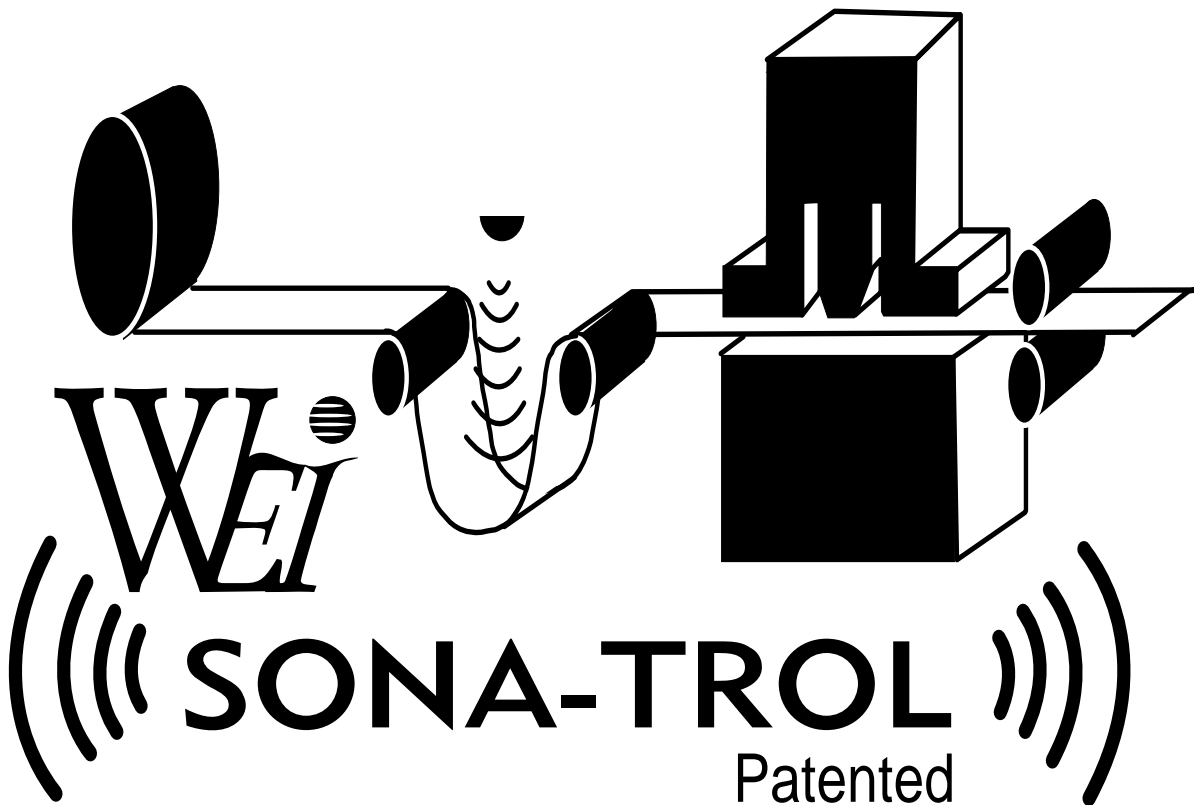


SONA-TROL

Sensing and Control system

Users Manual



Waddington Electronics Inc

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Model # _____

Serial # _____

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Product Description

SONA-TROL, the only **PATENTED NON-CONTACT** loop control, is NOT limited to loop control applications.

SONA-TROL installed in a storage tank, can be used to control the level of liquids or solids.

SONA-TROL can be used to control unwind and rewind tension.

SONA-TROL can be used to detect the presence or absence of objects, such as pallets in automated warehouses.

SONA-TROL can sense changes in distance, within its detection area, as small as 0.010 inches.

SONA-TROL is supplied in many models, each with a variety of standard and optional features, allowing you to customize your particular **NON-CONTACT** sensing and control system application.

ST-6 STANDARD FEATURES

Adjustable distance (from sensor) zero offset

Adjustable gain

Operating Range: 1.5 to 20 feet

Adjustable receiver sensitivity

Sensor head cable length: 10 feet

Oil-tight JIC controller enclosure

Electrically-isolated sensor head

An exclusive circuit, for use in loop control applications where bouncing strips are likely to cause false measurements. This proprietary circuit detects false signals and rejects them, allowing **SONA-TROL** to provide proper take-up or pay-out smoothness regardless of strip bounce or sway.

Built-in provisions for external control of measurement rate. This is often used in applications where **SONA-TROL** operates in conjunction with a programmable controller, an external computer, or one of the sequencers described below.

ST-6 OPTIONAL FEATURES

Dual sensors for wide sensing area

Multiple limit switch outputs (up to 20 per sensor)

Adjustable measurement repetition rate

Multiple sensor array sequencer (up to 128 sensors)

Digital or analog readout for object distance (from sensor) or height

Scaled readouts to measure the volume of liquids or solids contained in storage tanks

Wide range of voltage outputs

Current loop output: 0 to 10 MA or 4 to 20 MA

Sensor head cable length: up to 1000 feet

High resolution sensor head; detection distance range: 2 inches to 20 inches

SY-2 SYNCHRONIZER FEATURES

The **SY-2** is a two-channel synchronizer that allows the use of two sensor heads in close proximity to each other. It does this by connecting the external measurement control input of two **SONA-TROL ST-6** circuit boards. The **SY-2** controls when transmit will occur, eliminating interference between controls.

SY-8 SYNCHRONIZER FEATURES

The SY-8 is an eight-channel synchronizer that can control the sequence and measurement rate of up to eight **SONA-TROL** controls. This board also connects to the external rate control input of the ST-6 main circuit board.

OTHER OPTIONS

RMS Output Board

PID Output Board

Output: 0 to 10 MA or 4 to 20 MA

12 Bit Binary Output Isolated 5 to 15 V Logic

Analog Multiplier

0 to 78 PSI Output

0 to 90 VDC Output

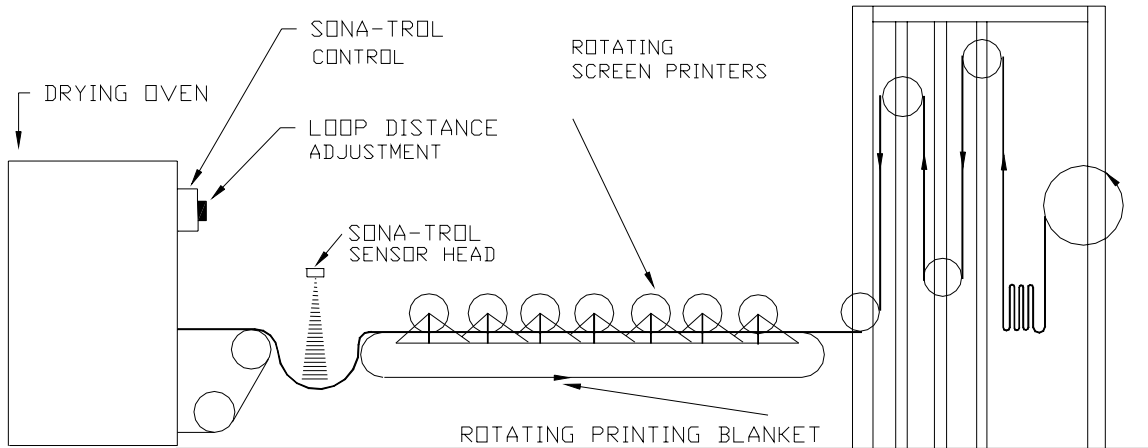
Acoustic Horn

Extended range sensor head 6 inches to 20 feet

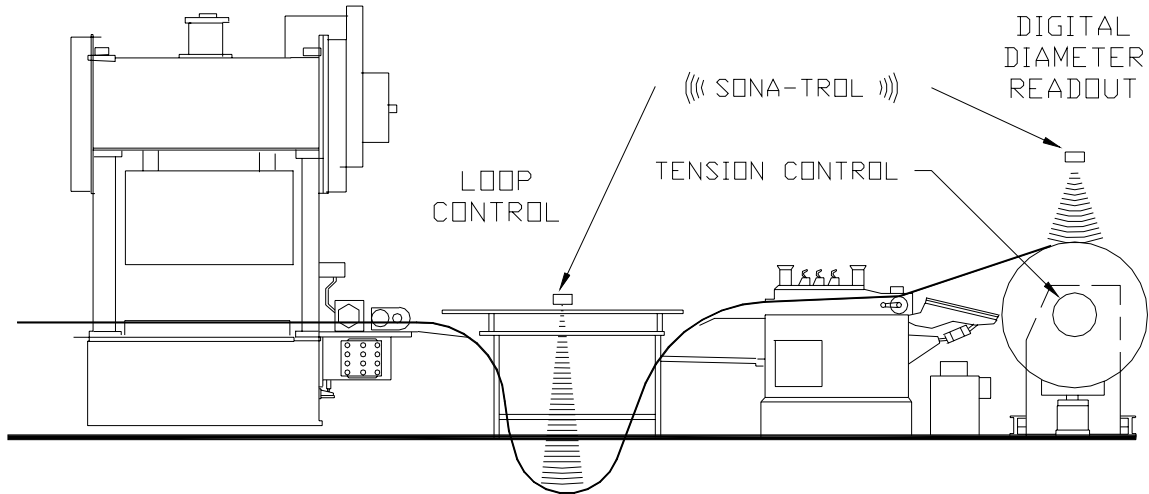
See EZ-Circuit Analog Function Modules catalog for additional options

Typical Applications

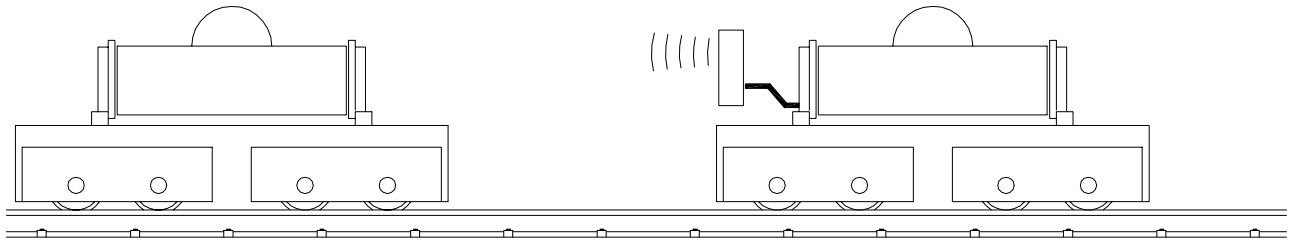
Rotary Screen print machine



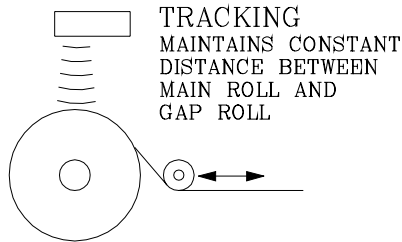
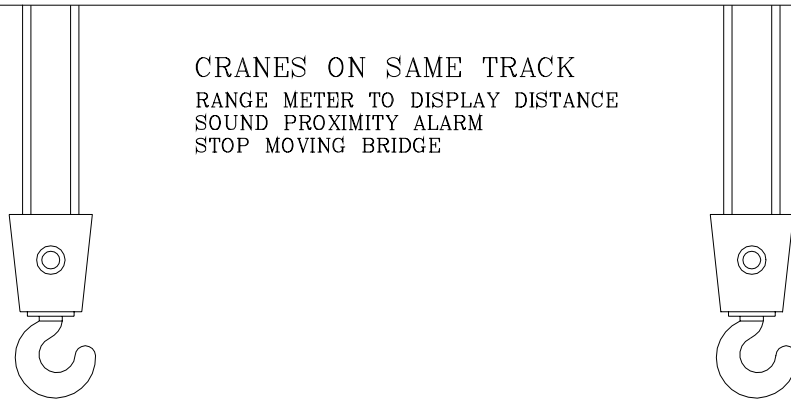
Metal Stamping Line



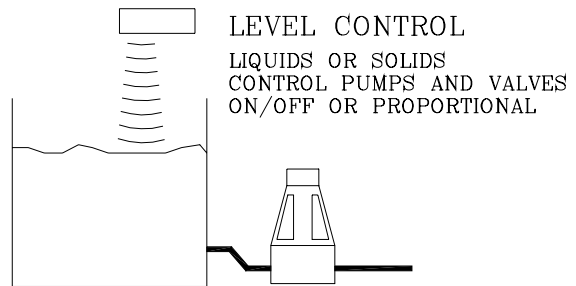
Distance Measurement



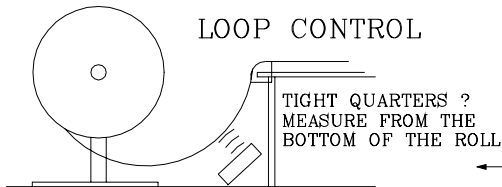
CRANES ON SAME TRACK
 RANGE METER TO DISPLAY DISTANCE
 SOUND PROXIMITY ALARM
 STOP MOVING BRIDGE



TRACKING
 MAINTAINS CONSTANT
 DISTANCE BETWEEN
 MAIN ROLL AND
 GAP ROLL

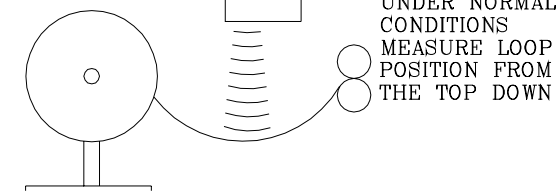


LEVEL CONTROL
 LIQUIDS OR SOLIDS
 CONTROL PUMPS AND VALVES
 ON/OFF OR PROPORTIONAL

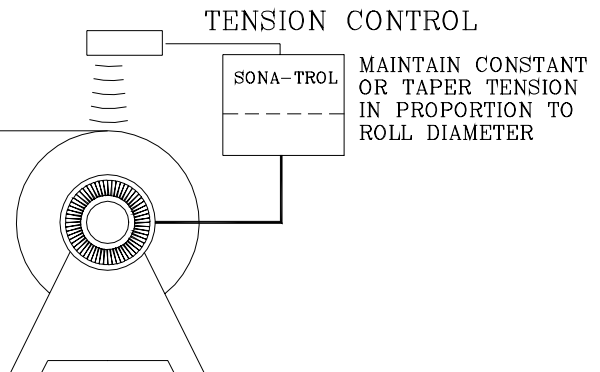


LOOP CONTROL

TIGHT QUARTERS ?
 MEASURE FROM THE
 BOTTOM OF THE ROLL



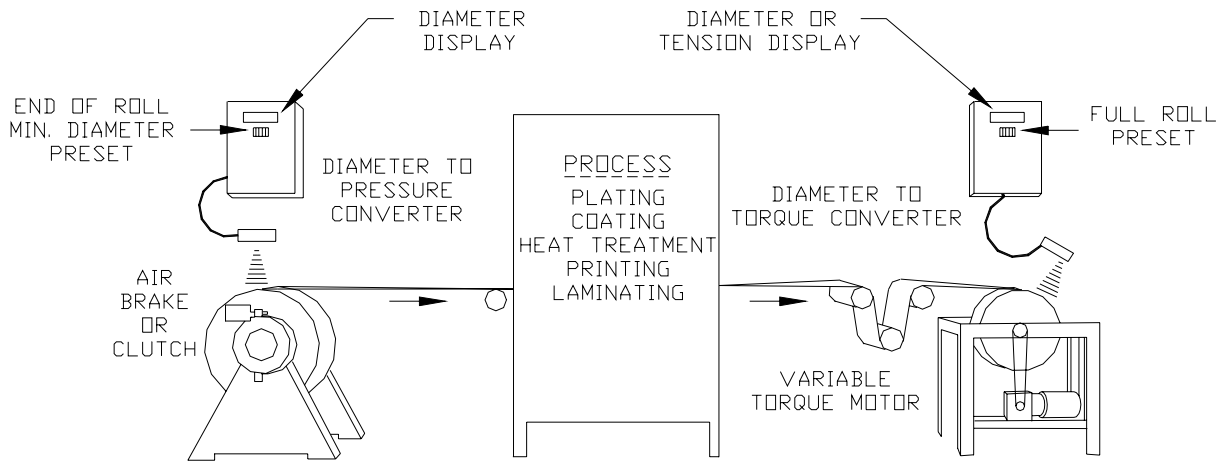
UNDER NORMAL
 CONDITIONS
 MEASURE LOOP
 POSITION FROM
 THE TOP DOWN



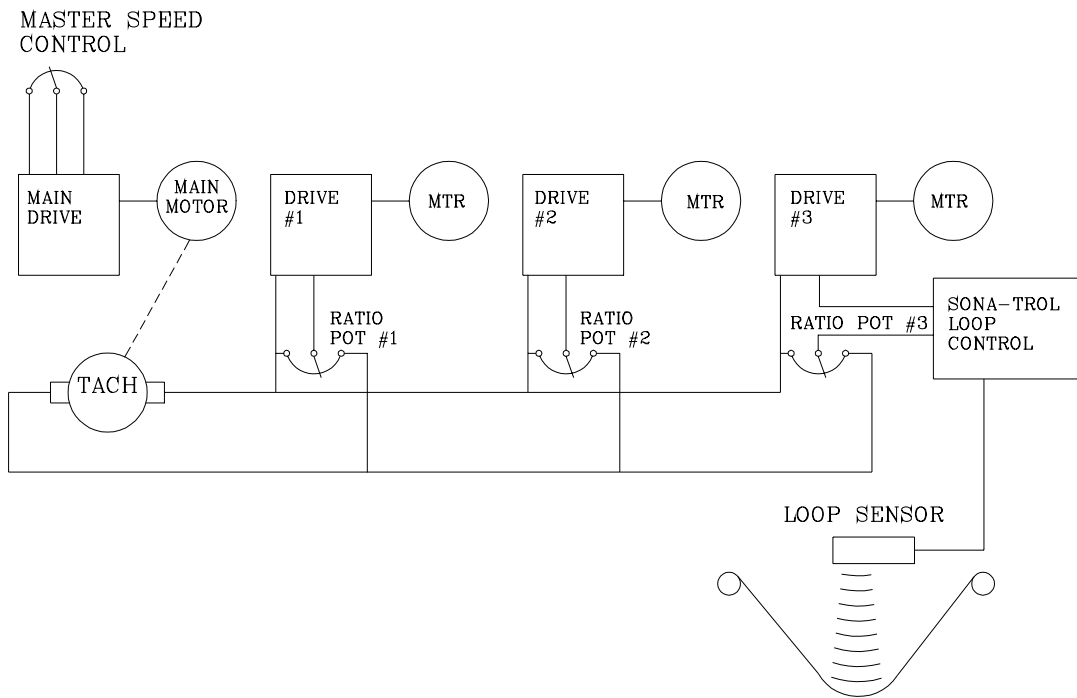
TENSION CONTROL

SONA-TROL
 MAINTAIN CONSTANT
 OR TAPER TENSION
 IN PROPORTION TO
 ROLL DIAMETER

Diameter Measurement



TACH-FOLLOWER SYSTEM



Specifications

OPERATING REQUIREMENTS

Power Requirements

115 VAC +/- 5% at 0.25 Amperes nominal, 60 Hz. (50 Hz. Optional) 220 VAC +/- 5% at 0.125 Amperes nominal, 50/60 Hz. Other voltages on request.

Environment

Operating Temperature 20 to 160 degrees Fahrenheit Storage Temperature same as Operating Temperature Humidity 95% (noncondensing)

TRANSDUCER RANGE RESOLUTION ACCURACY

Standard and Environmental

1.5 to 20 feet 0.05 in. +/- 0.050

Extended Range

6" to 20 feet 0.050 in. +/- 0.005 in

E201/215 High Resolution

3 to 24 inches 0.005 in. +/- 0.010 in.

E201/150 High Resolution

5 to 48 inches 0.005 in. +/- 0.010 in.

ENVIRONMENTAL TRANSDUCER

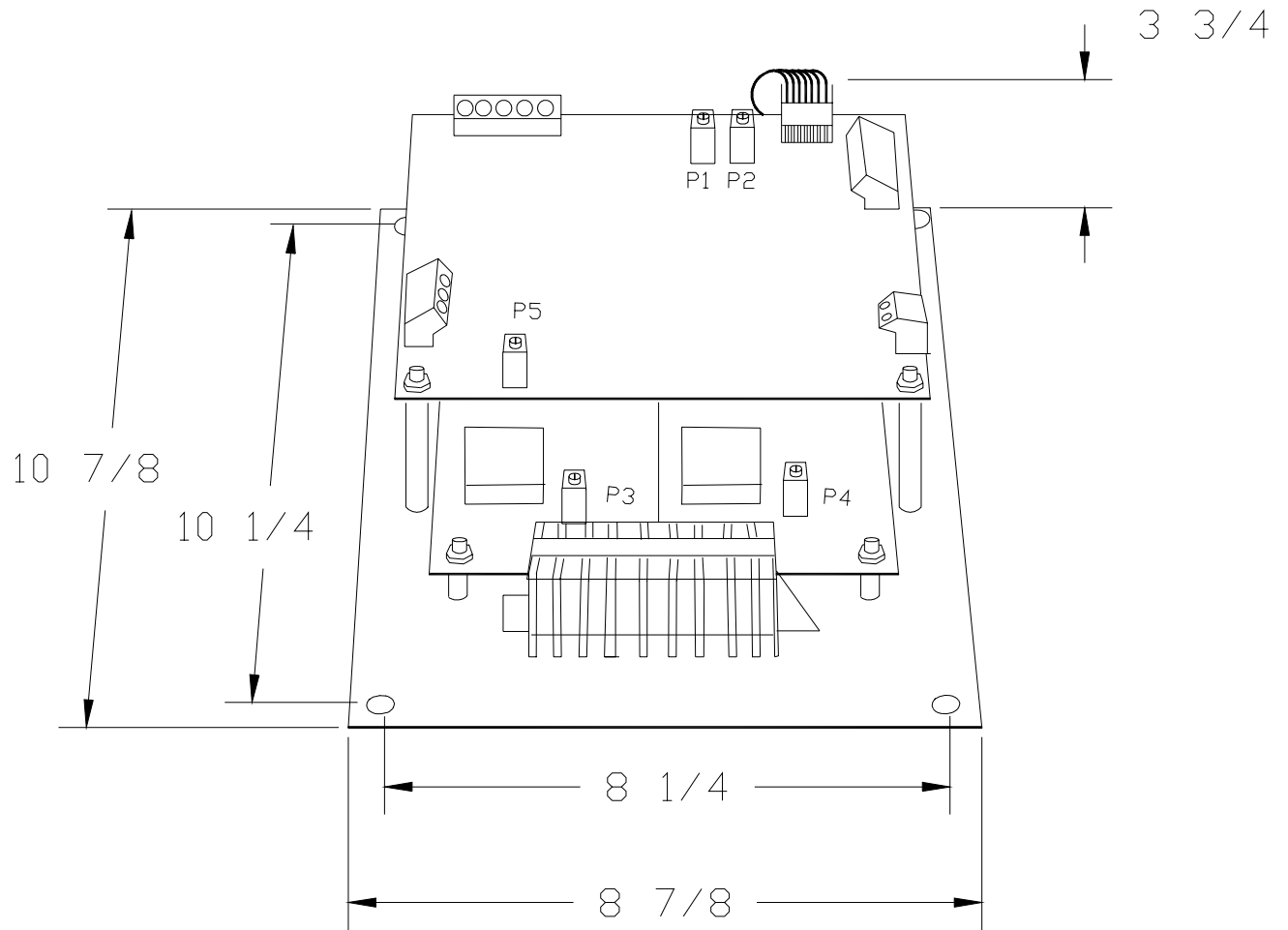
The Environmental Transducer is of stainless steel construction for operation in severe environments where other material would be degraded. Environmental Transducers should be used in applications such as the food industry, where frequent cleaning is required.

ANALOG OUTPUT VOLTAGE

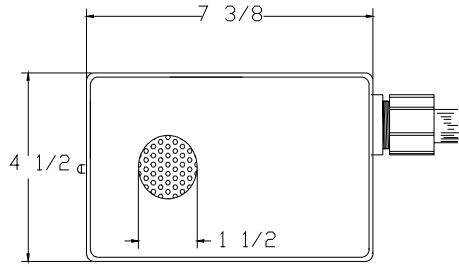
Analog Output Voltage Gain Range: 25 MV/Inch to 1.25 V/Inch. Other gain ranges available.

Note: Output is isolated on systems using standard type sensor heads only, not on high resolution models.

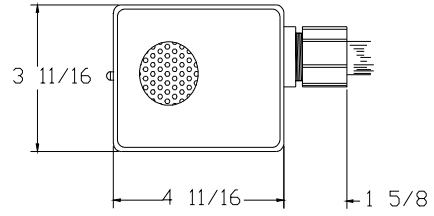
ALL POTENTIOMETERS ARE 15 TURN POTS



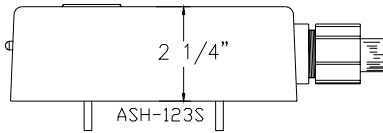
OLD STYLES



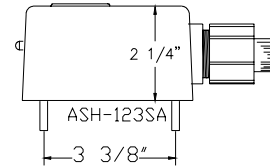
NEW STYLES



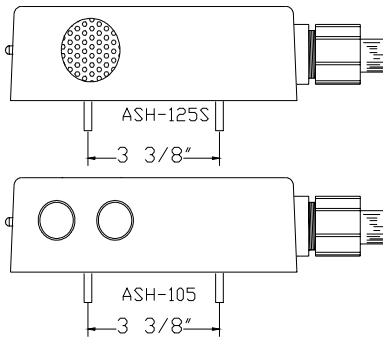
PART# MRSH-2



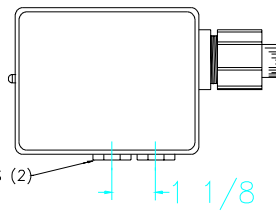
PART# MRSH REV 1
MRSH REV 2



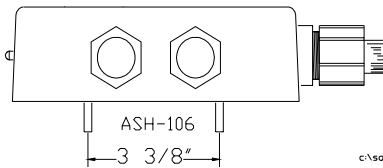
PART# HRSH-1



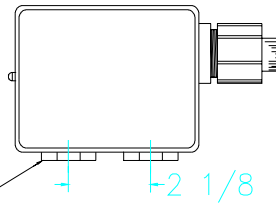
PART# HRSH REV 1



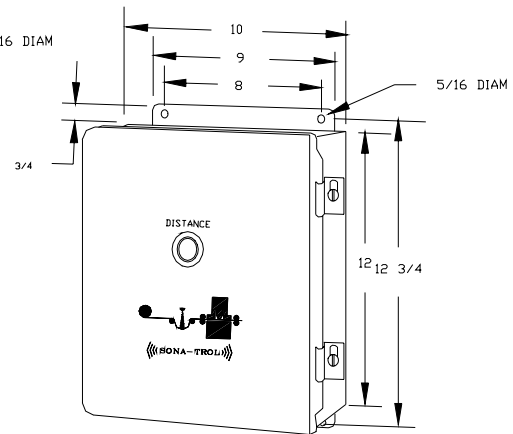
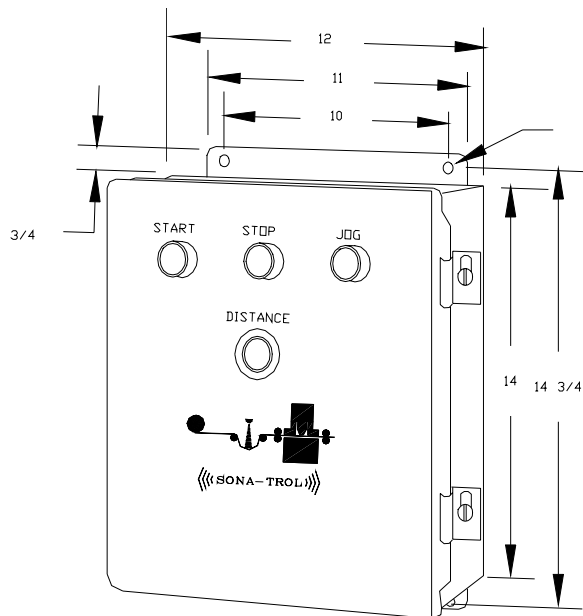
PART# HRSH-2

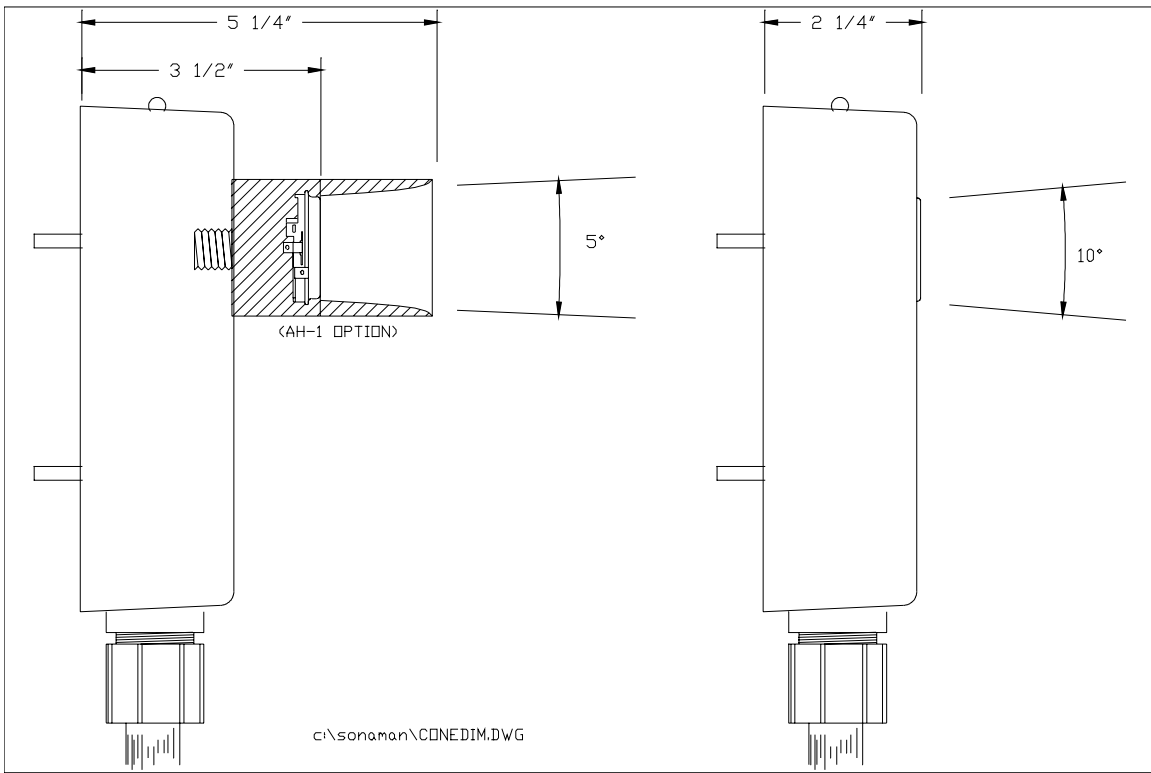
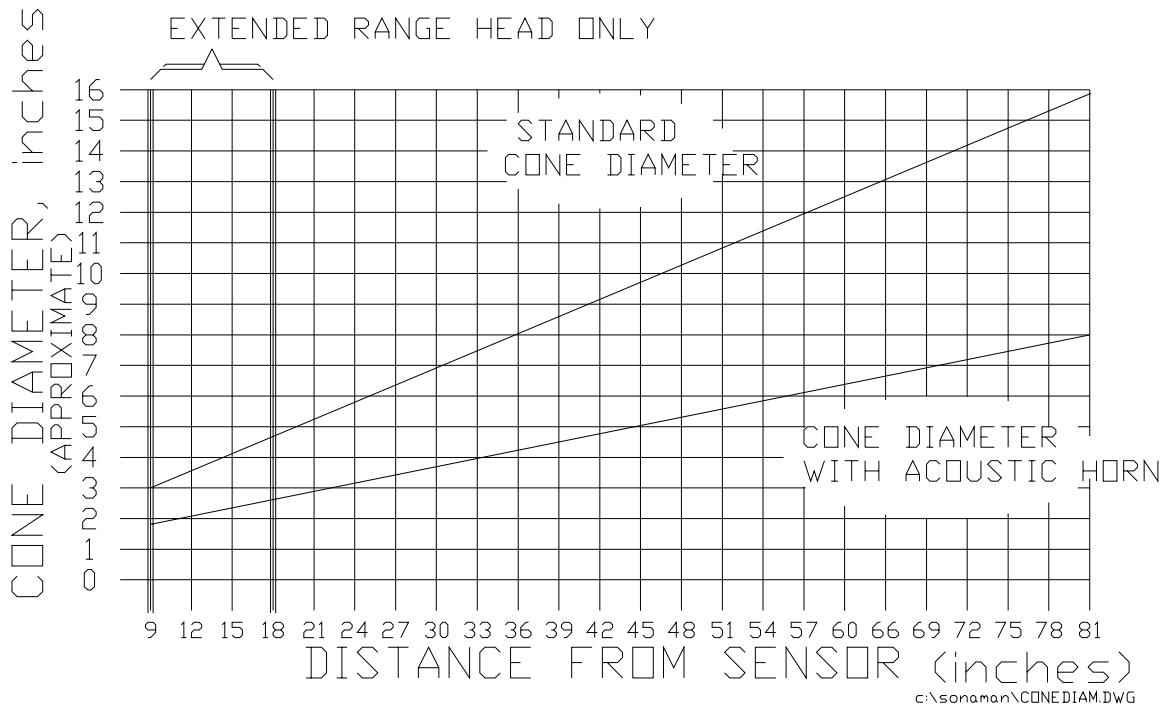


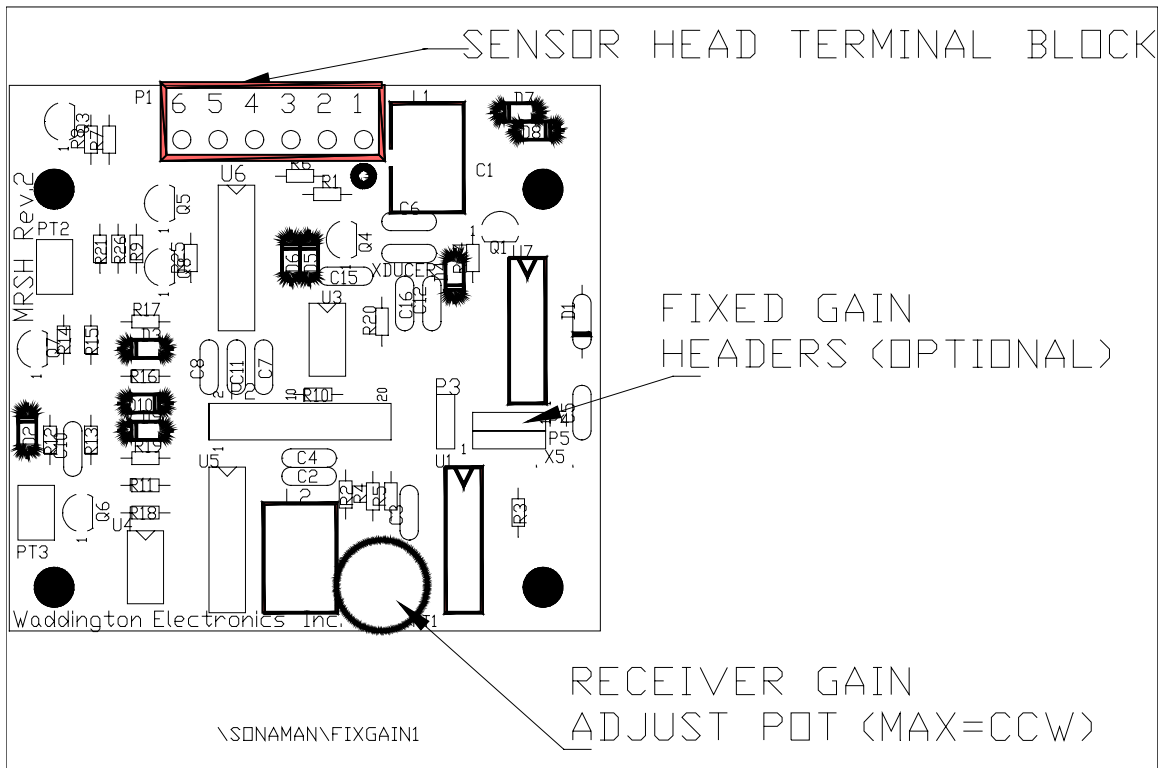
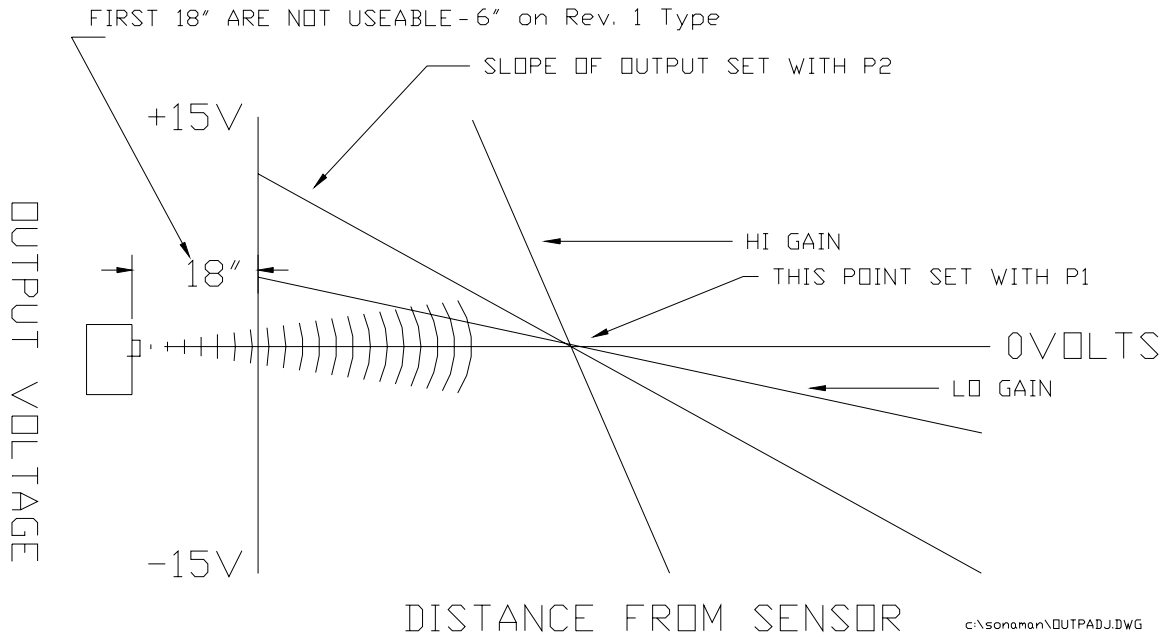
PART# HRSH REV 2



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Installation

UNPACKING

After unpacking the controller and/or motor, inspect the equipment for loose parts, broken or missing components, dents, and any evidence of mishandling. Check the model type, input voltage, and power rating against the order description.

CAUTION: IF THERE IS ANY EVIDENCE OF PHYSICAL DAMAGE, DO NOT CONTINUE. DO NOT INSTALL DAMAGED EQUIPMENT.

Installation Instructions

MOUNTING LOCATION

Avoid mounting the SONA-TROL main enclosure where it might be subjected to extremes of vibration (a bouncing press), temperature or moisture.

POWER CONNECTIONS

CAUTION: THE INTERNAL PARTS OF THE MOTOR AND CONTROLLER CAN BE AT LINE POTENTIAL WHETHER OR NOT THE EQUIPMENT IS FUNCTIONING. BEFORE TOUCHING ANY INTERNAL PARTS, DISCONNECT BOTH INCOMING A.C. POWER CABLES.

Before applying power to the SONA-TROL system, verify that the name plate data corresponds to the power source being connected to the terminal block.

Sensor Head Location

LOOP

In loop control applications, mount the sensor perpendicular to the center of the loop.

LEVEL

For level control applications, place the sensor facing perpendicular to the surface being measured.

DIAMETER

In applications for diameter measurement, diameter to tension control, and diameter to constant speed, mount the sensor at a right angle to the roll of material being sensed. The sensor should be mounted so that an imaginary line can be drawn from the sensor to a point on the axis of the roll at 90 degrees to the axis.

Adjustments

CAUTION: THE INTERNAL PARTS OF THE MOTOR AND CONTROLLER CAN BE AT LINE POTENTIAL WHETHER OR NOT THE EQUIPMENT IS FUNCTIONING. BEFORE TOUCHING ANY INTERNAL PARTS, DISCONNECT BOTH INCOMING A.C. POWER CABLES.

Preliminary Adjustments

(Also see Field Adjustments pg. 5-1)

LOOP CONTROL

Set P5 to adjust the Time Filter so that the row of lights, in the lower right corner of the board, begins to strobe (flash in sequence) when the strip is 2 inches from the floor. Above 2 inches from the floor, only the first light should flash. **THIS IS ESPECIALLY IMPORTANT WHEN A NARROW BOUNCING STRIP IS BEING CONTROLLED.**

Set P2 minimum full clockwise.

Set P1 for zero volts at the desired distance from the sensor.

Set P2 for the desired voltage change per inch of distance change. That is the amount of change in Speed, Tension, Volume, and Diameter.

OPTIONAL GAIN ADJUSTMENTS:

Fixed gain switches override the automatic gain changes to minimize the effects of interference; air blasts, obstructions in the detection area, etc.

LIMIT BOARD ADJUSTMENTS

SONA-TROL limit boards provide contact closure outputs for customer use. The status of the contacts, shown on the terminal block diagram, change when the preset limits are reached and the relays are de-energized. The relay SETPOINTS are adjusted with a potentiometer. When the Bottom Limit board is energized, the light (LED) on the sensor head turns on.

BOTTOM LIMIT OPERATION:

The bottom limit board is located on the left side of the enclosure. The bottom limit can be used to shut off a take-up control if the material being sensed breaks or if the loop is disturbed (for inspection by the operator). The bottom limit board de-energizes as the sensed object falls below its setpoint. **THE BOTTOM LIMIT SHOULD BE USED ON ALL PUNCH PRESS TAKEUPS OR OTHER SIMILAR APPLICATIONS**

FORCING ZERO OUTPUT WITH THE BOTTOM LIMIT:

To shut off SONA-TROL with the bottom limit, connect the normally closed bottom limit contact terminals, (14 and 15), to the analog output terminals (7 and 8). When the bottom limit is reached the relay de-energizes and forces the SONA-TROL to zero volts.

TOP LIMIT OPERATION:

The top limit can be used to control other equipment used in conjunction with SONA-TROL. The top limit board de-energizes as the sensed object moves above its setpoint.

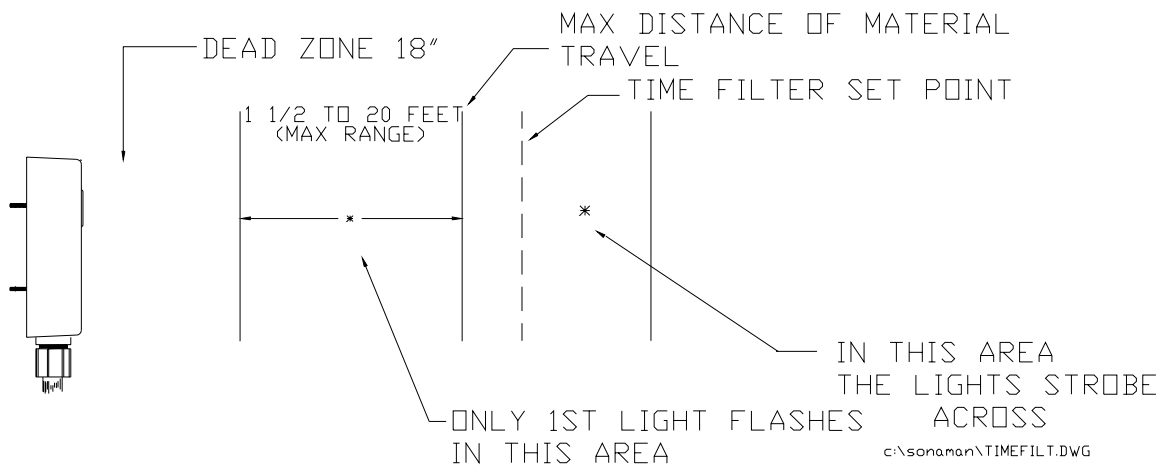
Field Adjustments

TIME FILTER P5

This potentiometer sets the maximum distance allowed for a round trip echo, before it is discounted by the time filter as a bad echo. Refer below. Set P5 to adjust the Time Filter so that the row of lights, in the lower right corner of the board, begin to strobe (flash in sequence) when the strip is 2 inches from the floor. Above 2 inches from the floor, only the first light should flash. **THIS IS ESPECIALLY IMPORTANT WHEN A NARROW BOUNCING STRIP IS BEING CONTROLLED.**

BOTTOM LIMIT P3

The bottom limit is located on the left side of the panel. The relay setpoint is moved further away from the transducer as the potentiometer is turned counterclockwise.



TOP LIMIT P4

- The top limit is located on the right side of the panel. The relay setpoint is moved further away from the transducer as the potentiometer is turned counterclockwise.

DISTANCE P1

- This potentiometer is used to set zero voltage (Zero Speed, Zero Tension, Zero Volume, Zero Diameter, etc.) at the desired distance from the sensor head.

GAIN P2

- Adjustment of this potentiometer will set the amount of voltage change per inch of distance change (Speed, Tension, Volume, Diameter, etc.).

Max Gain (CCW) = 1.25 V/inch.

Min Gain (CW) = 25 mV/inch.

Tension Adjustments (TC6 Models Only)

NOTE: In diameter measurement and diameter to tension control, it is important to direct the sensor at the core of the diameter being sensed. Otherwise false readings will result.

Locate center of roll.

Set Gain potentiometer (POT) P2 at midpoint.

Set Auto/Man switch on cover to Auto.

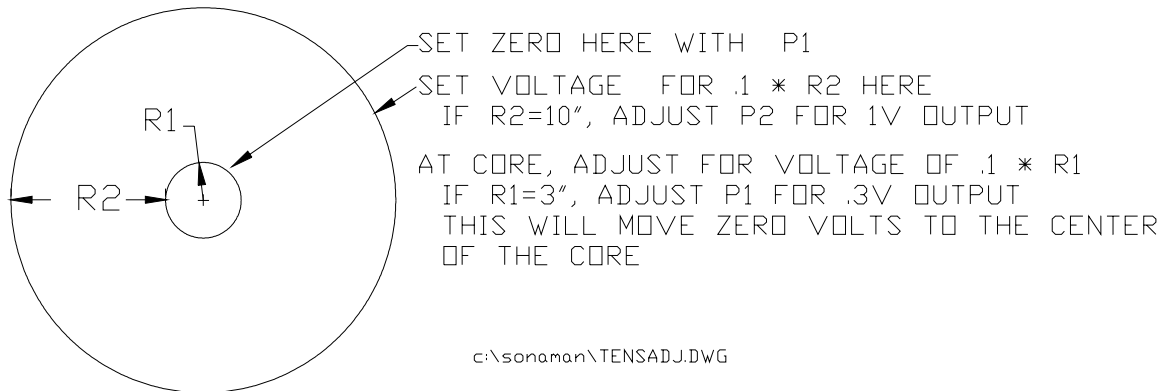
Set tension POT on cover to full on or 100%.

Set zero volts out at terminals 7 & 8 with POT P1 Distance Core Diameter.

Put Maximum Diameter roll on machine and set output at terminals 7 & 8 to be: $0.1 \text{ volts} \times \{(\text{Roll OD})/2 - (\text{Core OD})/2\}$.

Remove the roll and measure the output at terminals 7 & 8, the correct reading is zero volts. Otherwise repeat steps 2 and 3.

Adjust POT P1 until the output reads: $0.1 \text{ volts} \times \text{Core OD}/2$



CALIBRATION

Replace the maximum diameter roll on the machine and set the tension POT to full or 100%.

Set the output at terminals 7 & 8 on the ST-6 board to maximum torque command required for the particular application; 10 volts max. adjusted with Gain POT P2. The input voltage is measured at

terminals 1 and 2. (For the 4 to 20 MA option: at terminals 29 and 30; 0 Volts out = 4 MA, and 10 Volts out = 20 MA).

Constant tension can now be set with the Tension POT for any value between zero and 100%. Adjustment of POTS P1 and P2 is complete.

With Auto/Man switch in manual position use main adjustment POT on cover to set output (Note: Auto output is disconnected in this mode).

Level Control Adjustments

Mount the sensor so that it faces the bottom of the tank.

Set P5 on the ST-6 board until the first light flashes.

Set P2 on the ST-6 board at approximately 20% from minimum.

For an empty tank, set zero output at terminals 7 and 8 on the ST-6 board.

THE TANK MUST BE EMPTY FOR THIS ADJUSTMENT.

For a full tank, adjust P2 on the ST-6 board for the desired output at terminals 7 and 8 (with meter attached).

Diameter Measurement Adjustments (Fixed Core)

Use the procedures for Tension Control.

Loop Sensing Adjustments

Mount the sensor facing perpendicular to the center of the loop, at least 18 inches above the pass line or tight loop. Then remove the material.

Turn on the controller.

Adjust P5, on the ST-6 board, counter clockwise until the first LED flashes.

SLOWLY adjust P5 clockwise until the lights begin to strobe (flash sequentially).

To check P5 adjustment, place an object (or the material to be sensed) 6 inches above the floor. Only the first light should flash. Otherwise remove the object and repeat steps 3 and 4.

PAY OUT (MACHINE STOPPED)

Set the gain POT P2 for 50% of maximum.

Adjust P1 output at terminals 7 and 8, with a full loop (down to the 6 inch limit), so that only the first light flashes.

NOTE: For proper operation, terminals 7& 8 (and the zener diode if present) may have to be reversed.<R>

TAKE UP (MACHINE STOPPED)

Set the gain POT P2 for 50% of maximum.

Adjust P1 output at terminals 7 and 8 for zero volts at the desired loop size.

Start the machine

NOTE: For proper operation, terminals 7& 8 (and the zener diode if present) may have to be reversed.

PAY OUT (MACHINE STARTED)

If the loop gets too small, increase the gain using P2 (CCW).

Adjust P2 until smooth operation is achieved while machine is running.

TAKE UP (MACHINE STARTED)

If the loop gets too big, increase the gain using P2 (CCW).

Adjust P2 until smooth operation is achieved while machine is running.

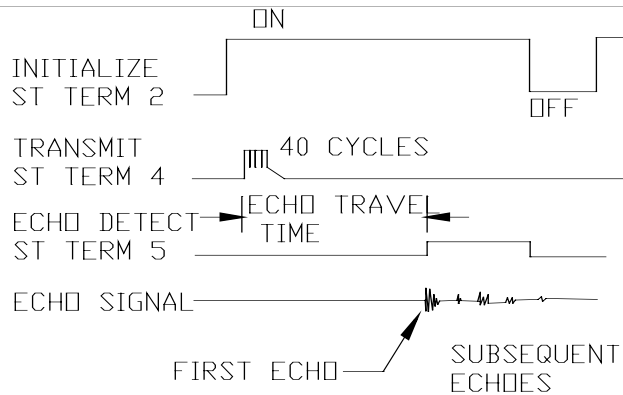
NOTE: Excessive gain will cause the loop to oscillate (fluctuate between big and small).

Theory of Operation

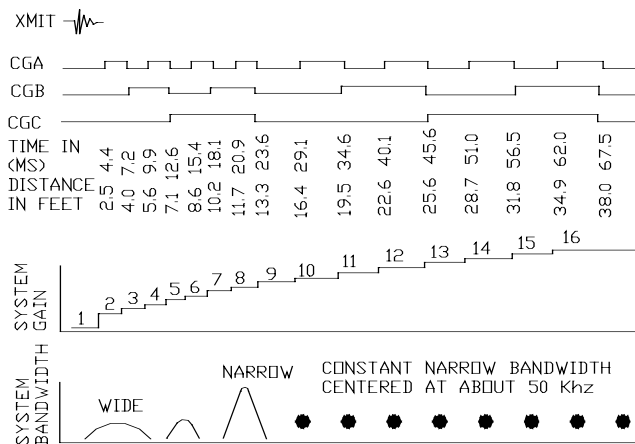
SONA-TROL operates on the basic principles of **SONAR** (**SO**und **NA**avigation and **R**anging) and incorporates state of the art digital and analog electronics.

The sound transducer, located in the sensor head, is driven by electronics also located in the sensor head. Driven by the sensor head electronics, the transducer emits a one millisecond tone burst (approximately 50 KHz). Then for a short time period the sensor waits for the transducer vibrations to subside. After the time delay the transducer acts as a microphone and waits for the tone burst to be reflected back from the object being sensed (controlled). It is this time interval, between transmit and receive, that forms the basis for all **SONA-TROL** control functions. In essence **SONA-TROL** "measures" the distance between the sensor and the sensed object.

The information derived from the time interval is either discarded by the time filter or the analog output is updated to the latest control conditions.



SENSOR HEAD TIMING DIAGRAM

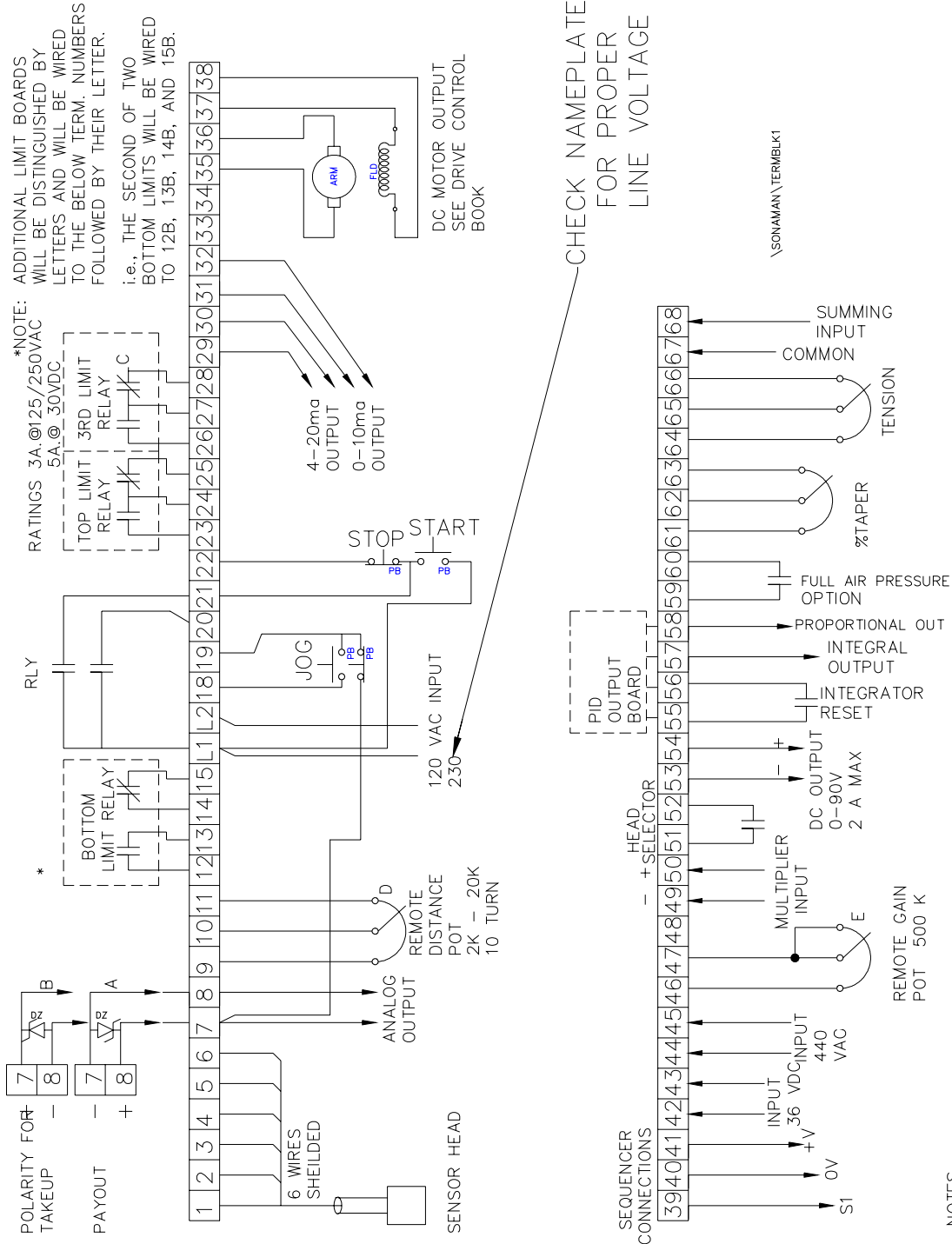


GAIN STEP TIMING DIAGRAM

c:\sonaman\SIGTIME.DWG

Connections

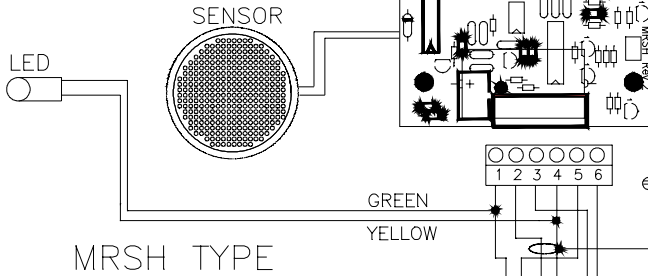
NOTE: DO NOT USE A ZENER DIODE ACROSS TERMINALS 7 & 8 FOR ROLL DIAMETER OR PRECISION MEASUREMENT APPLICATIONS.
 USE A 1N4007 DIODE OR EQUIVALENT FOR THESE APPLICATIONS.



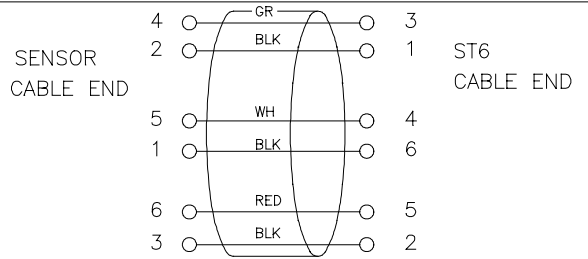
- NOTES**
- A OUTPUT VOLTAGE INCREASES AS OBJECT MOVES TOWARD SENSOR FOR PAYOUT
 - B OUTPUT VOLTAGE INCREASES AS OBJECT MOVES AWAY FROM SENSOR FOR TAKEUP
 - C CAN BE TOP OR BOTTOM
 - D P1 ON ST6-Z MUST BE REMOVED WHEN THIS OPTION USED
 - E P2 ON ST6-Z BOARD MUST BE REMOVED WHEN THIS OPTION USED
- ALL TERMINALS ARE NOT IN ALL SYSTEMS.
 REFERENCE TERMINALS IN SYSTEM TO TERMINALS LISTED HERE FOR FUNCTIONALITY.

Sensor Head Cable Connections

NOTE: LED TURNS ON WHEN BOTTOM LIMIT BOARD ENERGIZES. IF NO LIMIT SUPPLIED THE LED WILL TURN ON WITH POWER.



MRSH TYPE



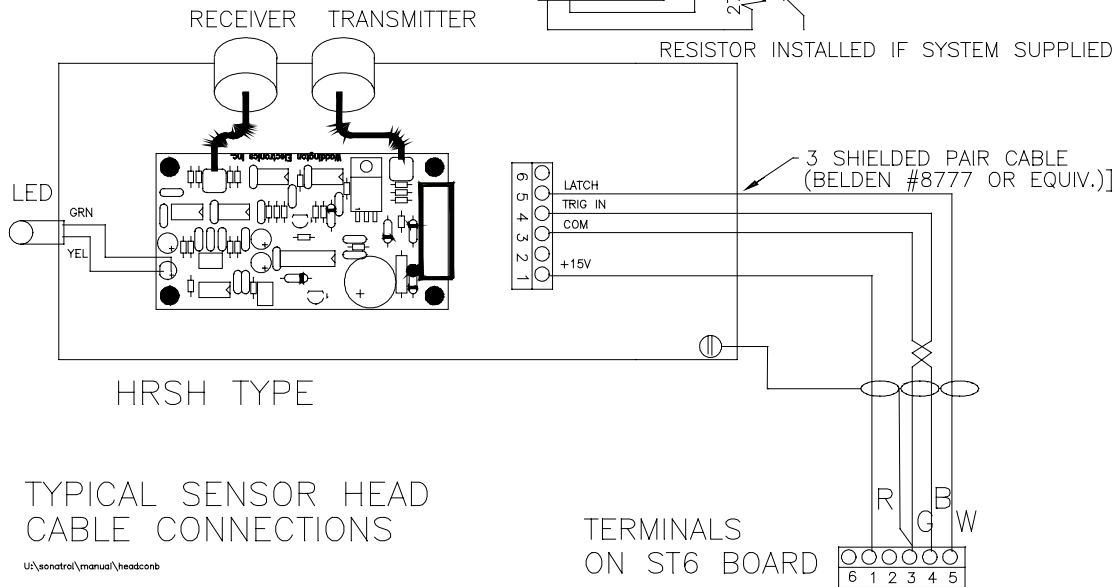
NOTE: ONLY SHIELD FROM GRN/BLK PAIR CONNECTS TO GROUND STUD IN SENSOR BOX.

3 SHIELDED PAIR CABLE
(BELDEN #8777 OR EQUIV.)

GREEN WIRE AND SHIELDEDS CONNECT AT TERMINAL #3 ON ST6

TERMINALS ON ST6 BOARD

RESISTOR INSTALLED IF SYSTEM SUPPLIED WITHOUT LIMITS



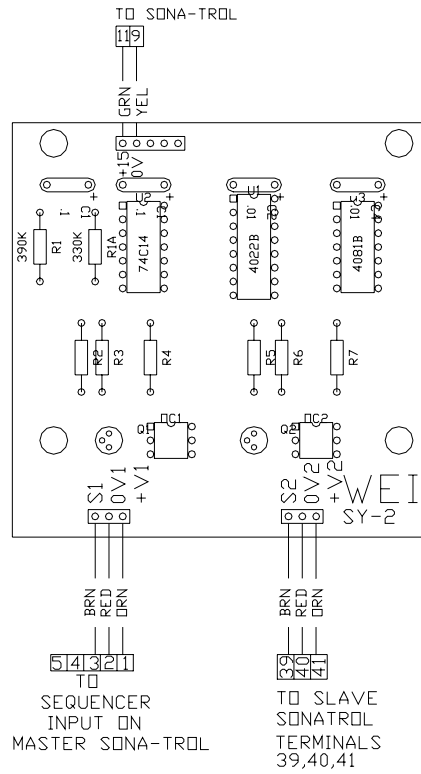
HRSH TYPE

TYPICAL SENSOR HEAD CABLE CONNECTIONS

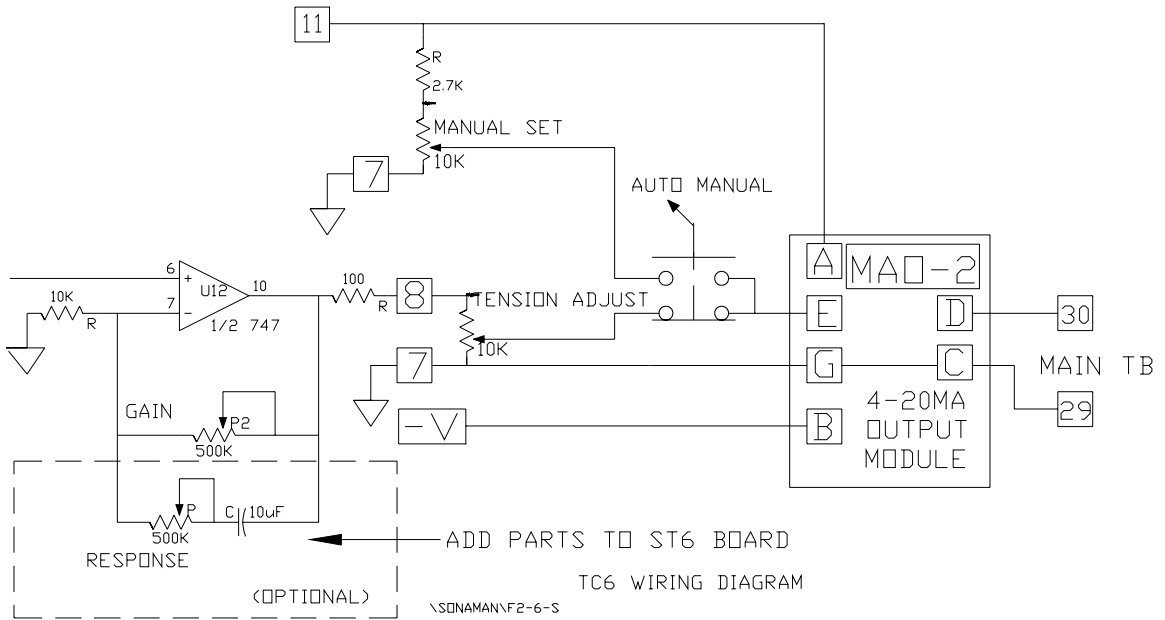
TERMINALS ON ST6 BOARD

U:\sonatrol\manual\headconb

Sy2 Master and Slave Options

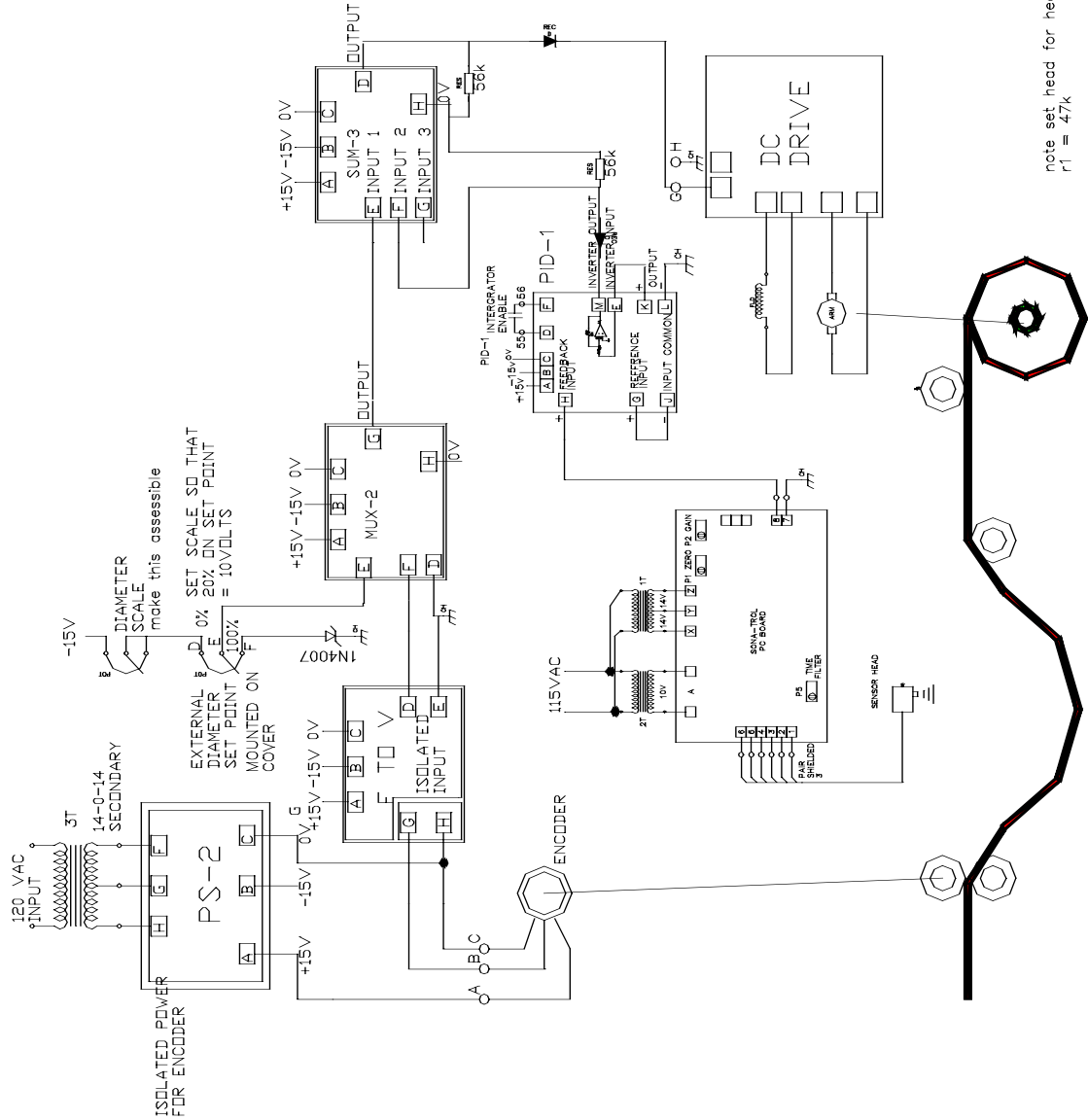


Base Speed Connection

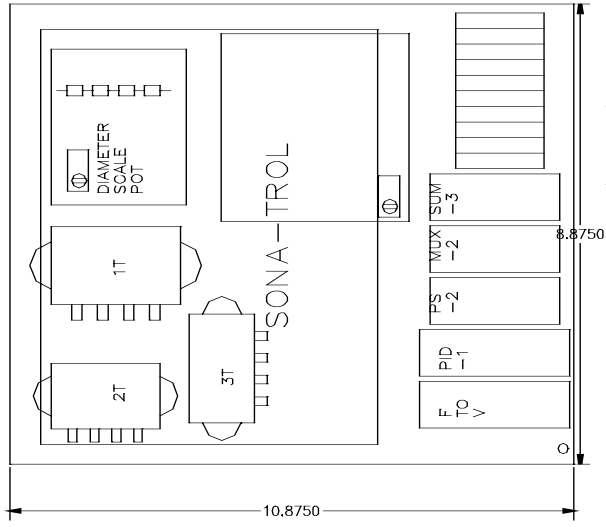


Rewind Controller For Data Machine

- 1 Loop control measures loop size
- 2 Encoder Wheel pulses will be converted to a voltage and will be ratioed by the core diameter setting on the operators station.
- 3 the ratioed linespeed signal is then summed with the P.S.D. processed loop control signal and becomes the drive velocity command signal.



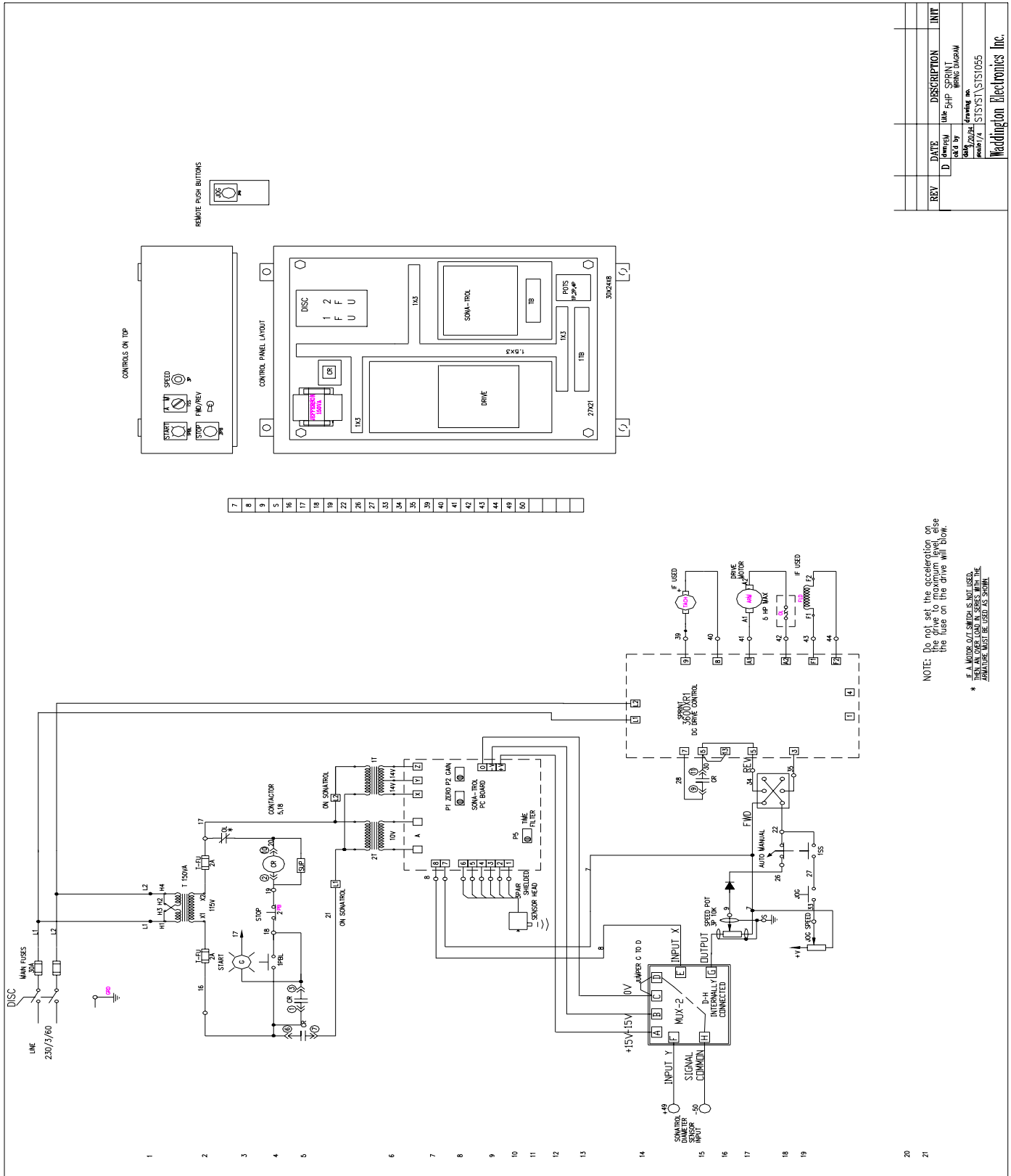
note set head for head gain
r1 = 47k



ITEM	P/N	DESCRIPTION	QTY.
	444-117	the Rewind Machine Loop	
	444-118	the Rewind Machine Loop	
	444-119	the Rewind Machine Loop	
	444-120	the Rewind Machine Loop	
	444-121	the Rewind Machine Loop	
	444-122	the Rewind Machine Loop	
	444-123	the Rewind Machine Loop	
	444-124	the Rewind Machine Loop	
	444-125	the Rewind Machine Loop	
	444-126	the Rewind Machine Loop	
	444-127	the Rewind Machine Loop	
	444-128	the Rewind Machine Loop	
	444-129	the Rewind Machine Loop	
	444-130	the Rewind Machine Loop	
	444-131	the Rewind Machine Loop	
	444-132	the Rewind Machine Loop	
	444-133	the Rewind Machine Loop	
	444-134	the Rewind Machine Loop	
	444-135	the Rewind Machine Loop	
	444-136	the Rewind Machine Loop	
	444-137	the Rewind Machine Loop	
	444-138	the Rewind Machine Loop	
	444-139	the Rewind Machine Loop	
	444-140	the Rewind Machine Loop	
	444-141	the Rewind Machine Loop	
	444-142	the Rewind Machine Loop	
	444-143	the Rewind Machine Loop	
	444-144	the Rewind Machine Loop	
	444-145	the Rewind Machine Loop	
	444-146	the Rewind Machine Loop	
	444-147	the Rewind Machine Loop	
	444-148	the Rewind Machine Loop	
	444-149	the Rewind Machine Loop	
	444-150	the Rewind Machine Loop	
	444-151	the Rewind Machine Loop	
	444-152	the Rewind Machine Loop	
	444-153	the Rewind Machine Loop	
	444-154	the Rewind Machine Loop	
	444-155	the Rewind Machine Loop	
	444-156	the Rewind Machine Loop	
	444-157	the Rewind Machine Loop	
	444-158	the Rewind Machine Loop	
	444-159	the Rewind Machine Loop	
	444-160	the Rewind Machine Loop	
	444-161	the Rewind Machine Loop	
	444-162	the Rewind Machine Loop	
	444-163	the Rewind Machine Loop	
	444-164	the Rewind Machine Loop	
	444-165	the Rewind Machine Loop	
	444-166	the Rewind Machine Loop	
	444-167	the Rewind Machine Loop	
	444-168	the Rewind Machine Loop	
	444-169	the Rewind Machine Loop	
	444-170	the Rewind Machine Loop	
	444-171	the Rewind Machine Loop	
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	444-180	the Rewind Machine Loop	
	444-181	the Rewind Machine Loop	
	444-182	the Rewind Machine Loop	
	444-183	the Rewind Machine Loop	
	444-184	the Rewind Machine Loop	
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	444-186	the Rewind Machine Loop	
	444-187	the Rewind Machine Loop	
	444-188	the Rewind Machine Loop	
	444-189	the Rewind Machine Loop	
	444-190	the Rewind Machine Loop	
	444-191	the Rewind Machine Loop	
	444-192	the Rewind Machine Loop	
	444-193	the Rewind Machine Loop	
	444-194	the Rewind Machine Loop	
	444-195	the Rewind Machine Loop	
	444-196	the Rewind Machine Loop	
	444-197	the Rewind Machine Loop	
	444-198	the Rewind Machine Loop	
	444-199	the Rewind Machine Loop	
	444-200	the Rewind Machine Loop	

Washington Electronics Inc.

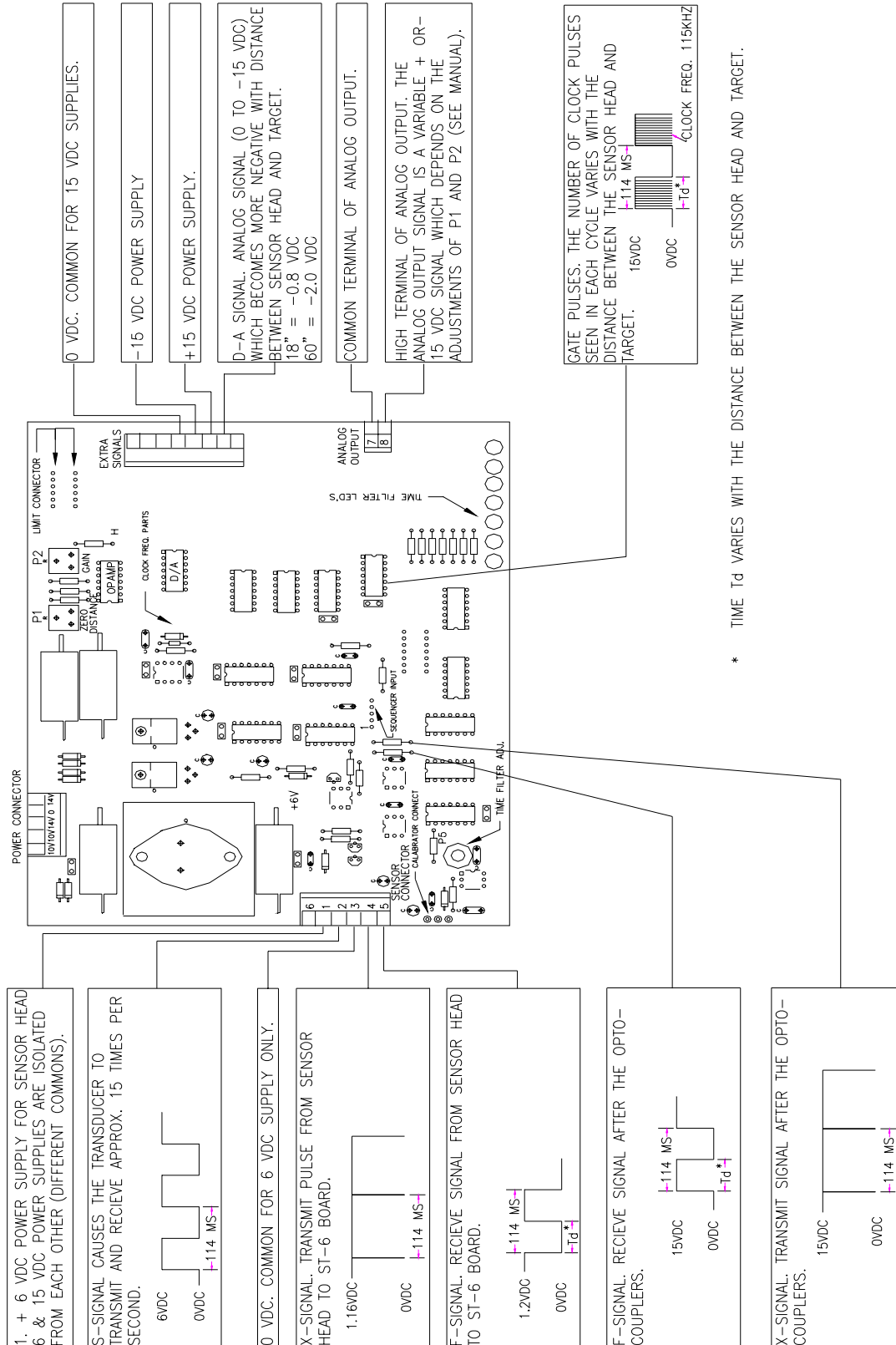
Example Sonatrol and 5 HP DC regen Straightener Package



REV	DATE	DESCRIPTION	INIT
D	10/29/74	5HP STRAIGHTENER	
	11/20/74	drawing in	
	1/21/75	ST5151S1055	

Waddington Electronics Inc.

Diagnostics Diagram for Sona-Trol



IF PROPER READINGS ARE NOT OBTAINED AT THE TEST POINTS CALL WADDINGTON ELECTRONICS AT (401)781-3904 FOR FURTHER ASSISTANCE.

ITEM	P/N	DESCRIPTION	QTY.
C	DATE PGM REVISED BY DATE/ISSUE REVISED	DATE DIAGNOSTIC DIAGRAM VOLTMETER & SCOPE TESTPOINTS DRAWING NO. D:\SONATROL\DIAGNOS	

Waddington Electronics Inc.

Troubleshooting

PREVIOUSLY FUNCTIONING INSTALLATIONS

PROBLEM CORRECTIVE ACTION

Loss of sensitivity Clean with low pressure air only or replace transducer.

Erratic operation Reduce electrical noise of customer equipment. Re-move interference from within the detection area (including air blasts).

NEW INSTALLATIONS

PROBLEM CORRECTIVE ACTION

False readings Adjust sensor head location

Erratic operation Adjust sensor head location

NOTE: A common problem in new loop control installations is faulty operation caused by positioning the sensor too close to the bottom of the loop. Raise the sensor, while keeping it positioned over the loop, until proper operation is obtained.

WARRANTY AND REPAIR

If the corrective procedures described in Section 4.1 fail to resolve the problem, and it appears that the **SONA-TROL** is the source of difficulty, call Waddington Electronics Customer Service at the telephone number shown below. Customer Service (401) 781-3904

Before calling the customer service number, you should have the following information available: A detailed description of the problem

Date you received the product

Model number and serial number of the product

Your shipping and billing address, should the product need to be returned.

If your SONA-TROL warranty has expired, you will also need the purchase order number for billing purposes.

RETURNING PRODUCT

Should the product need to be returned for repair, the Waddington Electronics Customer Service person will give you a **Return Authorization (RMA) Number**. The RMA number is valid for 30 days.

PLEASE NOTE All returns to factory (warranty, non-warranty, and exchanges) require a Return Merchandise Authorization (RMA) number.

A parcel received without an RMA number noted on the outside of the box WILL BE REFUSED by the Receiving Department at Waddington Electronics and **WILL BE RETURNED** freight collect.

Unless otherwise requested, all Waddington Electronics shipments within the continental U.S. are sent U.P.S. and are insured. All charges are prepaid and billed.

WADDINGTON ELECTRONICS CUSTOMER SERVICE NUMBER

Phone: (401) 781-3904 - Fax Number: (401) 781-1650

For warranty provisions, refer to Appendix B at the end of this manual. SONA-TROL products can be returned for repair (warranty or non-warranty) following the standard or emergency procedure detailed below.

FACTORY REPAIR

An RMA number, as described above, is required.

Product must be returned freight and insurance prepaid. See RMA marking requirements.

Product will be returned, repaired or exchanged within 10 working days.

The return freight will be paid by the customer.

EMERGENCY REPLACEMENT

An RMA number, as described above is required.

Product must be returned immediately, freight and insurance prepaid .

A replacement will be shipped air freight prepaid within one (1) business day.

Customer will be invoiced for a replacement unit, expedite charges of \$100, and return freight. Credit for the failed unit will be issued upon receipt of the failed unit.