 4
S6-1	On	On	Off	Off
S6-2	On	Off	On	Off

4.4.2.3 Adjusting the SDA Board A/D Converter

The following adjustment corrects all analog transceiver and auxiliary measurements that interface through the J-box.

1. Connect a DVM to TP4 with the return connected to TP9 on the SDA circuit board.
2. Configure the control unit to display Reference for this J-box number.
   a. Select `REF` from the `PANEL` menu.
   b. Increment the `REF` choice to display on the panel.
3. Adjust R18 until the displayed value agrees with the DVM reading.
4. Return the Ref panel display to its condition before this adjustment.

4.4.2.4 UV Lamp Current

Set the UV lamp current to 300 mA by adjusting R17 to 0.300 VDC. Make the adjustment at TP12 on the lamp power supply board in the J-box (see Figure 2-7). Ground is at TP11.

4.4.3 Visual Inspection

1. Release the six latches that secure the transceiver to the probe assembly and swing the transceiver to the side on its hinges.
2. Stand approximately two feet back from the probe assembly and look into the probe cavity. You should see a reflection of your eye at the end of the probe. If no image is visible, remove the probe from the stack and check the probe filter. Replace the filter if it is blocked, using the procedure in section 6.2.

Note

You may need to shine a flashlight down the probe.

Warning

Eye damage can result from looking directly at the UV lamp. Wear protective glasses.

3. Clean the outside surface of the transceiver lens with a clean, ***dry*** lens cloth.

Caution

Do not use solvents on the lens. Do not remove the lens from the transceiver. Do not turn the lens housing, because the focal point will be changed.

4. Swing the transceiver back into position. Be sure the thermal probe connector and purge tube are out of the light path. Ensure that the transceiver is properly aligned on the alignment pins opposite the hinged side. Secure the six latches.

5. Ensure that all mounting bolts at the probe/flange interface are secure.

Note

If the bolts and nuts that face the transceiver are loose, the transceiver/probe may require realignment (refer to the probe replacement procedure in section 6.7 for alignment instructions). If the bolts can be tightened without changing the previously established alignment, no adjustment is necessary.

6. Check the desiccant indicator on top of the transceiver. The center spot of the desiccant capsule should be blue. If not, replace the desiccant cartridge.

Note

If the transceiver desiccant cartridge requires replacement more frequently than every six months, an air dryer may be required on the instrument air supply. Desiccant capsules are also located inside the air filter in the J-box.

4.4.4 Wiring Check

Inspect the wiring between the J-box and the controller for any irregularity. Verify the J-box number. (Refer to the Instrument # Table in drawing 81750011 for the positions of S6-1 and S6-2 on the SDA board in the J-box.)

4.5 Field Test and Calibration Procedures

The following procedures can be used for initial instrument startup and any time instrument verification is required. The complexity and interactive nature of the following procedures require that the operator have SM8160 training and experience before proceeding.

Operators must also be familiar with the procedures for entering and changing parameters in the controller. Thoroughly review the LS710 Operation and Maintenance Manual before starting these procedures.

4.5.1 Recommended Equipment

- 4½ digit DVM (digital voltmeter), Fluke 80 Series or equivalent
- Independent temperature monitor capable of measuring process temperature at probe sampling point (also required to simulate a 100 ohm RTD)
- Oscilloscope
- Untreated lens cleaning cloth
- Flowmeter, 0 to 10 lpm or equivalent (recommended equipment)
- Two-stage gas regulator
- NO single gas, balance N_2
- SO_2/NO blend, balance N_2

Note

Select calibration gas values to be near the typical process values, or at least 70% of full scale.

4.5.2 Determining Zero Gas Flow

1. Put the SM8160 into continuous zero via the controller, or by placing the J-box in manual mode and activating the zero solenoid.

2. Set the flow rates for the zero gas by first adjusting the pressure regulator in the J-box for the lowest voltage at the SDA board TP1 (indicating that the process gas is being evacuated) .

Note

The voltage at TP1 changes with the position of the sequential shutter. NO is typically less than SO_2. Ground for voltage measurements on the SDA board is at TP9.

3. Reduce the pressure until the voltage at TP1 starts to increase (indicating process gas diffusing back into the cavity).

4. Increase the pressure until the lowest voltage is again obtained.

5. Increase the pressure by 1 to 2 psi to compensate for any minor changes in the process.

6. Record the pressure shown on the gauge in the J-box for future reference.

4.5.3 Determining Span Gas Flow

Two methods can be used to determine the optimum span gas flow. One method uses a flowmeter and the other uses the J-box pressure gauge. The method using a flowmeter is preferred over the method using gas regulator adjustment while monitoring J-box pressure. If more purge time is required (as with a 1-meter cavity), increase the purge time under [heading] Setup in increments of 60 seconds.

4.5.4 Using a Flowmeter

Refer to the list of recommended equipment in 4.5.1 above. The transceiver board d^2 signal must be peaked before this procedure (refer to 4.5.6.3 below).

1. Connect a span gas bottle through the flowmeter to the dynamic calibration port located on the front of the probe mounting flange. Do not use the cal fitting on the J-box.

2. Verify the site barometric pressure displayed on the controller. Refer to section 4.3, step 8a for `BARO FS` calibration procedure if adjustment is required.

3. Establish calibration gas pressure to agree with the zero gas pressure established in 4.5.2 above. For high temperature calibration (above 500° F), establish the gas flow required by slowly increasing the flow rate while monitoring the controller or the voltage at TP1 on the J-box SDA card. The data will only be valid for the shutter position corresponding to the span gas being used. Allow 5 to 10 seconds for an update at the controller. Plot the response (ppm or voltage) against flow rate. There will be a plateau in the curve where further increases in gas flow do not increase system response. Set the flowmeter for a safe margin above the knee of the curve.

4. Optimum gas flow depends on both probe cavity size and site installation. Record the flowmeter setting for future reference.

4.5.5 Probe Tests

4.5.5.1 Light Level Down the Probe

Refer to the LS710 Operation and Maintenance Manual for information about setup and operation of the controller.

The light level down the probe should not cause an excess of 13 mA reference current in continuous zero. Check the light level using the following steps.

1. Display the reference value on the controller front panel or monitor TP4 of the J-box SDA using a DVM.

2. Put the SM8160 in continuous zero via the controller or by placing the J-box in manual mode and activating the zero solenoid.

Note

The zero gas flow must be set in accordance with paragraph 4.5.2.

3. Verify that the reference current is equal to or less than 13 mA (1.3 volts at TP4).

4. Return the controller and J-box to the normal operational mode.

If you have a problem with high reference current readings, check for the following:

- *Dirty or damaged window and/or corner cube.* Inspect the window and corner cube for damage. Clean the window and all reflective surfaces of the corner cube with an untreated lens cleaning cloth.
- *Damaged and/or dirty beam splitter.* Inspect and clean or replace the beam splitter if necessary.
- *Defective photomultiplier tube (PMT)*. Inspect and replace if necessary.
- *Incorrectly adjusted or dirty focusing lens assembly.* The proper focus for probes that are four feet long or shorter is two turns counterclockwise from the fully clockwise position. Probes that are six feet long or longer are focused at 3/4 turn counterclockwise from the fully clockwise position.

Note

Clean the lens with an untreated cleaning cloth.

- *Incorrect probe alignment.* The probe must be removed from the stack for alignment. Position and clasp the probe on the transceiver in a vertical position. Loosen the three flange bolts, then rotate the two flange alignment rings independently and together in order to get the lowest voltage at TP4 on the SDA board in the J-box. Long probes may be subject to a significant change in alignment because of the effects of heat. In such cases, try alternate positions near the lowest voltage.

- *PMT alignment.* Lower the transceiver bottom cover for access to PMT adjustments. Switch the J-box SDA Manual and Shutter switches to the ON position (NO measurement). With the equipment operating, record the voltage at TP4 on the SDA circuit board. Loosen the three PMT mounting plate screws approximately one turn. Position the Shutter switch OFF (SO_2 measurement), grasp the PMT socket, and rotate the assembly for the lowest voltage at TP4 on the J-box SDA circuit board. Return the SDA switches to OFF and verify that the NO measurement recorded above has not increased in value. Button up the transceiver. Following the gas calibration procedure optimizes the SO_2 measurement. The NO measurement has a wider bandwidth and is not as sensitive to PMT alignment.

4.5.5.2 Probe Leaks

In some stack conditions, isolating probe leaks can be a challenge. A gas leak at the window in a negative stack can cause low gas readings, while the same leak in a positive stack can fill the probe body and cause high gas and light level readings. Verifying a leak-free probe is therefore very important. Use the following techniques to verify a leak-free probe.

Leak-testing the probe is best performed with the probe removed from the stack. Flow calibration gas into the dynamic calibration fitting at a much higher rate than required and verify that the readings do not continually increase. To verify that no gas leaked into the probe body, flow zero air into the probe and ensure that the reading is zero.

Gas can also leak into the probe body through the air filtration system. The air used to purge ozone from the transceiver is vented into the probe body through a small hole in front of the transceiver. Purge the transceiver with clean, dry, oil-free instrument air only.

Keep the transceiver access door and ports closed, especially when the atmosphere around the transceiver is suspected to be contaminated with gases.

When installing a probe in the stack, allow sufficient time for the entire probe to stabilize to process temperature (approximately one hour for shirt sleeve ambient conditions: 60° to 90° F).

4.5.6 Transceiver Test and Electronic Alignment

Note

Do not attempt to calibrate the transceiver until it has reached full operating temperature. A cold transceiver requires a minimum of three hours with all access doors and ports sealed to reach a stable temperature. When possible, allow the transceiver to warm up overnight.

When the transceiver temperature has stabilized, use the following procedures to test and calibrate the transceiver.

4.5.6.1 Optics Plate Temperature

Optics plate temperature affects the stability of the optics and the accuracy of readings. To verify this temperature, connect a thermocouple or other temperature measurement device under the temperature controller and tighten for good thermal contact. Using the temperature measurement device, verify that the temperature is 143° ±3° F. Adjust the coarse and fine potentiometer(s) on the temperature
controller, if required. Turn the bandwidth potentiometer fully clockwise. Close the transceiver housing when the procedure is complete.

4.5.6.2 Oscillator/SO_2 Scan Offset

The oscillator/SO_2 scan offset adjustments work together to peak the instrument for SO_2. In normal operation, the oscillator operates at a period of approximately 28 milliseconds when observed at TP3 on an oscilloscope. The transceiver is peaked when a positive symmetrical half-wave d^2 signal is present at TP5 while in the span mode (see Figure 4-2).

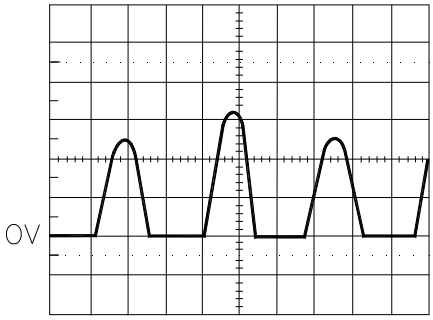


Figure 4-2. Transceiver Board, TP5: Time/Box = 20 ms Volts/Box = 0.5 V

The span mode is activated by switching S5 on the SDA board in the J-box to the MANUAL position (to the left). Activate Zero and Span switches S1 and S2 (to the left). If peaking is required, adjust R3 (SO_2 scan offset) for the best half-wave signal possible. Using R2 as a fine adjustment, turn R2 as necessary to bring both halves of the waveform to ground.

Move the oscilloscope to TP6 and observe the scanner drive signal. The signal should be a 0.6 ±0.25 volt peak-to-peak triangular waveform with slightly rounded peaks (refer to Figure 4-3).

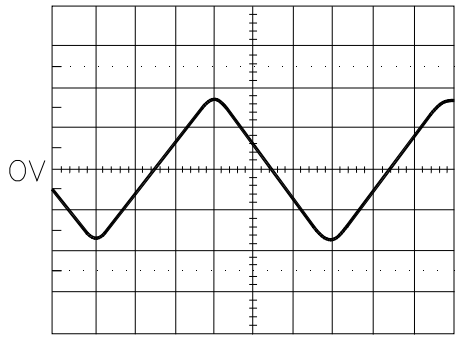


Figure 4-3. Transceiver Board, TP6: Time/Box = 20 ms Volts/Box = 0.2 V

Note

If the d^2 signal is not discernible, adjusting R2 to obtain a square wave at TP3 of 28 milliseconds and centering the scanner drive triangular waveform at 0 VDC at TP6 using R3 may help.

4.5.6.3 NO Scan Offset

The NO scan offset adjustment is required if the NO peak is not a good symmetrical half-wave signal while in the span mode. SO_2 must be satisfactorily peaked before NO can be adjusted. Activate Shutter switch S3 (to the left) on the SDA board in the J-box. Adjust R88 if necessary. Failure to obtain a good NO peak could indicate a problem with the optics alignment. If this occurs, contact Teledyne Monitor Labs for assistance.

When scan offset adjustments are complete, deactivate switches S1, S2, and S3 (to the right).

4.5.6.4 Scanner Feedback

Scanner feedback is tested at TP7. The waveform should be a half-wave with a negative peak of -7 ±1 VDC that does not go above ground (refer to Figure 4-4). Major irregularities in this signal could indicate a defective scanner motor. The scanner feedback signal is derived from a coil on the scanner motor that represents what the motor is doing.

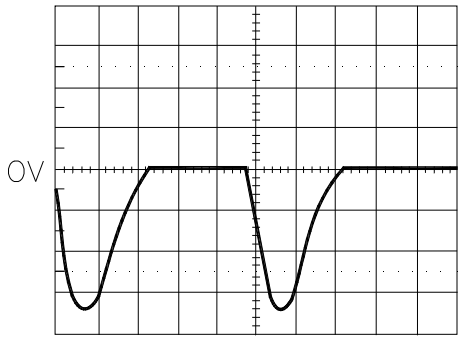


Figure 4-4. Transceiver Board, TP7: Time/Box = 20 ms Volts/Box = 2 V

4.5.6.5 Scanner Level Detect

The scanner level detect circuitry may need adjustment if a scanner alarm is present but the scanner feedback procedure in paragraph 4.5.6.4 above shows it to be normal. Adjust R4 for 0 ±50 mVDC at TP12.

4.5.6.6 Stack Temperature Adjustment

Disconnect the RTD at the transceiver and connect the RTD simulator for the length of the probe being tested. Switch the simulator to Low Temp. Connect positive lead of the DVM to TP3 on the SDA board. Adjust R72 on the transceiver board so that the meter reads the low temperature recorded on the simulator. Switch the simulator to Hi Temp. Adjust R137 on the transceiver board so that the meter reads the high temperature recorded on the simulator. Repeat both adjustments until the LS710 displays both temperatures as recorded on the simulator. Reconnect the RTD to the transceiver.

Note

The simulator is simply a three-terminal RTD simulator with the RTD lead resistance in series with all three leads. The series resistance can be measured between pins B and C on the RTD connector (the resistance per lead will be half the measured value). The Low Temp is the RTD platinum resistance at some low temperature (the lowest temperature of interest for the process). Similarly, the high temperature is the highest process temperature expected.

Note

Even though the temperature can read to 0° F, the temperature will default to the lowest table temperature in the LS710. When the SM8260 curves are selected, the lowest table temperature is 200° F. All other tables have entries down to 0° F.

4.5.7 Gas Calibration

Two different gas calibration methods are described below, one using flowmeters to monitor span gas flow and the other using the GAS CALIB sequence. The preferred method is to use flowmeters.

The following assumptions are made before performing gas calibrations:

- The transceiver test and electronic alignment has been completed.
- Optimum zero gas flow has been determined for the installed system.

Note

The operator must be familiar with the controller operating procedures and parameters before beginning this procedure. Refer to the LS710 Operation and Maintenance Manual.

4.5.7.1 Manual Gas Calibration Using a Flowmeter

1. Ensure that power to the controller is on and that a communication link exists between the controller and the J-box. Indicate either NO or SO_2 for the SM8160 under subheading PANEL TYPE on the controller. The appropriate J-box number must be selected.

2. Enter the calibration gains for each gas. Access heading GAS CALIB, subheading SO2 G and enter 1.000. Access subheading NO G and enter 1.000. If a blended gas is available, enter 1.000 for GAS CALIB NO&SO2 interference gain; otherwise, leave it at its previous setting.

3. Enter the full range of the instrument under heading SM8160, subheading SO2 FS and subheading NO FS. NO FS is determined by the measurement cavity size (ie, 188, 208, 375, 750). SO2 may be 150% of the cavity size and NO FS may be 75% to 125% of the cavity size.

4. Verify the ***site*** barometric pressure on the controller display. Refer to section 4.3, step 8a above if adjustments are required.

5. Verify the temperature of the thermal probe. Select the correct temperature detector type (STD R, 8100R, or HI R, where R denotes RTD). Note that K denotes the Type K thermocouple used on older instruments. The STD curve

selection covers 125° to 450° F, the HI curves cover 300° to 800° F, and the SM8100 is the older instrument with a lower degree of accuracy and linearity. If the HI curve set is not installed in the LS710 (U3 chip), the selection of HI will default to the prior selection.

Use the independent measurement device at or near the probe measurement point and record the temperature. Select the temperature channel to be displayed on the controller front panel. If the displayed temperature does not agree with the independent measurement, refer to *paragraph 4.5.6.6* above for adjustment.

Note

If only R72 is used to adjust temperature, temperature tracking with process temperature changes will not be accurate.

6. Put the SM8160 in continuous zero. Verify that the J-box pressure gauge is at the value obtained in the paragraph entitled *Determining Zero Gas Flow.*

7. Take the SM8160 out of continuous zero (return to normal operation).

8. Set the SO_2 and NO zero currents by starting an E/O calibration cycle. Refer to the *LS710 Operation and Maintenance Manual.* Allow the instrument to complete the E/O calibration.

9. If a flowmeter is used, connect the NO span gas bottle to the Cal to Probe line from the J-box using a flowmeter and two-stage regulator. If a flowmeter is not used, connect the NO gas to the J-box Cal Gas inlet port and set CONTinuous Span under the CALIBRATION MENU to flow gas. Flow the NO span at the rate established under the paragraph entitled *Determining Span Gas Flow*. With the controller NO G set to 1.000, adjust R15 on the transceiver PCA so that the controller display is the same as the named gas.

10. Set divider such that the display is 50% to 60% of scale. Change the value of heading SO2/NO SETUP subheading NO 55 such that the display shows the NO concentration times the divider setting.

11. Set divider such that the display is 20% to 30% of scale. Change the value of heading SO2/NO SETUP subheading NO 25 such that the display shows the NO concentration times the divider setting.

Note

A shutter inhibit function has been added to the LS710. When 666 is entered into the PANEL menu under CODE, the current state of the shutter will be maintained until 666 is reentered. A power interruption will cancel this inhibit function. Because the PANEL menu only updates when it is rewritten, the best way to determine the shutter state is to keep sequencing the <Select> then <Exit> or <PgUp> pushbuttons to view the current shutter state in the TYPE part of the PANEL menu. When the shutter is inhibited, a message will appear on the main menu status line and be sent out on the RS232 port.

Calibration errors will not be generated when the shutter is in the inhibit state.

12. Remove the NO gas and connect the mixed SO_2/NO cal as in step 9 above. Adjust R5 so that the controller display is the same as the named SO_2 gas. SO2 G must be set to 1.000 before final trim adjustment. Verify that the predetermined flow is maintained.

Note

R5 and R15 do not interact.

13. Change the value of the controller NO&SO G interference gain so the displayed value of NO agrees with the mixed NO gas concentration. Verify flow gas is at the optimum rate.

14. Set divider such that the display is 50% to 60% of scale. Change the value of heading SO2/NO SETUP subheading SO2 55 such that the display shows the SO_2 concentration times the divider setting.

15. Change the value of heading SO2/NO SETUP subheading N&S 55 such that the display shows the NO concentration times the divider setting.

16. Set divider such that the display is 20% to 30% of scale. Change the value of heading SO2/NO SETUP subheading SO2 25 such that the display shows the SO_2 concentration times the divider setting.

17. Change the value of heading SO2/NO SETUP subheading N&S 25 such that the display shows the NO concentration times the divider setting.

18. Disconnect the span gas bottle and flowmeter, and set CONTinuous to off if set in step 9 above. This completes manual gas calibration using a flowmeter. Run the internal span verification in paragraph 4.5.7.3 below at this time.

4.5.7.2 Gas Calibration Using the GAS CALIB Sequence

1. Ensure that power to the controller is on and that a communication link exists between the controller and the J-box. Indicate either NO or SO2 for the SM8160 under the PANEL TYPE subheading on the controller. The appropriate J-box number must be selected.

2. Enter the calibration gas gains for each gas. Access the GAS CALIB 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 SO2/NO SETUP menu NO&SO2 interference gain; otherwise, leave it at its previous setting.

3. Enter the full range of the instrument under the SO2/NO SETUP heading, SO2 FS and NO FS subheadings. NO FS is determined by the measurement cavity size (ie, 188, 208, 375, 750). SO2 FS may be 50% to 200% of NO FS.

4. Verify the ***site*** barometric pressure on the controller display under the PARAMETERS heading, BARO subheading. Refer to section 4.3, step 8a above for BARO FS calibration procedure if adjustment is required.

5. Verify the temperature of the thermal probe. Select the correct temperature detector type (8175R, 8100R, or 8260R, where the R denotes RTD). Note that K denotes the Type K thermocouple used on older instruments. The SM8175 curve selection covers 125° to 450° F, the SM8260 curves cover 300° to 800° F, and the SM8100 is the older instrument with a lower degree of accuracy and linearity. If the 8160 curve set is not installed in the LS710 (U3 chip), the selection of SM8160 will default to the last selection.

   Use an independent measurement device at or near the probe measurement point and record the temperature. Select the temperature channel to be displayed on the controller front panel. If the displayed temperature does not agree with the independent measurement, refer to paragraph 4.5.6.6 above for adjustment.

   Note

   If only R72 is used to adjust temperature, temperature tracking with process temperature changes will not be accurate.

6. Put the SM8160 in continuous zero, then start a timer to determine the time it takes to drop the voltage at TP1 to a zero condition (near 0.04 volts = 4 ma). Verify that the J-box pressure gauge is at the value obtained in paragraph 4.5.2. If the time to obtain a consistent zero is near or greater than 1 minute, change the entry under the CALIBration menu PURGE heading to a value that is greater than the above measured time.

7. Take the SM8160 out of continuous zero (return to normal operation), then start a timer to determine the time it takes to increase the voltage at TP1 to a stack condition. If the time to obtain a consistent stack condition is near or greater than 1 minute, change the entry under the CALIBration menu TEMP heading to a value that is greater than the above measured time.

8. Set the SO_2 and NO zero currents by starting an E/O calibration cycle. Refer to the LS710 Operation and Maintenance Manual.

9. Enter the calibration gas concentrations for each gas. Access the SO2/NO SETUP heading, SO2 C subheading and enter the value of SO_2 in the gas bottle. Access the NO C subheading and enter the value of NO in the gas bottle.

10. To set flow rate for the NO calibration gas, connect the calibration gas bottle to the Cal Gas In fitting on the J-box and perform the following steps:

    a. Switch S5 on the SDA board to the MANUAL position (to the left). Activate Gas switch S4 (to the left).

    b. Adjust the regulator on the calibration gas bottle for the same pressure shown on the J-box pressure gauge as the pressure obtained in paragraph 4.5.2. Record the voltage at TP1 that represents the NO response.

    c. Deactivate switches S4 and S5 (to the right).

    d. Select the CALIBration menu TYPE to GAS. Put the SM8160 in continuous span, then start a timer to determine the time it takes to increase the voltage at TP1 to a steady condition. Verify that the J-box pressure gauge is at the value obtained in paragraph 4.5.2. If the time to obtain a consistent up scale value is near or greater than 1 minute, change both entries under the CALIBration menu SPAN and ZERO headings to a value that is greater than the above measured time.

    e. Do not turn the calibration gas bottle regulator off at this time, as calibration gas will be used later in this procedure.

11. Perform a GAS CALIB sequence. Refer to the LS710 Operation and Maintenance Manual for details. Allow the calibration sequence to complete.

Note

SO_2 will fail the gas calibration because there is no SO_2 in the gas bottle.

12. If NO G is greater than 1.00, adjust R15 clockwise. If NO G is less than 1.00, adjust R15 counterclockwise. Initially, adjust R15 one turn to see how much effect it has.

Note

You will not see the effect of R15 adjustment until the end of the next GAS CALIB sequence.

13. Set NO G back to 1.00. Perform steps 12 and 13 until no further adjustment of R15 is needed to keep NO G as close as possible to 1.00.

Note

NO will now pass the gas calibration.

14. To make the SO_2 adjustment, connect the mixed SO_2/NO calibration gas to the Cal Gas fitting on the J-box and repeat step 10.

15. Initiate GAS CALIB and allow the sequence to complete.

16. If SO2 G is more or less than 1.00, adjust R5. Initially, adjust R5 only a little to determine the effect. You will not see the effect until the calibration sequence has completed.

17. Repeat steps 15 and 16 until SO2 G remains as close as possible to 1.00.

18. Connect the NO gas bottle to the Cal Gas fitting on the J-box and repeat step 10. If a blended gas is not available, leave the NO&SO2 subheading at the previous setting and go to step 22.

19. Initiate GAS CALIB and allow the sequence to complete.

20. If NO G is less than 1.00, increase the value under the NO&SO2 subheading. If NO G is greater than 1.00, decrease the NO&SO2 value.

Note

NO&SO2 is an adjustment that compensates for SO_2 interference with NO.

21. Repeat steps 19 and 20 until no further adjustment of the value under the NO&SO2 subheading is needed and NO G remains as close as possible to 1.00.

22. Disconnect the span gas bottle. This completes gas calibration using the GAS CALIB sequence. Run internal span verification at this time.

4.5.7.3 Verification of Internal Span

1. Find the internal span cell value and E/O temperature on the SM8160 factory data sheet.

Note

If the internal span value has been revised, refer to the last recorded value.

Note

Even though the E/O temperature entry can be set to 75° F, the temperature will default to the lowest table temperature in the LS710. When the SM8260 curves are selected, the lowest table temperature is 200° F. All other tables have entries at 75° F.

2. Begin an E/O CALIB sequence.

3. Allow the sequence to finish.

Note

The controller may produce a fault and display SPAN ERR at this time. It will clear shortly.

4. Record the span values under the CALIBration menu SO2 S and NO S subheadings.

5. Clear the SPAN ERR by entering ALL under the DIAGNOSTICS heading, CLEAR subheading.

6. Repeat steps 2 through 5 at least ***five*** times.

7. Enter the SO_2 and NO internal span values averaged in step 6 under the INSTRUMENT heading, SPAN SD and SPAN NO subheadings, respectively.

8. Repeat steps 2 and 5 to verify that there is no SPAN ERR message and that no faults occur.

If significant changes have been made to both previous span values, perform the probe leak test in paragraph 4.5.5.2 above.

4.5.7.4 Recorder Adjustments

1. Refer to Chapter 6 in the LS710 Operation and Maintenance Manual for recorder output calibration, if required.

2. To set recorder zero adjustment, record the menu settings under the RECORDER heading, SELECT subheading associated with each subheading DAC # (recorder output currently being used). Select ZERO under the SELECT subheading for each DAC #. Adjust the recorders for zero.

3. To set recorder span adjustment, select FS under the SELECT subheading for each DAC #. Adjust the recorders for full scale.

4. Return all SELECT assignments to the original menu settings.

5. For ease of reading the recorder output, verify that the recorder full scale is divisible by the graduation of the chart paper. Recorder full scale is found under the heading for each of the selected recorder assignments in step 4 and under the RANGE subheading.

4.6 Waveforms

See Figure 4-2 through Figure 4-8.

These waveforms occur with an external SO_2 span cell of typical ppm concentration. Because of variations among different systems, the amplitude values and repetition rates illustrated are only typical. Figure 4-2, Figure 4-5, and Figure 4-6 are directly related to the concentration of measured gas.

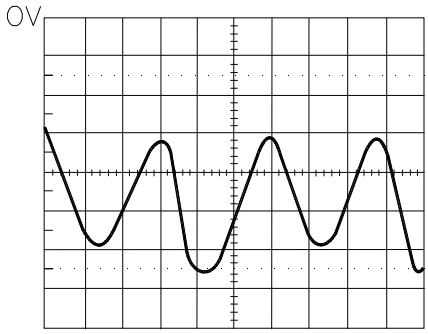


Figure 4-5. Transceiver Board, TP2: Time/Box = 20 ms Volts/Box = 0.2 V

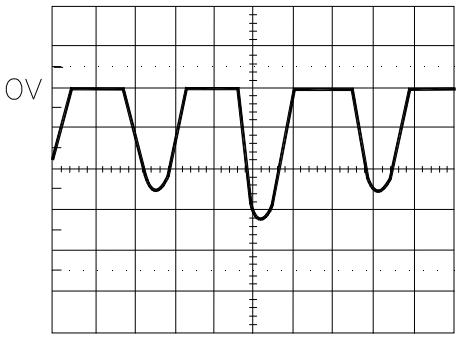


Figure 4-6. Transceiver Board, TP1: Time/Box = 20 ms Volts/Box = 1 V

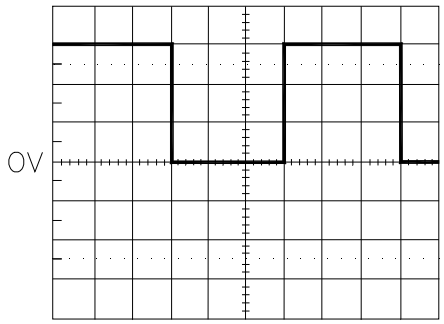


Figure 4-7. Transceiver Board, TP3: Time/Div: 5 ms Volts/Div: 5 V

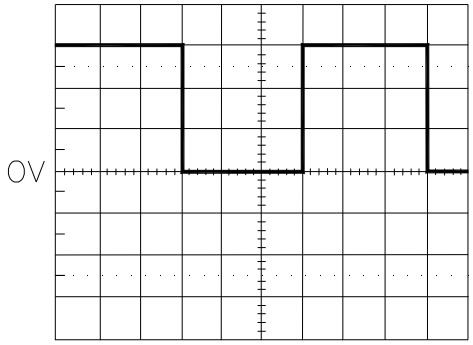


Figure 4-8. Transceiver Board, U8-1: Time/Box = 10 ms Volts/Box = 5 V

5.0 Diagnostics/Troubleshooting

5.1 Controller Diagnostics

Refer to the LS710 Operation and Maintenance Manual for complete information on the instrument.

5.1.1 Instrument Diagnostics

Instrument diagnostics are performed at power-up and during each E/O calibration sequence. Table 5-1 lists possible instrument failures and maintenance situations, including the message that is displayed and a brief description. If an instrument failure is detected, the message is displayed on the controller front panel and the Fault indicator lights.

Refer also to the descriptions of the status messages and diagnostics that occur during an E/O calibration sequence in the LS710 Operation and Maintenance Manual.

5.2 Instrument Status

Table 5-1. Instrument Status

Instrument Status	`SM REF`
Description	Indicates insufficient UV light levels in the transceiver.
More Information	See items 1, 5, 6, and 7 in the Troubleshooting Symptom/Action Chart.
Instrument Status	`SM TEMP`
Description	Appears when the optic plate temperature is out of tolerance. This fault indicates a failure in the transceiver electro-optical system that could result in an erroneous output.
More Information	See item 2 in the Troubleshooting Symptom/ Action Chart.

Instrument Status	SM SCANNER
Description	Appears when a failure has been detected in the transceiver scanner system.
More Information	See item 4 in the Troubleshooting Symptom/ Action Chart.

Instrument Status	FAILURE
Description	Appears on the lower display line (status line) when the controller diagnostics detect a fault.
More Information	Refer to the LS710 Operation and Maintenance Manual for details about each fault code.

Instrument Status	OUT OF SERVICE
Description	Appears with J-box number when a J-box and instrument have been taken out of service with the E/O CAL heading, CONTIN subheading.
More Information	Refer to the LS710 Operation and Maintenance Manual for more information about out-of-service instruments.

Instrument Status	SM MANUAL
Description	Appears with J-box number when J-box Manual switch S5 is in the manual mode.
More Information	The manual mode transfers instrument control from the controller to the J-box switches, and is only used temporarily during installation, maintenance, and servicing.

Instrument Status	J-BOX UART
Description	Indicates a bad transmission of RS422 to J-boxes. Appears with J-box number when the J-box transmission is faulty.
More Information	Remove and replace the SDA board, or replace U6 and/or U7 on the SDA board.

Troubleshooting Symptom/Action Chart		
Symptom	**Possible Cause**	**Added Information**
1. SM REF alarm	Deficient light level.	See symptom 5 below.

Troubleshooting Symptom/Action Chart		
Symptom	**Possible Cause**	**Added Information**
	Lamp off.	Cycle power at J-box circuit breaker CB1.
	Faulty lamp.	See UV lamp replacement procedure in Chapter 6.
	Excessive stack gas concentration.	
2. `SM TEMP` alarm.	Ambient temperature at transceiver out of limits.	Limits are -30° to +140° F.
	Transceiver internal temperature out of limits.	To verify this temperature, connect a thermal probe under temperature controller and tighten for good contact. Temperature range is 143° ±3° F. Adjust coarse and fine potentiometers on temperature controller if needed.
	Thermal fuse TF1.	TF1 is located on transceiver optic plate in lower right corner with transceiver door open. Replace as required.
3. Power failure in transceiver.	No power into J-box.	Check main power.
	J-box circuit breaker.	If breaker won't stay set, troubleshoot transceiver. Check thermal fuse TF1 on transceiver optic plate in lower right corner with transceiver door open.
4. `SM SCANNER` alarm.	Incorrect signal on TP3, transceiver board.	Check TP3 to verify that oscillator is working.
	Incorrect signal on TP5.	See Figure 4-3.
	Incorrect signal on TP6, drive signal.	See Figure 4-4.
	Incorrect signal on TP7, feedback signal.	See Figure 4-5. If there is no feedback signal or major irregularities in signal, scanner motor is faulty. Replace motor (see Chapter 6). If signals are OK, contact factory for assistance.
	R4 misadjusted.	When scanner is operating properly, TP12 voltage will be 0 ±50 mv.

Troubleshooting Symptom/Action Chart		
Symptom	**Possible Cause**	**Added Information**
5. Deficient light level (or high REF, or high Ref level).	Lamp not firing.	See symptom 6 below.
	Fogged lens.	See procedure for incorrectly adjusted or dirty lens.
	Dirty window.	See procedure for dirty or damaged window or corner cube.
5. Cont'd	Dirty corner cube.	See procedure for dirty or damaged window or corner cube.
	Probe misaligned.	See procedure for incorrect probe alignment.
	Probe misalignment due to high stack temperature.	See procedure for incorrect probe alignment.
	Excessive stack gas concentration.	See Chapter 2 specifications.
	Probe gas leak.	See probe leaks procedure in Chapter 4.
	Thermal probe cable or purge tube in light path.	Unlatch transceiver from probe. Swing transceiver open slowly and verify that thermal probe cable and purge tube are not blocking light path.
	Gas leak in transceiver.	See probe leaks procedure in Chapter 4.
	Inoperative air purge in transceiver.	Verify instrument air to J-box and purge air flow to probe.
	Shutter hangup or vibration.	Consult factory for assistance.
	PMT malfunction.	Replace PMT.
	Dynode chain malfunction.	Replace dynode chain.
	High voltage power supply malfunction.	Replace high voltage power supply.
	Dirty beam splitter.	Clean or replace as needed.
	Incorrect scanner position.	Consult factory for assistance.
	Lamp current too low.	Check lamp current and power supply circuit. See UV lamp current procedure.
	Loose lamp assembly.	Tighten screws on UV lamp cooling fan assembly.

Troubleshooting Symptom/Action Chart		
Symptom	**Possible Cause**	**Added Information**
	Fogged lamp.	Remove and clean lamp, or replace if needed.
	Low Reference.	Defective PMT power supply.
6. Lamp not firing.	Open lamp filament circuit (lamp not heating up).	Triac On LED (on power supply) lit. Replace lamp. LED does not come on when SDA Shutter LED is on and Fil Drive LED is on. Replace J-box transformer.
	Neither Lamp On LED nor Lamp Start On LED is on when SDA Shutter LED cycles on and off.	Replace Power Supply PCA.
	Faulty lamp.	See UV lamp replacement procedure in Chapter 6.
	Faulty Lamp Power Supply board in J-box.	Replace board.
	Lamp wires pinched to casting when lamp was last replaced.	Reinstall lamp housing with wires routed into inside of transceiver housing.
7. Lamp firing, flashing.	Improper adjustment of lamp current.	See UV lamp current procedure in Chapter 4.
	Faulty lamp.	See UV lamp replacement procedure in Chapter 6.
8. d^2 signal.	Scanner offset shift.	See scanner offset test in Chapter 5.
	Oscillator shift.	
	Faulty connection on scanner quick-disconnect terminals.	Check signals at TP5 (Figure 4-3).
9. Random or varying output readings.	Transceiver too hot.	See symptom 2.
	Heater controller on transceiver allowing wide temperature variations.	See symptom 2.
	Process gas in and around transceiver.	See probe leaks procedure in Chapter 4.
	Improper shutter position.	Consult factory for assistance.

Troubleshooting Symptom/Action Chart		
Symptom	**Possible Cause**	**Added Information**
	Incorrect lamp intensity current variations.	See symptoms 6 and 7 above.
	Unstable scanner.	Replace scanner motor.
10. Incorrect temperature.	Faulty thermal probe.*	See thermal probe replacement procedure in Chapter 6.
	Open or intermittent connection between thermal probe plug and transceiver.	Tighten thermal probe plug.
	Improper adjustment.	Refer to 4.5.6.6 for adjustment procedure.
	Faulty U16 on transceiver printed circuit board.	Replace transceiver board.
	Incorrect input selected on transceiver printed circuit board.	Select correct input using jumpers.
11. Output readings ramp (increase).	Probe leak.	See probe leaks procedure in Chapter 4. ***Caution: Do not make any monochromator adjustments.***
12. Unable to linearize unit.	Excessive 11 cycle modulating signal waveform (ratio of maximum to minimum signal greater than 2:1).	See symptom 15 below.
13. Low frequency modulation of signal.	Excessive scanner offset.	See scanner offset test in Chapter 4.
14. Excessive 11 cycle modulating signal waveform.	Improper optics alignment.	***Do not make any monochromator adjustments. Return to factory for alignment.***
	Excessive scanner offset.	See scanner offset test in Chapter 4.
15. Unable to reassemble cavity properly.	Probe not positioned correctly.	Probe must be vertical to assemble Grafoil ring/window assembly. Note: A new Grafoil ring is required every time window assembly is replaced or disassembled, and every time cavity is loosened.

Troubleshooting Symptom/Action Chart		
Symptom	**Possible Cause**	**Added Information**
16. Leaky probe.	Cracked window.	Replace window per section 6.4.
	Grafoil ring not sealed.	See probe leaks procedure in Chapter 4.
	Internal calibration gas tubing leaking.	Replace probe. See probe replacement procedure in Chapter 6.
16. Cont'd	Calibration gas inlet not plugged or connected to J-box.	Replace as required.
	Loose thermal probe fitting at measurement cavity end of probe.	Tighten or replace fitting.
17. 8-foot probe out of alignment.	Cantilever action due to weight of probe against transceiver.	If possible, do not bolt probe to stack. Allow probe to rest in its sleeve in stack.
18. Abnormal instrument readings.	High gas concentrations in ambient air surrounding transceiver.	See probe leaks procedure in Chapter 4.
	Calibration probe mounting flange not secured tightly.	See probe leaks procedure in Chapter 4.
	Leak at Grafoil ring separating probe body from measurement cavity.	See probe leaks procedure in Chapter 4.
	Blockage of ceramic filter at probe tip.	See probe filter replacement procedure in Chapter 6.

6.0 Component Replacement

Note

For this chapter, probes are categorized into four general groups according to basic cavity size: standard, 20 cm, 36 cm, and 100 cm. Each group may contain several measurement cavity sizes.

6.1 UV Lamp Replacement

Caution

Switch the transceiver power off (CB1) in the J-box before beginning any transceiver maintenance or component replacement procedures.

Caution

Avoid touching any glass surfaces (lens, window, corner cube reflector, lamp) when cleaning and/or servicing the SM8160.

1. Switch the transceiver power off and wait 15 minutes for the lamp to cool.

2. The black-finned lamp housing is secured to the side of the transceiver with four captive screws. Release the two screws that secure the electrical connector. Loosen the two screws that secure the lamp assembly to the lamp housing and remove the lamp assembly.

3. Remove the new lamp assembly from its container. Avoid touching the quartz envelope of the lamp and handle it only by the wires or by the block at the base of the lamp. Be certain that the envelope is clean.

4. Place the new lamp assembly in the lamp housing and secure it with two screws. Secure the electrical connector to the side of the lamp housing with two screws.

5. Place the lamp housing back in position. Verify that the lamp housing is properly aligned on the alignment pins. ***Be sure that the lamp wires are not caught under the housing***. Secure the four captive screws. Ensure that the face of the lamp housing lies flush against the mating transceiver surface.

6. The lamp does not require further adjustment. If, however, the adjustment locknuts have been changed or if peak performance is desired, proceed to step 7.

7. To adjust the lamp, first notice the two threaded cams secured with locknuts. Using a screwdriver and a small wrench, loosen the locking nut counterclockwise 1/2 turn while keeping the cam from turning with the screwdriver.

Loosen the four lamp housing mounting screws a few turns. Switch the J-box SDA Manual switch to the ON position and shutter switch to the OFF position. With the equipment operating, simultaneously rotate both adjustments for the lowest voltage at TP4 on the J-box SDA circuit board (note that the measurement return is TP9). Return the SDA switches to OFF and button up the transceiver.

6.2 Probe Filter Replacement

Note

This procedure is a guideline based on the standard probe configuration. Steps 3 through 6 are probe-dependent. Refer to the appropriate probe drawings to determine the filter replacement procedure for nonstandard probes.

1. Release the six latches that secure the transceiver to the probe. Swing the transceiver to the side and disconnect the purge tube and thermal probe connector below the transceiver lens. Lift the transceiver off the hinge pins and set it aside.

2. Release the mounting flange bolts on the ***stack side only***. Carefully draw the probe from the sampling port. Allow the probe to cool to room temperature.

3. Use an Allen wrench to back off the adjustment cup and screw until the ceramic filter is loose. Remove the two screws securing the adjustment cup support.

4. Remove the ceramic filter. Use a small screwdriver to remove the filter gasket from its seat in the probe end plate.

5. Carefully press a new filter gasket into place. Lower the new ceramic filter over the measurement cavity and onto the gasket. Replace the adjustment cup support and tighten the two screws.

Note

If the probe is used with a wet scrubber, thoroughly wet the gasket and pack it in the gasket seat.

6. Hold the ceramic filter firmly against the gasket and advance the adjustment cup down onto the center of the ceramic filter end until the filter is held firmly against the gasket.

7. Carefully insert the probe back into the sampling port and secure it in place with the mounting flange bolts.

8. Place the transceiver on the hinge pins. Attach the thermal probe connector and purge tube. Close and latch the transceiver to the probe.

6.3 Transceiver Lens Replacement or Cleaning

1. Release the six latches that secure the transceiver to the probe. Swing the transceiver to the side and disconnect the purge tube and thermal probe connector below the transceiver lens. Lift the transceiver off the hinge pins and set it aside.

2. With the transceiver in a vertical position (lens up), remove the lens assembly by rotating it counterclockwise.

Caution

Do not touch any glass surfaces when cleaning or servicing the SM8160. Remove the lens only in clean, dry air.

3. Before inserting the new lens assembly, clean both sides of the lens with a lens cloth. Ensure that an O-ring is located below the threads on the outside of the lens assembly (refer to the old lens assembly as an example). ***Do not use the new lens assembly without an O-ring*.** Insert the new assembly by rotating it clockwise.

4. Once the assembly is fully seated, back off the applicable number of turns as follows:

18 inch probe	2 turns out
4 foot probe	2 turns out
6 foot probe	3/4 turn out

5. Place the transceiver on the hinge pins. Attach the thermal probe connector and purge tube. Close and latch the transceiver to the probe.

6.4 Grafoil Ring and/or Window Cleaning or Replacement

Note

This procedure is a guideline based on the standard probe configuration. Steps 3 through 6 are probe-dependent. Refer to the appropriate probe drawings to determine the ring/window replacement procedure for nonstandard probes. Whenever the window is replaced, the Grafoil ring must be replaced.

Note

Any time the probe end is disassembled, the filter gasket must be replaced. If a wet scrubber is used, thoroughly wet the gasket before packing it into the gasket seat.

1. Release the six latches that secure the transceiver to the probe. Swing the transceiver to the side and disconnect the purge tube and thermal probe connector below the transceiver lens. Lift the transceiver off the hinge pins and set it aside.

2. Remove the probe from the stack.

3. Remove the ceramic filter.

4. Remove the complete measurement cavity assembly by placing a screwdriver or other strong instrument horizontally through the measurement cavity for leverage. Turn the complete assembly counterclockwise until it is disengaged.

5. Lift the window assembly out of the probe.

6. Pry the Grafoil ring out of its seat with a small screwdriver and clean the seat.

Caution
Avoid touching any glass surfaces.

7. Place the new Grafoil ring in its seat.

8. Clean the window assembly and place it on top of the Grafoil ring.

9. Ensure that the key on the window assembly is aligned with the keyway in the probe body.

10. Replace the complete measurement cavity by turning it clockwise until solid resistance is felt. Measure the length of the measurement cavity extending from the probe and tighten with a torque wrench until it moves 0.25 to 0.32 inch. Do not exceed 25 foot-pounds.

11. Replace the ceramic filter and reinstall the probe.

6.5 Retroreflector (Corner Cube) Replacement

Note

This procedure is a guideline based on the standard probe configuration. Steps 3 through 6 are probe-dependent. Refer to the appropriate probe drawings to determine the retroreflector replacement procedure for nonstandard probes. The retroreflector is determined by probe length rather than cavity size.

Caution

Avoid touching any glass surface when cleaning and/or servicing the SM8160.

1. Release the six latches that secure the transceiver to the probe. Swing the transceiver to the side and disconnect the purge tube and thermal probe connector below the transceiver lens. Lift the transceiver off the hinge pins and set it aside.

2. Remove the probe from the stack.

3. Remove the ceramic filter.

4. Hold the measurement cavity securely and loosen the jam nut. Do not move the main body of the measurement cavity during this procedure.

Note

If the main body of the measurement cavity does move, perform the Grafoil ring and/or window cleaning or replacement procedure.

5. Turn the retroreflector housing counterclockwise and remove it.

6. Remove the old retroreflector. Verify that the spring and plate remain within the end of the retroreflector housing.

7. Clean the new retroreflector and insert it in the retroreflector housing.

8. Position the probe with the measurement cavity downward, then place the retroreflector housing on the end and turn clockwise until there is contact. Turn one turn after contact (preload).

Warning

Overtightening will crack the retroreflector.

9. Tighten the jam nut.

10. Replace the ceramic filter and reinstall the probe.

6.6 Thermal Probe Replacement

Note

This procedure is a guideline based on the standard probe configuration. Steps 3 through 6 are probe-dependent. Refer to the appropriate probe drawings to determine the thermal probe replacement procedure for nonstandard probes. The engineering drawings in Chapter 9 are for probes with RTDs. If you are upgrading to an SM8160, replace the thermocouple with an RTD and change the transceiver jumper configuration.

Note

Any time the probe end is disassembled, the filter gasket must be replaced. If the probe is used with a wet scrubber, thoroughly wet the gasket and pack it in the gasket seat.

1. Release the six latches that secure the transceiver to the probe. Swing the transceiver to the side and disconnect the purge tube and thermal probe connector below the transceiver lens. Lift the transceiver off the hinge pins and set it aside.

2. Remove the probe from the stack.

3. With the probe in a horizontal position, remove the thermal probe Swagelock nut at the end of the probe. Remove the ferrule.

4. Insert the new thermal probe into the probe until approximately one inch protrudes through the end of the probe.

5. Insert the new ferrule.

6. Replace the Swagelock nut and tighten securely until thermal probe movement is totally restricted.

7. Reinstall the probe and reattach the transceiver to the probe.

8. Attach the thermal probe connector at the transceiver.

6.7 Probe Replacement

1. Release the six latches that secure the transceiver to the probe. Swing the transceiver to the side and disconnect the purge tube and thermal probe connector below the transceiver lens. Lift the transceiver off the hinge pins and set it aside.

2. Release the mounting flange bolts on the ***stack side only***. Carefully draw the probe from the sampling port. Allow the probe to cool to room temperature before transporting it.

3. Align the new probe. The probe must be out of the stack for alignment. Position and clasp the probe on the transceiver in a vertical position. Loosen the three flange bolts, then rotate the two flange rings independently and together in order to get the lowest voltage at TP4 on the SDA board in the J-box. Long probes may be subject to significant changes in alignment because of the effects of heat. In such cases, try alternate positions near the lowest voltage.

4. Carefully insert the new probe into the sampling port and secure it in place with the mounting flange bolts.

5. Place the transceiver on the hinge pins. Attach the RTD connector and purge tube. Ensure that the correct type of thermal probe is selected by the jumpers on the transceiver board. Close and latch the transceiver to the probe.

6.8 Transceiver Replacement

1. Release the six latches that secure the transceiver to the probe. Swing the transceiver to the side and disconnect the purge tube and thermocouple connector below the transceiver lens. Lift the transceiver off the hinge pins.

2. Place the new transceiver on the hinge pins. Ensure that the correct type of thermal detector is selected with the transceiver board jumpers. Attach the thermal probe connector and purge tube. Close and latch the transceiver to the probe.

3. Perform the transceiver test and calibration procedures.

4. Ensure that the transceiver lens is focused for the proper probe length (see section 6.3, step 4 above).

6.9 Span Cell Replacement

Caution

Switch the transceiver power off (CB1) in the J-box before beginning any transceiver maintenance or component replacement procedures.

Caution

Expose optical components only in a clean area.

Caution

Avoid touching any glass surfaces when cleaning and/or servicing the SM8160.

1. Release the six latches that secure the transceiver to the probe. Swing the transceiver to the side and disconnect the purge tube and thermal probe connector below the transceiver lens. Lift the transceiver off the hinge pins.

2. Position the transceiver with the black-finned lamp housing up.

3. Loosen the six screws on the transceiver access door and open the access door.

4. Remove the Allen screw located near the bottom of the photomultiplier tube (PMT) assembly, which has a lanyard to the access cover attached to it.

5. Disconnect the two plugs to the dynode chain.

6. Remove the three Allen screws that secure the PMT assembly. (It may be necessary to disconnect several wires from TB1 to allow clearance for removal of the assembly.)

7. Carefully remove the PMT assembly by pulling outward (see Figure 6-1 and Figure 6-2).

8. Loosen the Allen set screw on the span cell and remove the span cell.

9. Install a new span cell and tighten the Allen set screw.

10. Perform steps 1 through 8 in reverse order and reverse action to reassemble the transceiver.

11. Correct the `SPAN` values and `E-O TEMP` value under the `SO2/NO SETUP` menu.

6.10 Span Cell Solenoid Replacement

1. Remove the span cell using the span cell replacement procedure.

2. Remove the two Allen screws that secure the span solenoid to the PMT assembly.

3. Remove the two nuts that secure the span solenoid to the bracket. Remove the solenoid.

4. Install the new span solenoid.

Note

Once the new span solenoid with the span cell attached is installed, verify that it moves back and forth freely without dragging.

5. Perform steps 1 through 4 in reverse order and reverse action to reassemble the transceiver.

Note

If replacing the optic plate, turn the transceiver on its back and verify that the optic plate is firmly seated on its alignment pins.

6.11 Photomultiplier Tube and/or Dynode Replacement

Caution

Switch the transceiver power off (CB1) in the J-box before beginning any transceiver maintenance or component replacement procedures.

Caution

Expose optical components only in a clean area.

Caution

Avoid touching any glass surfaces when cleaning and/or servicing the SM8160.

1. Release the six latches that secure the transceiver to the probe. Swing the transceiver to the side and disconnect the purge tube and thermal probe connector below the transceiver lens. Lift the transceiver off the hinge pins.

2. Position the transceiver with the black-finned lamp housing up.

3. Loosen the six screws on the transceiver access door and open the access door.

4. Remove the two smaller screws on the PMT assembly (see Figure 6-1 and Figure 6-2).

5. Remove the PMT by pulling outward.

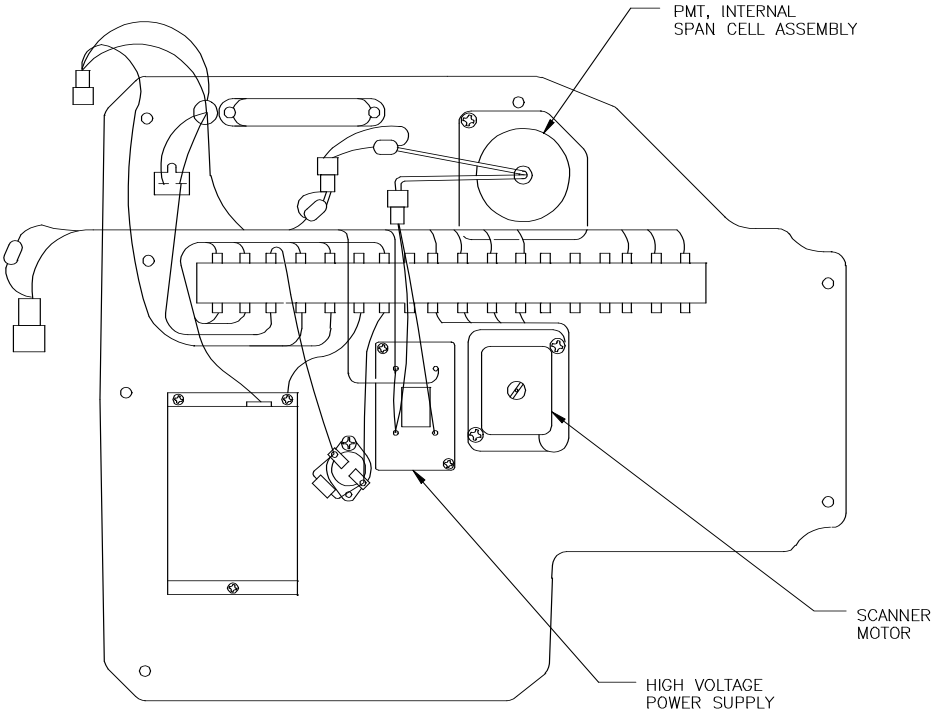


Figure 6-1. Optic Plate Assembly, Bottom View

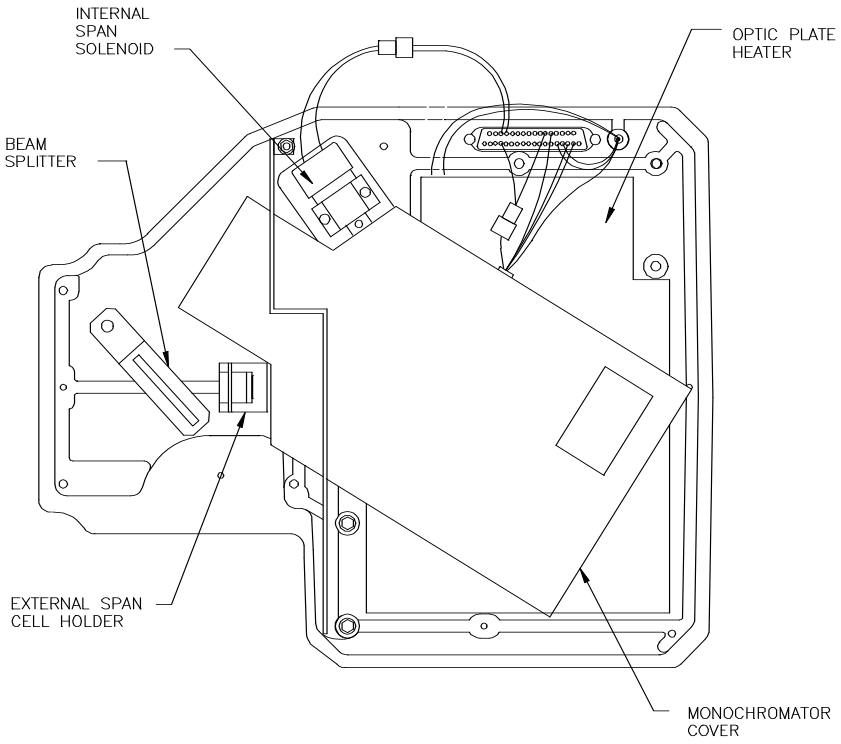


Figure 6-2. Optic Plate Assembly, Top View

6. Replacement of:

   PMT. Place the gasket on the seat (refer to the old PMT as an example). Disconnect the old PMT from the dynode and connect the new PMT to the dynode.

   Dynode. Remove the wires from the old dynode and remove the dynode. Connect the new dynode and reconnect the wires.

7. Carefully slide the PMT and dynode chain back into the optic plate, aligning the PMT grids with the hole inside the housing. Replace and tighten the two Allen screws.

8. Perform steps 1 through 7 in reverse order and reverse action to reassemble the transceiver.

6.11.1 PMT Base Plate Replacement

1. Remove power from the transceiver by tripping the J-box circuit breaker.

2. Drop the transceiver bottom cover for access to the PMT mounting hardware.

3. Remove the two screws securing the PMT socket.

4. Remove the PMT, being careful not to expose the tube to excessive light. (Direct sunlight will saturate the PMT, after which it takes several hours to recover.)

5. Remove the three screws securing the PMT assembly and remove the assembly. (The assembly will still be attached with wires to the span solenoid, but it can be dropped far enough to replace the plate.)

6. Remove the two screws attaching the mounting plate to the assembly and replace with the new mounting plate.

7. Reassemble in reverse order.

8. The PMT does not require further adjustment. If, however, peak performance is desired, proceed to step 9.

9. Loosen the three PMT mounting plate screws about a turn. Switch the J-box SDA Manual and Shutter switches to the ON position. With the equipment operating, grasp the PMT socket and rotate the assembly for the lowest voltage at TP4 on the J-box SDA circuit board (note that the measurement return is TP9). Return the SDA switches to OFF and button up the transceiver.

6.12 Scanner Assembly Replacement

6.12.1 Scanner Offset Test

Activate Manual switch S5 and Shutter switch S3 on the J-box SDA board (to the left for both switches). Transceiver board TP6 (Figure 4-4) shows a perfect scanner offset because the waveform is evenly centered around zero volts with the scope DC coupled at ground potential. The measurement technique is to DC-couple the scope, center the waveform as shown in Figure 4-4, and switch the scope to ground. The DC level above or below ground is the measured scanner offset voltage.

The SM8160 optical system is laser-aligned in the factory so that the scanner offset does not exceed 200 millivolts. However, reliable operation may be experienced with scanner offset as high as 400 millivolts. The criteria for proper scanner operation is that SO_2 d^2 and NO d^2 adjust properly, the scanner offset is within 400 millivolts, and no scanner alarm exists.

If the scanner offset is suspected, by the above criteria, to be contributing to a transceiver malfunction, replace the scanner motor using the replacement procedures in Chapter 6 or contact the factory for assistance. If replacing the motor does not correct the problem, contact the factory.

Caution

Switch the transceiver power off (CB1) in the J-box before beginning any transceiver maintenance or component replacement procedures.

Caution

Expose any optical components only in a clean area. Avoid touching any glass surface when cleaning and/or servicing the SM8160.

1. Remove the four nuts from the probe studs that retain the transceiver. Unplug the RTD bulkhead connector and disconnect the purge plumbing from the transceiver. Remove the transceiver from the probe. Note if the transceiver to J-box umbilical is too short to set the transceiver down, disconnect it from the J-box.

2. Position the transceiver with the black-finned lamp housing up.

3. Loosen the six screws on the transceiver access door and open the access door.

4. Remove wires #6 (green), #7 (yellow), #8 (black), and #9 (red) on the PMT side of the terminal strip.

5. Remove the two countersunk slotted screws on the scanner assembly

6. Remove the scanner assembly by pulling outward. This step may require some manipulation.

7. Insert the new scanner assembly. Be sure the new assembly is seated on the alignment pins. This procedure may be difficult. If it is, start the two screws, which should pull the assembly into place.

Caution

Do not pound on the scanner assembly or use any kind of tool to force it or alter the position of the scanner window.

8. Perform steps 1 through 7 in reverse order and reverse action to reassemble the transceiver.

6.13 Transceiver Printed Circuit Board Replacement

Caution

Switch the transceiver power off (CB1) in the J-box before beginning any transceiver maintenance or component replacement procedures.

Caution

Expose optical components only in a clean area.

Caution

Avoid touching any glass surfaces when cleaning and/or servicing the SM8160.

1. Release the six latches that secure the transceiver to the probe. Swing the transceiver to the side and disconnect the purge tube and thermal probe connector below the transceiver lens. Lift the transceiver off the hinge pins.

2. Position the transceiver with the black-finned lamp housing up.

3. Loosen the six screws on the transceiver access door and open the access door.

4. Disconnect the two connectors on the transceiver printed circuit board.

5. Remove the six screws that secure the PCB.

6. Remove the PCB and replace it with a new PCB.

7. Replace and tighten the six screws. Replace the two connectors.

8. Perform steps 1 and 2 in reverse order and reverse action to reassemble the transceiver.

9. Reconnect power and perform the transceiver test and calibration procedures. Ensure that the correct type of thermal detector is selected by jumpers 3 through 5 on the transceiver board.

6.14 Transceiver Sequential Shutter Replacement

Caution

Switch the transceiver power off (CB1) in the J-box before beginning any transceiver maintenance or component replacement procedures.

Caution

Expose optical components only in a clean area.

Caution

Avoid touching any glass surfaces when cleaning and/or servicing the SM8160.

1. Release the six latches that secure the transceiver to the probe. Swing the transceiver to the side and disconnect the purge tube and thermal probe connector below the transceiver lens. Lift the transceiver off the hinge pins.

2. Position the transceiver with the black-finned lamp housing up.

3. Loosen the six screws on the transceiver access door and open the access door.

4. Remove the bulkhead thermal probe connector from the transceiver casting and disconnect the wires after marking their leads for replacement. Remove the green lanyards that support transceiver bottom casting from the optic plate. Mark and disconnect all wire harness in-line connectors except those associated with the PMT. Remove the six screws attaching the optic plate to the transceiver casting (these are located near the edge of the optic plate). Remove the optic plate (note that the plate is slightly pressed onto two alignment pins, one under the thermal probe bulkhead connector and one on the other end of the optic plate).

Caution

Do not pound on the optic plate or use any kind of tool to force it or alter its position.

5. Remove the monochromator cover secured with a screw on either side.

6. Remove the two screws securing the solenoid mounting bracket.

7. Cut the grommet to remove the solenoid wires from the harness.

8. The solenoid bracket exhibits a tight fit, pinned to the monochromator plate. Do not remove the pin. A slight force will be required, but do not force it with hammer blows that can upset the monochromator alignment. Remove the solenoid bracket.

9. Remove the shutter arm by loosening the two set screws securing the arm to the solenoid shaft.

10. Replace the solenoid using the spacer and screws provided. Longer screws than provided will bind the solenoid.

11. If a 24 VAC supply is available, energize the solenoid and install the arm against the energized stop. If the arm chatters against the stop, it must be installed so that the solenoid asserts more force against the stop. If the supply is not available, assemble so that the solenoid asserts a force against the stop (when the transceiver is powered up and operating, there should be an audible sound when the shutter is positioned into the NO position without indications of excessive reference). Remove the power supply.

12. There should be a visible space between the arm and bracket so that the arm will not drag on the bracket.

13. Mount the solenoid bracket but do not tighten the screws. Be sure the new assembly is seated on the alignment pin. This procedure may be difficult. If it is, start the two screws, which should pull the assembly evenly into place.

14. Sight over the top of the mirror that is perpendicular to the exit slits. Rotate the solenoid bracket so that the exit slit to the right is well covered by the shutter arm and the space between the slits is evenly divided.

15. Tighten the solenoid bracket mounting screws. Feed the solenoid wires through the split grommet and install the monochromator cover. Plug the solenoid into the harness.

16. Perform steps 1 through 4 in reverse order and reverse action to reassemble the transceiver.

7.0 Functional Description

The following is a general description of the SM8160 optical and electronic subsystems, including what they are and what they do. Each narrative section is associated with a functional block diagram so that the two can be used together. In the diagrams, active circuits are represented by blocks with names that identify their functions. Blocks that relate to a single operation are grouped together. In the text, reference is made to the blocks. Emphasis is placed on signal input and output names and their connections to other places.

7.1 Optical System

The optical system uses a second-derivative absorption spectrometer, an instrument that optically generates and extracts the second-derivative signal of the NO or SO_2 absorption spectra.

The optical system is contained within the probe and transceiver assemblies and includes a beam splitter, lens, corner cube (retroreflector), mirrors, and a diffraction grating. The functional diagram for this system shows the optical device configuration (see Figure 7-1). Progression of the light path envelopes are indicated by straight lines with arrows, referred to as light rays or beams.

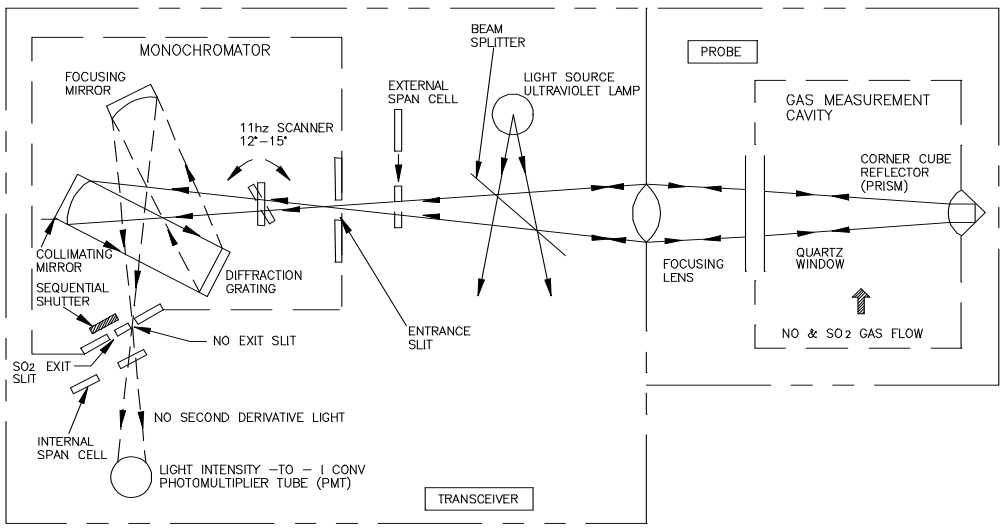


Figure 7-1. Optical System Functional Diagram

7.1.1 Transceiver Optics

The SM8160 functions when an electronically-controlled UV lamp emits a broadband UV light spectrum that impinges on the partially transparent surface of a beam splitter. The light reflects off the surface of the beam splitter towards a focusing lens located at the probe entrance. The lens converges light rays along the probe length toward the gas measurement cavity. The UV light passes through a quartz window and traverses the cavity. Any NO or SO_2 gas present in the cavity absorbs some UV light, thereby reducing the light intensity at the absorption wavelengths.

A focused corner cube reflector (a prism with a curved front surface to maintain the light beam shape) at the opposite end of the cavity returns the UV light along a different path by the principal of total internal reflection at two prism sides. The reflected light traverses the cavity again, passes back through the quartz window, and travels the probe length to strike the focusing lens, which converges the light towards the beam splitter.

After passing through the beam splitter, the UV light converges to a focal point at the monochromator entrance slit.

7.1.1.1 Monochromator

The monochromator is a self-contained unit that optically generates the second-derivative signals for NO and SO_2 from the focused UV light that passes through the entrance slit. In the monochromator, the light passes through a quartz plate scanner that periodically oscillates at 9 Hz through a 12° to 15° angle. The scanner motion continuously changes the incident angle of the light striking it, thereby displacing the light beam. This changing angle periodically shifts the UV spectrum, including the absorption wavelengths, in time and position, which results in wavelength modulation. The scanner induces second-derivative signals by wavelength-modulating the absorption wavelengths.

After the light passes through the scanner, it is reflected by a concave, collimating mirror that forms parallel (collimated) rays that impinge on a diffraction grating. The grating is a plane reflection-type with 2180 lines per millimeter. It is a device that diffracts, or bends, incident light at angles that are a function of the light wavelengths. This is called dispersion. It means that light is angularly separated according to wavelength in a manner similar to a prism separating visible white light into its rainbow of colors.

After dispersion, the light rays are reflected from the grating. The angle of the light rays is determined by their wavelength. They are directed to a concave focusing mirror that reflects and converges the dispersed light into a continuous spectrum across two exit slits. The fixed position and width (0.1 millimeter wide)

of the exit slits select only the NO and SO_2 absorption wavelengths from the continuous spectrum.

Note

The functional diagram depicts only the NO light rays being focused at and exiting from a slit.

A sequential shutter operated by electronics system timing selects either the NO or SO_2 absorption wavelength for measurement

7.1.1.2 Light Intensity-to-Current Converter

A photomultiplier tube (PMT) converts the intensity of light exiting the monochromator to an equivalent electrical current. This cyclic current varies according to the second-derivative frequency (2F). In the SM8160, the second-derivative frequency equals 18 Hz, twice the 9 Hz modulating frequency (F) of the scanner. The principal photomultiplier tube output signal components are a DC level corresponding to the average UV light intensity and the modulated frequency (2F). The electrical output from the photomultiplier tube goes to the PMT input in the second-derivative signal processor section of the transceiver board, located in the transceiver.

7.2 Electronic System

7.2.1 Transceiver

The transceiver performs the following functions:

- processes the PMT signal to produce the second-derivative signal
- controls the UV lamp
- controls the scanner motor
- controls the high voltage (HV) power supply for the PMT
- receives and processes the thermal probe signal.

The devices and circuits that implement these functions are:

- dynode chain and HV control power supply for the PMT
- UV lamp
- scanner motor
- thermal probe
- transceiver board
- output drive.

7.2.2 Second-Derivative Signal Processor

The second-derivative signal processor processes the PMT signal, which includes the second-derivative signal from the PMT, into appropriate PMT OUT and d^2 signals (see Figure 7-2). The PMT current is converted into an equivalent voltage called PMT OUT. This signal branches in two directions; to a low-pass, active filter and into PMT DC control.

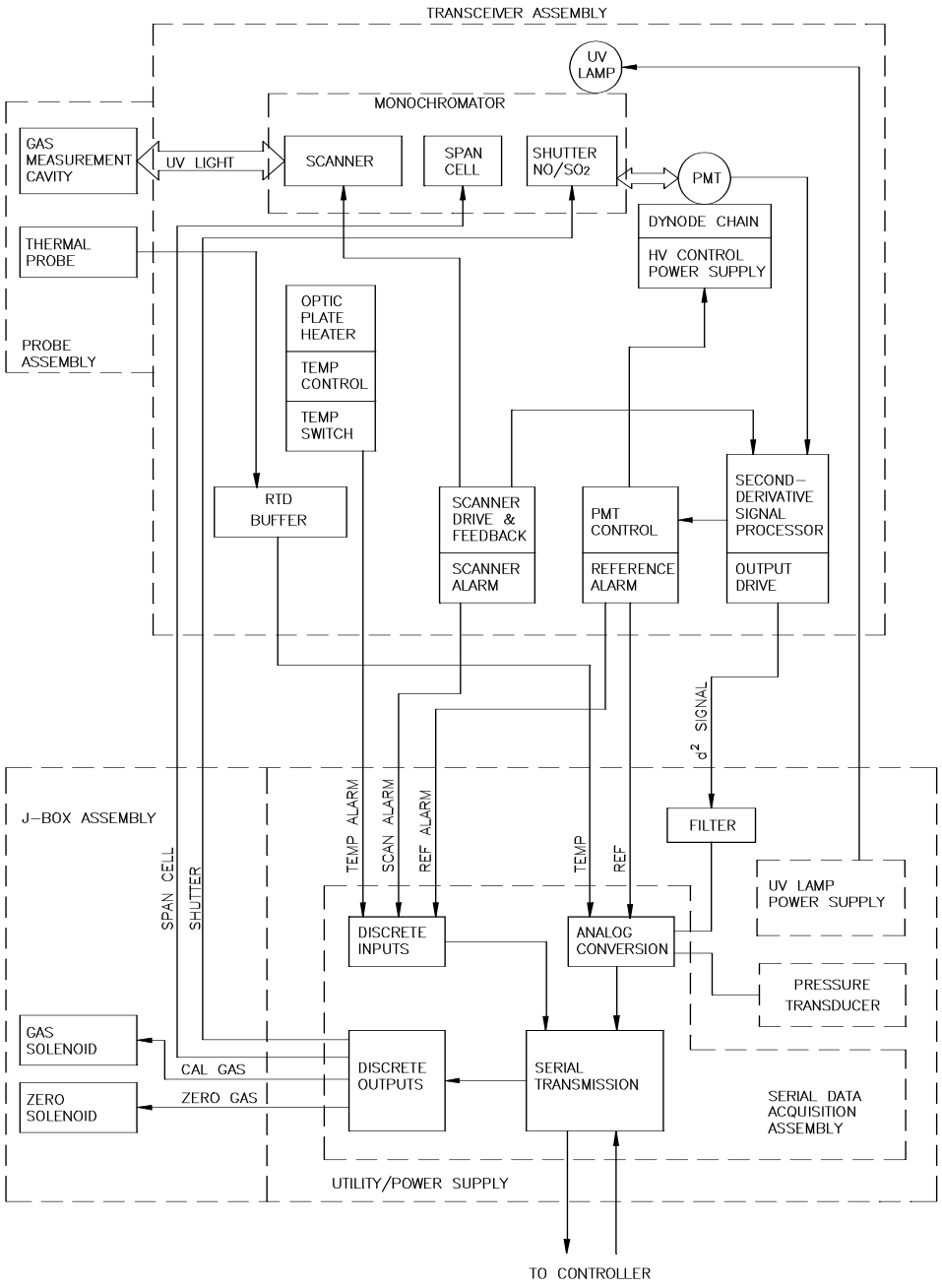


Figure 7-2. Block Diagram

After low-pass filtering and gain adjustments, the 18 Hz second-derivative signal is detected by a half-wave demodulator. A control signal from the scanner drive circuit switches the demodulator at a rate of 18 Hz. This rate is synchronized with the 9 Hz scanner drive signal to keep a correct phase relationship between them. The signal is then divided by the available light level to remove variations caused by an aging lamp or detector. The signal is then filtered to form a DC voltage. Finally, the output driver converts the signal to a current for transmission to the J-box.

7.2.3 Photomultiplier Tube DC Control

The photomultiplier tube (PMT) DC control compensates for UV lamp aging and contamination of the optics. As the UV lamp ages and the optics become contaminated, the light intensity received by the PMT decreases. This change is detected by monitoring the PMT output current. If the current decreases, the HV CONT signal increases to increase the PMT high voltage, which results in higher PMT gain. This causes an increase in PMT current that restores the desired 1 microamp level. HV CONT is available as a reference voltage (REF).

REF ALARM is a signal that activates when the PMT high voltage increases to a level that affects measurement accuracy. The signal goes to the J-box for transmission to the controller as a fault diagnostic.

7.2.4 Thermal Detector Buffer Amplifier

The thermal detector buffer amplifier is a voltage-to-current converter. The type of detector input, RTD (or thermocouple used on older SM8100s), is selected by means of jumpers on the transceiver board. The output of a thermocouple is a small DC voltage characteristic of temperature. The output of the RTD is a resistance characteristic of temperature which is converted to a voltage by a bridge network.

The detector output, which is proportional to thermal probe temperature, is converted into an equivalent current output (TEMP +). The output goes to the J-box for transmission to the controller.

7.2.5 Scanner Drive

The scanner drive operates the scanner motor in conjunction with a feedback signal that stabilizes scanner operation. The basis of operation is the timing reference: a 36 Hz oscillator. A frequency divider divides the oscillator frequency by 2 to produce an 18 Hz control signal that operates the half-wave demodulator. It also divides the oscillator signal by 4 to produce a 9 Hz signal that operates the scanner motor. The phase relationship between the two signals remains constant. Variable DC offset voltages (NO scan and SO_2 scan offset) are added to the 9 Hz signal to properly set the drive level for scanner motor operation. The 9 Hz signal

is converted by the driver from a voltage to a buffered current drive signal (scanner drive) that operates the scanner motor.

A feedback loop from the scanner is rectified and filtered by the scanner feedback circuit. It is then added to the 9 Hz drive signal to compensate for amplitude fluctuations in the scanner drive. This maintains correct scanner rotation amplitude.

7.2.6 Scanner Alarm

The scanner alarm circuit produces an alarm signal on the scanner alarm output whenever the scanner feedback voltage does not compensate enough for incorrect scanner amplitude.

7.3 J-Box

7.3.1 UV Lamp Power Supply

This supply is designed to drive a Deuterium lamp. After the lamp has been warmed up by its filaments, the lamp requires a high voltage drive at low current to strike an arc, then a lower voltage drive at the operating current. When the shutter signal changes state, the lamp start supply turns on. This supply ramps up toward 450 VDC, and the lamp fires when its firing potential is reached. The current regulator circuit then accurately maintains the current at 300 mA.

7.3.2 Serial Data Acquisition

The control unit retrieves transceiver status and analog measurements on a data acquisition basis. Acquisition starts when the control unit sends out a J-box identification code, along with the code for the required measurement and status. The control unit can then communicate with another instrument J-box until the requested data from the first J-box is ready.

When the data is ready, the serial data acquisition circuitry waits for the control unit to request the next measurement or status. When the request is received, the serial data acquisition circuitry transmits the last measurement or status and then starts on the next request, while the control unit again communicates with another J-box.

The control unit only communicates with a given J-box long enough to transmit its request and to receive the measurement or status from the last request. The control unit request can also set up the required discrete outputs. When calibration is required, the control unit operates the proper solenoid.

Transceiver diagnostic switches are also available on the serial data acquisition (SDA) board (see Figure 7-3). The switches are enabled when Manual switch S5 is activated (switched to the left). Activating Zero switch S1 (to the left) floods

the measurement cavity with zero calibration gas. Zero conditions can then be monitored on the J-box test points.

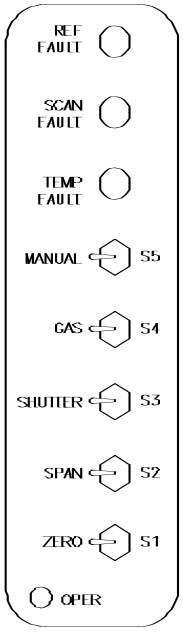


Figure 7-3. Serial Data Acquisition (SDA) Board Switches and Indicators

With both Zero switch S1 and Span switch S2 activated (to the left), the transceiver span cell is placed in the zero-gas-filled optic path, allowing the span cell measurement to be monitored on the test points. With S1 and S2 deactivated (to the right) and Gas switch S4 activated (to the left), the Gas Cal solenoid is activated to fill the measurement cavity with calibration gas, and the conditions of a gas calibration can be monitored on the test points. In the active position (to the left), Shutter switch S3 forces NO measurements; in the deactivated position (to the right), S3 forces SO_2 measurements. The three status LEDs indicate the status of the reference alarm, the scanner alarm, and the temperature alarm.

8.0 Technical Description

This chapter discusses how the transceiver printed circuit board sections work. Emphasis is placed on signal processing by circuits. Each circuit explanation relates to its associated printed circuit board (PCB) schematic. See Figures 4-3 through 4-9 for representative waveforms from board test points.

8.1 Transceiver Printed Circuit Board

8.1.1 Second-Derivative Signal Processor

See drawing 81751218.

U5 is a current-to-voltage converter that converts the PMT signal current from the photomultiplier tube (PMT) to a voltage (PMT OUT). The output at U5-6 branches into three directions. PMT OUT goes to the divider IC though U19. Another branch goes to integrator input U7-2. The third branch goes to the input of a low-pass, dual-pole, active filter U8. R38 and C13 form the first filter section and R59, R57, R58, C14, and C22 form the second filter section.

After filtering, the signal goes to U15, which is an adjustable gain amplifier. The U15-1 output connects to analog switch U13-2, U13-7, and U13-11. The U13 outputs switch on and off at an 18 Hz rate determined by the logic states of the control signals coming from flip-flop U12-1 and U12-2. Because the 18 Hz control signals are synchronized with the 9 Hz scanner drive signal, they properly select the 18 Hz second-derivative signal from the input to U13.

The U13 output is a half-wave demodulated signal at TP1 (Figure 4-7). The divider U16 Z input is multiplied by 10 and divided by the available light on the X input. The normalized output is then converted to DC current by the circuitry associated with U19.

8.1.2 Photomultiplier Tube (PMT) DC Control

See drawing 81751218.

The U5-6 output signal is a small AC voltage (<10 mV) with a +1 VDC offset. Signal current from U5-6 goes through R53 to integrator U7-2. A reference voltage of +1.035 volts, derived from the junction of R55 and R56, is applied to the noninverting input of U7.

Variations above or below +1 VDC at U7-6 indicate a change in the operating point of the PMT. This variation is compared to the setpoint voltage at U7-3. As a result, the charge on C23 changes to alter to the U7 output and Q5 emitter voltag-

es at TP4. TP4 should be 4 to 10 VDC. This voltage (HV CONT) goes to the power supply A2 for the PMT.

If the U5-6 offset increases, it causes the output at U7-6 to decrease. Thus, the voltage output on the emitter of Q5 decreases. This voltage decrease, going to the HV CONT power supply at J2-14, decreases the PMT voltage, which reestablishes the proper operating point.

Conversely, if the signal offset from U5-6 decreases, U7 and Q5 will increase the voltage at TP4. As a result, an increase of the PMT voltage reestablishes the proper operating point.

Emitter-follower Q3 transfers HV CONT at its base to REF at its emitter. The REF signal goes to the J-box and the controller where it can be displayed.

To produce a REF ALARM the HV CONT from Q5 goes to integrator U15-5. If U15-5 has a higher voltage than the junction of R77 and R71 (8.3 volts), the output of U15 rises to forward-bias emitter-follower Q6. Relay K2 is energized and closes the contacts between REF ALARM J1-23 and ALARM RET J1-24. As a result, REF ALARM is pulled low to illuminate the REF LED on the SDA board in the J-box and a REF ALARM is transmitted to the controller.

8.1.3 Thermal Detector Buffer Amplifier

See drawing 81751218.

The RTD produces a resistance dependent on probe temperature (≈ 100 ohms at 0° C). This resistance is converted to a millivolt signal with a bridge circuit at the input to U3. A three-wire RTD configuration is used to help balance out part of the lead resistance in the probe. U3 and Q4 comprise a circuit that converts the millivolt DC voltage from the thermal probe to a current-source signal. This is a low-impedance drive that permits transmission of the signal over the cable between the transceiver and the J-box.

Note

Curve fit for the RTD is accomplished in the controller firmware.

8.1.4 Scanner Drive

See drawing 81751218.

Oscillator U11 sends a 36 Hz signal to dual flip-flop U12-3. The first part of U12 divides the oscillator signal down to 18 Hz, and the second part further divides it down to 9 Hz. The 9 Hz signal goes from U12-13 to the base of emitter-follower

Q8. It is then coupled by C41 and integrated by R46 and C25 to form a triangular wave before going to adder U10, which adds this signal to SO_2 scan offset.

TP6 (Figure 4-4) typically has a 0.6 volt peak-to-peak signal that is transmitted through U6, then to Q1 and Q2 where these push-pull transistors produce a current drive signal (scanner drive) that operates the scanner. Potentiometer R3 (SO_2 scan offset) moves the scanner position to the proper SO_2 absorption wavelength. R3 voltage goes through R61 to the positive input at adder U10-3. R3 is adjusted to produce a DC bias current that is necessary for proper scanner position when the system measures SO_2 and/or NO.

R88 is the NO scan offset potentiometer. It is connected into the circuit when relay K1 is activated. R88 voltage is applied to U10-2, where it is used to adjust the wavelength separation between the SO_2 and NO peaks. Usually, any wavelength shift is correctable by adjusting SO_2 scanner offset.

Feedback circuitry consisting of U4, U17, and Q8 compensates for any circuit variations or changes in scanner amplitude (typical ±3° allowed movement) that can cause erroneous second-derivative signals. The scanner drive amplitude originates from the peak-to-peak voltage transition of the square-wave output at Q8. When the scanner operates properly, the Q8 output range is +4 to +10 volts.

For example, if the SO_2 scanner amplitude is too great, the scanner angle exceeds +3° and scanner feedback increases. This signal is half-wave-rectified by U17, filtered by integrator U18, and then applied to the emitter of Q8, which is a summing junction. The emitter voltage rises to a higher DC level. This diminishes the peak-to-peak square-wave voltage going to U10. Therefore, if instead of a 5 volt square-wave amplitude there is a 4.5 volt amplitude, it produces less current drive to the scanner. Scanner amplitude is reduced to reestablish the proper ±3° scanner angle movement. If the scanner angle is less than the desired angle, the feedback signal decreases and the feedback increases the scanner drive current. Proper scanner amplitude is then reestablished.

8.1.5 Scanner Alarm

See drawing 81751218.

U17 output voltage is added to voltage from potentiometer R4 (scanner alarm reference) at adder input U9-2. R4 adjusts the U9-6 output to equal 0 VDC with a small AC signal added to it. If the scanner operates at an improper angle and the feedback system is unable to compensate for it, the output at U9-6 goes positive or negative, depending on the direction of scanner variation. U9-6 goes to D5 and D8, which steer the respective positive or negative outputs to integrator input U17-5 or U17-6. The output at U17-7 forward-biases emitter-follower Q7, which energizes relay K3. When the K3 contacts close, they allow scanner alarm J1-20

to illuminate the scanner alarm LED on the SDA board in the J-box, and a scanner alarm is transmitted to the controller.

8.2 J-Box

8.2.1 UV Lamp Power Supply

Refer to drawing 81750014.

The UV lamp power supply is designed to drive a Deuterium lamp. Initial lamp heating is achieved with lamp filaments and then maintained by the power dissipated by the arc discharge. After the lamp has been warmed up by its filaments (approximately 20 to 30 seconds), the lamp requires a high voltage drive at low current to strike an arc, then a lower voltage drive at the operating current. Lamp starting uses the shutter signal to turn on the filaments when SO_2 is selected. Because the lamp is initially off, the other input to the AND gate is high, allowing the filaments to turn on. The shutter signal changes state about every 60 seconds, so the lamp has more than enough time to warm up.

When the shutter signal changes state, the lamp start supply turns on. This supply ramps up toward 450 VDC, and the lamp fires when its firing potential is reached (about 350 VDC). The current regulation circuit attempts to deliver 300 mA by driving the anode toward ground, so its output holds the lamp cathode near 0 volts. The lamp anode attempts to draw 300 mA, which loads down the lamp start supply, and the lamp anode voltage drops to the level of the lamp run supply (about 120 VDC). The anode current increases until the lamp current equals the current regulation circuit output. The lamp run supply detects that the cathode voltage is above its setpoint of 3 volts and decreases the anode voltage until the cathode voltage is at its setpoint.

The Lamp On detector detects that the lamp cathode is above 1.5 volts and turns off the lamp start supply. Once the lamp is on, the Lamp On detector and the lamp start logic hold off the lamp start supply and the filament switch. If for some reason the lamp goes out, the lamp starting sequence repeats and restarts the lamp.

The current regulation operational amplifier is configured as a voltage follower driving a MOSFET. The amplifier turns on the MOSFET until the voltage drop across R34 is equal to the R17 setpoint. Because little current is drawn through the MOSFET gate, the MOSFET drain current equals the current flowing through R34. The circuit requires that the load be connected to a positive supply. The drain voltage rises toward this supply until the load current equals the current through R34.

The current regulator circuit accurately maintains the current through R34 once it has achieved steady state. However, when the lamp is being fired, the op amp

output is at the positive stops of +15 volts, attempting to increase the current through R34. With this gate bias, the MOSFET is fully on and looks like a 2 ohm resistor. When the lamp turns on, the surge current would be approximately several amps until the op amp output could slew to its steady state output. However, transistor Q5 with its base emitter across R34 limits this surge current to 0.7 amps. When the voltage across R34 reaches 0.7 volts, the transistor turns on and stops any further increase in the gate voltage of the MOSFET. This limits the current to 0.7 amps. Under normal running conditions where the drop across R34 is 0.3 volts, this transistor is off.

The filament heater is driven by a triac, rated for 12 amps at 80° C case temperature. However, the heat sinking on this assembly limits the current to 4 amps. This limitation occurs under fault conditions when the lamp does not fire and the filaments are turned on continuously. The gate current required to turn the triac on is 125 mA at -40° C. The gate current for the triac flows through the MOSFET, which is the output of the current regulator circuit. Consequently, the current regulator circuit must be functional before the triac turns on.

The lamp start supply uses the energy stored in an inductor to charge capacitor C19 to about 450 volts. Each time the MOSFET Q10 turns on, energy is stored in inductor L2 and transferred to the capacitor due to flyback action. This action pumps up the capacitor voltage until the voltage feedback to the comparator turns off the MOSFET. The maximum output voltage from this circuit is limited by either the rate of change of current through the inductor or the feedback to the comparator. Each cycle of energy into the inductor is sufficient to charge the capacitor about 15 volts. When the output exceeds 450 volts, the comparator turns off the MOSFET, driving the inductor until the output voltage bleeds down below 450 volts.

The lamp run supply uses a pulse-width modulator (PWM) driving two MOSFETs, Q13 and Q14, in a push-pull configuration. The output filter is an LC filter, so the output voltage is the average of the full-wave rectified signal. The period is fixed at about 15 μs and the on time is variable, controlled by the PWM integrated circuit. As the on time changes, the average output voltage changes.

The circuit has two control loops controlled by two different error amplifiers within U5. The amplifier outputs are designed so that the amplifier trying to decrease the output has control. Amplifier U5-5, 16 is normally active and amplifier U5-1, 2 is inactive. Amplifier U5-15, 16 is designed to hold the voltage across the current regulator to 3 volts. A feedback resistor from pin 3 to pin 15 of the PWM U5 reduces the control loop gain, making the loop easier to stabilize. A parallel capacitor decreases the gain with frequency to ensure stabilization.

Current-sensing resistor R64 is in the current return leg of the lamp run circuit output. This resistor limits the short circuit current in the event the lamp anode is shorted to ground. This resistor is 1 ohm and the current-limiting op amp (U5-1, U5-2) is biased to 0.5 volt, so the short circuit current is limited to 0.5 amp. Note that the voltage fed back from the current-sensing resistor is negative.

8.2.2 Conditioning

The input to d^2 circuit U1 is a current of 20 mA full scale. This input is terminated by a 200 ohm resistor to convert this to 2 volts full scale. The resistor is chosen to have a 25 ppm per °C temperature coefficient to minimize temperature drift. A precision zener limiting circuit is added to the output of the filter to avoid driving the SDA A/D converter into overload. This circuit clamps the filter output to 2.5 volts ±1%. The low pass filter is a second order filter that attenuates at 40 dB per decade. The filter time constant is 1 second, which yields a cutoff frequency of 0.159 Hz. This circuit should reduce a 16 Hz signal by 10,000:1.

8.2.3 Serial Data Acquisition

See drawing 81750011.

Communication from the controller to the J-box is by means of an RS422 differential line transceiver U7/U6. Communication from the J-box to the controller is disabled by U6-3 until data is requested by the controller. The controller transmitted setup data is received through U7 by U3. U3 is a Universal Asynchronous Receiver Transmitter (UART) hardwired for the data format required by the controller (8 bits, even parity, one stop bit). The controller data is available on pins U3-5 through U3-12.

Pins U3-5 and U3-6 are the selection code for the J-box. The unique identification code for each J-box is established through S6-1 and S6-2 as shown in the Instrument # Table in drawing 81750011. S6-1 and S6-2 are configured so that U17-10 and U17-11 will go low when the J-box identification code has been selected. When selected, U16-10 and hence, U6-3, allow any data residing in U3 to be transmitted. When U6-3 is low, the transmission line to the controller is released for use by another J-box.

When selected, U13 latches and decodes the discrete/digital output requested by the controller. The discrete drivers in U14 will go low, light the required LED, and assert a ground to activate a solid-state relay in the J-box. Note that the discrete outputs can also be manually activated by a switch. The switches are enabled only while Manual switch S5 is in the manual mode (to the left). The Manual switch becomes a discrete input to inform the controller to release control of all discrete outputs for use by the J-box operator.

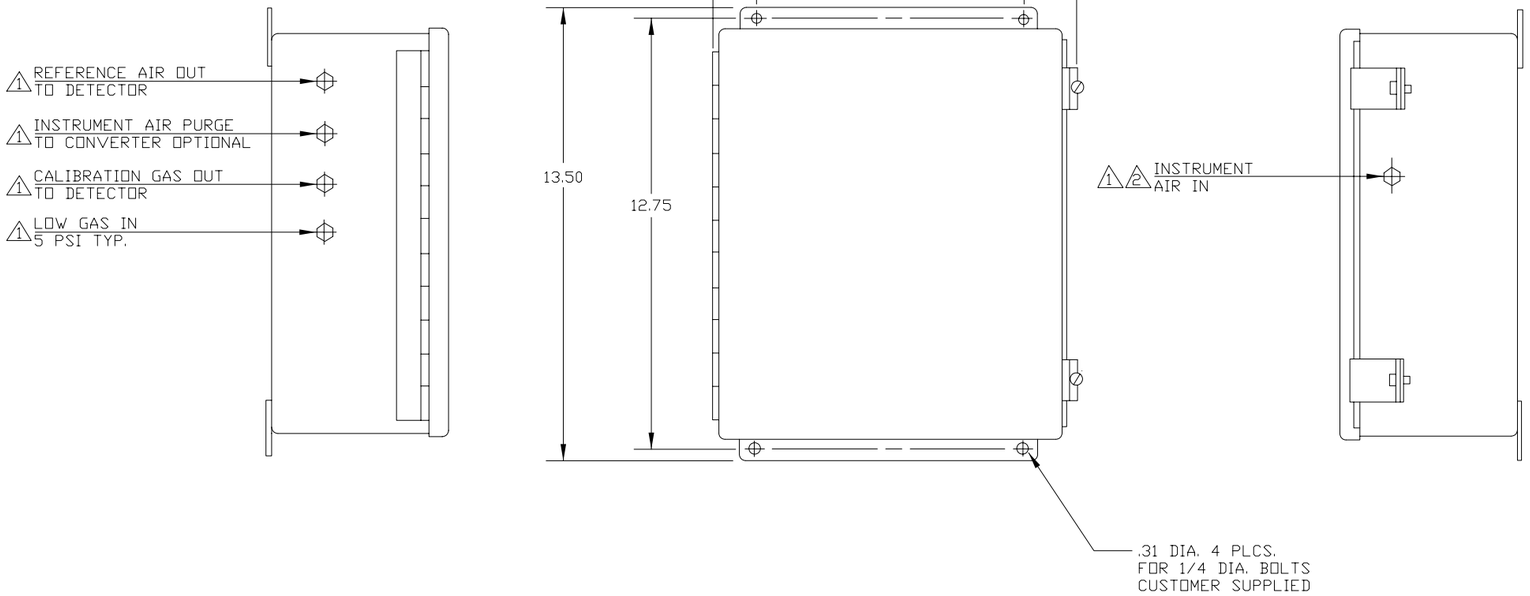
The controller selection of discrete/digital inputs and analog inputs is available on U3-10 through U3-12. Analog inputs are selected by U11. If the selection is zero (pins U3-10 through U3-12 all low), then the analog input on P3-K will be connected to the analog-to-digital converter U1-35. If only U3-12 is high, then P3-H will be connected. The discrete inputs are similarly selected; however, the selected input is only loaded into the UART transmit buffer when the analog-to-digital converter is transmitting its most significant byte (asserting a low on U13-15).

The UART controls the serial transmission as requested by the controller. The analog-to-digital converter is placed in the run mode when U1-26 is asserted high by selecting the identification code and having the receiver data ready (high on U3-19). When the analog-to-digital conversion is complete, the converter places the most significant byte on the UART transmitter byte lines and, by placing a high on U13-15, asks the discrete input to place its requested status bit on bit 8 of the transmitter byte. The converter then sends the least significant byte to the UART for transmission.

When the most significant byte has been transferred to a holding register within the UART (by assertion of a low on U3-23 by the converter), the UART asserts transmitter empty high (U3-22). When the UART asserts transmitter empty a second time, the converter starts conversion for the next measurement requested by the controller. This conversion proceeds even though the J-box is not selected, giving the controller time to communicate with another J-box.

9.0 Engineering Drawings

Drawing	Title
80390010-3	Installation, O_2 Calibration with UNICON Assembly
80390075	Plumbing and Wiring Diagram, O_2 Calibration
80610023-1	Wiring Diagram, LS710 System Interconnect
80610023-2	Wiring Diagram, LS710 to System J-Box (es) with Surge Protection
80610032-1	Wiring Diagram, Interconnection /8 Analog
81751201	Probe Assembly Drawing 10 cm & Under (0-6000 ppm)
81751203	Probe Assembly Drawing 15/20 cm (0-500 ppm)
81001205	Probe Assembly Drawing 36 cm (208 ppm)
81001239	Probe Assembly, 75 cm/5’ Long
81001240	SM8100A 75 cm Probe Assembly with Housing
81750001-2	Wiring Diagram, Interconnect
81750002-2	Site Installation
81750004	Mounting Plate Assembly, J-Box
81750006	J-Box Assembly
81750007-3	J-Box Schematic, 8175, 115 VAC Without Heat Exchanger
81750007-4	J-Box Schematic, 8175, 220 VAC Without Heat Exchanger
81750011	Serial Data Acquisition (SDA) Schematic
81750012	Serial Data Acquisition (SDA) PCB Assembly
81750014	Utility/Power Supply Schematic
81750015	Utility/Power Supply PCB Assembly
81750027	Optic Plate Assembly
81750042-X	Access Door Assembly, SM8175/8100B
81751218-X	Transceiver Schematic, SM8175
81751219	Transceiver PCB Assembly, SM8175/8100B
81750048	Wiring Diagram, Transceiver, SM8175
94200018	Typical Installation, LS420 with Calibration to SM and EX Instruments

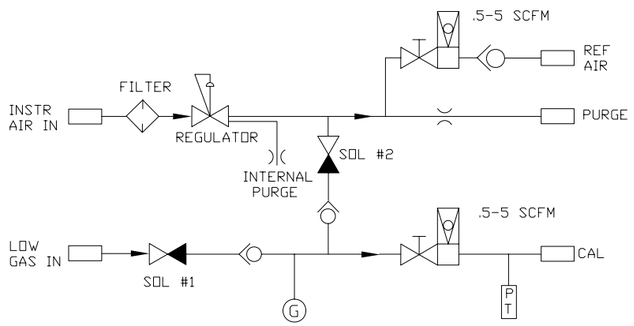


CUSTOMER WIRING

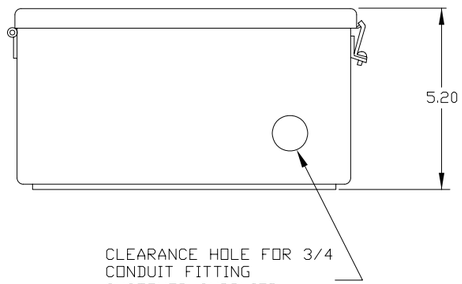
TBI

RTN	26	TO INSTRUMENT J-BOX
LO CAL	27	
HI CAL	28	

#8 SCREW



PLUMBING & WIRING DIAGRAM



3. O_2 CALIBRATION ASSY MUST NOT BE MORE THAN 20' FROM DETECTOR.

2 INSTRUMENT AIR IS 20 TO 100 PSI, 2 SCFH, CLEAN TO 50 PPM HYDROCARBONS MAX. & DRY TO -20°F. MIN. DEW POINT.

1 1/4 O.D. TUBING CUSTOMER SUPPLIED.

NOTES:

Printed Documents Are UNCONTROLLED

FILENAME= C6001061

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2	ADD PLUMBING/WIRING DIAG.	8/2/89	DAC	FM
1		1-88	KSS	FM

REVISIONS

NEXT ASSEMBLY	USED ON
80390072	81600002 SM8160 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 D.CRAWFORD DATE 5-29-85
CHECKED BY
PROJ. ENG. BY

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

TYPICAL INSTALLATION O2 CALIBRATION WITH UNICON ASSY

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SCALE

SHEET 1 OF 1

PLOTTED 10/02/1995 10:52:39

DWG NO | SH

REVISIONS				
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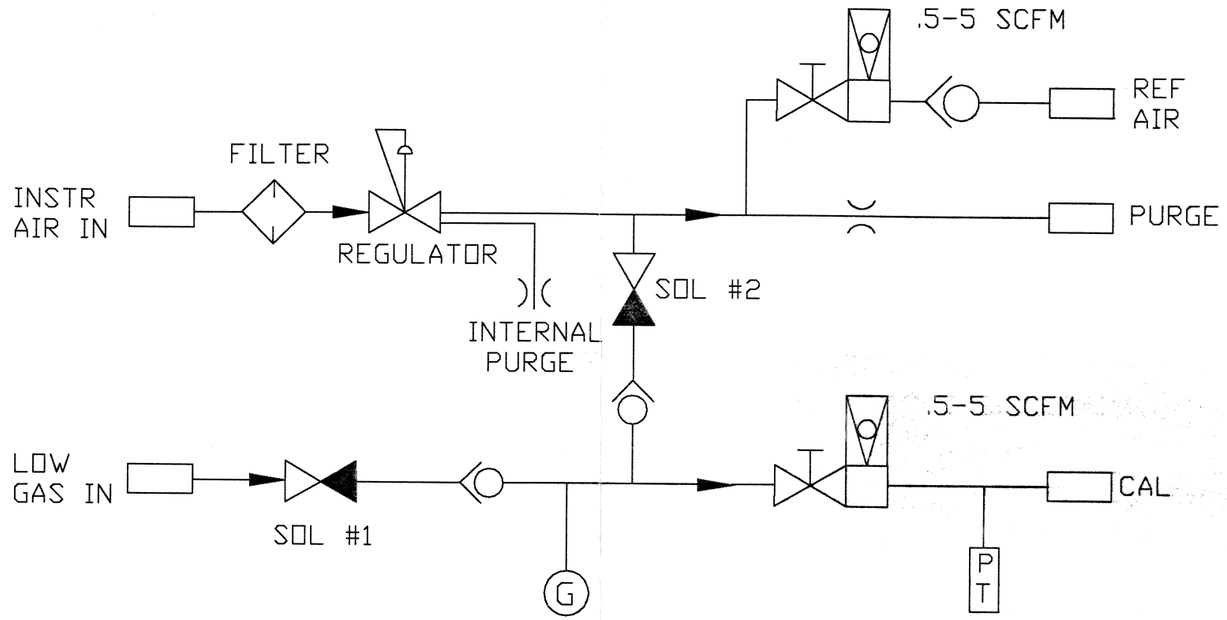
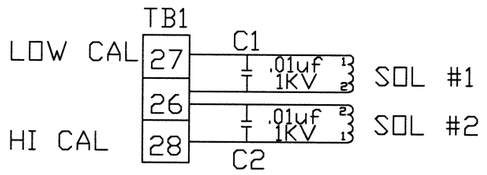
C	ECO 5762-ADD MANUAL # TO TITLE BLK	7/16/98	CJR	LS





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80390078	CM60
NEXT ASSEMBLY	USED ON

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES
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TOLERANCE ON ANGLES ±0°30'

DO NOT SCALE DRAWING

MATERIAL | FINISH

DRAWN BY	DATE
CJR	7/16/98
FMM	4/30/85

FILENAME= C6007501

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

PLUMBING AND WIRING DIAGRAM-02 CALIBRATION

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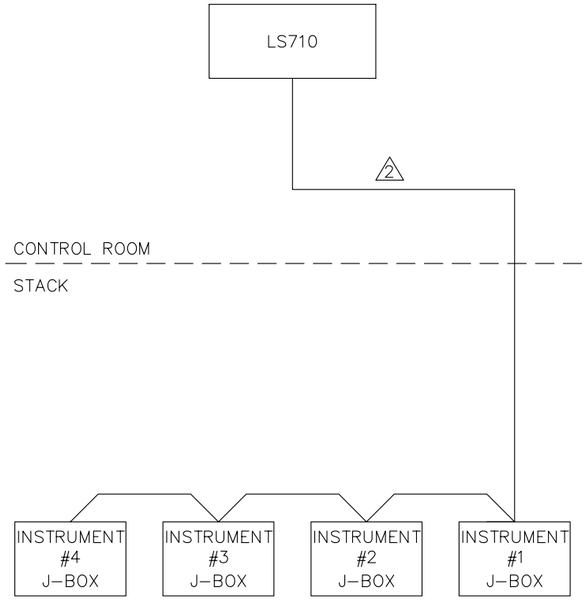
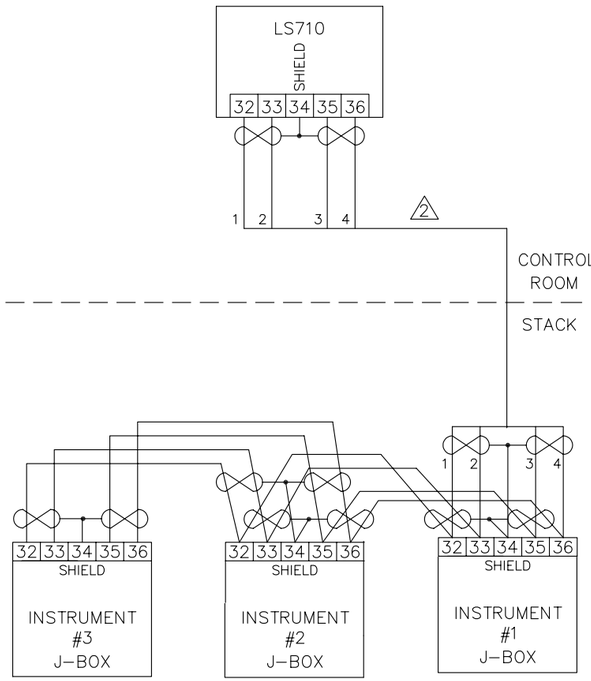
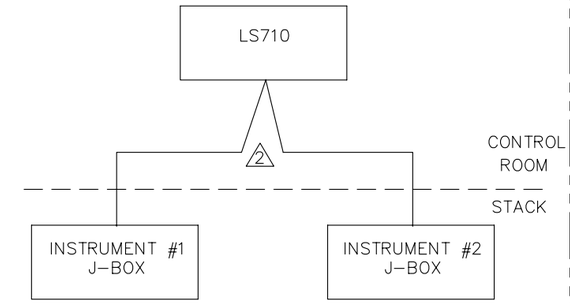


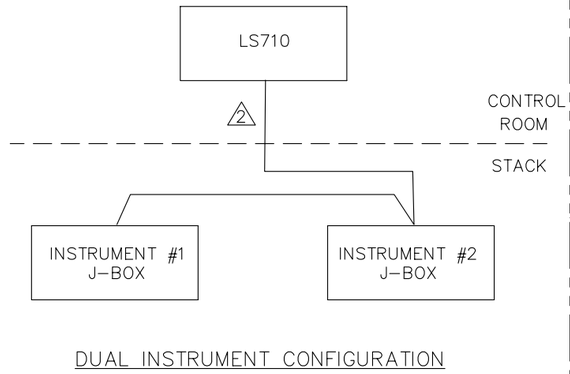
FOUR INSTRUMENT CONFIGURATION



THREE INSTRUMENT CONFIGURATION



DUAL STACK CONFIGURATION



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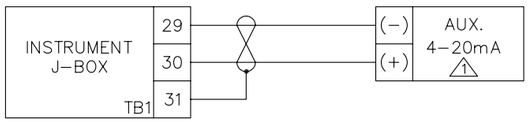
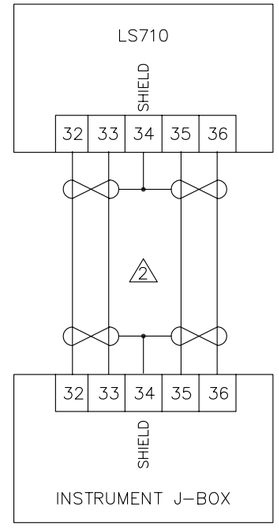
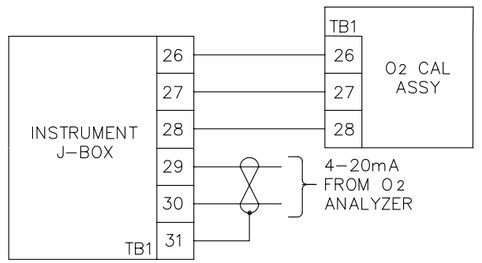


TYPICAL J–BOX CONNECTION
AUXILIARY INPUT



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: O 2 AUX. INPUTS ARE ASSOCIATED WITH CO, CO_2, SO_2 & NO MEASUREMENTS; VELOCITY AUX. INPUTS ARE ASSOCIATED WITH OPACITY/O.D. MEASUREMENTS.

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.

Printed Documents Are UNCONTROLLED

FILENAME=MP002311

LTR.	DESCRIPTION	DATE	DRAWN	APPR
C	ADD MANUAL #'S TO TITLE BLK– ECO 5762	7/14/98	CJR	
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
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	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

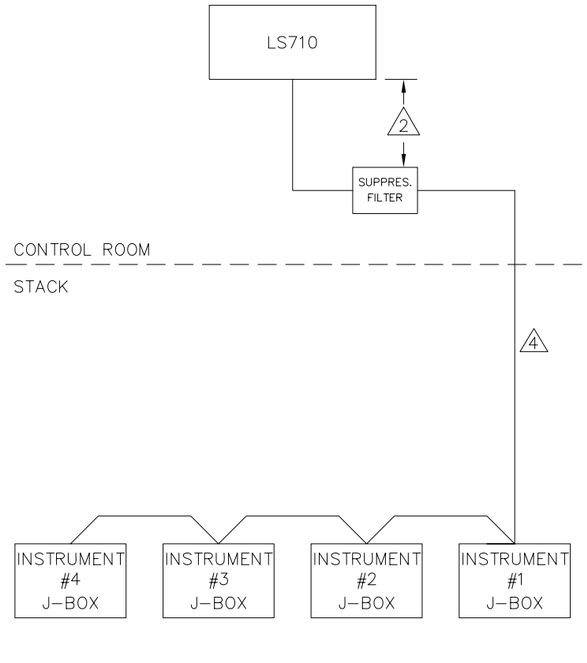
DRAWN BY FMM DATE 2/11/93
CHECKED BY
PROJ. ENG. BY
FINISH

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

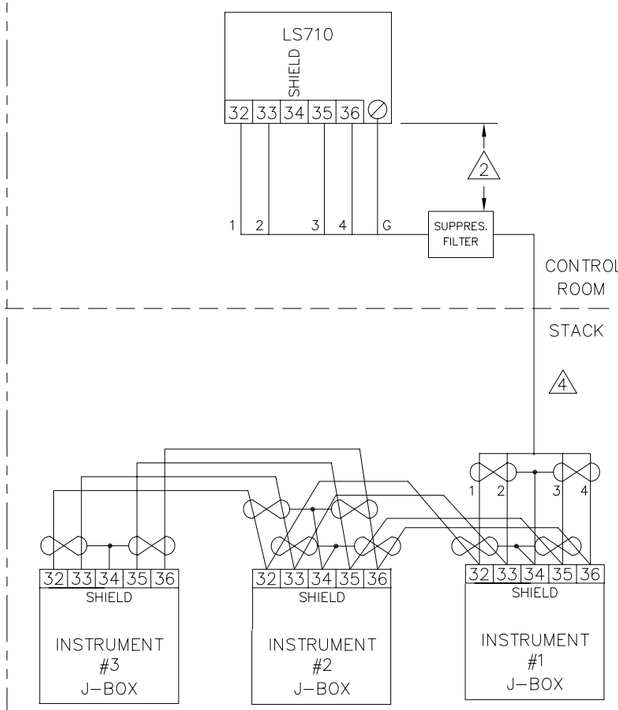
WIRING DIAGRAM LS710 TO SYSTEM J–BOX(s)

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

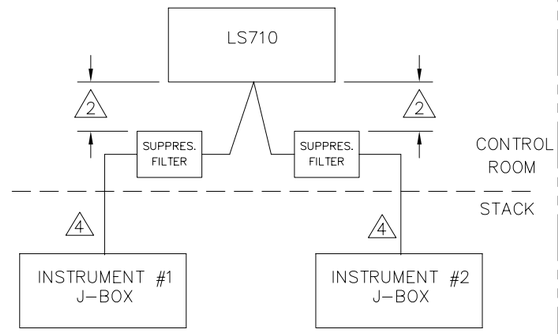
SCALE | SHEET 1 OF 1



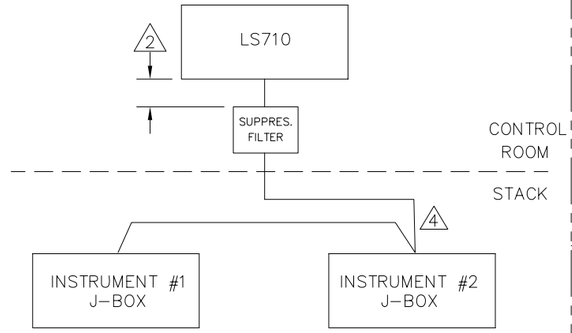
FOUR INSTRUMENT CONFIGURATION



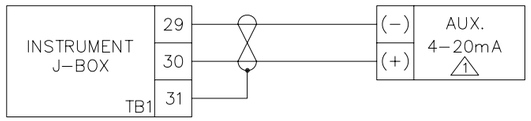
THREE INSTRUMENT CONFIGURATION



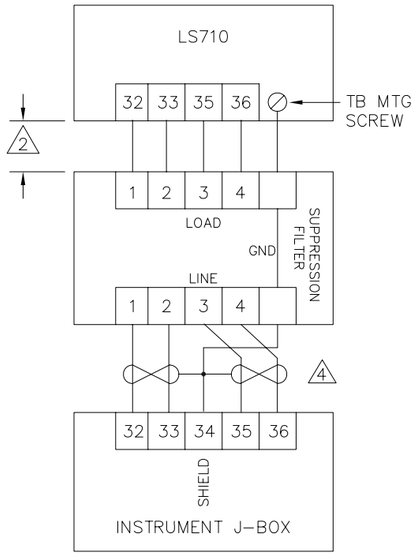
DUAL STACK CONFIGURATION



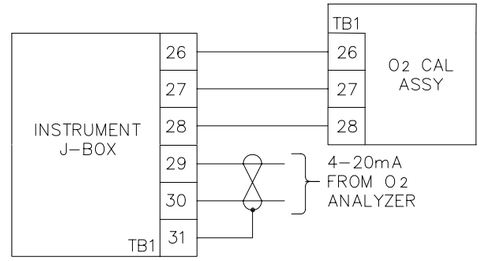
DUAL INSTRUMENT CONFIGURATION



TYPICAL J-BOX CONNECTION
AUXILIARY INPUT



SINGLE INSTRUMENT CONFIGURATION
DATA TRANSMISSION LINE
CONNECTIONS



TYPICAL J-BOX CONNECTION
O2 CALIBRATION OPTION

NOTES:

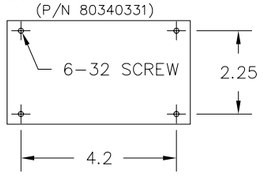
1. ALL INSTRUMENT J-BOXES HAVE PROVISION FOR ONE LINEAR 4-20mA DC AUXILIARY INPUT. TYPICALLY: O 2 AUX. INPUTS ARE ASSOCIATED WITH CO, CO2, SO2 & NO MEASUREMENTS; VELOCITY AUX. INPUTS ARE ASSOCIATED WITH OPACITY/O.D. MEASUREMENTS.

2. WIRE LENGTH BETWEEN THE SUPPRESSOR AND LS710 MUST BE KEPT AS SHORT AS POSSIBLE-6" MAX.

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.

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

SUPPRESSION FILTER
(P/N 80340331)



MOUNTING DIMENSIONS
(SCALE: 1:2)

Printed Documents Are UNCONTROLLED

FILENAME=MP002321

LTR.	DESCRIPTION	DATE	DRAWN	APPR
C	ECO 5762-ADD MANUAL #'S TO TITLE BLK	7/14/98	CJR	
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"

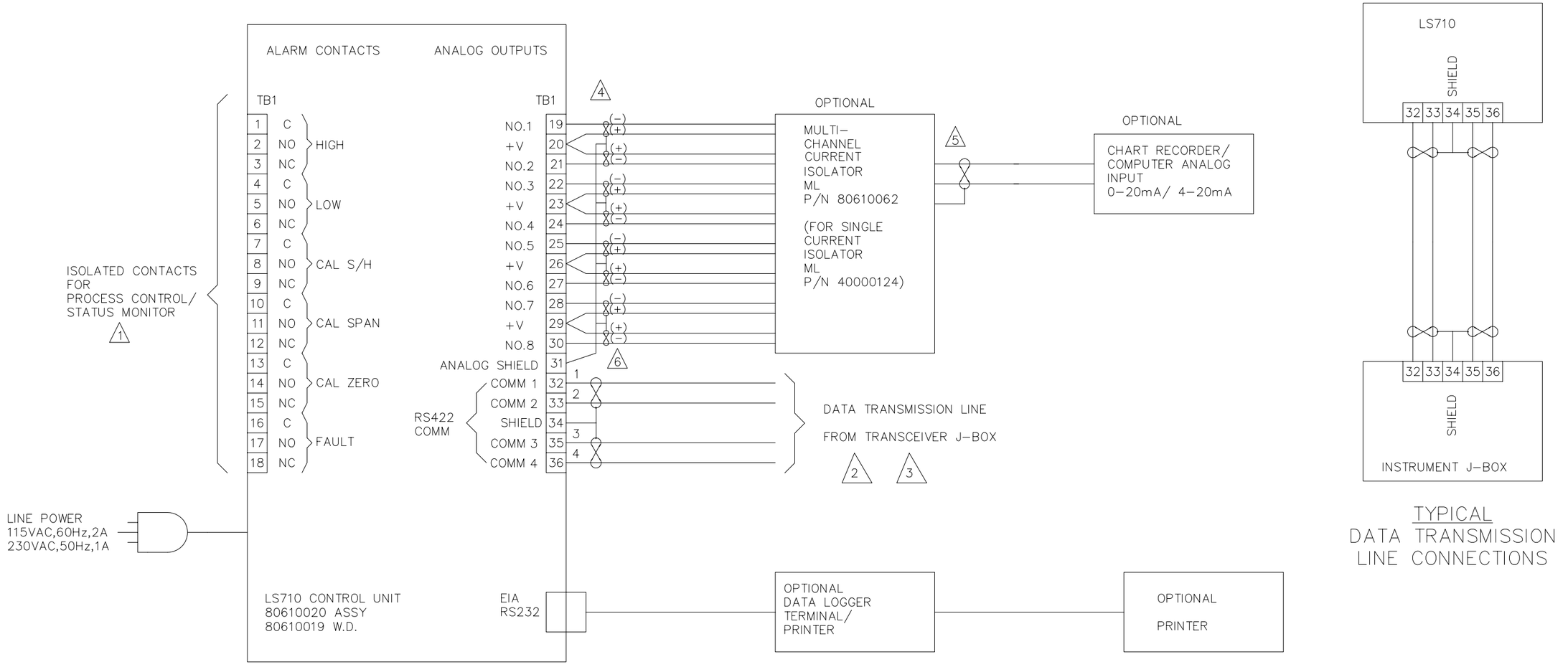
DRAWN BY FMM — DATE 2/11/93
CHECKED BY
PROJ. ENG. BY
DO NOT SCALE DRAWING
MATERIAL
FINISH

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

WIRING DIAGRAM
LS710 TO SYSTEM J-BOX(s)
WITH SURGE PROTECTION

SIZE	CAGE CODE	DWG NO	REV
D		80610023-2	C

SCALE — SHEET 1 OF 1



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

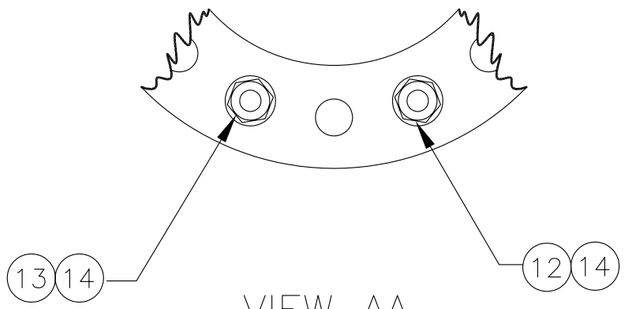
MONITOR LABS, INC.
74 INVERNESS DRIVE EAST
ENGLEWOOD, COLORADO 80112

WIRING DIAGRAM
INTERCONNECTION
LS710 8 ANALOG

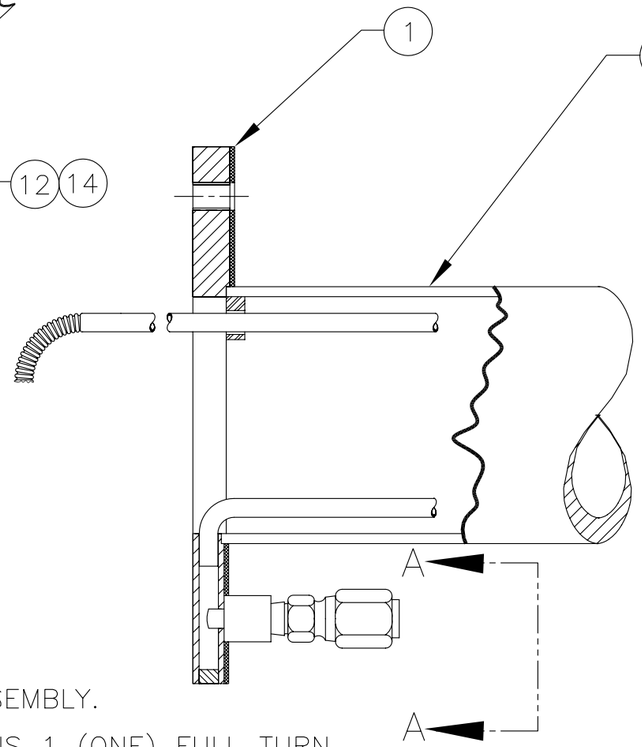
SIZE D | CAGE CODE | DWG NO 80610032–1 | REV D

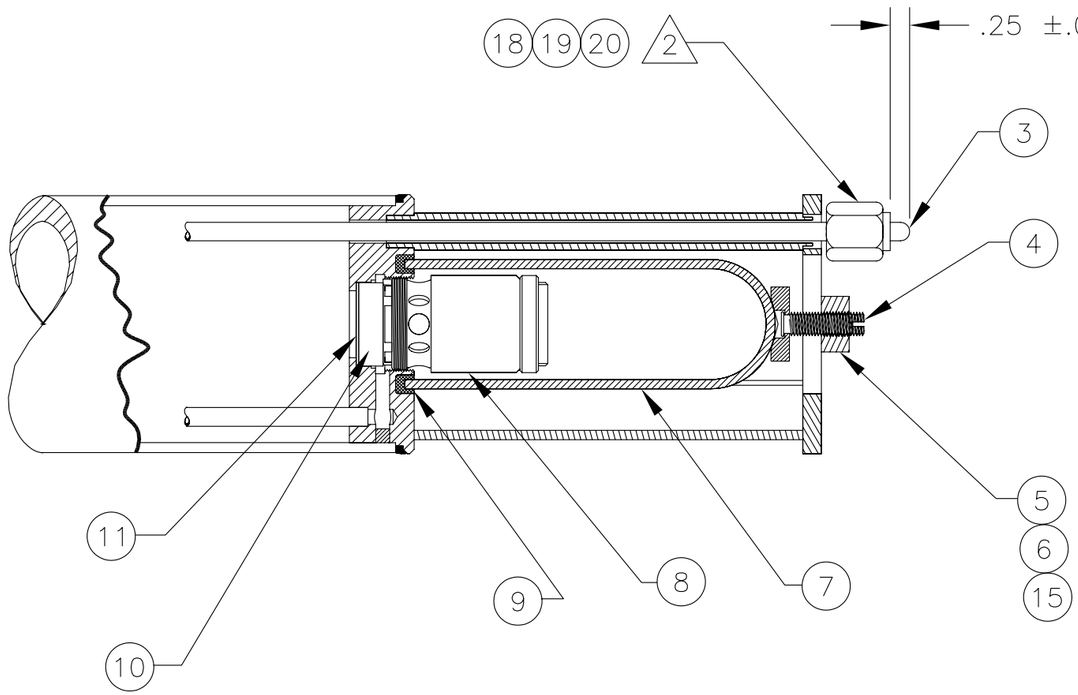
SCALE | SHEET 1 OF 1

PLOTTED 10/11/1996 14:40:15



VIEW AA





NOTES:

1. CLEAN ALL PARTS PRIOR TO ASSEMBLY.
2. TIGHTEN NUT, FINGER TIGHT, PLUS 1 (ONE) FULL TURN.
3. LEAK/FLOW TEST SPECIFICATION:
   (METHODOLOGY AT MANUFACTURING DISCRETION)
   FLOW @ 10 PSI MUST BE AT LEAST 7 LPM
   LEAK TEST @ 15± 1 PSI MUST BE:
   .25 PSI OR LESS AFTER TWO (2) HOURS
   OR
   .50 PSI OR LESS AFTER FOUR (4) HOURS
4. USE TEFLON TAPE, 16000052, ON F/N 12 & 13.
5. USE SHOP SUPPLY ANTI-SIEZE TML#16000091 (LOCTITE# 39896) F/N (17) ON ALL COMPONENTS DEEMED APPROPRIATE. THIS ADDRESSES FUTURE RGR/DISASSEMBLY CONCERNS.

PROBE LENGTH	PART NO. 81751201	−3	−6	−9	−12	−15
8 FT		−2	−5	−8	−11	−14
6 FT		−1	−4	−7	−10	−13
4 FT	PPM	0−3000 (2.5CM)	0−750 (10CM)	0−1500 (5CM)	0−1000 (7.5CM)	0−6000 (1.25CM)

LTR.	DESCRIPTION	DATE	DRAWN	APPR
E	SEE DCN 81751201E; REF ECO# 6640	3/23/07	CAD	KH
D	SEE DCN 81751201D; REF ECO# 6623	8/30/06	CAD	JN
C	ECO 6500 ADD NOTE 6	4/1/05	CJC	KEH
B	ECO 5854−ADD DASH 13,14,15.& NOTES	10/30/98	CJR	KEH
A	MFG REL ECO 4329	5/6/94	FM2	GWP

REVISIONS

NEXT ASSEMBLY	USED ON
81751200	SM8175

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

		DATE
DRAWN BY	L PRICE	2/28/94
CHECKED BY	FM2	6/15/94
PROJ. ENG. BY	GW PRICE	6/15/94

FINISH

TELEDYNE INSTRUMENTS
Monitor Labs
A Teledyne Technologies Company

PROBE ASSEMBLY
10CM & UNDER
SM8175

SIZE	CAGE CODE	DWG NO	REV
D		81751201	E

SCALE 1:1 SHEET 1 OF 11

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	UNIT QTY −1	UNIT QTY −2	UNIT QTY −3	REFERENCE	TOTAL REQ.	STOCK ISSUED	SHORT QTY
1	81750564	GASKET	1	1	1				
2	81750959−1	WELDMENT, PROBE 4 FT	1						
2	81750959−2	WELDMENT, PROBE 6 FT		1					
2	81750959−3	WELDMENT, PROBE 8 FT			1				
3	53000188−8	RTD PROBE 316 SS	1						
3	53000188−9	RTD PROBE 316 SS		1					
3	53000188−10	RTD PROBE 316 SS			1				
4	81000435−2	ADJUSTING SCREW ASSY	1	1	1				
5	81000201−2	NUT PLATE	1	1	1				
6	8−32 X 3/4	SCREW, PNHD SS	2	2	2				
7	28000262	FILTER, CERAMIC	1	1	1				
8	81000565−4	CORNER CUBE ASSY (2.5 CM)	1	1	1	△			
9	81000205	GASKET	1	1	1				
10	81000789−2	WINDOW ASSY	1	1	1				
11	81000790−2	GRAFOIL RING	1	1	1				
12	28100402−3	CONN, MALE 1/8NPT−1/4ø	1	1	1				
13	81750022−2	FITG., MOD 1/8NPT−1/4ø W/.03 ORIFICE	1	1	1				
14	28470400−3	PLUG 1/4ø	2	2	2				
15	#8	WASHER, SPLIT LK	2	2	2				

DRAWN BY L. PRICE DATE 2/25/94 | CHECKED BY DATE | PROJ. ENG. BY DATE

TELEDYNE INSTRUMENTS
Monitor Labs
A Teledyne Technologies Company

ASSEMBLY, PROBE 0−3000 PPM
SM8175 10CM & UNDER

SIZE	CAGE CODE	DWG NO	REV
A		81751201	E

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	UNIT QTY -1	UNIT QTY -2	UNIT QTY -3	REFERENCE	TOTAL REQ.	STOCK ISSUED	SHORT QTY
16	20400-5007-3	CORNER CUBE PRISM 4'	1			△			
16	20400-5007-4	CORNER CUBE PRISM 6'		1		△			
16	20400-5007-5	CORNER CUBE PRISM 8'			1	△			
17	16000091	ANTI-SIEZE LOCTITE DRY MOLY	A/R	A/R	A/R	#39896			
18	28490400-3	NUT, FRACTION TUBE, 1/4", SS	1	1	1				
19	28510400-3	BACK FERRULE, FR TUBE, 1/4", SS	1	1	1				
20	28530400-3	FRONT FERRULE, FR TUBE, 1/4", SS	1	1	1				

△ CORNER CUBE PRISM MUST BE INSTALLED INTO THE CORNER CUBE ASSY AT THE TIME OF ITS ASSEMBLY.

DRAWN BY	DATE	CHECKED BY	DATE	PROJ. ENG. BY	DATE
FMM	2/28/94				

TELEDYNE INSTRUMENTS
Monitor Labs
A Teledyne Technologies Company

PROBE ASSEMBLY
SM8175 10CM & UNDER 0-3000 PPM

SIZE	CAGE CODE	DWG NO	REV
A		81751201	E

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	UNIT QTY −4	UNIT QTY −5	UNIT QTY −6		REFERENCE	TOTAL REQ.	STOCK ISSUED	SHORT QTY
1	81750564	GASKET	1	1	1					
2	81750959−1	WELDMENT, PROBE 4 FT	1							
2	81750959−2	WELDMENT, PROBE 6 FT		1						
2	81750959−3	WELDMENT, PROBE 8 FT			1					
3	53000188−8	RTD PROBE 316 SS	1							
3	53000188−9	RTD PROBE 316 SS		1						
3	53000188−10	RTD PROBE 316 SS			1					
4	81000435−2	ADJUSTING SCREW ASSY	1	1	1					
5	81000201−2	NUT PLATE	1	1	1					
6	8−32 X 3/4	SCREW, PNHD SS	2	2	2					
7	28000262	FILTER, CERAMIC	1	1	1					
8	81000791−2	CORNER CUBE ASSY (10 CM)	1	1	1		△			
9	81000205	GASKET	1	1	1					
10	81000789−2	WINDOW ASSY	1	1	1					
11	81000790−2	GRAFOIL RING	1	1	1					
12	28100402−3	CONN, MALE 1/8NPT−1/4ø	1	1	1					
13	81750022−2	FITG., MOD 1/8NPT−1/4ø W/.03 ORIFICE	1	1	1					
14	28470400−3	PLUG 1/4ø	2	2	2					
15	#8	WASHER, SPLIT LK	2	2	2					

DRAWN BY L. PRICE DATE 2/25/94 | CHECKED BY DATE | PROJ. ENG. BY DATE

TELEDYNE INSTRUMENTS
Monitor Labs
A Teledyne Technologies Company

ASSEMBLY, PROBE 0−750 PPM
SM8175 10CM & UNDER

SIZE	CAGE CODE	DWG NO	REV
A		81751201	E

SHEET 4 OF 11

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	UNIT QTY −4	UNIT QTY −5	UNIT QTY −6	REFERENCE	TOTAL REQ.	STOCK ISSUED	SHORT QTY
16	20400−5007−3	CORNER CUBE PRISM 4'	1			△			
16	20400−5007−4	CORNER CUBE PRISM 6'		1		△			
16	20400−5007−5	CORNER CUBE PRISM 8'			1	△			
17	16000091	ANTI−SIEZE LOCTITE DRY MOLY	A/R	A/R	A/R				
18	28490400−3	NUT, FRACTION TUBE, 1/4", SS	1	1	1				
19	28510400−3	BACK FERRULE, FR TUBE, 1/4", SS	1	1	1				
20	28530400−3	FRONT FERRULE, FR TUBE, 1/4", SS	1	1	1				

△ CORNER CUBE PRISM MUST BE INSTALLED INTO THE CORNER CUBE ASSY AT THE TIME OF ITS ASSEMBLY.

DRAWN BY FMM DATE 2/28/94 | CHECKED BY DATE | PROJ. ENG. BY DATE

TELEDYNE INSTRUMENTS
Monitor Labs
A Teledyne Technologies Company

PROBE ASSEMBLY
SM8175 10CM & UNDER 0− 750 PPM

SIZE	CAGE CODE	DWG NO	REV
A		81751201	E

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	UNIT QTY −7	UNIT QTY −8	UNIT QTY −9	UNIT QTY	REFERENCE	TOTAL REQ.	STOCK ISSUED	SHORT QTY
1	81750564	GASKET	1	1	1					
2	81750959−1	WELDMENT, PROBE 4 FT	1							
2	81750959−2	WELDMENT, PROBE 6 FT		1						
2	81750959−3	WELDMENT, PROBE 8 FT			1					
3	53000188−8	RTD PROBE 316 SS	1							
3	53000188−9	RTD PROBE 316 SS		1						
3	53000188−10	RTD PROBE 316 SS			1					
4	81000435−2	ADJUSTING SCREW ASSY	1	1	1					
5	81000201−2	NUT PLATE	1	1	1					
6	8−32 X 3/4	SCREW, PNHD SS	2	2	2					
7	28000262	FILTER, CERAMIC	1	1	1					
8	81000565−3	CORNER CUBE ASSY (5 CM)	1	1	1		△			
9	81000205	GASKET	1	1	1					
10	81000789−2	WINDOW ASSY	1	1	1					
11	81000790−2	GRAFOIL RING	1	1	1					
12	28100402−3	CONN, MALE 1/8NPT−1/4ø	1	1	1					
13	81750022−2	FITG., MOD 1/8NPT−1/4ø W/.03 ORIFICE	1	1	1					
14	28470400−3	PLUG 1/4ø	2	2	2					
15	#8	WASHER, SPLIT LK	2	2	2					

DRAWN BY L. PRICE DATE 2/25/94 | CHECKED BY DATE | PROJ. ENG. BY DATE

TELEDYNE INSTRUMENTS
Monitor Labs
A Teledyne Technologies Company

ASSEMBLY, PROBE 0−1500 PPM
SM8175 10CM & UNDER

SIZE	CAGE CODE	DWG NO	REV
A		81751201	E

SHEET 6 OF 11

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	UNIT QTY -7	UNIT QTY -8	UNIT QTY -9	REFERENCE	TOTAL REQ.	STOCK ISSUED	SHORT QTY
16	20400-5007-3	CORNER CUBE PRISM 4'	1			△			
16	20400-5007-4	CORNER CUBE PRISM 6'		1		△			
16	20400-5007-5	CORNER CUBE PRISM 8'			1	△			
17	16000091	ANTI-SIEZE LOCTITE DRY MOLY	A/R	A/R	A/R				
18	28490400-3	NUT, FRACTION TUBE, 1/4", SS	1	1	1				
19	28510400-3	BACK FERRULE, FR TUBE, 1/4", SS	1	1	1				
20	28530400-3	FRONT FERRULE, FR TUBE, 1/4", SS	1	1	1				

△ CORNER CUBE PRISM MUST BE INSTALLED INTO THE CORNER CUBE ASSY AT THE TIME OF ITS ASSEMBLY.

DRAWN BY FMM DATE 2/28/94 | CHECKED BY DATE | PROJ. ENG. BY DATE

TELEDYNE INSTRUMENTS
Monitor Labs
A Teledyne Technologies Company

PROBE ASSEMBLY
SM8175 10CM & UNDER 0- 1500 PPM

SIZE	CAGE CODE	DWG NO	REV
A		81751201	E

SHEET 7 OF 11

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	UNIT QTY -10	UNIT QTY -11	UNIT QTY -12	REFERENCE	TOTAL REQ.	STOCK ISSUED	SHORT QTY
1	81750564	GASKET	1	1	1				
2	81750959-1	WELDMENT, PROBE 4 FT	1						
2	81750959-2	WELDMENT, PROBE 6 FT		1					
2	81750959-3	WELDMENT, PROBE 8 FT			1				
3	53000188-8	RTD PROBE 316 SS	1						
3	53000188-9	RTD PROBE 316 SS		1					
3	53000188-10	RTD PROBE 316 SS			1				
4	81000435-2	ADJUSTING SCREW ASSY	1	1	1				
5	81000201-2	NUT PLATE	1	1	1				
6	8-32 X 3/4	SCREW, PNHD SS	2	2	2				
7	28000262	FILTER, CERAMIC	1	1	1				
8	81001159-1	CORNER CUBE ASSY (7.5 CM)	1	1	1	△			
9	81000205	GASKET	1	1	1				
10	81000789-2	WINDOW ASSY	1	1	1				
11	81000790-2	GRAFOIL RING	1	1	1				
12	28100402-3	CONN, MALE 1/8NPT-1/4ø	1	1	1				
13	81750022-2	FITG., MOD 1/8NPT-1/4ø W/.03 ORIFICE	1	1	1				
14	28470400-3	PLUG 1/4ø	2	2	2				
15	#8	WASHER, SPLIT LK	2	2	2				

DRAWN BY L. PRICE DATE 2/25/94 | CHECKED BY DATE | PROJ. ENG. BY DATE

TELEDYNE INSTRUMENTS
Monitor Labs
A Teledyne Technologies Company

ASSEMBLY, PROBE 0-1000 PPM
SM8175 10CM & UNDER

SIZE	CAGE CODE	DWG NO	REV
A		81751201	E

SHEET 8 OF 11

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	UNIT QTY -10	UNIT QTY -11	UNIT QTY -12	REFERENCE	TOTAL REQ.	STOCK ISSUED	SHORT QTY
16	20400-5007-3	CORNER CUBE PRISM 4'	1			△			
16	20400-5007-4	CORNER CUBE PRISM 6'		1		△			
16	20400-5007-5	CORNER CUBE PRISM 8'			1	△			
17	16000091	ANTI-SIEZE LOCTITE DRY MOLY	A/R	A/R	A/R				
18	28490400-3	NUT, FRACTION TUBE, 1/4", SS	1	1	1				
19	28510400-3	BACK FERRULE, FR TUBE, 1/4", SS	1	1	1				
20	28530400-3	FRONT FERRULE, FR TUBE, 1/4", SS	1	1	1				

△ CORNER CUBE PRISM MUST BE INSTALLED INTO THE CORNER CUBE ASSY AT THE TIME OF ITS ASSEMBLY.

DRAWN BY FMM DATE 2/28/94 | CHECKED BY DATE | PROJ. ENG. BY DATE

TELEDYNE INSTRUMENTS
Monitor Labs
A Teledyne Technologies Company

PROBE ASSEMBLY
SM8175 10CM & UNDER 0- 1000 PPM

SIZE	CAGE CODE	DWG NO	REV
A		81751201	E

SHEET 9 OF 11

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	UNIT QTY -13	-14	-15		REFERENCE	TOTAL REQ.	STOCK ISSUED	SHORT QTY
1	81750564	GASKET	1	1	1					
2	81750959-1	WELDMENT, PROBE 4 FT	1							
2	81750959-2	WELDMENT, PROBE 6 FT		1						
2	81750959-3	WELDMENT, PROBE 8 FT			1					
3	53000188-8	RTD PROBE 316 SS	1							
3	53000188-9	RTD PROBE 316 SS		1						
3	53000188-10	RTD PROBE 316 SS			1					
4	81000435-2	ADJUSTING SCREW ASSY	1	1	1					
5	81000201-2	NUT PLATE	1	1	1					
6	8-32 X 3/4	SCREW, PNHD SS	2	2	2					
7	28000262	FILTER, CERAMIC	1	1	1					
8	81000786-2	CORNER CUBE ASSY (1.25CM)	1	1	1		△			
9	81000205	GASKET	1	1	1					
10	81000789-2	WINDOW ASSY	1	1	1					
11	81000790-2	GRAFOIL RING	1	1	1					
12	28100402-3	CONN, MALE 1/8NPT-1/4ø	1	1	1					
13	81750022-2	FITG., MOD 1/8NPT-1/4ø W/.03 ORIFICE	1	1	1					
14	28470400-3	PLUG 1/4ø	2	2	2					
15	#8	WASHER, SPLIT LK	2	2	2					

DRAWN BY L. PRICE DATE 2/25/94 | CHECKED BY DATE | PROJ. ENG. BY DATE

TELEDYNE INSTRUMENTS
Monitor Labs
A Teledyne Technologies Company

ASSEMBLY, PROBE 0-1000 PPM
SM8175 10CM & UNDER

SIZE	CAGE CODE	DWG NO	REV
A		81751201	E

SHEET 10 OF 11

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	UNIT QTY -13	UNIT QTY -14	UNIT QTY -15	REFERENCE	TOTAL REQ.	STOCK ISSUED	SHORT QTY
16	20400-5007-3	CORNER CUBE PRISM 4'	1			△			
16	20400-5007-4	CORNER CUBE PRISM 6'		1		△			
16	20400-5007-5	CORNER CUBE PRISM 8'			1	△			
17	16000091	ANTI-SIEZE LOCTITE DRY MOLY	A/R	A/R	A/R				
18	28490400-3	NUT, FRACTION TUBE, 1/4", SS	1	1	1				
19	28510400-3	BACK FERRULE, FR TUBE, 1/4", SS	1	1	1				
20	28530400-3	FRONT FERRULE, FR TUBE, 1/4", SS	1	1	1				

△ CORNER CUBE PRISM MUST BE INSTALLED INTO THE CORNER CUBE ASSY AT THE TIME OF ITS ASSEMBLY.

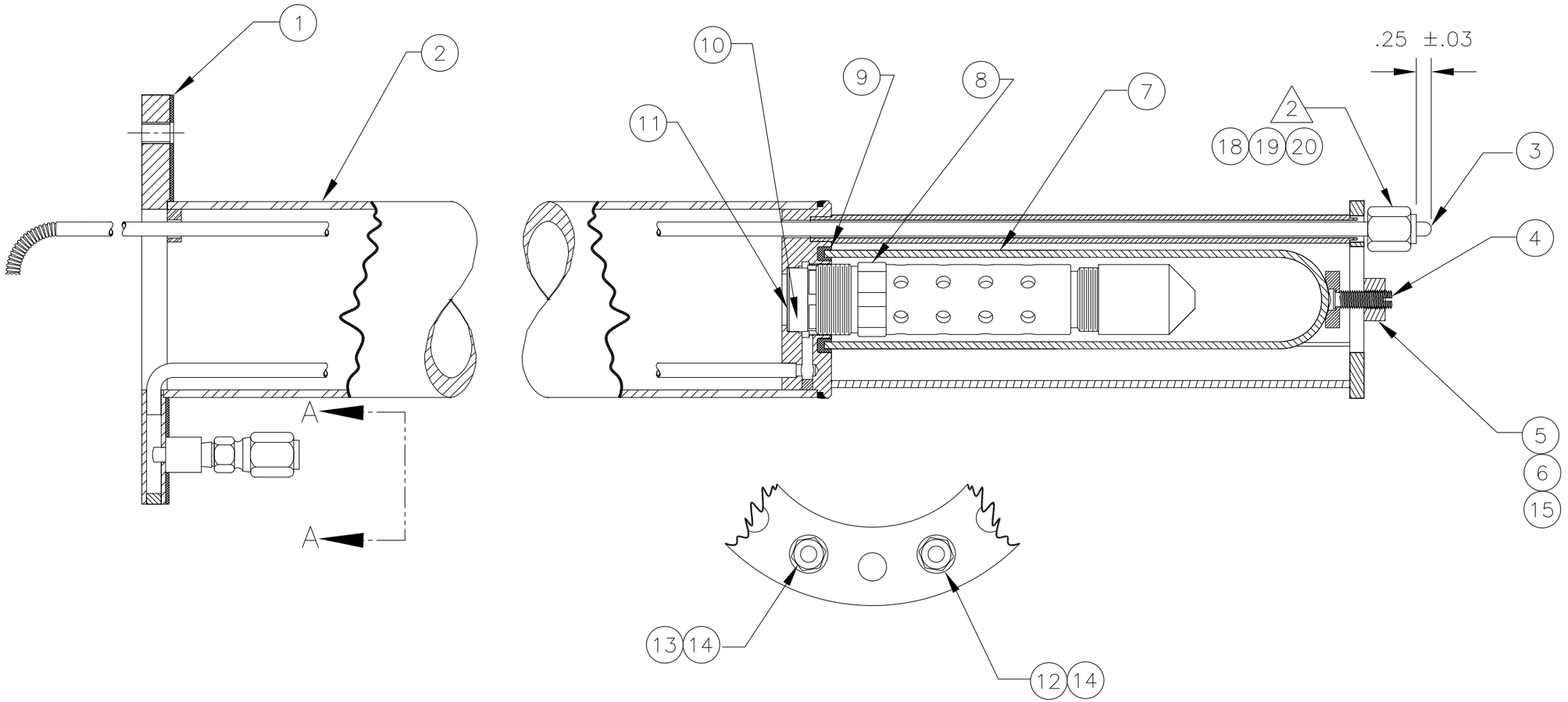
DRAWN BY	DATE	CHECKED BY	DATE	PROJ. ENG. BY	DATE
FMM	2/28/94				

TELEDYNE INSTRUMENTS
Monitor Labs
A Teledyne Technologies Company

PROBE ASSEMBLY
SM8175 10CM & UNDER 0- 1000 PPM

SIZE	CAGE CODE	DWG NO	REV
A		81751201	E

SHEET 11 OF 11



VIEW AA

NOTES:

1. CLEAN ALL PARTS PRIOR TO ASSEMBLY.
2. TIGHTEN NUT, FINGER TIGHT, PLUS ONE (1) FULL TURN.
3. LEAK/FLOW TEST SPECIFICATION:
   (METHODOLOGY AT MANUFACTURING DISCRETION)
   FLOW @ 10 PSI MUST BE AT LEAST 7 LPM
   LEAK TEST @ 15 ±1 PSI MUST BE:
   .25 PSI OR LESS AFTER TWO (2) HOURS
   OR
   .50 PSI OR LESS AFTER FOUR (4) HOURS
4. USE TEFLON TAPE, 16000052, ON F/N 12 & 13.
5. USE SHOP SUPPLY ANTI-SIEZE TML# 16000091 (LOCTITE# 39896) F/N (17) ON ALL COMPONENTS DEEMED APPROPRIATE. THIS ADDRESSES FUTURE RGR/DISASSEMBLY CONCERNS.

PROBE LENGTH	PART NO. 81751203		
22"		–	–22
8 FT		–3	–6
6 FT		–2	–5
4 FT		–1	–4
	PPM	0–500 (15CM)	0–375 (20CM)

LTR.	DESCRIPTION	DATE	DRAWN	APPR
E	SEE DCN 81751203E; REF ECO# 6661	1/4/08	CAD	KH
D	SEE DCN 81751203D; REF ECO# 6640	3/24/07	CAD	KH
C	SEE DCN 81751203C; REF ECO# 6623	8/30/06	CAD	JN
B	ECO 6500– ADD NOTE 5	4/1/05	CJC	KEH
A	MFG REL ECO 4329	5/6/94	FM2	GWP

REVISIONS

NEXT ASSEMBLY	USED ON
81751202	SM8175

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	L PRICE	2/28/94
CHECKED	FM2	6/15/94
PROJ. ENG.	GW PRICE	6/15/94

TELEDYNE INSTRUMENTS
Monitor Labs
A Teledyne Technologies Company

PROBE ASSEMBLY
15/20 CM
SM8175

SIZE	CAGE CODE	DWG NO	REV
D		81751203	E

SCALE 1:1 SHEET 1 OF 5

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	UNIT QTY −1	UNIT QTY −2	UNIT QTY −3		REFERENCE	TOTAL REQ.	STOCK ISSUED	SHORT QTY
1	81750564	GASKET	1	1	1					
2	81750958−1	WELDMENT, PROBE 4 FT	1							
2	81750958−2	WELDMENT, PROBE 6 FT		1						
2	81750958−3	WELDMENT, PROBE 8 FT			1					
3	53000188−8	RTD PROBE 316 SS	1							
3	53000188−9	RTD PROBE 316 SS		1						
3	53000188−10	RTD PROBE 316 SS			1					
4	81000435−2	ADJUSTING SCREW ASSY	1	1	1					
5	81000201−2	NUT PLATE	1	1	1					
6	8−32 X 3/4	SCREW, PNHD SS	2	2	2					
7	81000935−1	FILTER, CERAMIC	1	1	1					
8	81001084−1	CORNER CUBE ASSY (15CM)	1	1	1		△			
9	81000205	GASKET	1	1	1					
10	81000789−2	WINDOW ASSY	1	1	1					
11	81000790−2	GRAFOIL RING	1	1	1					
12	28100402−3	CONN, MALE 1/8NPT−1/4ø	1	1	1					
13	81750022−2	FITG., MOD 1/8NPT−1/4ø W/.03 ORIFICE	1	1	1					
14	28470400−3	PLUG FITTING 1/4ø	2	2	2					
15	#8	WASHER, SPLIT LK	2	2	2					

DRAWN BY L. PRICE DATE 2/25/94 | CHECKED BY DATE | PROJ. ENG. BY DATE

TELEDYNE INSTRUMENTS
Monitor Labs
A Teledyne Technologies Company

PROBE ASSEMBLY
SM8175 15CM

0−500 PPM
15CM

SIZE	CAGE CODE	DWG NO	REV
A		81751203	E

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	UNIT QTY −1	UNIT QTY −2	UNIT QTY −3	REFERENCE	TOTAL REQ.	STOCK ISSUED	SHORT QTY
16	20400−5007−3	CORNER CUBE PRISM 4'	1			△			
16	20400−5007−4	CORNER CUBE PRISM 6'		1		△			
16	20400−5007−5	CORNER CUBE PRISM 8'			1	△			
17	16000091	ANTI−SIEZE LOCTITE DRY MOLY	A/R	A/R	A/R	△			
18	28490400−3	NUT, FRACTIONAL TUBE, 1/4", S.S.	1	1	1				
19	28510400−3	BACK FERRULE, FR TUBE, 1/4" SS	1	1	1				
20	28530400−3	FRONT FERRULE, FR TUBE, 1/4" SS	1	1	1				

△ CORNER CUBE PRISM MUST BE INSTALLED INTO THE CORNER CUBE ASSY AT THE TIME OF ITS ASSEMBLY.

DRAWN BY	DATE	CHECKED BY	DATE	PROJ. ENG. BY	DATE
FMM	2/28/94				

TELEDYNE INSTRUMENTS
Monitor Labs
A Teledyne Technologies Company

PROBE ASSEMBLY
SM8175 15CM

0−500 PPM
15CM

SIZE	CAGE CODE	DWG NO	REV
A		81751203	E

SHEET 3 OF 5

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	UNIT QTY −4	UNIT QTY −5	UNIT QTY −6	UNIT QTY −22	REFERENCE	TOTAL REQ.	STOCK ISSUED	SHORT QTY
1	81750564	GASKET	1	1	1	1				
2	81750958−1	WELDMENT, PROBE 4 FT	1							
2	81750958−2	WELDMENT, PROBE 6 FT		1						
2	81750958−3	WELDMENT, PROBE 8 FT			1					
2	81750958−22	WELDMENT, PROBE 22" LENGTH				1				
3	53000188−8	RTD PROBE 316 SS	1							
3	53000188−9	RTD PROBE 316 SS		1						
3	53000188−10	RTD PROBE 316 SS			1					
3	53000188−7	RTD PROBE 316 SS				1				
4	81000435−2	ADJUSTING SCREW ASSY	1	1	1	1				
5	81000201−2	NUT PLATE	1	1	1	1				
6	8−32 X 3/4	SCREW, PNHD SS	2	2	2	2				
7	81000935−1	FILTER, CERAMIC	1	1	1	1				
8	81000887−2	CORNER CUBE ASSY (20CM)	1	1	1	1	△			
9	81000205	GASKET	1	1	1	1				
10	81000789−2	WINDOW ASSY	1	1	1	1				
11	81000790−2	GRAFOIL RING	1	1	1	1				
12	28100402−3	CONN, MALE 1/8NPT−1/4ø	1	1	1	1				
13	81750022−2	FITG., MOD 1/8NPT−1/4ø W/.03 ORIFICE	1	1	1	1				

DRAWN BY L. PRICE DATE 2/25/94 | CHECKED BY DATE | PROJ. ENG. BY DATE

TELEDYNE INSTRUMENTS
Monitor Labs
A Teledyne Technologies Company

PROBE ASSEMBLY
SM8175
0−375 PPM
20CM

SIZE	CAGE CODE	DWG NO	REV
A		81751203	E

SHEET 4 OF 5

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	UNIT QTY −4	UNIT QTY −5	UNIT QTY −6	UNIT QTY −22	REFERENCE	TOTAL REQ.	STOCK ISSUED	SHORT QTY
14	28470400−3	PLUG 1/4ø	2	2	2	2	△			
15	#8	WASHER, SPLIT LK	2	2	2	2	△			
16	20400−5007−3	CORNER CUBE PRISM 4’	1				△			
16	20400−5007−4	CORNER CUBE PRISM 6’		1						
16	20400−5007−5	CORNER CUBE PRISM 8’			1					
16	20400−5007−2	CORNER CUBE PRISM 18”				1				
17	16000091	ANTI−SIEZE LOCTITE DRY MOLY	A/R	A/R	A/R	A/R				
18	28490400−3	NUT, FRACTIONAL TUBE, 1/4”, S.S.	1	1	1					
19	28510400−3	BACK FERRULE, FR TUBE, 1/4” SS	1	1	1					
20	28530400−3	FRONT FERRULE, FR TUBE, 1/4” SS	1	1	1					
		△ CORNER CUBE PRISM MUST BE INSTALLED INTO THE CORNER CUBE ASSY AT THE TIME OF ITS ASSEMBLY.								

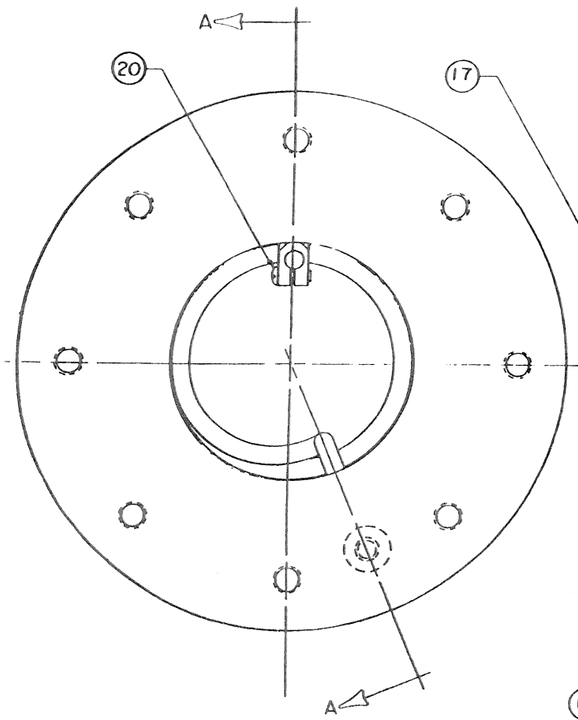
DRAWN BY FMM DATE 2/28/94 | CHECKED BY DATE | PROJ. ENG. BY DATE

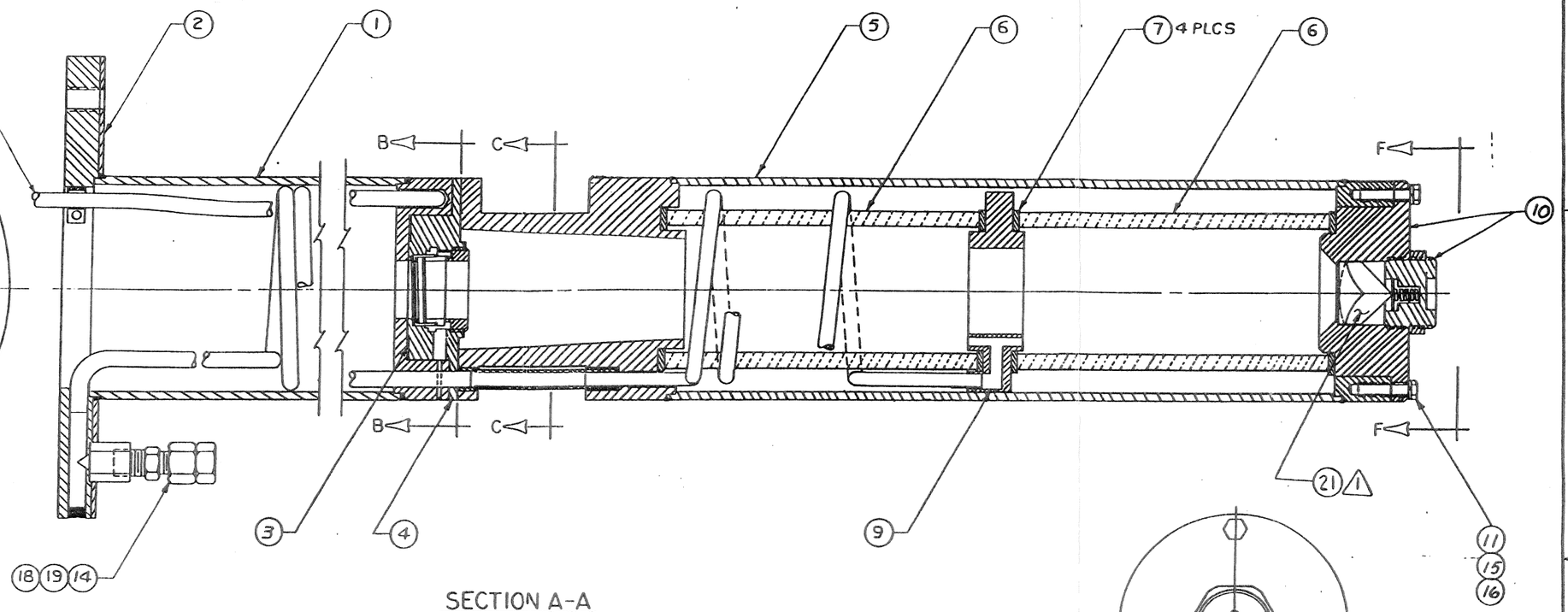
TELEDYNE INSTRUMENTS
Monitor Labs
A Teledyne Technologies Company

PROBE ASSEMBLY 0−375 PPM
SM8175 20CM 20CM

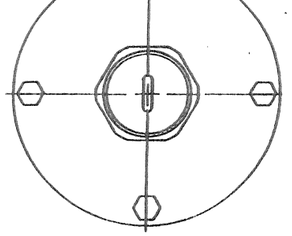
SIZE	CAGE CODE	DWG NO	REV
A		81751203	E

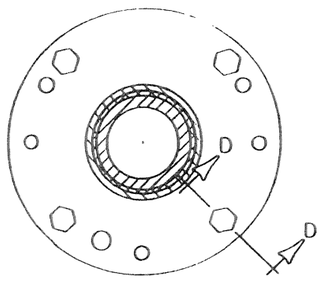
SHEET 5 OF 5



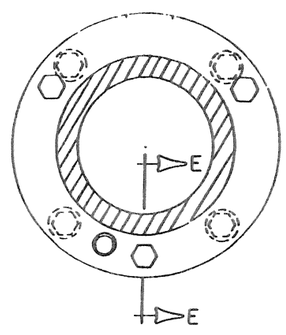


SECTION A-A

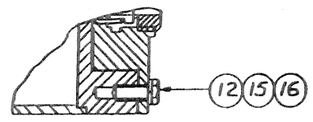




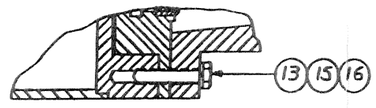
SECTION B-B



SECTION C-C



SECTION D-D



SECTION E-E

NOTES:

1. ITEM 21 (CORNER CUBE) MUST BE INSTALLED IN ITEM 10 (CORNER CUBE ASSEMBLY) PRIOR TO INSTALLATION IN PROBE ASSEMBLY.

81001205 -4 18"
-3 8 FT
-2 6 FT
81001205-1 4 FT
} 316L SS

FILENAME = SM120501

LTR.	DESCRIPTION	DATE	DRAWN	APPR
D	ECO 5762 - ADD MANUAL #	7/15/98	CJR	
C	REVISE PER ECO 4338	6/8/94	CJR	
B	REVISED PER ECO 3649	12/21/92	CJR	RH
A	RELEASE TO MFG PER ECO 2800	5/9/91	FM2	JN

REVISIONS

81001204 NEXT ASSEMBLY

B1600002 SM816A MANUAL USED ON

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES
TOLERANCE ON DECIMALS .X ± .1 .XX ± .03 .XXX ± .010
TOLERANCE ON ANGLES ± 0°30'

DO NOT SCALE DRAWING

MATERIAL

FINISH

	BY	DATE
DRAWN	FM	5/9/91
CHECKED	JN	6/25/91
PROJ. ENG.	RH	6/25/91

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

PROBE ASSEMBLY 36CM

SIZE D | CAGE CODE | DWG NO 81001205 | REV D

SCALE | SHEET 1 OF 3

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	UNIT QTY -1	UNIT QTY -2	UNIT QTY -3	UNIT QTY -4	REFERENCE	TOTAL REQ.	STOCK ISSUED	SHORT QTY
1	81001005-6	PROBE WELDMENT 4FT	1							
1	81001005-7	PROBE WELDMENT 6FT		1						
1	81001005-8	PROBE WELDMENT 8FT			1					
1	81001005-1	PROBE WELDMENT 18"				1				
2	81000564	GASKET, FLANGE	1	1	1	1				
3	81000790-3	GRAFOIL RING	1	1	1	1				
4	81001007-1	WINDOW ASSY, PROBE	1	1	1	1				
5	80340003-3	FILTER HSG ASSY WELDMENT	1	1	1	1				
6	80340018	FILTER, CERAMIC	2	2	2	2				
7	81001176	GASKET, FILTER	4	4	4	4				
8										
9	80340019-1	AIR DISTRIBUTER	1	1	1	1				
10	81001010-1	CORNER CUBE PRISM ASSY	1	1	1	1				
11	10-32 X 5/8	SCREW, HEX HD CAP	4	4	4	4				
12	10-32 X 1/2	SCREW, HEX HD CAP	4	4	4	4				
13	10-32 X 3/4	SCREW, HEX HD CAP	3	3	3	3				
14	28100402-3	CONN. MALE 1/4ø-1/8NPT	1	1	1	1				
15	#10	WASHER, LOCK SPLIT	11	11	11	11				
16	16000091	COMPOUND, ANTI-SEIZE	A/R	A/R	A/R	A/R				

DRAWN BY	DATE	CHECKED BY	DATE	PROJ. ENG. BY	DATE
FM	5/9/91	JN	6/25/91	RH	6/25/91

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

PROBE ASSEMBLY 36CM
0-208PPM

SIZE	CAGE CODE	DWG NO	REV
A		81001205	D

FILENAME= SM120502 SHEET 2 OF 3

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	UNIT QTY -1	-2	-3	-4	REFERENCE	TOTAL REQ.	STOCK ISSUED	SHORT QTY
17	53000188-2	RTD PROBE 304 4FT	1							
17	53000188-3	RTD PROBE 304 6FT		1						
17	53000188-4	RTD PROBE 304 8T			1					
17	53000188-1	RTD PROBE 304 18"				1				
18	28470400-3	PLUG 1/4ø	1	1	1	1				
19	16000052	SEALANT, PIPE THRD	A/R	A/R	A/R	A/R				
20	6-32 X 3/8	SCREW HEX HD	1	1	1	1				
21	20400-5007-3	CORNER CUBE PRISM, 4' PROBE	1	–	–	–				
21	20400-5007-4	CORNER CUBE PRISM, 6' PROBE	–	1	–	–				
21	20400-5007-5	CORNER CUBE PRISM, 8' & 9' PROBE	–	–	1	–				
21	20400-5007-2	CORNER CUBE PRISM, 18" PROBE	–	–	–	1				

DRAWN BY FMM	DATE 5/9/91	CHECKED BY JN	DATE 6/25/91	PROJ. ENG. BY RH	DATE 6/25/91

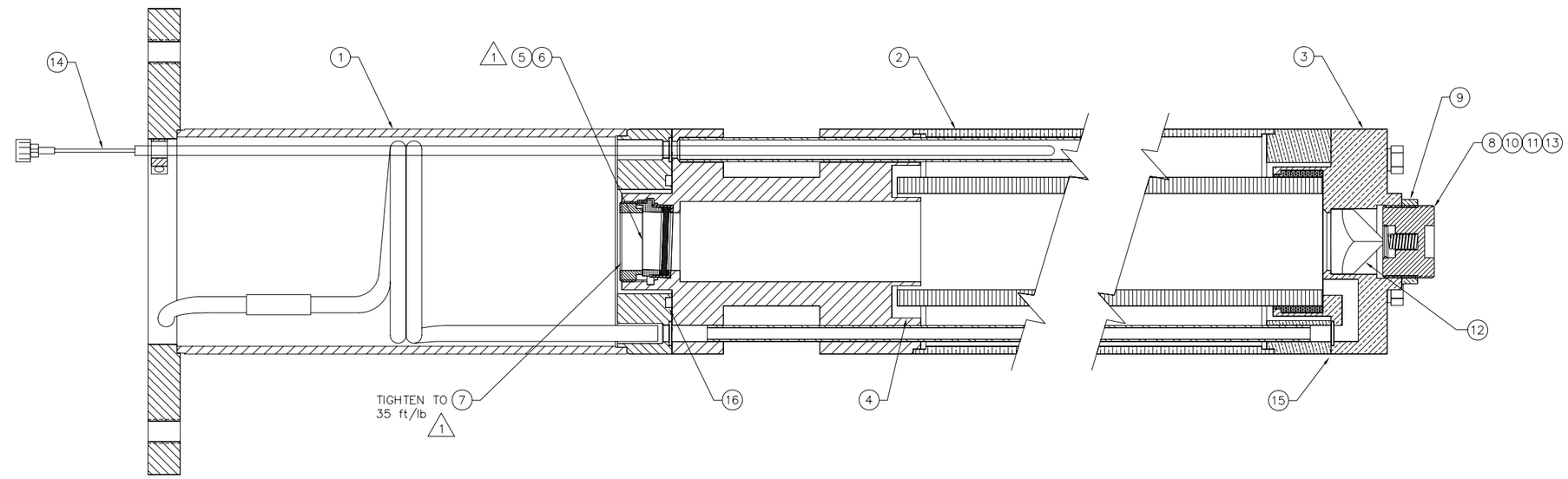
MONITOR LABS, INC.
74 INVERNESS DRIVE EAST
ENGLEWOOD, COLORADO 80112

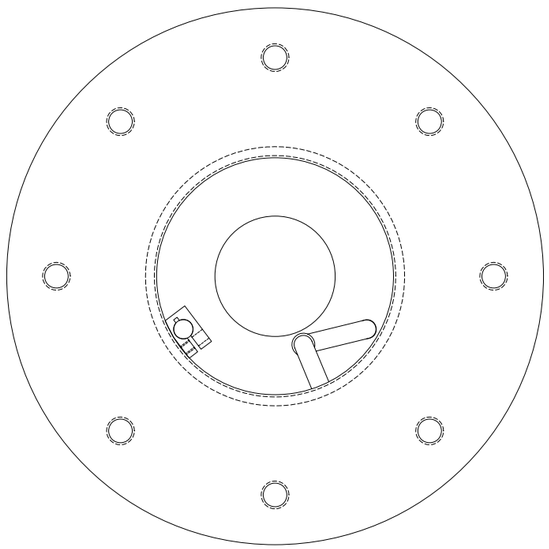
PROBE ASSEMBLY 36CM
0-208PPM

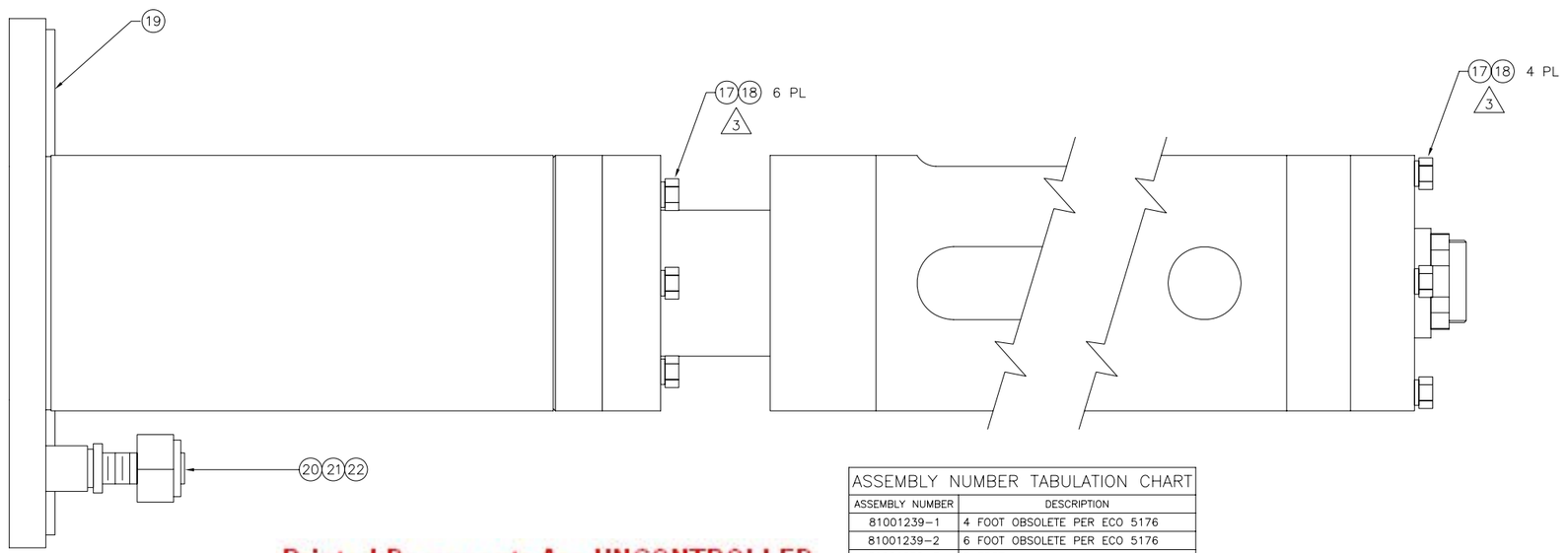
SIZE	CAGE CODE	DWG NO	REV
A		81001205	D

FILENAME= SM120503 SHEET 3 OF 3

DWG NO 81001239 SH







ASSEMBLY NUMBER TABULATION CHART	
ASSEMBLY NUMBER	DESCRIPTION
81001239-1	4 FOOT OBSOLETE PER ECO 5176
81001239-2	6 FOOT OBSOLETE PER ECO 5176
81001239-3	5 FOOT
81001239-4	1 METER

FILENAME= SM123901

NOTES:

1. PRESSURE TEST (15 psi FOR 15 MIN.) WINDOW ASSY IN FILTER HOUSING, F/N 2, PRIOR TO ASSY TO F/N 1.
2. PRESSURE TEST F/N1 AFTER ASSY TO F/N 2.
3. APPLY ANTI-SEIZE FILM 16000091.

LTR.	DESCRIPTION	DATE	DRAWN	APVD
D	ECO 5762-ADD MANUAL #'S TO TITLE BLK	7/16/98	CJR	
C	ADD -4 AND CHG ITEM 14/ECO 5204	1/15/97	CJR	GWP
B	REVISED PER ECO 5176	10JAN97	JDP	GWP
A	RELEASE TO MFG PER ECO 5031	4/24/96	DAC	KH

REVISIONS

NEXT ASSEMBLY	USED ON
	81600002 SM8160 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	DATE
TRENCONSKY	6/29/95
R. TRENCONSKY	6/29/95

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

PROBE ASSEMBLY 75CM 5' LG

SIZE D | CAGE CODE | DWG NO 81001239 | REV D

SCALE 1=1 | SHEET 1 OF 3

PLOTTED 07/18/1997 14:40:20

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	UNIT QTY −1	UNIT QTY −2	UNIT QTY −3	UNIT QTY −4	REFERENCE	TOTAL REQD.	STOCK ISSUED	SHORT QTY
1	81001135−1	PROBE WELDMENT 4FT	1	–	–	–				
	81001135−2	PROBE WELDMENT 6FT	–	1	–	–				
	81001238−1	FLANGE, PROBE WELDMENT	–	–	1	–				
	81001238−2	FLANGE, PROBE WELDMENT	–	–	–	1				
2	81001127−1	FILTER HOUSING ASSY	1	1	–	–				
	81001230−1	HOUSING ASSY, FILTER, 75CM	–	–	1	1				
3	81001130−1	FILTER ASSY	1	1	–	–				
	81001130−75	FILTER ASST, 75CM	–	–	1	1				
4	81001137	GASKET, FILTER	1	1	1	1				
5	81000790−2	GRAFOIL RING	1	1	1	1				
6	81000789−2	WINDOW ASSY	1	1	1	1				
7	81001009−1	THRD BUSHING	1	1	1	1				
8	81000458−2	END CAP	1	1	1	1				
9	81000119−2	NUT, JAM	1	1	1	1				
10	81000204	PLATE, SPRING	1	1	1	1				
11	25000091	SPRING	1	1	1	1				
12	20400−5007−3	CORNER CUBE	1	–	–	1				
	20400−5007−4	CORNER CUBE	–	1	1	–				
13	81000460	RETAINING RING	1	1	1	1				
14	53000188−5	RTD PROBE 4 FT	1	–	–	–				
	53000188−6	RTD PROBE 6 FT	–	1	–	–				
	53000188−2	46" RTD 304SS	–	–	1	–				
	53000188−16	RTD PROBE 28" 304SS	–	–	–	1				
15	28001075−1	C−RING .375 O.D.	2	2	2	2				
16	28001075−2	C−RING 1.75 I.D.	1	1	1	1				

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

PROBE ASSEMBLY
SM8160A

SIZE	CAGE CODE	DWG NO	REV
A		81001239	D

FILENAME= SM123902 SHEET 2 OF 3

PLOTTED
07/18/1997 14:43:43

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	UNIT QTY −1	UNIT QTY −2	UNIT QTY −3	UNIT QTY −4	REFERENCE	TOTAL REQD.	STOCK ISSUED	SHORT QTY
17	1/4−20 X 1.25	SCREW, HEX CAP	10	10	10	10				
18	# 1/4	WASHER, LK SPLIT	10	10	10	10				
19	81000564	GASKET. FLANGE	1	1	1	1				
20	28100402−3	CONN MALE 1/4ø−1/4NPT	1	1	1	1				
21	28470400−1	PLUG 1/4ø	1	1	1	1				
22	16000052	SEALANT, PIPE THRD	A/R	A/R	A/R	A/R				
23	16000091	COMPOUND, ANTI−SEIZE	A/R	A/R	A/R	A/R				

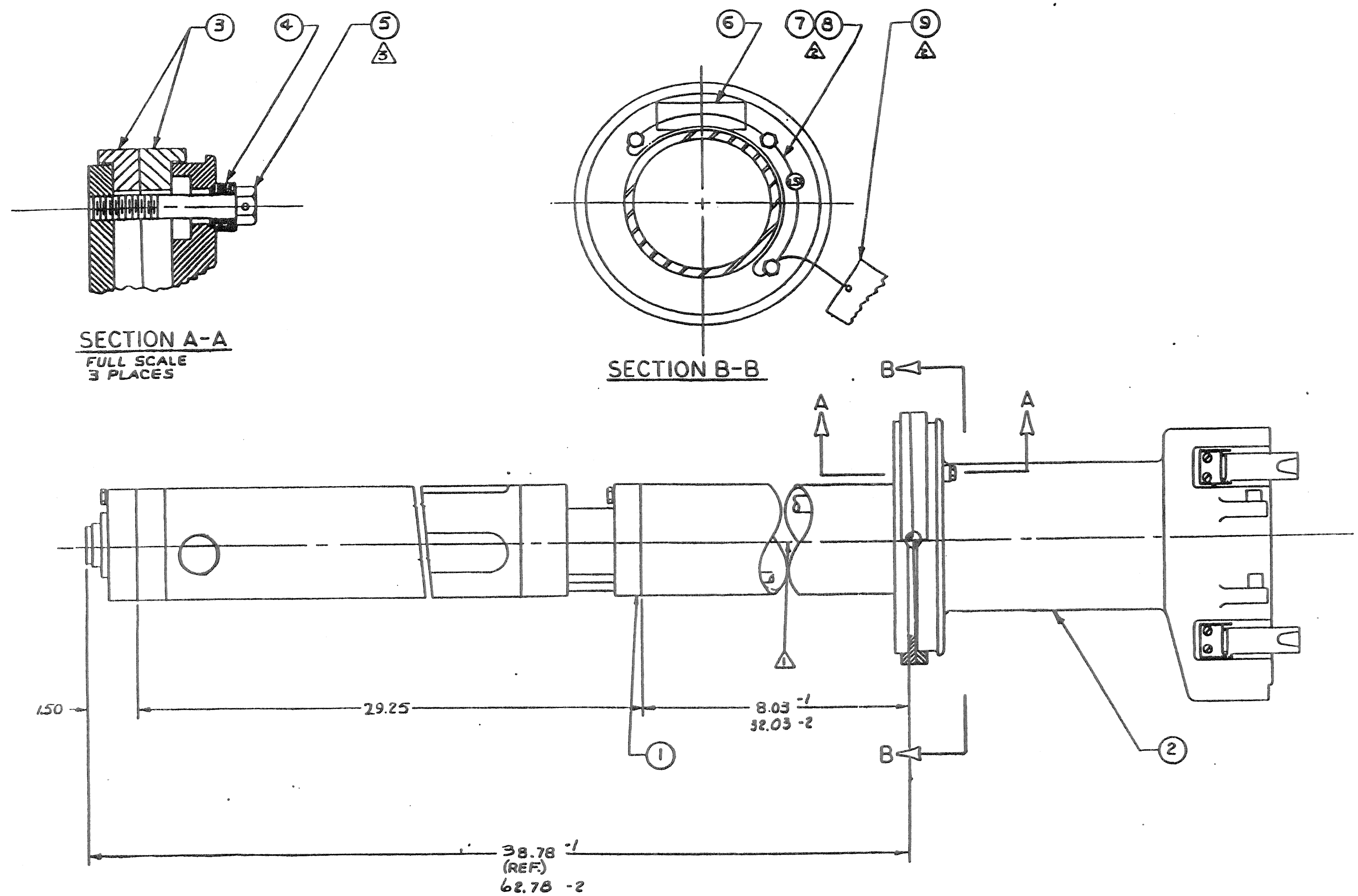
B A B A

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

PROBE ASSEMBLY
SM8160A

SIZE	CAGE CODE	DWG NO	REV
A		81001239	D

FILENAME= SM123902 SHEET 3 OF 3



NOTES:

1. ALIGN PER LSI PROCEDURE NO. 81000685.
2. F/N's 7,8 & 9 TO BE INSTALLED BY THE TEST DEPARTMENT PRIOR TO SHIPPING.
3. APPLY ANTI-SEIZE FILM 16000091.

-2	5FT 316L SS
81001240-1	1 METER 316L SS

LTR.	DESCRIPTION	DATE	DRW	APPR
C	ECO 5762-ADD MANUAL	7/20/98	CR	LS
B	ECO 5176	12/19/96	CJR	CB
A	RELEASE TO MFG PER ECO 5031	4/24/96	DAC	KH

REVISIONS

NEXT ASSEMBLY	USED ON
	81600002
	8160 MANUAL

DO NOT SCALE DRAWING

MATERIAL

DRAWN BY FM 5-6-91
CHECKED BY JN 6/25/91

MEASUREMENT CONTROLS CORPORATION

PROBE ASSEMBLY
W/HOUSING
SM8100A 75CM

SIZE D DRAWING NO. 81001240 REV C

SHEET 1 OF 2

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	UNIT QTY -1	UNIT QTY -2			REFERENCE	TOTAL REQD.	STOCK ISSUED	SHORT QTY
1	81001239-3	PROBE ASSEMBLY 5 FEET	1	–						
	81001239-4	PROBE ASSEMBLY 1 METER	–	1						
2	80410023-3	HOUSING ASSY	1	1						
3	81000242	ALIGNMENT RING	2	2						
4	80010076	SPACER	3	3						
5	28000550	BOLT, HEX HD 3/8-16 X 2.5"	3	3						
6	81000690	LABEL	1	1						
7	28000547	LEAD SEAL	1	1						
8	28000548	WIRE 20" LG	1	1						
9	80030363	LABEL, S/N TAG	1	1						
10	16000091	COMPOUND, ANTI-SEIZE	A/R	A/R						

B A B A

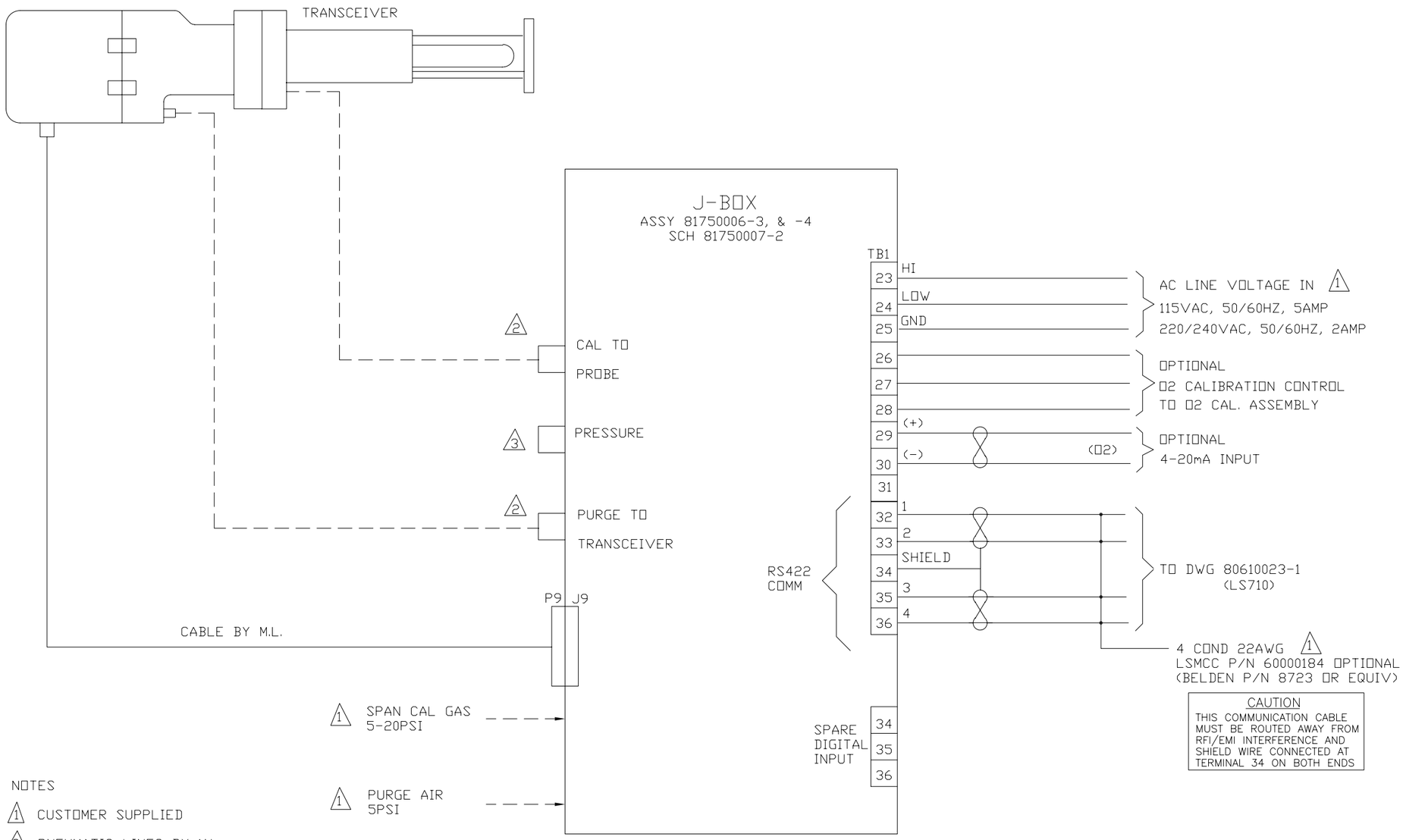
MONITOR LABS, INC.
74 INVERNESS DRIVE EAST
ENGLEWOOD, COLORADO 80112

PROBE ASSEMBLY 75CM
W/HOUSING SM8160A

SIZE A | CAGE CODE | DWG NO 81001240 | REV C

FILENAME= SM124002.--B | SHEET 2 OF 2

PLOTTED
01/17/1997 07:55:39



NOTES

1. CUSTOMER SUPPLIED
2. PNEUMATIC LINES BY M.L.
3. DO NOT CAP PRESSURE PORT.

Printed Documents Are UNCONTROLLED

FILENAME=E2000121

LTR.	DESCRIPTION	DATE	DRAWN	APPR
C	ECO 5762- ADD MANUAL # TO TITLE BLK	7/15/98	CJR	
B	ECO 5272-CHG POLARITY ON 29/30	3/3/97	CJR	
A	RELEASE TO MFG PER ECO 4709	5/16/95	CJR	KEH

REVISIONS

NEXT ASSEMBLY	USED ON
	81750003 SM8175 MANUAL
	SM8100B
	8175

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

DO NOT SCALE DRAWING

MATERIAL

FINISH

DRAWN BY FMM DATE 3/28/94
CHECKED BY
PROJ. ENG. BY

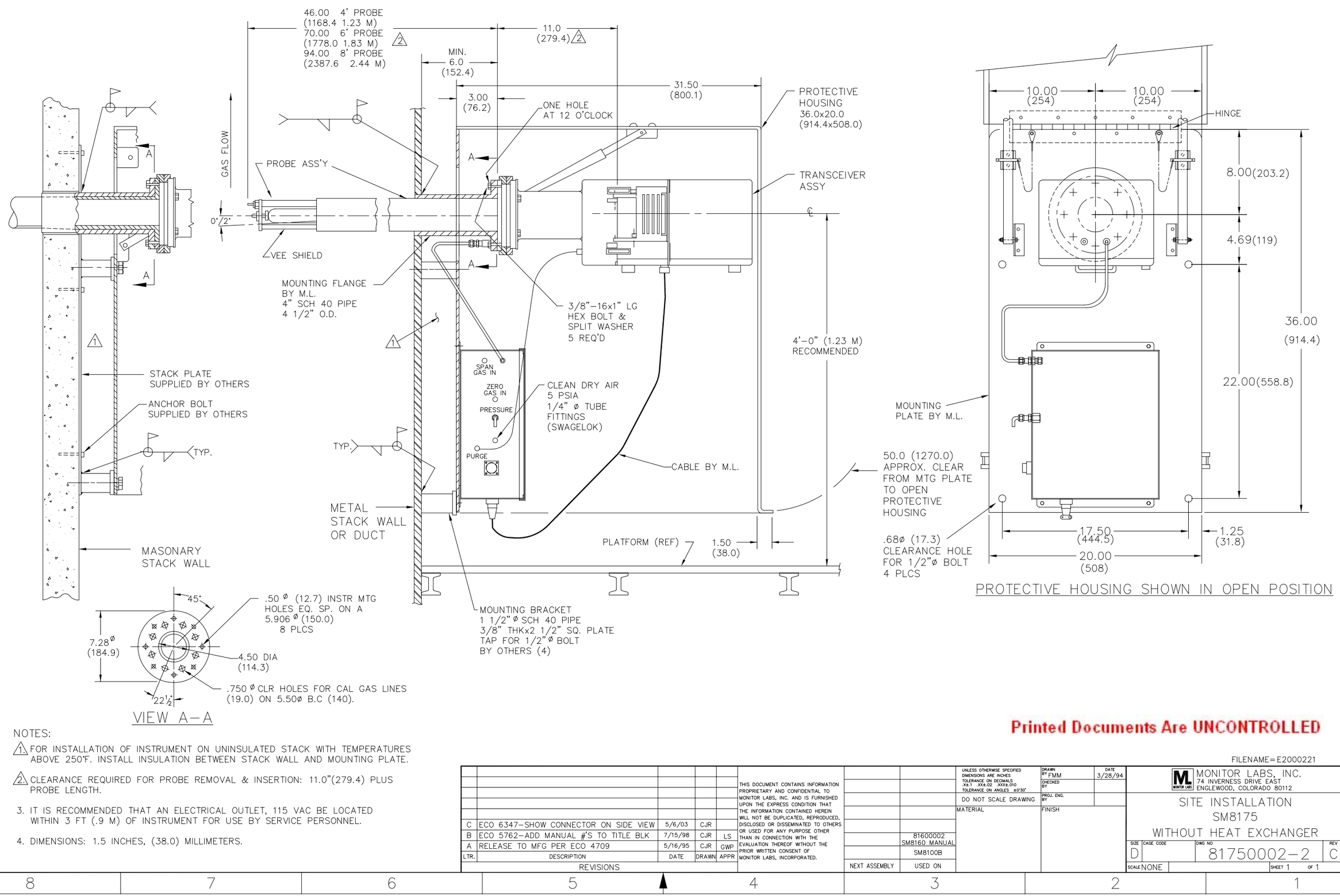
MONITOR LABS, INC.
74 INVERNESS DRIVE EAST
ENGLEWOOD, COLORADO 80112

SM8175 WIRING DIAGRAM SYSTEM INTERCONNECT WITHOUT HEAT EXCHANGER

SIZE D | CAGE CODE | DWG NO 81750001-2 | REV C

SCALE NONE | SHEET 1 OF 1

PLOTTED 03/03/1997 12:55:59



NOTES:

1. FOR INSTALLATION OF INSTRUMENT ON UNINSULATED STACK WITH TEMPERATURES ABOVE 250°F. INSTALL INSULATION BETWEEN STACK WALL AND MOUNTING PLATE.
2. CLEARANCE REQUIRED FOR PROBE REMOVAL & INSERTION: 11.0"(279.4) PLUS PROBE LENGTH.
3. IT IS RECOMMENDED THAT AN ELECTRICAL OUTLET, 115 VAC BE LOCATED WITHIN 3 FT (.9 M) OF INSTRUMENT FOR USE BY SERVICE PERSONNEL.
4. DIMENSIONS: 1.5 INCHES, (38.0) MILLIMETERS.

LTR.	DESCRIPTION	DATE	DRAWN	APPR
C	ECO 6347–SHOW CONNECTOR ON SIDE VIEW	5/6/03	CJR	
B	ECO 5762–ADD MANUAL #'S TO TITLE BLK	7/15/98	CJR	LS
A	RELEASE TO MFG PER ECO 4709	5/16/95	CJR	GWP

REVISIONS

NEXT ASSEMBLY	USED ON
	81600002 SM8160 MANUAL
	SM8100B

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

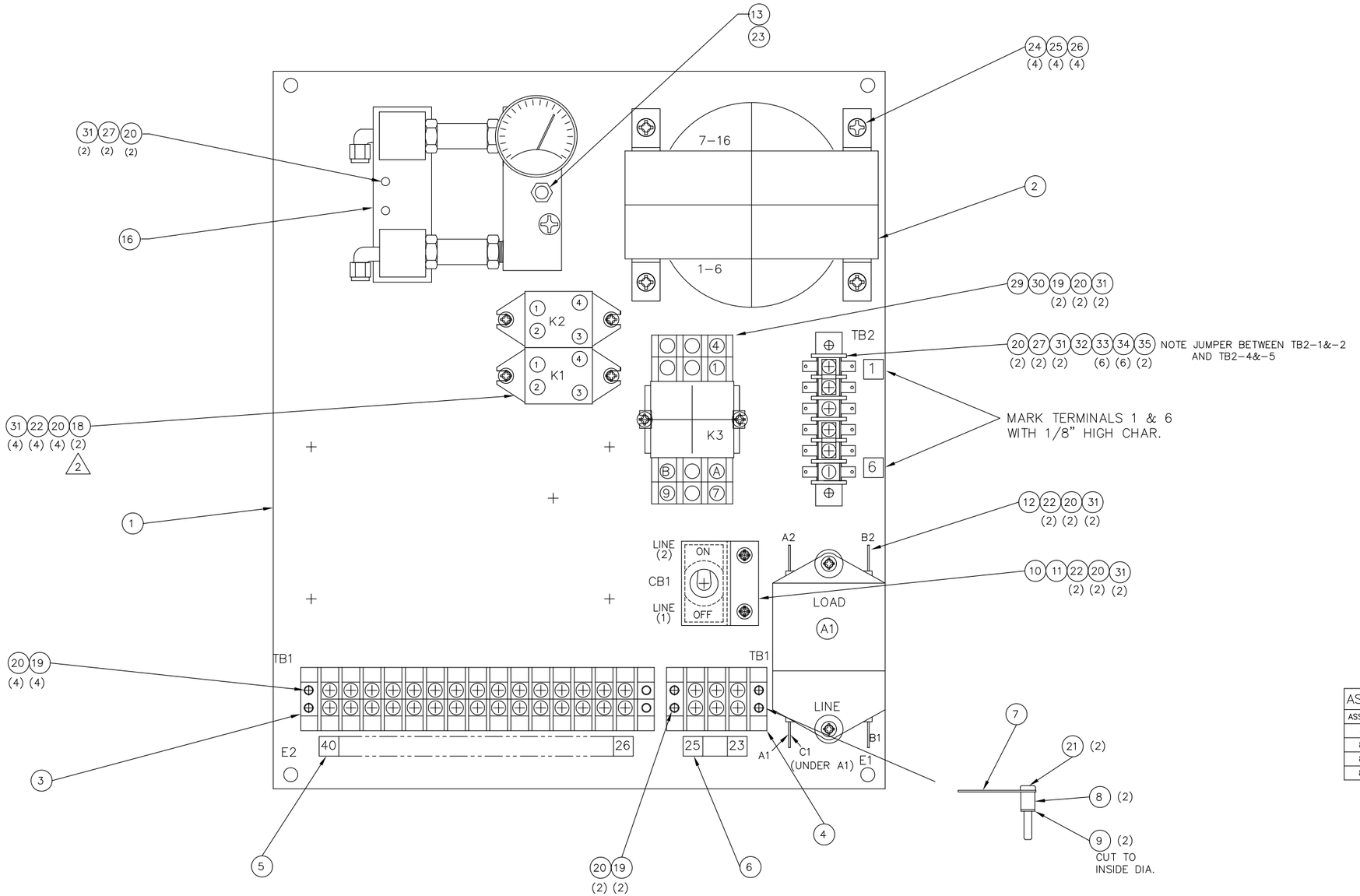
DRAWN BY FMM 3/28/94
CHECKED BY
PROJ. ENG. BY
FINISH

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

SITE INSTALLATION SM8175 WITHOUT HEAT EXCHANGER

SIZE D | CAGE CODE | DWG NO 81750002–2 | REV C
SCALE NONE | SHEET 1 OF 1

FILENAME=E2000221



ASSEMBLY NUMBER TABULATION CHART	
ASSEMBLY NUMBER	DESCRIPTION
81750004–1	8175 115VAC
81750004–2	8175 220VAC
81750004–3	8160 115VAC
81750004–4	8160 220VAC

2 NOTE THAT THE SCREW POSTS ON THE RELAYS ARE NOT THE SAME DISTANCE APART. THIS WILL ASSURE PROPER ASSEMBLY WHEN MOUNTED PER THIS DRAWING.

NOTES: UNLESS OTHERWISE SPECIFIED.

LTR.	DESCRIPTION	DATE	DRAWN	APPR
F	SEE DCN 81750004F; REF ECO 6665	2/5/08	CAD	JDR
E	ECO 6477 ADD CORRECT HARDWARE	9/27/04	CJR	MTC
D	ECO 5747 ADDED –3 AND –4 ASSEMBLIES	09JUN98	JDP	GWP
C	REVISE PER ECO 5536	11/6/97	CJR	GWP
B	ECO 5286 ADDED NOTES 1&2 AND OTHER INFO	23APR97	JDP	GWP
A	RELEASE TO MFG PER ECO 4333	6/15/94	CJR	GWP

REVISIONS

NEXT ASSEMBLY	USED ON
8160002	SM8160 MANUAL
8175003	SM8175 MANUAL
81750041	
81750006	8175

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 2/8/94
CHECKED BY GWP
PROJ. ENG. BY GW PRICE 6/15/94

TELEDYNE INSTRUMENTS
Monitor Labs
A Teledyne Technologies Company

MOUNTING PLATE ASSY J–BOX

SIZE	CAGE CODE	DWG NO	REV
D		81750004	F

SCALE 1:1 SHEET 1 OF 3

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	QTY. REQ. PER ASSY							MFR P/N	TOTAL REQD.	STOCK ISSUED	SHORT QTY
			-1	-2	-3	-4							
1	81750005	PLATE	1	1	1	1							
2	81750016	TRANSFORMER ASSY	1	1	1	1							
3	21000426	TERM. BLOCK 15 POS.	1	1	1	1							
4	21000068	TERM. BLOCK 3 POS.	1	1	1	1							
5	25000371-4	LABEL	1	1	1	1							
6	25000371-3	LABEL	1	1	1	1							
7	25000358-1	LABEL, CAUTION 115 VAC	1	–	1	–							
7	25000358-3	LABEL, CAUTION 220 VAC	–	1	–	1							
8	28001015	SPACER, RD. 1/4ø, 5/16 LG	2	2	2	2							
9	28001306-TAB	WASHER, #4, FLAT, NYLON	2	2	2	2							
10	80340158	BRACKET	1	–	1	–							
10	80340402	BRACKET	–	1	–	1							
11	51000345-9	CIRCUIT BREAKER, 8 AMP	1	–	1	–							
11	51000345-14	CIRCUIT BREAKER, 3 AMP	–	1	–	1							
12	27000014	FILTER, RFI	1	1	1	1							
13	28001283-TAB	10-32 X 1-1/2 PAN PH HD SS	1	1	1	1							
14													
15													
16	81600014-5	MANIFOLD, CAL ASSY. 115VAC NO ORIFICE	1	–	–	–							
16	81600014-6	MANIFOLD, CAL ASSY. 220VAC NO ORIFICE	–	1	–	–							
16	81600014-1	MANIFOLD, CAL ASSY. 115VAC W/.030 ORIFICE	–	–	1	–							
16	81600014-3	MANIFOLD, CAL ASSY. 220VAC W/.030 ORIFICE	–	–	–	1							
17													
18	45000168	RELAY 24-280VAC	2	2	2	2							
19	28001279-TAB	SCREW, 6-32 X 1/2, PAN HD	8	8	8	8							

TELEDYNE INSTRUMENTS
Monitor Labs
A Teledyne Technologies Company

MOUNTING PLATE ASSEMBLY
J-BOX

SIZE	CAGE CODE	DWG NO	REV
A		81750004	F

DRAWN BY: CAD | DATE: 2/5/08 | SHEET 2 OF 3

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	QTY. REQ. PER ASSY							MFR P/N	TOTAL REQD.	STOCK ISSUED	SHORT QTY
			-1	-2	-3	-4							
20	28001323-TAB	WASHER, #6, SPLIT LOCK	20	20	20	20							
21	28001279-TAB	SCREW, 6-32 X 7/8, PAN HD	2	2	2	2							
22	28001279-TAB	SCREW, 6-32 X 3/8, PAN HD	8	8	8	8							
23	28001324-TAB	WASHER, #10, SPLIT LOCK, STAINLESS	1	1	1	1							
24	28001279-TAB	SCREW, 8-32 X 3/8, PAN HD	4	4	4	4							
25	28001323-TAB	WASHER, #8, SPLIT LOCK	4	4	4	4							
26	28001304-TAB	WASHER, #8, FLAT	4	4	4	4							
27	28001279-TAB	SCREW, 6-32 X 5/8, PAN HEAD STAINLESS	4	4	4	4							
28													
29	45000129	RELAY, 24VDC	1	1	1	1							
30	045-000360	SOCKET	1	1	1	1							
31	28001304-TAB	WASHER, #6, FLAT	14	14	14	14							
32	21000787-2	SINGLE ROW TERMINAL BLOCK, BASE, 6 POS.	1	1	1	1							
33	21000787-3	FULL QUICK CONNECT, 45 DEGREE BEND	6	6	6	6							
34	21000787-4	FULL QUICK CONNECT, 90 DEGREE BEND	6	6	6	6							
35	21000787-5	LINE TO LINE JUMPER	2	2	2	2							

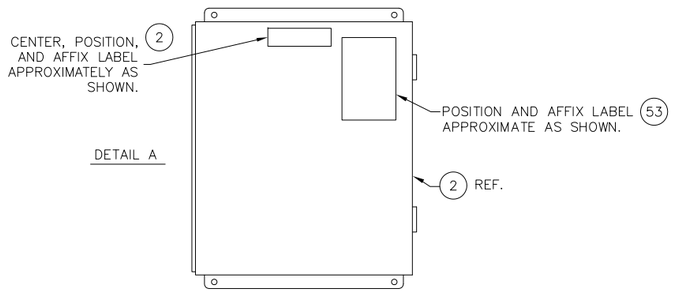
TELEDYNE INSTRUMENTS
Monitor Labs
A Teledyne Technologies Company

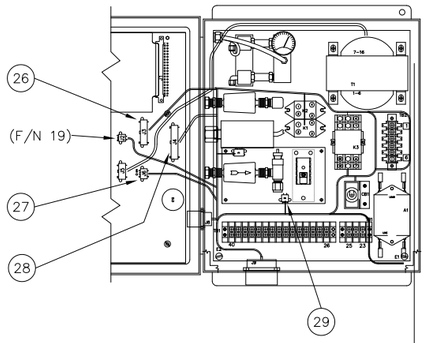
MOUNTING PLATE ASSEMBLY
J-BOX

SIZE	CAGE CODE	DWG NO	REV
A		81750004	F

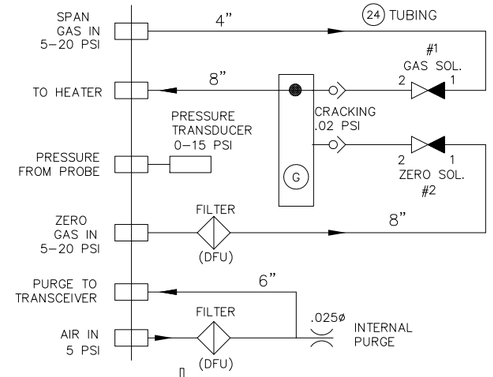
DRAWN BY: CAD | DATE: 2/4/08 | SHEET 3 OF 3

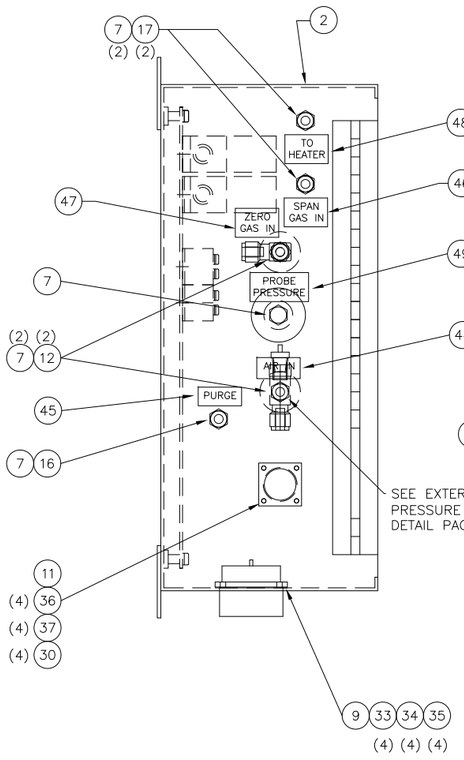
REVISIONS				
REVISED BY: CAD	APPR. BY: KEH	REV. R	9/23/08	SEE DCN 81750006R FOR CHANGE DESC. REF ECO# 6745

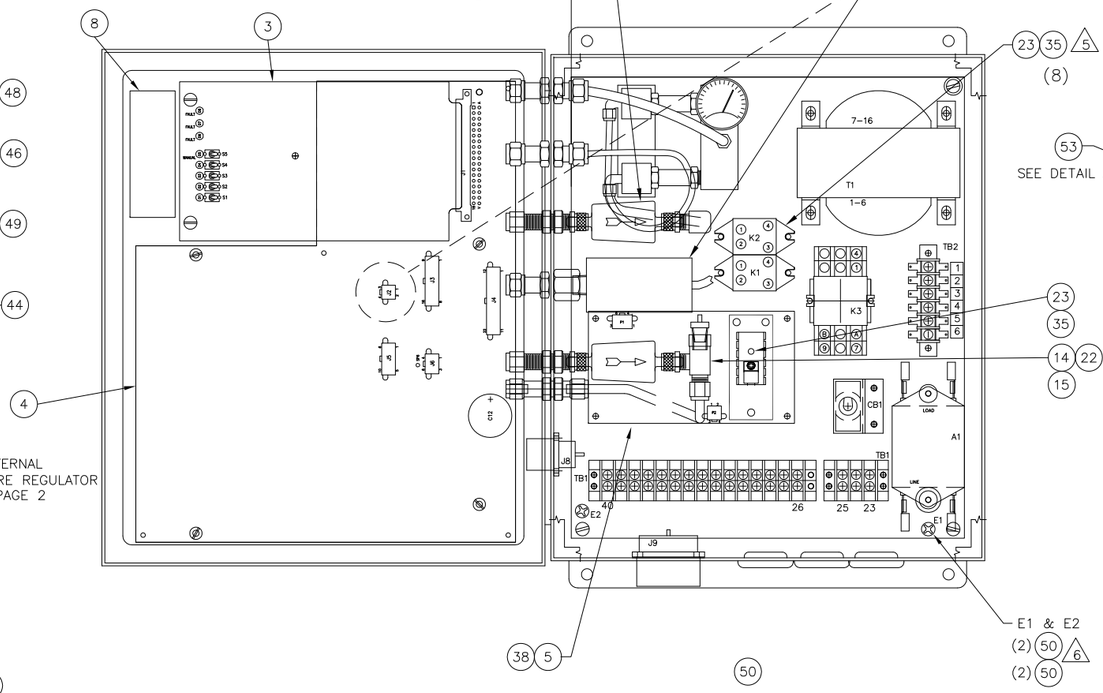


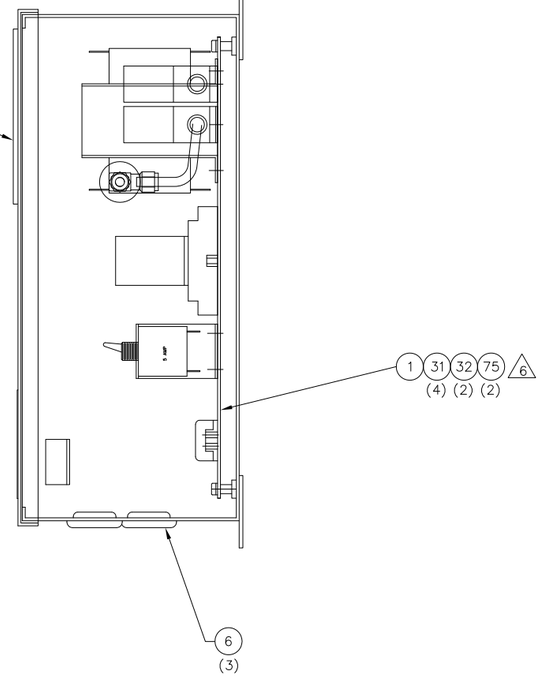


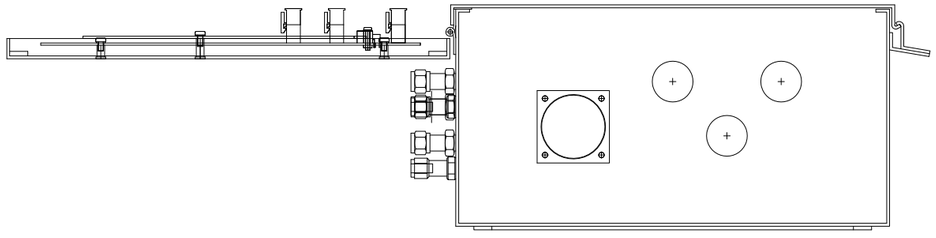
PLUMBING DIAGRAM











THIS VIEW IS FOR –1 & –2 ASSEMBLY

ASSEMBLY NUMBER TABULATION CHART	
ASSEMBLY NUMBER	DESCRIPTION
81750006–1	8175 115 VAC WITH HEAT EXCHANGER
81750006–2	8175 220 VAC WITH HEAT EXCHANGER
81750006–3	8160 115 VAC WITHOUT HEAT EXCHANGER
81750006–4	8160 220 VAC WITHOUT HEAT EXCHANGER

8. DO NOT ATTACH S/N LABEL F/N (50) UNTIL J–BOX IS FINAL INSPECTED.
7. USE TEFLON TAPE ITEM (76) ON ALL PIPE THREADS.
△6 INTERNAL TOOTH STAR LOCK WASHER BETWEEN TERMINALS E1, E2, AND PLATE. BETWEEN SCREW AND PLATE AT UNPAINTED MOUNTING HOLES.
△5 DISCARD SCREWS SUPPLIED WITH RELAYS.
4. USE TIE WRAPS ITEM (71) TO DRESS UP INTERNAL WORKINGS OF J–BOX.
3.
2. PLUMBING DIAGRAM 81750009–1.
1. SCHEMATIC 81750007–1.

NOTES:

81600002	SM8160 MANUAL
81750003	SM8175 MANUAL
81751000	SM8175
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

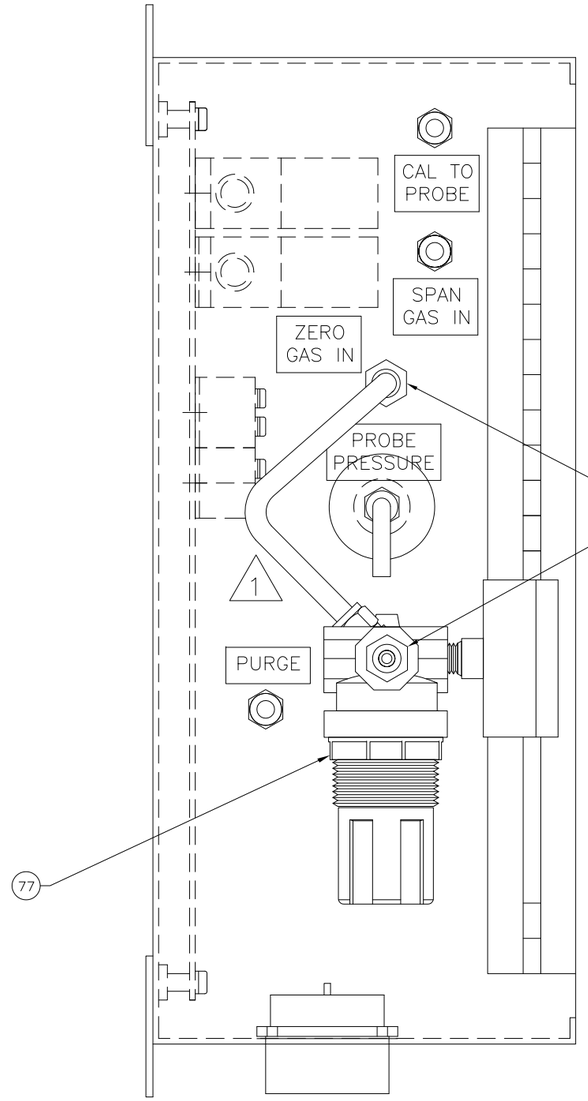
DRAWN BY CAD
DATE 9/23/08
FINISH – BREAK ALL SHARP EDGES 125
THIRD ANGLE PROJECTION

TELEDYNE MONITOR LABS
A Teledyne Technologies Company

J–BOX ASSEMBLY
SM8175

SIZE	CAGE CODE	DWG NO	REV
D		81750006	R

SCALE 1:1 SHEET 1 OF 11



FOR PART 60 APPLICATION:
CONNECT EXTERNAL PRESSURE REGULATOR TO THE "AIR IN" PORT AND CONNECT THE BRASS TUBE FROM PRESSURE REGULATOR TO "ZERO GAS IN" PORT.

FOR PART 75 APPLICATION:
CONNECT EXTERNAL PRESSURE REGULATOR TO THE "AIR IN" PORT AND CAP THE UNUSED TEE OUTPUT.

1. ASSEMBLE AS SHOWN. BAG BRASS PLUG FRACTIONAL FITTING AND TIE TO BRASS TUBE.

THIS VIEW IS FOR -1 & -2 ASSEMBLY

81600002	SM8160 MANUAL
81750003	SM8175 MANUAL
81751000	SM8175
NEXT ASSEMBLY	USED ON

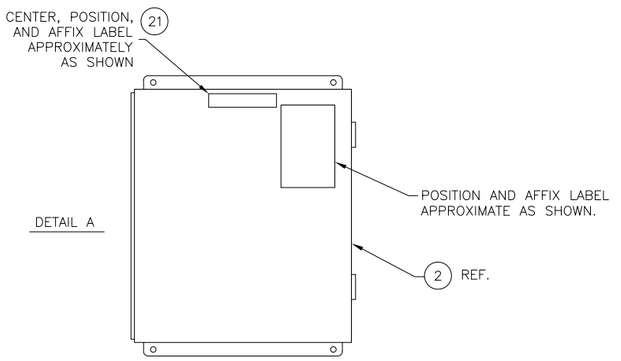
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES
TOLERANCE ON DECIMALS .X ± .1 .XX ± .02 .XXX ± .010
TOLERANCE ON ANGLES ± 0°30'
DO NOT SCALE DRAWING
MATERIAL
DRAWN BY CAD
DATE 9/23/08
FINISH – BREAK ALL SHARP EDGES 125
FINISH
THIRD ANGLE PROJECTION

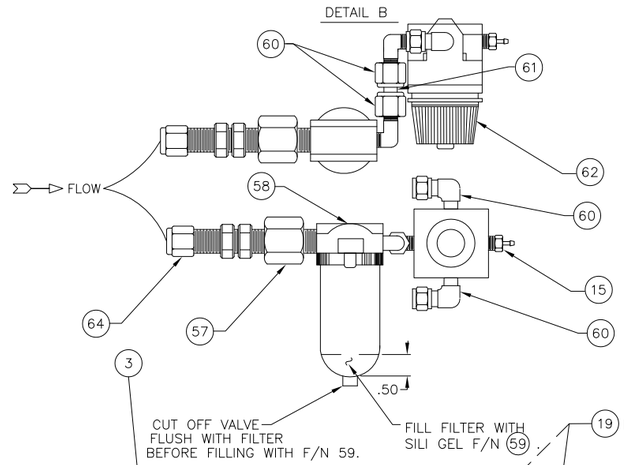
TELEDYNE MONITOR LABS
A Teledyne Technologies Company

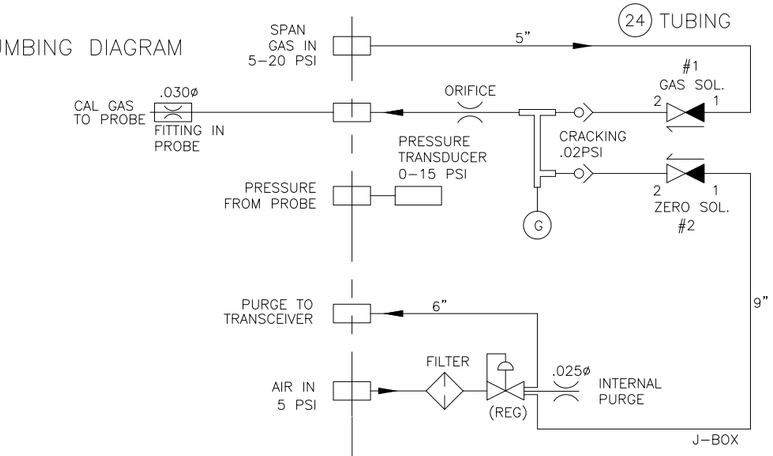
J-BOX ASSEMBLY
SM8175

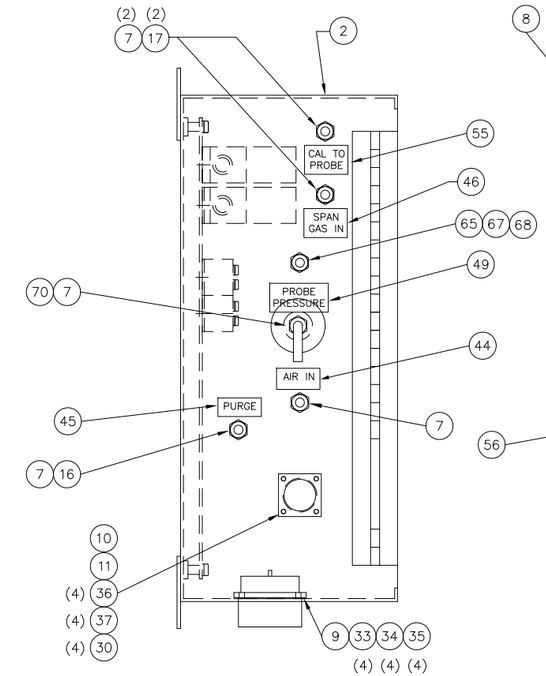
SIZE	CAGE CODE	DWG NO	REV
D		81750006	R

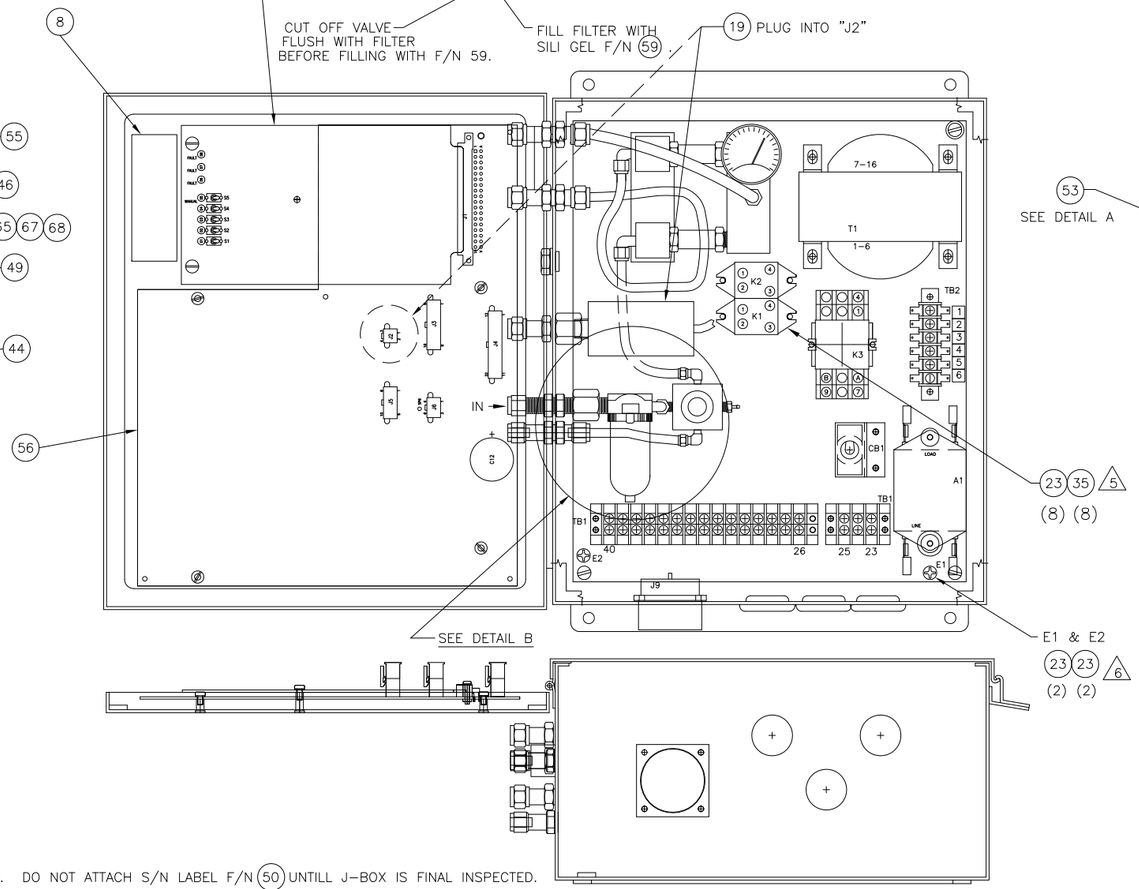
SCALE 1:1 SHEET 2 OF 11

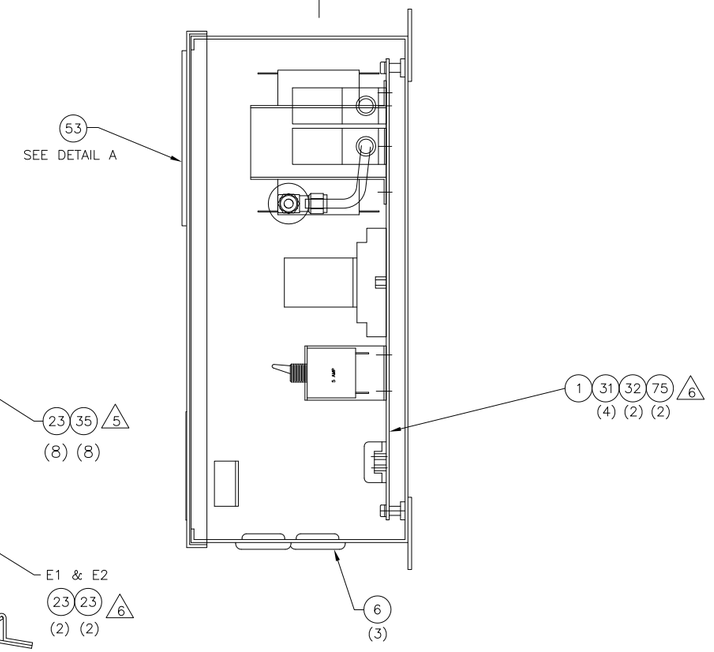


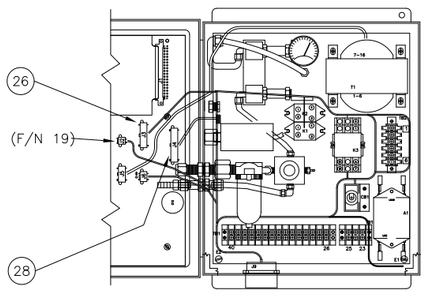












8. DO NOT ATTACH S/N LABEL F/N (50) UNTILL J–BOX IS FINAL INSPECTED.
7. USE TEFLON TAPE ITEM (76) ON ALL PIPE THREADS.
△6 INTERNAL TOOTH STAR LOCKWASHER BETWEEN TERMINALS E1, E2, AND PLATE. BETWEEN SCREW AND PLATE AT UNPAINTED MOUNTING HOLES.
△5 DISCARD SCREWS SUPPLIED WITH RELAYS.
4. USE TIE WRAPS ITEM (71) TO DRESS UP INTERNAL WORKINGS OF J–BOX.
3.
2. PLUMBING DIAGRAM 81750009–2.
1. SCHEMATIC 81750007–2.

NOTES:

THIS VIEW IS FOR –3 & –4 ASSEMBLY

81600002	SM8160 MANUAL
81750003	SM8175 MANUAL
81751000	SM8175
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 CAD
DATE 9/23/08
FINISH – BREAK ALL SHARP EDGES 125
THIRD ANGLE PROJECTION

TELEDYNE MONITOR LABS
A Teledyne Technologies Company

J–BOX ASSEMBLY
SM8175

SIZE	CAGE CODE	DWG NO	REV
D		81750006	R

SCALE 1:1 SHEET 3 OF 11

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	UNIT QTY				REFERENCE	TOTAL REQD.	STOCK ISSUED	SHORT QTY
			-1	-2	-3	-4				
1	81750004-3	MOUNTING PLATE ASSY 115VAC 8175	1	-	-	-				
1	81750004-4	MOUNTING PLATE ASSY 220VAC 8175	-	1	-	-				
1	81750004-1	MOUNTING PLATE ASSY 115VAC 8160	-	-	1	-				
1	81750004-2	MOUNTING PLATE ASSY 220VAC 8160	-	-	-	1				
2	81750008	J-BOX MODIFIED	1	1	1	1				
3	81750012	SDA PC ASSY	1	1	1	1				
4	81750015	UTILITY/PWR SUPPLY PC ASSY	1	1	-	-				
5	81750025	HEAT EXCHG TEMP CONT'L PC ASSY	1	1	-	-				
6	28000970-9	CAP PLUG 1 1/8	3	3	3	3				
7	28000380	WASHER, SEAL NEOPRENE 7/16	6	6	5	5				
8	81000985	LABEL, SWITCH	1	1	1	1				
9	80340086	GASKET, CONN.	1	1	1	1				
10	81750091	COVER PLATE	-	-	1	1				
11	81000281	GASKET, CONN.	1	1	1	1				
12	28990046-1	BULKHD UNION 1/4ø-1/4ø	2	2	-	-				
13	28990046-2	ELBOW UNION 1/4ø-1/4ø	1	1	-	-				
14	28990046-3	TEE, FEM RUN 1/4ø-1/8 NPT	1	1	-	-				
15	28001014-1	FITG, BARB 1/8 NPT W/.025ø ORIFICE	1	1	1	1				
16	28290400-1	BULKHD UNION 1/4ø-1/4ø	1	1	1	1				
17	28290400-3	BULKHD UNION 1/4ø-1/4ø TUBE - TUBE	2	2	2	2				
18										

TELEDYNE MONITOR LABS
A Teledyne Technologies Company

J-BOX ASSEMBLY
SM8175

SIZE	CAGE CODE	DWG NO	REV
A		81750006	R

SHEET 4 OF 11

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	UNIT QTY				REFERENCE	TOTAL REQD.	STOCK ISSUED	SHORT QTY
			-1	-2	-3	-4				
19	81001227-2	TRANSDUCER ASSY	1	1	1	1				
20										
21	81600017	LABEL, STANDING WATER	1	1	1	1				
22	036-040180	DFU	2	2	–	–				
23	6-32 X 1/4	SCREW, PAN HD PHILLIPS STAINLESS	9	9	8	8				
24	032-050260	TUBING, FEP 1/4 O.D.	26"	26"	34"	34"				
25										
26	81750028	CABLE ASSY, UTILITY/PS TO TERM BLOCK	1	1	1	1				
27	81750029	CABLE ASSY, UTILITY/PS TO TEMP CONTL	1	1	–	–				
28	81750030	CABLE ASSY, UTILITY/PS TO XCEIVER CON.	1	1	1	1				
29	81750031	CABLE ASSY, HEAT EXC CONN TO PCB	1	1	–	–				
30	#4	WASHER, LOCK	4	4	4	4				
31	10-32 x 3/8	SCREW, PAN HD	6	6	6	6				
32	#10	WASHER, LOCK	2	2	2	2				
33	6-32 x 7/16	SCREW, PAN HD	4	4	4	4				
34	6-32	NUT, HEX	4	4	4	4				
35	#6	WASHER, LOCK SPLIT STAINLESS	13	13	12	12				
36	4-40 x 3/8	SCREW, PAN HD	4	4	4	4				
37	4-40	NUT, HEX	4	4	4	4				

TELEDYNE MONITOR LABS
A Teledyne Technologies Company

J-BOX ASSEMBLY
SM8175

SIZE	CAGE CODE	DWG NO	REV
A		81750006	R

SHEET 5 OF 11

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	UNIT QTY				REFERENCE	TOTAL REQD.	STOCK ISSUED	SHORT QTY
			-1	-2	-3	-4				
38	81750032	COVER, TEMP CONTROL PCA	1	1	–	–				
39										
39										
40	21000320	TERMINAL, RING #6 22/16	15	15	15	15				
41	21000290	TERMINAL, Q.D. e 22/18	14	17	14	17				
42	21000119-3	TERMINAL, SPADE LK #6 22/16	5	5	5	5				
43	21000324	TERMINAL, Q.D. 1/4 22/18	11	12	11	12				
44	80340013-1	LABEL, AIR IN	1	1	1	1				
45	80340013-2	LABEL, PURGE	1	1	1	1				
46	80340013-14	LABEL, SPAN GAS IN	1	1	1	1				
47	80340013-17	LABEL, ZERO GAS IN	1	1	–	–				
48	80340013-18	LABEL, TO HEATER	1	1	–	–				
49	80340013-19	LABEL, PROBE PRESSURE	1	1	1	1				
50	009-004000	LABEL, S/N (SERIAL NUMBER) TML BLUE	1	1	1	1				
51	60000146	WIRE 18 AWG	A/R	A/R	A/R	A/R				
52	21000580-29	TERMINAL, RING #10 12/10	1	1	1	1				
53	80180300-30	LABEL, SM8175	1	1	–	–				
53	81600007	LABEL, MODEL SM8160, SMALL	–	–	1	1	(SHIP LOOSE)			
54	31000046	TUBE 1/4 I.D.	24"	24"	24"	24"				
55	80340013-9	LABEL, CAL TO PROBE	–	–	1	1				
56	81750015-2	UTILITY/POWER SUPPLY PC ASSY.	–	–	1	1				

TELEDYNE MONITOR LABS
A Teledyne Technologies Company

J-BOX ASSEMBLY
SM8175

SIZE	CAGE CODE	DWG NO	REV
A		81750006	R

SHEET 6 OF 11

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	UNIT QTY				REFERENCE	TOTAL REQD.	STOCK ISSUED	SHORT QTY
			-1	-2	-3	-4				
57	28820402-1	REDUCER 1/4 FEM X 1/8 MALE NPT	-	-	1	1				
58	26000073	AIR FILTER	-	-	1	1				
59	16000042	SILI. GEL	-	-	A/R	A/R				
60	28150402-1	MALE ELBOW 1/4 ø-1/8 NPT	-	-	4	4				
61	28430400-1	CONNECTOR PORT 1/4 O.D. TUBE	-	-	1	1				
62	28000339	REGULATOR	-	-	1	1				
63										
64	28140404-1	BULKHEAD FITTING 1/4 ø X 1/4 MALE NPT	-	-	1	1				
65	28001274-1	WASHER, NEO, 3/4" OD X .434 ID	-	-	1	1				
66										
67	28001275-406	BOLT, 3/8-16 X 3/4, SS	-	-	1	1				
68	28001276-108	LOCKNUT, 3/8-16	-	-	1	1				
69										
70	81750092	PRESSURE PORT TUBE	-	-	1	1				
71	060-060140	TIE WRAPS	28	28	30	30				
72										
73										
74	21000833-1	SOLDER SLEEVE	-	1	-	1				
75	#10 STAR	#10 INTERNAL TOOTH STAR LOCKWASHER STAINLESS	4	4	4	4				
76	028-090630	TAPE, 1/4" WIDE TEFLON	A/R	A/R	A/R	A/R				
77	81751225	EXT. PRESS. REGULATOR PART 60/75 TYPE	1	1	-	-				
78										
79										
80	TP8I000983	TEST PROCEDURE 81XX J-BOX	REF	REF	REF	REF				

TELEDYNE MONITOR LABS
A Teledyne Technologies Company

J-BOX ASSEMBLY
SM8175

SIZE	CAGE CODE	DWG NO	REV
A		81750006	R

SHEET 7 OF 11

WIRE LIST

WIRE NO	WIRE LG	WIRE COLOR	WIRE AWG/TYPE	FROM		TERM METHOD	TO		TERM METHOD	REMARKS
				UNIT	TERM		UNIT	TERM		
1	5.15"	BLK	18	TB1	23	F/N 40	A1	A1	F/N43	
2	5.5"	GRN	18	TB1	25	F/N 40	A1	C1	F/N43	
3	11.8"	GRN	18	TB1	25	F/N 40	E1			
4	15.1"	GRN	18	TB1	31	F/N 40	E1		F/N52	
5	16.8"	GRN	18	TB1	34	F/N 40	E1			
6	7.25"	WHT	18	TB1	24	F/N 40	A1	B1	F/N43	
7	11"	BLK	18	TB1	26	F/N 40	TB2	2	F/N41	
8	5"	RED	18	TB1	27	F/N 40	K3	7	F/N42	
9	5.25"	ORN	18	TB1	28	F/N 40	K3	9	F/N42	
10	5.5"	BLK	18	A1	A2	F/N43	CB1	1	F/N43	
11	8.25"	BLK	18	CB1	2	F/N43	TB2	1	F/N41	
12	6"	WHT	18	A1	B2	F/N43	TB2	4	F/N41	
13	3.5"	BRN	18	K1	2	F/N 40	K2	2	F/N40	
14	13.8"	WHT	18	K1	3	F/N 40	TB2	5	F/N41	
15	12.3"	WHT	18	K2	3	F/N 40	TB2	5	F/N41	
16	8.35"	WHT	18	K3	6	F/N 42	TB2	5	F/N41	
17	14.5"	BLK	18	SOL#1	1	F/N43	TB2	2	F/N41	
18	14.8"	BLK	18	SOL#2	1	F/N43	TB2	2	F/N41	
19	15"	GRY	18	SOL#1	2	F/N43	TB2	3	F/N41	

TELEDYNE MONITOR LABS
A Teledyne Technologies Company

J-BOX ASSEMBLY
SM8175

SIZE	CAGE CODE	DWG NO	REV
A		81750006 -1 -3	R

SHEET 8 OF 11

WIRE LIST

WIRE NO	WIRE LG	WIRE COLOR	WIRE AWG/TYPE	FROM		TERM METHOD	TO		TERM METHOD	REMARKS
				UNIT	TERM		UNIT	TERM		
20	12.5"	GRY	18	K1	4	F/N40	TB2	3	F/N41	
21	12.8"	VIO	18	K2	4	F/N40	TB2	6	F/N41	
22	15.5"	VIO	18	SOL#2	2	F/N43	TB2	6	F/N41	
23	7.6"	VIO	18	K3	1	F/N42	TB2	6	F/N41	
24	7.5"	GRY	18	K3	3	F/N42	TB2	3	F/N41	
25	4"	BRN	–	T1	–1	–	TB2	1	–	0V
26	4.25"	YEL	–	T1	–4	–	TB2	1	–	0V
27	4.75"	ORN	–	T1	–3	–	TB2	4	–	120V
28	5.25"	BLU	–	T1	–6	–	TB2	4	–	120V

TELEDYNE MONITOR LABS
A Teledyne Technologies Company

J–BOX ASSEMBLY
SM8175

SIZE	CAGE CODE	DWG NO	REV
A		81750006 –1 –3	R

SHEET 9 OF 11

WIRE LIST

WIRE NO	WIRE LG	WIRE COLOR	WIRE AWG/TYPE	FROM		TERM METHOD	TO		TERM METHOD	REMARKS
				UNIT	TERM		UNIT	TERM		
1	5.15"	BRN	18	TB1	23	F/N 40	A1	A1	F/N43	
2	5.5"	GRN/YEL	18	TB1	25	F/N 40	A1	C1	F/N43	
3	11.8"	GRN/YEL	18	TB1	25	F/N 40	E1			
4	15.1"	GRN	18	TB1	31	F/N 40	E1		F/N52	
5	16.8"	GRN	18	TB1	34	F/N 40	E1			
6	7.25"	BLU	18	TB1	24	F/N 40	A1	B1	F/N43	
7	11"	BLK	18	TB1	26	F/N 40	TB2	2	F/N41	
8	5"	RED	18	TB1	27	F/N 40	K3	7	F/N42	
9	5.25"	ORN	18	TB1	28	F/N 40	K3	9	F/N42	
10	5.5"	BRN	18	A1	A2	F/N43	CB1	1	F/N43	
11	8.25"	BRN	18	CB1	2	F/N43	TB2	1	F/N41	
12	6"	BLU	18	A1	B2	F/N43	CB1	3	F/N41	
13	3.5"	BRN	18	K1	2	F/N 40	K2	2	F/N40	
14	13.8"	WHT	18	K1	3	F/N 40	TB2	5	F/N41	
15	12.3"	WHT	18	K2	3	F/N 40	TB2	5	F/N41	
16	8.35"	WHT	18	K3	6	F/N 42	TB2	5	F/N41	
17	14.5"	BLK	18	SOL#1	1	F/N43	TB2	2	F/N41	
18	14.8"	BLK	18	SOL#2	1	F/N43	TB2	2	F/N41	
19	15"	GRY	18	SOL#1	2	F/N43	TB2	3	F/N41	

TELEDYNE MONITOR LABS
A Teledyne Technologies Company

J-BOX ASSEMBLY
SM8175

SIZE	CAGE CODE	DWG NO	REV
A		81750006 -2 -4	R

SHEET 10 OF 11

WIRE LIST

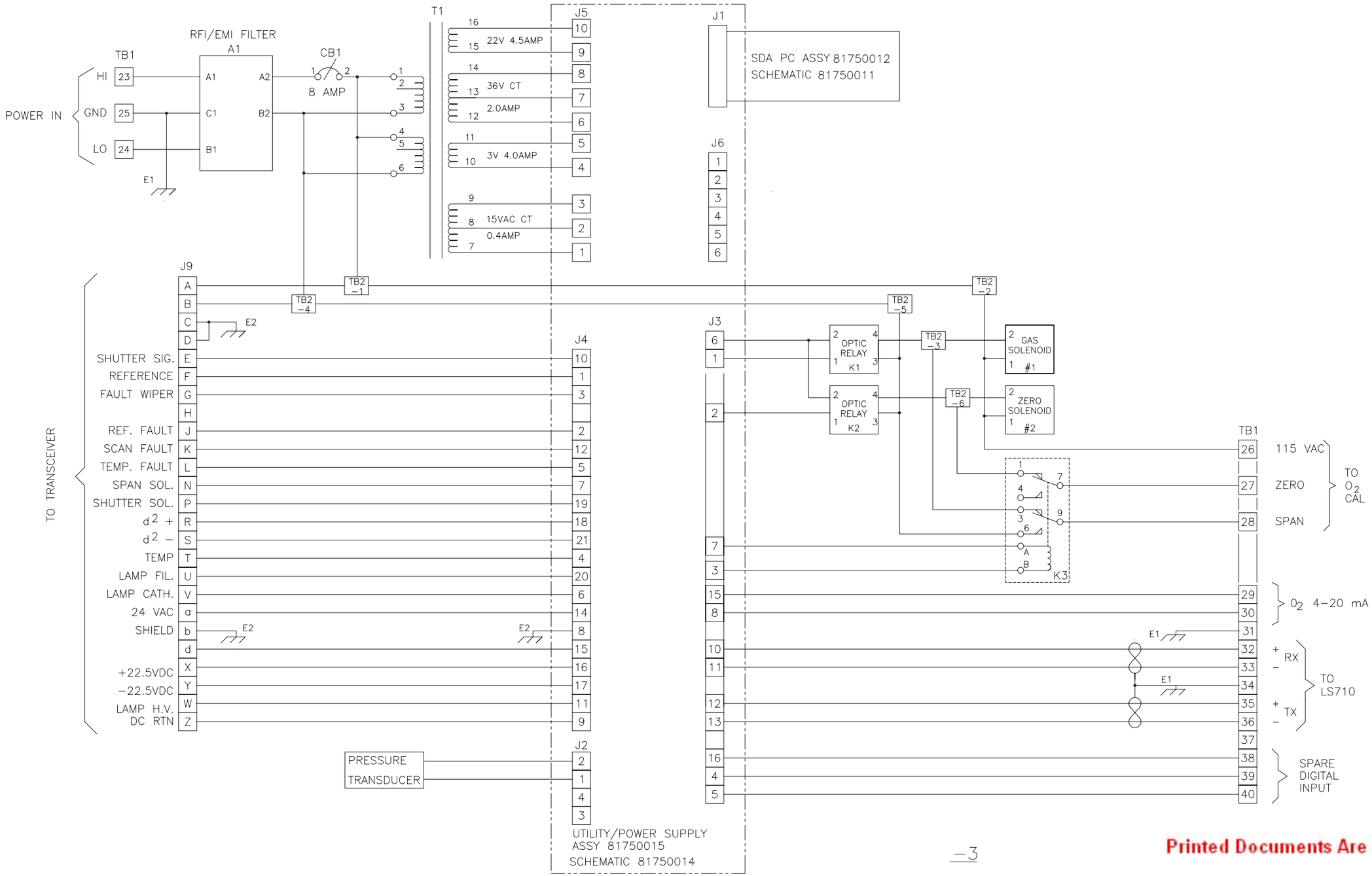
WIRE NO	WIRE LG	WIRE COLOR	WIRE AWG/TYPE	FROM		TERM METHOD	TO		TERM METHOD	REMARKS
				UNIT	TERM		UNIT	TERM		
20	12.5"	GRY	18	K1	4	F/N40	TB2	3	F/N41	
21	12.8"	VIO	18	K2	4	F/N40	TB2	6	F/N41	
22	15.5"	VIO	18	SOL#2	2	F/N43	TB2	6	F/N41	
23	7.6"	VIO	18	K3	1	F/N42	TB2	6	F/N41	
24	7.5"	GRY	18	K3	3	F/N42	TB2	3	F/N41	
25	4"	BRN	–	T1	–1	–	TB2	1	F/N41	
26	4.25"		–	T1	–4	–	T1	3	*	
27	4.75"	BLU	–	CB1	–4	F/N43	TB2	4	F/N41	
28	5.25"	BLU	–	T1	–6	–	TB2	4	F/N41	

* CUT TO THREE INCHES, STRIP 1/4" AND TERMINATE TOGETHER WITH F/N 74

TELEDYNE MONITOR LABS
A Teledyne Technologies Company

J–BOX ASSEMBLY
SM8175

SIZE	CAGE CODE	DWG NO	REV
A		81750006 –2 –4	R
		SHEET 11 OF 11	



Printed Documents Are UNCONTROLLED

FILENAME=E2000733

LTR.	DESCRIPTION	DATE	DRAWN	APPR
	REVISIONS			
D	ECO 6162– CHG SHEET 2 & 4 TO 220 VAC	02/07/01	CJR	MC
C	ECO 5762–ADD MANUAL # TO TITLE BLK	7/15/98	CJR	GWP
B	REVISED PER ECO 5199	12/18/96	DAC	GWP
A	RELEASE TO MFG PER ECO 4709	5/16/95	CJR	GWP
X2		4/15/94	FMM	

NEXT ASSEMBLY	USED ON
	81600002 SM8160 MANUAL
	SM8100B
81750006	8175

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 12/23/93
CHECKED BY GWP
PROJ. ENG. BY GW PRICE 5/23/95

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

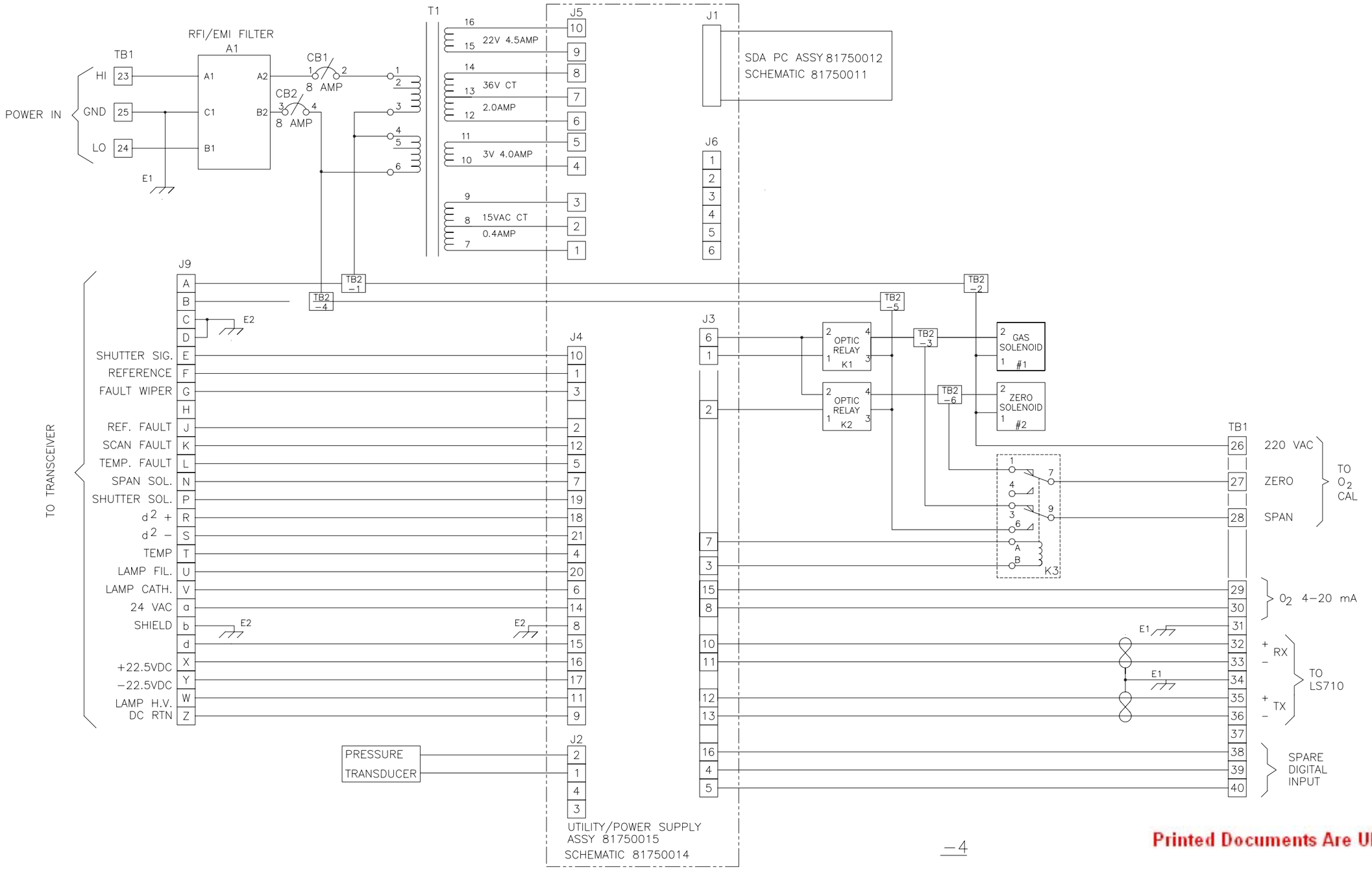
SCHEMATIC, J–BOX 8175, 115VAC WITHOUT HEAT EXCHANGER

SIZE	CAGE CODE	DWG NO	REV
D		81750007	D

SCALE

SHEET 3 OF 4

PLOTTED 01/02/1997 14:33:56



Printed Documents Are UNCONTROLLED

FILENAME=E2000744

LTR.	DESCRIPTION	DATE	DRAWN	APPR
	REVISIONS			
D	ECO 6162– CHG SHEET 2 & 4 TO 220 VAC	02/07/01	CJR	MC
C	ECO 5762–ADD MANUAL # TO TITLE BLK	7/15/98	CJR	GWP
B	REVISED PER ECO 5199	12/18/96	DAC	GWP
A	RELEASE TO MFG PER ECO 4709	5/16/95	CJR	GWP
X2		4/15/94	FMM	

NEXT ASSEMBLY	USED ON
	81600002 SM8160 MANUAL
	SM8100B
81750006	8175

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 12/23/93
CHECKED BY GWP
PROJ. ENG. BY GW PRICE 5/23/95

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

SCHEMATIC, J–BOX 8175, 220VAC WITHOUT HEAT EXCHANGER

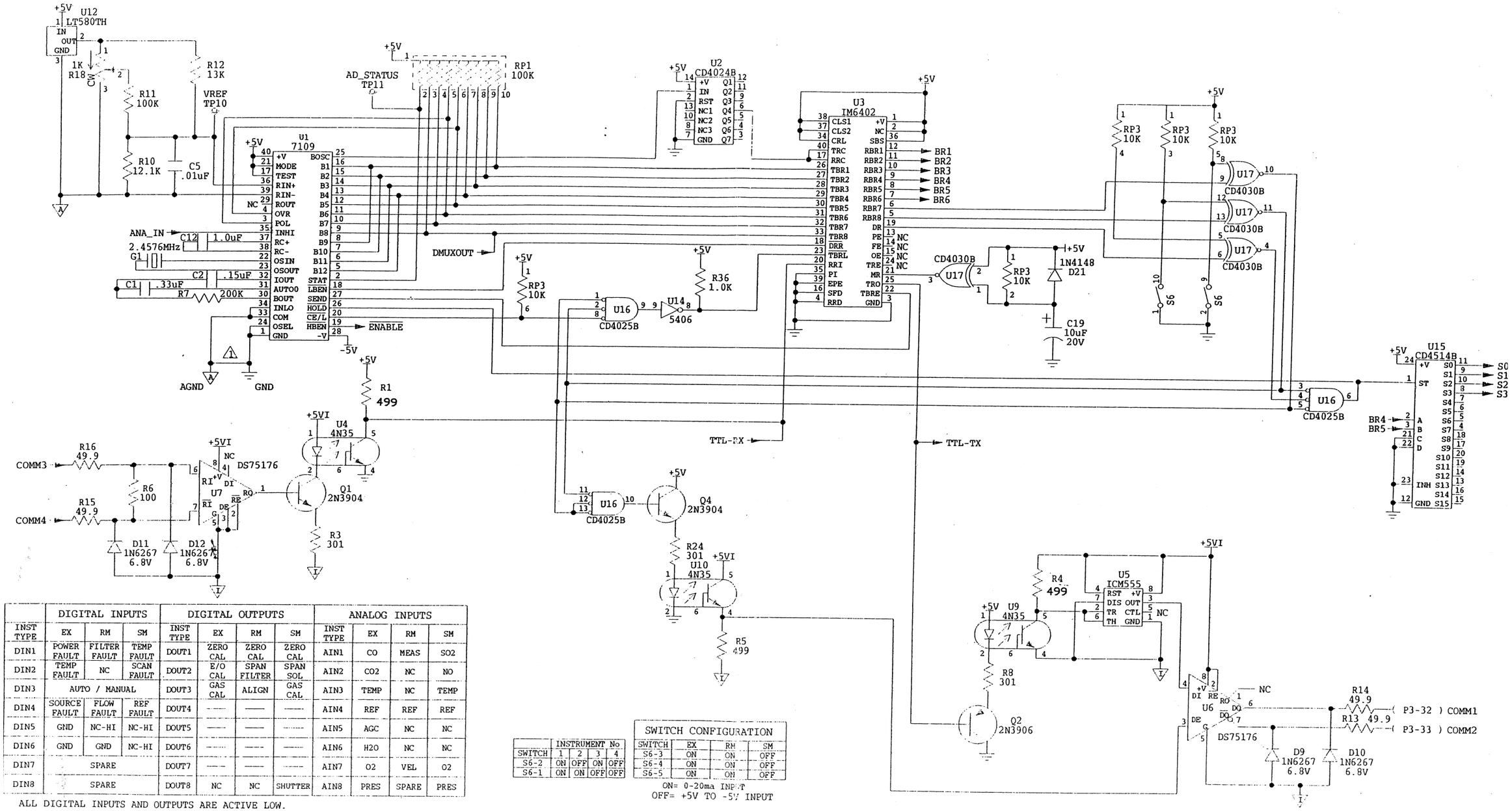
SIZE	CAGE CODE	DWG NO	REV
D		81750007	D

SCALE

SHEET 4 OF 4

PLOTTED 01/02/1997 14:36:15

REVISIONS					
REVISED BY: CAD	APPR. BY: JR	REV. G	5/9/08	SEE DCN 81750011G	FOR CHANGE DESC. REF ECO# 6727



	DIGITAL INPUTS			DIGITAL OUTPUTS				ANALOG INPUTS			
INST TYPE	EX	RM	SM	INST TYPE	EX	RM	SM	INST TYPE	EX	RM	SM
DIN1	POWER FAULT	FILTER FAULT	TEMP FAULT	DOUT1	ZERO CAL	ZERO CAL	ZERO CAL	AIN1	CO	MEAS	SO2
DIN2	TEMP FAULT	NC	SCAN FAULT	DOUT2	E/O CAL	SPAN FILTER	SPAN SOL	AIN2	CO2	NC	NO
DIN3	AUTO / MANUAL			DOUT3	GAS CAL	ALIGN	GAS CAL	AIN3	TEMP	NC	TEMP
DIN4	SOURCE FAULT	FLOW FAULT	REF FAULT	DOUT4	------	------	------	AIN4	REF	REF	REF
DIN5	GND	NC-HI	NC-HI	DOUT5	------	------	------	AIN5	AGC	NC	NC
DIN6	GND	GND	NC-HI	DOUT6	------	------	------	AIN6	H2O	NC	NC
DIN7	SPARE			DOUT7	------	------	------	AIN7	O2	VEL	O2
DIN8	SPARE			DOUT8	NC	NC	SHUTTER	AIN8	PRES	SPARE	PRES

ALL DIGITAL INPUTS AND OUTPUTS ARE ACTIVE LOW.

	INSTRUMENT No			
SWITCH	1	2	3	4
S6-2	ON	OFF	ON	OFF
S6-1	ON	ON	OFF	OFF

SWITCH CONFIGURATION			
SWITCH	EX	RM	SM
S6-3	ON	ON	OFF
S6-4	ON	ON	OFF
S6-5	ON	ON	OFF

ON= 0-20ma INPUT
OFF= +5V TO -5V INPUT

NOTES:

1. ANALOG AND DIGITAL GROUND ARE CONNECTED AT THIS SINGLE POINT BY CHANGING PIN 33 TO PINTYPE 3 AFTER ANALOG GROUND IS ROUTED.
2. RESISTOR VALUES ARE IN OHMS.
3. USED FOR P.C.B. NO. 81750010-2.

81600002	SM8160/8175 MAN	
81750003	EX4700 MANUAL	
80250257-1	UNICON 700	
81750012	SM8175	
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 CAD
DATE 5/9/08
FINISH — BREAK ALL SHARP EDGES 125
THIRD ANGLE PROJECTION

TELEDYNE INSTRUMENTS Monitor Labs
A Teledyne Technologies Company

SCHEMATIC, SERIAL DATA ACQUISITION BOARD

SIZE	CAGE CODE	DWG NO	REV
D		81750011	G
SCALE NONE		SHEET 1 OF 2	

REVISIONS

I.C. POWER NOT SHOWN AT SYMBOLS			
REFERENCE DESIGNATOR	TYPE	PIN=PWR	PIN=PWR
U17	CD4030	14=+5V	7=GND
U16	CD4025	14=+5V	7=GND
U14	7406	14=+5V	7=GND

P3BOT
GND 1
GND 2
AGND 3
TTL-TX 4 ► TTL-TX
TTL-RX 5 ◄ TTL-RX
DOUT3 6
COMM3 7 ◄ COMM3
COMM4 8 ◄ COMM4
COMM2 9 ◄ COMM2
COMM1 10 ◄ COMM1
RS422
11
DOUT2 12
DOUT1 13
14
16VAC 15
16VAC 16
AIN8 17 ► AIN8
DOUT8 18

P3TOP
GND A
GND B
AGND C
AIN7 D ► AIN7
AIN4 E ► AIN4
AIN3 F ► AIN3
AIN2 H ► AIN2
AIN6 J ► AIN6
AIN1 K ► AIN1
AIN5 L ► AIN5
DIN6 M ► DIN6
DIN5 N ► DIN5
DIN1 P ► DIN1
DIN4 R ► DIN4
DIN2 S ► DIN2
DIN3 T ► DIN3
SPARE U ► DIN7
SPARE V ► DIN8

1N4148 D19
1N4148 D20

BR6
R21 49.9
D3 SHUTTER MEASURE_NO
R17 100
R9 10K
S3
Q3 MJE800
S5
R32 499
D18 OPERATE
R20 100
D1 ZERO
R34 2.74K
R22 121
R33 649
D2 SPAN
R35 2.74K
D4 GAS
S0 ◄ U14 5406
S1 ◄ U14 5406
S2 ◄ U14 5406
S3 ◄ U14 5406
S4
S2
S1
D13 1N4001
D14 1N4001
D16 1N4001
D15 1N4001
D17 1N4148

+5V
R25 200K
R27 200K
R31 200K
R26 200K
R30 249
D8 FAULT
D5 MAN
D7 FAULT
D6 FAULT
R19 249
R29 249
R28 249
DIN1
DIN2
DIN3
DIN4
DIN5
DIN6
DIN7
DIN8
U13 CD4512B
X0 X1 X2 X3 X4 X5 X8 X7
+V Z INH OE A B C GND
RP3 10K
DMUXOUT
ENABLE

BR3
BR2
BR1
TP8 TP7 TP6 TP5 TP4 TP3 TP2 TP1
AIN1
AIN2
AIN3
AIN4
AIN5
AIN6
AIN7
AIN8
U11 DG508AAK
S1 S2 S3 S4 S5 S6 S7 S8
+V1 +V2 D EN A0 A1 A2 GND
+5V
RP3 10K
-5V
ANA_IN
R45 100
R44 100
R43 100
R42 100
R41 100
R40 100
R39 100
R38 100
PIN 1 OF RP2
R38-R45 ARE MOUNTED IN PLACE OF RP2

+5V TP14
R23 1.0K
+VUNREG
U19 MC78T05ABT
IN OUT GND
+5V
+5VI
+5VI TP13
U8 HPR100
+IN -IN +OUT -OUT
(U5) C7 0.1uF
(U7) C9 0.1uF
(U6) C8 0.1uF
ISOGND TP12
R2 1.0M
D22 KBL01
GND TP9
C27 2200uF 16V
C26 .33uF
C22 10uF 20V
C21 0.1uF
C25 2.2uF 30V
C24 100uF 16V
C23 .33uF
C20 0.1uF
GND
IN OUT
MC79L05ABP U18
-5V
R37 1.0K
TP15 -5V

+5V
(U17) C18 0.1uF
(U3) C13 .01uF
(U11) C10 .01uF
(U13) C14 .01uF
(U16) C17 0.1uF
(U15) C16 0.1uF
(U14) C15 0.1uF
(U1) C3 .01uF
(U2) C6 0.1uF
(U11) C11 .01uF
(U1) C4 .01uF
-5V

81600002	SM8160/8175 MAN
81750003	EX4700 MANUAL
80250257-1	UNICON 700
81750012	SM8175
NEXT ASSEMBLY	USED ON

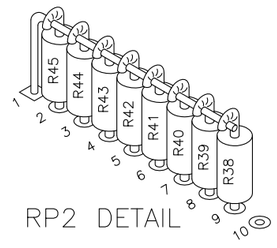
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES
TOLERANCE ON DECIMALS .X± .1 .XX± .02 .XXX± .010
TOLERANCE ON ANGLES ± 0°30'
DO NOT SCALE DRAWING
MATERIAL
DRAWN BY CAD
DATE 5/9/08
FINISH – BREAK ALL SHARP EDGES 125
FINISH
THIRD ANGLE PROJECTION

TELEDYNE INSTRUMENTS
Monitor Labs
A Teledyne Technologies Company

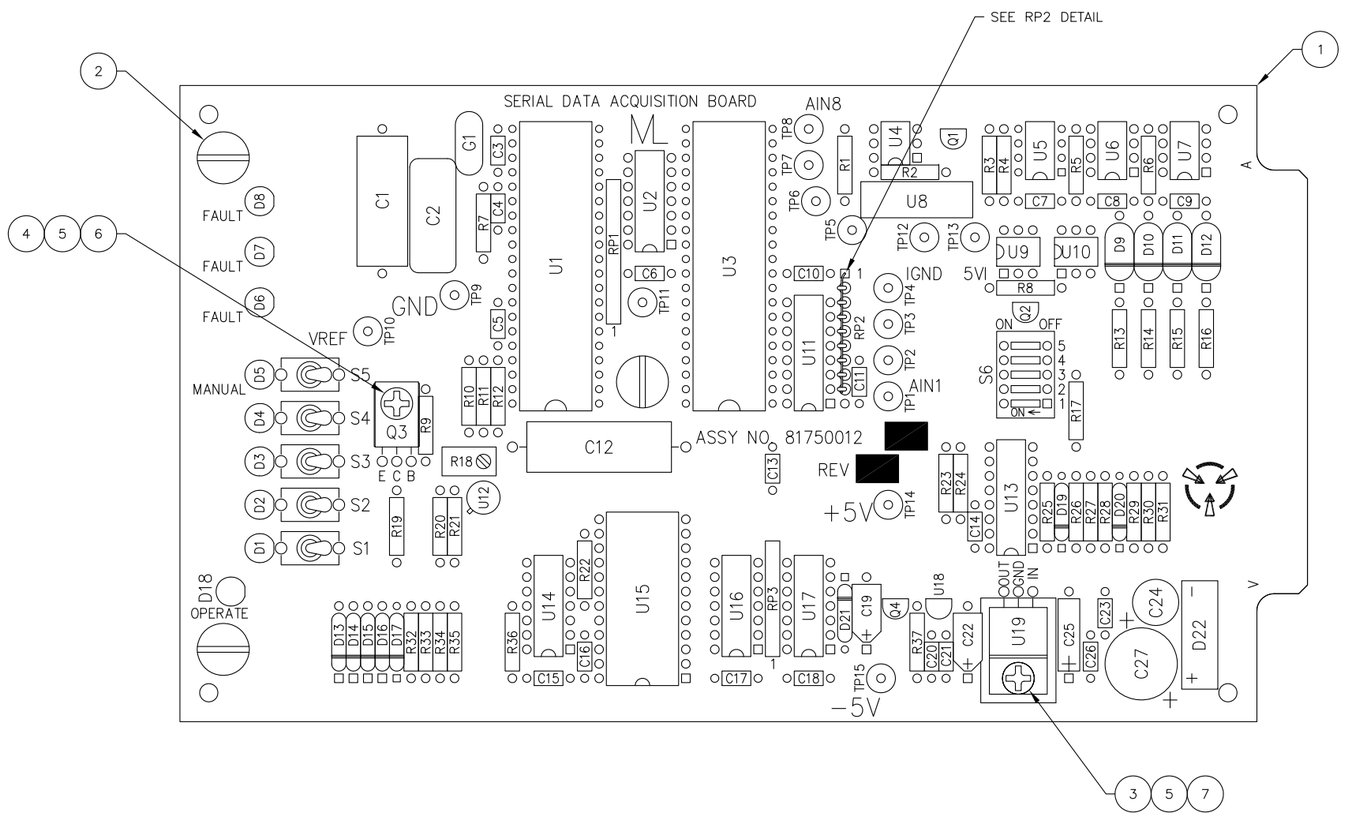
SCHEMATIC, SERIAL DATA ACQUISITION BOARD

SIZE	CAGE CODE	DWG NO	REV
D		81750011	G

SCALE NONE SHEET 2 OF 2



RP2 DETAIL



CROSS–REFERENCE CHART	
DESCRIPTION	DRAWING No.
P.C.B. FABRICATION	81750010–2
SCHEMATIC	81750011
P.C.B. ASSEMBLY PARTS LIST	THIS DWG.
P.C.B. DATABASE	———

5. SQUARE PAD INDICATES + SIDE OF CAPACITORS, CATHODE OF DIODES AND PIN 1 OF INTEGRATED CIRCUITS AND OTHER PARTS.
4. LEAD PROJECTION BELOW BOARD SURFACE SHALL BE .020 MIN .060 MAX.
3. IDENTIFY ASSEMBLY WITH ASSEMBLY NUMBER, DASH NUMBER, REVISION LETTER AND ECO NUMBER(S) IN ACCORDANCE WITH MONITOR LABS WORKMANSHIP STANDARDS MANUAL.
2. AFTER SOLDERING, CLEAN ASSEMBLY TO REMOVE ALL FLUX RESIDUE.
1. PART ATTACHMENT, WIRING, SOLDERING, CLEANING AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH MONITOR LABS INC. WORKMANSHIP STANDARDS MANUAL.

NOTES: UNLESS OTHERWISE SPECIFIED.

SEE SEPARATE PARTS LIST ON "A" SIZE

LTR.	DESCRIPTION	DATE	DRAWN	APPR
J	SEE DCN 81750012J; REF ECO# 6727	5/09/08	CAD	JR
H	SEE DCN 81750012H; REF ECO# 6613	9/01/06	CAD	KH
G	ECO 6250– CHG R1 & R4 TO 499	5/20/02	CJR	LS
F	ECO 5762–ADD MANUAL # TO TITLE BLK	7/15/98	CJR	GWP
E	ECO 5730–ADD MANUAL# TO TITLE BLK	5/8/98	CJR	GWP
C	ECO 5235 – U11 P/N WAS 31300233	11JUL97	JDP	GWP
C	REVISED PER ECO 4833	09/04/95	JDP	GWP
B	REVISED PER ECO 4335	06/24/94	MLS	RLS
A	RELEASE TO MFG PER ECO 4328	04/22/94	JDP	RLS

REVISIONS

NEXT ASSEMBLY	USED ON
	81600002 SM8160 MANUAL
	81750003 SM8175 MANUAL
	80250257–1 EX4700A MANUAL
8175	8175

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	PHILLIPS	04/25/94
CHECKED	SEELEY	04/25/94
PROJ. ENG.	SEELEY	04/25/94

TELEDYNE INSTRUMENTS
Monitor Labs
A Teledyne Technologies Company

P.C.B. ASSEMBLY
SERIAL DATA
ACQUISITION BOARD

SIZE	CAGE CODE	DWG NO	REV
D		81750012	J

SCALE 2:1 SHEET 1 OF 5

LIST OF MATERIAL

FIND No.	QTY	REFERENCE-DESIGNATOR	PART NUMBER	DESCRIPTION
1	1		81750010-2	PRINTED CIRCUIT BOARD
1	3		28001238-4	SCREW, #6 CAPTIVE
3	1	U19	28001188-31	SCREW, M3x6 PH W/LW
4	1	Q3	28001188-32	SCREW, M3x8 PH W/LW
5	2	Q3 U19	28001187-8	NUT, M3 PRESSNUT
6	1	Q3	25000459	INSULATOR, FOR CASE #77
7	1	U19	31000105	INSULATOR, FOR TO-220 PKG
	1	U15	21000552	SOCKET, 24 PIN I.C.
	2	U6 U7	21000709-1	SOCKET, 8 PIN I.C.
	1	U11	21000709-3	SOCKET, 16 PIN I.C.
	2	U1 U3	21000512	SOCKET, 40 PIN I.C.
	15	TP9 TP15 TP14 TP1 TP2 TP3 TP4 TP5 TP6 TP7 TP8 TP11 TP13 TP10 TP12	021-070280	TERMINAL, TURRET
	1	C24	015-010470	CAPACITOR, 100uF 16V ELECT
	2	C22 C19	15000342	CAPACITOR, 10uF 20V TANTALUM
	1	C25	15000167	CAPACITOR, 2.2uF 30V TANTALUM
	1	C12	15000042	CAPACITOR, 1.0uF 50V MYLAR

LIST OF MATERIAL

FIND No.	QTY	REFERENCE-DESIGNATOR	PART NUMBER	DESCRIPTION
	2	C23 C26	15000344	CAPACITOR, .33uF 50V CERAMIC Z5U
	1	C1	15000240	CAPACITOR, .33uF 50V MYLAR
	1	C2	15000376	CAPACITOR, .15uF 50V POLYPROPYLENE
	10	C21 C20 C8 C17 C15 C16 C18 C7 C6 C9	15000336	CAPACITOR, 0.1uF 50V CERAMIC Z5U
	7	C5 C14 C3 C10 C11 C4 C13	15000339	CAPACITOR, .01uF 50V CERAMIC X7R
	1	C27	15000375	CAPACITOR, 2200uF 16V ELECTROLYTIC
	1	R2	47151004	RESISTOR, 1.0M .125W 1% FILM
	5	R26 R31 R27 R25 R7	47152003	RESISTOR, 200K .125W 1% FILM
	1	R11	47151003	RESISTOR, 100K .125W 1% FILM
	1	R12	47151302	RESISTOR, 13K .125W 1% FILM
	1	R10	47151212	RESISTOR, 12.1K .125W 1% FILM
	1	R9	47151002	RESISTOR, 10K .125W 1% FILM
	2	R34 R35	47152741	RESISTOR, 2.74K .125W 1% FILM
	3	R23 R37 R36	47151001	RESISTOR, 1.0K .125W 1% FILM
	1	R33	47156490	RESISTOR, 649 .125W 1% FILM
	4	R32 R5 R4 R1	47154990	RESISTOR, 499 .125W 1% FILM
	3	R8 R3 R24	47153010	RESISTOR, 301 .125W 1% FILM

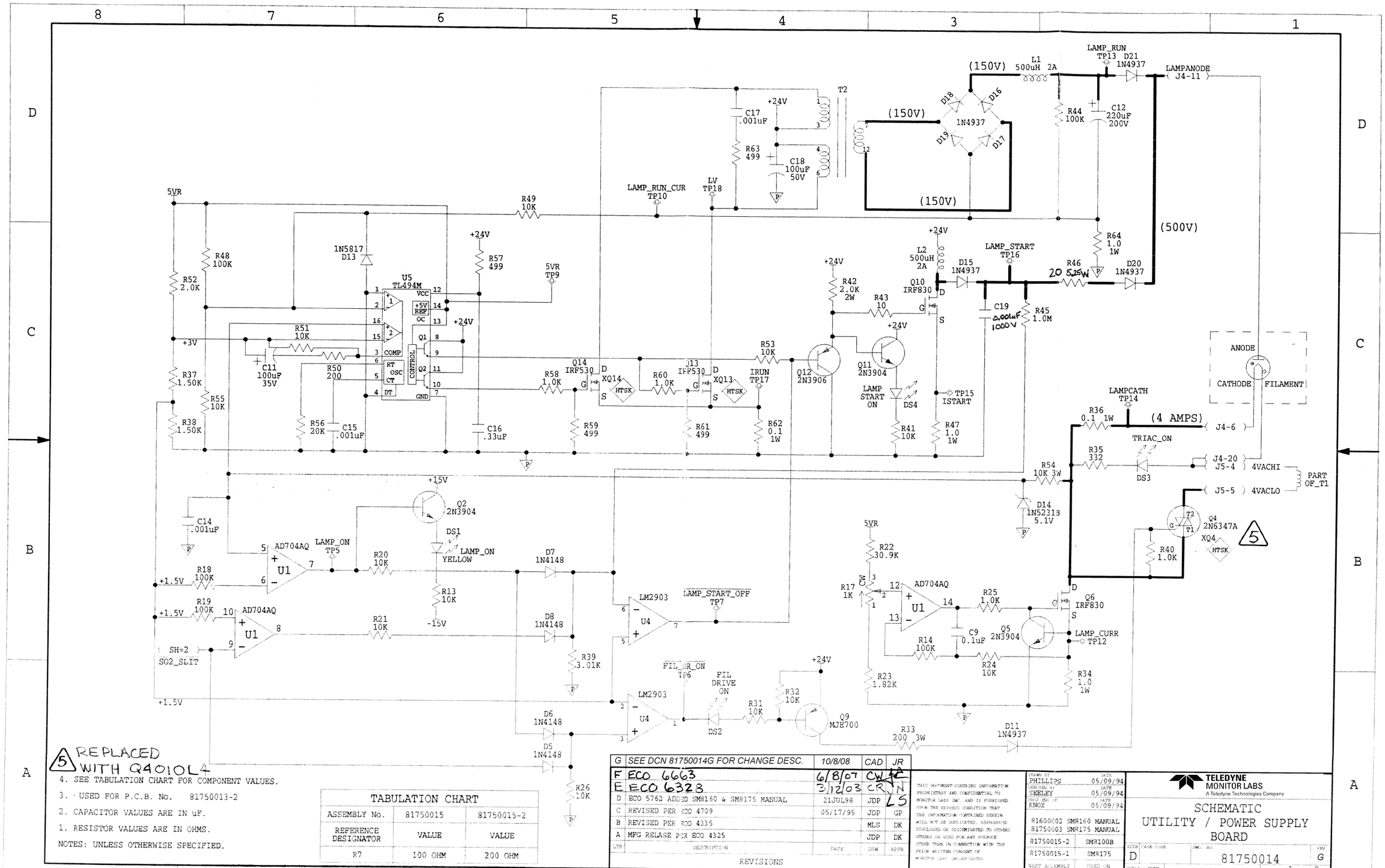
LIST OF MATERIAL

FIND No.	QTY	REFERENCE-DESIGNATOR	PART NUMBER	DESCRIPTION
	4	R28 R29 R19 R30	47152490	RESISTOR, 249 .125W 1% FILM
	1	R22	47151210	RESISTOR, 121 .125W 1% FILM
	3	R17 R20 R6	47151000	RESISTOR, 100 .125W 1% FILM
	8	R38 THRU R45	47141000	RESISTOR, 100 .125W .1% 25ppm
	5	R21 R14 R13 R16 R15	471549R9	RESISTOR, 49.9 .125W 1% FILM
	1	R18	47500114	RESISTOR, VARIABLE 1K 20 TURN CERMET
	1	RP1	47490156	RESISTOR, NETWORK 100K .125W 2% FILM
	1	RP3	47490186	RESISTOR, NETWORK 10K .2W 2% FILM
	4	D16 D15 D13 D14	48000046	DIODE, 1N4001 RECTIFIER
	4	D17 D21 D19 D20	48000035	DIODE, 1N4148 SIGNAL
	4	D10 D9 D11 D12	48000160	DIODE, 1N6267 6.8V ZENER (TVS)
	9	D1 D5 D7 D6 D2 D3 D4 D18 D8	48000130	DIODE, RED L.E.D.
	3	U9 U4 U10	042-130090	I.C., 4N35 OPTO-ISOLATOR,
	1	U14	31300431	I.C., 5406 HEX INVERTER
	1	U2	31300113	I.C., CD4024B 7 STAGE BINARY COUNTER
	1	U16	31300223	I.C., CD4025B 3 INPUT NOR
	1	U17	31300066	I.C., CD4030B EXCLUSIVE OR

LIST OF MATERIAL

FIND No.	QTY	REFERENCE-DESIGNATOR	PART NUMBER	DESCRIPTION
	1	U13	31300298	I.C., CD4512B 8 CH. SERIAL DATA SELECTOR,
	1	U15	31300301	I.C., CD4514B 4 BIT LATCHED DECODER
	1	U11	31300233-2	I.C., DG508A 8 CH. MULTIPLEXER
	2	U6 U7	19000002	I.C., DS75176 RS-422 TRANSCEIVER
	1	U1	31300299-2	I.C., 7109 12 BIT A/D CONVERTER
	1	U5	031-030840	I.C., ICM555 CMOS TIMER
	1	U3	31300348	I.C., IM6402 CMOS U.A.R.T.
	1	U12	31300427	I.C., LT580TH PRECISION REFERENCE 2.5V
	1	U19	40000169	I.C., MC78T05ABT REGULATOR, +5V
	1	U18	40000170	I.C., MC79L05ABP REGULATOR, -5V
	2	Q1 Q4	48000157	TRANSISTOR, 2N3904, NPN
	1	Q2	048-080120	TRANSISTOR, 2N3906, PNP
	1	Q3	48000099	TRANSISTOR, MJE800 DARLINGTON
	5	S3 S2 S1 S5 S4	51000402	SWITCH, SPDT, TINY TOGGLE, VERTICAL PCB MOUNT
	1	U8	40000168	CONVERTER, HPR100, .75W(150ma) 5V DC/DC
	1	D22	48000188	BRIDGE, KBL01 RECTIFIER
	1	S6	51000401	SWITCH, SPST DIP SLIDE, 5 POSITION
	1	G1	23000011	CRYSTAL, 2.4576MHz

Teledyne Monitor Labs Incorporated | Drawn Sharp | Checked | Proj. Engr. | Date 11JUL97 | Date | Date | Title: PARTS LIST, SERIAL DATA AQUISITION BOARD | Filename | Drawing No. 81750012 | Revision J | Sheet 5 of 5



5 REPLACED WITH Q4010L4

4. SEE TABULATION CHART FOR COMPONENT VALUES.
3. USED FOR P.C.B. No. 81750013-2
2. CAPACITOR VALUES ARE IN uF.
1. RESISTOR VALUES ARE IN OHMS.

NOTES: UNLESS OTHERWISE SPECIFIED.

TABULATION CHART

ASSEMBLY No.	81750015	81750015-2
REFERENCE DESIGNATOR	VALUE	VALUE
R7	100 OHM	200 OHM

REVISIONS

LTR	DESCRIPTION	DATE	DRW	APPR
G	SEE DCN 81750014G FOR CHANGE DESC.	10/8/08	CAD	JR
F	ECO 6663	6/8/07	CW	
E	ECO 6328	3/12/03	CR	LS
D	ECO 5762 ADDED SM8160 & SM8175 MANUAL	21JUL98	JDP	
C	REVISED PER ECO 4709	05/17/95	JDP	GP
B	REVISED PER ECO 4335		MLS	DK
A	MFG RELASE PER ECO 4325		JDP	DK

DRAWN BY	PHILLIPS	DATE 05/09/94
CHECKED BY	SEELEY	DATE 05/09/94
PROJ ENG BY	KNOX	DATE 05/09/94
81600002 SM8160 MANUAL		
81750003 SM8175 MANUAL		
81750015-2	SM8100B	
81750015-1	SM8175	
NEXT ASSEMBLY		USED ON

TELEDYNE MONITOR LABS
A Teledyne Technologies Company

SCHEMATIC UTILITY / POWER SUPPLY BOARD

SIZE D | CAGE CODE | DWG. NO. 81750014 | REV G
SCALE = NONE | SHEET 1 OF 2

D2 0.2 Hz LOW PASS FILTER

I.C. POWER NOT SHOWN AT SYMBOLS			
REFERENCE DESIGNATOR	TYPE	PIN=PWR	PIN=PWR
U1	AD704AQ	4=+15V	11=-15V
U4	LM2903	8=+15V	4=PGND

D2+ (J4-18)
R6 1.0M
R3 1.0M
R7 SEE NOTE 4
C2 1.0uF
C1 1.0uF
AD704AQ U1
R5 1.0K
R4 10K
D1 LT1029M. (OR EQUIVALENT), 5V REF.
R8 10K
AIN1

ANALOG GROUND PLANE

(J4-16) +22.5V
R10 1.0K
R9 10
Q1 2N3904
+15V TP2
C4 2200uF 35V
D2 1N965 15V
C3 10uF 20V
(U2) C5 .33uF
TGND TP4
TGND
JP2 JUMPER
D4 1N965 15V
C7 10uF 20V
(U2) C6 .33uF
-15V TP3
Q3 2N3906
C8 2200uF 35V
R12 1.0K
R11 10
-22.5V (J4-17)

T1 120V/240V
J5
TGND
36VACHI
D3 KBL01
+24V TP8
+24V
22VACHI
D12 KBL01
C10 8200uF 50V
(U1) C13 .33uF
PGND TP11
22VACLO
36VACLO
(SH=1) 4VACHI
(SH=1) 4VACLO

PRESSURE TRANSDUCER
J2
AIN8
+22.5V
SP4
1 PRESSURE
2 TRANSDUCER POWER
3 NC
4 NC

HEAT EXCHANGER
J6
AIN3
SP6
1
2 HEAT EXCH CNTLR RETURN
3 HEAT EXCH SET POINT
4 HEAT EXCH CNTLR POWER
5 NC
6 NC

AIN3
TRANSCEIVER
J4
AIN4
R2 9.09K
R1 2.05K
DIN4
AIN3
DIN1
LAMPCATH
SP5
LAMPANODE
DIN2
DIN3
+24V
+22.5V
-22.5V
D2+
1 REFERENCE
2 REF FAULT
3 FAULT WIPER
4 TEMP
5 TEMP FAULT
6 LAMP CATHODE
7 SPAN SOLENOID
8
9 DC RETURN
10 SHUTTER SIGNAL/SPARE
11 LAMP ANODE
12 SCAN FAULT
13 SPARE DIGITAL INPUT 3
14 SOLENOID POWER
15 NC
16 +22.5V
17 -22.5V
18 D2+
19 SHUTTER SOLENOID
20 LAMP FILAMENT
21 D2-
22 NC

SDA BOARD
J1
AGND TP1
GND 1
GND 2
AGND 3
TTL-TX 4
TTL-RX 5
DOUT3 6
(RX-) COMM3 7
(RX+) COMM4 8
(TX-) COMM2 9
(TX+) COMM1 10
NC 11
DOUT2 12
DOUT1 13
+VUNREG 14
15VACHI 15
15VACLO 16
AIN8 17
DOUT8 18
GND A
GND B
AGND C
AIN7 D
AIN4 E
AIN3 F
AIN2 H
AIN6 J
AIN1 K
AIN5 L
DIN6 M
DIN5 N
DIN1 P
DIN4 R
DIN2 S
DIN3 T
DIN7 U
DIN8 V
SP1 TTL-TX
SP2 TTL-RX
SP3
+VUNREG
DOUT8
AIN7
AIN4
AIN3
AIN1
AIN5
DIN1
DIN4
DIN2
DIN3
DIN7
DIN8
DIGITAL OUT BUS
DOUT3
COMM3
COMM4
COMM2
COMM1
DOUT2
DOUT1
ANALOG IN BUS
DIGITAL IN BUS
RS422BUS
JP1 JUMPER
LOOP_RTN

SHUTTER DRIVE
+VUNREG
U3 5VR 4N35
R16 1.0K
R30 10K
R29 2.0K
(SH=1) SO2_SLIT
+24V
D10 1N4004
Q8 MJE800
DOUT8

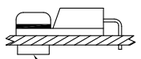
SPANDRIVE
+VUNREG
U2 5VR 4N35
R15 1.0K
R28 10K
R27 2.0K
+24V
D9 1N4004
Q7 MJE800
DOUT2

LS710/CAL CONTROL
J3
DOUT3
DOUT1
DIN7
DIN8
+VUNREG
+24V
COMM1
COMM2
COMM3
COMM4
AIN7
1 OPTIC RELAY
2 OPTIC RELAY
3 RELAY
4 SPARE DIGITAL INPUT 7
5 SPARE DIGITAL INPUT 8
6 OPTIC RELAY POWER
7 RELAY POWER
8 O2-
9 ESD GUARD (NC)
10 COMM1
11 COMM2
12 COMM3
13 COMM4
14 ESD GUARD (NC)
15 O2+
16 SPARE DIG. INPUTS GND

SIZE	CAGE CODE	DWG. NO.	REV
D		81750014	G
SCALE: NONE		SHEET 2 OF 2	

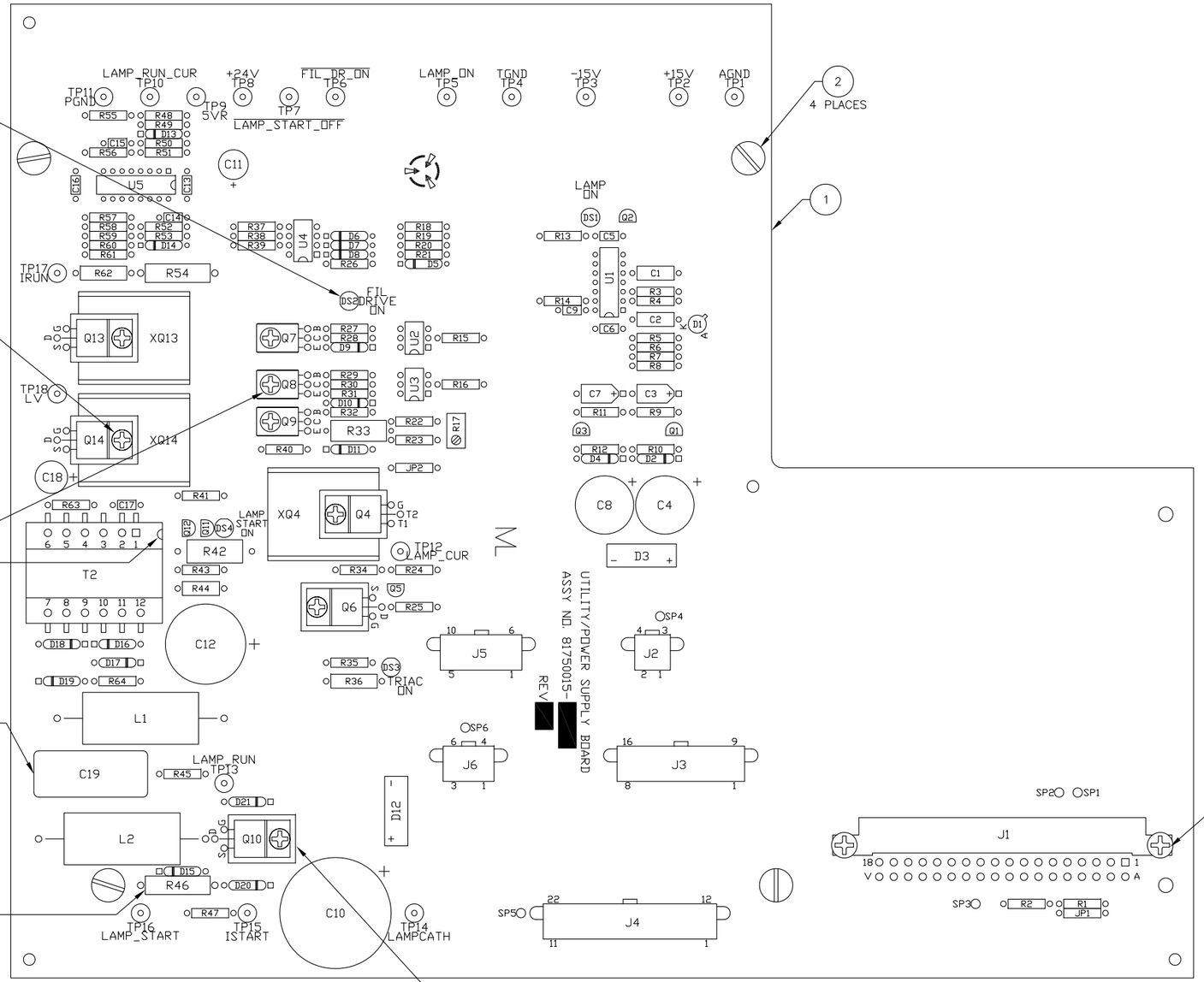
SHORT LEAD TO SQUARE PAD

DETAIL A



SCREW THREADS NOT REQUIRED TO PROTRUDE THROUGH PEM FASTENER

SEE DETAIL A 4 PLACES



VERSION TABULATION CHART	
PART OR ASSY No.	DESCRIPTION
81750015	FOR USE IN SM8175 UNIT
81750015-2	FOR USE IN SM8100B UNIT

CROSS-REFERENCE CHART	
DESCRIPTION	DRAWING No.
P.C.B. FABRICATION	81750013-2
SCHEMATIC	81750014
P.C.B. ASSEMBLY PARTS LIST PARTS LIST -2	THIS DWG. THIS DWG.
P.C.B. DATABASE	———
PC-DRC DESIGN RULES CHECK REPORT	
PC-ECO PCB/SCH COMPARISON REPORT	

NOTES: UNLESS OTHERWISE SPECIFIED.

1. PART ATTACHMENT, WIRING, SOLDERING, CLEANING AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH MONITOR LABS INC. WORKMANSHIP STANDARDS MANUAL.
2. AFTER SOLDERING, CLEAN ASSEMBLY TO REMOVE ALL FLUX RESIDUE.
3. IDENTIFY ASSEMBLY WITH ASSEMBLY NUMBER, DASH NUMBER, REVISION LETTER AND ECO NUMBER(S) IN ACCORDANCE WITH MONITOR LABS WORKMANSHIP STANDARDS MANUAL.
4. LEAD PROJECTION BELOW BOARD SURFACE SHALL BE .020 MIN .060 MAX.
5. SQUARE PAD INDICATES + SIDE OF CAPACITORS, CATHODE OF DIODES AND PIN 1 OF INTEGRATED CIRCUITS AND OTHER PARTS.
6. THESE "HIGHER" WATTAGE RESISTORS MUST BE STOOD OFF FROM THE PCB 1/8" TO 1/4" (UNDER RESISTOR). BEND LEADS AS REQUIRED AS SHOWN.

7 PIN 1 OF TRANSFORMER INDICATED BY NOTCH ON BOBBIN.

8 ADD 1/2" LENGTH OF TEFLON INSULATION TUBING TO CAPACITOR LEADS.

LTR.	DESCRIPTION	DATE	DRAWN	APVD
K	SEE DCN 81750015K; REF ECO #6770	10/08/08	CAD	JR
J	SEE DCN 81750015J; REF ECO #6663	06/11/07	CLW	JR
H	SEE DCN 81750015H; REF ECO# 6570	8/29/06	CAD	KH
G	ADD NOTE 7 -- ECO 6526	11-29-05	KEH	
F	ECO 6378 ADD NOTE 6,REMOVE REF TO -1	8/18/03	CJR	
E	ECO 5762-ADD MANUAL # TO TITLE BLK	7/15/98	CJR	LS
D	REVISED PER ECO 5132	11/4/96	DAC	GWP
C	REVISED PER ECO 4709	05/17/95	JDP	GWP
B	REVISED PER ECO 4335	06/24/94	MLS	DK
A	RELEASE TO MFG PER ECO 4325	05/09/94	JDP	DK

REVISIONS

SEE SEPARATE PARTS LIST ON "A" SIZE

NEXT ASSEMBLY	USED ON
	81600002 SM8160 MANUAL
	81750003 SM8175 MANUAL
	SM8100B
	8175

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	PHILLIPS	05/09/94
CHECKED	SEELEY	05/09/94
PROJ. ENG.	KNOX	05/09/94

TELEDYNE MONITOR LABS
A Teledyne Technologies Company

P.C.B. ASSEMBLY
UTILITY / POWER SUPPLY
BOARD

SIZE	CAGE CODE	DWG NO	REV
D		81750015	K

SCALE 1.5:1 SHEET 1 OF 5

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	QTY. REQ. PER ASSY					REFERENCE-DESIGNATOR
			NO DASH	-2				
1	81750013-2	PRINTED CIRCUIT BOARD	1	1				
2	28001238-4	SCREW, #6 CAPTIVE	4	4				
3	28001188-32	SCREW, M3 X 8 PH W/LW	6	6				Q4 Q7 Q8 Q9 Q13 Q14
4	28001188-31	SCREW, M3 X 6 PH W/LW	2	2				Q6 Q10
5	28001197-314	SCREW, M3 X 14 PH	2	2				J1
6	28001187-8	NUT, M3 PRESSNUT	10	10				Q4 Q6 Q7 Q8 Q9 Q10 Q13 Q14 J1
7	28001194-1	WASHER, M3 LOCK	2	2				J1
8	31000105	INSULATOR, FOR TO-220 PKG	5	5				Q4 Q6 Q10 Q13 Q14
9	25000459	INSULATOR, FOR CASE #77	3	3				Q7 Q8 Q9
10	28001189-4	WASHER, M3 FLAT	2	2				J1
	47151004	RESISTOR, 1.0M .125W 1% FILM	3	3				R3 R6 R45
	47151003	RESISTOR, 100K .125W 1% FILM	4	4				R48 R18 R14 R19
	47153092	RESISTOR, 30.9K .125W 1% FILM	1	1				R22
	47152002	RESISTOR, 20K .125W 1% FILM	1	1				R56
	47151002	RESISTOR, 10K .125W 1% FILM	16	16				R28 R4 R8 R55 R51 R21 R20 R49
								R26 R53 R31 R32 R24 R13 R30 R41
	47159091	RESISTOR, 9.09K .125W 1% FILM	1	1				R2
	47153011	RESISTOR, 3.01K .125W 1% FILM	1	1				R39
	47152051	RESISTOR, 2.05K .125W 1% FILM	1	1				R1
	47152001	RESISTOR, 2.0K .125W 1% FILM	3	3				R27 R29 R52
	47151821	RESISTOR, 1.82K .125W 1% FILM	1	1				R23
	47151501	RESISTOR, 1.50K .125W 1% FILM	2	2				R38 R37
	47151001	RESISTOR, 1.0K .125W 1% FILM	9	9				R15 R16 R12 R10 R60 R58
								R25 R40 R5
	47154990	RESISTOR, 499 .125W 1% FILM	4	4				R61 R59 R63 R57

TELEDYNE MONITOR LABS
A Teledyne Technologies Company

PARTS LIST
UTILITY P/S BOARD

SIZE	CAGE CODE	DWG NO	REV
A		81750015	K

DRAWN BY: CAD | DATE: 8/29/06 | SHEET 2 OF 5

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	QTY. REQ. PER ASSY NO DASH	QTY. REQ. PER ASSY -2	REFERENCE-DESIGNATOR
	47153320	RESISTOR, 332 .125W 1% FILM	1	1	R35
	47152000	RESISTOR, 200 .125W 1% FILM	1	1	R50
	47490230	RESISTOR, 10 .125W 1% FILM	3	3	R11 R9 R43
	47171003	RESISTOR, 100K .25W 1% FILM	1	1	R44
	47142000	RESISTOR, 200 1/8W 0.1% 25PPM/C FILM	–	1	R7
	47141000	RESISTOR, 100 1/8W 0.1% 25PPM/C FILM	1	–	R7
	47490239	RESISTOR, 10K 3W 1% WIREWOUND	1	1	R54 (6)
	1-1387	RESISTOR, 2.0K 2W 1% WIREWOUND	1	1	R42 (6)
	47490063	RESISTOR, 200 3W 5% WIREWOUND	1	1	R33 (6)
	47490237	RESISTOR, 1.0 1W 1% WIREWOUND	3	3	R64 R47 R34 (6)
	047-140590	RESISTOR, 0.1 1W 1% WIREWOUND	2	2	R36 R62 (6)
	47500114	RESISTOR, VARIABLE 1K 20 TURN CERMET	1	1	R17
	15000372	CAPACITOR, 8200UF 50V ELECTROLYTIC	1	1	C10
	15000374	CAPACITOR, 2200UF 35V ELECTROLYTIC	2	2	C8 C4
	15000371	CAPACITOR, 220UF 200V ELECTROLYTIC	1	1	C12
	15000370	CAPACITOR, 100UF 50V ELECTROLYTIC	1	1	C18
	15000335	CAPACITOR, 100UF 35V ELECTROLYTIC	1	1	C11
	15000342	CAPACITOR, 10UF 20V TANTALUM	2	2	C3 C7
	15000012	CAPACITOR, .001UF 1000V DISK	1	1	C19 (8)
	15000351	CAPACITOR, 1.0UF 50V CERAMIC Z5U	2	2	C2 C1
	15000344	CAPACITOR, .33UF 50V CERAMIC Z5U	4	4	C13 C5 C16 C6
	15000336	CAPACITOR, 0.1UF 50V CERAMIC Z5U	1	1	C9
	15000340	CAPACITOR, .001UF 100V CERAMIC X7R	3	3	C15 C17 C14
	21000719	JUMPER, MACHINE INSERTABLE	2	2	JP2 JP1
	48000024	DIODE, 1N965 15V ZENER	2	2	D4 D2

TELEDYNE MONITOR LABS
A Teledyne Technologies Company

PARTS LIST
UTILITY P/S BOARD

SIZE	CAGE CODE	DWG NO	REV
A		81750015	K

DRAWN BY: CAD | DATE: 8/29/06 | SHEET 3 OF 5

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	QTY. REQ. PER ASSY					REFERENCE-DESIGNATOR
			NO DASH	-2				
	048-010030	DIODE, 1N4004 RECTIFIER	2	2				D10 D9
	48000035	DIODE, 1N4148 SIGNAL	4	4				D7 D8 D5 D6
	048-000070	DIODE, 1N4937 RECTIFIER	8	8				D19 D16 D17 D21 D15 D20
								D11 D18
	48000142	DIODE, 1N5231B 5.1V ZENER	1	1				D14
	048-070100	DIODE, 1N5817 RECTIFIER	1	1				D13
	31300425	DIODE, LT1029M, OR EQUIVALENT, 5V REFERENCE	1	1				D1
	48000131	DIODE, YELLOW L.E.D.	1	1				DS1
	48000130	DIODE, RED L.E.D.	3	3				DS4 DS3 DS2
	48000188	BRIDGE, KBL01 RECTIFIER	2	2				D12 D3
	021-070280	TERMINAL, TURRET	18	18				TP11 TP1 TP13 TP17 TP14 TP10
								TP18 TP5 TP7 TP16 TP6 TP12
								TP4 TP8 TP3 TP9 TP15 TP2
	18000008	INDUCTOR, 500UH 2A FERRITE	2	2				L2 L1
	48000157	TRANSISTOR, 2N3904	4	4				Q1 Q5 Q11 Q2
	048-080120	TRANSISTOR, 2N3906 PNP	2	2				Q3 Q12
	48000095	TRANSISTOR, 2N6347A TRIAC	1	1				Q4
	048-100100	TRANSISTOR, IRF530 MOSFET	2	2				Q13 Q14
	48000187	TRANSISTOR, IRF830 MOSFET	2	2				Q6 Q10
	48000139	TRANSISTOR, MJE700 PNP DARLINGTON	1	1				Q9
	48000099	TRANSISTOR, MJE800 DARLINGTON	2	2				Q8 Q7
	48500014	HEATSINK, TO-220 CASE	3	3				XQ4 XQ13 XQ14
	042-130090	I.C., 4N35 OPTO-ISOLATOR	2	2				U2 U3
	31300395	I.C., AD704AQ PICOAMP OP.AMP.	1	1				U1
	31300424	I.C., LM2903 COMPARATOR	1	1				U4

TELEDYNE MONITOR LABS
A Teledyne Technologies Company

PARTS LIST
UTILITY P/S BOARD

SIZE	CAGE CODE	DWG NO	REV
A		81750015	K

DRAWN BY: CAD | DATE: 8/29/06 | SHEET 4 OF 5

LIST OF MATERIAL

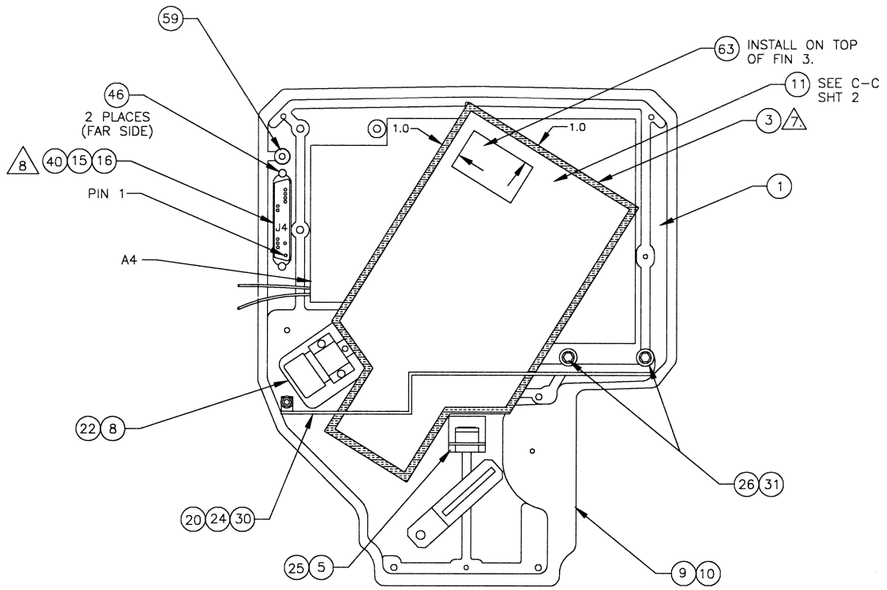
FIND NO.	PART NO.	DESCRIPTION	QTY. REQ. PER ASSY					REFERENCE–DESIGNATOR
			NO DASH	–2				
	31300426–2	I.C., TL494M MODULATOR	1	1				U5
	21000733–3	CONNECTOR, MINIFIT–JR. 4 PIN	1	1				J2
	21000733	CONNECTOR, MINIFIT–JR. 6 PIN	1	1				J6
	21000733–6	CONNECTOR, MINIFIT–JR. 10 PIN	1	1				J5
	21000733–9	CONNECTOR, MINIFIT–JR. 16 PIN	1	1				J3
	21000733–5	CONNECTOR, MINIFIT–JR. 22 PIN	1	1				J4
	21000746	CONNECTOR, CARD EDGE 36 PIN RA	1	1				J1
	56000079	TRANSFORMER, CUSTOM	1	1				T2
	47490107	RESISTOR, 20 OHM 5.25W WIREWOUND	1	1				R46 △6
	31000011–22	TUBING, 22 GA, TEFLON	1"	1"				2 X .5" LENGTH △8
	81750014	SCHEMATIC	REF	REF				

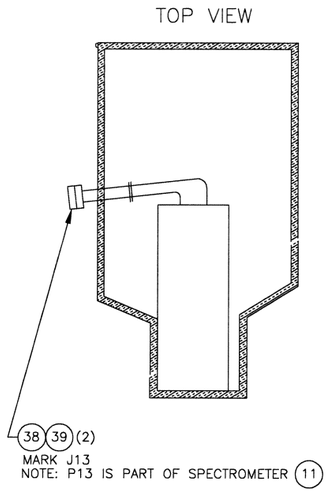
TELEDYNE MONITOR LABS
A Teledyne Technologies Company

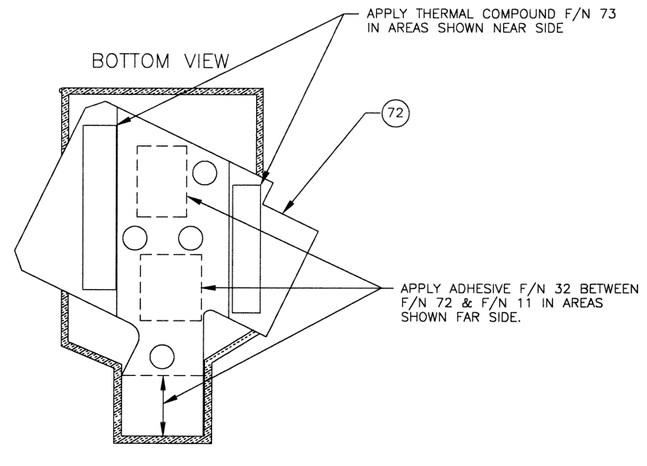
PARTS LIST
UTILITY P/S BOARD

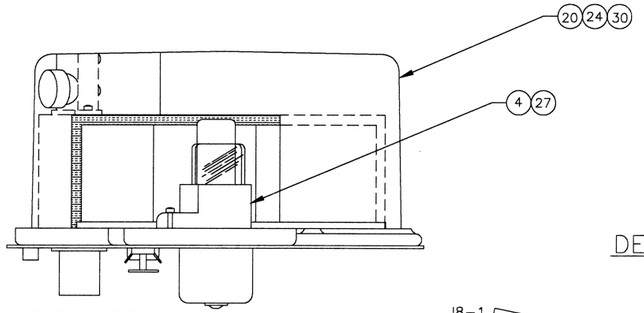
SIZE	CAGE CODE	DWG NO	REV
A		81750015	K

DRAWN BY: CAD | DATE: 8/29/06 | SHEET 5 OF 5







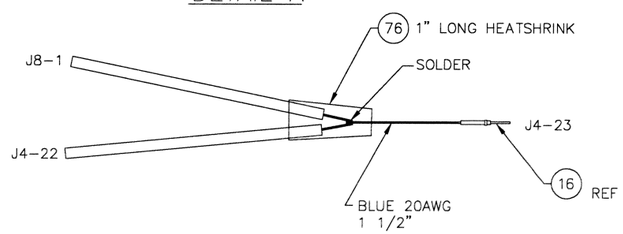


NOTES:

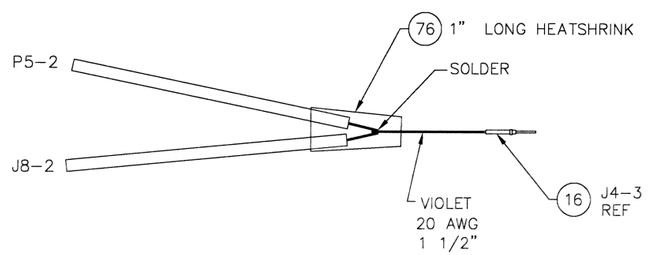
UNLESS OTHERWISE NOTED.

1. APPLY (18) TO FARSIDE OF ITEMS (36) & (37) & PRESS IN PLACE. CURE FOR 15 MINUTES.
2. NOTE REMOVED.
3. AFTER MECHANICAL ASSEMBLY IS COMPLETE, PROCEED TO SHEET 2 FOR CABLE COMPOSITION.
   CAUTION – SPECTROMETER DUST COVER MIUST BE IN PLACE DURING SOLDERING.
7. AFTER INSTALLING INSULATION, SLIT ALONG ALL EDGES OR CORNERS TO PREVENT THE INSULATION FROM "PEELING" AS THE UNIT WARMS UP.
8. PINS MAY BE INCLUDED WITH CONNECTOR, IF NOT, SHOP SUPPLY.

DETAIL A



DETAIL B



LTR.	DESCRIPTION	DATE	DRAWN	APPR
N	ECO 6507 SPECTROMETER CHANGES REQ'D	01/18/06	KEH	KEH
M	ECO 6486- ADD NOTE 8	10/25/04	CJR	KEH
L	ECO 6424-REMOVE NOTE 2.	4/05/04	CJR	KEH
K	ECO 6375- ADD DETAIL C	8/4/03	CJR	KEH
J	ECO 6323 - ADD WIRING DETAIL	2/24/03	CJR	KEH
H	ECO 6217 - ADD NOTES 1B AND 1C	1/21/02	CJR	KEH
G	ECO 5762-ADD MANUAL #'S TO TITLE BLK	7/15/98	CJR	KEH
F	ECO 5594-CHG BOM AND ADD NOTES	11/4/97	CJR	KEH
E	REVISE PER ECO 4928	11/8/95	CJR	JN
D	REVISED PER ECO 4603	4/18/95	DAC	KEH
C	REVISE PER ECO 4372	6/15/94	CJR	GWP
B	ECO 4354	5/31/94	LJR	GWP
A	MFG REL ECO 4329	5/6/94	FM2	GWP

REVISIONS

NEXT ASSEMBLY	USED ON
	81600002 SM8160 MANUAL
	81750003 SM8175 MANUAL
81750026	SM8175

81750027-1 115V
81750027-2 220V

FILENAME=

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

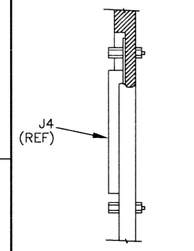
	BY	DATE
DRAWN	LJR	5/27/94
CHECKED	GWP	5/15/94
PROJ. ENG.	GW PRICE	5/15/94

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

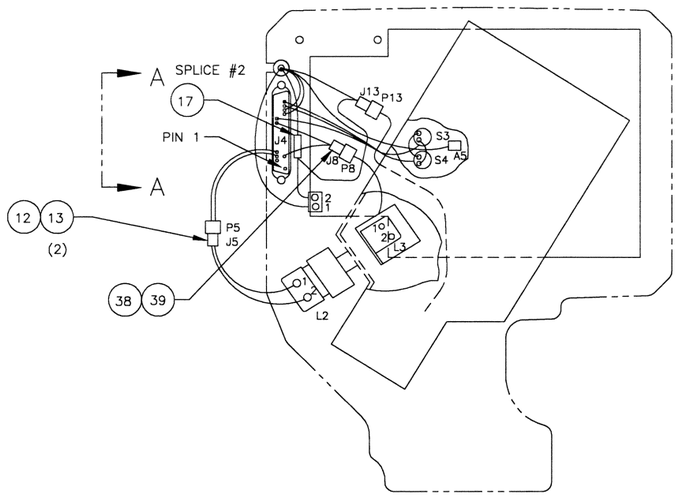
OPTIC PLATE ASSY
SM8175

SIZE	CAGE CODE	DWG NO	REV
D		81750027	N

SCALE NONE SHEET 1 OF 10

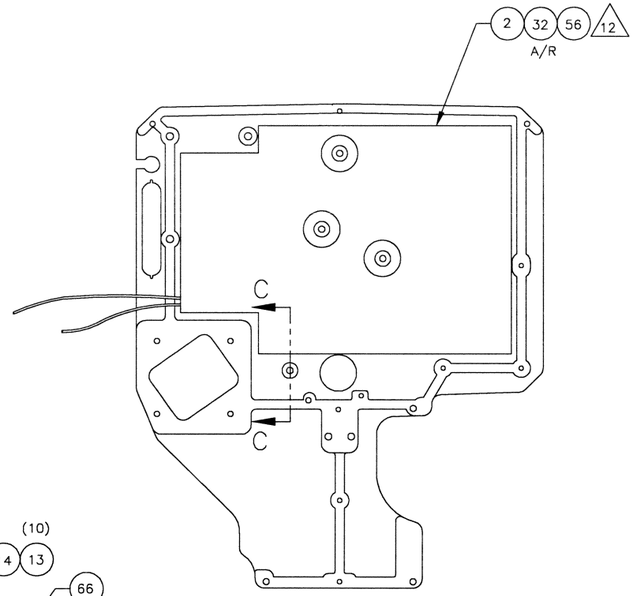


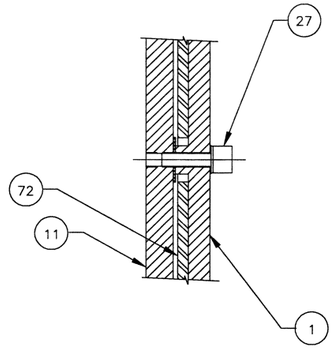
VIEW A–A



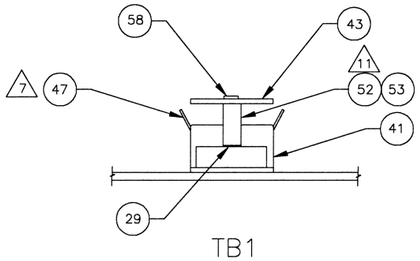
CABLE ROUTING

MECHANICAL DETAILS DELETED FOR CLARITY



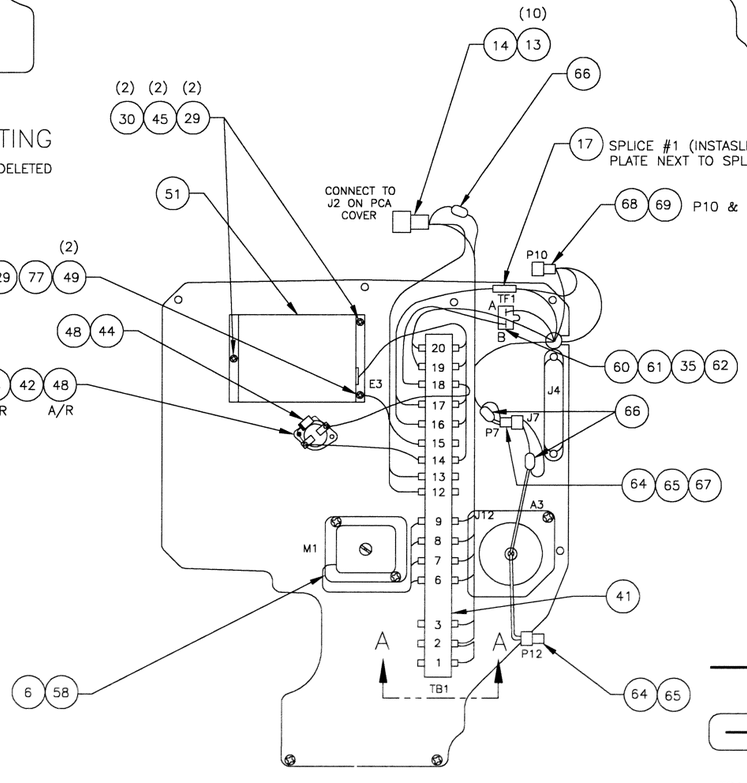


SECTION C–C

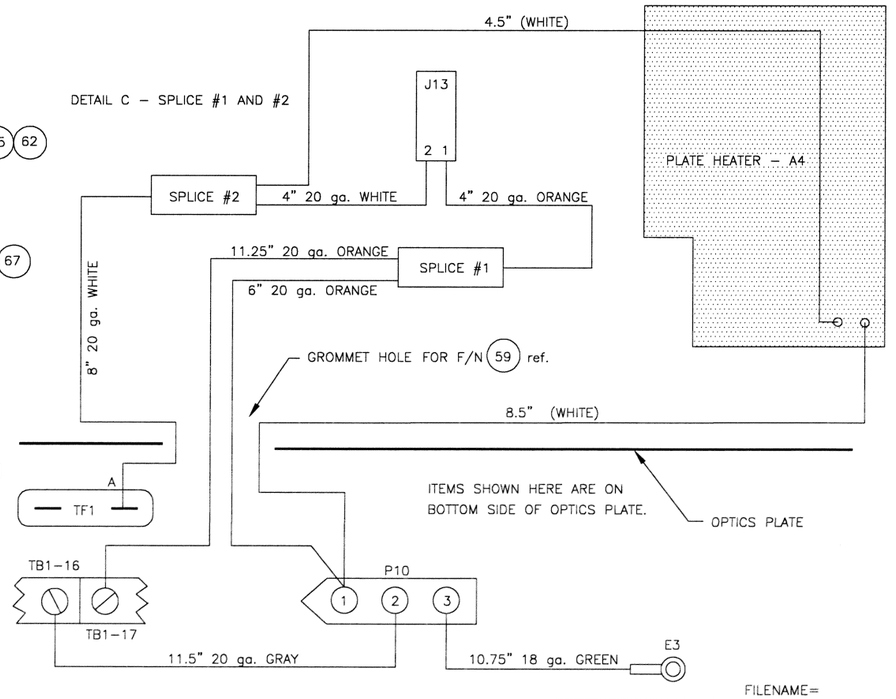


TB1

SECTION A–A



VIEW B–B



FROM SHEET 1

NOTES:

7. INSTALL IN POSITIONS 1–9 & 15–20 ONLY.
8. SEE VIEW B–B FOR CABLE ORIENTATION.
9. REF. DWGS WIRING DIAGRAM, 81750048 POINT TO POINT WIRING LIST, SHEETS 7,8&9.
10. SPOT TIE ALL CABLES AS REQUIRED.
11. TO PREVENT SET SCREW F/N (52) FROM PENETRATING HEAT BLANKET, INSTALL SET SCREW WITH 3/8" –0, +1/16" OF THREAD SHOWING ABOVE PLATE SURFACE. USE LOCTITE 222 (19) TO LOCK IN PLACE.
12. USING TAPE F/N (56) COVER 9 THREADED THRU HOLES PRIOR TO ADHESIVE APPLICATION. (9 X 1/2" LONG)
13. CAUTION: DO NOT INSTALL (77) WITHOUT ALL OTHER F/N'S OR F/N (77) MAY PENETRATE AND DAMAGE F/N (2).

CAUTION: NO SOLDER CONNECTIONS TO BE MADE UNLESS SPECTROMETER DUST COVER IS IN PLACE.

FILENAME=

SIZE	CAGE CODE	DWG NO	REV
D		81750027	N
SCALE 1/1		SHEET 2 OF 10	

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	UNIT QTY −1	UNIT QTY −2			REFERENCE	TOTAL REQ.	STOCK ISSUED	SHORT QTY
1	81000091	OPTIC PLATE	1	1						
2	53000194−1	HEAT BLANKET 115V 300W A4	1							
2	53000194−2	HEAT BLANKET 220V 300W A4		1						
4	81000160−2	BEAM SPLITTER ASSY	1	1						
5	81000409−1	SPAN CELL RECPT ASSY	1	1						
6	81000164−2	SCANNER ASSY M1	1	1						
8	81000166−2	PM TUBE HSG ASSY A2, WITH L2	1	1						
9	81000186	DUST SHIELD	1	1						
10	16000043	ADHESIVE, CARBOLINE	A/R	A/R						
11	81751230−1	SPECTROMETER ASSY 115 V	1							
11	81751230−2	SPECTROMETER ASSY 220/240 V		1						
12	21000250	CONNECTOR, HSG 2 PIN P5	1	1						
13	21000251	PIN MALE 24/18 P2,P5	12	12						
14	21000279	CONNECTOR, HSG 15 PIN P2	1	1						
15	21000345	PIN MALE 20/18	2	2			8			
16	21000298	PIN MALE 24/20	5	5			8			
17	21000833−1	SOLDER SLEEVE/SPLICE	2	2						
18	16000114	ADHESIVE, THERMAL CONDUCTIVE LOCTITE # 384	A/R	A/R						

DRAWN BY	DATE	CHECKED BY	DATE	PROJ. ENG. BY	DATE
FMM	3/18/94			GW PRICE	6/15/94

TELEDYNE INSTRUMENTS
Monitor Labs

OPTIC PLATE ASSY
SM8175

SIZE	CAGE CODE	DWG NO	REV
A		81750027	N

FILENAME= E2002703 SHEET 3 OF 10

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	UNIT QTY -1	UNIT QTY -2			REFERENCE	TOTAL REQ.	STOCK ISSUED	SHORT QTY
19	16000041	ADHESIVE, LOCTITE #222	A/R	A/R						
20	81000215	SHIELD, LIGHT	1	1						
21	16000017	ADHESIVE, RTV 732	A/R	A/R						
22	6-32 X 1/4"	SCREW, SOC HD CAP	3	3						
23	6-32 X 1/4"	SCREW, PAN PHILLIPS	1	1						
24	6-32 X 3/8"	SCREW, SOC HD CAP	5	5						
25	8-32 X 5/8"	SCREW, SOC HD CAP	2	2						
26	10-32 X 1/2"	SCREW, SOC HD CAP	2	2						
27	10-32 X 3/4"	SCREW, SOC HD CAP	4	4						
28										
29	#6	WASHER, LK INT. STAR	7	7						
30	#6	WASHER, FLAT	3	3						
31	#10	WASHER, FLAT	5	5						
32	16000115	ADHESIVE, HI-THERMAL 2 PART	A/R	A/R						
33										
34										
35	#4	WASHER, LOCK SPLIT	3	3						
36										
37										

DRAWN BY FMM	DATE 3/18/94	CHECKED BY	DATE	PROJ. ENG. BY GW PRICE	DATE 6/15/94

TELEDYNE INSTRUMENTS
Monitor Labs

OPTIC PLATE ASSY
SM8175

SIZE	CAGE CODE	DWG NO	REV
A		81750027	N

FILENAME= E2002704 SHEET 4 OF 10

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	UNIT QTY -1	UNIT QTY -2			REFERENCE	TOTAL REQ.	STOCK ISSUED	SHORT QTY
38	21000313	CONNECTOR, HSG 2 PIN J13,P7,J8	3	3						
39	21000314	SOCKET 30/22	6	6						
40	21000296	CONNECTOR, HSG 37 PIN J4	1	1						
41	21000380	TERMINAL BLOCK 20 POS TB1	1	1						
42	053-020100	THERMOSTAT 150° F S5	1	1						
43	81000432-2	COVER, TERMINAL BLOCK	1	1						
44	48000156	DIODE	1	1						
45	6-32 X 3/8"	SCREW, PAN HD, ST ST	2	2						
46	21000301	SCREW LOCK ASSY FEM	2	2						
47	21000290	TERMINAL Q.D. 3/16-.020 22/18 FEM	25	25						
48	032-080040	TUBING, HEAT SHRINK, 1/4"	2"	2"						
49	21000320	TERMINAL RING #6 22/18	3	3						
50										
51	81000623-3	TEMP CONTROLLER ASSY E3	1	1						
52	6-32 X 5/8"	SCREW, SET CUP PT. STAINLESS	2	2						
53	028-040240	STANDOFF 6-32 X .375	2	2						
54										
55										
56	45250002	TAPE, POLYESTER, 3M, 850	4.5"	4.5"						

DRAWN BY	DATE	CHECKED BY	DATE	PROJ. ENG. BY	DATE
FMM	3/18/94			GW PRICE	6/15/94

TELEDYNE INSTRUMENTS
Monitor Labs

OPTIC PLATE ASSY
SM8175

SIZE	CAGE CODE	DWG NO	REV
A		81750027	N

FILENAME= E2002705 SHEET 5 OF 10

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	UNIT QTY −1	UNIT QTY −2			REFERENCE	TOTAL REQ.	STOCK ISSUED	SHORT QTY
57	28000258	DOWEL PIN	1	1						
58	6−32 X 1/4"	SCREW. FLAT HD 82°	4	4						
59	28000971	GROMMET, RUBBER	1	1						
60	53000093−2	FUSE, THERMAL 72° C TF1	1	1						
61	4−40 X 1/4"	SCREW, PAN HD	1	1						
62	21000324	TERMINAL Q.D. FEM 1/4 22/18	2	2						
63	81000978	LABEL, CAUTION	1	1						
64										
65										
66	21000287	COAXIAL SHIELD TERMINATOR	2	2						
67	60000154	CABLE, SHIELD RG174	1	1						
68	21000307	CONNECTOR, HSG 3 PIN P10	1	1						
69	21000090	PIN MALE 24/18	3	3						
70										
71	016−000380	ADHESIVE, LOCTITE #609	A/R	A/R						
72	81750086	HEATSINK, MONOCHROMETER	1	1						
73	028−090120	THERMAL COMPOUND	A/R	A/R						
74	28001296−106	#6 INT/EXT STAR ST ST	1	1						
75										

DRAWN BY FMM	DATE 3/18/94	CHECKED BY	DATE	PROJ. ENG. BY GW PRICE	DATE 6/15/94

TELEDYNE INSTRUMENTS
Monitor Labs

OPTIC PLATE ASSY
SM8175

SIZE	CAGE CODE	DWG NO	REV
A		81750027	N

FILENAME= E2002706 SHEET 6 OF 10

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	UNIT QTY −1	UNIT QTY −2	UNIT QTY	UNIT QTY	REFERENCE	TOTAL REQ.	STOCK ISSUED	SHORT QTY
76	032−080020	HEAT SHRINK BLACK 1/8"	A/R	A/R						
77	6−32 X 3/8"	SCREW, PAN PHILLIPS	1	1						

DRAWN BY FMM	DATE 3/18/94	CHECKED BY	DATE
PROJ. ENG. BY GW PRICE	DATE 6/15/94		

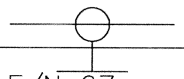
TELEDYNE INSTRUMENTS
Monitor Labs

OPTIC PLATE ASSY
SM8175

SIZE	CAGE CODE	DWG NO	REV
A		81750027	N

FILENAME= E2002707 SHEET 7 OF 10

WIRE LIST

WIRE NO	WIRE LGTH	WIRE COLOR	WIRE AWG/TYPE	FROM UNIT	FROM TERM	TERM METHOD	TO UNIT	TO TERM	TERM METHOD	REMARKS
1										
2										
3										
4	8.5"	WHT	PART OF HEATBLNK	A4	1		P10	1	F/N 69	①
5		RED	PART OF F/N 6	M1			TB1	9	F/N 69	8
6		BLK	PART OF F/N 6	M1			TB1	8	F/N 69	8
7		YEL	PART OF F/N 6	M1			TB1	7	F/N 69	8
8		GRN	PART OF F/N 6	M1			TB1	6	F/N 69	8
9	13"	RED	20	TB1	9	F/N 47	P2	13	F/N 13	8
10	14"	BLK	20	TB1	8	F/N 47	P2	11	F/N 13	8
11	14.25"	W/YEL	20	TB1	7	F/N 47	P2	10	F/N 13	8
12	14.5"	GRN	20	TB1	6	F/N 47	P2	8	F/N 13	8
13	12"	WHT		P7	1	F/N 39	P2	12	F/N 13	
14	3"	BLK	F/N 67	P7	2	F/N 39	P2	6	F/N 13	
15	14.5"	BLK	20	TB1	13	CRIMP 47	P2	14	F/N 13	
16	14.5"	GRN	20	TB1	12	CRIMP 47	P2	5	F/N 13	
17										
18	16"	BLU	20	TB1	1	F/N 49	P2	4	F/N 13	8
19	16"	RED	20	TB1	2	F/N 49	P2	7	F/N 13	8

DRAWN BY	DATE	CHECKED BY	DATE	PROJ. ENG. BY	DATE
FMM	3/23/94			GW PRICE	6/15/94

OPTIC PLATE ASSY

TELEDYNE INSTRUMENTS
Monitor Labs

SIZE	CAGE CODE	DWG NO	REV
A		81750027	N

FILENAME= E2002708 SHEET 8 OF 10

WIRE LIST

WIRE NO	WIRE LGTH	WIRE COLOR	WIRE AWG/TYPE	FROM UNIT	FROM TERM	TERM METHOD	TO UNIT	TO TERM	TERM METHOD	REMARKS
20										
21										
22										
23										
24										
25										
26										
27	2.5"	BLU	20	J4	22	F/N 16	J4	23	F/N 16	SEE DETAIL A PG 1
28	5.25"	RED	20	TB1	18	F/N 47	TF1	B	F/N 62	⚠8
29										
30	11.5"	GRY	20	TB1	16	F/N 47	P10	2	F/N 69	⚠8
31	4.75	WHT	20	P5	1	F/N 13	J4	25	F/N 16	
32	3.5"	VIO	20	P5	2	F/N 13	J4	3	F/N 16	SEE DETAIL B PG 1
33	3.5"	BLU	20	J8	1	F/N 39	J4	23	F/N 16	SEE DETAIL A PG 1
34	3.5"	VIO	20	J8	2	F/N 39	J4	3	F/N 16	SEE DETAIL B PG 1
35	10.75"	GRN	18	P10	3	F/N 69	E3	–	F/N 49	
36		BLK	PART OF F/N 51	A6			TB1	16	F/N 47	⚠8
37		WHT	PART OF F/N 51	A6			TB1	17	F/N 47	⚠8
38		RED	PART OF F/N 51	A6			TB1	14	F/N 47	⚠8

DRAWN BY FMM	DATE 3/23/94	CHECKED BY	DATE	PROJ. ENG. BY GW PRICE	DATE 6/15/94

TELEDYNE INSTRUMENTS
Monitor Labs

OPTIC PLATE ASSY

SIZE	CAGE CODE	DWG NO	REV
A		81750027	N

FILENAME= E2002709 SHEET 9 OF 10

WIRE LIST

WIRE NO	WIRE LGTH	WIRE COLOR	WIRE AWG/TYPE	FROM UNIT	FROM TERM	TERM METHOD	TO UNIT	TO TERM	TERM METHOD	REMARKS
39		YEL	PART OF F/N 51	A6			TB1	19	F/N 47	8
40		YEL	PART OF F/N 51	A6			TB1	20	F/N 47	8
41	3.25"	GRN	18	E3	—	F/N 49	TB1	15	F/N 47	8
42	16"	BLU	20	TB1	3	F/N 49	P2	9	F/N 13	8
43	7"	RED	20	TB1	14	F/N 47	S5		SOLDER	
44	4.5"	RED	20	TB1	18	F/N 47	S5		SOLDER	
	6"	ORN	20	P10	1	F/N 69	SPLICE #1	F/N 17		
	11.25"	ORN	20	TB1	17	F/N 47	SPLICE #1	F/N 17		
	4"	ORN	20	J13	1	F/N 39	SPLICE #1	F/N 17		
	4.5"	WHT	PART OF HEATBLNK	A4	2		SPLICE #2	F/N 17		
	8"	WHT	20	TF1	A	F/N 62	SPLICE #2	F/N 17		
	4"	WHT	20	J13	2	F/N 39	SPLICE #2	F/N 17		
	8"	BLK	PART OF F/N 8	L2	1		P5	1	F/N 13	
	8"	BLK	PART OF F/N 8	L2	2		P5	2	F/N 13	

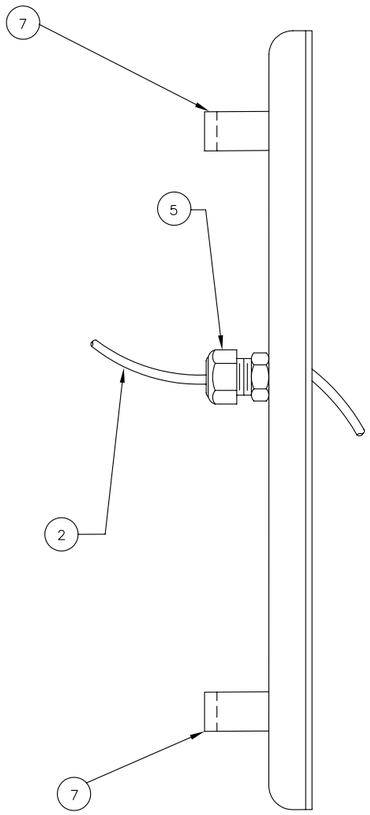
DRAWN BY	DATE	CHECKED BY	DATE	PROJ. ENG. BY	DATE
FMM	3/23/94			GW PRICE	6/15/94

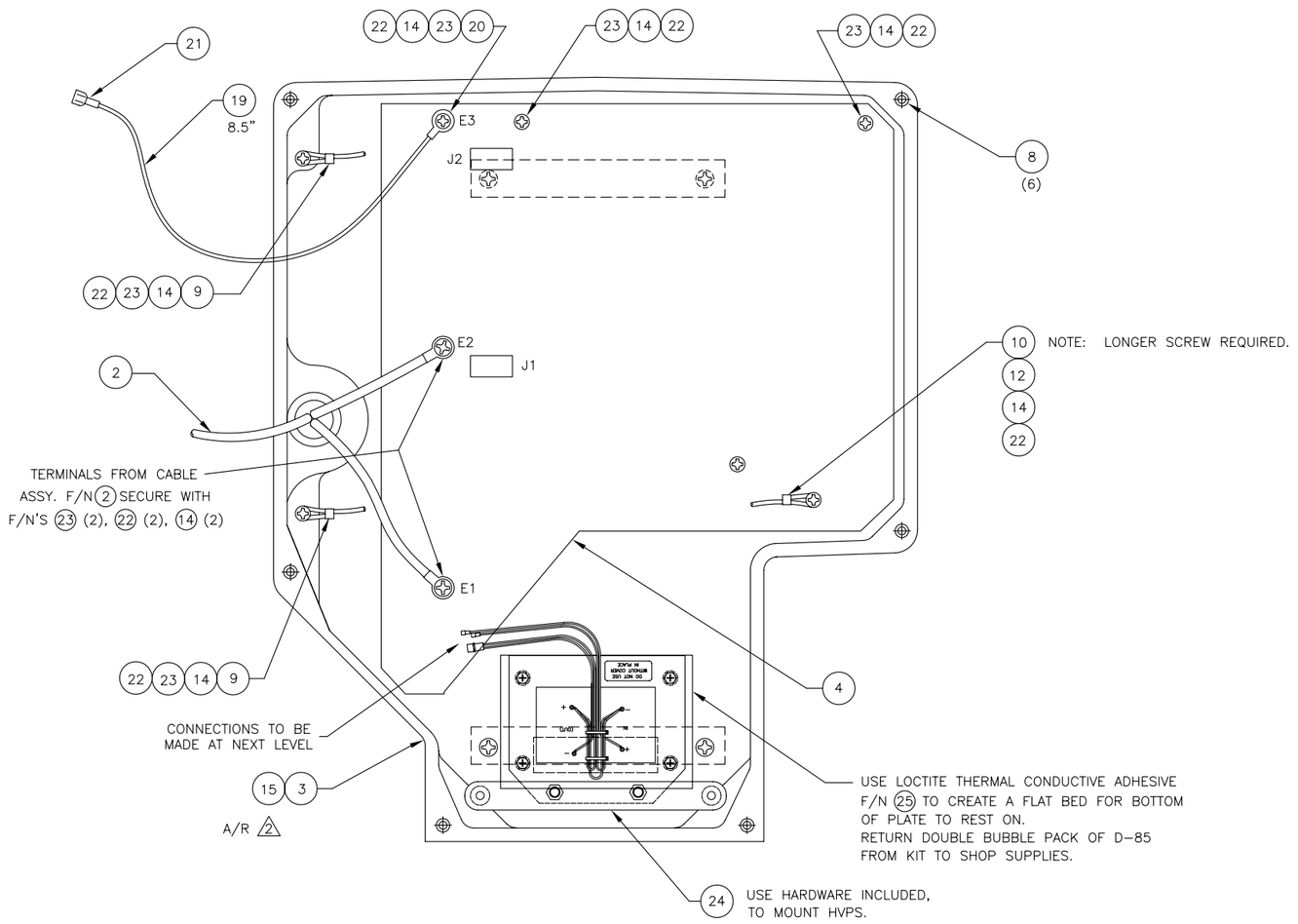
TELEDYNE INSTRUMENTS
Monitor Labs

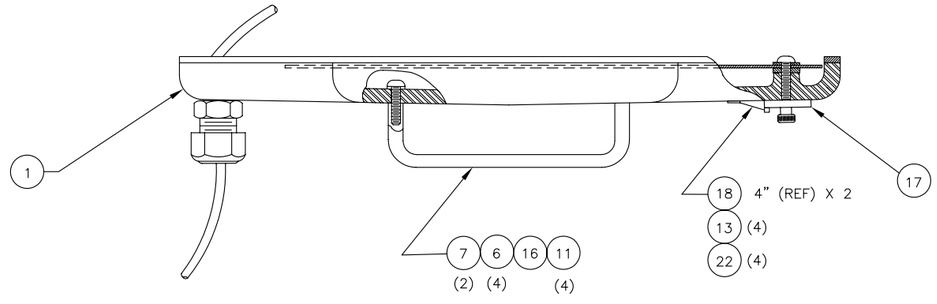
OPTIC PLATE ASSY

SIZE	CAGE CODE	DWG NO	REV
A		81750027	N

FILENAME= E2002710 SHEET 10 OF 10







NOTES:

1. APPLY A THIN COAT (.03 THK) OF ADHESIVE (F/N 15) TO TOP EDGE OF DOOR. PRESS (F/N 3) IN PLACE AND WIPE OFF EXCESS. ADHESIVE.

2 USE CAUTION AND ALL REQUIRED SAFETY PROCEDURES WHEN APPLYING NEOPRENE ADHESIVE, (MFR MAY VARY). THESE PROCEDURES MAY INCLUDE EQUIPMENT i.e. VENT HOODS, RESPIRATORS, GLOVES AND EYE SHIELDS.

ASSY NUMBER TABULATION CHART	
ASSY NUMBER	DESCRIPTION
81750042-1	USES 8175 TRANSCEIVER BOARD
81750042-2	USES 8100B TRANSCEIVER BOARD

Printed Documents Are UNCONTROLLED

REVISIONS					
LTR.	DESCRIPTION	DATE	DRAWN	APPR	
G	SEE DCN 81750042G FOR CHANGE DESC.	6/6/06	CAD	MTC	
F	ECO 6486- ADD NOTE TO ITEM 18	10/25/04	CJR	KEH	
E	ECO 6424-ADD HVPS RETRO KIT	4/05/04	CJR	KEH	
D	ECO 6361-UPDATE BILL & DWG TO AS BUILT	5/22/03	CJR	RDC	
C	ECO 5762-ADD MANUAL # TO TITLE BLK	7/15/98	CJR	LS	
B	REVISED PER ECO 4812	09/26/95	JDP	GWP	
A	MFG REL ECO 4329	5/6/94	FM	GWP	

NEXT ASSEMBLY	USED ON
	81750003 SM8175 MANUAL
81750026	81600002 SM8160 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

	BY	DATE
DRAWN	CJR	5/12/94
CHECKED	GWP	
PROJ. ENG.	GW PRICE	10/18/95

TELEDYNE INSTRUMENTS
Monitor Labs
A Teledyne Technologies Company

ACCESS DOOR ASSY SM8175/8100B

SIZE	CAGE CODE	DWG NO	REV
D		81750042	G

SCALE 3/4=1 SHEET 1 OF 3

LIST OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION	QTY. REQ. PER ASSY							REFERENCE	TOTAL REQD.	STOCK ISSUED	SHORT QTY
			-1	-2									
1	81000089-2	ACCESS DOOR, MACHINED	1	1									
2	81000996-1	CABLE ASSY	1	1									
3	81000185	GASKET	1	1									
4	81750045-1	PC ASSY, TRANSCEIVER	1	-									
4	81750045-2	PC ASSY, TRANSCEIVER	-	1									
5	60000015	STRAIN RELIEF	1	1									
6	28000296-2	WASHER, SEALING, #8	4	4									
7	28000789	HANDLE	2	2									
8	28000255	SCREW, CAPTIVE, 8-32	6	6									
9	81000173-1	HINGE CABLE ASSY	2	2									
10	81000173-2	SAFETY CABLE ASSY	1	1									
11	28001279-0820	SCREW, PAN HD, PHIL, SS, 8-32 X 5/8"	4	4									
12	28001279-0612	SCREW, PAN HD, PHIL, SS, 6-32 X 3/8"	1	1									
13	28001279-0608	SCREW, PAN HD, PHIL, SS, 6-32 X 1/4"	4	4									
14	28001304-06	WASHER, FLAT, #6, STAINLESS	8	8									
15	16000043	ADHESIVE, NEOPRENE	A/R	A/R						SEE NOTE 2			
16	16000014	ADHESIVE, LOCTITE #222	A/R	A/R									
17	81000733-4	ACCESS COVER ASSY	1	1									
18	28000026	CHAIN	8"	8"						4" X 2 REQ'D			
19	60000146-1805	WIRE, 18 AWG, GREEN	8.5	8.5									
20	21000320	TERMINAL RING, #6, 18/22, RED	1	1									
21	21000290	QUICK DISCONNECT	1	1									
22	28001324-06	SPLIT LOCK WASHER, #6, STAINLESS	12	12									
23	28001279-0610	SCREW, PAN HD, PHIL, SS, 6-32 X 5/16"	7	7									
24	81751220	HVPS, RETRO KIT	1	1									

TELEDYNE INSTRUMENTS
Monitor Labs
A Teledyne Technologies Company

ACCESS DOOR ASSEMBLY
SM8175/8100B

SIZE	CAGE CODE	DWG NO	REV
A		81750042	G

DRAWN BY: CAD | DATE: 6/6/06 | SHEET 2 OF 3

LIST OF MATERIAL

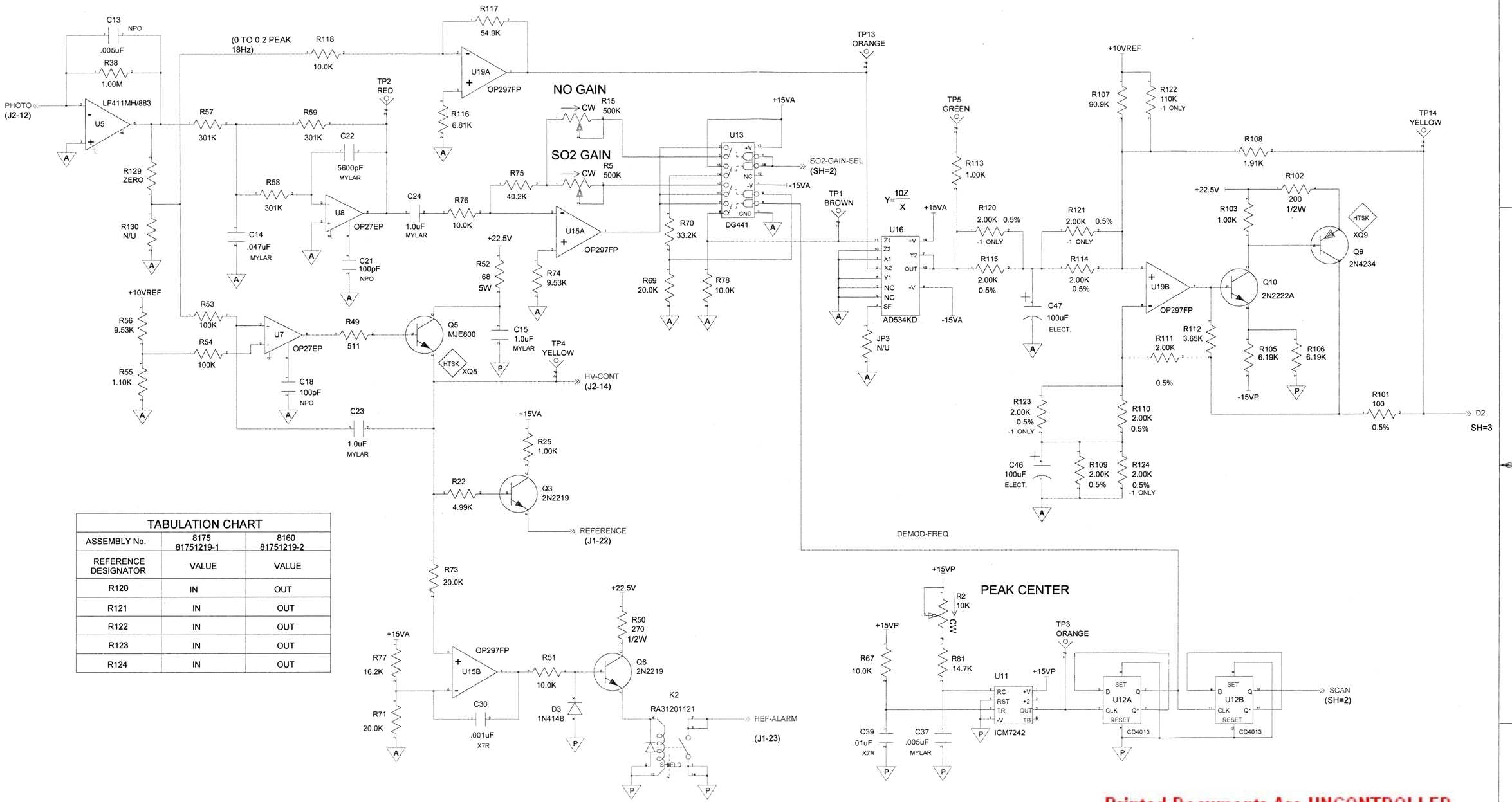
FIND NO.	PART NO.	DESCRIPTION	QTY. REQ. PER ASSY							REFERENCE	TOTAL REQD.	STOCK ISSUED	SHORT QTY
			-1	-2									
25	16000114	LOCTITE, THERMAL COND ADH #384	A/R	A/R									

TELEDYNE INSTRUMENTS
Monitor Labs
A Teledyne Technologies Company

ACCESS DOOR ASSEMBLY
SM8175/8100B

SIZE	CAGE CODE	DWG NO	REV
A		81750042	G

DRAWN BY: CAD | DATE: 6/6/06 | SHEET 3 OF 3



TABULATION CHART		
ASSEMBLY No.	8175 81751219-1	8160 81751219-2
REFERENCE DESIGNATOR	VALUE	VALUE
R120	IN	OUT
R121	IN	OUT
R122	IN	OUT
R123	IN	OUT
R124	IN	OUT

Printed Documents Are UNCONTROLLED

8-16-04

NOTES: UNLESS OTHERWISE SPECIFIED:

1. RESISTOR VALUES ARE IN OHMS, 1/4 WATT, 1%.
2. CAPACITOR VALUES ARE IN uF, TYPE CERAMIC Z5U.
3. USED FOR P.C.B. No. 81751217.

REF- FILENAME = TELEDYNE_042703_2245.OPJ

LTR	DESCRIPTION	DATE	DRW	APPR
D	PER ECO #6533, changed R79 from 243 ohms to 182 ohms	11-28-05	M.Curry	
C	PER ECO #6533, skipped to match current BOM	11-28-05	M.Curry	
B	PER ECO #5900	8-26-04	DCH Gibsonia	M.Curry
A	PER ECO #6368	6-24-04	DCH Gibsonia	M.Curry

REVISIONS

DRAWN BY	D.C.HUTCHINSON	DATE	6/24/03
CHECKED BY	M. CURRY	DATE	8/20/03
PROJ'ENG BY	J.NIKLAUS	DATE	6-24-04
81751219-2	8160		
81751219-1	8175		
NEXT ASSEMBLY	USED ON		

TELEDYNE INSTRUMENTS
Monitor Labs
A Teledyne Technologies Company

SCHEMATIC TRANSCEIVER BOARD SM81751219-1/2

SIZE	CAGE CODE	DWG NO	REV
D		81751218	D

SCALE = NONE | SHEET 1 OF 3

U6A
OP297FP
(SPARE)

ALARM
+10VREF
R4
10K
CW
R65
100K
C35
20uF
MYLAR
TP12
RED
R62
499K
R64
100K
U9
OP27EP
R63
49.9K
C29
100pF
NPO
+15VP
R98
1.00M
R97
1.00K
D8
1N4148
D5
1N4148
U17B
OP297FP
R96
1.00K
C45
.01uF
X7R
R68
10.0K
D4
1N4148
+22.5V
R66
270
1/2W
Q7
2N2219
K3
RA31201121
SHIELD
SCAN-ALARM
(J1-20)

SHUTTER-HI
(J1-17)
SHUTTER-LO
(J1-13)
D1
DF04
AC
AC
C3
10uF
ELECT.
+15VA
D25
RED
R83
56.2K
U20
4N35
R95
2.43K
R90
1.00M
SO2-GAIN-SEL
(SH=1)
U21
ADG419
+15VP
-15VP
+10VREF
R88
2K
CW
R7
1.00K
NO
SCAN
OFFSET
R8
33.2K

+10VREF
D7
1N4148
D6
1N4148
+15VP
SCAN
(SH=1)
R91
3.32K
1/8W
Q8
2N6427
R92
49.9K
TP7
VIOLET
R100
499K
D9
1N4148
C42
4.0uF
MYLAR
LF411MH/883
U18
R84
3.01K
C41
10uF
ELECT.
R46
75.0K
R48
75.0K
C25
.22uF
MYLAR
TP11
BROWN
TP6
BLUE
R60
200K
C26
1.0uF
MYLAR
R85
150K
U10
OP27EP
C34
100pF
NPO
R43
10.0K
R42
30.1K
+22.5V
E5
Q2
2N5758
HTSK
XQ2
R47
499
U6B
OP297FP
C9
MYLAR
.047uF
Q1
MJ15016
HTSK
XQ1
E4
-22.5V
R44
30.1K
R45
10.0K
R41
24.9
1/2W
R14
150
SCAN-DRIVE
(J2-13)

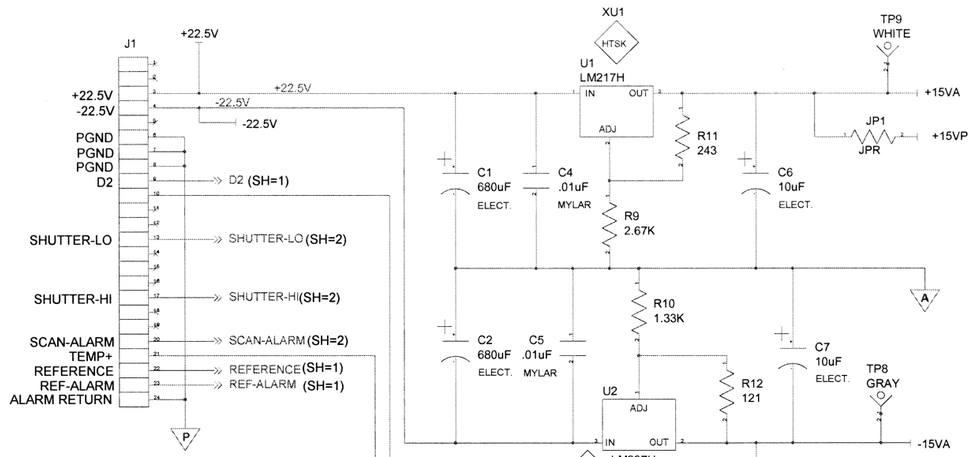
SCAN-COM
(J2-8,11)
SCAN-FEEDBACK
(J2-10)
R16
150
R13
5.11
1/2W
R17
51.1
R18
100K
R19
162K
R39
100K
R40
162K
U4
OP27EP
C12
100pF
NPO
C36
1.0uF
MYLAR
R80
17.8K
U17A
OP297FP
R82
17.8K
D10
1N4148
R89
200K
+10VREF
R93
9.53K
R94
1.82K
R87
200K
R86
100K
R99
23.7K
R3
10.0K
CW
R61
82.5K
R104
16.5K
SO2 SCAN
OFFSET

P

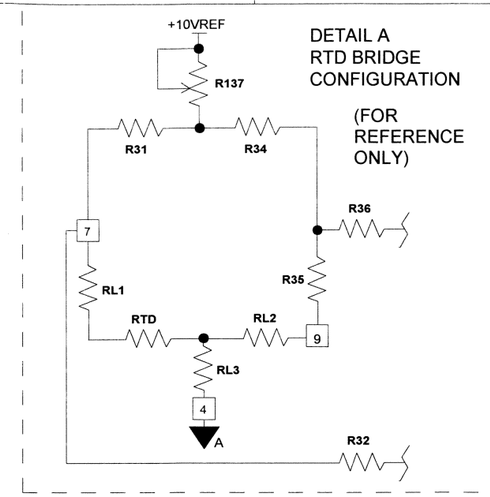
REF- FILENAME =
TELEDYNE_042403_2245.OPJ

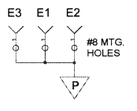
8-16-04

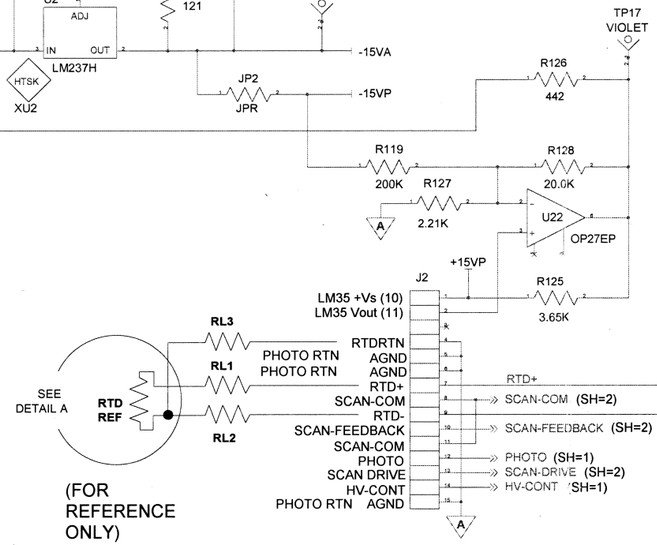
SIZE	CAGE CODE	DWG NO	REV
D		81751218	D
SCALE = NONE		SHEET 2 OF 3	

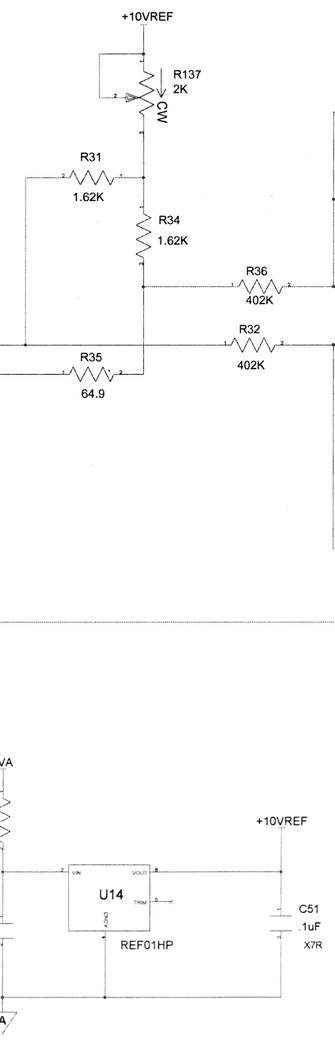


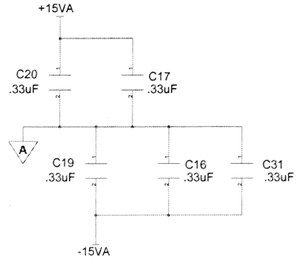
I.C. POWER NOT SHOWN AT SYMBOLS			
REFERENCE DESIGNATOR	TYPE	PIN=PWR	PIN=PWR
U6, U17	OP297FD	8= +15VP	4= -15VP
U4, U9, U10, U22	OP27EP	7= +15VP	4= -15VP
U3, U5	LF411/883	7= +15VA	4= -15VA
U12	CD4013B	14= +15VP	7= PGND
U15, U19	OP297FP	8= +15VA	4= -15VA
U7, U8	OP27EP	7= +15VA	4= -15VA
U18	LF411/883	7= +15VP	4= -15VP

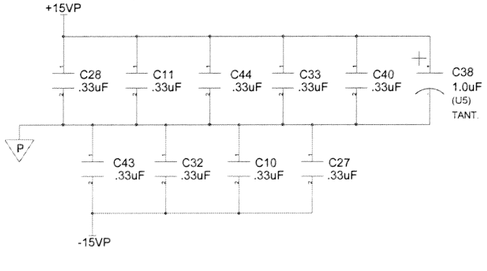


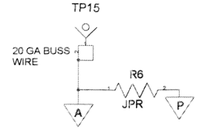










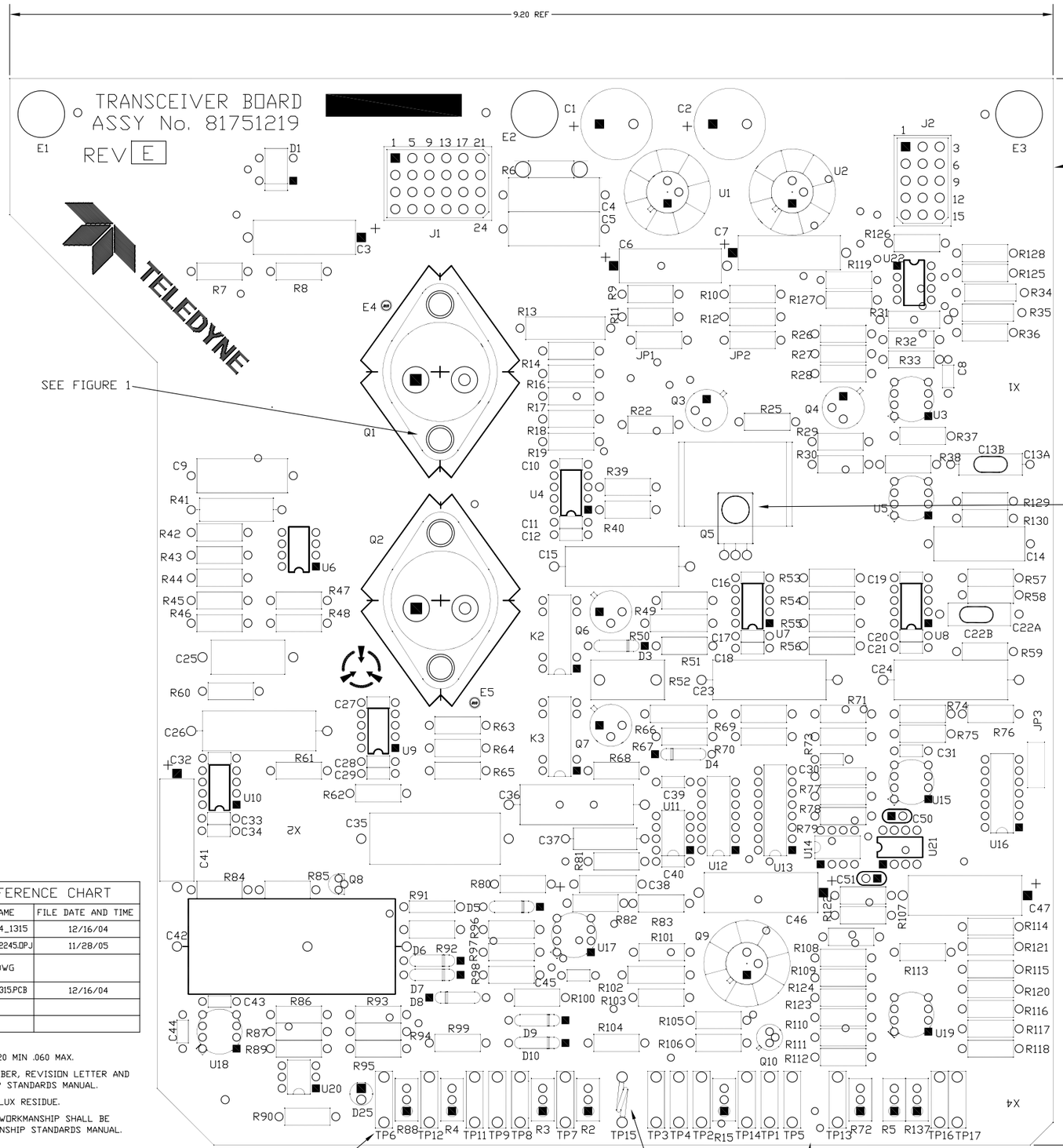


REF- FILENAME = TELEDYNE_042703_2245.OPJ

8-16-04

SIZE	CAGE CODE	DWG NO	REV
D		81751218	D
SCALE = NONE		SHEET 3 OF 3	

REVISIONS				
ZONE	SYM.	DESCRIPTION	DATE	APPD.
	A	PER ECO #6368	6-24-04	JNIKLAUS
	B	PER ECO #6488	12-16-04	JNIKLAUS
	C	ECO 6498 CORRECT BOM	12-16-04	
	D	R79 CHANGE --ECO 6533	11-29-05	
	E	SEE DCN 81751219E	4/4/06	MTC
	F	SEE DCN 81751219F	9/12/08	CAD



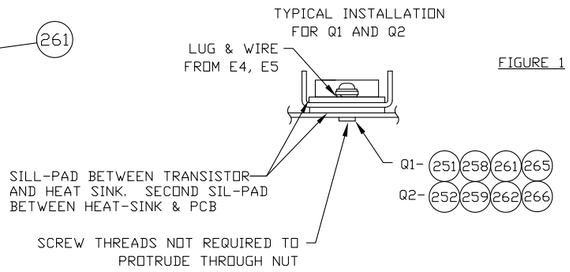


FIGURE 1

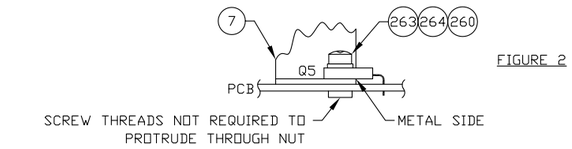


FIGURE 2

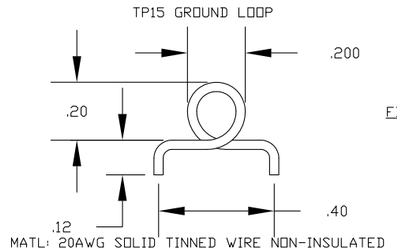


FIGURE 3

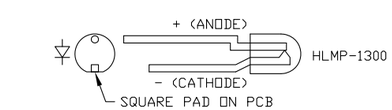


FIGURE 4

ASSEMBLY NUMBER TABULATION CHART	
ASSEMBLY NUMBER	DESCRIPTION
81751219-1	8175 TRANSCEIVER PCA
81751219-2	8100B & 8160 TRANSCEIVER PCA

REVISION AND DATA FILE CROSS-REFERENCE CHART				
DESCRIPTION	DRAWING No.	REV.	DATA FILENAME	FILE DATE AND TIME
P.C.B. FABRICATION	81751217	B	81751217_092004_1315	12/16/04
SCHEMATIC	81751218	D	TELEDYNE_042703_2245.DPJ	11/28/05
P.C.B. ASSEMBLY PARTS LIST	81751219	D	81751219X1.DWG	
P.C.B. DATABASE	81751217	B	81751217_092004_1315.PCB	12/16/04
PC-DRC DESIGN RULES CHECK REPORT				
PC-CPR PCB/SCH COMPARISON REPORT				

4. LEAD PROJECTION BELOW BOARD SURFACE SHALL BE .020 MIN .060 MAX.
3. IDENTIFY ASSEMBLY WITH ASSEMBLY NUMBER, DASH NUMBER, REVISION LETTER AND ECO NUMBER(S) IN ACCORDANCE WITH TML WORKMANSHIP STANDARDS MANUAL.
2. AFTER SOLDERING, CLEAN ASSEMBLY TO REMOVE ALL FLUX RESIDUE.
1. PART ATTACHMENT, WIRING, SOLDERING, CLEANING AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH TELEDYNE MONITOR LABS WORKMANSHIP STANDARDS MANUAL.

NOTES: UNLESS OTHERWISE SPECIFIED.

DIMENSIONAL TOLERANCES
UNLESS OTHERWISE SPECIFIED
FRACTIONS DECIMALS ANGLES
0 TO 4 ±1/32 .XX ±.01 ±0°30'
4 TO 8 ±1/16 .XXX ±.005 RMS FINISH
8 AND UP ±1/8
ALL DIMENSIONS ARE IN INCHES
DO NOT SCALE THIS DRAWING

AUTHORIZATION

	BY	DATE
DRAWN	DCH	9-8-03
CHECKED	MC	9-3-03
DESIGNED	MC	9-3-03
ENGINEERED	JNIKLAUS	6-24-04
PRODUCTION		
Q.A.		

PROJECTION

USED ON

DASH NO	NEXT ASSEMBLY
-1	8175
-2	8160

TITLE
TRANSCEIVER
PC BOARD
ASSEMBLY DRAWING

MAT'L. | FINISH

JIG NO.

SCALE	SHEET
2:1	1 OF 13

DRAWING NO.	LATEST REVISION
D 81751219	F

BOM 81751219

SM81XX Transceiver Board

	Quantity								
LINE	-1	-2	TML PN	REF	VALUE	MFR	MFR PN	DESC	TYPE
1	1	1	15000129	C1	680uF	PANASONIC	EEU-FC1V681	CAPACITOR	ELECTROLYTIC
2	1	1	15000129	C2	680uF	PANASONIC	EEU-FC1V681	CAPACITOR	ELECTROLYTIC
3	1	1	15000063	C3	10uF	SPRAGUE	150D106X9050R	CAPACITOR	ELECTROLYTIC
4	1	1	15000018	C4	.01uF	CDE	MMWA1S1K	CAPACITOR	MYLAR
5	1	1	15000018	C5	.01uF	CDE	MMWA1S1K	CAPACITOR	MYLAR
6	1	1	15000062	C6	10uF	SPRAGUE	150D106X9035R	CAPACITOR	ELECTROLYTIC
7	1	1	15000062	C7	10uF	SPRAGUE	150D106X9035R	CAPACITOR	ELECTROLYTIC
8	1	1	15000339	C8	.01uF	AVX	SL05E103MAA	CAPACITOR	CERAMIC X7R
9	1	1	15000274	C9	.047uF	CDE	MMWA1S47J	CAPACITOR	MYLAR
10	1	1	15000344	C10	.33uF	AVX	SA115E334ZAA	CAPACITOR	CERAMIC Z5U
11	1	1	15000344	C11	.33uF	AVX	SA115E334ZAA	CAPACITOR	CERAMIC Z5U
12	1	1	15000338	C12	100pF	AVX	SA102A101KAA	CAPACITOR	CERAMIC NPO
13	1	1	15000276	C13	.005uF	XICON	PF2A502J	CAPACITOR	MYLAR
14	1	1	15000274	C14	.047uF	CDE	MMWA1S47K	CAPACITOR	MYLAR
15	1	1	15000042	C15	1.0uF	CDE	MMWA05W1K	CAPACITOR	MYLAR
16	1	1	15000344	C16	.33uF	AVX	SA115E334ZAA	CAPACITOR	CERAMIC Z5U
17	1	1	15000344	C17	.33uF	AVX	SA115E334ZAA	CAPACITOR	CERAMIC Z5U
18	1	1	15000338	C18	100pF	AVX	SA102A101KAA	CAPACITOR	CERAMIC NPO
19	1	1	15000344	C19	.33uF	AVX	SA115E334ZAA	CAPACITOR	CERAMIC Z5U
20	1	1	15000344	C20	.33uF	AVX	SA115E334ZAA	CAPACITOR	CERAMIC Z5U
21	1	1	15000338	C21	100pF	AVX	SA102A101KAA	CAPACITOR	CERAMIC NPO

	Quantity								
LINE	-1	-2	TML PN	REF	VALUE	MFR	MFR PN	DESC	TYPE
22	1	1	15000275	C22	5600pF	XICON	PF2A562J	CAPACITOR	MYLAR
23	1	1	15000042	C23	1.0uF	CDE	MMWA05W1K	CAPACITOR	MYLAR
24	1	1	15000042	C24	1.0uF	CDE	MMWA05W1K	CAPACITOR	MYLAR
25	1	1	15000034	C25	.22uF	SPRAGUE	192P224X908	CAPACITOR	MYLAR
26	1	1	15000042	C26	1.0uF	CDE	MMWA05W1K	CAPACITOR	MYLAR
27	1	1	15000344	C27	.33uF	AVX	SA115E334ZAA	CAPACITOR	CERAMIC Z5U
28	1	1	15000344	C28	.33uF	AVX	SA115E334ZAA	CAPACITOR	CERAMIC Z5U
29	1	1	15000338	C29	100pF	AVX	SA102A101KAA	CAPACITOR	CERAMIC NPO
30	1	1	15000340	C30	.001uF	AVX	SA101C102KAA	CAPACITOR	CERAMIC X7R
31	1	1	15000344	C31	.33uF	AVX	SA115E334ZAA	CAPACITOR	CERAMIC Z5U
32	1	1	15000344	C32	.33uF	AVX	SA115E334ZAA	CAPACITOR	CERAMIC Z5U
33	1	1	15000344	C33	.33uF	AVX	SA115E334ZAA	CAPACITOR	CERAMIC Z5U
34	1	1	15000338	C34	100pF	AVX	SA102A101KAA	CAPACITOR	CERAMIC NPO
35	1	1	15000149	C35	20uF	ELECTROCUBE	230B1Z206K	CAPACITOR	MYLAR
36	1	1	15000042	C36	1.0uF	CDE	MMWA05W1K	CAPACITOR	MYLAR
37	1	1	15000276	C37	.005uF	CDE	WMF-1D5J	CAPACITOR	MYLAR
38	1	1	15000119	C38	1.0uF	SPRAGUE	150D105X9035A	CAPACITOR	TANTALUM
39	1	1	15000339	C39	.01uF	AVX	SL05E103MAA	CAPACITOR	CERAMIC X7R
40	1	1	15000344	C40	.33uF	AVX	SA115E334ZAA	CAPACITOR	CERAMIC Z5U
41	1	1	15000063	C41	10uF	SPRAGUE	150D106X9050R	CAPACITOR	ELECTROLYTIC
42	1	1	15000407	C42	4.0uF	CDE	WMF05W4K	CAPACITOR	MYLAR
43	1	1	15000344	C43	.33uF	AVX	SA115E334ZAA	CAPACITOR	CERAMIC Z5U

	Quantity								
LINE	-1	-2	TML PN	REF	VALUE	MFR	MFR PN	DESC	TYPE
44	1	1	15000344	C44	.33uF	AVX	SA115E334ZAA	CAPACITOR	CERAMIC Z5U
45	1	1	15000339	C45	.01uF	AVX	SL05E103MAA	CAPACITOR	CERAMIC X7R
46	1	1	15000154	C46	100uF	SPRAGUE	500D107M025CC	CAPACITOR	ELECTROLYTIC
47	1	1	15000154	C47	100uF	SPRAGUE	500D107M025CC	CAPACITOR	ELECTROLYTIC
48	1	1	15000402	C50	.1uF	VISHAY	VP32BY104KB	CAPACITOR	CERAMIC X7R
49	1	1	15000402	C51	.1uF	VISHAY	VP32BY104KB	CAPACITOR	CERAMIC X7R
50	1	1	48000159	D1	DF04	COLLMER	DF04	DIODE_BRIDGE	SIL. BRIDGE
51	1	1	48000035	D3	1N4148	ANY	1N4148	SIGNAL	DO-35
52	1	1	48000035	D4	1N4148	ANY	1N4148	SIGNAL	DO-35
53	1	1	48000035	D5	1N4148	ANY	1N4148	SIGNAL	DO-35
54	1	1	48000035	D6	1N4148	ANY	1N4148	SIGNAL	DO-35
55	1	1	48000035	D7	1N4148	ANY	1N4148	SIGNAL	DO-35
56	1	1	48000035	D8	1N4148	ANY	1N4148	SIGNAL	DO-35
57	1	1	48000035	D9	1N4148	ANY	1N4148	SIGNAL	DO-35
58	1	1	48000035	D10	1N4148	ANY	1N4148	SIGNAL	DO-35
59	1	1	48000130	D25	RED	HP	HLMP-1301	LED	LED
60	1	1	NA	E1	#8MTGHOLE	NA	NA	#8 MOUNTING HOLE	#8 MOUNTING HOLE
61	1	1	NA	E2	#8MTGHOLE	NA	NA	#8 MOUNTING HOLE	#8 MOUNTING HOLE
62	1	1	NA	E3	#8MTGHOLE	NA	NA	#8 MOUNTING HOLE	#8 MOUNTING HOLE
63	1	1	21000213-4	E4				#8 MOUNTING HOLE	WITH NET
64	1	1	21000213-4	E5				#8 MOUNTING HOLE	WITH NET
65	1	1	21000719	JP1	JPR	DALE	FRJ-55	RESISTOR	MF
66	1	1	21000719	JP2	JPR	DALE	FRJ-55	RESISTOR	MF

	Quantity								
LINE	-1	-2	TML PN	REF	VALUE	MFR	MFR PN	DESC	TYPE
67	0	0		JP3	NOT USED				
68	1	1	21000280	J1	conn24p	MOLEX	3/6/2242	CONNECTOR	24 PIN HSG
69	1	1	21000273	J2	conn15p	MOLEX	03-06-1152	CONNECTOR	15 PIN HSG
70	1	1	45000006-1	K2	RA31201121	ELECTROL	RA31201121	RELAY	REED
71	1	1	45000006-1	K3	RA31201121	ELECTROL	RA31201121	RELAY	REED
72	1	1	48000047	Q1	MJ15016	ANY	MJ15016	PNP TRANSISTOR	TO-3
73	1	1	48000086	Q2	2N5758	ANY	2N5758	NPN TRANSISTOR	TO-3
74	1	1	48000011	Q3	2N2219	ANY	2N2219	NPN TRANSISTOR	TO-39
75	1	1	48000011	Q4	2N2219	ANY	2N2219	NPN TRANSISTOR	TO-39
76	1	1	48000099	Q5	MJE800	ANY	MJE800	DARL. NPN TRANSISTOR	TO-126
77	1	1	48000011	Q6	2N2219	ANY	2N2219	NPN TRANSISTOR	TO-39
78	1	1	48000011	Q7	2N2219	ANY	2N2219	NPN TRANSISTOR	TO-39
79	1	1	48000102	Q8	2N6427	ANY	2N6427	DARL.NPN TRANSISTOR	TO-92
80	1	1	48000005	Q9	2N4234	ANY	2N4234	PNP TRANSISTOR	TO-5
81	1	1	48000010	Q10	2N2222A	ANY	2N2222A	NPN TRANSISTOR	TO-18
82	1	1	47500001	R2	10K	BECKMAN	66WR10K	RESISTOR VARIABLE	20 TURN CERMET
83	1	1	47500001	R3	10.0K	BECKMAN	66WR10K	RESISTOR VARIABLE	20 TURN CERMET
84	1	1	47500001	R4	10K	BECKMAN	66WR10K	RESISTOR VARIABLE	20 TURN CERMET
85	1	1	47500129	R5	500K	BECKMAN	66WR500K	RESISTOR VARIABLE	20 TURN CERMET
86	1	1	21000719	R6	JPR	DALE	FRJ-55	RESISTOR	MF
87	1	1	47171001	R7	1.00K	ANY	RN60C1001F	RESISTOR	MF
88	1	1	47173322	R8	33.2K	ANY	RN60C3322F	RESISTOR	MF

	Quantity								
LINE	-1	-2	TML PN	REF	VALUE	MFR	MFR PN	DESC	TYPE
89	1	1	47172671	R9	2.67K	ANY	RN60C2671F	RESISTOR	MF
90	1	1	47171331	R10	1.33K	ANY	RN60C1331F	RESISTOR	MF
91	1	1	47172430	R11	243	ANY	RN60C2430F	RESISTOR	MF
92	1	1	47171210	R12	121	ANY	RN60C1210F	RESISTOR	MF
93	1	1	47490112	R13	5.11	ANY	RN65D5R11F	RESISTOR	MF
94	1	1	47171500	R14	150	ANY	RN60C1500F	RESISTOR	MF
95	1	1	47500129	R15	500K	BECKMAN	66WR500K	RESISTOR VARIABLE	20 TURN CERMET
96	1	1	47171500	R16	150	ANY	RN60C1500F	RESISTOR	MF
97	1	1	47490146	R17	51.1	ANY	RN60C51R1D	PREC. RESISTOR	MF
98	1	1	47171003	R18	100K	ANY	RN60C1003F	RESISTOR	MF
99	1	1	47171623	R19	162K	ANY	RN60C1623F	RESISTOR	MF
100	1	1	47174991	R22	4.99K	ANY	RN60C4991F	RESISTOR	MF
101	1	1	47171001	R25	1.00K	ANY	RN60C1001F	RESISTOR	MF
102	1	1	47178873	R26	887K	ANY	RN60C8873F	RESISTOR	MF
103	1	1	47174751	R27	4.75K	ANY	RN60C4751F	RESISTOR	MF
104	1	1	47171002	R28	10.0K	ANY	RN60C1002F	RESISTOR	MF
105	1	1	47490014	R29	49.9	ANY	RN60C49R9F	RESISTOR	MF
106	1	1	47176810	R30	681	ANY	RN60C6810F	RESISTOR	MF
107	1	1	47490253	R31	1.62K	DALE	CMF601621FT2	RESISTOR	MF50ppm
108	1	1	47174023	R32	402K	ANY	RN60C4023F	RESISTOR	MF
109	1	1	47178873	R33	887K	ANY	RN60C8873F	RESISTOR	MF
110	1	1	47490253	R34	1.62K	DALE	CMF601621FT2	RESISTOR	MF50ppm
111	1	1	47490096	R35	64.9	DALE	CMF6064R9FT2	RESISTOR	MF50ppm

	Quantity								
LINE	-1	-2	TML PN	REF	VALUE	MFR	MFR PN	DESC	TYPE
112	1	1	47174023	R36	402K	ANY	RN60C4023F	RESISTOR	MF
113	1	1	47171001	R37	1.00K	ANY	RN60C1001F	RESISTOR	MF
114	1	1	47171004	R38	1.00M	ANY	RN60C1004F	RESISTOR	MF
115	1	1	47171003	R39	100K	ANY	RN60C1003F	RESISTOR	MF
116	1	1	47171623	R40	162K	ANY	RN60C1623F	RESISTOR	MF
117	1	1	47490070	R41	24.9	ANY	RN65D24R9F	RESISTOR	MF
118	1	1	47173012	R42	30.1K	ANY	RN60C3012F	RESISTOR	MF
119	1	1	47171002	R43	10.0K	ANY	RN60C1002F	RESISTOR	MF
120	1	1	47173012	R44	30.1K	ANY	RN60C3012F	RESISTOR	MF
121	1	1	47171002	R45	10.0K	ANY	RN60C1002F	RESISTOR	MF
122	1	1	47177502	R46	75.0K	ANY	RN60C7502F	RESISTOR	MF
123	1	1	47174990	R47	499	ANY	RN60C4990F	RESISTOR	MF
124	1	1	47177502	R48	75.0K	ANY	RN60C7502F	RESISTOR	MF
125	1	1	47175110	R49	511	ANY	RN60C5110F	RESISTOR	MF
126	1	1	47050271	R50	270	ANY	RN65C2700F	RESISTOR	MF
127	1	1	47171002	R51	10.0K	ANY	RN60C1002F	RESISTOR	MF
128	1	1	47490139	R52	68	OHMITE	R5J68R	RESISTOR	WIREWOUND
129	1	1	47171003	R53	100K	ANY	RN60C1003F	RESISTOR	MF
130	1	1	47171003	R54	100K	ANY	RN60C1003F	RESISTOR	MF
131	1	1	47171101	R55	1.10K	ANY	RN60C1101F	RESISTOR	MF
132	1	1	47179531	R56	9.53K	ANY	RN60C9531F	RESISTOR	MF
133	1	1	47173013	R57	301K	ANY	RN60C3013F	RESISTOR	MF

	Quantity								
LINE	-1	-2	TML PN	REF	VALUE	MFR	MFR PN	DESC	TYPE
134	1	1	47173013	R58	301K	ANY	RN60C3013F	RESISTOR	MF
135	1	1	47173013	R59	301K	ANY	RN60C3013F	RESISTOR	MF
136	1	1	47172003	R60	200K	ANY	RN60C2003F	RESISTOR	MF
137	1	1	47178252	R61	82.5K	ANY	RN60C8252F	RESISTOR	MF
138	1	1	47174993	R62	499K	ANY	RN60C4993F	RESISTOR	MF
139	1	1	47174992	R63	49.9K	ANY	RN60C4992F	RESISTOR	MF
140	1	1	47171003	R64	100K	ANY	RN60C1003F	RESISTOR	MF
141	1	1	47171003	R65	100K	ANY	RN60C1003F	RESISTOR	MF
142	1	1	47050271	R66	270	ANY	RN65D2700F	RESISTOR	MF
143	1	1	47171002	R67	10.0K	ANY	RN60C1002F	RESISTOR	MF
144	1	1	47171002	R68	10.0K	ANY	RN60C1002F	RESISTOR	MF
145	1	1	47172002	R69	20.0K	ANY	RN60C2002F	RESISTOR	MF
146	1	1	47173322	R70	33.2K	ANY	RN60C3322F	RESISTOR	MF
147	1	1	47172002	R71	20.0K	ANY	RN60C2002F	RESISTOR	MF
148	1	1	47500005	R72	100K	BECKMAN	66WR100K	RESISTOR VARIABLE	20 TURN CERMET
149	1	1	47172002	R73	20.0K	ANY	RN60C2002F	RESISTOR	MF
150	1	1	47179531	R74	9.53K	ANY	RN60C9531F	RESISTOR	MF
151	1	1	47174022	R75	40.2K	ANY	RN60C4022F	RESISTOR	MF
152	1	1	47171002	R76	10.0K	ANY	RN60C1002F	RESISTOR	MF
153	1	1	47171622	R77	16.2K	ANY	RN60C1622F	RESISTOR	MF
154	1	1	47171002	R78	10.0K	ANY	RN60C1002F	RESISTOR	MF
155	1	1	47490014	R79	49.9	ANY	RN60C49R9F	RESISTOR	MF
156	1	1	47171782	R80	17.8K	ANY	RN60C1782F	RESISTOR	MF
157	1	1	47171472	R81	14.7K	ANY	RN60C1472F	RESISTOR	MF
158	1	1	47171782	R82	17.8K	ANY	RN60C1782F	RESISTOR	MF

	Quantity								
LINE	-1	-2	TML PN	REF	VALUE	MFR	MFR PN	DESC	TYPE
159	1	1	47175622	R83	56.2K	ANY	RN60C5622F	RESISTOR	MF
160	1	1	47173011	R84	3.01K	ANY	RN60C3011F	RESISTOR	MF
161	1	1	47171503	R85	150K	ANY	RN60C1503F	RESISTOR	MF
162	1	1	47171003	R86	100K	ANY	RN60C1003F	RESISTOR	MF
163	1	1	47172003	R87	200K	ANY	RN60C2003F	RESISTOR	MF
164	1	1	47500002	R88	2K	BECKMAN	66WR2K	RESISTOR VARIABLE	20 TURN CERMET
165	1	1	47172003	R89	200K	ANY	RN60C2003F	RESISTOR	MF
166	1	1	47171004	R90	1.00M	ANY	RN60C1004F	RESISTOR	MF
167	1	1	47153321	R91	3.32K	ANY	RN55C3321F	RESISTOR	MF
168	1	1	47174992	R92	49.9K	ANY	RN60C4992F	RESISTOR	MF
169	1	1	47179531	R93	9.53K	ANY	RN60C9531F	RESISTOR	MF
170	1	1	47171821	R94	1.82K	ANY	RN60C1821F	RESISTOR	MF
171	1	1	47172431	R95	2.43K	ANY	RN60C2431F	RESISTOR	MF
172	1	1	47171001	R96	1.00K	ANY	RN60C1001F	RESISTOR	MF
173	1	1	47171001	R97	1.00K	ANY	RN60C1001F	RESISTOR	MF
174	1	1	47171004	R98	1.00M	ANY	RN60C1004F	RESISTOR	MF
175	1	1	47172372	R99	23.7K	ANY	RN60C2372F	RESISTOR	MF
176	1	1	47174993	R100	499K	ANY	RN60C4993F	RESISTOR	MF
177	1	1	47490077	R101	100	ANY	RN60C1000D	PREC. RESISTOR	MF
178	1	1	47050201	R102	200	DALE	RN65D2000F	RESISTOR	MF
179	1	1	47171001	R103	1.00K	ANY	RN60C1001F	RESISTOR	MF
180	1	1	47171652	R104	16.5K	ANY	RN60C1652F	RESISTOR	MF
181	1	1	47176191	R105	6.19K	ANY	RN60C6191F	RESISTOR	MF
182	1	1	47176191	R106	6.19K	ANY	RN60C6191F	RESISTOR	MF

	Quantity								
LINE	-1	-2	TML PN	REF	VALUE	MFR	MFR PN	DESC	TYPE
183	1	1	47179092	R107	90.9K	ANY	RN60C9092F	RESISTOR	MF
184	1	1	47490079	R108	1.91K	ANY	RN60C1911D	PREC. RESISTOR	MF
185	1	1	47490078	R109	2.00K	ANY	RN60C2001D	PREC. RESISTOR	MF
186	1	1	47490078	R110	2.00K	ANY	RN60C2001D	PREC. RESISTOR	MF
187	1	1	47490078	R111	2.00K	ANY	RN60C2001D	PREC. RESISTOR	MF
188	1	1	47173651	R112	3.65K	ANY	RN60C3651F	RESISTOR	MF
189	1	1	47171001	R113	1.00K	ANY	RN60C1001F	RESISTOR	MF
190	1	1	47490078	R114	2.00K	ANY	RN60C2001D	PREC. RESISTOR	MF
191	1	1	47490078	R115	2.00K	ANY	RN60C2001D	PREC. RESISTOR	MF
192	1	1	47176811	R116	6.81K	ANY	RN60C6811F	RESISTOR	MF
193	1	1	47175492	R117	54.9K	ANY	RN60C5492F	RESISTOR	MF
194	1	1	47171002	R118	10.0K	ANY	RN60C1002F	RESISTOR	MF
195	1	1	47172003	R119	200K	ANY	RN60C2003F	RESISTOR	MF
196	1		47490078	R120	2.00K	ANY	RN60C2001D	PREC. RESISTOR	MF
197	1		47490078	R121	2.00K	ANY	RN60C2001D	PREC. RESISTOR	MF
198	1		47490266	R122	110K	ANY	RN60C1103F	RESISTOR	MF
199	1		47490078	R123	2.00K	ANY	RN60C2001D	PREC. RESISTOR	MF
200	1		47490078	R124	2.00K	ANY	RN60C2001D	PREC. RESISTOR	MF
201	1	1	47153651	R125	3.65K	ANY	RN60C3651D	PREC. RESISTOR	MF
202	1	1	47490267	R126	442	ANY	RN60C4420F	RESISTOR	MF
203	1	1	47490269	R127	2.21K	ANY	RN60C2211D	PREC. RESISTOR	MF
204	1	1	47172002	R128	20.0K	ANY	RN60C2002D	PREC. RESISTOR	MF
205	1	1	21000719	R129	ZERO	DALE	FRJ-55	RESISTOR	MF
206	0	0		R130	NOT USED				

Quantity

LINE	-1	-2	TML PN	REF	VALUE	MFR	MFR PN	DESC	TYPE
207	1	1	47500002	R137	2K	BECKMAN	66WR2K	RESISTOR VARIABLE	20 TURN CERMET
208	1	1	21000043	TP1	BROWN	E.F. JOHNSON	105-0758-001	TEST POINT JACK	JACK
209	1	1	21000044	TP2	RED	E.F. JOHNSON	105-0752-001	TEST POINT JACK	JACK
210	1	1	21000045	TP3	ORANGE	E.F. JOHNSON	105-0756-001	TEST POINT JACK	JACK
211	1	1	21000046	TP4	YELLOW	E.F. JOHNSON	105-0757-001	TEST POINT JACK	JACK
212	1	1	21000047	TP5	GREEN	E.F. JOHNSON	105-0754-001	TEST POINT JACK	JACK
213	1	1	21000049	TP6	BLUE	E.F. JOHNSON	105-0760-001	TEST POINT JACK	JACK
214	1	1	21000190	TP7	VIOLET	E.F. JOHNSON	105-0762-001	TEST POINT JACK	JACK
215	1	1	21000191	TP8	GRAY	E.F. JOHNSON	105-0763-001	TEST POINT JACK	JACK
216	1	1	21000192	TP9	WHITE	E.F. JOHNSON	105-0751-001	TEST POINT JACK	JACK
217	1	1	21000043	TP11	BROWN	E.F. JOHNSON	105-0758-001	TEST POINT JACK	JACK
218	1	1	21000044	TP12	RED	E.F. JOHNSON	105-0752-001	TEST POINT JACK	JACK
219	1	1	21000045	TP13	ORANGE	E.F. JOHNSON	105-0756-001	TEST POINT JACK	JACK
220	1	1	21000046	TP14	YELLOW	E.F. JOHNSON	105-0757-001	TEST POINT JACK	JACK
221	1	1		TP15	20AWG	TML		BUSS WIRE TEST POINT	20 GA WIRE LOOP
222	1	1	21000049	TP16	BLUE	E.F. JOHNSON	105-0760-001	TEST POINT JACK	JACK
223	1	1	21000190	TP17	VIOLET	E.F. JOHNSON	105-0762-001	TEST POINT JACK	JACK
224	1	1	31300279	U1	LM217H	NATIONAL	LM217H	I.C, REGULATOR	TO-39
225	1	1	31300280	U2	LM237H	NATIONAL	LM237H	I.C, REGULATOR	TO-39
226	1	1	31300005	U3	LF411MH/883	NATIONAL	LF411MH/883	I.C, FET OP AMP	METCAN8
227	1	1	31300496	U4	OP27EP	NATIONAL	OP27EP	I.C, OP AMP AMP	DIP8
228	1	1	31300005	U5	LF411MH/883	NATIONAL	LF411MH/883	I.C, FET OP AMP	METCAN8
229	1	1	31300497	U6B	OP297FP	NATIONAL	OP297FP	I.C, DUAL OP AMP	METCAN8
230	1	1	31300497	U6A	OP297FP	NATIONAL	OP297FP	I.C, DUAL OP AMP	METCAN8

	Quantity								
LINE	-1	-2	TML PN	REF	VALUE	MFR	MFR PN	DESC	TYPE
231	1	1	31300496	U7	OP27EP	NATIONAL	OP27EP	I.C, OP AMP AMP	DIP8
232	1	1	31300496	U8	OP27EP	NATIONAL	OP27EP	I.C, OP AMP AMP	DIP8
233	1	1	31300496	U9	OP27EP	NATIONAL	OP27EP	I.C, OP AMP AMP	DIP8
234	1	1	31300496	U10	OP27EP	NATIONAL	OP27EP	I.C, OP AMP AMP	DIP8
235	1	1	31300341	U11	ICM7242	INTERSIL	ICM7242IPA	I.C, CMOS TIMER	DIP8
236	1	1	31300065	U12A	CD4013	T.I.	CD4013BE	I.C, DUAL D FLIP-FLOP	DIP14
237	1	1	31300065	U12B	CD4013	T.I.	CD4013BE	I.C, DUAL D FLIP-FLOP	DIP14
238	1	1	31300343	U13	DG441	INTERSIL	DG441DJ	I.C, CMOS ANLG SW	DIP16
239	1	1	31300495	U14	REF01HP	ANALOG DEV	REF01HP	I.C, PREC.VOLT.REF.	DIP8
240	1	1	31300497	U15B	OP297FP	NATIONAL	OP297FP	I.C, DUAL OP AMP	METCAN8
241	1	1	31300497	U15A	OP297FP	NATIONAL	OP297FP	I.C, DUAL OP AMP	METCAN8
242	1	1	31300161	U16	AD534KD	ANALOG DEV	AD534KD	I.C, DIVIDER	DIP14
243	1	1	31300497	U17B	OP297FP	NATIONAL	OP297FP	I.C, DUAL OP AMP	METCAN8
244	1	1	31300497	U17A	OP297FP	NATIONAL	OP297FP	I.C, DUAL OP AMP	METCAN8
245	1	1	31300005	U18	LF411MH/883	NATIONAL	LF411MH/883	I.C, FET OP AMP	METCAN8
246	1	1	31300497	U19B	OP297FP	NATIONAL	OP297FP	I.C, DUAL OP AMP	METCAN8
247	1	1	31300497	U19A	OP297FP	NATIONAL	OP297FP	I.C, DUAL OP AMP	METCAN8
248	1	1	042-130090	U20	4N35	FAIRCHILD	4N35	I.C, OPTO ISOL.	DIP6
249	1	1	45000197	U21	ADG419TQ	VISHAY	ADG419TQ	I.C, ANLG SW.	DIP8
250	1	1	31300496	U22	OP27EP	NATIONAL	OP27EP	I.C, OP AMP AMP	DIP8
251	1	1	48500048	XQ1		AAVID	501303B0000	HEATSINK TO-3 CASE	TO-3 H.S.
252	1	1	48500048	XQ2		AAVID	501303B0000	HEATSINK TO-3 CASE	TO-3 H.S.

	Quantity								
LINE	-1	-2	TML PN	REF	VALUE	MFR	MFR PN	DESC	TYPE
253	1	1	48500017	XQ5		AAVID	530714B0000	HEATSINK TO-220 CASE	MOUNTED
254	1	1	48500001	XQ9		WAKEFIELD	207CB	HEATSINK TO-5 TOP HAT	MOUNTED
255	1	1	48500001	XU1		WAKEFIELD	207CB	HEATSINK TO-5 TOP HAT	MOUNTED
256	1	1	48500001	XU2	WAKEFIELD	207CB	HEATSINK TO-5 TOP HAT		MOUNTED
257	1	1	81751218		Schematic	TML	81751218	SM81XX Schematic	
258	2	2	2800187-8		XQ1	Nut, M3	Pressnut	Pressnut	
259	24	24	21000282	J1				Connector Pin, Female	Pin
260	15	15	21000282	J2				Connector Pin, Female	Pin
261	1	1	81751217		PCB			PCB, Transceiver Board	PCB
262									
263									
259	2	2	2800187-8	XQ2				Nut, M3 Pressnut	Pressnut
260	1	1	2800187-8	XQ5				Nut, M3 Pressnut	Pressnut
261	2	2	28001188-32	XQ1				Screw, M3X8 Pan head	Screw
262	2	2	28001188-32	XQ2				Screw, M3X8 Pan head	Screw
263	1	1	28001188-32	XQ5				Screw, M3X8 Pan hd	Screw
264	1	1	25000459	XQ5				Insulator TO77	Insulator
265	2	2	033-030350	XQ1				Insulator TO3	Insulator
266	2	2	033-030350	XQ2				Insulator TO3	Insulator

TRANSCEIVER HOUSING ASSEMBLY – 81750026

SPAN SOLENOID L2 — J5 P5 1 — 3 WHT; J5 P5 2 — 10 VIO

SHUTTER SOLENOID L3 — P8 J8 1 — 9 BLU; P8 J8 2 — 5 VIO

△3 LABEL BOTH SIDES 'S'.

THERMAL SWITCHES: 125 °F, 162 °F — A — S3, S4 — B — 6 BLK, 7 BRN, 8 ORANGE

TB1

△2 GRN OR BLK, BLK OR VIO

DYNODE CHAIN A3 — 5, 6, SHIELD

P12 J12 1 1; P12 J12 2 2

−OUT +OUT H.V. PWR. SPLY. A2 +IN −IN — BLK 12, GRN 13

SCANNER MOTOR M1 — RED 1, BLK 2, YEL 3, GRN 4

HEATER BLANKET A4 — B A

HEATER A6 — J13 P13 1 1; J13 P13 2 2

△3 LABEL BOTH SIDES 'H'.

THERMAL FUSE 72 °C TF1 — A B

△1

TEMP. CONTROLLER–E3 — 3 1 2 6 7 8 9 20 19 17 16 14 15 18

14 BLU, 8 BLU, 7 RED, 4, 3, 2, 1, 12, 13, GRN, RED

9 BLU, 7 BLU, 8 RED, 4, GRN 3, WHT/YEL 2, 1 BLK, RED, YEL, YEL, WHT, BLK, RED, GRN

S5 150 °F

TEMP SENSOR A5 — 12, 13

RED

LABEL BOTH SIDES 'UV'. △3

BLK 11, BLK 10, RED 9 — J6 P6 C C; J6 P6 B B; J6 P6 A A; J6 P6 D D — BLK, BLK, RED

DSI — UV LAMP HOUSING

7, 8, 14 — J3 P3 A A; J3 P3 B B; J3 P3 C C — RED, BLU, BLU

THERMAL PROBE RTD

P9

1	U	LAMP FIL.
2	V	LAMP CATH.
3	W	LAMP H.V.
5	A	HI
4	B	LO
6	C	GND
	D	POWER SHIELD
2	X	+22.5 VDC
4	Y	−22.5 VDC
8	Z	D.C. RTN
5	a	24 VAC
	b	SHIELD
	d	
15	E	SHUTTER SIGNAL
6	F	REFERENCE
7	G	FAULT WIPER
	H	
9	J	REF FAULT
10	K	SCAN FAULT
11	L	TEMP. FAULT
12	M	SPARE
13	N	SPAN SOL
14	P	SHUTTER SOL
1	R	d 2,TEMP.(+)
16	S	d 2,TEMP.(−)
3	T	TEMP.(+)

LINE POWER IN

TRANSCEIVER OPTICS PLATE ASSEMBLY 81750027

E1, E2, E3

LABEL BOTH SIDES 'HTR'. △3

GRN 6, WHT 4, BLK 5

J4 25 22 3 27 15 16 23 — P4 26 25 22 3 27 15 16 23 — 12, 13, 18, 5, 20, 11, 7, 19, 14

J7 1 2 — P7 1 2 — 5, 6, SHIELD

J10 3 1 2 — P10 3 1 2

J11 1 2 3 — P11 1 2 3 — 11 BLK, 10 BLK, 9 RED

TRANSCEIVER P.C.B. 81750045–1 — A1

P1 8 10 9 21 22 6 23 20 13 24 17 3 4 — J1 8 10 9 21 22 6 23 20 13 24 17 3 4 — 16, 15, 1, 3, 6, 8, 9, 10, 18, 19, 20, 2, 4

P2 9 13 11 10 8 7 4 12 6 14 5 — J2 9 13 11 10 8 7 4 12 6 14 5 — 9, 1, 2, 3, 4, 8, 7, WHT, 5, 6, 12, 13

ACCESS DOOR ASSEMBLY 81750042–1

FILENAME= E2004801

NOTES:

△1 RED WIRE MUST TERMINATE AT TB1–2.

△2 WIRES ARE BLACK AND GREEN OR BLACK AND VIOLET.

△3 MARK WITH A BLACK SHARPEE MARKER AS APPROPRIATE.

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LTR.	DESCRIPTION	DATE	DRAWN	APPR
G	SPECTROMETER CHANGES REQ'D ECO 6507	1/18/06	KEH	
F	ECO 6190 LABEL CONN. FOR EASE OF ASSY	5/2/01	CJR	RDC
E	ECO 5762	7/15/98	CJR	KEH
D	REVISED PER ECO 4812	09/27/95	JDP	GWP
C	REVISE PER ECO 4603	4/21/95	DAC	KEH
B	REVISE PER ECO 4372	6/15/94	CJR	KEH
A	REL MFG ECO 4354	5/31/94	LJR	FMM

REVISIONS

NEXT ASSEMBLY	USED ON
81750026	81600002 SM8160 MANUAL; 81750003 SM8175 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

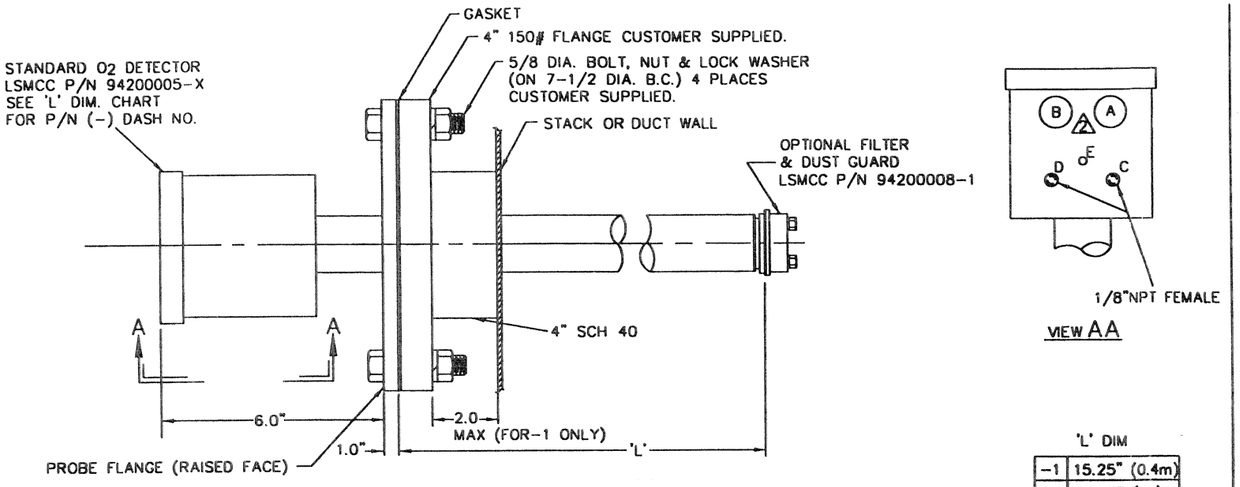
	BY	DATE
DRAWN	LJR	5–11–94
CHECKED	DLK	6/15/94
PROJ. ENG.	G.W. PRICE	6/15/94

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

WIRING DIAGRAM TRANSCEIVER SM8175

SIZE	CAGE CODE	DWG NO	REV
D		81750048	G

SCALE NONE — SHEET 1 OF 1

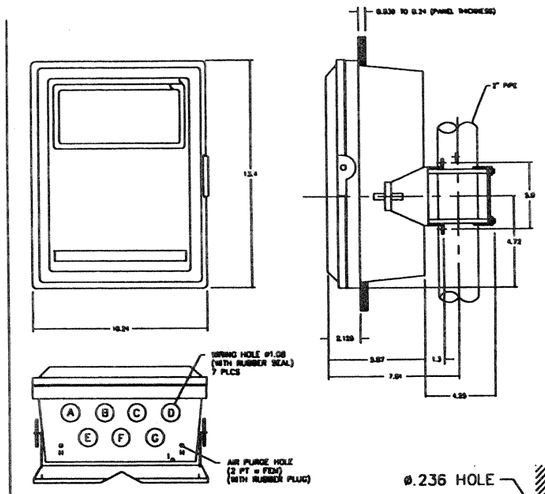


VIEW AA

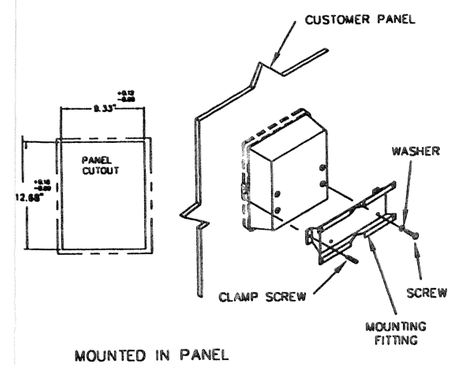
'L' DIM

-1	15.25" (0.4m)
-2	3.3 FT (1m)
-3	5.0 FT (1.5m)
-4	6.6 FT (2m)
-5	10 FT (3m)

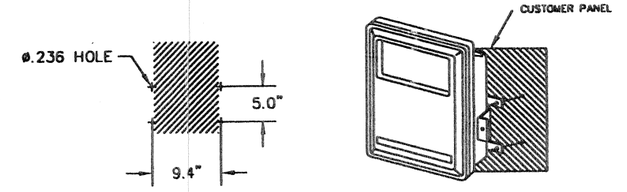
NOTES:
1. A=HEATER FROM CONVERTER, B=SIGNAL FROM CONVERTER } 3/4 CONDUIT FITTING IS RECOMMENDED
   C=CAL GAS IN. CAP WHEN NOT USED.
   D=REFERENCE GAS IN. USE WHERE ATMOSPHERE IS CONTAMINATED OR HUMIDITY VARIES SIGNIFICANTLY (1.5 LPM).
   E=GROUND SCREW
2. IT IS RECOMMENDED THAT THE FIRST 10' OF CONDUIT BE FLEXIBLE CONDUIT WITH A SERVICE LOOP.



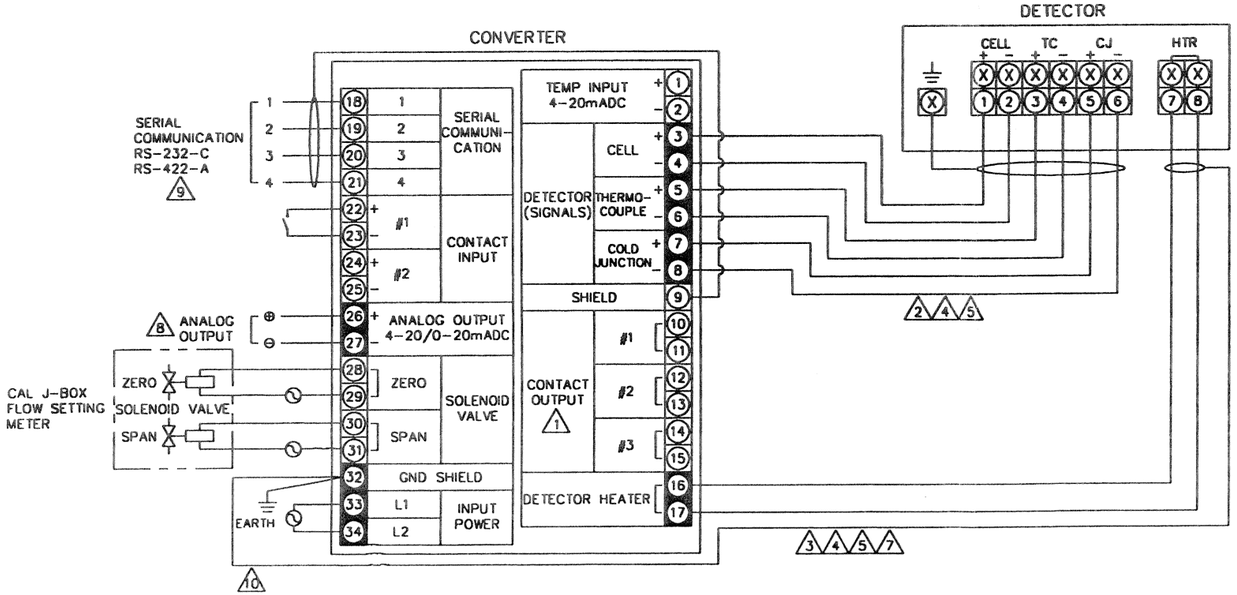
NOTES:
1. A=SIGNAL FROM DETECTOR, B=HEATER FROM DETECTOR, C=115 VAC, D=SPARE, E=SPARE, F=SPARE, G=SPARE } 3/4 CONDUIT FITTING IS RECOMMENDED
   H=PURGE INLET. FITTING (PT 1/8 FEMALE) CAP WHEN NOT USED.
   I=GROUND SCREW
2. BRACKET TO MOUNT CONVERTER TO A 2-1/2" O.D. PIPE IS SUPPLIED.



MOUNTED IN PANEL



MOUNTED ON PANEL OR WALL



NOTES UNLESS OTHERWISE SPECIFIED

1. CONTACT RATING: 30VDC 2A, 250VAC 2A, (RESISTANCE LOAD).
2. CABLE OPTIONAL; 3 TWISTED PAIR OF 16 AWG WIRE WITH OVERALL SHIELD. WHEN CONDUIT IS USED, USE FLEXIBLE CONDUIT AT DETECTOR FOR REMOVAL DURING MAINTENANCE.
3. CABLE OPTIONAL: 1 TWISTED SHIELDED PAIR OF 16 AWG WIRE.
4. MAXIMUM DISTANCE BETWEEN DETECTOR & CONVERTER MUST NOT EXCEED 1500' (USING 16AWG 7 STRAND CABLE LSMCC P/N 60000172).
5. DO NOT RUN THE DETECTOR AND HEATER CABLES TOGETHER (ISOLATE HEATER WIRES).
6. IT IS RECOMMENDED THAT AN ELECTRICAL OUTLET (115 VAC) BE LOCATED WITHIN 3 FT. OF INSTRUMENT FOR USE BY SERVICE PERSONNEL.
7. THESE WIRES (14 AWG OR HEAVIER) ARE REQUIRED FOR NON-GROUNDED STACK.
8. CABLE RESISTANCE BETWEEN CONVERTER OUT AND CUSTOMERS RECEIVER MUST BE A RESISTIVE LOAD OF 550Ω OR LESS.
9. MAXIMUM CABLE LENGTH FOR RS-232-C IS 49 FT. MAXIMUM CABLE LENGTH FOR RS-422-A IS 1640 FT. (PROVIDING CABLE IS CONNECTED BETWEEN A I/O ISOLATED COMPUTER AND THE CONVERTER OUTPUT.
10. WHERE THE AMB. TEMPERATURE OF THE DETECTOR IS 176°F OR LESS, CONNECT SHIELD TO CONVERTER TERMINAL NO. 32. FOR INSTALLATIONS ABOVE 177°F, CONSULT MANUAL FOR PROPER WIRING.

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FILENAME= B4001801

LTR.	DESCRIPTION	DATE	DRAWN	APVD
E	ECO 5899-INTERNAL CAL NOT NEEDED	2/8/98	CJR	
D	ECO 5762- ADD MANUAL # TO TITLE BLK	7/15/98	CJR	L.S.
C	ECO 5730-ADD MANUAL # TO TITLE BLK	5/8/98	CJR	GWP
B	REVISED PER ECO 5059	6/7/96	DC	GWP
A	RELEASE TO MFG PER ECO 3819	5/18/93	CJR	DG

REVISIONS

NEXT ASSEMBLY	USED ON
	81600002 SM8150 MANUAL
	802500257-1 EX4700A MANUAL

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES. TOLERANCE ON DECIMALS .XX ±.02 .XXX ±.010. TOLERANCE ON ANGLES ±2°30'. DO NOT SCALE DRAWING. MATERIAL. FINISH.

DRAWN	DATE
D CRAWFORD	2/4/93
K.B.	2/18/98
K.B.	2/18/98

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

TYPICAL INSTALLATION-LS420 W/A CAL-(SM/EX INSTERFACE) STANDARD DETECTOR

SIZE	CAGE CODE	DWG NO	REV
D		94200018	E

SCALE | SHEET 1 OF 2

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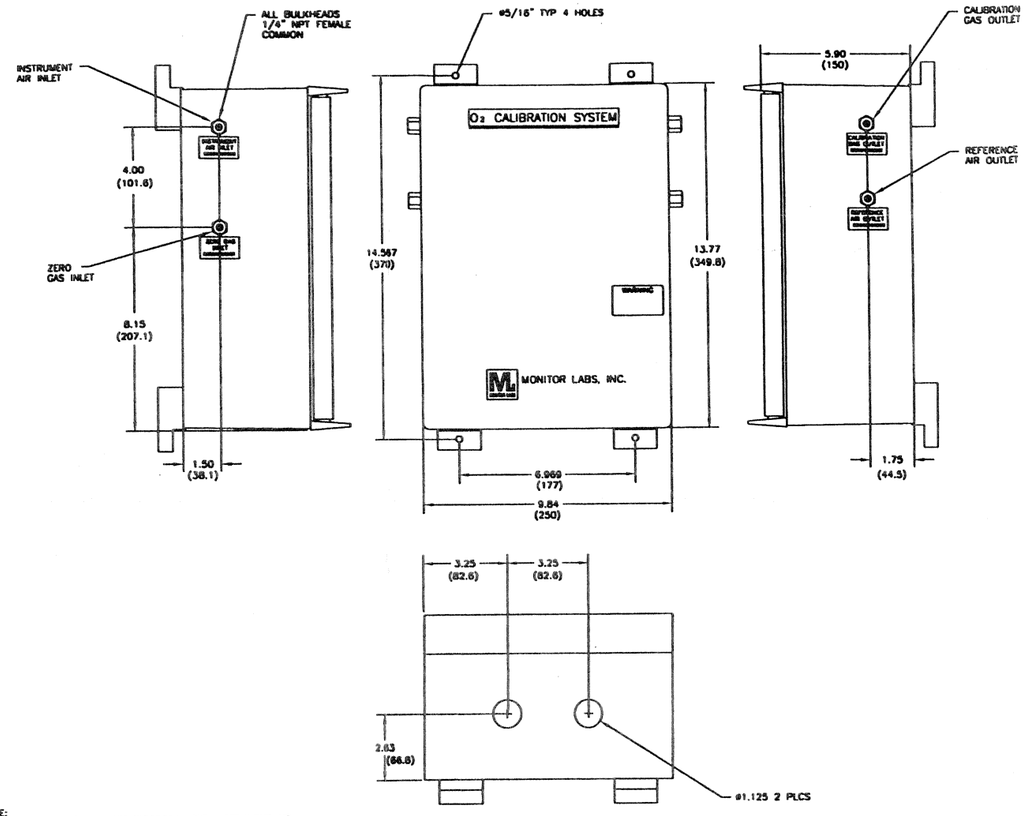
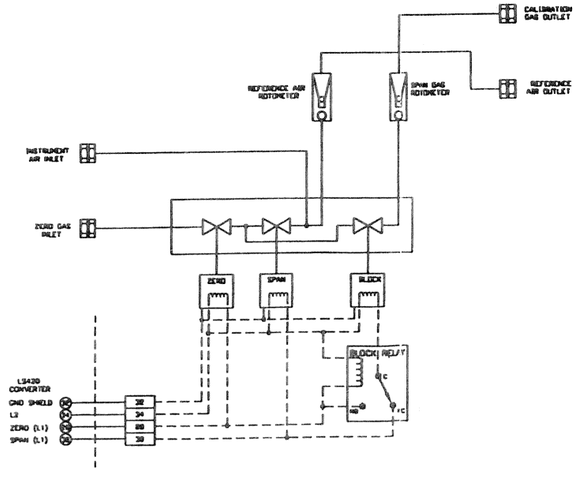


NOTE:
CAUTION: 50 PSIG MAXIMUM PRESSURE FOR INSTRUMENT AIR AND ZERO GAS INLET. 20 PSIG NOMINAL.



FILENAME = B4001802

SIZE	CAGE CODE	DWG NO	REV
D		94200018	E
SCALE		SHEET 2 OF 2	

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Appendix A. O_2 Calibration Assembly

The O_2 calibration assembly works in conjunction with the SM8160 so that whenever the SM8160 is put in calibration, either manually or automatically, the O_2 assembly also actuates the appropriate solenoid to cause the oxygen monitor to calibrate simultaneously.

The assembly must be mounted by the customer (see drawings 80390075 and 80390010-6) no more than 20 feet from the O_2 detector. Instrument air and a low O_2 calibration gas bottle should be located near the calibration assembly. Connect like terminal numbers 26, 27, and 28 between the SM8160 J-box and the O_2 calibration assembly with 18 AWG wire.

When the SM8160 does a zero calibration, the O_2 calibration assembly actuates SOL 1, turning on low gas to the O_2 detector. When the SM8160 does a span calibration, the O_2 calibration assembly actuates SOL 2, turning on HI CAL (instrument air) to the O_2 detector. Swap TB1 terminals 27 and 28 to reverse this sequence and use instrument air (20.9% O_2) for auto zero calibration. (This reserves calibration gas for use during E/O calibrations.)

Appendix B. Second-Derivative Spectroscopy Mathematical Theory

Second-derivative spectroscopy is an optical process that extracts the second derivative $d^2I/d\lambda^2$ of light intensity (I) versus wavelength (λ) from a narrow wavelength region about a peak absorption wavelength (λ_O).

In the SM8160 gas measurement cavity, ultraviolet (UV) light traverses through a constant length absorption medium (Figure 1). Whenever NO or SO_2 exists in the cavity, absorption of UV light occurs. The mathematical relationship between these physical quantities is expressed by this equation:

$$I = I_O e^{-aLc}$$

Equation 1

Where:

I_O = initial UV light intensity before traveling through the cavity

$I = I(\lambda)$ = UV light intensity exiting the cavity; I is a function of λ

$a = a(\lambda)$ = absorption coefficient; a is also a function of pressure and temperature

L = total light path length in the cavity

c = NO or SO_2 gas concentration.

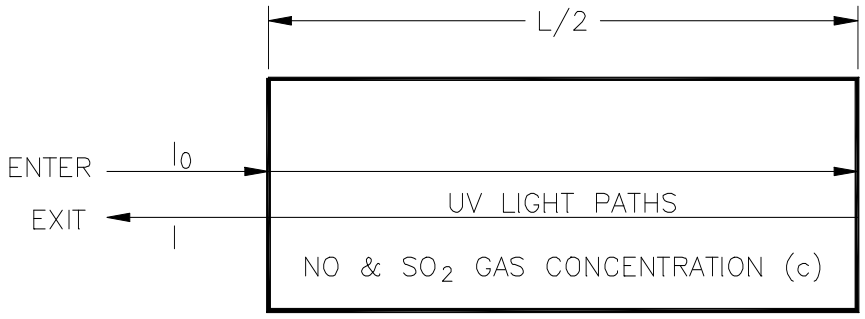

Figure 1. Gas Measurement Cavity

The first derivative of intensity with respect to wavelength is:

$$\frac{dI}{d\lambda} = (\frac{dI_O}{d\lambda})e^{-aLc} - (\frac{da}{d\lambda})LcI_O e^{-aLc}$$

Equation 2

Dividing each side of Equation 2 by Equation 1:

$$\frac{dI}{d\lambda} \div I = (\frac{1}{I_O})(\frac{dI_O}{d\lambda}) - Lc(\frac{da}{d\lambda})$$

Equation 3

Where $da/d\lambda$ is the rate of change of absorption coefficient with wavelength.

The two right-side terms of Equation 3 are independent of intensity. The first is a constant indicating the amount of slope in the UV source spectrum. The second term varies linearly with gas concentration

Taking the second derivative of intensity with respect to wavelength:

$$\frac{d^2I}{d\lambda^2} \div I = (\frac{1}{I_O})(\frac{d^2I_O}{d\lambda^2}) + (Lc[\frac{da}{d\lambda}])^2 - (\frac{2}{I_O})(\frac{dI_O}{d\lambda})(\frac{da}{d\lambda}) - Lc(\frac{d^2a}{d\lambda^2})$$

Equation 4

At the point of maximum curvature, which is at the peak absorption wavelength (I_O), the slope da/d I= 0; Equation 4 then reduces to:

$$(\frac{d^2I}{d\lambda^2}) \div I = \frac{1}{I_O}(\frac{d^2I_O}{d\lambda^2}) - Lc(\frac{d^2a}{d\lambda^2})$$

Equation 5

The first term on the right side of Equation 5 is a constant that measures curvature in the source spectrum. The second term is the curvature in the absorption coefficient.

See Figure 2 for a graphic representation of the absorption spectrum and its first and second derivatives.

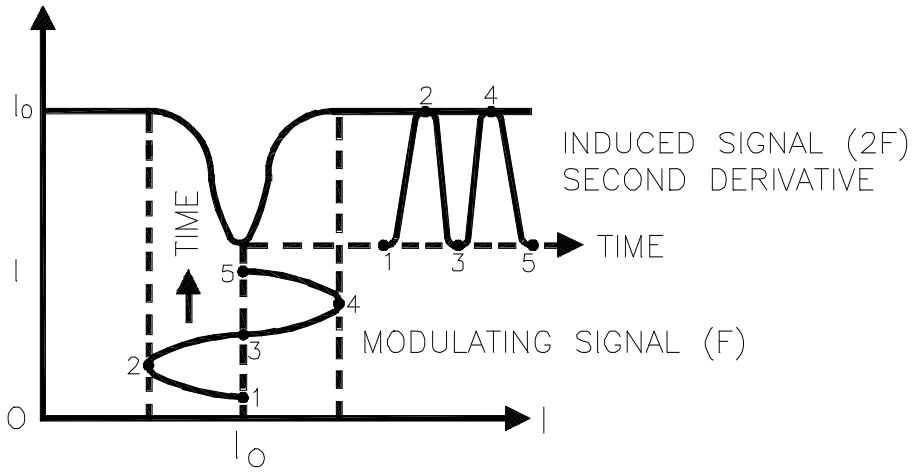

Figure 2. Absorption Curves and Their Derivatives

Next examine the effect of modulating the measured wavelength, λ, over time. I(I) is first expanded into a Taylor series:

$$I(\lambda) = I(\lambda_O) + (\frac{dI}{d\lambda})[\lambda - \lambda_O] + (\frac{d^2I}{d\lambda^2})[\frac{(\lambda - \lambda_O)^2}{2!}] +$$

Equation 6

Now, the wavelength and time variables are introduced. Let:

$$\lambda = \lambda_O + A\sin\omega t$$

Equation 7

A is the amplitude of wavelength modulation and $\omega = 2\pi f$, where f is the modulating frequency. I_O is the peak absorption wavelength.

Note

The quartz window within the monochromator driven by the scanner motor performs this modulation (see paragraph 7.1.1.1).

Substituting Equation 7 into Equation 6:

$$I(\lambda_{O'}t) = I(\lambda_O) + (\frac{dI}{d\lambda})A\sin\omega t + (\frac{d^2I}{d\lambda^2})(\frac{A^2\sin^2(\omega t)}{2!}) + \cdots$$

Equation 8

Substituting the formula $\sin^2 \omega t = (1/2)(1 - \cos 2\omega t)$ for the sine-squared term in Equation 8 gives:

$$I(\lambda_{O'}t) = I(\lambda_O) + (\frac{dI}{d\lambda})A\sin\omega t + (\frac{A^2}{4})(\frac{d^2I}{d\lambda^2}) - (\frac{A^2}{4})(\frac{d^2I}{d\lambda^2})\cos(2\omega t) + \cdots$$

Equation 9

In Equation 9, the amplitudes of sin (ωt) and cos (2 ωt) are respectively proportional to $(dI/d\lambda)$ and $(d^2I/d\lambda^2)$ evaluated at I_O.

Extracting the coefficient expressing the amplitude of the second-derivative signal cos (2 ωt) from Equation 9 and defining it as the signal S (2F, used for the second-derivative signal in the previous section, approximately equals S):

$$S = (\frac{A^2}{4})(\frac{d^2I}{d\lambda^2})[\lambda - \lambda_O]$$

Equation 10

Rewriting Equation 5:

$$(\frac{d^2I}{d\lambda^2}) = -ILc(\frac{d^2a}{d\lambda^2})$$

Equation 11

where $(d^2I_O/d\lambda^2)$ is assumed negligible (ie, a linear source spectrum).

Substituting Equation 11 into Equation 10:

$$S = \left(\frac{-A^2 ILc}{4}\right)\left(\frac{d^2 a}{d\lambda^2}\right)[\lambda - \lambda_O]$$

Equation 12

Assuming a Gaussian distribution for a:

$$a(\lambda) = a_O e - \left[\frac{(\lambda_O - \lambda)}{Z}\right]^2$$

Equation 13

where Z is the half-width of the band at $a = a_O/e$

Differentiating Equation 13 twice with respect to I:

$$\left(\frac{d^2 a}{d\lambda^2}\right)\lambda = \lambda_O = \left(\frac{-a_O}{Z^2}\right)$$

Equation 14

Substituting Equation 14 into Equation 12:

$$S = (A^2 ILca_O) \div (4Z^2)$$

Equation 15

If the modulation amplitude, A, is chosen as 2Z and substituted into Equation 13, then:

$$S = ILca_O$$

Equation 16

Thus S varies linearly with gas concentration. This result is important, because the electronics measurement system is better able to process a linearly-changing signal (S) than a nonlinear one.

The instrument measures the amplitude of the waveform at frequency 2ω coming from the detector. This amplitude is proportional to $d^2a/d\lambda^2$ if measured at a wavelength where "a" is a maximum and where the gas exhibits narrow band absorption.

Reducing this results to direct absorption spectroscopy by setting the product Lc, <<1, then Equation 1 can be expressed as:

$$I = I_O e^{-aLc} \approx I_O (1 - aLc)$$

Equation 17

Solving for the difference between I_O and I:

$$I_O - I = I_O aLc$$

Equation 18

Let $a = a_O$, since a_O is the maximum value at I_O:

$$I_O - I = I_O a_O Lc$$

Equation 19

The right side of Equation 19 equals the right side of Equation 16. Therefore:

$$S = I_O - I$$

Equation 20

Equation 20 shows that the second-derivative maximum signal amplitude S is equal to the difference between the initial, UV light intensity (I_O) and the absorption wavelength light intensity (I) exiting from the cavity. This result is identical to direct absorption methods.

The signal levels from the two techniques are, then, approximately the same. However, there is one important difference. The derivative spectrometer is a signal which is proportional to concentration, where the direct absorption is the difference between light levels (a very small value). Note also that the derivative is a function of the signature of the gas making this method highly specific;

hence, immune to interference. Figure 3 shows that Equation 20 is approximately correct, because the (2F) amplitude nearly equals (S).

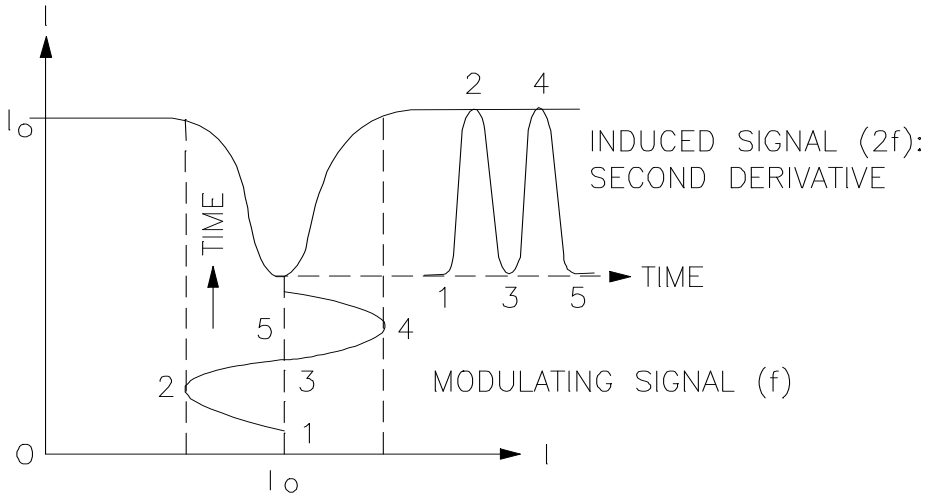

Figure 3. Absorption Curve Modulated with Curvature

Appendix C. Temperature vs Resistance Table

For European Curve, Alpha = .00385 — 1° Celsius Increments

°C	Ohm	Diff	°C	Ohm	Diff	°C	Ohm	Diff	°C	Ohm	Diff	°C	Ohm	Diff	°C	Ohm	Diff
-200	18.49		**-140**	43.87	.42	**-80**	68.33	.41	**-20**	92.16	.39	**±0**	100.00	.39	**+60**	123.24	.38
199	18.93	.44	**139**	44.28	.41	**79**	68.73	.40	**19**	92.55	.39	**+1**	100.39	.39	**61**	123.62	.38
198	19.36	.43	**138**	44.70	.42	**78**	69.13	.40	**18**	92.95	.40	**2**	100.78	.39	**62**	124.01	.39
197	19.79	.43	**137**	45.11	.41	**77**	69.53	.40	**17**	93.34	.39	**3**	101.17	.39	**63**	124.39	.38
196	20.22	.43	**136**	45.52	.41	**76**	69.93	.40	**16**	93.73	.39	**4**	101.56	.39	**64**	124.77	.38
195	20.65	.43	**135**	45.94	.42	**75**	70.33	.40	**15**	94.12	.39	**5**	101.95	.39	**65**	125.16	.39
194	21.08	.43	**134**	46.35	.41	**74**	70.73	.40	**14**	94.52	.40	**6**	102.34	.39	**66**	125.54	.38
193	21.51	.43	**133**	46.76	.41	**73**	71.13	.40	**13**	94.91	.39	**7**	102.73	.39	**67**	125.92	.38
192	21.94	.43	**132**	47.18	.42	**72**	71.53	.40	**12**	95.30	.39	**8**	103.12	.39	**68**	126.31	.39
191	22.37	.43	**131**	47.59	.41	**71**	71.93	.40	**11**	95.69	.39	**9**	103.51	.39	**69**	126.69	.38
190	22.80	.43	**130**	48.00	.41	**70**	72.33	.40	**10**	96.09	.40	**10**	103.90	.39	**70**	127.07	.38
189	23.23	.43	**129**	48.41	.41	**69**	72.73	.40	**9**	96.48	.39	**11**	104.29	.39	**71**	127.45	.38
188	23.66	.43	**128**	48.82	.41	**68**	73.13	.40	**8**	96.87	.39	**12**	104.68	.39	**72**	127.84	.39
187	24.09	.43	**127**	49.23	.41	**67**	73.53	.40	**7**	97.26	.39	**13**	105.07	.39	**73**	128.22	.38
186	24.52	.43	**126**	49.64	.41	**66**	73.93	.40	**6**	97.65	.39	**14**	105.46	.39	**74**	128.60	.38
185	24.94	.42	**125**	50.06	.42	**65**	74.33	.40	**5**	98.04	.39	**15**	105.85	.39	**75**	128.98	.38
184	25.37	.43	**124**	50.47	.41	**64**	74.73	.40	**4**	98.44	.40	**16**	106.24	.39	**76**	129.37	.39
183	25.80	.43	**123**	50.88	.41	**63**	75.13	.40	**3**	98.83	.39	**17**	106.63	.39	**77**	129.75	.38
182	26.23	.43	**122**	51.29	.41	**62**	75.53	.40	**2**	99.22	.39	**18**	107.02	.39	**78**	130.13	.38
181	26.65	.42	**121**	51.70	.41	**61**	75.93	.40	**1**	99.61	.39	**19**	107.40	.38	**79**	130.51	.38
180	27.08	.43	**120**	52.11	.41	**60**	76.33	.40				**20**	107.79	.39	**80**	130.89	.38
179	27.50	.42	**119**	52.52	.41	**59**	76.73	.40				**21**	108.18	.39	**81**	131.27	.38
178	27.93	.43	**118**	52.92	.40	**58**	77.13	.40				**22**	108.57	.39	**82**	131.66	.39
177	28.35	.42	**117**	53.33	.41	**57**	77.52	.39				**23**	108.96	.39	**83**	132.04	.38
176	28.78	.43	**116**	53.74	.41	**56**	77.92	.40				**24**	109.35	.39	**84**	132.42	.38
175	29.20	.42	**115**	54.15	.41	**55**	78.32	.40				**25**	109.73	.38	**85**	132.80	.38
174	29.63	.43	**114**	54.56	.41	**54**	78.72	.40				**26**	110.12	.39	**86**	133.18	.38
173	30.05	.42	**113**	54.97	.41	**53**	79.11	.39				**27**	110.51	.39	**87**	133.58	.38
172	30.47	.42	**112**	55.38	.41	**52**	79.51	.40				**28**	110.90	.39	**88**	133.94	.38
171	30.90	.43	**111**	55.78	.40	**51**	79.91	.40				**29**	111.28	.38	**89**	134.32	.38
170	31.32	.42	**110**	56.19	.41	**50**	80.31	.40				**30**	111.67	.39	**90**	134.70	.38
169	31.74	.42	**109**	56.60	.41	**49**	80.70	.39				**31**	112.06	.39	**91**	135.08	.38
168	32.16	.42	**108**	57.00	.40	**48**	81.10	.40				**32**	112.45	.39	**92**	135.46	.38
167	32.59	.43	**107**	57.41	.41	**47**	81.50	.40				**33**	112.83	.38	**93**	135.84	.38
166	33.01	.42	**106**	57.82	.41	**46**	81.89	.39				**34**	113.22	.39	**94**	136.22	.38
165	33.43	.42	**105**	58.22	.40	**45**	82.29	.40				**35**	113.61	.39	**95**	136.60	.38
164	33.85	.42	**104**	58.63	.41	**44**	82.69	.40				**36**	113.99	.38	**96**	136.98	.38
163	34.27	.42	**103**	59.04	.41	**43**	83.08	.39				**37**	114.38	.39	**97**	137.36	.38
162	34.69	.42	**102**	59.44	.40	**42**	83.48	.40				**38**	114.77	.39	**98**	137.74	.38
161	35.11	.42	**101**	59.85	.41	**41**	83.88	.40				**39**	115.15	.38	**99**	138.12	.38
160	35.53	.42	**100**	60.25	.40	**40**	84.27	.39				**40**	115.54	.39	**100**	138.50	.38
159	35.95	.42	**99**	60.66	.41	**.39**	84.67	.40				**41**	115.93	.39	**101**	138.88	.38
158	36.37	.42	**98**	61.06	.40	**38**	85.06	.39				**42**	116.31	.38	**102**	139.26	.38
157	36.79	.42	**97**	61.47	.41	**37**	85.46	.40				**43**	116.70	.39	**103**	139.64	.38
156	37.21	.42	**96**	61.87	.40	**36**	85.85	.39				**44**	117.08	.38	**104**	140.02	.38
155	37.63	.42	**95**	62.28	.41	**35**	86.25	.40				**45**	117.47	.39	**105**	140.39	.37
154	38.04	.41	**94**	62.66	.40	**34**	86.64	.39				**46**	117.85	.38	**106**	140.77	.38
153	38.46	.42	**93**	63.09	.41	**33**	87.04	.40				**47**	118.24	.39	**107**	141.15	.38
152	38.88	.42	**92**	63.49	.40	**32**	87.43	.39				**48**	118.62	.38	**108**	141.53	.38
151	39.30	.42	**91**	63.90	.41	**31**	87.83	.40				**49**	119.01	.39	**109**	141.91	.38
150	39.71	.41	**90**	64.30	.40	**30**	88.22	.39				**50**	119.40	.39	**110**	142.29	.38
149	40.13	.42	**89**	64.70	.40	**29**	88.62	.40				**51**	119.78	.38	**111**	142.66	.37
148	40.55	.42	**88**	65.11	.41	**28**	89.01	.39				**52**	120.16	.38	**112**	143.04	.38
147	40.96	.41	**87**	65.51	.40	**27**	89.40	.39				**53**	120.55	.39	**113**	143.42	.38
146	41.38	.42	**86**	65.91	.40	**26**	89.80	.40				**54**	120.93	.38	**114**	143.80	.38
145	41.79	.41	**85**	66.31	.40	**25**	90.19	.39				**55**	121.32	.39	**115**	144.17	.37
144	42.21	.42	**84**	66.72	.41	**24**	90.59	.40				**56**	121.70	.38	**116**	144.55	.38
143	42.63	.42	**83**	67.12	.40	**23**	90.98	.39				**57**	122.09	.39	**117**	144.93	.38
142	43.04	.41	**82**	67.52	.40	**22**	91.37	.39				**58**	122.47	.38	**118**	145.31	.38
141	43.45	.41	**81**	67.92	.40	**21**	91.77	.40				**59**	122.86	.39	**119**	145.68	.37
+120	146.06	.38	**+180**	168.46	.37	**+240**	190.45	.36	**+300**	212.02	.36	**+360**	233.17	.35	**+420**	253.90	.34
121	146.44	.38	**181**	168.83	.37	**241**	190.81	.36	**301**	212.37	.35	**361**	233.52	.35	**421**	254.24	.34
122	146.81	.37	**182**	169.20	.37	**242**	191.18	.37	**302**	212.73	.36	**362**	233.87	.35	**422**	254.59	.35

°C	Ohm	Diff	°C	Ohm	Diff	°C	Ohm	Diff	°C	Ohm	Diff	°C	Ohm	Diff	°C	Ohm	Diff
123	147.19	.38	**183**	169.57	.37	**243**	191.54	.36	**303**	213.09	.36	**363**	234.22	.35	**423**	254.93	.34
124	147.57	.38	**184**	169.94	.37	**244**	191.90	.36	**304**	213.44	.35	**364**	234.56	.34	**424**	255.27	.34
125	147.94	.37	**185**	170.31	.37	**245**	192.26	.36	**305**	213.80	.36	**365**	234.91	.35	**425**	255.61	.34
126	148.32	.38	**186**	170.68	.37	**246**	192.63	.37	**306**	214.15	.35	**366**	235.26	.35	**426**	255.95	.34
127	148.70	.38	**187**	171.05	.37	**247**	192.99	.36	**307**	214.51	.36	**367**	235.61	.35	**427**	256.29	.34
128	149.07	.37	**188**	171.42	.37	**248**	193.35	.36	**308**	214.86	.35	**368**	235.96	.35	**428**	256.64	.35
129	149.45	.38	**189**	171.79	.37	**249**	193.71	.36	**309**	215.22	.36	**369**	236.31	.35	**429**	256.98	.34
130	149.82	.37	**190**	172.16	.37	**250**	194.07	.36	**310**	215.57	.35	**370**	236.65	.34	**430**	257.32	.34
131	150.20	.38	**191**	172.53	.37	**251**	194.44	.37	**311**	215.93	.36	**371**	237.00	.35	**431**	257.66	.34
132	150.57	.37	**192**	172.90	.37	**252**	194.80	.36	**312**	216.28	.35	**372**	237.35	.35	**432**	258.00	.34
133	150.95	.38	**193**	173.26	.36	**253**	195.16	.36	**313**	216.64	.36	**373**	237.70	.35	**433**	258.34	.34
134	151.33	.38	**194**	173.63	.37	**254**	195.52	.36	**314**	216.99	.35	**374**	238.04	.34	**434**	258.68	.34
135	151.70	.37	**195**	174.00	.37	**255**	195.88	.36	**315**	217.35	.36	**375**	238.39	.35	**435**	259.02	.34
136	152.08	.38	**196**	174.37	.37	**256**	196.24	.36	**316**	217.70	.35	**376**	238.74	.35	**436**	259.36	.34
137	152.45	.37	**197**	174.74	.37	**257**	196.60	.36	**317**	218.05	.35	**377**	239.09	.35	**437**	259.70	.34
138	152.83	.38	**198**	175.10	.36	**258**	196.96	.36	**318**	218.41	.36	**378**	239.43	.34	**438**	260.04	.34
139	153.20	.37	**199**	175.47	.37	**259**	197.33	.37	**319**	218.76	.35	**379**	239.78	.35	**439**	260.38	.34
140	153.58	.38	**200**	175.84	.37	**260**	197.69	.36	**320**	219.12	.36	**380**	240.13	.35	**440**	260.72	.34
141	153.95	.37	**201**	176.21	.37	**261**	198.05	.36	**321**	219.47	.35	**381**	240.47	.34	**441**	261.06	.34
142	154.32	.37	**202**	176.57	.36	**262**	198.41	.36	**322**	219.82	.35	**382**	240.82	.35	**442**	261.40	.34
143	154.70	.38	**203**	176.94	.37	**263**	198.77	.36	**323**	220.18	.36	**383**	214.17	.35	**443**	261.74	.34
144	155.07	.37	**204**	177.31	.37	**264**	199.13	.36	**324**	220.53	.35	**384**	241.51	.34	**444**	262.08	.34
145	155.45	.38	**205**	177.68	.37	**265**	199.49	.36	**325**	220.88	.35	**385**	241.86	.35	**445**	262.42	.34
146	155.82	.37	**206**	178.04	.36	**266**	199.85	.36	**326**	221.24	.36	**386**	242.20	.34	**446**	262.76	.34
147	156.19	.37	**207**	178.41	.37	**267**	200.21	.36	**327**	211.59	.35	**387**	242.55	.35	**447**	263.10	.34
148	156.57	.38	**208**	178.78	.37	**266**	200.57	.36	**328**	221.94	.35	**388**	242.90	.35	**448**	236.43	.33
149	156.94	.37	**209**	179.14	.36	**269**	200.93	.36	**329**	222.29	.35	**389**	243.24	.34	**449**	263.77	.34
150	157.31	.37	**210**	179.51	.37	**270**	201.29	.36	**330**	222.65	.36	**390**	243.59	.35	**450**	264.11	.34
151	157.69	.38	**211**	179.88	.37	**271**	201.65	.36	**331**	223.00	.35	**391**	243.93	.34	**451**	264.45	.34
152	158.06	.37	**212**	180.24	.36	**272**	202.01	.36	**332**	223.35	.35	**392**	244.28	.35	**452**	264.79	.34
153	158.43	.37	**213**	180.61	.37	**273**	202.36	.35	**333**	223.70	.35	**393**	244.62	.34	**453**	265.13	.34
154	158.81	.38	**214**	180.97	.36	**274**	202.72	.36	**334**	224.06	.36	**394**	244.97	.35	**454**	265.47	.34
155	159.18	.37	**215**	181.34	.37	**275**	203.08	.36	**335**	224.41	.35	**395**	245.31	.34	**455**	265.80	.33
156	159.55	.37	**216**	181.71	.37	**276**	203.44	.36	**336**	224.76	.35	**396**	245.66	.35	**456**	266.14	.34
157	159.93	.38	**217**	182.07	.36	**277**	203.80	.36	**337**	225.11	.35	**397**	246.00	.34	**457**	266.48	.34
158	160.30	.37	**218**	182.44	.37	**278**	204.16	.36	**338**	225.46	.35	**398**	246.35	.35	**458**	266.82	.34
159	160.67	.37	**219**	182.80	.36	**279**	204.52	.36	**339**	225.81	.35	**399**	246.69	.34	**459**	267.15	.33
160	161.04	.37	**220**	183.17	.37	**280**	204.88	.36	**340**	226.17	.36	**400**	247.04	.35	**460**	267.49	.34
161	161.42	.38	**221**	183.53	.36	**281**	205.23	.35	**341**	226.52	.35	**401**	247.38	.34	**461**	267.83	.34
162	161.79	.37	**222**	183.90	.37	**282**	205.59	.36	**342**	226.87	.35	**402**	247.73	.35	**462**	268.17	.34
163	162.16	.37	**223**	184.26	.36	**283**	205.95	.36	**343**	227.22	.35	**403**	248.07	.34	**463**	268.50	.33
164	162.53	.37	**224**	184.63	.37	**284**	206.31	.36	**344**	227.57	.35	**404**	248.41	.34	**464**	268.84	.34
165	162.90	.37	**225**	184.99	.36	**285**	206.67	.36	**345**	227.92	.35	**405**	248.76	.35	**465**	269.18	.34
166	163.27	.37	**226**	185.38	.37	**286**	207.02	.35	**346**	228.27	.35	**406**	249.10	.34	**466**	269.51	.33
167	163.65	.38	**227**	185.72	.36	**287**	207.38	.36	**347**	228.62	.35	**407**	249.45	.35	**467**	269.85	.34
168	164.02	.37	**228**	186.09	.37	**288**	207.74	.36	**348**	228.97	.35	**408**	249.79	.34	**468**	270.19	.34
169	164.39	.37	**229**	186.45	.36	**289**	208.10	.36	**349**	229.32	.35	**409**	250.13	.34	**469**	270.52	.33
170	164.76	.37	**230**	186.82	.37	**290**	208.45	.35	**350**	229.67	.35	**410**	250.48	.35	**470**	270.86	.34
171	165.13	.37	**231**	187.18	.36	**291**	208.81	.36	**351**	230.02	.35	**411**	250.82	.34	**471**	271.20	.34
172	165.50	.37	**232**	187.54	.36	**292**	209.17	.36	**352**	230.37	.35	**412**	251.16	.34	**472**	271.53	.33
173	165.87	.37	**233**	187.91	.37	**293**	209.52	.35	**353**	230.72	.35	**413**	251.50	.34	**473**	271.87	.34
174	166.24	.37	**234**	188.27	.36	**294**	209.88	.36	**354**	231.07	.35	**414**	251.85	.35	**474**	272.20	.33
175	166.61	.37	**235**	188.63	.36	**295**	210.24	.36	**355**	231.42	.35	**415**	252.19	.34	**475**	272.54	.34
176	166.98	.37	**236**	189.00	.37	**296**	210.59	.35	**358**	231.77	.35	**416**	252.53	.34	**476**	272.88	.34
177	167.35	.37	**237**	189.36	.36	**297**	210.95	.36	**357**	232.12	.35	**417**	252.88	.35	**477**	273.21	.33
178	167.72	.37	**238**	189.72	.36	**298**	211.31	.36	**358**	232.47	.35	**418**	253.22	.34	**478**	273.55	.34
179	168.09	.37	**239**	190.09	.37	**299**	211.66	.35	**359**	232.82	.35	**419**	253.56	.34	**479**	273.88	.33

Note: At 100° C resistance is 138.50 Ohms.

Din 43 760

SM8160 Glossary of Terms and Abbreviations

Absorption. The process by which the number of particles or photons entering a body of matter is reduced by interaction with that matter.

Absorption coefficient. The ratio of light energy absorbed by a medium to the total intensity of light leaving the original source.

Beam splitter. A device used to divide a light beam into two parts, one transmitted and the other reflected.

Collimated light. Parallel light rays as opposed to converging or diverging rays. In the SM8160, a collimating mirror is used in the monochromator to divert parallel rays to the diffusion grating.

Configuration Menu. The basic menu that includes all headings and subheadings programmed into the controller; used primarily during initial setup or reconfiguration of a system.

Demodulator. A device that operates on a previously modulated wave to give it substantially the same characteristics as the original modulating wave. The SM8160 demodulator is a half-wave demodulator.

Diffraction grating. A device that bends incident light at angles that are a function of the light wavelengths. Light is separated according to wavelength in a manner similar to a prism separating white light into a rainbow of colors.

DVM. Digital voltmeter.

Dynode. An auxiliary electrode that, when functioning within a PMT and bombarded by photoelectrons, gives rise to secondary emission and amplification.

Electromagnetic wave spectrum. The range of electromagnetic wavelengths including radio frequency waves, light waves, infrared waves, X-rays, and gamma rays.

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 places a zero gas and span filter into the measurement path, rather than using NBS-traceable gases injected into the measurement cavity.

Ferrule. A metal ring near the end of the SM8160 thermocouple probe that secures the thermocouple connection.

Gain factors (XX G). Gain factors used to trim out variations from instrument to instrument that can be manipulated manually or calculated from NO G and SO_2 G during a manually-activated 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 instead of span gases.

HV. High voltage.

HV CONT. High voltage control or high voltage controller.

In situ. In situ analysis places the sensor in the process being measured.

J-box. Junction box; a separate component of the SM8160 that houses test points, circuit boards, manual switches, and interface points/terminal strips.

Low-pass filter. A filter that passes all frequencies below a specified cutoff point and attenuates (decreases the amplitude of) all frequencies above that point.

Modulation. The process of modifying some characteristics of a wave; controlled variation of frequency, phase, or amplitude.

Monochromator. An instrument used to isolate narrow portions of the spectrum by making use of the dispersion of light into its component wavelengths. In the SM8160, the monochromator is a self-contained unit that optically generates the second-derivative signals for NO and SO_2.

Nanometer. One billionth of a meter (10^{-9})

PCB. Printed circuit board.

PMT. Photomultiplier tube; a phototube (photoelectric tube) with one or more dynodes that acts as a simple photocell with a high-gain amplifier in a self-contained unit. In the SM8160, the PMT transforms UV light into an electrical current.

Retroreflector. A reflector that returns light along a straight path regardless of the angle of the light striking the reflector.

RTD. Resistance temperature detector.

SCR. Silicon controller rectifier.

Scroll. A repeating list or display of the controller 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.

SDA. Serial data acquisition.

Second-derivative spectroscopy. The measurement of the amount of curvature in a narrow wavelength band. The SM8160 determines SO_2 and NO concentrations by measuring the amount of curvature around specific absorption wavelengths.

Spectroscopy. The measurement of radiation absorbed or emitted when molecules change from one energy level to another; the branch of science dealing with the theory and interpretation of spectra; a branch of optics dealing with radiation in the infrared, visible, and ultraviolet regions of the spectrum.

Transceiver. Transmitter/receiver. In the SM8160, the transceiver houses the UV lamp optics, detector, and signal processing electronics used to measure NO and SO_2.

UART. Universal asynchronous receiver transmitter; a component of the serial data acquisition circuit in the SM8160 J-box that controls communication with the controller.

UV. Ultraviolet.

XCVR. Transceiver.