ENGINEERING LABORATORY DESIGN, INC.

BOX 278 • LAKE CITY, MINNESOTA 55041 • TELEPHONE 612-345-4515

SUBSONIC WIND TUNNEL

Instrumentation System

Operating Instructions

ENGINEERING LABORATORY DESIGN, INC.

BOX 278 • LAKE CITY, MINNESOTA 55041 • TELEPHONE 612-345-4515 651-345-4515

12" OPEN CIRCUIT WIND TUNNEL

RECEIVING, INSTALLATION, OPERATING AND MAINTENANCE INSTRUCTIONS

RECEIVING AND UNPACKING

1. The 12" Open Circuit Wind Tunnel is shipped in two crates. One crate contains the fan/silencer assembly and its frame. A second crate carries the duct assembly and its supporting frame.

2. Inspect the shipping containers at the time of delivery for evidence of external damage. Note any damage to the crates on the delivery receipt. Failure to do so may result in the refusal of the carrier honor a claim for damages.

3. Carefully unpack the crates and thoroughly examine the contents for damage as soon as possible after delivery. If damage is discovered during unpacking notify the carrier immediately and request a concealed damage inspection. Retain all packing materials until after they have been inspected by the carriers agent.

SITE SELECTION AND ELECTRIC SERVICE

1. The tunnel should be sited so that convenient access is available to both sides of the test section. Allow at least 6 feet of clear area at the inlet and the fan discharge. Cross flow and/or asymetric flow situations at the inlet should be avoided. Proximity to the electric service should also be considered.

   If the tunnel is to be permanently located the casters may be removed.

2. This unit should be provided with a separate branch electric circuit. The fan motor "full load amperage" is shown on the motor name plate and on the wind tunnel serial number plate. The National Electrical Code, Paragraph 430-22 specifies a branch circuit capacity of 140% of the motor nameplate "full load amperage" for a motor operating in this service.

ASSEMBLY

1. Move the components to the assembly site. Using the attached drawing as a guide assemble the wind tunnel.

2. A mating recepticle is furnished with the service cord electrical connector.

3. Verify that the fan shaft is rotating in the proper direction. "Jog" the motor by pushing the "start" button and then the "stop" button. As the motor decelerates sense the direction of rotation by inserting a pencil through an aperture in the belt guard so that it contacts the moving belt. A label on the fan shell indicates the proper rotation direction. If the rotation is incorrect simply interchange any two of the three motor wires in the magnetic starter enclosure.

DESCRIPTION AND OPERATION

1. The wind tunnel is an Eiffel type. Air is drawn into the radiused inlet, through a honeycomb /filter / screen pack flow straightener and accelerated through the contraction into the test section. The flow then passes through the diffuser section into the cent-axial fan and is discharged through the silencer to the room.

2. Test section speed is regulated using a bypass system. A handwheel, located on the frame below the test section, turns a lead screw which traverses the fan/silencer assembly along the axis of the tunnel. As the gap between the fan inlet and the diffuser outlet is increased the test section velocity is diminished. The minimum velocity, with a fully open gap, is about 20 fps.

3. The test section interior may be accessed by removing the cover or the side wall port plug. The plexiglass walls of the test section may be drilled and tapped to facilitate mounting of instruments and test fixtures. Additional wall port plugs can be furnished if required. The quick release fasteners on the cover are arranged so that the cover can be fitted in only one orientation.

CAUTIONS

1. Insure that all persons using this equipment have been familiarized with its operation.

2. Do not operate the system at high speeds with the test section cover removed.

3. Verify that models and test fixtures are securely fastened in the test section before starting the fan.

MAINTENANCE

1. Users and maintenance personnel are urged to read and follow the manufacturer's instructions furnished with the components of this equipment. Adherence to the fan and motor lubricating instructions and schedule is especially important.

2. Dirt and grease marks may be removed from the fiberglass surfaces using a detergent and water solution applied with a soft cloth.

3. The plexiglass test section should be washed periodically with a mild detergent and clean water using a soft cloth. Care should be taken to avoid scratching the surface. Remove residual water spots with clean paper towelling. Fine abrasions and cloudiness may be removed by fine sanding and polishing. We recommend a scratch removal kit available from MICRO-FINISHING PRODUCTS, INC., Box 456, Wilton, Iowa 52788. Attempts to remove deep scratches are generally futile.

SUBSONIC WIND TUNNEL INSTRUMENTATION SYSTEM

The Engineering Laboratory Design, Inc. Wind Tunnel Instrumentation System is a complete basic package which has been designed for use with subsonic wind tunnels in undergraduate student laboratories.

The basic functions of the unit are the measurements of lift, drag, pressure, and the longitudincal and vertical coordinates of a total head probe.

The system consists of four major components: The dynamometer assembly, the pressure transducer, the test section assembly and the meter-control cabinet.

Dynamometer Assembly

The dynamometer assembly measures the forces of lift and drag with two separate dynamometers which are positioned to respond to forces acting at right angles to each other.

The dynamometers are similar in construction and operation and utilize pairs of parallel aluminum beams, as shown in Figure A. These beams are designed to respond with great sensitivity to forces within their expected load ranges.

A lift or drag force applied to the dynamometer produces a deflection of the beams which is directly proportional to the magnitude of that force. This deflection is sensed by a linear variable differential transformer (LVDT), the core of which is fixed to a movable armature. Output signals from the LVDT's are demodulated and amplified by signal conditioning modules. The resulting DC voltages represent the direction and magnitude of the force applied to the dynamometer.

Pressure Transducer

The pressure transducer is a differential type consisting of a pressure capsule, an LVDT and exitation, demodulating and amplification circuitry.

Pressure is applied to the interior of the pressure capsule. The chamber surrounding the pressure capsule may be vented to atmosphere or connected to the test section static pressure tap.

Differential pressures applied to the capsule deflect the coupled LVDT core. The resulting electrical signal is proportional to the applied pressure.

The pressure transducer is mounted in the left side of the meter/control cabinet. Please consult the manufacturer's instructions for additional information and specifications.

Test Section Assembly

The velocity can be measured at any location in the vertical-longitudinal test section center line plane by means of a movable total head probe.

The exact position of the velocity probe is indicated by a pair of precision multi-turn potentiometers. Electrical output signals from these potentiometers represent the X and Y coordinates of the probe.

Meter-Control Cabinet

The electrical signals representing the five modes, lift, drag, pressure, X and Y are transmitted to the meter-control cabinet via an interconnecting plug-in cable. Trimmer potentiometers are provided in the circuit to adjust the input voltage signals to the digital meter. The digital meter can thus be calibrated to read directly in any units desired.

The system is normally calibrated prior to delivery to read:

Lift and Drag . . . . Pounds
Pressure . . . . Inches of water
X and Y Coordinates . . . . Inches.

The force, pressure, or coordinate to be measured is selected by the mode control located on the right front of the cabinet.

Individual pressure taps are connected to the pressure transducer by the pressure selector valve located on the left front of the cabinet.

All components of the electrical circuit are protected by a 2 amp. fuse. The fuse holder is located on the back of the cabinet.

A switch for electrical current supply is located on the front of the cabinet. Schematic diagrams of the electrical circuit are shown in figure C.

Models

Several models are available as accessories to the Engineering Laboratory Design Wind Tunnel Instrumentation System. These include:

1. NACA 0012 Wing Section with a 4-inch chord and adjustable angle of attack for use with the dynamometer.

2. NACA 0012 Wing Section with a 4-inch chord and adjustable angle of attack with pressure taps installed for use in determining pressure distributions. (See fig. E.)

CALIBRATION PROCEDURE

I. Dynamometer

A. Lift component.

1. Remove the dynamometer assembly from the test section and clamp the base plate firmly on a bench or table with the sting and shield extending over the edge.

2. Fasten a suitable weight pan to the sting.

3. Set the mode selector switch to "Lift" and adjust the meter display to zero by turning the lift LVDT core thumb wheel.

4. Place a suitable known weight on the weight pan.

5. Adjust the digital meter display to correspond with the value of the applied load by trimming the LIFT-SPAN potentiometer located in the back of the meter cabinet.

6. After completion of calibration the tare weight of the model and sting is removed from the display by adjusting the zeroing thumb wheel as in 3 above.

B. Drag component.

1. Remove the dynamometer assembly from the test section and rigidly fasten the base plate in a vertical position so that the drag beams may be loaded.

2. Fasten a suitable weight pan to the sting.

3. Set the mode selector switch to "DRAG" and adjust the meter display to zero by turning the drag LVDT core thumb wheel.

4. Place a suitable known weight on the weight pan.

5. Adjust the meter display to correspond with the value of the applied load by trimming the DRAG-SPAN potentiometer located in the rear of the meter cabinet.

6. The tare weight may be removed as before by adjusting the zeroing thumb wheel.

II. Velocity tracking probe assembly.

A. Longitudinal tracking - (x-coordinate)

1. Set the mode selector to "x". Traverse the probe to its extreme downstream position. The meter display should read zero.

2. Fasten a suitable scale to the test section cover adjacent to a prominent feature of the velocity probe base.

3. Traverse the probe assembly upstream until the prominent feature identified in 2 above is opposite a major division on the scale (i.e. 12.000").

4. Adjust the trimming potentiometer marked "x-span" until the meter display corresponds with the major scale increment.

B. Vertical tracking (Y coordinate)

1. Adjust the vertical probe so that zero is displayed on the meter with the mode selector set at "Y".

2. Position a suitable scale adjacent to the vertical probe and flush with the top of the probe support.

3. Scribe a mark on the probe at a suitable major scale division.

4. Traverse the probe vertically until the scribe mark made in 3 above is flush with the top of the probe support.

5. Adjust the trimming potentiometer marked "Y-span" until the meter display corresponds with the major scale increment.

III. Pressure transducer

A. Set the mode selector switch to "pressure".

B. Connect the pressure tube No. 0 to a valved tee fitting on one leg of a suitable air/water manometer.

C. Set the pressure selector valve to position zero. Insure that the pressure tube labeled "static" and the other leg of the manometer are open to atmospheric pressure.

D. Adjust the potentiometer marked "pressure zero" so that the display reads zero.

E. Apply a pressure at the valved tee within the range of the pressure transducer.

F. Adjust the "Pressure-span" potentiometer until the meter display corresponds with the units of the applied pressure.

G. Re-check the zero with pressure differential released from the manometer.

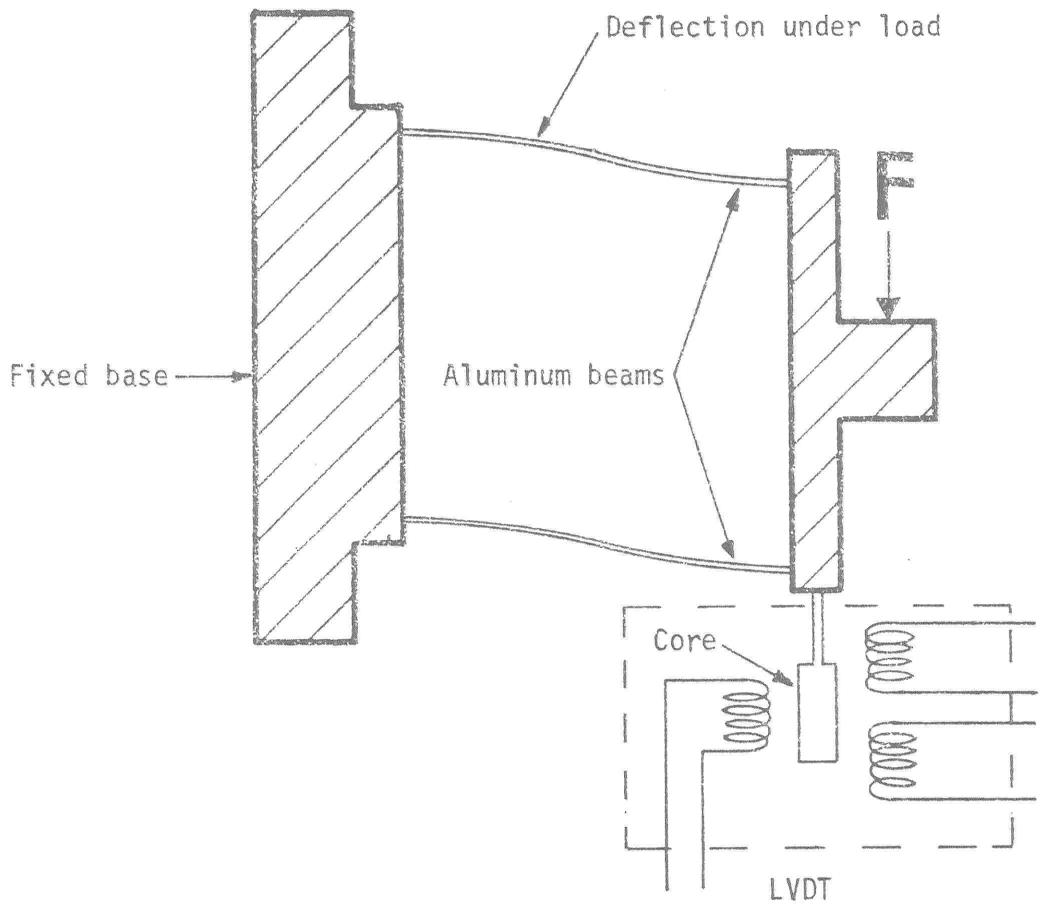

Figure A

Engineering Laboratory Design, Inc. Box 278 Lake City, MN 55041 612-345-4515	This drawing and the information it contains are the property of Engineering Laboratory Design, Inc. Reproduction by any means and/or transmission to others without authorization is prohibited.	Reference	Scale None	Diagram of Dynamometer
		Date 8-82	Drawn by	

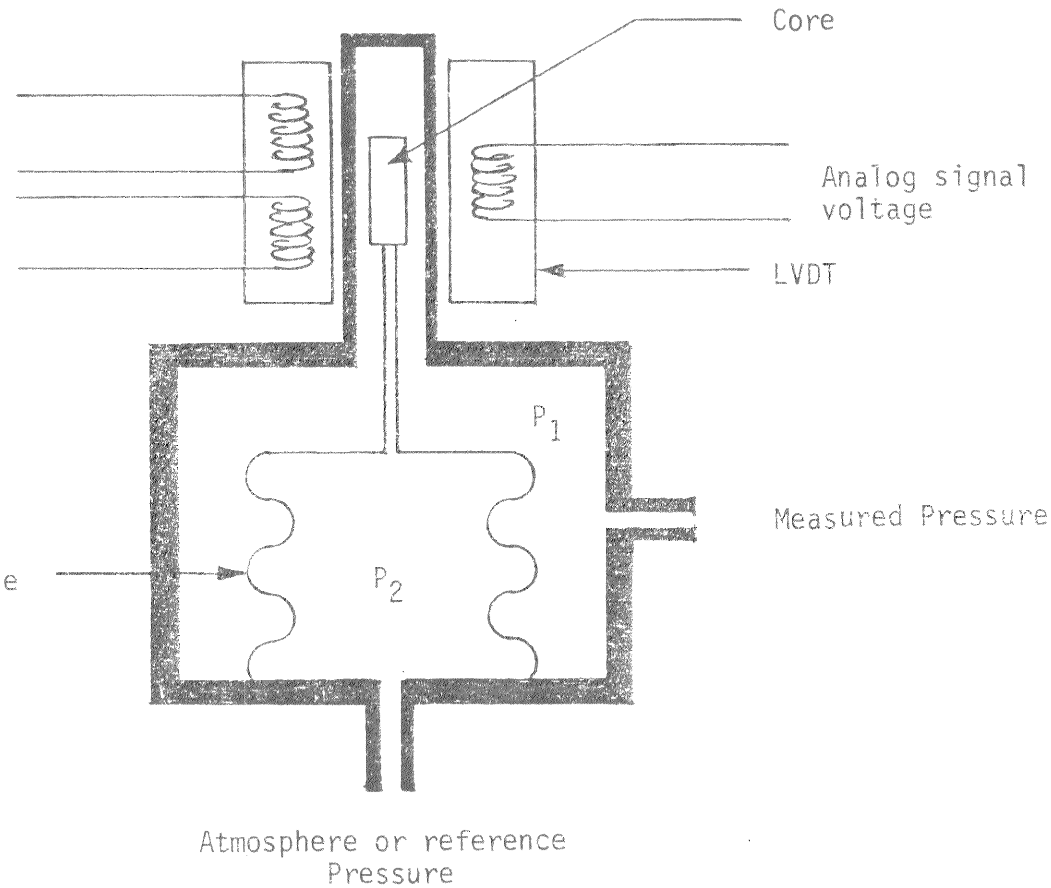

Figure B

Engineering Laboratory Design, Inc. Box 278 Lake City, MN 55041 612-345-4515	This drawing and the information it contains are the property of Engineering Laboratory Design, Inc. Reproduction by any means and/or transmission to others without authorization is prohibited.	Reference	Scale None	Diagram of Pressure Transducer
		Date 8-82	Drawn by	

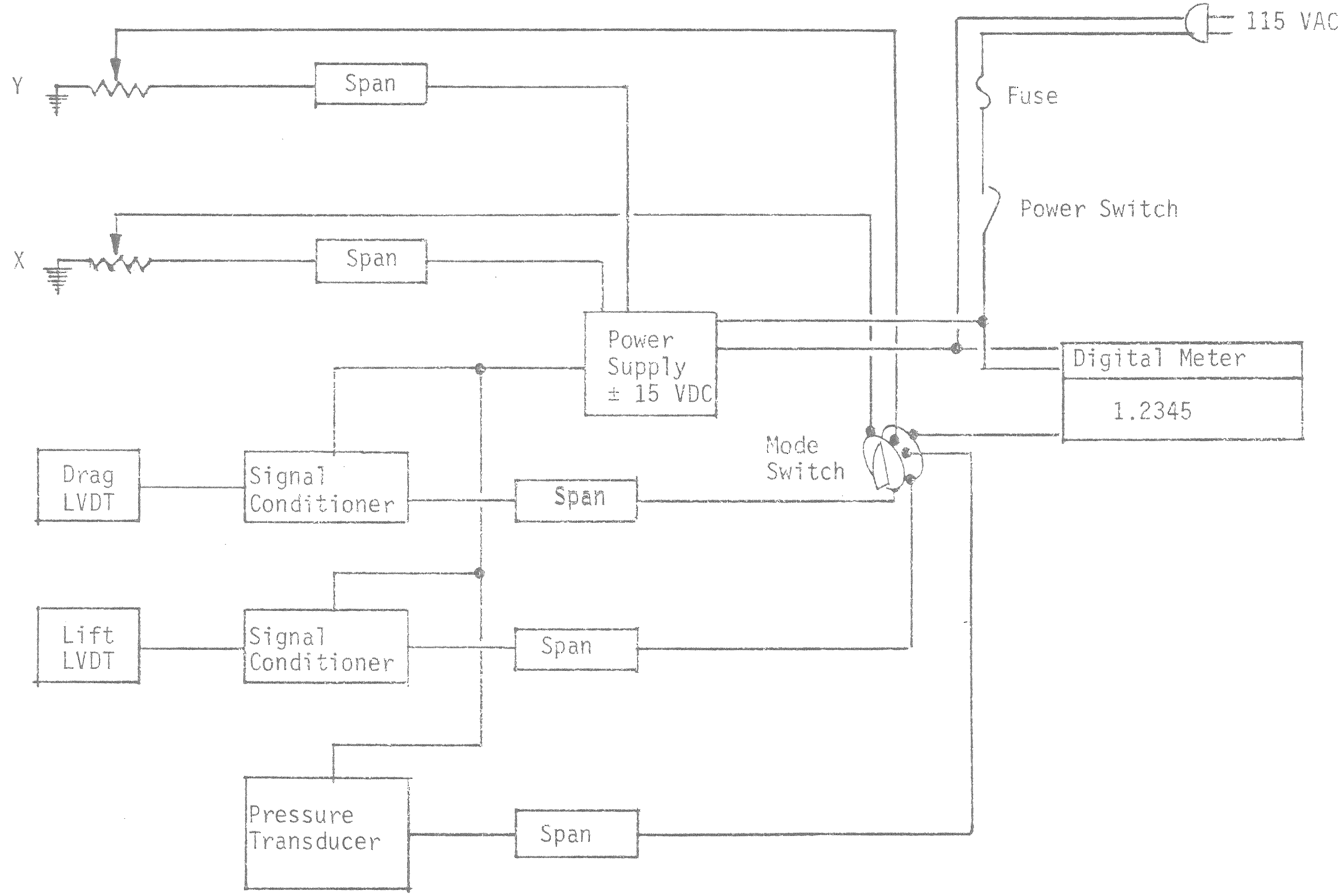

Figure C

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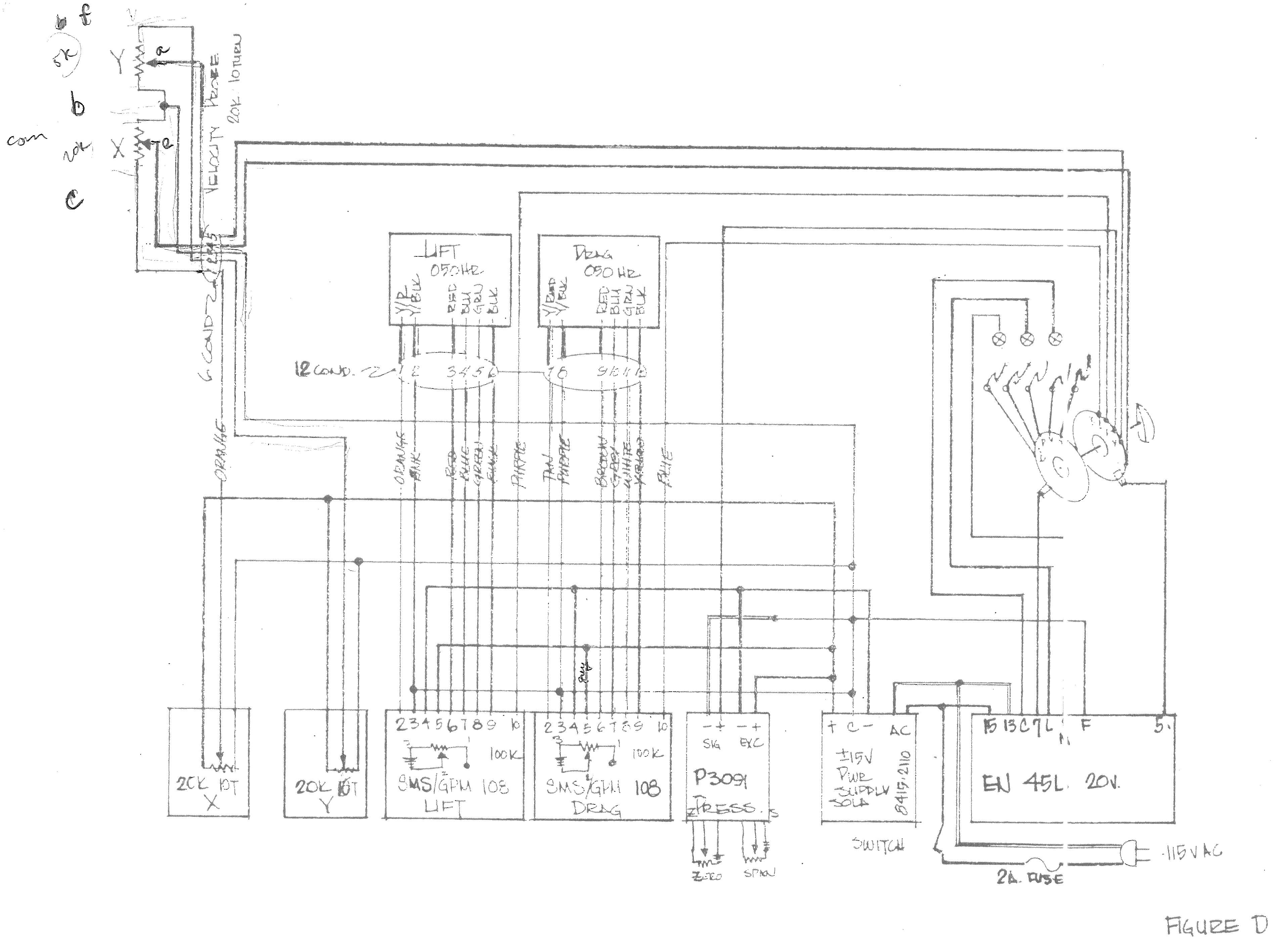
Reference	Scale None	Schematic Diagram
Date 8-82	Drawn by	Instrumentation System



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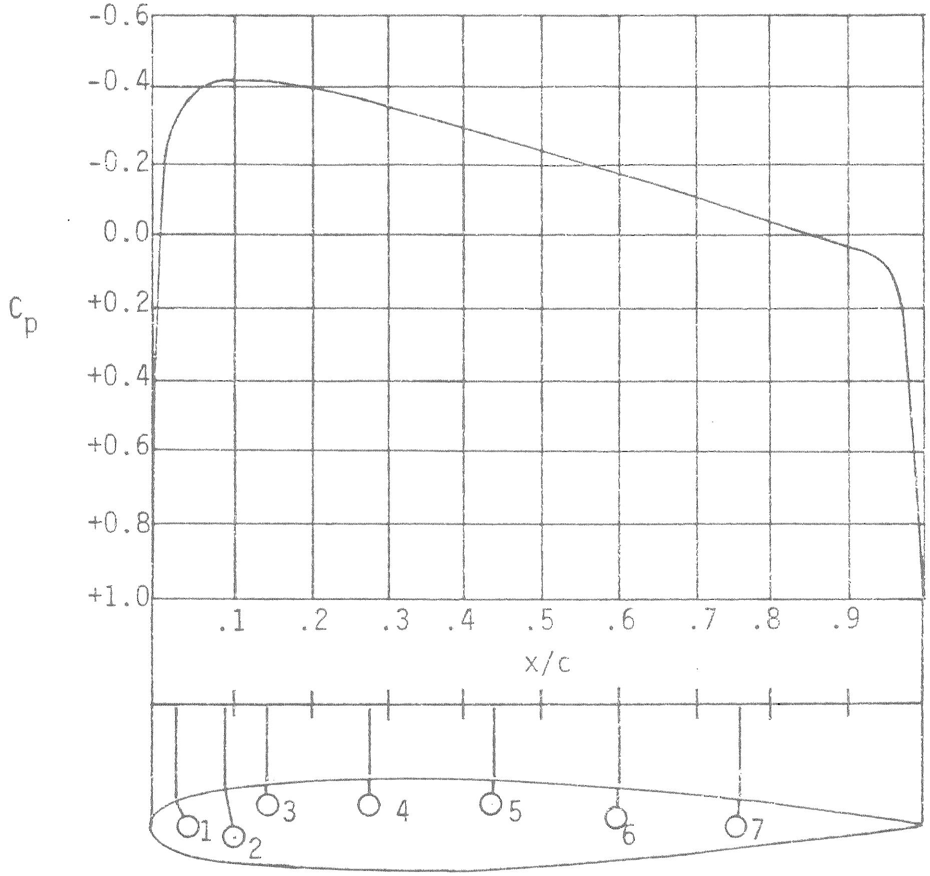
Reference	Scale NONE
Date 8-18-82	Drawn by

SCHEMATIC WIRING DIAGRAM

INSTRUMENTATION METER ASSY.



Section of NACA 0012 Airfoil, 4" cord, showing locations of pressure taps.

NACA 0012 Airfoil

X (% cord)	Y (% cord)	C_p
0.0	0.0	+1.000
0.5	....	+0.460
1.25	1.894	-0.010
2.25	2.615	-0.241
5.0	3.555	-0.378
7.5	4.200	-0.402
10.0	4.683	-0.411
15.0	5.345	-0.411
20.0	5.737	-0.399
25.0	5.941	-0.378
30.0	6.002	-0.350
40.0	5.803	-0.288
50.0	5.294	-0.228
60.0	4.563	-0.166
70.0	3.664	-0.109
80.0	2.623	-0.044
90.0	1.448	+0.044
95.0	0.807	+0.094
100.0	0.126	+1.000

Figure E

Engineering Laboratory Design, Inc.
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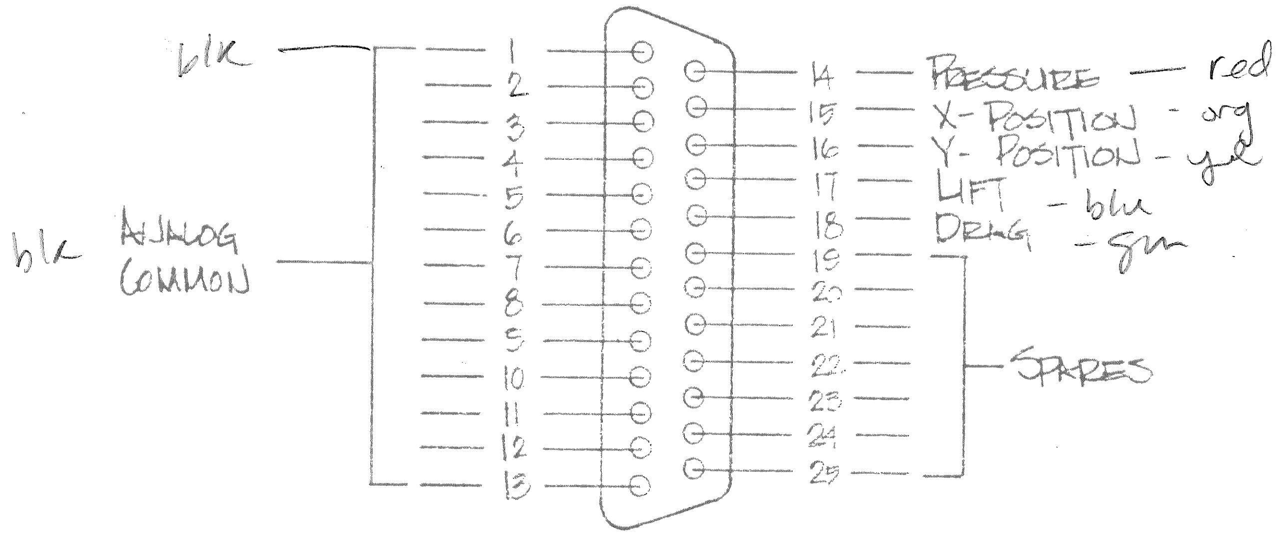
Reference
Date 8-82
Scale None
Drawn by
NACA 0012 Airfoil

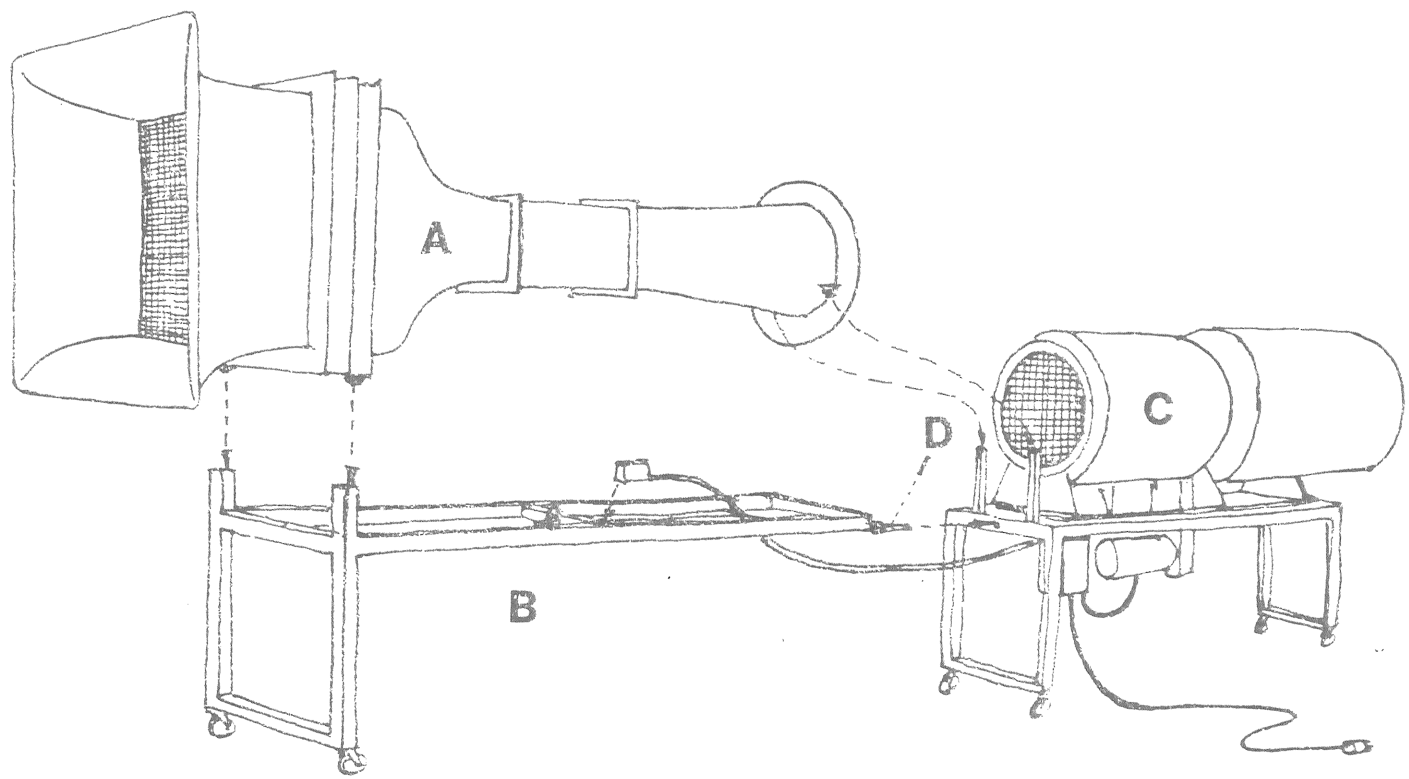


DB-25 PANEL CONNECTOR

ANALOG VOLTAGE SIGNALS IN THE ±15V. RANGE ARE AVAILABLE FROM THE INDICATED CONNECTOR PINS. THESE SIGNALS REFLECT THE UNITS DISPLAYED ON THE DIGITAL PANEL METER AND MAY BE ACCESSED CONCURRENTLY. DECIMAL POINTS ARE NOT SUPERIMPOSED.

Engineering Laboratory Design, Inc. Box 278 Lake City, MN 55041 612-345-4515	This drawing and the information it contains are the property of Engineering Laboratory Design, Inc. Reproduction by any means and/or transmission to others without authorization is prohibited.	Reference	Scale NTS	WIND TUNNEL
		Date 7.86	Drawn by	INSTRUMENTATION SYSTEM

ASSEMBLY SEQUENCE 12 INCH OPEN CIRCUIT WIND TUNNEL



1. Unpack and lay out all components

2. Bolt frame B to frame C.

3. Secure handwheel shaft, bearing and adapter to the lead screw under fan C using drive pin D. Fasten the remote start/stop station.

4. Carefully position tunnel assembly A on frames B and C and fasten the rubber isolation mountings using the bolts provided.

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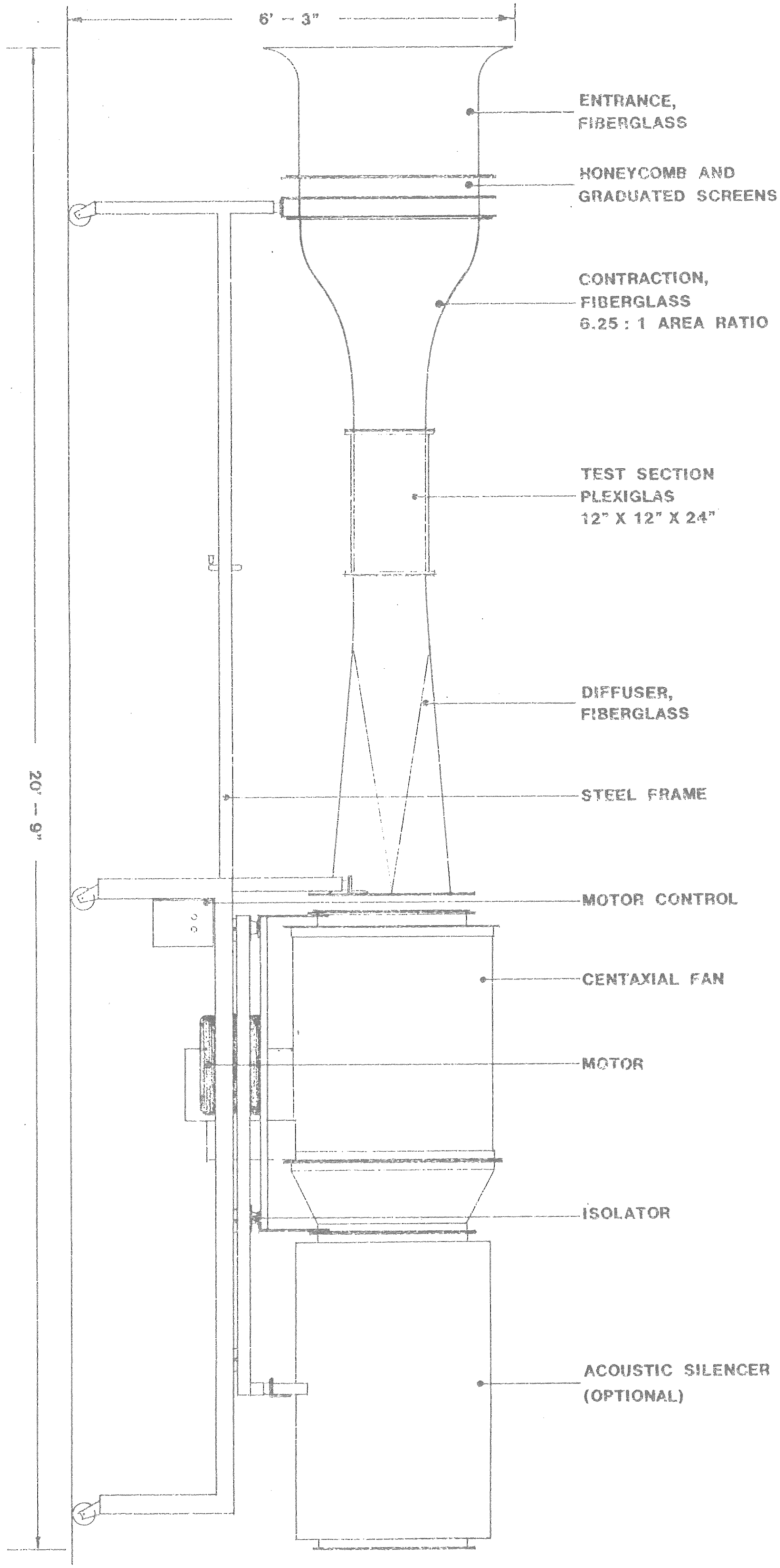
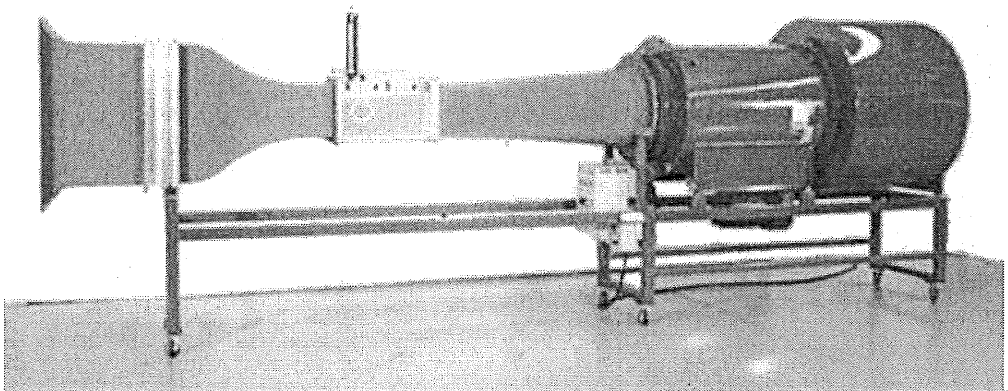
Reference	Scale NTS	Assembly Sequence
Date	Drawn by	12" Open Circuit Wind Tunnel

ENGINEERING LABORATORY DESIGN, INC. · BOX 278 · LAKE CITY, MN 55041

12 INCH OPEN CIRCUIT WIND TUNNEL



Wind Tunnel Model 402 A/B 12" - Open Circuit - Eiffel



Specifications	Model 402(B)
Arrangement	Open Circuit-Eiffel
Test Section Dimensions (HxWxL) cm / (inches)	30.5 x 30.5 x 61.0 / (12" x 12" x 24")
Velocity Range m/s / (fps)	3.0-48.7 / (10.0-160.0)
Motor kW (HP)	7.5(10.0)
Electrical Requirements	208-220VAC/ 3f /60Hz 440-460VAC/ 3f /60Hz 380VAC/ 3f /50Hz
Overall Dimensions (HxWxL) m / (ft)	5.9 x 1.1 x 1.9 / (19.5' x 3.7' x 6.3')
Footprint	3.7m (12'-2') by 1.07m (3'-6')
Height	1.9m (6'-3')
Weight	595kg (1300 lbs)

UCSB 12 inch Wind Tunnel Dynamometer Calibration

Background:

The dynamometer uses a pair of parallel aluminum beams (known as flexures), which under an applied force, deflects proportional to the magnitude of the force. Linear variable differential transformers (LVDT) sense the deflection and output a signal that is demodulated and amplified by signal condition modules contained within the console shown in Figure 1. The DC voltage output represents the magnitude and direction of the applied force.

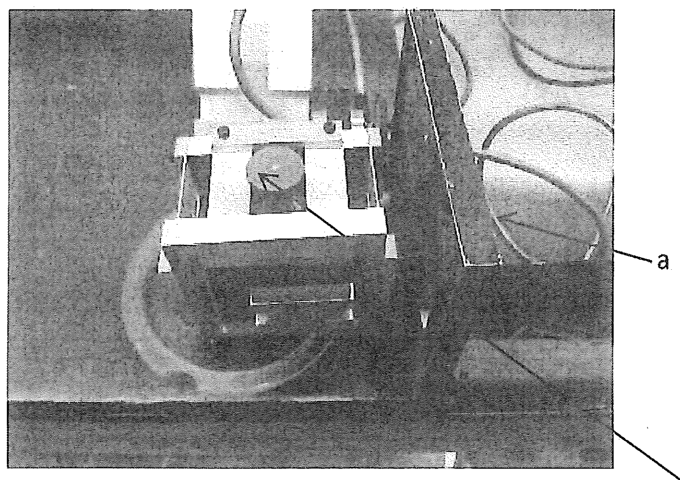


Figure 1: Dynamometer in vertical position (a) and LVDT thumb wheel (b).

The two component dynamometer assembly utilizes two separate dynamometers positioned at 90 degrees to respond to the drag on the x-axis and the lift on the y-axis.

Drag Calibration Instructions:

1. Remove the dynamometer assembly from the test section and fasten the base plate firmly to the testing bench in a vertical position, as shown in Figure 2 using the orthogonal (blue) clamping vise. Insure that the dynamometer plate is ~~level.~~ vertical and level along the top surface.

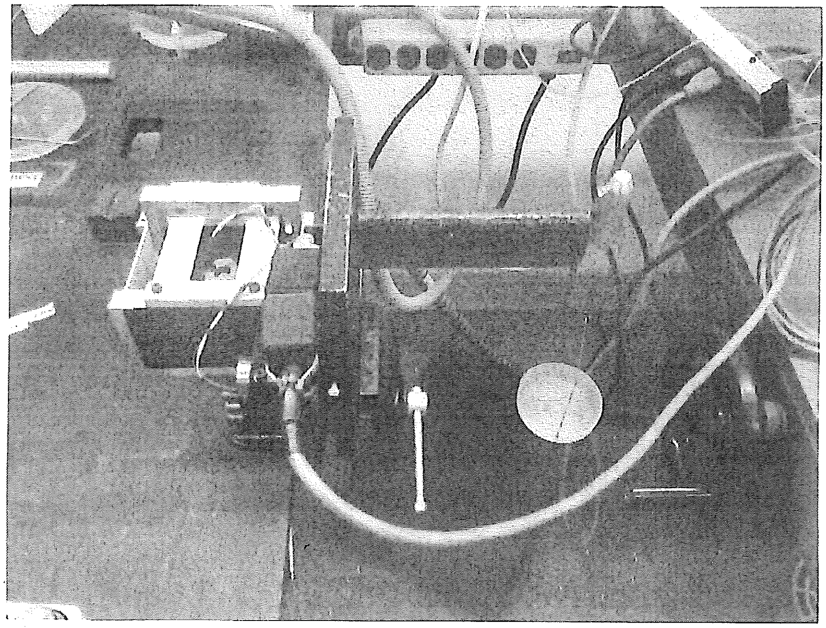


Figure 2: Dynamometer in vertical position with weight pan attached to the sting.

2. Fasten the rectangular rod to dynamometer assembly. This allows the end of the beam (or "sting") to be loaded by weights.

3. Turn on the Lift and Drag Console shown in Figure 3 (switch is on the back).

4. Zero the meter display by adjusting the LVDT thumb wheel shown in Figure 4.

5. Deposit known weights ranging between 20 and 400 grams to the weight pan at the end of the rod. WARNING: Loads past 400g may cause damage to sensors.

6. ~~Trim~~ the DRAG-SPAN potentiometer~~, shown in Figure X,~~ located in the rear of the meter ~~cabinet to~~ adjust the meter display to the corresponding applied force.

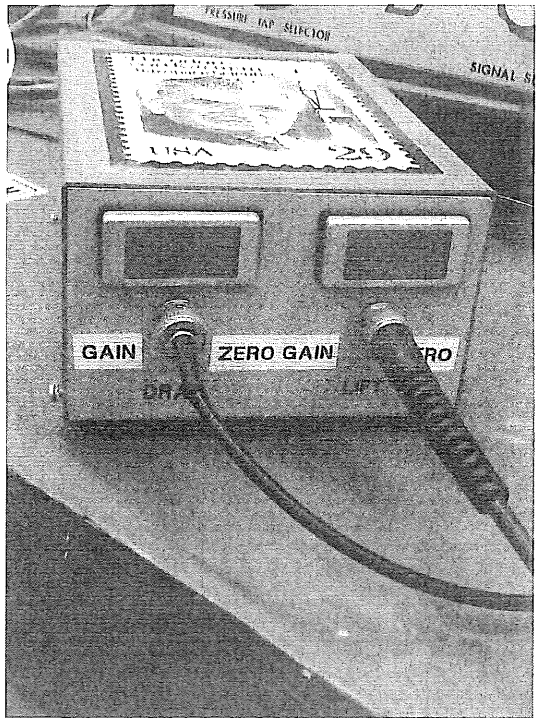


Figure 3: Lift and Drag console.

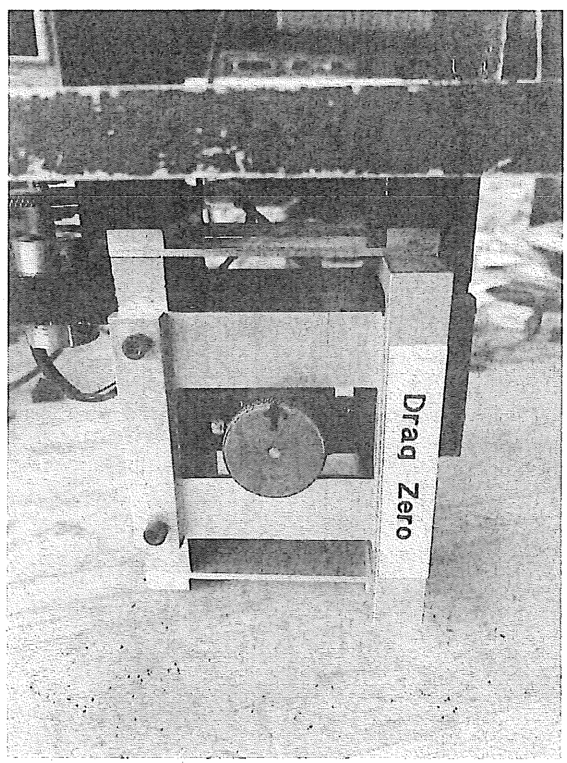


Figure 4:Drag zero thumb wheel.

7. Remove existing weight and add different weights to the pan. If display reads the applied load the dynamometer is operating properly.

8. Remove weights and fasten dynamometer assembly to test section. Zero dynamometer using the LVDT thumb wheel before testing. REMEMBER: When zeroing, the beams deflect under their own weight.

9. Example of Drag calibration Voltage versus Weight (grams):

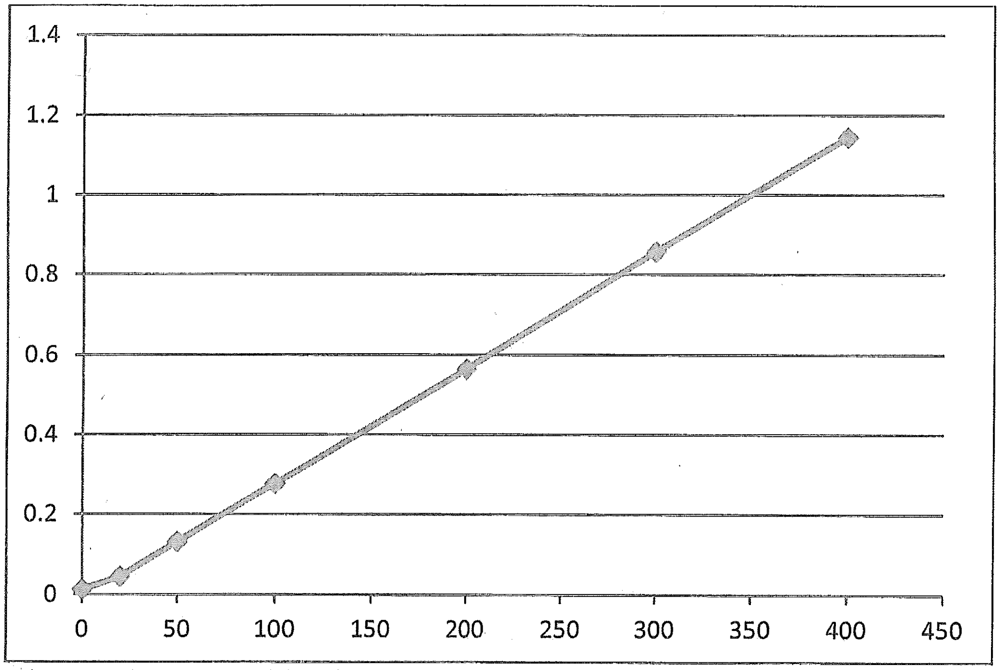


Diagram 1. Drag calibration of Voltage versus Weight (grams)

Lift Calibration Instructions:

1. Remove the dynamometer assembly from the test section and fasten the base plate firmly to the testing bench in a horizontal position, as shown in Figure 4 using the standard clamping vise. Insure that the dynamometer plate is level.
2. Fasten the rectangular rod to dynamometer assembly and the weight pan to the end of the rod. This allows the end of the beam (or "sting") to be loaded by weights.
3. Turn on the Lift and Drag Console shown in Figure 3 (switch is on the back).
4. Zero the meter display by adjusting the LVDT thumb wheel shown in Figure 5.

Figure 5:Lift zero thumb wheel.

5. Deposit known weights ranging between 20 and 400 grams to the weight pan at the end of the rod. WARNING: Loads past 400g may cause damage to sensors.
6. ~~Trim the LIFT-SPAN~~ potentiometer, ~~shown in Figure X, located in the rear of the meter~~ cabinet to ~~adjust the~~ meter display to the corresponding applied force.
7. Remove existing weight and add different weights to the pan. If display reads the applied load the dynamometer is operating properly.
8. Remove weights and fasten dynamometer assembly to test section. Zero dynamometer using the LVDT thumb wheel before testing. REMEMBER: When zeroing, the beams deflect under their own weight.
9. Example of Lift calibration Voltage versus Grams:

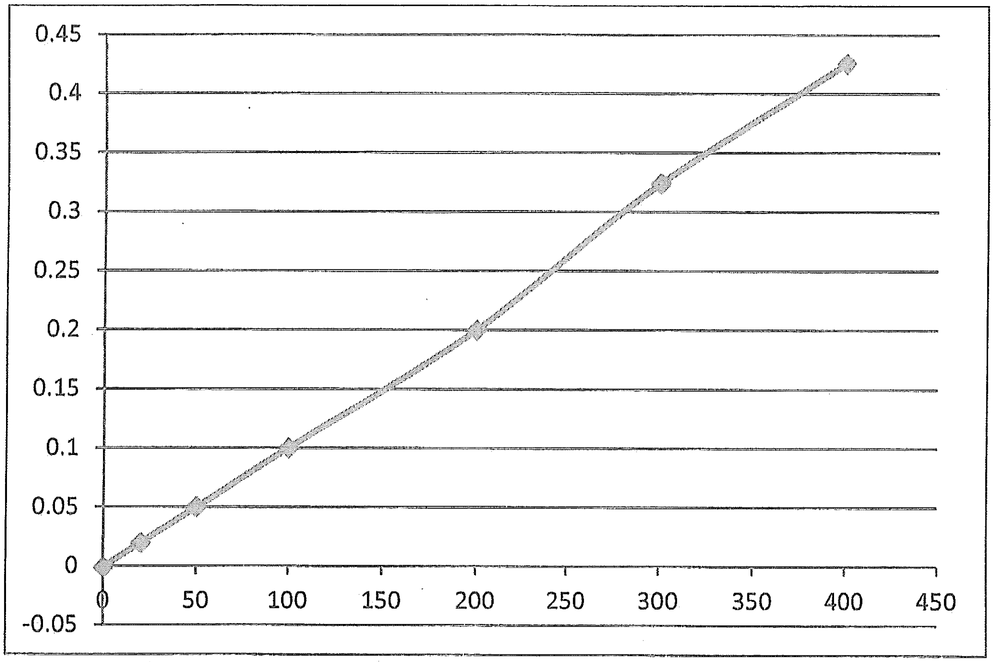


Diagram 2. Lift calibration Voltage versus Weight (grams)

APPENDIX

Note: The stock EDL flexure beams were replaced with thinner flexures. This work was undertaken to achieve better sensitivity at low aerodynamics loading. Below is part of a communication with Kurt Banaszynski of ELD regarding a stock flexure dynamometer.

The standard dynamometer for the 12" tunnel is rated for 5 lbs drag (2.27 kg). I am not sure where the 400g value comes from. The LVDT has a linear output with deflections of up to +/-0.050". With the beams used to suspend the LVDT's, it takes a lot of force to achieve the 0.050" deflection. If the anticipated forces are less than 2.27kg, then there should not be any issues. You should be good even to 3 kg.

I hope that this information is helpful. Please let me know if you have any additional questions or should require anything further.

Sincerely,

Kurt

Kurt A. Banaszynski
Project Engineer
shinski@eldinc.com
Engineering Laboratory Design, Inc.
2021 South Highway 61

1.

CALIBRATION PROCEDURE

I. Dynamometer

A. Lift component.

1. Remove the dynamometer assembly from the test section and clamp the base plate firmly on a bench or table with the sting and shield extending over the edge.

2. Fasten a suitable weight pan to the sting.

3. Set the mode selector switch to "Lift" and adjust the meter display to zero by turning the lift LVDT core thumb wheel.

4. Place a suitable known weight on the weight pan.

5. Adjust the digital meter display to correspond with the value of the applied load by trimming the LIFT-SPAN potentiometer located in the back of the meter cabinet.

6. After completion of calibration the tare weight of the model and sting is removed from the display by adjusting the zeroing thumb wheel as in 3 above.

B. Drag component.

1. Remove the dynamometer assembly from the test section and rigidly fasten the base plate in a vertical position so that the drag beams may be loaded.

2. Fasten a suitable weight pan to the sting.

3. Set the mode selector switch to "DRAG" and adjust the meter display to zero by turning the drag LVDT core thumb wheel.

4. Place a suitable known weight on the weight pan.

5. Adjust the meter display to correspond with the value of the applied load by trimming the DRAG-SPAN potentiometer located in the rear of the meter cabinet.

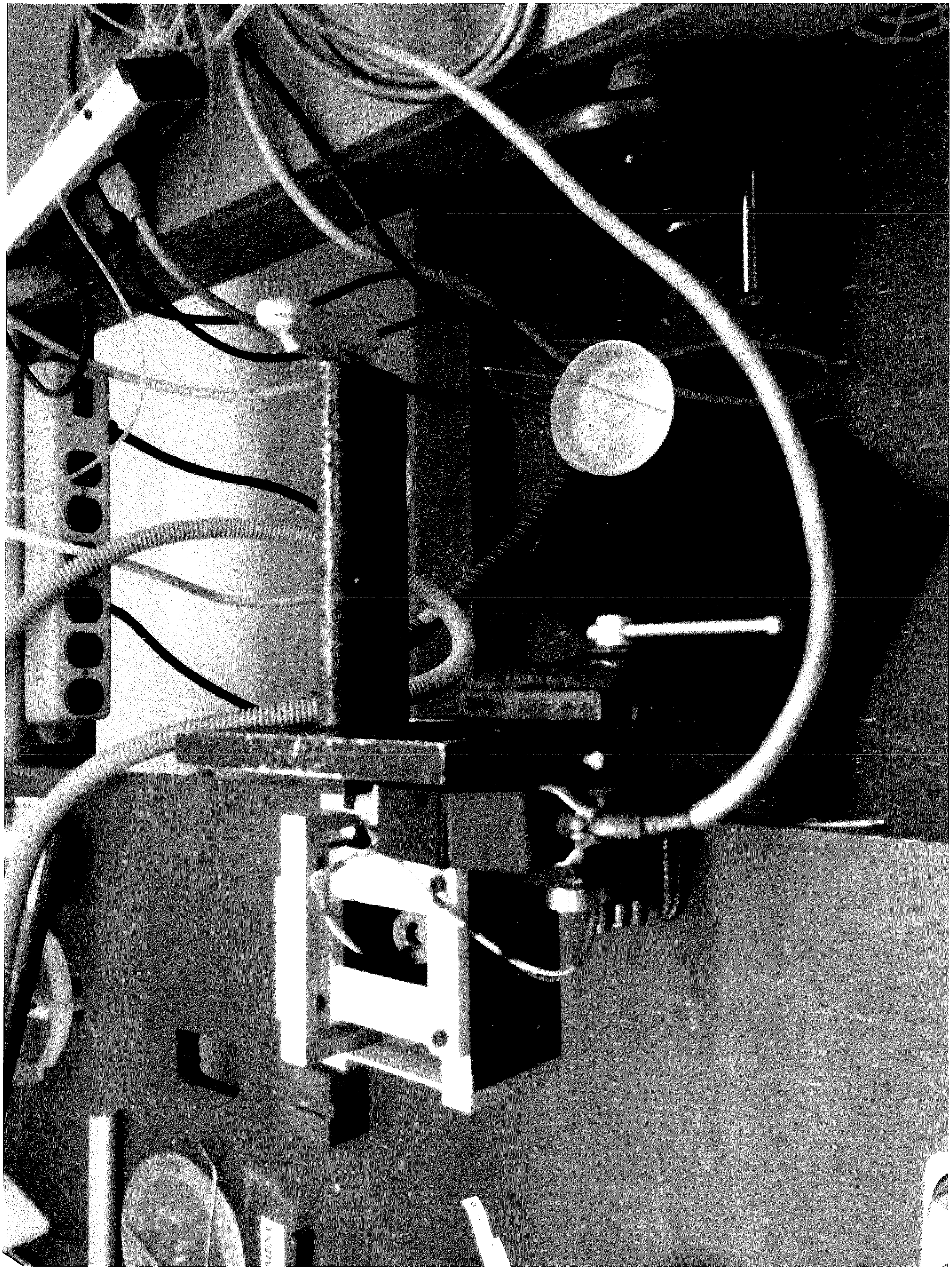
6. The tare weight may be removed as before by adjusting the zeroing thumb wheel.

II. Velocity tracking probe assembly.

A. Longitudinal tracking - (x-coordinate)

1. Set the mode selector to "x". Traverse the probe to its extreme downstream position. The meter display should read zero.

2. Fasten a suitable scale to the test section cover adjacent to a prominent feature of the velocity probe base.



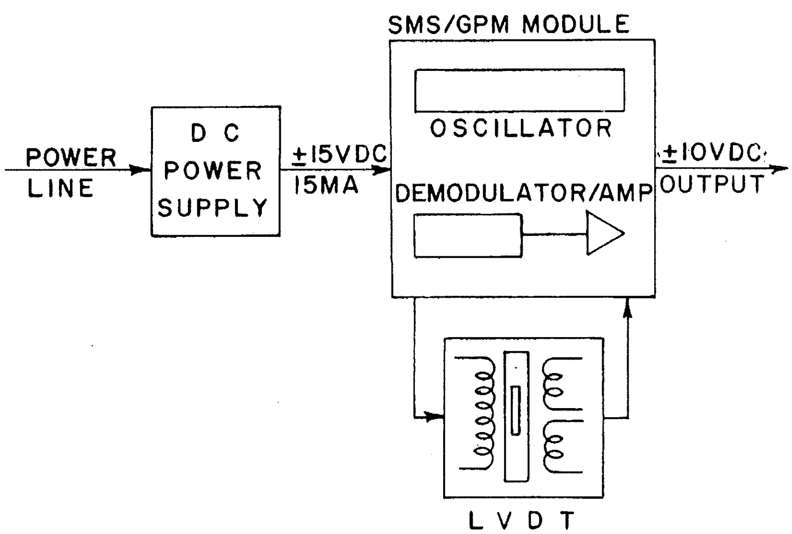
instruction manual 7202A

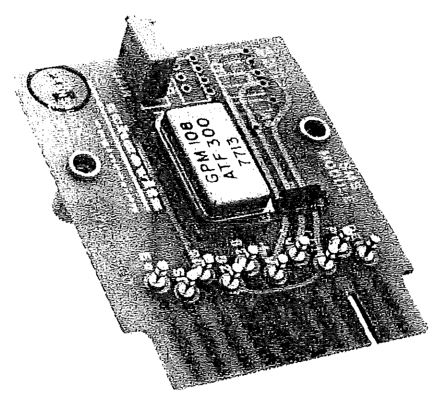
schaevitz

engineering

SMS/GPM/LVDT SIGNAL CONDITIONING MODULE

SMS/GPM-108A: 2.5 KHz LVDT EXCITATION
SMS/GPM-109A: 8 KHz LVDT EXCITATION



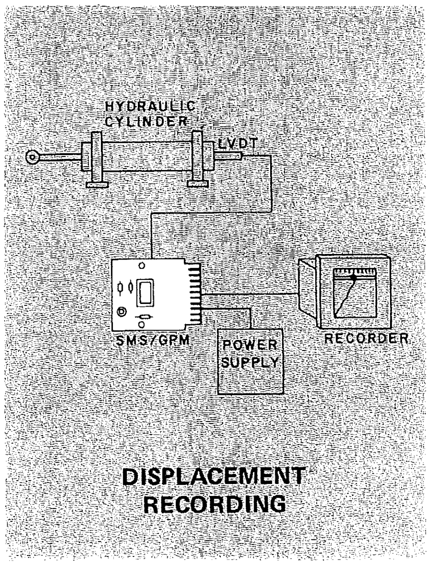


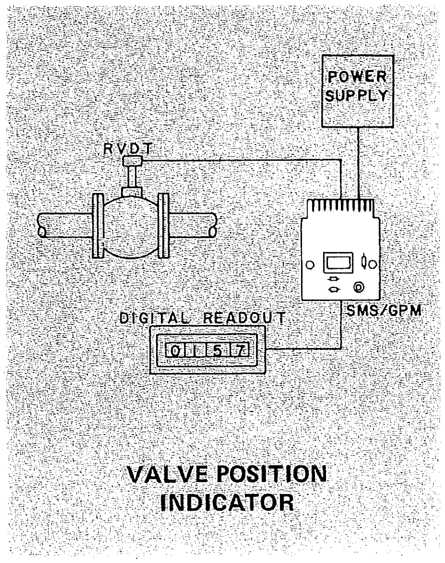
The SMS/GPM module is used to provide AC excitation, demodulation, and signal amplification for an LVDT. It converts the LVDT output into a filtered, high level DC signal which can drive voltmeters, high response recorders, or other dynamic indicators.

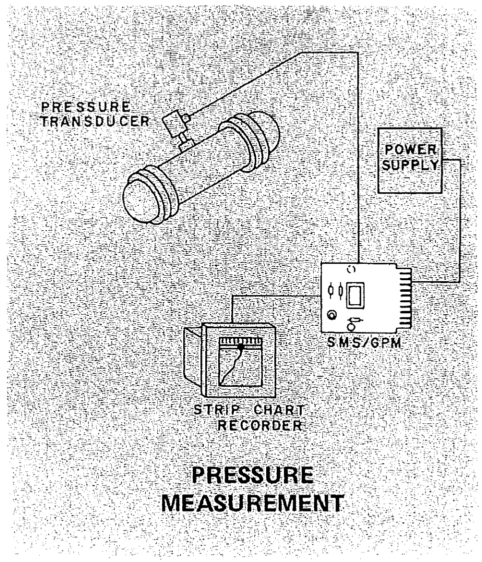
The SMS/GPM requires connection to all 4 secondary leads, so it cannot be used with XS-B series LVDT's or LBB Gage Heads.

INSTALLATION: The SMS/GPM module is designed for either plug-in installation into a PC card connector, or by hard wiring into equipment by solder-pin terminals. It can be mounted or stacked by permanently attached threaded stand-offs or by a PC card guide; cards are keyed to prevent improper installation.

TYPICAL APPLICATIONS OF THE SMS/GPM MODULE







HOOK-UP INSTRUCTIONS

1. Connect the SMS/GPM to a ±15V DC power source (Schaevitz PSM-120 or equal):

DC Power Source	SMS/GPM Terminal Number
Positive	+V (Pin 5)
Negative	–V (Pin 4)
Ground (Common)	COM (Pin 3)

CAUTION: CHECK VOLTAGE INPUT TO SMS/GPM BEFORE CONNECTING; voltage in excess of 18V DC (either supply) could damage module.

2. Connect the LVDT transducer (see Figure 1)

Connect the primary leads from the LVDT transducer as follows:

LVDT Primary	SMS/GPM Terminal Number
Yel/Red (Brn) or F	P_1 (Pin 2)
Yel/Blk (Yel) or E	P_1 COM (Pin 3)

Connect the secondary leads from the LVDT transducer as follows:

LVDT Secondary	SMS/GPM Terminal Number
Green or C	S_1 (Pin 8)
Black or D	S_1 (Pin 9)
Blue or B	S_2 (Pin 7)
Red or A	S_2 (Pin 6)

3. Adjust the electrical zero of the readout in accordance with instructions from instrument manufacturer before connection to SMS/GPM. Connect the readout as follows:

Readout	SMS/GPM Terminal Number
Negative Lead	COM (Pin 3)
Positive Lead	E_0 (Pin 10)

4. Switch unit on and allow one-half hour for stabilization.

CALIBRATING THE SYSTEM

1. Set the LVDT transducer to mechanical zero by moving the LVDT core until readout returns to zero.

2. Displace LVDT transducer core to full range and adjust GAIN control until readout comes to desired level (±10V DC or less). If gain adjust is not sufficient to provide instrument full scale of ±10V DC or less, see section on GAIN ADJUST. Output voltage should be positive polarity when the core is displaced toward the lead, or connector end of the LVDT.

SPECIAL ADJUSTMENTS

1. If desired, zero volts at a point other than transducer electrical null can be achieved by the installation of the optional zero control circuit. This modification requires the following components to the SMS/GPM Board.

SMS/GPM Board Ref.	Description	Schaevitz Part No.
R3	10K ohms Trimpot	64714081-000
R4, R5	1K ohms Type RN55D resistors	64713193-000
*R6	52.3K ohms Type RN55D resistor	64713357-000
D1, D2	IN823A Reference Diodes	64801003-000

*For 100% zero suppression; R6 = 15.4K ohms

2. If the output voltage polarity is opposite of that required, interchange the connections to S1 and S2 (Pins 8 and 6 respectively). Zero calibration should be repeated after this change. For example, if the polarity of the output was +4.1 volts DC, interchanging the connections would yield an output of –4.1 volts DC. Zero calibration should be repeated.

GAIN ADJUST

1. The SMS/GPM has a 100K ohm gain adjustment potentiometer for setting the voltage output of the SMS/GPM to a level that results in the desired indication on the readout. A 600mV rms change of input will produce a 10V DC change in output at maximum gain setting.

2. Under certain conditions, more gain may be required than the gain potentiometer can provide; should this occur, remove the gain pot and replace it with a fixed resistor or a similar pot with a higher value. The easiest method to determine the size of this resistor or trimpot is to use a decade resistance box; alternatively it can be calculated from the formula:

$$R_2 = \frac{V_0}{V_{IN}} \times 5.0 \text{ kilohms}$$

Where:

V_{IN} = LVDT secondary input in V_{rms}

V_{OUT} = output DC voltage desired (10V DC typical)

R_2 = gain resistor to be calculated in kilohms.

5.0 is a gain factor for SMS/GPM — 108A/109A

EXAMPLE:

V_0 = 10V DC (desired)

V_{IN} = 200 mV rms

THEN

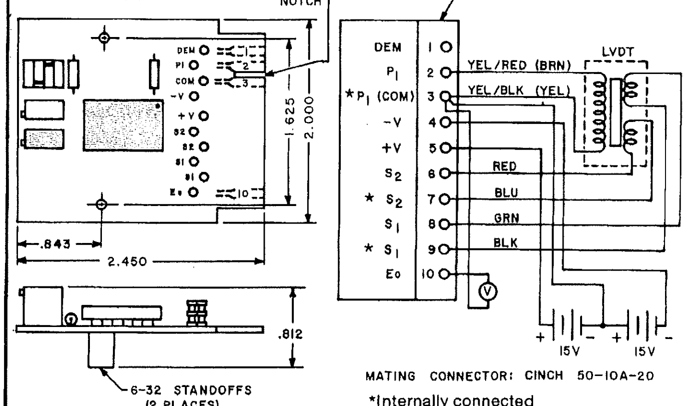
$$R_2 = \frac{10}{.200} \times 5 = 250 \text{ kilohms}$$

NOTE: The maximum recommended total value of R_2 is 300 kilohms. Attendant increase in noise and instability precludes the use of higher values.

SPECIFICATIONS

Power Requirements	±15V DC @ 25 mA 0.1% regulation
Output Full Range	±10V DC @ 5 mA max.
Transducer Excitation	SMS/GPM - 108A: 3V rms; 2.5 kHz; 20 mA rms (max.) in series with 100 Ohms. SMS/GPM - 109A: 5V rms; 8 kHz; 20 mA rms (max.) in series with 100 Ohms.
Sensitivity	600 mV rms change of input will produce 10V DC change in output.
Input Impedance	25 K ohms
Frequency Response	SMS/GPM - 108A: −3dB down @ 250 Hz (200 Hz min.) Roll-off 35dB/decade 1° phase shift at 3 Hz SMS/GPM - 109A: −3dB down @ 600 Hz (500 Hz min.) Roll-off 35dB/decade 1° phase shift at 7 Hz
Output Impedance	Less than 1 Ohm.
Combined Noise and Ripple	Less than 25 mV rms
Non-Linearity and Hysteresis	Less than 0.1% of full scale
Thermal Coefficient of Sensitivity	0.04%/°C (0.02%/°F)
Stability (after 30 min. of warm-up)	0.1% of full scale
Operating Temperature Range	0°C to 55°C (30°F to 130°F)
Weight	25 grams (1 oz.)
Controls	Gain (board mounted)

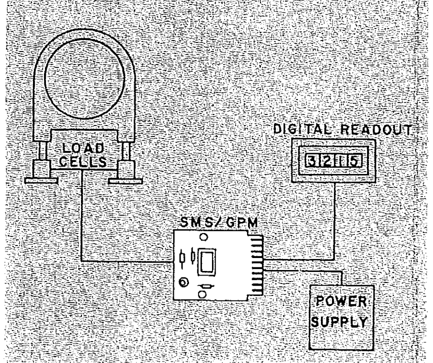
FIGURE 1



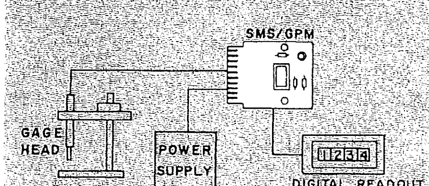
MATING CONNECTOR: CINCH 50-10A-20

*Internally connected

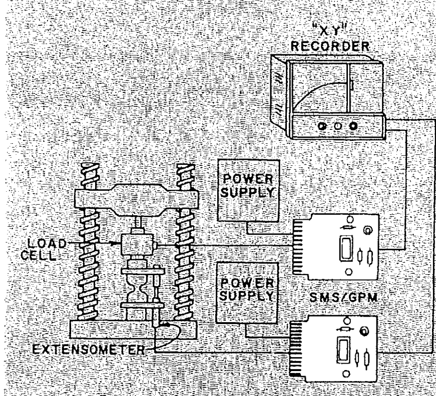
TYPICAL APPLICATIONS OF THE SMS/GPM MODULE



TANK WEIGHT READOUT



PARTS GAGING



STRESS-STRAIN RECORDING

SCHAEVITZ ENGINEERING PRODUCES THESE LINEAR VARIABLE DIFFERENTIAL TRANSFORMER (LVDT) PRODUCTS FOR SENSING/CONTROLLING/INDICATING/AND RECORDING:

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- ACCELERATION
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- FORCE/WEIGHT
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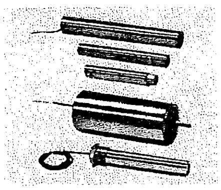
PRODUCT LISTING

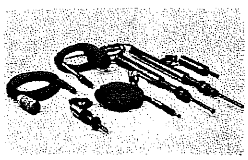
DISPLACEMENT



- AC OR DC—OPERATED
- RANGES TO 20" STANDARD
- LINEARITY TO ±0.05%
- MODELS AVAILABLE FOR LINEAR OR ANGULAR DISPLACEMENT, VELOCITY, OR PROXIMITY

Over 400 different LVDT models with suitable physical and electrical characteristics to meet almost any displacement measurement requirement. Miniature, long stroke, large bore, and other models are available, AC or DC-operated, with or without hermetic sealing. LVDT's are also available for operation in cryogenic, high temperature, radioactive, hostile industrial, and other unusual environments.
For more information, request Series 10 Technical Bulletins.

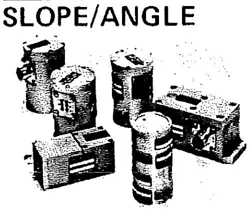
DIMENSIONAL GAGING



- RANGES TO ±1.000 INCH
- REPEATABILITY TO 0.000 004 INCH
- RESOLUTION TO 0.000 000 3 INCH
- LINEARITY TO ±0.2% STANDARD, ±0.05% SPECIAL

Schaevitz precision gage heads are rugged enough to be used in hostile industrial environments, yet accurate enough to be used as laboratory standards. Both spring-actuated and pneumatically-actuated types are available from stock. Units are supplied for either AC or DC-operation, and will work with virtually any gage amplifier.
For more information, request Series 15 Technical Bulletins.

SLOPE/ANGLE



- MEASURES CHANGE OF SLOPE OR ANGLE TO 0.1 SECOND OF ARC
- LINEARITY TO ±0.02%

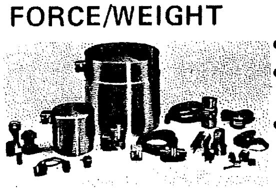
Schaevitz inclinometers measure horizontal angle or vertical deviation with exceptionally high accuracy and virtually infinite resolution. These DC-operated transducers are entirely self-contained in hermetically sealed housings and require no external electronics or amplifier. Their ±5V DC analog output (proportional to tilt) can be used for automatically setting slope of road grading and paving machines, in geophysics for tilt and strong-motion studies, for ship and barge leveling, and other applications where high-accuracy measurement of tilt is required.
For more information, request Series 46 Technical Bulletins.

PRESSURE

- GAGE, DIFFERENTIAL, ABSOLUTE AND BAROMETRIC
- RANGES FROM 10" H_2O TO 10,000 PSI
- AC or DC—OPERATED
- HERMETICALLY SEALED

Schaevitz LVDT and Bonded Strain Gage pressure transducers and transmitters constitute a broad family of sturdily-constructed yet laboratory-precise sensors to satisfy the most stringent pressure measurement requirements. These units represent the widest selection of pressure ranges from any manufacturer (from 0-5 inches of water to 0-10,000 psi), and are available with combined error down to ±0.1%.
For more information, request:
Series 30 Technical Bulletins for LVDT Types
Series 35 Technical Bulletins for Strain Gage Types

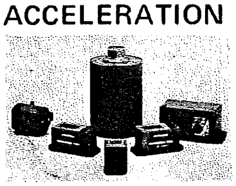
FORCE/WEIGHT



- AC OR DC—OPERATED
- RANGES FROM 10 GRAMS TO 10,000 LBS
- TARE-TO-LIVE-LOAD RATIOS TO 10:1

High output, infinite resolution, excellent signal-to-noise ratio, and all stainless-steel construction are some of the outstanding characteristics of Schaevitz LVDT load cells. Typical applications are measurement of force in structures, and tank and hopper weighing.
For more information, request Series 50 Technical Bulletins.

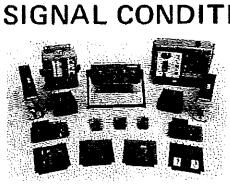
ACCELERATION



- DC INPUT – DC OUTPUT
- SMALL SIZE – LIGHT WEIGHT
- RANGES AVAILABLE FROM ±0.25 g TO ±50 g's
- LINEARITY TO ±0.05%

Schaevitz servo accelerometers are closed-loop, force-balance transducers that provide an analog DC output signal proportional to acceleration. These DC-operated miniature devices are entirely self-contained within light-weight, hermetically sealed housings and require no additional amplifier or other electronics. They are suited for use in guidance and closed-loop control systems and for measurement of vibration or performance studies of vehicles and other moving systems.
For more information, request Series 45 Technical Bulletins.

SIGNAL CONDITIONING



- FULLY SELF–CONTAINED
- SINGLE–CHANNEL AND MULTIPLE–CHANNEL PLUG–IN CARDS
- DISPLAYS AVAILABLE TO 5–PLACE DIGITAL READOUT

These Schaevitz signal conditioners operate from standard AC power sources, and typically deliver an output of ±10V DC from a low impedance. Modular units are ready to hard-wire into your equipment; only external power is needed to produce an operating system.
For more information, request Series 70 Technical Bulletins.

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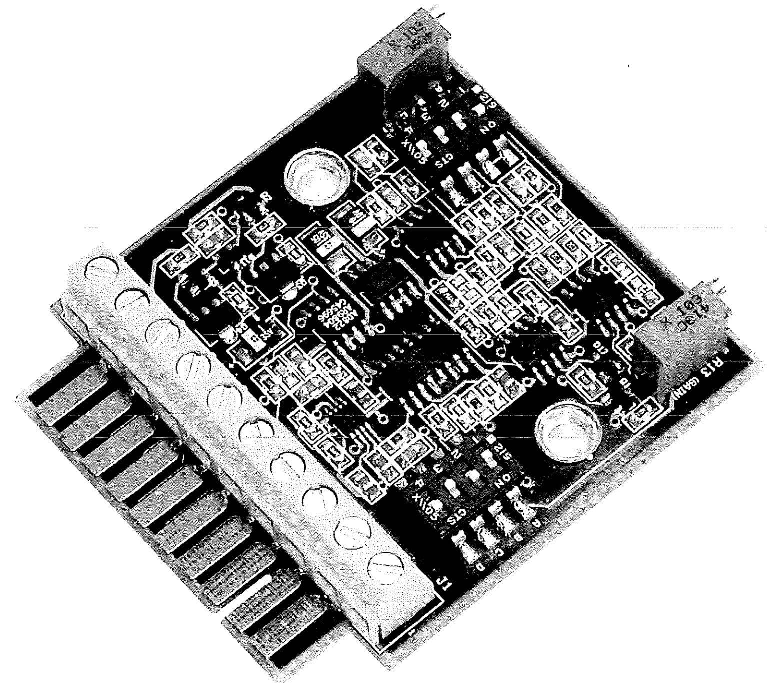
SPECIALTIES

SCHAEVITZ SENSORS

LVM-110
LVDT Signal Conditioning Module



Specifications • Operating Instructions • Installation

measurement
SPECIALTIES

Initial Set-Up Procedure:
In order to begin this process, you must first know a few basic things about the LVDT or RVDT you intend to use with the LVM-110 conditioning board. This is the minimum information required to perform a successful calibration. This information may be obtained from the sensor calibration sheet, catalog literature or on the Schaevitz web site at www.meas-spec.com

- Recommended operating frequency
- Sensitivity at that frequency
- Primary (input) impedance at that frequency
- The ± full scale stroke you intend to calibrate over
- Analog output signal required by your application

Oscillator Frequency:
Once you have established the proper excitation frequency for your sensor, refer to the table below and the DIP switch locations on the page 4 diagram, to set the LVM-110 oscillator frequency.

OSCILLATOR FREQUENCY	S1-C	S1-D
2.5 KHZ	OFF	OFF
5.0 KHZ	ON	OFF
8 KHZ	OFF	ON
10 KHZ	ON	ON

Oscillator Frequency Table

Oscillator Mode:
The Oscillator mode setting will depend on the number of LVM-110s and LVDT or RVDTs in your system.

For a single LVDT system you will be running the LVM card in the stand alone (master) mode. For multi sensor systems, it is best to master and slave the LVM oscillators, to prevent beat frequencies and cross talk between amplifiers and LVDTs.

You will be selecting one LVM to serve as the master oscillator, and the balance will be set-up in the slave mode.
CAUTION: Attempting to synchronize two LVMs set as masters may damage one or both units.

Connecting pin-1 of the barrier strip, from unit to unit, will complete the sync bus circuit. The power common serves as the return line. Use the table below to configure you oscillator mode.

S1-B	MODE
OFF	SLAVE
ON	MASTER

Oscillator Mode Table

Oscillator drive capability:
To insure LVDT compatibility with the LVM-110 you must know the sensor current draw. The new LVM is designed with a more robust oscillator than its predecessor, however it is rated for a maximum drive current of 20 mA rms. To insure compatibility you will need to know the LVDT input impedance, at the frequency you intend to operate at. The minimum sensor input impedance **must** be equal to or greater than 150Ω, which will result in maximum current draw of 20 mA. Or less. The input impedance information will be available on the Schaevitz LVDT data sheet.

etting Amplifier Gain:

ou will need to calculate the LVDT full scale output, using he simple formula below.

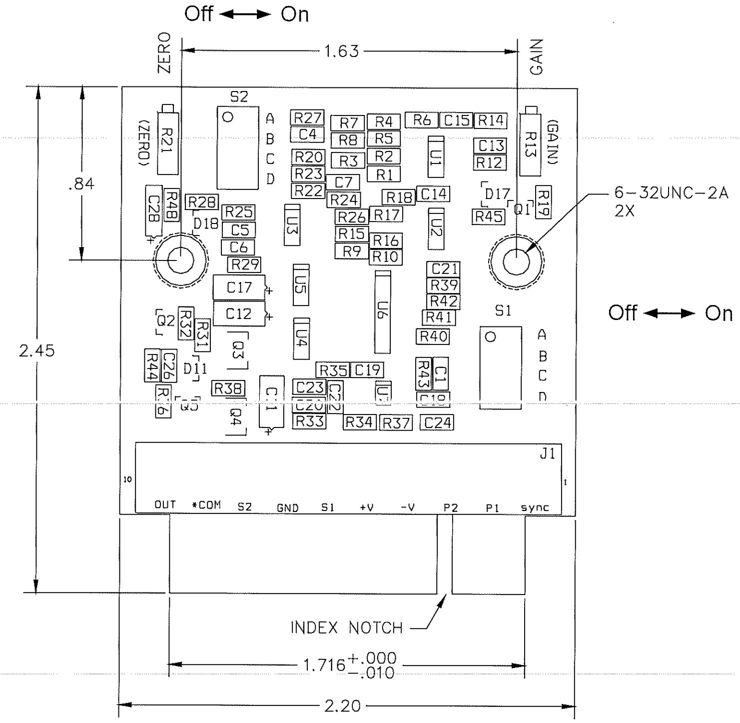
VDT sensitivity *(in **mV** / V / .001")* (at the selected frequency)
imes
he LVDT excitation voltage, (***3.0*** *V rms*. for the LVM-110)
imes
he full scale displacement of the LVDT in .001"
.e. a 1000 HR full scale is ± **1,000** thousandths of an inch).
s an example, the calculation for a 1000-HR, with a ensitivity of 0.39mV/V/.001", would be done as follows:
.39(mV) x **3.0**(V rms) x **1,000**(thousandths) = 1,170 mV full scale utput, or 1.17 Volts at ± 1 inch.

Jsing the gain table below, select the gain setting that ppears to the left of the V rms range your full scale output alls into. In our example, you would select gain x 0.2, HIGH, r x 0.5, LOW, either will work, due to range overlap.

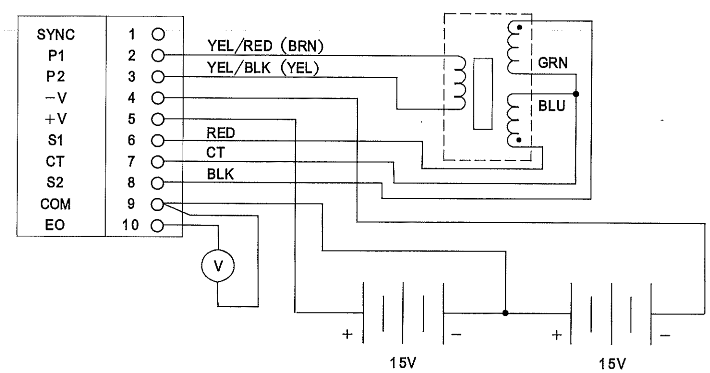
his table assumes you want to calibrate the LVM-110 for a 10 V dc, full scale output.

1ST STAGE			2ND STAGE		SENSITIVITY RANGE FOR 10 VDC OUTPUT CHANGE
GAIN	SWITCHES		GAIN	SWITCH	
	S2—A	S2—B		S1—A	(VRMS INPUT)
X0.2	OFF	OFF	LOW	ON	2.10 TO 5.55
X0.2	OFF	OFF	HIGH	OFF	1.00 TO 2.64
X0.5	ON	OFF	LOW	ON	0.84 TO 2.22
X0.5	ON	OFF	HIGH	OFF	0.40 TO 1.00
X2	OFF	ON	LOW	ON	0.21 TO .55
X2	OFF	ON	HIGH	OFF	0.10 TO 0.26

LVM-110 Gain Selection Table



LVM-110 Top View



LVM-110 Connection Diagram

Product Description:
The LVM-110 is a low-cost LVDT / RVDT signal conditioning board, primarily designed for OEM process automation applications.

The design has been optimized to provide maximum versatility while offering good performance at a moderate cost.

This device is compatible with most, but NOT all, 5 and 6 wire LVDTs and RVDTs. Please consult the product specification page to ensure compatibility with your particular sensor.

DIP switches are provided to allow selection of four sensor excitation frequencies, from 2.5 to 10.0 kHz.

Switches are also provided to select six course gain ranges, two zero offsets, and master / slave or stand alone operation.

Installation may be accomplished by use of the card-edge connector or threaded stand-offs and screw-lock barrier strip connections.

The next few pages will take you, step by step, through the simple set-up and calibration process. This device may be set-up for several different full scale analog outputs, some of the potential configurations are listed below.

The set-up configurations to be discussed will be:

- ± 10 V dc. out
- ± 5 V dc. out
- 0 to 10 V dc. out
- stand alone operation
- master / slave operation

Calibration Procedure (for ±10 V dc output)**:**
Using the connection diagram in the front of this manual, connect the LVDT, a dc volt meter and bi-polar power supply to the LVM-110.

Note: To calibrate your LVDT for a ± 5 V dc output, double the result of your full scale output calculation, prior to consulting the gain table. This will result in you selecting half the normal gain, therefore resulting in half the normal output.

Note: The 0 to 10 volt calibration process is at the end of this section.

Note: Changing course gain settings after step 6 may result in a zero shift. Should you find it necessary to change gain, you should repeat steps 1 through 6.

1. Disconnect the S-2 connection from terminal 8, (black LVDT lead)
2. Place a temporary shorting jumper across terminals 6 and 8.
3. Adjust the zero potentiometer for zero volts output, between terminals 9 and 10.
4. Remove shorting jumper and re-install black wire to terminal 8.
5. Move the core to the approximate center of the LVDT coil, using the volt meter to find the sensor null, (zero).
6. Using the zero potentiometer, adjust out any remaining output signal, due to positioning difficulty.
7. Using a gage block micrometer or other precision positioning device, move the LVDT core in a positive direction, (toward the leads or connector), to the full scale displacement used in your calculation, (+1.0 inches in our example).
8. Adjust the GAIN potentiometer for the required positive full scale dc output, between pins 9 and 10.
9. Return to the original zero position to re-check your null voltage, then displace the core to minus full scale position, (the end opposite the lead exit or connector).

You should have approximately the same minus full scale output voltage, at this location.

Zero Suppression Calibration:
To perform a 0 to 10 Volt calibration, follow the instructions for the ± 5 Volt calibration, then displace the core to the minus full scale position, (- 5V dc).

Using the table below, select a +4 Volt offset. After you have set the zero switches for the offset, your output should have increased to about –1V dc.

S2–C	S2–D	OFFSET
OFF	OFF	NO FIXED OFFSET
ON	OFF	NEG (–4V) OFFSET
OFF	ON	POS (+4V) OFFSET

LVM-110 Zero Offset Table

Using the ZERO potentiometer, adjust the –1 V reading until the output signal is zero volts.

Return to your original zero position, you should now read a +5 Volts.

Continue in the same direction to your original + full scale position, you should now read +10 Volts output.

Your calibration is now complete.

LVM-110 Specifications:

Power Supply Requirements:

Voltage	±15 V dc. ±10%	(for ± 10V dc. output)
	±12 V dc. ±10%	(for ± 5V dc. output)
Current Draw	30mA. (max)	

Transducer Excitation:

Voltage	3.0 V-rms. ± 10%
Current	≤ 20 mA
	(min LVDT Input impedance 150 Ω)
Frequency	2.5, 5, 8 & 10 kHz

Position Signal: ±10, ±5, 0 to 10 and 0 to 5 V dc. (5 mA. max current)

Required Signal for ± 10Vdc Output:

Minimum	100 mV. rms.
Maximum	5.6 V. rms.

(In six DIP-switch selectable gains)

Frequency Response	250 Hz. (-3db, 3-pole Butterworth)
Linearity	≤ .05%
Operating Temperature Range	**-13F° to 160°F(-25°C to +70°C)**
Tempco	< .02%/• F
Zero Suppression	± 4 V dc. (fixed offset)
	± 2 V dc. (adjustable)
Output Impedance	<1Ω
Noise and Ripple	≤ 15 mV rms
Stability	.05% of FSO (after 15 min. warm-up)

Warranty

Schaevitz instruments are warranted during a period of one year form date of shipment to original purchaser to be free from defects in material and workmanship. The liability of Seller under this warranty is limited to replacing or repairing any instrument or component thereof which is returned by Buyer, at his expense, during such period and which has not been subjected to misuse, neglect, improper installation, repair, alteration, or accident. Seller shall have the right to final determination as to the existence and cause of a defect. In no event shall Seller be liable for collateral or consequential damages. This warrant is in lieu of any other warranty, expressed, implied, or statutory; and no agreement extending or modifying it will be binding upon Seller unless in writing and signed by a duly authorized officer.

Receiving Inspection

Every Schaevitz instrument is carefully inspected and is in perfect working order at the time of shipment. Each instrument should be checked as soon as received. If the unit is damaged in any way, or fails to operate, a claim should immediately be filed with the transportation company.

Service Concerns

If a Schaevitz instrument requires service, first contact the nearest Schaevitz Representative. He may be able to solve the problem without returning the unit to the factory. If it is determined that factory service is required, call the Repair Department for an RMA number before return.

Returns

All units being returned to the factory require an RMA (Return Material Authorization) number before they will be accepted. This number may be obtained by calling the Repair Department at 1-800-745-8008 with the following information: model number, quantity, serial number, and symptoms of the problem, if being returned for service. You must include the original P.O. number or Schaevitz sales number if under warranty.

Inquiries

Address all inquiries on operation or applications to your nearest Sales Representative, or to Sales Manager, Schaevitz Sensors, 1000 Lucas Way, Hampton, VA 23666, USA.

Setting Amplifier Gain:

You will need to calculate the LVDT full scale output, using the simple formula below.

LVDT sensitivity *(in **mV / V / .001"**)* (at the selected frequency)
Times
The LVDT excitation voltage, (***3.0*** *V rms*. for the LVM-110)
Times
The full scale displacement of the LVDT in .001"
(i.e. a 1000 HR full scale is ± **1,000** thousandths of an inch).
As an example, the calculation for a 1000-HR, with a sensitivity of 0.39mV/V/.001", would be done as follows:
0.39(mV) X **3.0**(V rms) X **1,000**(thousandths) = 1,170 mV full scale output, or 1.17 Volts at ± 1 inch.

Using the gain table below, select the gain setting that appears to the left of the V rms range your full scale output falls into. In our example, you would select gain x 0.2, HIGH, or x 0.5, LOW, either will work, due to range overlap.

This table assumes you want to calibrate the LVM-110 for a ±10 V dc, full scale output.

1ST STAGE			2ND STAGE		SENSITIVITY RANGE FOR 10 VDC OUTPUT CHANGE
GAIN	SWITCHES		GAIN	SWITCH	
	S2—A	S2—B		S1—A	(VRMS INPUT)
X0.2	OFF	OFF	LOW	ON	2.10 TO 5.55
X0.2	OFF	OFF	HIGH	OFF	1.00 TO 2.64
X0.5	ON	OFF	LOW	ON	0.84 TO 2.22
X0.5	ON	OFF	HIGH	OFF	0.40 TO 1.00
X2	OFF	ON	LOW	ON	0.21 TO .55
X2	OFF	ON	HIGH	OFF	0.10 TO 0.26

LVM-110 Gain Selection Table

Calibration Procedure (for ±10 V dc output):

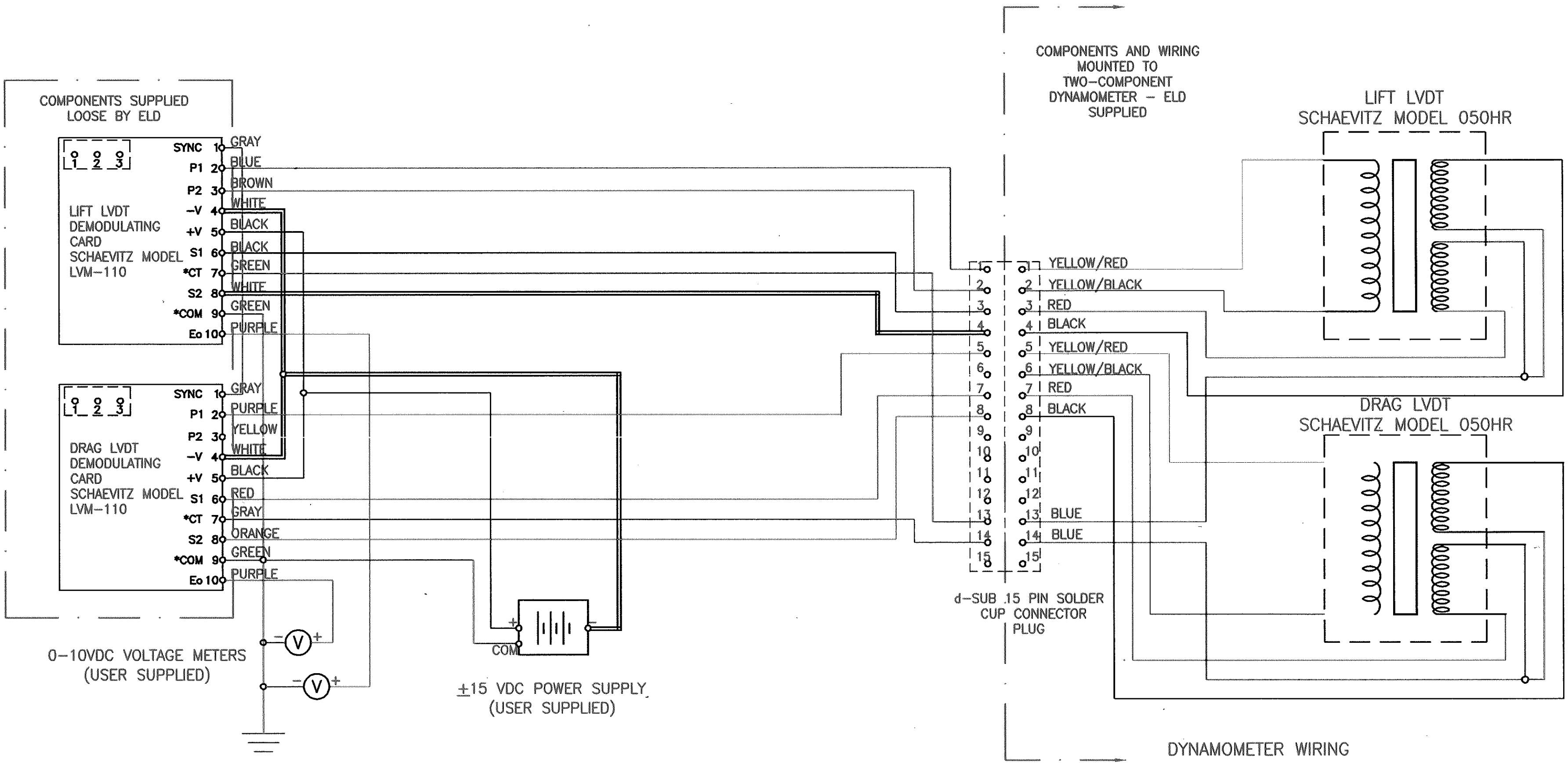
Using the connection diagram in the front of this manual, connect the LVDT, a dc volt meter and bi-polar power supply to the LVM-110.

Note: To calibrate your LVDT for a ± 5 V dc output, double the result of your full scale output calculation, prior to consulting the gain table. This will result in you selecting half the normal gain, therefore resulting in half the normal output.

Note: The 0 to 10 volt calibration process is at the end of this section.

Note: Changing course gain settings after step 6 may result in a zero shift. Should you find it necessary to change gain, you should repeat steps 1 through 6.

1. Disconnect the S-2 connection from terminal 8, (black LVDT lead)
2. Place a temporary shorting jumper across terminals 6 and 8.
3. Adjust the zero potentiometer for zero volts output, between terminals 9 and 10.
4. Remove shorting jumper and re-install black wire to terminal 8.
5. Move the core to the approximate center of the LVDT coil, using the volt meter to find the sensor null, (zero).
6. Using the zero potentiometer, adjust out any remaining output signal, due to positioning difficulty.
7. Using a gage block micrometer or other precision positioning device, move the LVDT core in a positive direction, (toward the leads or connector), to the full scale displacement used in your calculation, (+1.0 inches in our example).
8. Adjust the GAIN potentiometer for the required positive full scale dc output, between pins 9 and 10.
9. Return to the original zero position to re-check your null voltage, then displace the core to minus full scale position, (the end opposite the lead exit or connector).



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REFERENCE: P.O. NO. 519K260–022504	DATE: 03/03/14	SCALE: NTS

Product Description:
The LVM-110 is a low-cost LVDT / RVDT signal conditioning board, primarily designed for OEM process automation applications.

The design has been optimized to provide maximum versatility while offering good performance at a moderate cost.

This device is compatible with most, but NOT all, 5 and 6 wire LVDTs and RVDTs. Please consult the product specification page to ensure compatibility with your particular sensor.

DIP switches are provided to allow selection of four sensor excitation frequencies, from 2.5 to 10.0 kHz.

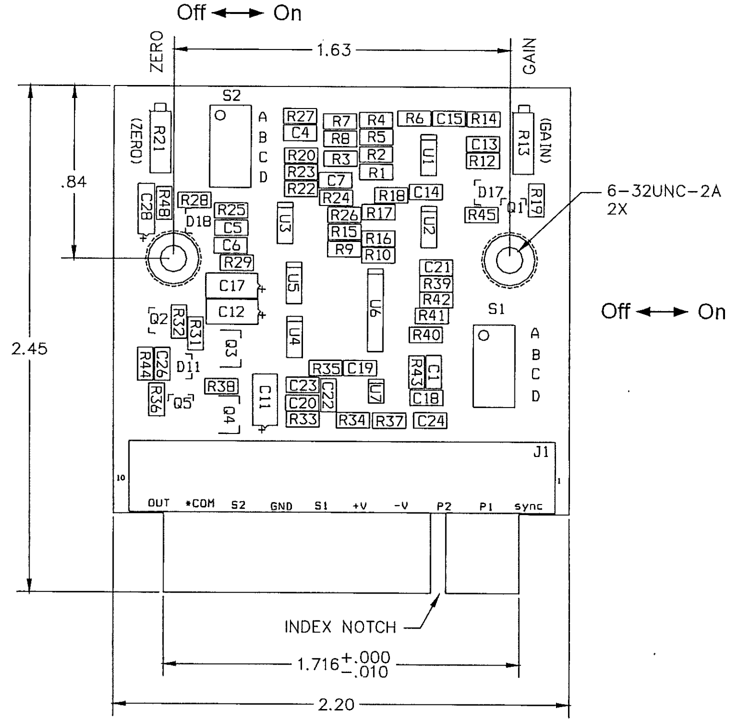
Switches are also provided to select six course gain ranges, two zero offsets, and master / slave or stand alone operation.

Installation may be accomplished by use of the card-edge connector or threaded stand-offs and screw-lock barrier strip connections.

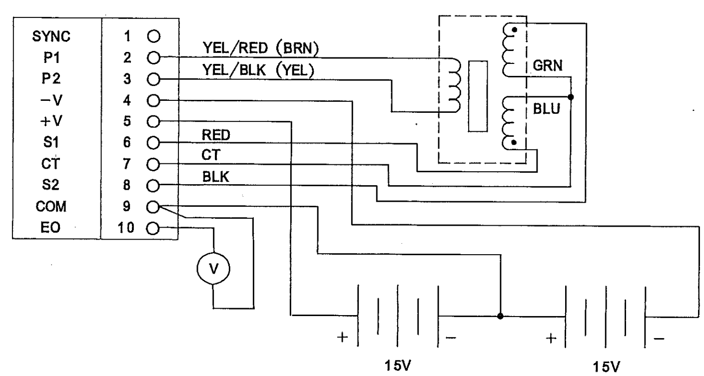
The next few pages will take you, step by step, through the simple set-up and calibration process. This device may be set-up for several different full scale analog outputs, some of the potential configurations are listed below.

The set-up configurations to be discussed will be:

- ± 10 V dc. out
- ± 5 V dc. out
- 0 to 10 V dc. out
- stand alone operation
- master / slave operation



LVM-110 Top View



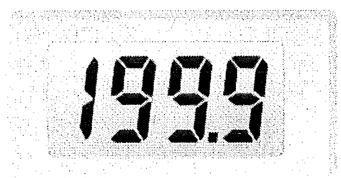
LVM-110 Connection Diagram

EMV 1125

Single Hole Mounting Meter

EMV 1125 is an easy to mount LCD digital panel meter. The user need only drill a single 5.5mm / 7/32" hole in the panel. The module is fitted to the panel by locating its screw threaded stud through the hole, fitting the washer and tightening the nut provided. The module's 10 connecting wires pass through the hollow stud into the target application, where they can be easily soldered into place. The module features 200mV full scale input, auto-zero and auto-polarity. A separate screw terminal adaptor board (T/BLK-4) simplifies connection and calibration. A rubber seal is included, providing splashproof protection for the unit when fitted to the meter during installation.

- Single Hole Mounting
- 200mV Full Scale Reading
- 12.5mm / 0.5" LCD Digit Height
- Auto-zero, Auto-polarity
- 10 Wire Connections
- Low Battery Warning
- Screw Terminal Board (T/BLK-4)
- Splashproof



Shown Actual Size

Easy Mounting Voltmeter with T/BLK-4				Stock Number EMV 1125
Specification	**Min.**	**Typ.**	**Max.**	**Unit**
Accuracy (overall error)*		0.05	0.1	% (±1 count)
Linearity			±1	count
Displayed reading	-1999		1999	
Resolution		0.1		mV d.c.
Sample rate		3		sample/sec
Operating temperature range	0		50	°C
Temperature stability		100		ppm/°C
Supply voltage	7.5	9	15	V d.c.
Supply current		150		µA

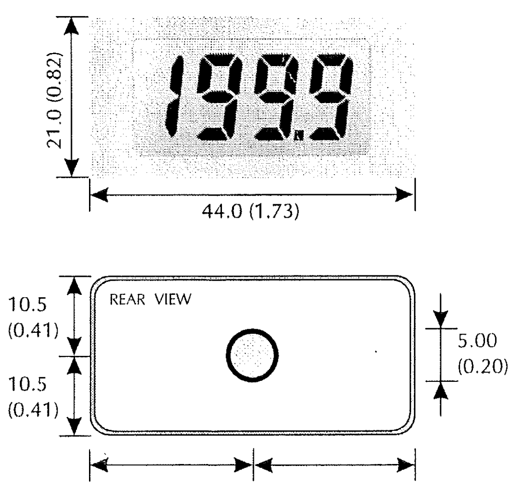
* To ensure maximum accuracy, re-calibrate periodically.

Unless otherwise noted, specifications apply at TA=25°C, V_{supply}=9Vd.c. (f_{clock}=48kHz) and are tested with the module configured for fully floating input mode.

SAFETY

To comply with the Low Voltage Directive (LVD 93/68/EEC), input voltages to the module's pins must not exceed 60Vd.c. If voltages to the measuring inputs do exceed 60Vd.c., then fit scaling resistors externally to the module. The user must ensure that the incorporation of the meter into the user's equipment conforms to the relevant sections of BS EN 61010 (Safety Requirements for Electrical Equipment for Measuring, Control and Laboratory Use).

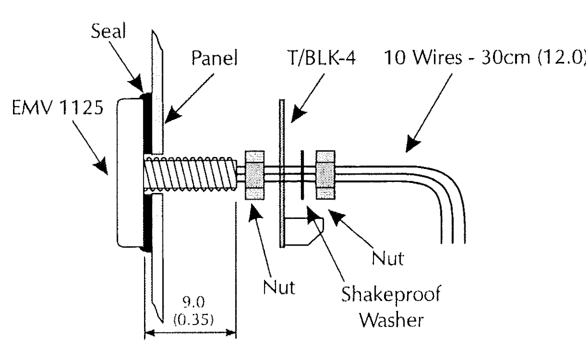
DIMENSIONS All dimensions in mm (inches)



Module thickness 5.5mm (0.22)

FITTING THE EMV 1125

Drill a 5.5mm / 7/32" hole in the panel. Fit seal to the rear of the module. Fit the module to the panel by passing its screw threaded stud and the wires through the hole, fitting the washer and tightening the nut provided. Take care not to trap any of the connecting wires. Do not to overtighten the nut as this may damage the meter.



If T/BLK-4 is not fitted, then do not fit the first nut.

1.970 .22) .63 2.08

1.137" H 1.622"

LASCAR

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WIRE CONNECTIONS (EMV 1125) and SCREW TERMINAL FUNCTIONS (T/BLK-4)

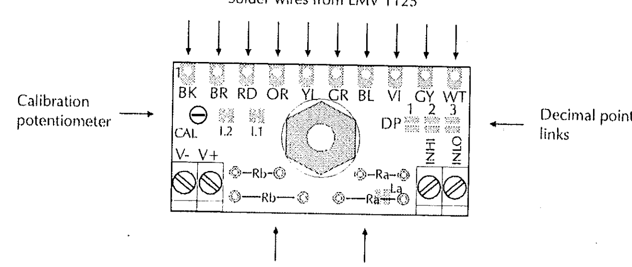
0.	Black (BK)	V-	Negative power supply connection.
1.	Brown (BR)	COM	The ground for the analogue section of the A/D converter, held actively at 2.8V (nom.) below V+. COM must not be allowed to sink excessive current (>100μA) by connecting it directly to a higher voltage.
2.	Red (RD)	V+	Positive power supply connection.
3.	Orange (OR)	Vref	Connection for calibration circuit (see diagram below).
4.	Yellow (YL)	IN HI	Positive measuring differential input. } IN HI and IN LO must be no closer than 1V to either the positive or negative supply.
5.	Green (GR)	IN LO	Negative measuring differential input. } (On T/BLK-4, IN LO is connected to COM via normally-closed Link L2.)
6.	Blue (BL)	DP COM	Common connection for decimal points DP1, DP2 and DP3, see below.
7.	Violet (VI)	DP1	199.9 } Connect to DP COM to display required decimal point.
8.	Grey (GY)	DP2	19.99 } (or make appropriate solder link on T/BLK-4)
9.	White (WT)	DP3	1.999 }

SCALING and CALIBRATION

A calibration circuit and two resistors (Ra and Rb) may be added on the EMV 1125 or T/BLK-4 board (cut Link La if fitting Ra) to alter the full scale reading of the meter - see table. Note that the meter will have to be (re-)calibrated by adjusting the potentiometer.

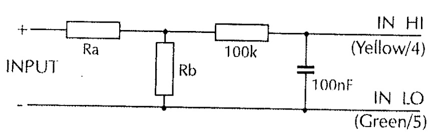
Required F.S.R.	Ra	Rb	CAL
200mV	N/A	N/A	Adjust
2V	910k	100k	Adjust
20V	1M	10k	Adjust
200μA	0R	1k	Adjust
2mA	0R	100R	Adjust
20mA	0R	10R	Adjust
200mA	0R	1R	Adjust

Connecting to T/BLK-4



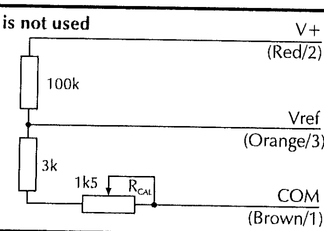
Note: There are two locations for each scaling resistor (Ra and Rb) to allow for different types. It is only necessary to fit a resistor in one of these locations.

Adding an input filter and scaling resistors when T/BLK-4 is not used



Note: To reduce noise on the meter's input, fit the input filter components (1M and 10nF) shown above. The input filter is fitted as standard on T/BLK-4.

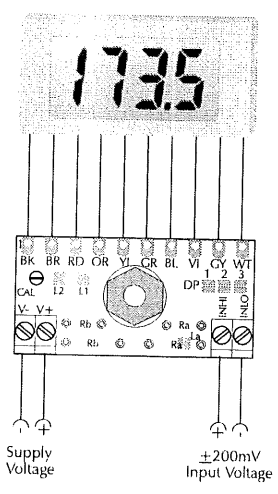
Adding a calibration circuit when T/BLK-4 is not used



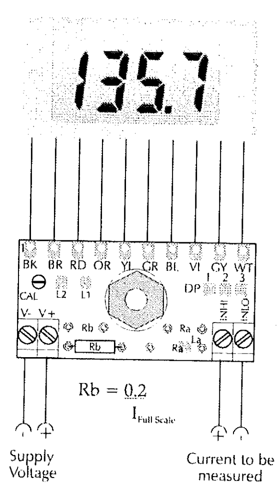
Note: The calibration circuit must always be fitted, even when scaling resistors are not fitted. This circuit is fitted as standard on T/BLK-4.

APPLICATIONS

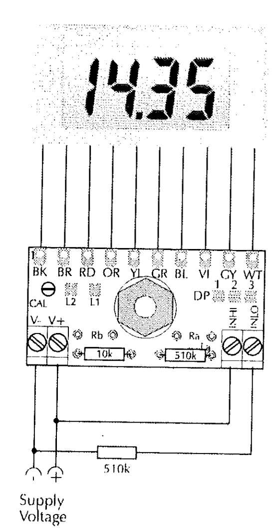
Do not connect more than one meter to the same power supply if the meters cannot use the same signal ground. Taking any input beyond the power supply rails will damage the meter. Keep leads short to ensure noise-free operation.



Measuring a floating voltage source of 200mV full scale.
Add Ra and Rb and cut Link La to increase the measurement range.



Measuring current.
Recalibrate the module.
The current to be measured must be isolated from the module's power supply.



Measuring a supply voltage.
(min. 7.5V, max. 15V)
Cut Links La and L2.
Recalibrate the module.

measurement
SPECIALTIES

FINAL TEST LVDT HR 050 ASSY

02560389-000
RANGE +/-0.05 Inches
INDEPENDENT LINEARITY DATA LEAST SQUARES LINE

S/N J90803
2012-9-7

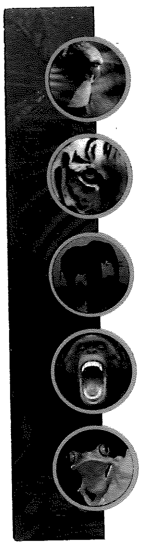
MEASURED Inches	MEASURED Volts RMS	CALC. Volts RMS	CALC. DEVIATION
-0.0500	-0.8694	-0.8698	+0.0004
-0.0400	-0.6954	-0.6955	+0.0000
-0.0300	-0.5213	-0.5211	-0.0002
-0.0200	-0.3471	-0.3468	-0.0003
-0.0100	-0.1729	-0.1725	-0.0004
+0.0100	+0.1762	+0.1760	+0.0002
+0.0200	+0.3505	+0.3503	+0.0002
+0.0300	+0.5248	+0.5246	+0.0002
+0.0400	+0.6990	+0.6989	+0.0000
+0.0500	+0.8731	+0.8733	-0.0002

Linearity = 0.02%
Sensitivity =5.8105 mv/Volts RMS/.001 Inches
NULL (actual) =0.0073 Volts RMS

Tested by Haiyan Wei

Inspected by [illegible]

Measurement Specialties,Inc
1000 Lucas Way
Hampton,Virginia 23666
(800)745-8008
Fax:(757)766-4297



measurement SPECIALTIES

Linear Variable Differential Transducers

Test and Inspection Data

Type: HR 050 Serial No. ______ Range ± 0.05"

PLEASE READ BEFORE USING THIS TRANSDUCER

This measurement device is manufactured to high precision standards. Our factory tests prior to shipment assure its performance. To obtain the optimum performance in your application. handle and install with care. Do not machine, grind or tap core and coil assembly. Core and coils are matched sets; for best performance do not interchange cores.

TEST CONDITIONS	
Primary connections	yel/black and yel/red ☒ grounded ☐ not grounded
Secondary Connections	black and red ☒ grounded ☐ not grounded
Secondary Midpoints	(a) green (b) blue ☒ (a) tied to (b) ☐ (a) not tied to (b)
Case Connections	☐ grounded ☒ not grounded
Primary Excitation	3 volts at 2500 Hz
Secondary Load	0.5 Meg ohms (in parallel with) ______ mfd)

TEST DATA	
Displacement	+ ______ Inches
Output	______ volts ______ volts/input volts
Linearity	+ ______ % of full range output
Null (Combined Quadrature and Harmonics)	______ mv (rms)
Output-to-Input Phase Angle	______ degrees ☐ leading (+) ☐ lagging (−)
Special Tests	______ ______

INSPECTION	☒ Workmanship ☒ High Voltage Test ☒ Completeness of assembly

REMARKS	______ ______

ACCEPTANCE	Tested by ______ Date ______ Inspected by ______ Date ______ Military Inspection ______ Date ______ (When Required)

measurement SPECIALTIES

FINAL TEST LVDT HR 050 ASSY

02560389-000

RANGE +/-0.05 Inches

S/N J90263

INDEPENDENT LINEARITY DATA   LEAST SQUARES LINE

2012-8-4

MEASURED Inches	MEASURED Volts RMS	CALC. Volts RMS	CALC. DEVIATION
-0.0500	-0.8950	-0.8955	+0.0005
-0.0400	-0.7166	-0.7166	+0.0001
-0.0300	-0.5383	-0.5377	-0.0006
-0.0200	-0.3591	-0.3588	-0.0002
-0.0100	-0.1806	-0.1799	-0.0006
+0.0100	+0.1786	+0.1778	+0.0009
+0.0200	+0.3563	+0.3567	-0.0004
+0.0300	+0.5365	+0.5356	+0.0010
+0.0400	+0.7143	+0.7145	-0.0002
+0.0500	+0.8929	+0.8934	-0.0004

Linearity = 0.05%

Sensitivity =5.9633 mv/Volts RMS/.001 Inches

NULL (actual) =0.0069 Volts RMS

Tested by Shengwen Tai   Inspected by

Measurement Specialties,Inc
1000 Lucas Way
Hampton,Virginia 23666
(800)745-8008
Fax:(757)766-4297

Lift

measurement SPECIALTIES

Linear Variable Differential Transducers

Test and Inspection Data

Type: HR 050 Serial No. ________ Range ± 0.05"

PLEASE READ BEFORE USING THIS TRANSDUCER

This measurement device is manufactured to high precision standards. Our factory tests prior to shipment assure its performance. To obtain the optimum performance in your application. handle and install with care. Do not machine, grind or tap core and coil assembly. Core and coils are matched sets; for best performance do not interchange cores.

TEST CONDITIONS	
Primary connections	yel/black and yel/red ☒ grounded ☐ not grounded
Secondary Connections	black and red ☒ grounded ☐ not grounded
Secondary Midpoints	(a) green (b) blue ☒ (a) tied to (b) ☐ (a) not tied to (b)
Case Connections	☐ grounded ☒ not grounded
Primary Excitation	3 volts at 2500 Hz
Secondary Load	0.5 Meg ohms (in parallel with) ______ mfd)

TEST DATA	
Displacement	+ ______ Inches
Output	______ volts ______ volts/input volts
Linearity	+ ______ % of full range output
Null (Combined Quadrature and Harmonics)	______ mv (rms)
Output-to-Input Phase Angle	______ degrees ☐ leading (+) ☐ lagging (−)
Special Tests	______

INSPECTION	
	☒ Workmanship ☒ High Voltage Test ☒ Completeness of assembly

REMARKS	
	______

ACCEPTANCE	
	Tested by ______ Date ______ Inspected by ______ Date ______ Military Inspection ______ Date ______ (When Required)