HyDAC®

MODU-MAX™

CONDUCTIVITY CONTROL MANUAL FOR COOLING TOWER OPERATION

Beta

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SYSTEM DESCRIPTION

The Modu-Max Conductivity Controller is an electronic controller which automatically maintains safe levels of dissolved mineral concentration in all types of open recirculating water systems; e.g., cooling towers, evaporative condensers and spray ponds.

The Modu-Max Conductivity Controller continuously measures the conductivity of circulating water and compares it to a preselected control point. When the dissolved solids (mineral salts) concentration increases due to evaporation, the conductivity of the water also increases. When the conductivity control point is exceeded, the controller senses this and opens a bleed valve. The resultant call for fresh makeup water dilutes the circulating water until the controller is satisfied. The bleed valve closes until the dissolved solids build up again; when the conductivity control point is exceeded, the bleed valve reopens. This automatic control of bleed responds to changes in the cooling system load, thereby eliminating wasteful overbleed or harmful underbleed.

Modu-Max can also be used to control the addition of water treatment chemicals. By operating at maximum, but safe, levels of dissolved solids concentration, the user benefits by optimized water and chemical consumption. Energy savings are realized by the prevention of scale deposits.

EQUIPMENT/PARTS SUPPLIED

Since Modu-Max uses a "building block" concept, the equipment necessary will depend on the cooling tower and its installation. A typical Modu-Max system, using an "A"-size enclosure, will be covered throughout this text, although mounting dimensions are included for the "B"-size and "C"-size enclosures also.

This manual will cover:

1. "A"—size enclosure (with transformer assembly), P/N 015142 (receptacle model) P/N 015184 (conduit model)
2. Tower conductivity control module, digital display, 0-20,000 micromhos, P/N 015096 (Refer to Parts List, page 11, for additional ranges). NOTE: New style modules are easily identified by viewing the front panel of the module. On new style units, the "OPERATE" light appears above the digital conductivity display as shown on nodule marked B in Parts List.
3. 20 amp relay module, Catalog No. 013320
   Add-On modules such as Hi-Lo Conductivity Alarm, P/N 012907, have separate instruction sheets.

ADDITIONAL EQUIPMENT/PARTS NEEDED FOR INSTALLATION

This section covers items which can be ordered initially with the basic Modu-Max controller.

1. Probe assembly. See Figure 1.
2. 3/4" bleed valve, 120 VAC, P/N 1034676 (or larger as required by system size)

*3. 3/8" polyethylene tubing, P/N 030044 (specify length)

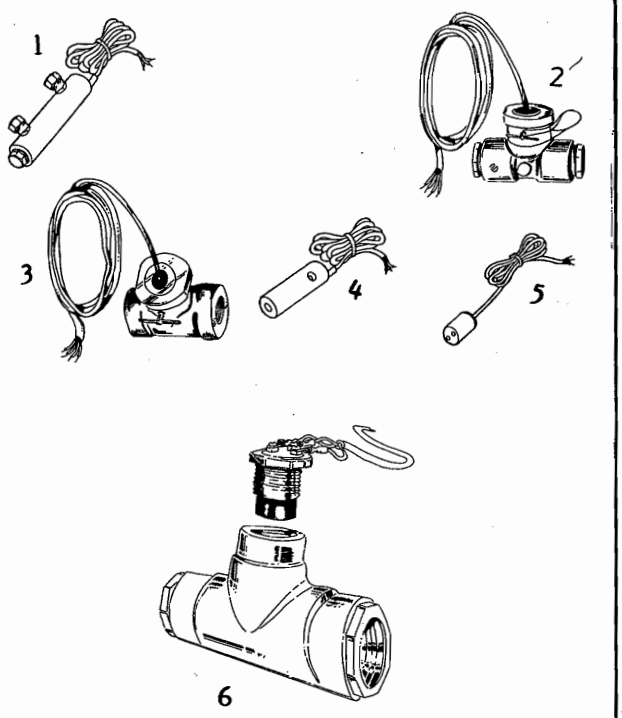
*4. (2) - 3/8" tubing adaptors for tapping into the circulating water main. (Pipe size as required by individual situations)

*Note for probe 014200 only; for other flow-thru probes refer to Figure 11.

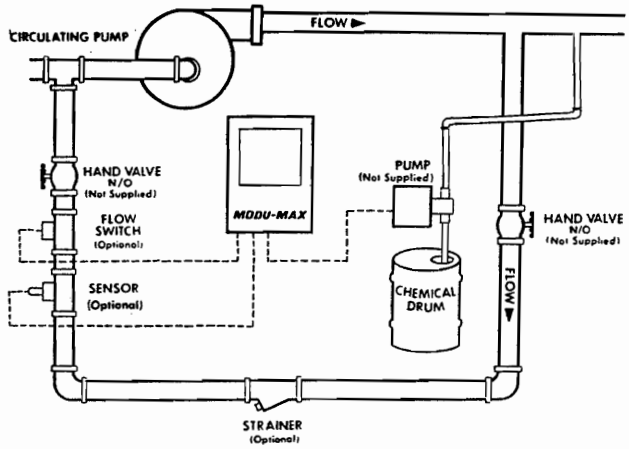
The following items are required for installation, not supplied by BETA.

1. Two-conductor cable for the bleed valve. Should be rated @ 5 amp/120 VAC
2. Wood screws or masonry fasteners to mount sensor and controller (Holes 1/4" for controller, 3/16" for sensor)
3. "Controlled" primary power outlet (See Instruction Preparation)

FIGURE 1 - PROBE SELECTION CHART

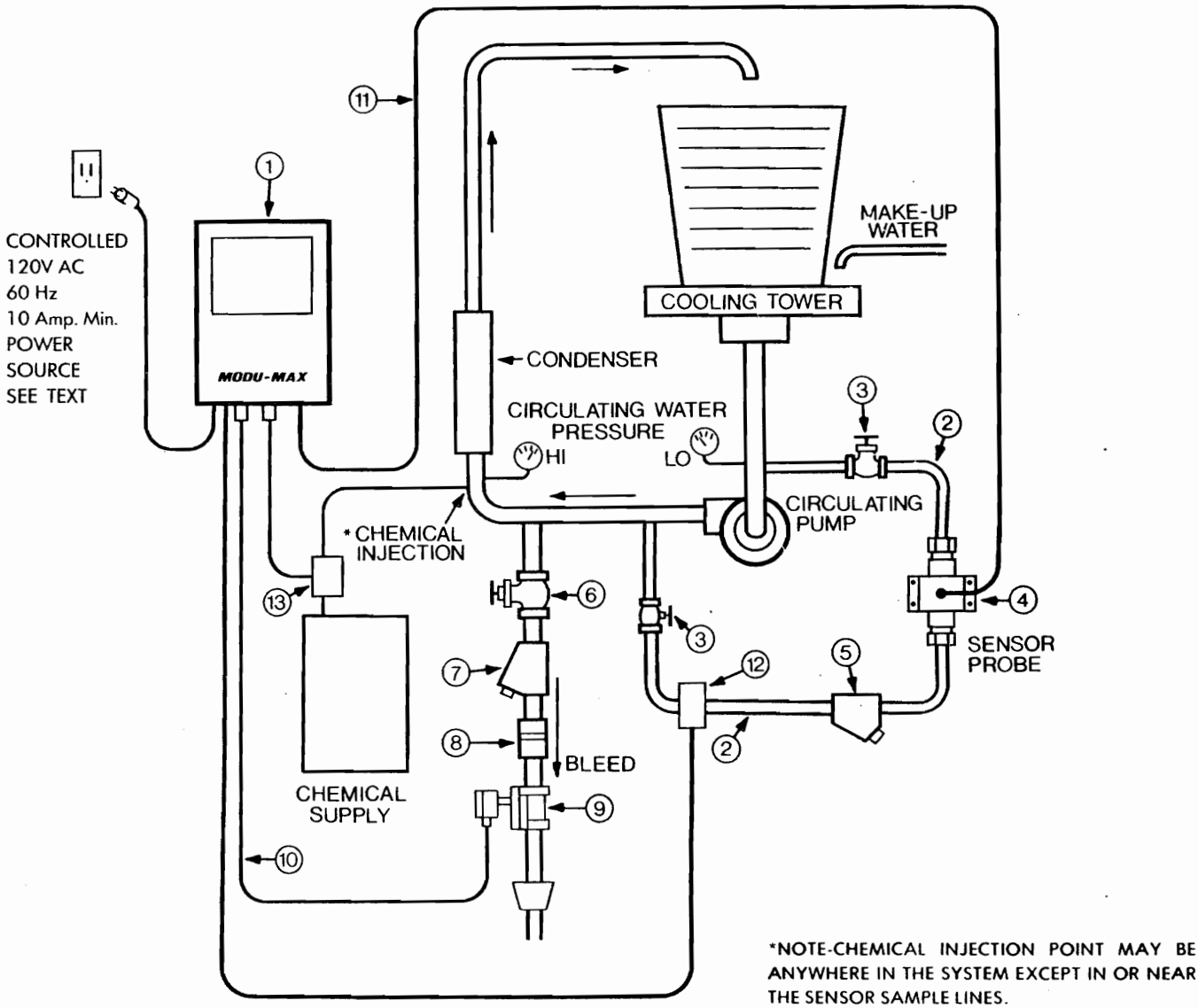


Description	Temp. Rating	Pressure Rating	P/N
1 Conductivity probe, flo-thru (w/integral 3/8" tubing conn.)	140° F	100 psi	014200
2 Conductivity probe, flo-thru pin-type	120° F	150 psi	028454
3 Conductivity probe, flo-thru pin-type CPVC probe mounted in metal tee	150° F	300 psi	015421
4 Conductivity probe, drop-in	150° F	-------	014950
5 Conductivity probe, drop-in	150° F	-------	028321
6 Conductivity probe, screw-type, 2.2 cell, temp. compensated	115° F	100 psi	013607



NOTE: In a recirculating water system, the sensor probe line should be across the main circulating pump.

Figure II



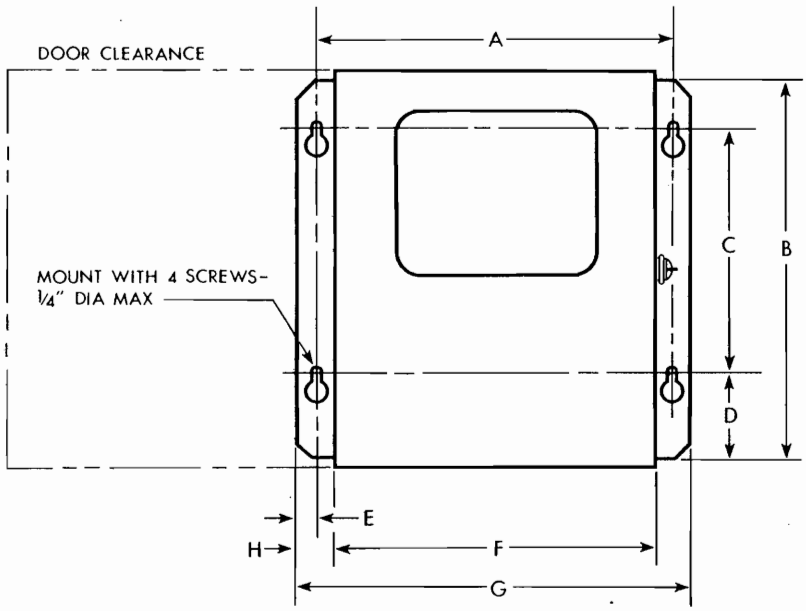
*NOTE-CHEMICAL INJECTION POINT MAY BE ANYWHERE IN THE SYSTEM EXCEPT IN OR NEAR THE SENSOR SAMPLE LINES.

1. CONTROLLER
2. SENSOR SAMPLE LINES, ¾''
3. HAND VALVE ¾''
4. SENSOR PROBE
5. STRAINER ¾''
6. HAND VALVE, SIZE TO SYSTEM
7. STRAINER, SIZE TO SYSTEM
8. FLOW REGULATOR, SIZE TO SYSTEM
9. SOLENOID VALVE, SIZE TO SYSTEM
10. 2 CONDUCTOR CABLE (VALVE)
11. 3 CONDUCTOR CABLE (SENSOR)
12. FLOW SWITCH
13. CHEMICAL PUMP

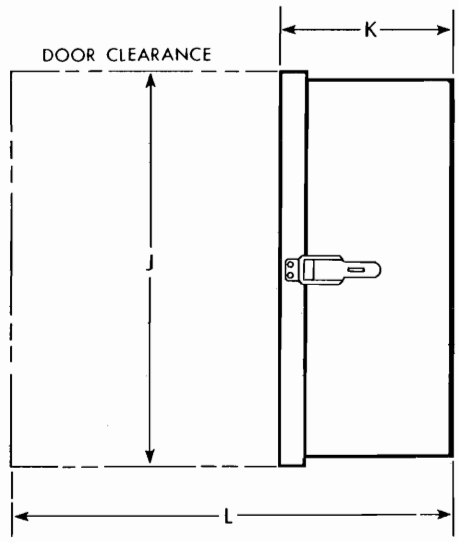
TYPICAL INSTALLATION

FIGURE III

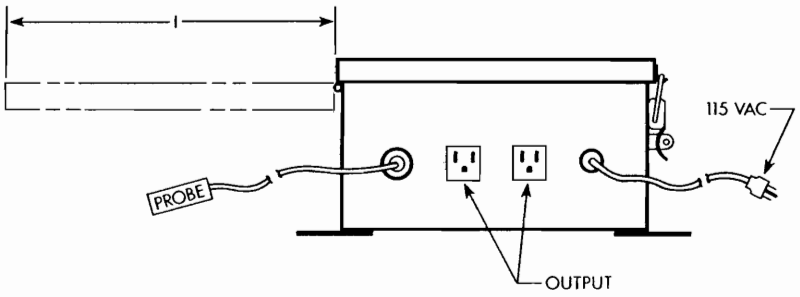
Mechanical and Mounting Dimensions



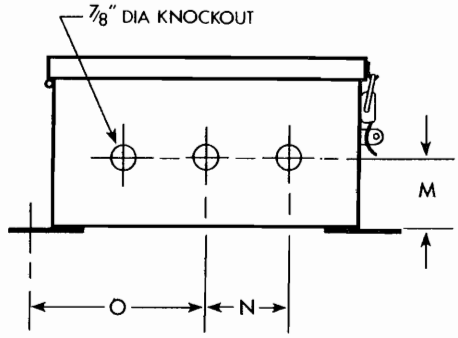
FRONT VIEW



SIDE VIEW



BOTTOM VIEW
(Receptacle Model)



BOTTOM VIEW
(Conduit Model)

A-size box	B-size box	C-size box
A=10-5/8"	A=13-3/4"	A=16-1/4"
B=11-3/8"	B=14"	B=17"
C=7-3/8"	C=10"	C=10"
D=2-17/32"	D=2-17/32"	D=4"
E=5/8"	E=5/8"	E=5/8"
F=9-3/4"	F=12-7/8"	F=15-3/8"
G=11-15/16" (max.)	G=15-1/32" (max.)	G=17-17/32"
H=1-5/32"	H=1-5/32"	H=1-5/32"
I=10" (max.)	I=13-1/8" (max.)	I=15-5/8"
J=12" (max.)	J=14-1/2" (max.)	J=17-1/2"
K=5-3/8" (max.)	K=5-3/8" (max.)	K=5-3/8"
L=14-1/4" (max.)	L=17-3/8" (max.)	L=19-7/8"
M=2-1/16" (typ.)	M=2-3/16"	M=2-3/16
N=2-1/16" (typ.)	N=3" (typ.)	N=3 (typ.)
O=5-5/16"	O=6-7/8"	O=8-1/8"

Figure IV

OPTIONAL EQUIPMENT/PARTS

1. Chemical feed pump. Available from BETA on request. If a separate HOA switch is desired for the pump, a relay driver module P/N 012945 and an additional relay module P/N 073320 are required. Note that the Modu-Max system discussed in this manual will handle the bleed valve and the chemical pump; in this case, the "BLEED" HOA switch controls both the bleed valve and the chemical pump.
2. Strainers: Sensor 3/4". P/N 034669
   Bleed Line 3/4" P/N 034669
   (Larger depending on system size; contact factory)
3. Motor-operated Valves (High Suspended Solids Situation)
   Low pressure 3/4" P/N 027035
   High pressure 3/4" P/N 034757
   (Contact factory)

(Note 20 amp relay module, P/N 013320, should be substituted for 6 amp relay module, 013320 when controlling pumps)

4. Flow Switch, P/N 016098 and Interface "No Flow" Module, P/N 015180
5. Pressure Switch, P/N 026574
6. Relay (Activated by circulating Pump Power), 120VAC, P/N 030546
7. Analog Strip Chart Recorder (0-5 VDC), P/N 015194 (includes "B" - size enclosure)

INSTALLATION PREPARATION

1. Provide convenient access pipes for obtaining a continuous sample of the circulating water. Ideally, the access points are at the discharge and suction sides of the main circulating pump. Provision for a separate access point should be made if chemicals are going to be added automatically. Do not inject chemicals into the sensor sample lines.
   Similarly, the bleed access point should be separate. Do not "tie-in" bleed piping with sample lines.
   Refer to Figure III.
2. Provide a "controlled" 120VAC power source for the Modu-Max. This should be energized only when the main circulating pump is on. This can be accomplished by the use of either auxiliary contacts on the main circulating pump motor starting relay, a relay across the pump motor windings, a pressure switch in the circulating water line or a flow switch in the water line. Select the easiest method for your situation. A flow switch in the sample line not only "activates" the controller automatically, it also "detects" a clogged sample line and "deactivates" the controller. Such a flow switch is available from BETA; order P/N 016098. Also, required for the operation of this switch is an Interface "No Flow" Module, order P/N 015180.

   Note: The "controlled" power source described above is desirable, but not critical. The controller line cord may be connected to any 120VAC source; however, operating personnel should be instructed to turn the controller "on and off" as dictated by system usage. Failure to do this could result in excessive water and chemical usage. In other words, wasteful.

3. Under certain adverse conditions, a flow-through sensor is impractical. HyDAC offers an alternate "drop-in" sensor for measurement in the tower sump. The sensor is then handy for frequent cleaning. When ordering specify the alternate sensor P/N 028321.
4. The Modu-Max controller is compatible with a 0-5 volts DC Movement recorder.
   Terminals for the recorders are located on the module. See Figure VI.
5. Proceed to Installation Section.

INSTALLATION

See Figures III–VI

1. Mount the sensor close to the pre-selected water sample access points (Installation Preparation).
2. Probe installation:
   a. Probes (see Figure I). Refer to Figure II for installation.
   b. Series 014200 probes. Install the 3/8" tubing sample lines. Input water at bottom; output at top; clean-out/drain plug facing downward with no obstructions for at least one foot. Avoid long runs of tubing.
3. Open both hand valves and check for water leaks.
4. Mount the controller close to the sensor, but avoid hostile environments; i.e., dust, dripping water, vibration, vapors, etc. Controller must be mounted in a vertical position (front facing the horizon).
5. Connect sensor cable to the internal terminal strip. See Figures V and VI. Figure V shows the routing of the probe wiring along the left side of the connection box. An 8-foot cable is provided, but it can be spliced and extended; avoid long runs. If extending the cable, use #18-22 gauge stranded wire.

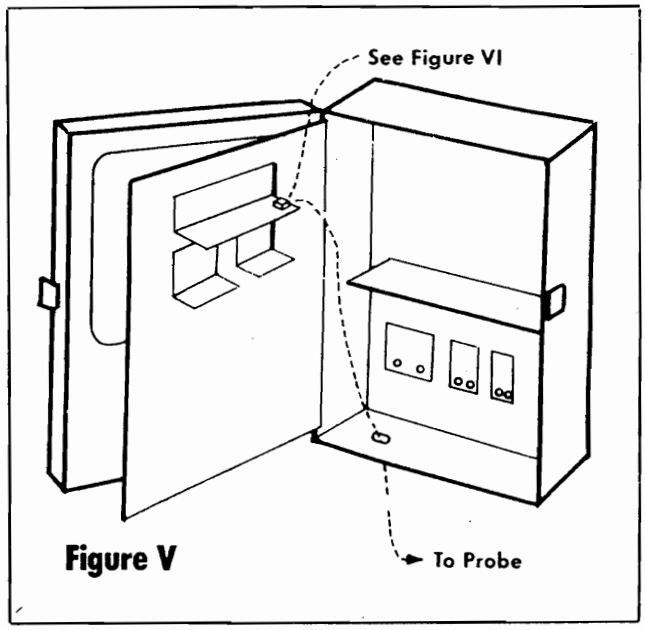


Figure V

6. Install the bleed valve, strainer (optional) and Flow Regulator (optional). It is desirable for the bleed flow to be visible from the controller; it is essential that the bleed flow be visible at the end of the bleed line wherever it may be located.
7. Run conduit or sheathed cable to the bleed valve. On the receptacle enclosure, P/N 015142, being used here as a typical Modu-Max box, receptacles are provided for the bleed valve plus an optional chemical pump. Conduit connections are made inside the controller, in the power supply compartment (behind the fuse panel). Note: Do not run valve and sensor cables within the same conduit.

CONTROLLER CHECKOUT AND ADJUSTMENT

1. Open the windowed door and turn "Power" switch on (upward position). Observe that the digital display is illuminated. Make sure that the HOA "BLEED" valve switch is in "AUTO."

2. Open the inner (white) door by pulling on the latch (black) with an outward motion.

3. Push the test switch to the left. See Figure VI.

4. Close the inner door. The display should be indicating close to mid-scale:

Catalog No.	Maximum Range	Test Position
*015096	20,000 micromhos	950 - 1050
*015294	10,000 micromhos	485 - 535
*015518	5,000 micromhos	255 - 280
015100	2,000 micromhos	950 - 1050
015151	200 micromhos	95 - 105
015504	20 micromhos	9.5 - 10.5

*IMPORTANT NOTE: Readings on the 0 - 5,000 range module, 0 - 10,000 range module and 0 - 20,000 range module must be multiplied by a factor of 10; i.e., 485 micromhos on the display times 10 = actual conductivity of 4850 micromhos.

Turn the "SET" adjustment to the point where the "OPERATE" light on the display goes on and off (with a slight rocking motion of the adjustment potentiometer).

The "BLEED" light should go on and off with the "OPERATE" light. This is true only when the "BLEED" valve HOA switch is in "AUTO".

Note that the "OPERATE" light on-off point occurs at the approximate midpoint of the "SET" adjustment potentiometer.

5. If you want to change the factory-set Hysteresis (Dead-band) operating point, open the inner (white) door and adjust the 2K potentiometer on the control module PC board. See Figure VI.

   Turn clockwise to decrease the dead-band and counter-clockwise to increase the dead-band. Do not disturb any of the other potentiometer settings.

6. Open the inner door and push the test switch to the right.

7. Close the inner door. Press the "Read"/"Set" switch to "Set" and hold. Turn the "Set" potentiometer until the display indicates the desired conductance level (operating point). Release the Read/Set switch.

8. Display is now reading actual tower water conductance. If the reading is significantly higher than the set point, the bleed light should be on and the valve open. Make sure that water is flowing from the bleed line and there is flow through the sensor.

   If the reading is significantly lower than the set point, the bleed light should be off and the valve closed. Make sure that water is not flowing from the line. Turn the "BLEED" valve HOA switch to "ON" and check for flow; reset the switch to "AUTO" after you have confirmed that the valve is opening and closing properly.

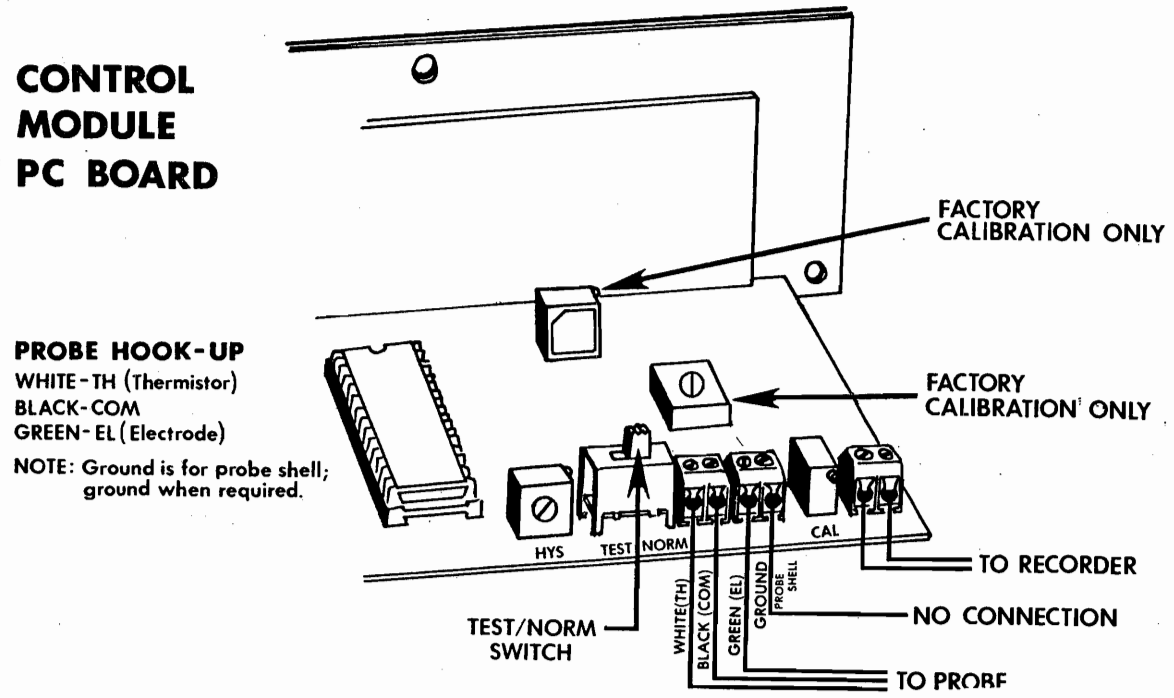
9. Check the tower water conductance with a portable conductivity tester; it should be reasonably close to the value indicated on the controller display.

10. If a chemical pump is being used, make sure it is activated and pumping chemical whenever the "BLEED" light is on. See Page 1 for comments on optional modules.

CHEMICAL PUMP ADJUSTMENT

By use of a simple concept, the Modu-Max can also be used to proportionately add chemical treatment. No chemical is lost by evaporation; only bleeding loses chemical; so, chemical is replaced while bleeding. The bleed rate must be constant and of a known value so that the proper chemical feed rate can be selected. This approach will not work on systems with leaks and/or overflow (these conditions represent uncontrolled bleed). If you have these problems use a HyDAC Modu-Max Counter Timer Module, P/N 015097, with a properly sized contacting head water meter. Note that this module can be ordered with a conductivity module, P/N 015096, in a single

FIGURE VI



Modu-Max B-size enclosure; ask for Bulletin 010130.
The easiest way to control bleed rate is with a flow regulator (see Dole bulletin in the appendix), although it can be done a hand valve. To select the proper size, use two formulae:

Evaporation = .03 x tonnage

Note-Double Evaporation occurs on Absorption Machines

$$\text{Bleed rate} = \frac{\text{Evaporation}}{\text{Cycles of Concentration -1}}$$

For example: a 300 ton centrifugal Machine with desired cycles of concentration = 3

Evaporation = .03x300 = 9 GPM

$$\text{Bleed} = \frac{9}{3\text{-}1} = \frac{9}{2} = 4.5 \text{ GPM}$$

The worst case bleed rate is 4-1/2 gallons per minute. There is no 4-1/2 gallon per minute Dole Flow Regulator; go up to 5, 6, 7 or better yet, 8 gallon per minute for flexibility in chemical pump selection.

To size the chemical pump, use the formula*:

$$\frac{\text{Dole Flow Reg. Size}}{16} \times \frac{\text{Chemical Residuals (PPM)}}{120} = \text{Chemical Pumping Ratepints per hour}$$

*For a proper value, check with your water treatment salesman

EXAMPLE:
8 gpm Dole Flow Regulator; 360 parts per million chemical residual.

$$\frac{8}{16} \times \frac{360}{120} = \frac{1}{2} \times 3 = 1\frac{1}{2} \text{ pints per hour or}$$

4.5 gallons per day (gpd)

If you select a 7 GPD pump, set it at 65%.

A 5 gallon per minute Dole Flow Regulator dictates a lower pumping rate (2.8 gpd). The most common chemical pumps are typically rated at 7 gpd. Cutting back a 7 gpd pump to 2.8 gpd '40%) results in less reliable operation. If you already have a 7 gpd chemical pump, you may work the formula "backwards", e.g.,

$$\frac{\text{Dole Flow Regulator} \times 360}{1920} = 2\text{-}1/3 \text{ pts/hr. (or 7 gpd)}$$

Dole Flow Reg.x360-4480

$$\text{Dole Flow Reg.} = \frac{4480}{360} = 12.4 \text{ gpm}$$

After solving this problem the theoretical Dole size is now 12.4 gallons per minute; 12 gpm is the closest available size and should be used. The pump would initially be set at 100% and later adjusted downward if required.

With any automatic feed and bleed system based on conductivity, keep in mind, the two major rules:

1. No leaks or overflow; only controlled bleed
2. If you increase bleed rate, chemical pumping rate must be increased; if you decrease bleed rate, chemical pumping rate must be decreased.

CAUTION:

To prevent accidental emptying of chemical drum and draining of the tower sump, the Modu-Max must be disabled when the main circulating pump is off. See Page 4, Installation Preparation, paragraph 2.

Periodic monitoring (by analytical methods) of the chemical residual is recommended. Adjust the pump as required. Changes in the conductivity "TRIP POINT" do not require pump readjustment, provided chemical residual is at the desired level.

MODU-MAX TROUBLE SHOOTING GUIDE
REFER TO CONTROLLER CHECKOUT AND ADJUSTMENT PROCEDURE

CHECKOUT STEP	SYMPTOM	POSSIBLE CAUSE	REMEDY
1	Controller fuse blows repeatedly	Shorted or incorrect solenoid bleed valve coil	Replace coil
		Defective solenoid bleed valve wiring	Replace wiring if shorted
		Chemical pump motor is 1/4 hp or greater	Use motor starting relay between controller & pump
		Defective Controller	Check controller power supply and control module/output relay, for possible short
	Digital Display is not illuminated	Blown fuse in the controller	Replace fuse. P/N 016666 (Buss GLH 10 or equivalent)
		No power to the controller	Check switches, circuit breakers/fuses and wiring
		Defective controller	Replace controller module
4	Display does not indicate 9,000 to 11,000 micromhos (for control module 015096 only)	Defective controller	Replace controller module
7	Unable to set display on desired conductivity operating point	Defective controller	Replace controller module. NOTE: Desired conductivity point must be within the controller range.
8	Bleed light is on, but no water is flowing out of bleed line	Wrong or defective solenoid valve coil (should be 120 VAC)	Replace coil
		Plumbing error/s	Check plumbing; e.g., bleed valve installed backwards
		Defective valve	Replace valve
		Defective relay	Clean contacts or replace relay module
		Defective or incorrect wiring	Correct or replace wiring
	Bleed light is off, but water is flowing out of bleed line	Incorrect wiring	Correct wiring
		Dirt/particles in valve	Clean valve
		Defective valve	Replace valve

		Insufficient water pressure (5psi)	Relocate bleed valve
9	Display reading does not agree with actual conductivity (as measured by another instrument: HyDAC portable tester)	No flow through the sensor	Check sample lines for blockage. Check strainer and clean if necessary. Check installation for at least 5 psi pressure drop across the sensor and **modify if necessary**
		Fouled sensor	a) For probes 028454, 015421, 028321 and 013607, clean conductivity portion with a fine grit sandpaper (400 or finer). b) probes 014200 and 014948, clean with a wire brush. Use muriatic acid if necessary.
		Defective sensor wiring	Check for shorts and/or opens
		Defective sensor	Replace sensor. Clean with acid and recheck before replacing. (014200 probe only)
		Defective controller	Replace controller module. Confirm that the controller does not pass check-out steps 1-8 before replacing
		Defective cross-check instrument (portable tester)	Obtain another instrument. Calibration can be checked by measuring a sample of known conductivity
10	Pump not working	Defective or incorrect wiring	Check wiring and repair
		Defective pump	Repair or replace pump
		Defective relay	If steps 1-9 check ok, clean relay contacts or replace relay
POST-CHECKOUT PROCEDURE	Display reading is more than 20 % above the desired set point and the ''Bleed'' light is on.	Clogged bleed line	Check & clean valve/strainer assembly; bleed should be visible
		Insufficient bleed rate	Increase bleed rate. Use a Dole flow regulator or measure the bleed rate manually
		Wrong solenoid bleed valve	Check valve coil rating; should be 120 Volts AC
		Insufficient pressure differential across solenoid bleed valve.	Repipe to obtain 5 PSI differential or replace with a zero pressure valve
		Defective solenoid bleed valve	Repair or replace valve
		Shorted sensor wires	Check wiring and replace if shorted

Display reading is more than 20% below the desired set point and the "control" light is off.	Conductivity is low due to recent start-up	Allow time for system water to "concentrate"
	Leaks, overflow or excessive windage losses	Locate the source of the uncontrolled bleed and correct
	Open sensor wire	Check wiring and repair if open
	Defective sensor	**Replace sensor**
	Ruptured diaphragm in solenoid bleed valve	Replace diaphragm, Valve repair kit P/N 016922 for 3/4" ASCO Valve

APPENDIX

It is imperative that bleed valves be kept clean. This note deals with an explanation of "how they work" to aid the user in disassembly, cleaning and/or replacement of parts and correct reassembly! It also covers problems frequently encountered in the field.

For illustration of typical valve supplied by BETA, see Electric Bleed Valve Assembly. The following describes the operation of the "moving" parts. The SMALL DIAMETER SPRING pushes the rubber-tipped core against the hole in the center of the diaphragm which is being held closed by the large diameter spring plus the pressure of the water which enters the top chamber through the bleed hole in the diaphragm. When the coil is energized, the plunger compresses the small diameter spring (which was also helping to keep the valve closed) as it moves away from the hole in the center of the diaphragm. This hole is larger than the bleed hole, so the back water pressure is quickly relieved. The line pressure now can overcome the force of the large diameter spring; the diaphragm moves "up" and the valve is open. When the coil is de-energized, the small spring pushes the core (with its rubber tip) against the center hole of the diaphragm. Water now comes into the "upper" chamber through the bleed hole and builds up pressure which, when added to the forces of the two springs, pushes the diaphragm "down" and the valve is closed. Note that it is essential that the input and output connections must be observed when the valve is installed or replaced in the bleed line.

The aforementioned "moving" parts are readily accessible simply by removing four bolts to separate the body of the valve into two parts. It is not necessary to remove the coil assembly unless, of course, you have determined that the coil is defective.

A CLOSED BLEED LINE IS NOT RECOMMENDED BECAUSE YOU CANNOT OBSERVE OR MEASURE BLEED FLOW.

Problems encountered:

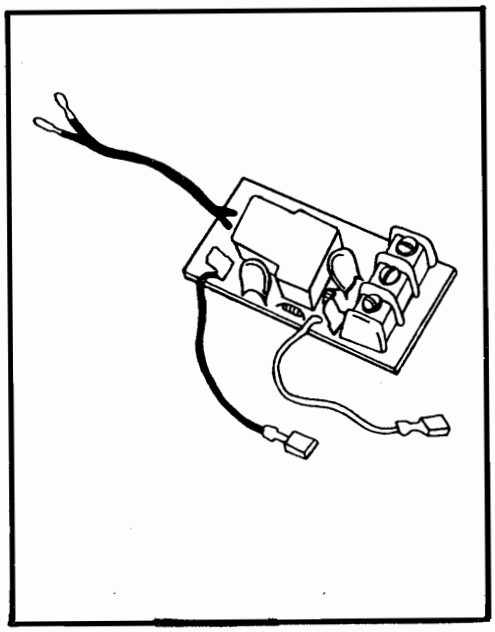
1. Coils open/short. When coil shorts it will blow a fuse. A coil will short if the core is stuck in the "down" position or if someone has removed the core. A missing core can be detected easily because you will observe that the valve stays open. If you can't see any bleed when the controller is calling for bleed or when the press-to-test button is pressed, the valve, strainer or line is clogged.

2. A fouled plunger stuck in the "up" position will keep the valve open (coil will not short, as described in #1)

3. Clogged bleed/center holes in the diaphragm. This is why we recommend strainers. Clogged strainers are frequently the culprits on service calls and should be cleaned routinely.

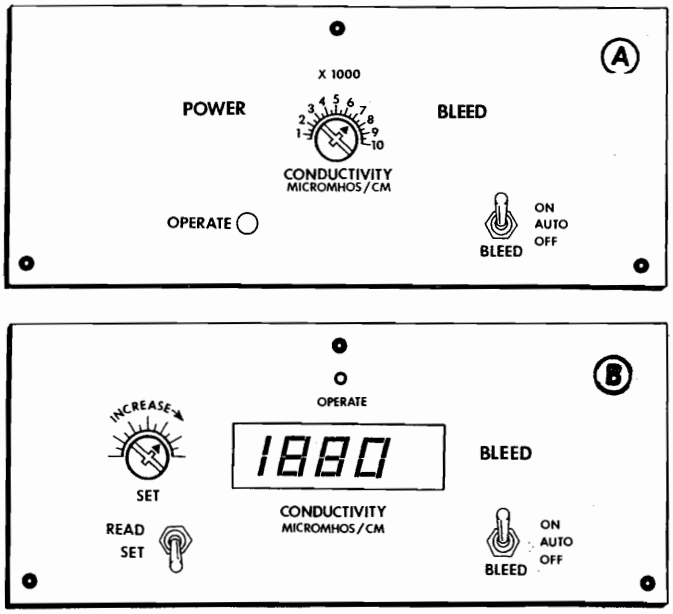
4. Ruptured diaphragm, broken/missing springs, etc.

This Service Note applies to the standard (5 to 125 lbs.) valve. The zero pressure valve which we supply on request is slightly different mechanically: it also has a "heftier" coil.



RELAY MODULE, 20 AMP. P/N 013320

PARTS LIST

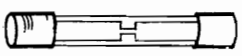


TOWER CONDUCTIVITY CONTROL MODULE

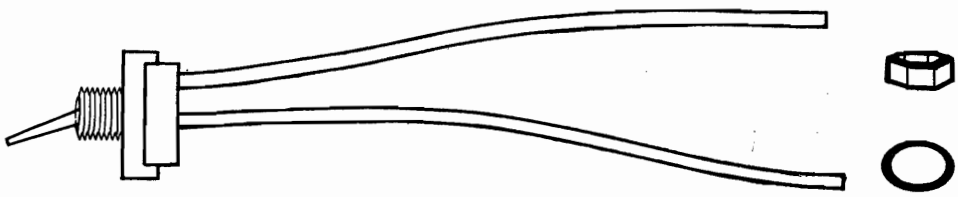
(Select Appropriate Module)

- **A. P/N 015141** Module with set point dial
- **B. P/N 015096** Digital display, 0-20,000 micromhos
- **C. P/N 015294** Digital display, 0-10,000 micromhos*
- **D. P/N 015518** Digital display, 0-5,000 micromhos*
- **E. P/N 015100** Digital display, 0-2,000 micromhos*
- **F. P/N 015151** Digital display, 0-200 micromhos*
- **G. P/N 015504** Digital display, 0-20 micromhos*

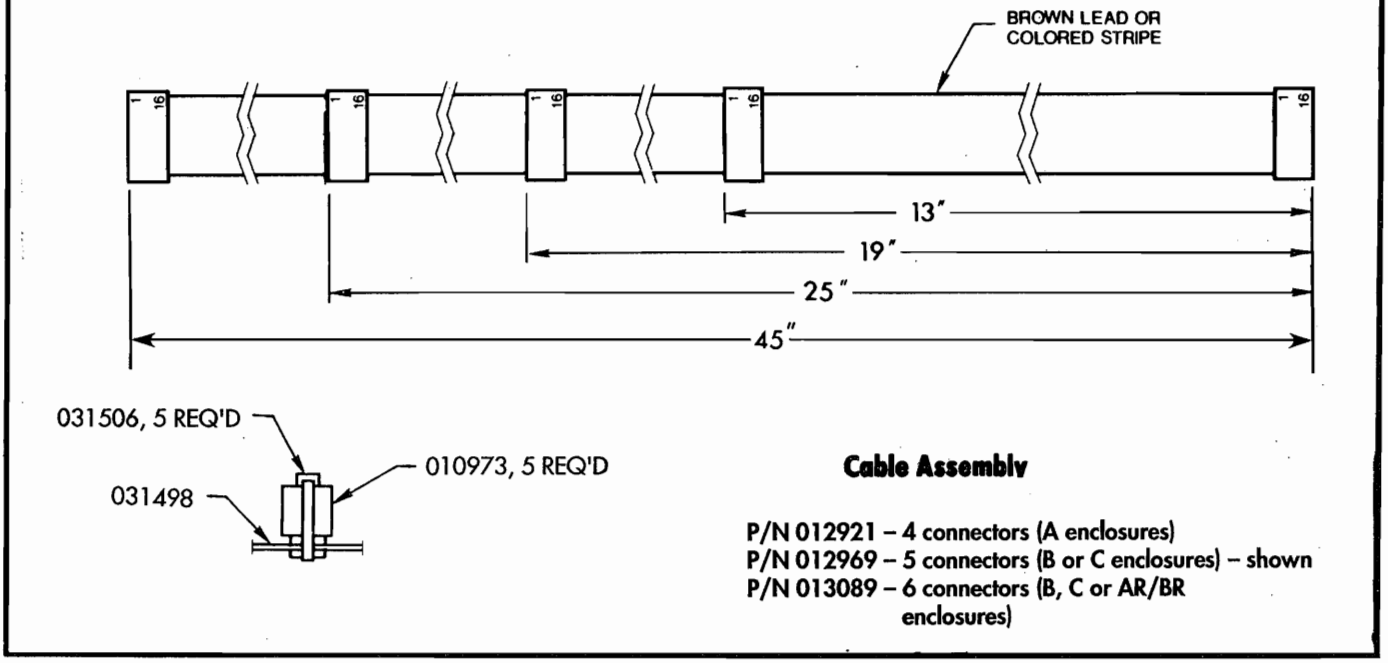
*NOT SHOWN



FUSE, P/N 016666



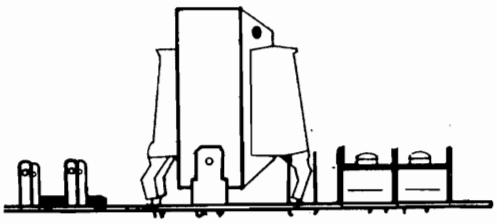
POWER SWITCH, P/N 010971



Cable Assembly

P/N 012921 – 4 connectors (A enclosures)
P/N 012969 – 5 connectors (B or C enclosures) – shown
P/N 013089 – 6 connectors (B, C or AR/BR enclosures)

NEW STYLE



Transformer Assembly

(Shown) P/N 013134 – A Enclosure
P/N 013150 – B Enclosure
P/N 013151 – C Enclosure

FLOW CONTROLS

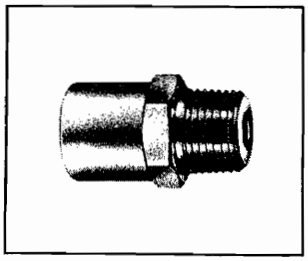
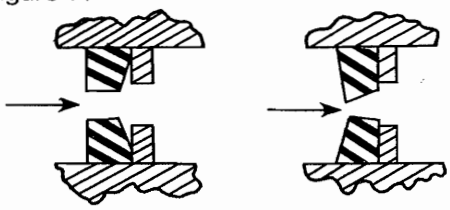


Figure A



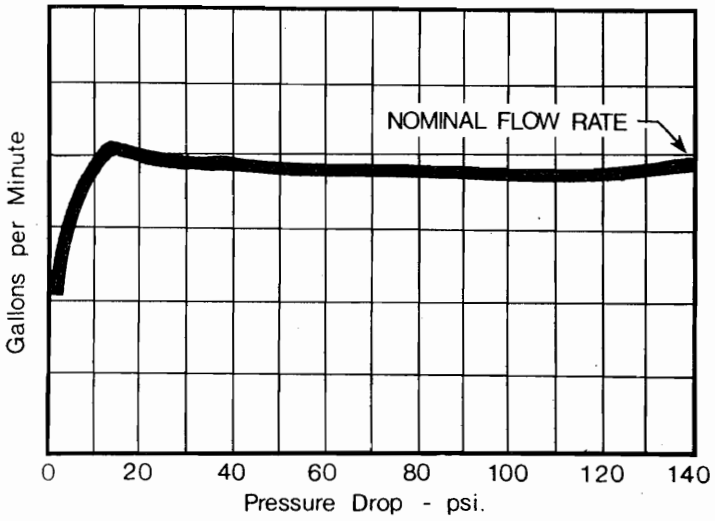
Flow Control Under Minimum Pressure

Flow Control Under High Pressure

How Flow Controls Work

The Dole Flow Control is a simple, self-cleaning device designed to deliver a constant volume of water from any outlet whether the pressure is 15 psi or as high as 125 psi. The controlling mechanism consists of a flexible orifice that varies its area inversely with the pressure so that a constant flow rate is maintained. Figure A illustrates how a single orifice, for simplicity of explanation, changes shape to maintain a constant flow rate as the inlet pressure increases.

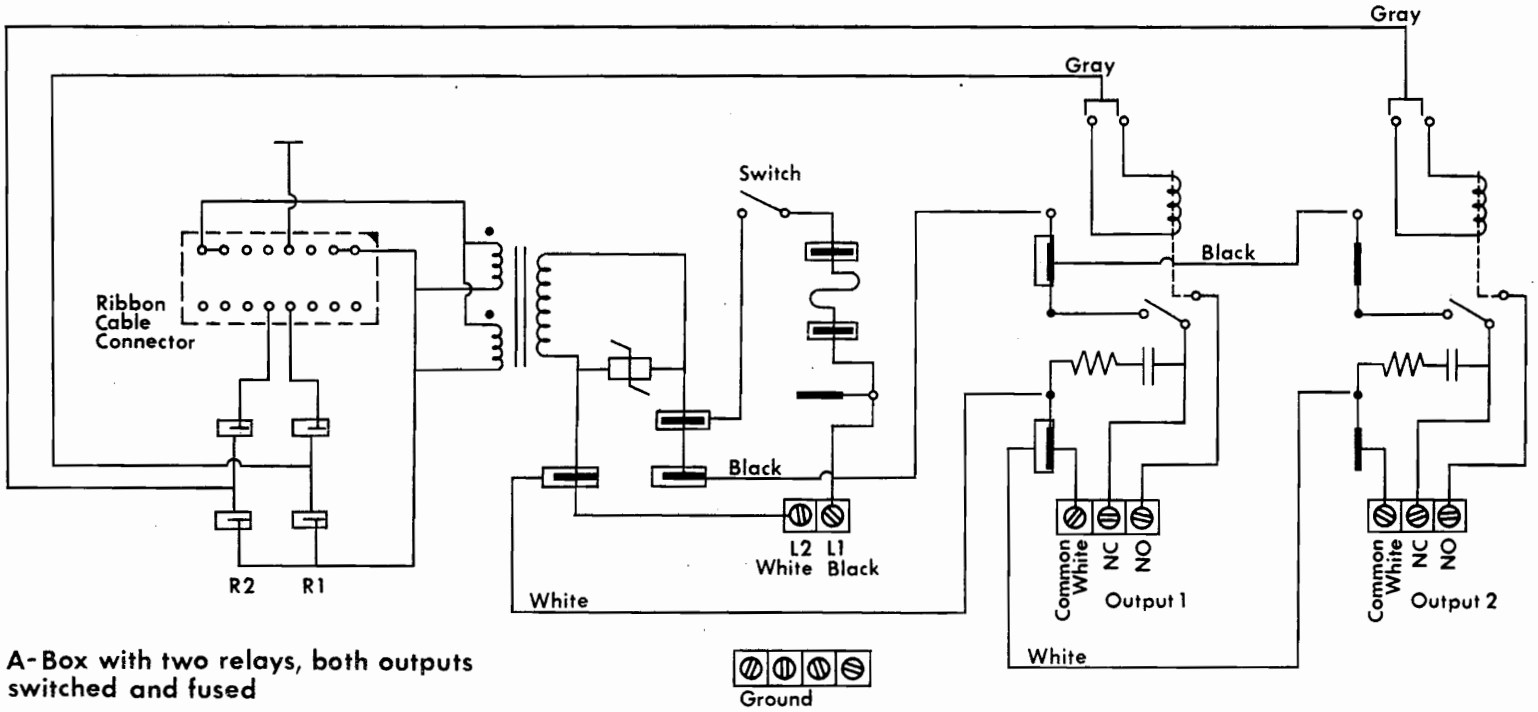
Control Accuracy



Until the inlet pressure reaches the threshold pressure, generally 12 to 15 psi, the flexible insert remains as a fixed orifice. After the threshold pressure is reached, the pressure drop will be whatever is necessary to absorb the energy not required to overcome the system resistance and to sustain a rated flow. The curve shown is typical of most controls regardless of the rated flow. It is possible to approximate the flow of an individual control by using the line marked "Nominal Flow Rate" as the desired rate. Flow rates are accurate within plus or minus 10% of the nominal flow rate. Considering individual flow controls, the rate will stay within 5% to 8% of the mean flow rate through the full range. Accuracy is maintained to about 125 psi. The above figures represent pressure drop across the valve. Maximum allowable working temperature is 160°F.

Nominal Flow Rate Selection Chart

P.N.	Flow G.P.M.	Inlet Conn.	Outlet Conn.	PN.	Flow G.P.M.	Inlet Conn.	Outlet Conn
030167	2.0	¾" M NPT	¾" F NPT	030093	8.0	¾" M NPT	¾" F NPT
030277	2.5	¾" M NPT	¾" F NPT	901235	9.0	¾" M NPT	¾" F NPT
901231	3.0	¾" M NPT	¾" F NPT	900887	10.0	1" F NPT	1" F NPT
901232	3.5	¾" M NPT	¾" F NPT	027102	12.0	1" F NPT	1" F NPT
030092	4.0	¾" M NPT	¾" F NPT	030160	15.0	1" F NPT	1" F NPT
900888	5.0	¾" M NPT	¾" F NPT	030278	20.0	1" F NPT	1" F NPT
901233	6.0	¾" M NPT	¾" F NPT	030279	25.0	1" F NPT	1" F NPT
901234	7.0	¾" M NPT	¾" F NPT	030280	30.0	1" F NPT	1" F NPT

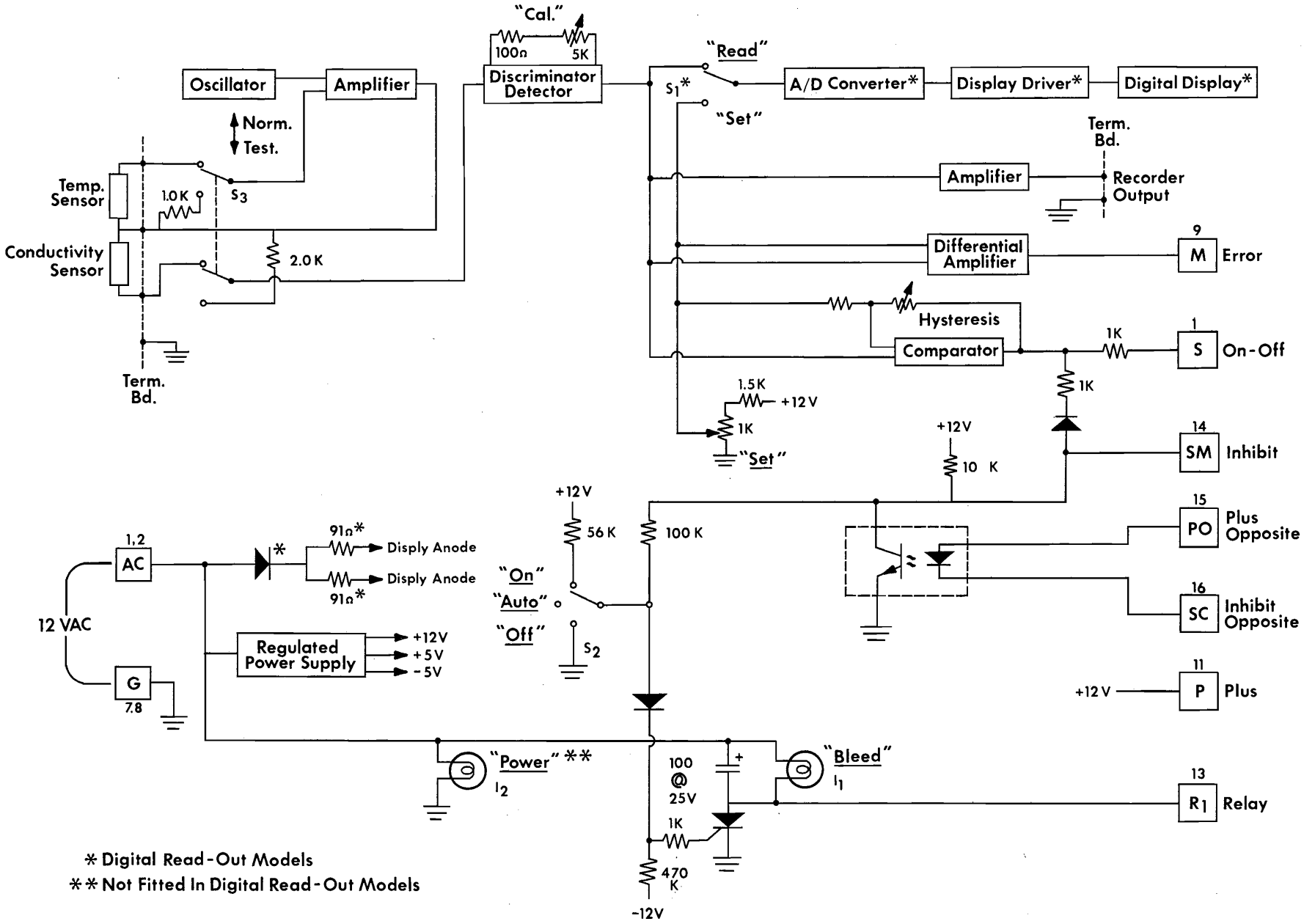


A-Box with two relays, both outputs switched and fused

Recommended for solenoid valve, small pump, alarm bells, etc.

Combined load must not exceed 10 A.

TOWER CONDUCTIVITY CONTROL FUNCTIONAL SCHEMATIC | REF: 015096, 015100, 015140



LIMITED TWENTY-FOUR MONTH WARRANTY

Beta Technology Incorporated ("BETA") warrants each new item of HyDAC brand equipment manufactured and sold by BETA to be free from defects in materials and workmanship under normal use and operation in accordance with "BETA" instructions and use directions for a period of twenty-four (24) months from date of delivery to the original purchaser. **Exception:** pH probes are only guaranteed to be operational at the time of delivery. All claims must be submitted in writing within 30 days from the date of shipment from BETA.

BETA's obligation under this warranty are limited to the repair or replacement of any such item of equipment (or part thereof) shown to be defective or, at BETA's option, to refunding the purchase price of any such defective item of equipment less a reasonable allowance for prior use. Each item of equipment for which a warranty claim is asserted shall, at the request of request of BETA, be returned on a prepaid basis to BETA's factory at the expense of the purchaser. Replacement parts furnished by BETA shall be warranted as stated above for the unexpired portion of the original twenty-four (24) month warranty. This does not extend to any item or part subjected to misuse, accident, improper installation, maintenance or application, improper packing by purchaser in return shipment to BETA, or to any item or part repaired or altered outside of BETA's factory without the express prior authorization of BETA.

THE FOREGOING WARRANTY IS IN LIEU OF ANY OTHER WARRANTY, EXPRESS OR IMPLIED, IN FACT OR IN LAW, INCLUDING WITHOUT LIMITATION THE WARRANTY OF MERCHANTABILITY OR THE WARRANTY OF FITNESS FOR PARTICULAR PURPOSE. IT IS EXPRESSLY UNDERSTOOD THAT PURCHASER'S SOLE AND EXCLUSIVE REMEDY IS LIMITED TO ENFORCEMENT OF BETA's OBLIGATION AS SET FORTH ABOVE AND BETA SHALL NOT BE LIABLE TO PURCHASER OR OTHERS FOR LOSS OF USE OF THE EQUIPMENT OR FOR OTHER DIRECT, SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES.