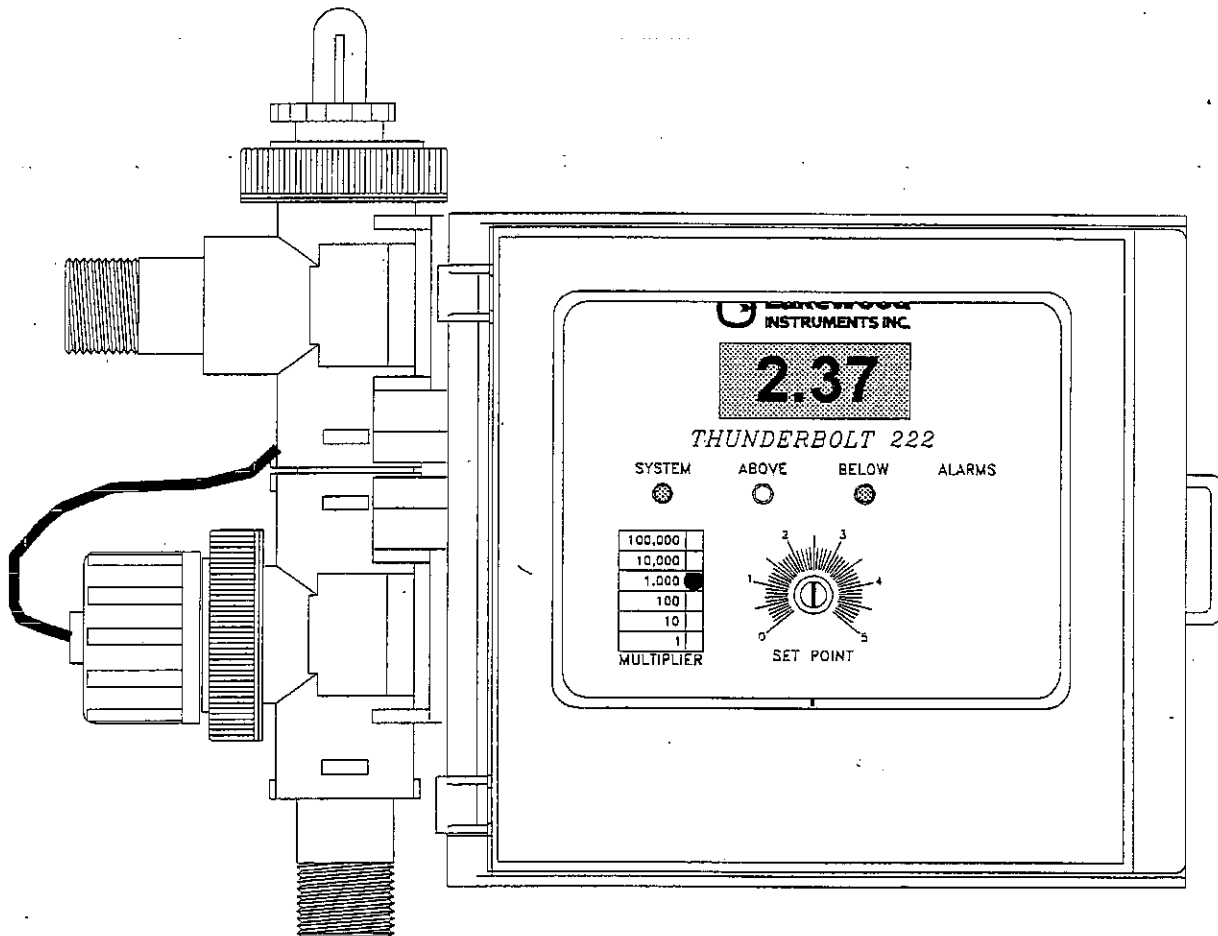


THUNDERBOLT 222C and 224C CONDUCTIVITY CONTROLLERS

INSTRUCTION MANUAL



SERIAL #: _____



5730 North Glen Park Road, Milwaukee, WI 53209 USA
Phone: (262) 238-4400 Fax (262) 238-4402

Important

CAUTION CHEMICAL FEED

All electromechanical devices are subject to failure from a variety of causes. These include mechanical stress, component degradation, electromagnetic fields, mishandling, improper setup, physical abuse, chemical abuse, improper installation, improper power feeds and exposure.

While every precaution is taken to insure proper functioning, extra precautions should be taken to limit the ability of over-feeding by limiting chemical quantities available, secondary shut-downs, alarms and redundancy or other available methods.



CAUTION POWER SOURCE AND WIRING

Low voltage wiring and high voltage (110 plus) should not be run in the same conduit. Always run separately. Even shielded low voltage is not a guarantee of isolation.

Every precaution should be taken to insure proper grounding and elimination of shorting or Electromagnetic field (EMF) interference.

THUNDERBOLT 222C & 224C

INSTALLATION and OPERATION MANUAL

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THUNDERBOLT 222C and 224C

INTRODUCTION

The cost-efficient THUNDERBOLT 220C Series conductivity controllers provide accurate conductivity control in a very wide range of conductivity levels. Special sensor diagnostics and tampering indicators eliminate worrisome control problems. The THUNDERBOLT's automated control processes reduce manpower requirements and help you conserve water while reducing energy and chemical consumption. That means you are protecting your capital investments while reducing your operating costs. Just in energy savings alone, the THUNDERBOLT controllers have an attractive return-on-investment (See Figure 1 on the next page).

Applications

These controllers can be used effectively in many applications with conductivity levels from 1 to 1,000,000 uS. Unlike most conductivity controllers, the THUNDERBOLT 220C Series can be used in cooling water, boiler water as well as in some waste water treatment programs. Some of the special areas of application include:

- Condensate monitoring
- Cooling water cycles control
- Chill & hot water chemical control
- Rinse tank water conservation
- Chemical concentration control
- Demineralizer regeneration

Features

Designed with the needs of the end user in mind, the Lakewood Instruments THUNDERBOLT 220C Series has many special features:

- Push button electrode test circuits to make it easy to check the electrodes
- Automatic temperature compensation
- Tampering indicator for increased security
- Wide range of conductivity levels (1 - 1,000,000 uS) with field adjustment capability
- Alarm timer to limit chemical overfeed
- Built-in flow switch to lock out control during no flow conditions
- Watertight enclosure
- U.L. listed materials
- Digital display with a hidden ON/OFF switch
- In the field THUNDERBOLT 220C Series upgrade kits for Model 211 and 215 controllers

Fouling Compensator/Fouling Alarm

The THUNDERBOLT 224C has a unique 4 electrode fouling compensator that allows the system to continue operating despite fouling conditions. This ensures steady, accurate conductivity control even in dirty solutions. When fouling finally exceeds the 224C's ability to compensate properly, a fouling alarm lets you know it is time to clean or replace the 4 electrode sensor.

THUNDERBOLT 222C and 224C

Most companies work hard to control operating costs. The THUNDERBOLT 220C Series conductivity controllers help you do just that. Here is a brief explanation and example to demonstrate how controlling conductivity levels with a THUNDERBOLT allows you to protect your capital investments while also reducing your operating costs.

As water in a cooling tower or boiler system evaporates, solids remain. The presence of these minerals (salts) increases the level of conductivity in the water. Untreated cooling or boiler water will corrode and deposit scale. Fouling causes increased power consumption and can potentially damage products and plant equipment.

One way to limit the increasing salt concentrations is to "blowdown" some of the concentrated cooling or boiler water. Fresh makeup water replaces the highly conductive water that is released. The THUNDERBOLT 220C Series controllers allow you to efficiently control water consumption during blowdown. While conserving a precious natural resource you are also reducing operating costs. This unit can help you maintain compliance with EPA and local discharge regulations.

Chemical treatments are also used to control water quality. Your Water Treatment Engineer can tell you what chemicals you use. Some are very expensive so the THUNDERBOLT controllers have an alarm timer that limits chemical overfeeding in case of blowdown failure. The THUNDERBOLT is designed so you can easily attach a Model 66 Microprocessor Clock Timer that provides even greater control of the chemical feed processes during blowdown. After all, it is the proper control of chemicals that allows you to maximize their effectiveness.

It is easy to see how a THUNDERBOLT quickly pays for itself. Even though you may also reduce your water and chemical consumption, just look at how scaling affects energy costs.

FIGURE 1

ENERGY INCREASE REQUIRED TO OVERCOME SCALE

FOULING FACTOR	INCHES OF SCALE*	% INCREASE IN ENERGY
0.0005	0.006	5.0
0.001	0.012	11.0
0.002	0.024	21.5
0.004	0.036	32.0
0.004	0.048	43.0
0.005	0.060	53.0

* Scale assumed to be calcium carbonate type with a thermal conductivity of: 1 BTU/(hr)*(Sq. Ft.) (F)

COST EXAMPLE:

The energy consumption of a 500 ton air conditioning compressor is approximately 500 kilowatts an hour. To operate the unit for 30 days, 24 hours a day, it would require 360,000 kw-hr: $[(500) \times (24) \times (30) = 360,000 \text{ kw-hr}]$

If this same system operated with 0.012 inches calcium carbonate type scale on the condenser (0.001 fouling factor), the monthly increase in energy required would be 11% or 39,600 kw-hr. At a cost of \$0.10 per kw-hr, this scale deposit costs \$3,960.00 per month.

The bottom line is this:

THUNDERBOLT Conductivity Controllers can actually reduce your operating costs!

THUNDERBOLT 222C & 224C

Face Plate Components:

SIMULATOR ON

An arrow in the LCD points to these words when the unit is in simulation mode. The simulator switch is on the back of the front panel.

LCD

A Liquid Crystal Display with a hidden ON/OFF switch on the back of the front panel. The decimal point is determined by the range selected.

ABOVE

This light comes on whenever the conductivity level is ABOVE the set point value.

ALARM TIMER

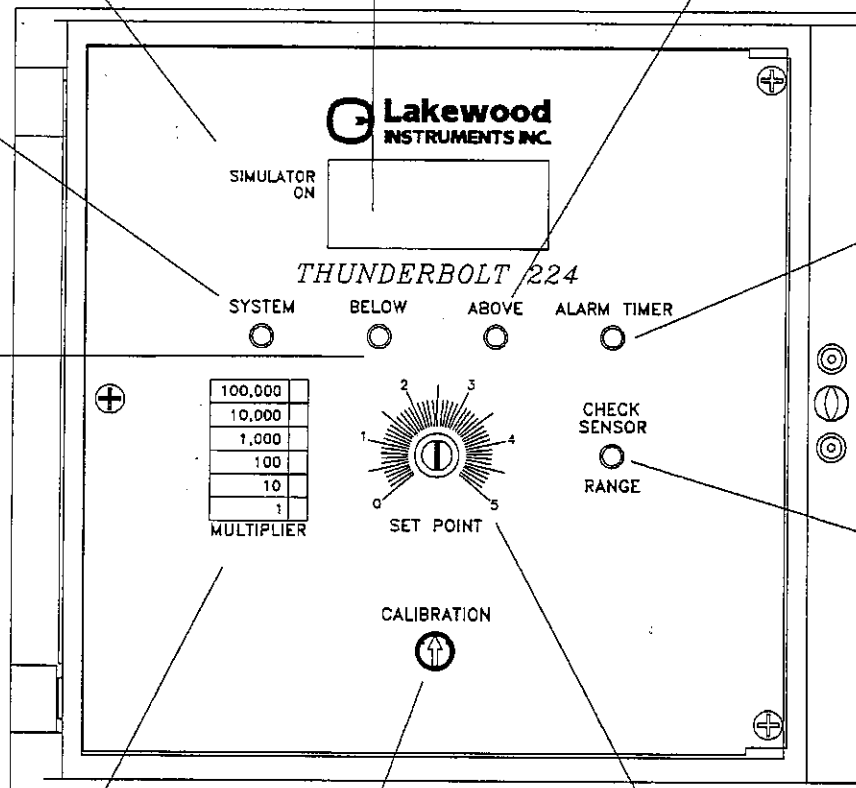
This light comes on when the alarm has timed out to let you know that the blowdown process has failed to satisfy the set point so the chemical pump was turned off in order to limit overfeeding.

SYSTEM

The SYSTEM light is ON when the inlet flow has raised the flow switch float. Without flow, the float is not visible in the flow sight, the SYSTEM light is OFF, and all of the outlets are OFF.

BELOW

This light comes on whenever the conductivity level is BELOW the set point value.



CHECK SENSOR

RANGE

This light comes on if the sensor fouling has exceeded the 224C's compensation capability or if the conductivity level has exceeded the range selected.

MULTIPLIER

After you select the operating range for your unit, you can mark the appropriate multiplier. (i.e. if you select 0-50,000 uS, then you would mark the 10,000 multiplier. When the LCD reads 2.50 it is a 25,000 uS reading.)

CALIBRATION

Use this knob to calibrate your unit by turning it until the LCD reads the same as the conductivity of your sample flow.

SET POINT

The set point level you select, based on your Water Treatment Engineer's recommendation, will determine the conductivity level that the controller will maintain. When the conductivity level rises above the set point the blowdown process is activated. The blowdown valve opens and the chemical pump feeds chemical until the set point is achieved.

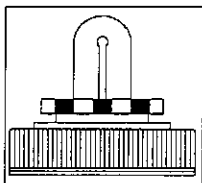
THUNDERBOLT 222C & 224C

START UP AND CALIBRATION

Programming and calibrating the THUNDERBOLT 220C Series is easy. Just start at the beginning and work all the way through this section.

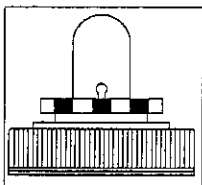
Inspection: All the plumbing and wiring needs to be properly attached before turning on the flow or power [see Plumbing and Wiring sections]. Check for loose wire connections if you have the weatherproof enclosure, and make sure the sensor and flow switch lock rings are secure. Then plug the unit in.

Flow Switch: The flow switch is located on the left side of the controller. The float has a magnet that rises due to flow. When water flow is present, the float rises in the flow sight and a magnetically operated reed switch activates the SYSTEM light and all power outlets are operative. Without flow, the float is not visible in the flow sight, the SYSTEM light is off, and all of the outlets are inoperative. A built-in back check valve helps prevent reverse flow. When the flow stops, this valve helps keep chemicals that were injected downstream away from the flow switch assembly and the electrodes.



Turn the water flow ON to check the flow switch. Use the sample line inlet valve if you installed one.

The float should rise in the flow sight and the SYSTEM light should come on to indicate flow is ON.



Now turn the water flow OFF. The float should drop to indicate there is no flow and the SYSTEM light should go off.

Turn the flow back ON for the rest of the start up.

SETUP PROCEDURE

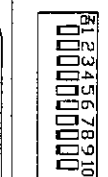
Because of the flexible nature of the THUNDERBOLT 220C Series, you must decide what range you want to establish before you begin. Two different face plates are available but as you can see below, the setup procedure is the same. If the CHECK RANGE light is on, it means the conductivity level is higher than the range you selected. In such a case, simply select a higher range.

Turn the lock screw and swing the front panel open. Use the following charts to set the S1 switches in order to get the conductivity range you desire. (See Print 5103660 to locate S1 switch on the back of the front panel)

If your face plate has the 0 - 5 set point range, use this chart:

0 - 50 range: Set S1 switches 5,8 to ON position.
 0 - 500 range: Set S1 switches 5,7 to ON position.
 0 - 5,000 range: Set S1 switches 1,2,4,7,9 to ON position.
 0 - 50,000 range: Set S1 switches 1,2,3,7,8 to ON position.
 0-500,000 range* Set S1 switches 1,2,3,6 to ON position.

EXAMPLE

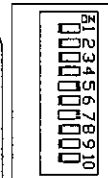


0-500 range

If your face plate has the 0 - 10 set point range, use this chart:

0 - 100 range: Set S1 switches 5,8 to ON position.
 0 - 1,000 range: Set S1 switches 5,7 to ON position.
 0 - 10,000 range: Set S1 switches 1,2,4,7,9 to ON position.
 0 - 100,000 range: Set S1 switches 1,2,3,7,8 to ON position.
 0-1,000,000 range* Set S1 switches 1,2,3,6 to ON position.

EXAMPLE



0-1,000 range

*Model 224C only

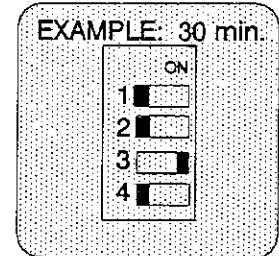
Set the Alarm Timer

While you have the front panel open, locate the S2 switch to select the alarm time. The **TIMER** light on the front panel will come on after the time you select expires. The light means that blowdown failed to satisfy the set point so the controller shut off the chemical pump in order to limit chemical overfeed. (See Print 5103660 to locate)

To select the alarm time, set the S2 switch to the proper setting based on this chart:

Switch ON	Time
1	15 sec
2	15 min
3	30 min
4	60 min
None	Timer Disabled

For example, if you want the alarm set for 30 minutes, then set switch 3 to **ON**. Switch 1 (15 sec) is useful for testing purposes.



CALIBRATION

In order to calibrate your unit you must first measure the sample water. You can use a Lakewood Instruments calibrated hand-held conductivity meter, a Myron L unit, or other similar meters. A small straight screwdriver may also be needed to adjust the **CALIBRATE** shaft.

Measure the sample water. Use the sample valve spout if you installed one.

- Measure the water conductivity level with a calibrated hand-held conductivity meter. If you do not have a meter, contact your Water Treatment Engineer for instructions or a service call.
- Make careful note of the conductivity level since you will use it to calibrate your unit.

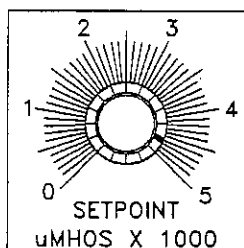
Now you can CALIBRATE the controller.

- Make sure the **SYSTEM** light is **ON**, indicating flow.



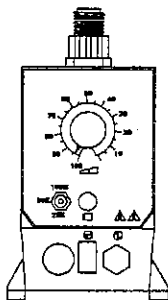
- You should adjust the **CALIBRATE** shaft until the LCD reads the same as the sample read on the hand-held meter. For example, if the meter read 1500 umhos, then the LCD should read:

1.50 – Assuming a multiplier of 1000.



Establish the conductivity set point.

- Now adjust the set point to the value your Water Treatment Engineer recommends. In most cases, as an example, you can take your makeup water conductivity level and multiply it by 3 in order to maintain 3 cycles of concentration (i.e. 1500 umhos x 3 = 4500 umhos set point).



Set the inhibitor chemical pump output.

- Set the inhibitor chemical pump to the output capacity your Water Treatment Engineer recommends. (i.e. 50% output capacity)
- Allow the system to run for a day. After you, or your Water Treatment Engineer, determine the proper amount of inhibitor needed for your system, you can adjust the chemical pump output capacity to get the recommended PPM residual level.

Simulator Switch

On the back of the front panel, a simulator switch allows you to verify controller operation, a fixed value conductivity.

- Turn and pull on the front panel lock screw to open the front panel.
- The switch is on the back of the front panel, numbered S4. Push the slide down for "SIMULATOR ON" mode. The LCD on the front panel should have an arrow pointing to "SIMULATOR ON."

After you are finished verifying the setpoint operation, the display read-out, valve and pump operation, turn the simulator to the "OFF" position.

Hidden LCD ON/OFF Switch

If you decide that you do not want the LCD to be readable, an easy to use white ON/OFF push button has been included for your convenience. Simply open the front panel and push the white button once to turn the LCD OFF. Push it again to turn it back ON. (See Print 5103669 to locate)

Temperature Compensation Simulator

you can use the yellow simulator button to check you probe's Temperature Compensator. When you push and hold the button in it simulates the temperature compensation you would get from water at 25°C. If you have an erratic reading you can push the button in and it will bring the reading back to normal if the temperature compensator is bad in you probe. (See Print 5103660 to locate)

Fouling Compensator - Model 224C only

The Model 224C will compensate for fouling. When the CHECK SENSOR light is on it means that fouling has exceeded the compensation capability and the sensor should be removed, and cleaned. (See Maintenance section for cleaning procedure)

DON'T FORGET TO SETUP YOUR OPTIONS AS SHOWN ON THE NEXT FEW PAGES!

THUNDERBOLT 222C & 224C OPTIONS SETUP

-35C Isolated 4-20mA Output Option.

The THUNDERBOLT 220C Series can be equipped with isolated 4-20 mA outputs for a recorder or computer. This option allows you to monitor your system from a remote location. This interface card plugs into the back panel. The output is factory preset for 0 conductivity = 4 mA and the full scale = 20 mA. The ZERO and SPAN adjustments allow you to scale the output whenever you change the conductivity range. The charts below are examples of these calibrations. Before you calibrate, wire the recorder or computer to terminal block TF.

(NOTE: If you want both the -35C and -42C options, you need the -44C option.)

- Unplug your inhibitor pump and blowdown valve.
- Connect a DC volt meter (DVM) to the -35C card -- [(+) to TP-2 and (-) to TP-1]
- Disconnect the conductivity sensor and expose it to the air until the LCD on the front panel reads "0" -- the 4 mA value.
- Then turn the R-14 (ZERO) adjustment screw on the -35C card until your DVM reads "0" Volts -- the 4 mA value. Then replace and secure the sensor.
- On the back of the front panel, push the simulation switch to "SIMULATOR ON" then turn the Simulator Pot (R82) until the LCD on the front panel reads the full scale value you have established for your unit (i.e. 50,000) -- the 20 mA value.
- Finally, turn the R-17 (SPAN) adjustment screw on the -35C card until your DVM reads "4" Volts -- the 20 mA value.
- Because the extreme ranges have been set, the mid-ranges should be automatic. To check the proportional adjustments, turn the Simulator Pot (R82) until the LCD reads the half scale value (i.e. 25,000). The DVM should read "2" Volts -- the 12 mA value.
- On the back of the front panel, push the simulation switch to the off position.
- Plug your inhibitor pump and blowdown valve back into their proper outlets, or wire them to their proper terminal points if you have the -WP option.

Range: 0 - 5,000 uS

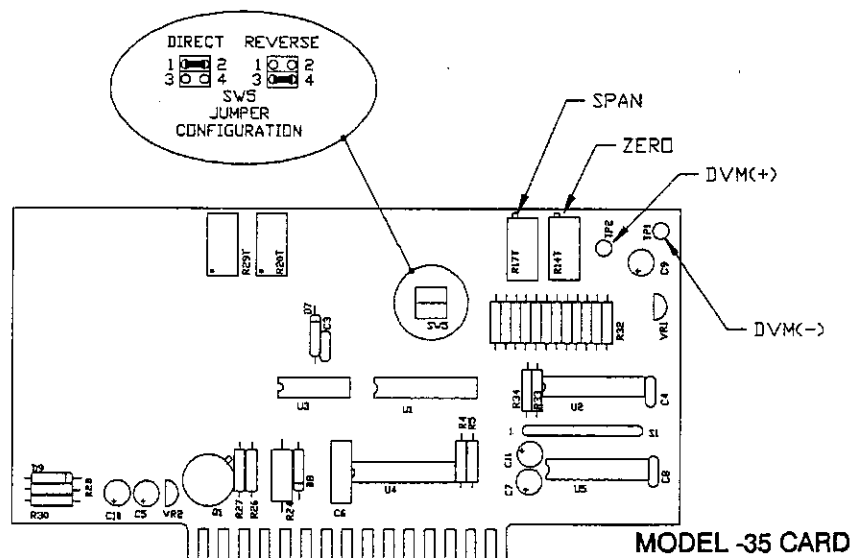
Conductivity	mA	TP12 Volts
0	4	0
2,500	12	2
5,000	20	4

Range: 0 - 50,000 uS

Conductivity	mA	TP12 Volts
0	4	0
25,000	12	2
50,000	20	4

Range: 0 - 100,000 uS

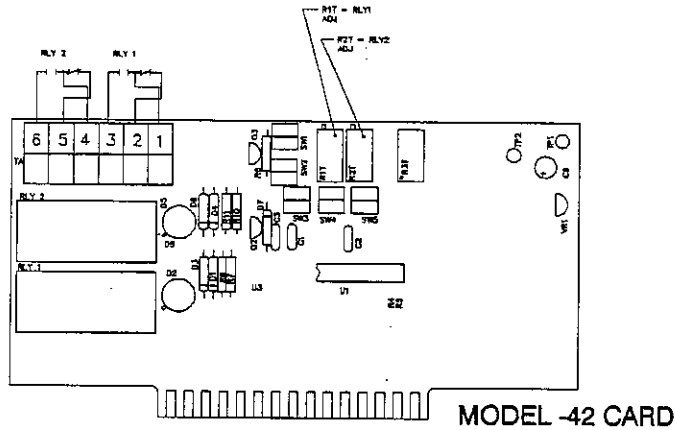
Conductivity	mA	TP12 Volts
0	4	0
50,000	12	2
100,000	20	4



-42C High/Low Alarms Option.

Extra High and Low Alarms for remote alarm status or computer alarm log are available with this option. The -42C card plugs into the back panel. (NOTE: If you want both the -35C and -42C options, you need the -44C option)

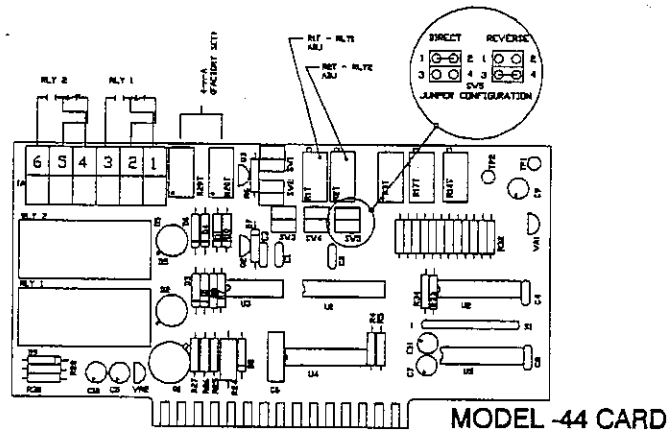
- Unplug your inhibitor pump and blowdown valve.
- On the back of the front panel, push the simulator switch to "SIMULATOR ON". Then turn the Simulator Pot (R82) until the LCD on the front panel reads the value you desire for your Low Alarm trip point.
- Then open the front panel again. On the -42C card, turn the Low Alarm screw (R-1T) counterclockwise until the alarm is activated. Your Low Conductivity Alarm is now set.
- Now turn the Simulator Pot (R82) until the LCD reads the value you desire for your High Alarm trip point.
- On the -42C card, turn the High Alarm screw (R-2T) clockwise until the alarm is activated. Your High Conductivity Alarm is now set.
- On the back of the front panel, push the simulation switch to the off position.
- Plug your inhibitor pump and blowdown valve back into their proper outlets, or wire them to their proper terminal points if you have the -WP option.



- NOTES:
- SW 1 _____ HIGH RELAY 1
 - SW 2 _____ LOW RELAY 1
 - SW 3 _____ HIGH RELAY 2
 - SW 4 _____ LOW RELAY 2

-44C Option.

The -35C and -42C Options are combined on one card so you can operate a 4-20 mA output and the High/Low Alarms at the same time. Refer to the setup procedures for both cards described above.



- NOTES:
- SW 1 _____ HIGH RELAY 1
 - SW 2 _____ LOW RELAY 1
 - SW 3 _____ HIGH RELAY 2
 - SW 4 _____ LOW RELAY 2

BIOCIDE TIMER OPTIONS.

Model 63 -- Electromechanical 7-day timer Conductivity High/Low Alarm.

- One biocide feed, 15 minute increments with a day skip feature.
- Wiring information is provided in the Wiring section of this manual.

Model 66 -- Microprocessor Clock Timer.

- Up to 3 biocide feeds and delay timer for biocide retention.
- Refer to the Model 66 Instruction and Operation Manual. Wiring information is provided in this manual as well (See Wiring section).

-RP OPTION

- For remote preamp switch settings, consult the Lakewood Factory.
- For wiring information, see Print 5103659-3.

JUMPER SETTINGS

The jumper settings are factory set. The table below can be used to modify the THUNDERBOLT after installation. RECOMMENDATION: Contact the Lakewood Instruments Service Department for additional instructions for specific changes.

Action	Jumper	For	Application
Temp. Compensator (TC)	1 & 4 2 & 5 3 & 6	10k TC 500 ohm TC 4k TC	Condensate Cooling water Remote 4 electrode sensor
Regular Set Point Reverse Set Point	8 & 9 7 & 10	High (Normal) Low	Cooling water Chill/Hot Nitrate feed
Remote Pre Amp Integral Pre Amp	11 & 12 13	Remote Pre Amp STD.	Distant sensor location
Flow Switch	14 None	No Flow Switch With a Flow Switch	Remote sensor/pre amp
Set Point	15 None	"5" Scale "10" Scale	Set Point Set Point

Your THUNDERBOLT controller is now ready for use.

THUNDERBOLT 222C & 224C INSTALLATION

CHECKING

Inspect the shipping carton for obvious external damage. Note on the carrier's Bill of Lading the extent of the damage and/or notify the carrier.

Save the shipping carton until your THUNDERBOLT controller is started up. If there was shipping damage, call the Lakewood Instruments Customer Service Department at (602) 272-5100 and return the controller to the factory in the original carton.

MOUNTING

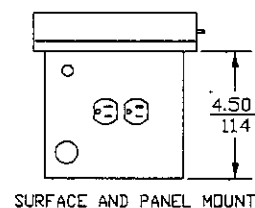
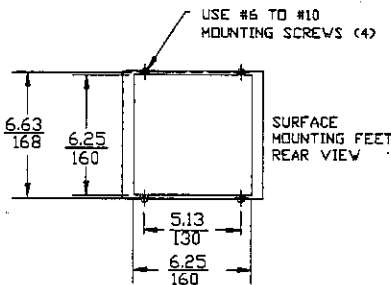
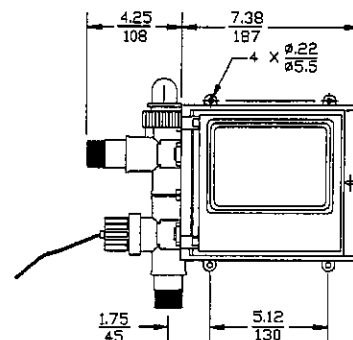
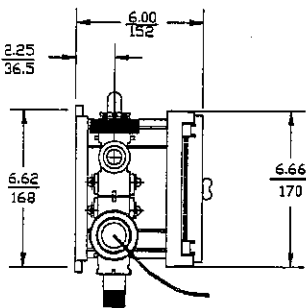
Mount the controller or prefabricated system on a FLAT, NON-VIBRATING wall.

Avoid drilling or punching additional holes in the controller enclosure. Damage incurred as a result of any alterations to the enclosure is not covered under the Lakewood Instruments product warranty.

NOTE: Excessive heat and direct sunlight exposure will darken the LCD making it difficult to read and may shorten the life of other electronic components.

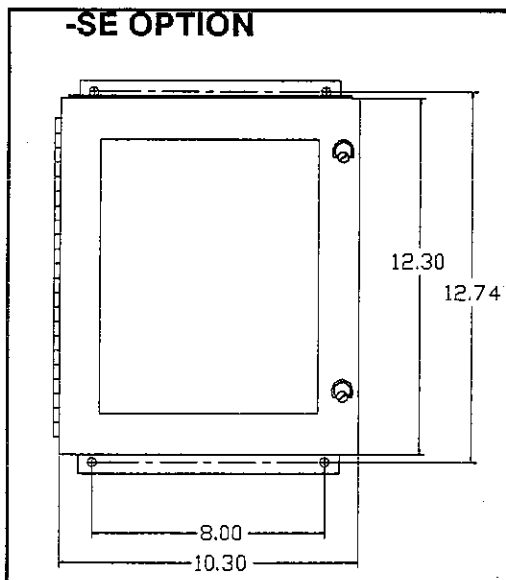
NOTES:

1. INSTALL ON SMOOTH SURFACE TO PREVENT STRESS ON MOUNTING FEET.
2. DO NOT INSTALL ON VIBRATING WALL.
3. IF ENCLOSURE IS INSTALLED IN CORROSIVE ENVIRONMENTS, CONSIDER AIR PURGING
4. MATERIAL: BEZEL-ABS, BODY-PVC



PANEL CUTOUT
6.25 X 6.25 INCHES
160mm X 160mm

INCHES
MILLIMETERS



The SE Option combines a THUNDERBOLT and a Model 66 in this larger single enclosure.

PLUMBING

Standard THUNDERBOLT 220C Series Controller Plumbing

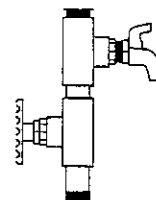
Plumbing materials

- Inlet plumbing can be 3/4" PVC, iron, or copper pipe.
- Provide at least 1 GPM to the controller. A 4 psi differential from take-off to injection is sufficient. If flow is marginal, consult your LAKEWOOD INSTRUMENTS Factory Representative.
- Outlet plumbing can be 3/4" PVC or CPVC. Schedule 80 is recommended for strength and sunlight protection.
- If copper or iron pipe is used, install a PVC union to relieve the stress on the controller plumbing.

PLUMBING—Cooling Tower Applications

- First, plumb the inlet flow. This line brings the sample water in past the conductivity sensor for evaluation and then pushes the flow switch float up to activate the unit.

RECOMMENDATION: For your convenience, include a sample line shut-off valve and a sample valve spout in the inlet flow plumbing.



- Then, plumb the Outlet Flow (solution/sample line) to the tower return line where you will insert your chemical feed system.
- The Outlet Flow should be connected to the tower return or condenser water return line. If you choose to plumb the controller across the circulating water pump, the chemical must be injected into the circulating pump discharge after the controller take off.
- If your piping layout does not allow you to plumb the controller properly (i.e. to the tower return line or to the tower basin), contact the Lakewood Instruments Customer Service Dept.-(602) 272-5100. A phone call can save a lot of construction time.

WARNING! Never inject chemicals upstream from the controller flowcells.

IMPORTANT! Some chemicals may have to be injected directly into the cooling tower water line and not into the sample line.

Prefabricated Chemical Pump and Controller Assemblies

These units follow the same instructions given for the standard THUNDERBOLT controller listed above.

RECOMMENDATION: If the solution/sample line is returned to the cooling tower return line, use a corporation stop (Model 9160), a solution line injector (Model 9006), or a dispersing pipe such as the Model 9175. This aids chemical - water mixing and enhances water treatment control capabilities.

Blowdown Valve

If you have a way to measure your blowdown flow rate and pressure range (psi), you can use the chart below to determine the correct valve size. If not, consult your Water Treatment Engineer.

Adjustable flow rate diaphragm valves require at least 5 psi differential pressure to close. If your water pressure is marginal, use a supply water pressure actuated diaphragm valve or a valve designed to work with 0 differential pressure.

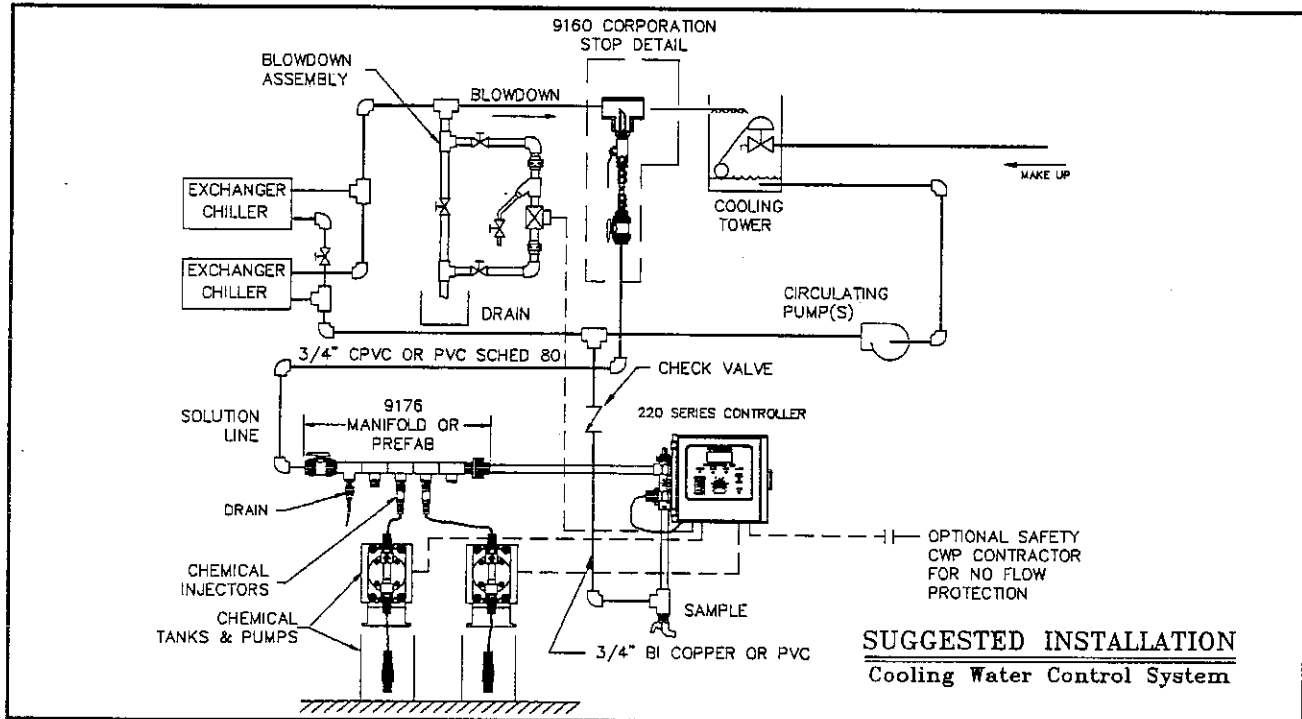
Extremely dirty cooling water will plug diaphragm valves. In such cases, use a motorized ball valve and a globe valve for flow control. A strainer ahead of the valve may be O.K., but you must flush it regularly. If your flow lines are above 3" (for large systems), use a pneumatically operated butterfly valve.

Be sure to provide isolation and bypass valves (See print below). If your blowdown valve ever fails you need to be able to bypass it in order to service it.

Remember on occasion to purge your "Y" strainer screen to maintain flow accuracy.

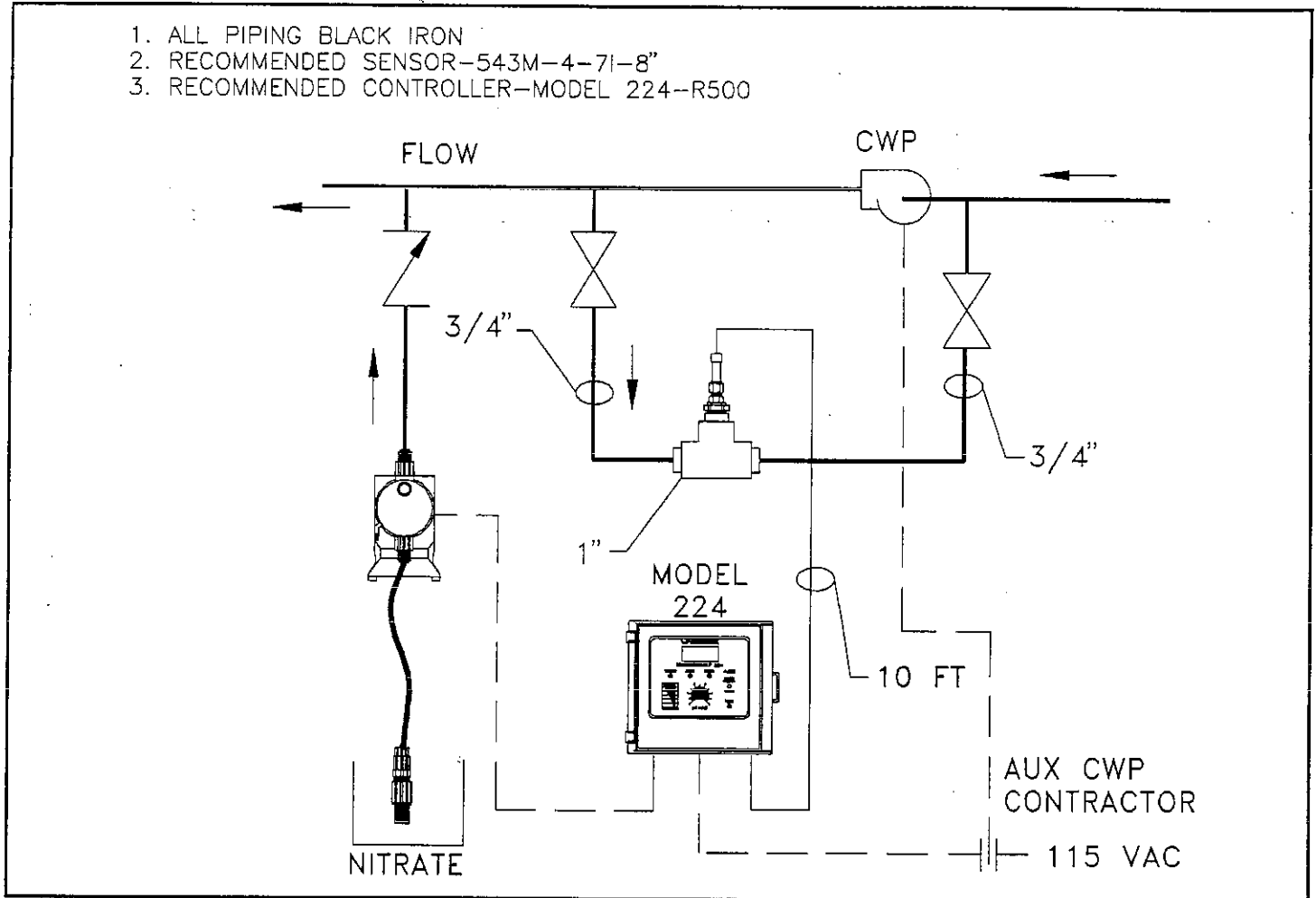
BLOWDOWN VALVE SIZING CHART

Pressure Range (psi)	Blowdown Flow Rate Range (GPM)	Suggested Valve Size
10 - 50	1 - 5	3/4"
50 - 150	5 - 10	3/4"
10 - 50	5 - 10	1"
50 - 150	10 - 15	1"
10 - 50	10 - 15	1 1/2"
50 - 150	15 - 20	1 1/2"
10 - 50	15 - 20	2"
50 - 150	20 - 20	2"
10 - 50	30 - 100	3"
10 - 50	100 - 300	4"



PLUMBING – Hot & Cold Water Closed Loop Chemical Feed

- A reverse set point is required so the controller feeds on low conductivity.
- A remote sensor is directly plumbed into a 1" tee with a 3/4" reducer for the sensor.
- A black iron tee is preferred.
- For proper pressure ratings, check local building codes.



NOTE: If this manual has been supplied for the application shown here, please call the Lakewood Factory to have the application specific manual mailed to you.

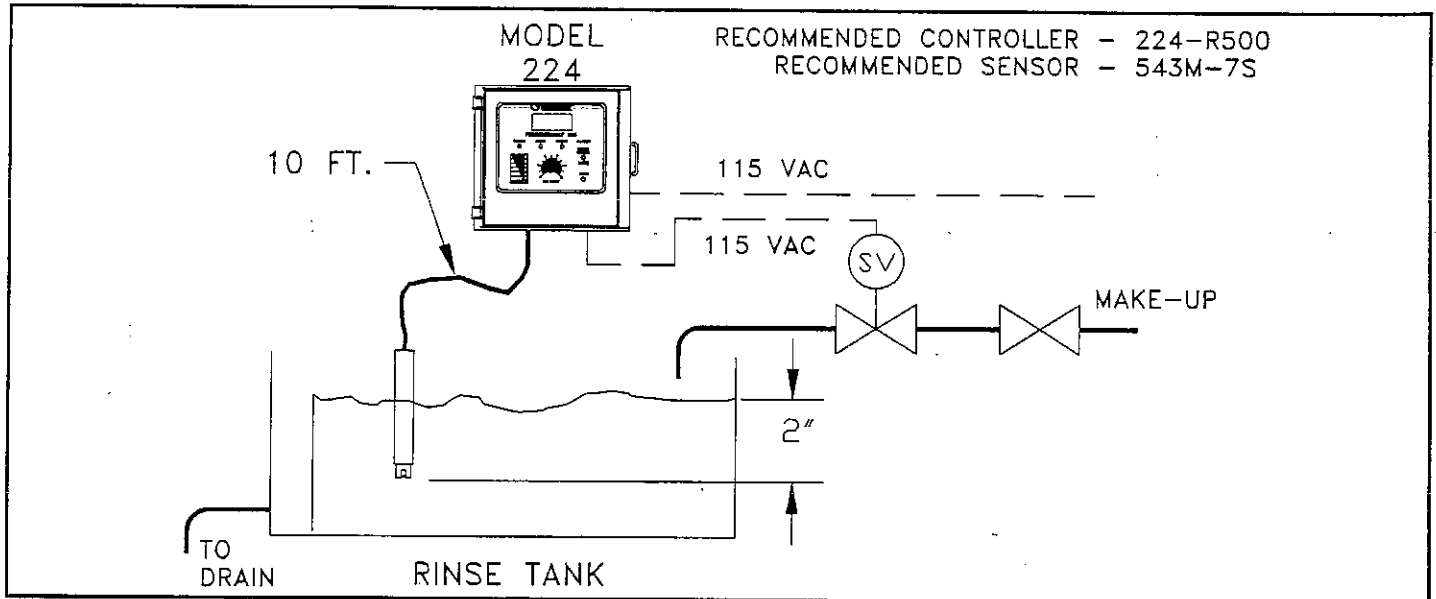
WARNING! PVC is **NOT** recommended for hot water or pressures above 150 psi.

NOTE: If this manual has been supplied for the applications shown below, please call the Lakewood Factory to have the application specific manual mailed to you.

PLUMBING – Rinse Tank Controller

The THUNDERBOLT 224 controller is set up to open a solenoid valve on high conductivity.

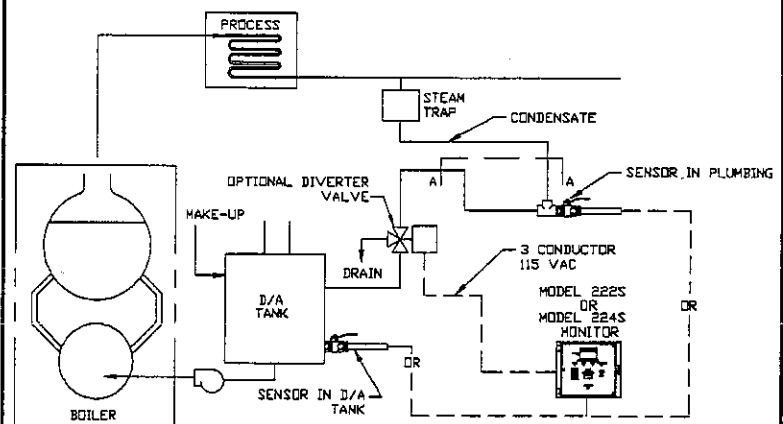
This application requires a 543M-7S submersible sensor. The THUNDERBOLT 224 should not be equipped with a flow sight assembly since there is no direct plumbing to the controller with a remote sensor.



PLUMBING – Condensate Monitoring

- The controller diverts contaminated condensate to waste and keeps it out of the boiler. Always install the sensor in the bottom of a "U" to make sure the pipe is full.
- If the sensor must be > 10 ft from the controller, use Model 222S-RP2 and Model 540-2-10R-12" that includes a remote preamplifier.
- If the condensate contaminants are oily or animal fats, use the Model 224S controller and the 543L-4-7R sensor for 4 electrode fouling compensation. (If > 10ft use Model 224S-RP4 and a 543L-2-7R sensor.)
- Do not use PVC or CPVC plumbing.
- The alarm timer may be used for a delayed remote alarm indicator.

NOTES: UNLESS OTHERWISE SPECIFIED:
1. "A-A" PIPING IN "U" TO KEEP FULL.
2. FOR SENSOR TO MONITOR DISTANCES GREATER THAN 10 FEET(3 METERS) A PREAMP MUST BE USED, 222S-RP OR 224S-RP.



APPLICATIONS			
SENSOR	MONITOR	FEATURES	
540-4-7R	222S	2 ELECTRODE, 1" NPT SENSOR FITTING, CLEAN CONDENSATE, RETRACTABLE	
540-4-7I	222S	2 ELECTRODE, 3/4" NPT SENSOR FITTING, CLEAN CONDENSATE, INLINE	
543L-4-8	224S	4 ELECTRODE, 1 1/2" NPT SENSOR FITTING, COATING CONDENSATE, RETRACTABLE	
543L-4-7	224S	4 ELECTRODE, 1" NPT SENSOR FITTING, COATING CONDENSATE, INLINE	

WIRING

Standard THUNDERBOLT 220C Series Controller with Power Cord and Outlets.

The THUNDERBOLT Series has a number of options available. The standard units come with a power cord and outlets for your blowdown valve and chemical pumps. Follow the wiring procedure in the order it is stated below:

Make sure the power cord is unplugged while you are working with the wiring.

Plug the blowdown solenoid valve into the outlet marked BLEED OFF. This may not be consistent with local electrical codes. If local codes require internal wiring, do the following:

On the left side of the face plate, turn and pull on the lock screw and swing open the panel to expose the terminal blocks on the back panel for wiring connections.

Wire the blowdown solenoid valve through conduit to the 1/2" conduit knockout provided on the right side of the enclosure. Connect the hot (blue) wire to the #8 lug on the TA Terminal (CAUST/BLEED). The ground wire (green) should be wired to the ground lug #1 on the TA Terminal. The neutral (white) wire goes to the TA lug #3 (ACC) with the other neutral wires. (Refer to print 5103659).

After you are done, make sure there are no loose connections and that all tools and debris are removed. Close the panel. Tighten the face plate screw and continue the wiring process.

Plug the inhibitor chemical pump into the INH PUMP outlet. This outlet is set up to feed inhibitor proportional to blowdown. Plug your biocide pumps into the appropriately marked outlets on your THUNDERBOLT or more appropriately into your Model 63 or Model 66 biocide feed limit timer.

Plug in the power cord to a convenient 115 VAC outlet.

WARNING: DO NOT plug in chemical pumps that are larger than 1/6HP. The control relays are intended for electronic or small motor driven chemical pumps. Large pumps require the -HR option with 25 amp rated interposing relays. Contact LAKEWOOD INSTRUMENTS for special instructions.

Weatherproof Enclosure (-WP Option) Without Outlets.

Instead of having outlets to plug pumps into, the -WP option provides conduit knockouts so you can bring all the wiring into the unit through conduit. You then wire the pumps directly to the terminal blocks as shown in the wiring diagram (See Print 5103659).

WARNING: Punching or drilling more knockouts may allow stray metal chips to ruin circuit board components.

Prefabricated Chemical Pump and Controller Assemblies.

The chemical pumps, biocide timers, and other options are already prewired with prefabricated systems. You only need to wire the power source and the solenoid blowdown valve (See Print 5103659). DO NOT use less than 16 gauge wire because the system is fused for 10 amps.

21-220 Prefab: All external power connections are made to a junction box with terminal blocks located on the left hand side of the controller.

21-220 Polyethylene Shelf Prefab: All external power connections are made to the controller terminal blocks located on the rear of the enclosure.

Biocide Timer and Other Custom Options.

Model 63 -- Electromechanical 7-day timer.

The timer is prewired in its own separate enclosure. To connect the timer to the THUNDERBOLT, open the front panel, bring the wiring in through the conduit knockout on the right side of the unit, directly adjacent to the biocide plug-in receptacle. Simply plug the biocide timer into the back panel, close the front panel and plug your biocide pump(s) into the appropriate outlet(s) on your timer.

Model 66 -- Microprocessor based timer.

The timer is prewired in its own separate enclosure. To connect the timer to the THUNDERBOLT, open the front panel, bring the wiring in through the conduit knockout on the right side of the unit, directly adjacent to the biocide plug-in receptacle. Simply plug the biocide timer into the back panel, close the front panel and plug your biocide pump(s) into the appropriate outlet(s) on your Model 66. See the Model 66 manual for proper wiring connections and operation instructions.

MP Option.

This option is a biocide timer (M63 or M66) mounted on a 316 S.S. plate that is prewired to the controller. All you need to do is provide power to the THUNDERBOLT.

Refer to the biocide timer manual for wiring details.

SE Option.

This option combines a THUNDERBOLT and a Model 66 in a single enclosure.

Refer to the Model 66 manual for wiring details.

THUNDERBOLT 222C & 224C MAINTENANCE

In every case below, make sure you have shut off the sample flow and the power to the controller before you do anything.

CONDUCTIVITY SENSOR

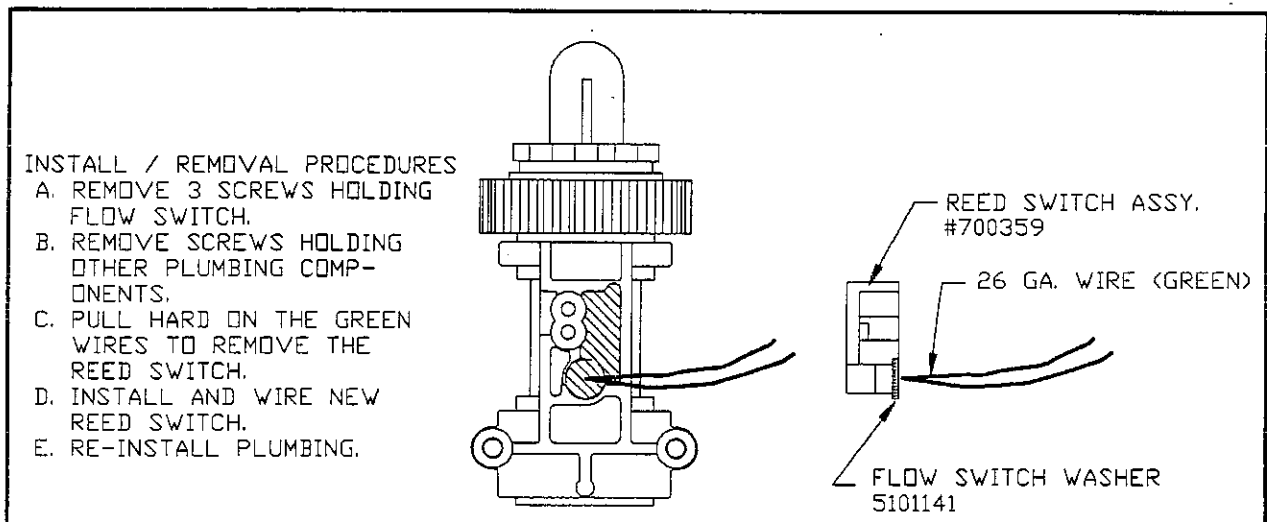
Clean the electrode end of the conductivity sensor once a month if you have the THUNDERBOLT 222C. The 224C has a fouling compensator which reduces the need for sensor cleaning. The fouling alarm will tell you when the sensor is too fouled to provide accurate readings. You must clean the sensor at that time.

- Unlock the red lock ring and remove the sensor.
- Use a soft brass brush or a coarse rag and gently clean the sensor tips.
- Replace the sensor and make sure the red lock ring is secured.
- Turn sample flow back on.
- Calibrate the controller then allow the controller to operate several hours in order to stabilize the electrodes. Then you can re-calibrate the controller for best accuracy.

FLOW SWITCH CLEAN OUT

- Unlock the red lock ring and remove the flow sight.
- Remove the float with your fingers.
- Bottle brush the float, flow sight and the flow switch assembly to remove any residue.
- Clean off the "O" ring and then apply silicone base lube to keep the "O" ring moist.
- Make sure you lock down the red lock ring after you replace the components.
- After you turn the inlet flow back on, check for leaks.

REED SWITCH REPLACEMENT



TROUBLE-SHOOTING CHART

PROBLEM NOTED	CHECK	CORRECTIVE ACTION
<p>No power to solenoid valve or chemical pump.</p>	<p>1. SYSTEM light is OFF. A. Is the flow switch float up in the sight glass? B. Is the fuse blown?</p> <p>2. SYSTEM light is ON</p>	<p>NO Increase sample flow. Need 1 GPM minimum. Clean the flow switch.</p> <p>YES Replace flow relay, reed switch block and/or float.</p> <p>YES Check for 24V solenoid. Check outlets for 115 VAC. Check chemical pump in another outlet. Turn set point below current conductivity level. Check outputs for 115 VAC. Check valve solenoid and chemical pump.</p>
<p>If all of the above checks out OK but you still don't have power to the outputs, return the rear circuit board for repair.</p>		
<p>Conductivity not working or reading too low.</p>	<p>1. Clean the sensor. 2. Place a key or metal object across the 2 electrode tips (222 only). The LCD should be above 10.00. 3. Turn ON the CONDUCTIVITY SIMULATOR switch (S4). The LCD should be above "000". 4. Check the TEMP COMP. Push and hold in the SIMULATOR button (S3). The LCD reading should change by more than 20%. 5. Does the set point work? 6. Is 1 electrode eaten away? 7. Calibrate in buffer solutions.</p>	<p>See Maintenance section in this manual.</p> <p>If not, replace the sensor.</p> <p>If it is, go to #4. If not, replace the front panel.</p> <p>If it does, replace the sensor. If not, go to #5. If it does, go to #6. If not, replace the front panel. If it is, replace the front panel and probe. If it does not calibrate accurately, replace the sensor.</p>
<p>Controller reads properly, but isn't feeding chemicals or activating blow-down processes.</p>	<p>1. Does flow sight show proper flow? 2. Is the SYSTEM light ON?</p>	<p>YES Proceed to #2. NO Initiate proper flow or replace the flow switch then proceed to #2.</p> <p>NO Short terminal TB, lugs 1 & 2 . If the light comes on, the flow switch is faulty and needs replaced or flow is simply insufficient.</p> <p>YES Check and see if biocide feeding. Check and see if the lockout time has expired. Check jumper for biocide plug. (See Print 5103659)</p>
<p>The TIMER light is on indicating blowdown failed.</p>	<p>1. Is the blowdown valve working properly?</p>	<p>NO Replace the valve. YES Check the blowdown line for water flow. Valve may be dirty and not giving enough flow.</p>

WHEN ANY PARTS ARE RETURNED TO THE FACTORY FOR REPAIR, please include:

- Customer's name and address.
- Individual at customer location to send the repaired controller to.
- Person to call if controller is beyond repair or any warranty questions.

REPLACEMENT PARTS LIST

When any parts are returned to the factory for repair, please include:

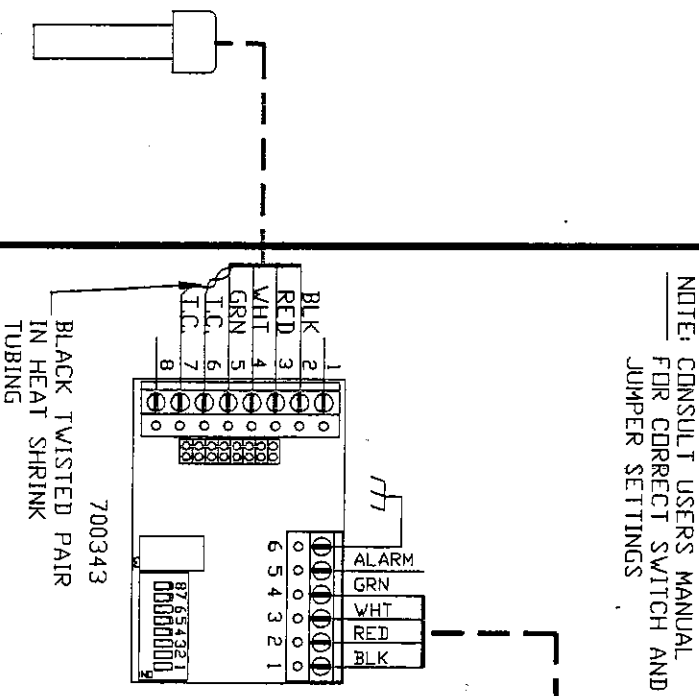
- Customer's name and address.
- Individual at customer location to send the repaired controller to.
- Person to call if the controller is beyond repair or any warranty questions. Include the phone number.

<u>PART NUMBER</u>	<u>DESCRIPTION</u>
7000558	Model 222C front board and panel
7000323	Model 222C rear circuit board
7000558-1	Model 224C front board and panel
7000323	Model 224C rear circuit board
7000185	2 electrode conductivity sensor
7000480	4 electrode conductivity sensor
7000358	Flow switch magnet
700314	Molded flow switch and flow cell
700359	Replacement reed switch block
700449	Flow sight

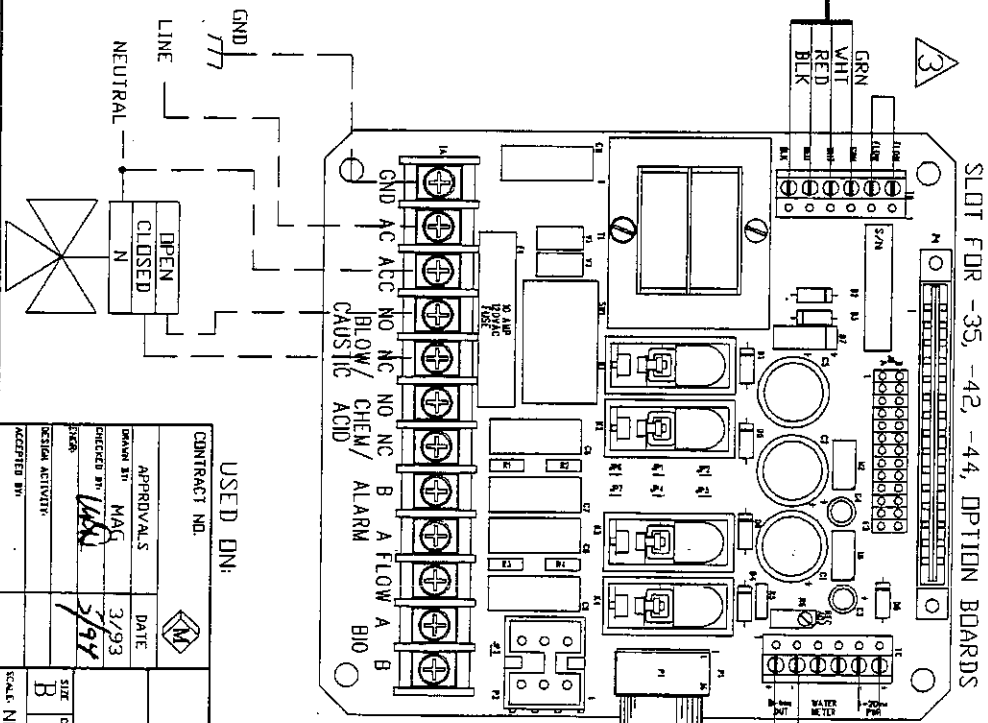
- NOTES: UNLESS OTHERWISE SPECIFIED:
1. WIRING BY LAKEWOOD
 2. WIRING BY OTHERS
- ▲ FLOW SWITCH MUST BE JUMPED.
- ▲ -35 OR -44 OPTION BOARD REQUIRED.

SENSOR

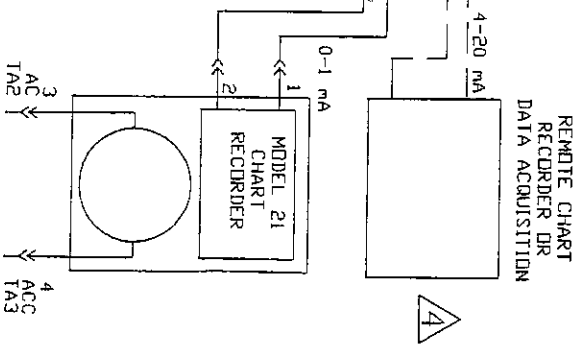
PREAMP



CONTROLLER



REMOTE



REVISIONS			DATE	APPROVALS
ZONE	REV	DESCRIPTION		
	NEW	W/D 0318	MAG 3/93	
	A	SEE ECN 0404	MAG 9/93	
	A1	W/D 0557	MAG 5/94	

USED ON:

CONTRACT NO.		DATE		DATE	
APPROVALS		DATE		DATE	
DRAWN BY: MAG		3/93		3/94	
CHECKED BY: WAG					
SCALE: NONE		SIZE: 1/2" x 1/2"		SCALE: NONE	
MODEL NUMBER		SHEET 2 OF 5		REV: A1	



DIAGRAM - WIRING
BACKBOARD WIRING
MODEL 824-RP

5103659

NOTES: UNLESS OTHERWISE SPECIFIED:

1. WIRING BY LAKEWOOD
2. WIRING BY OTHERS

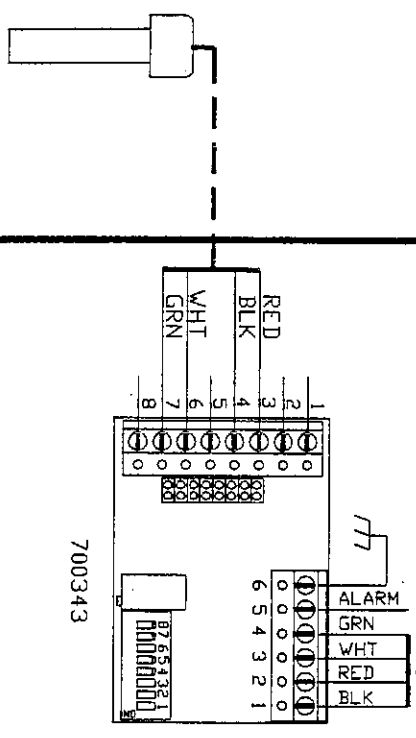
▲ FLOW SWITCH MUST BE JUMPED.

▲ -35 OR -44 OPTION BOARD REQUIRED.

SENSOR

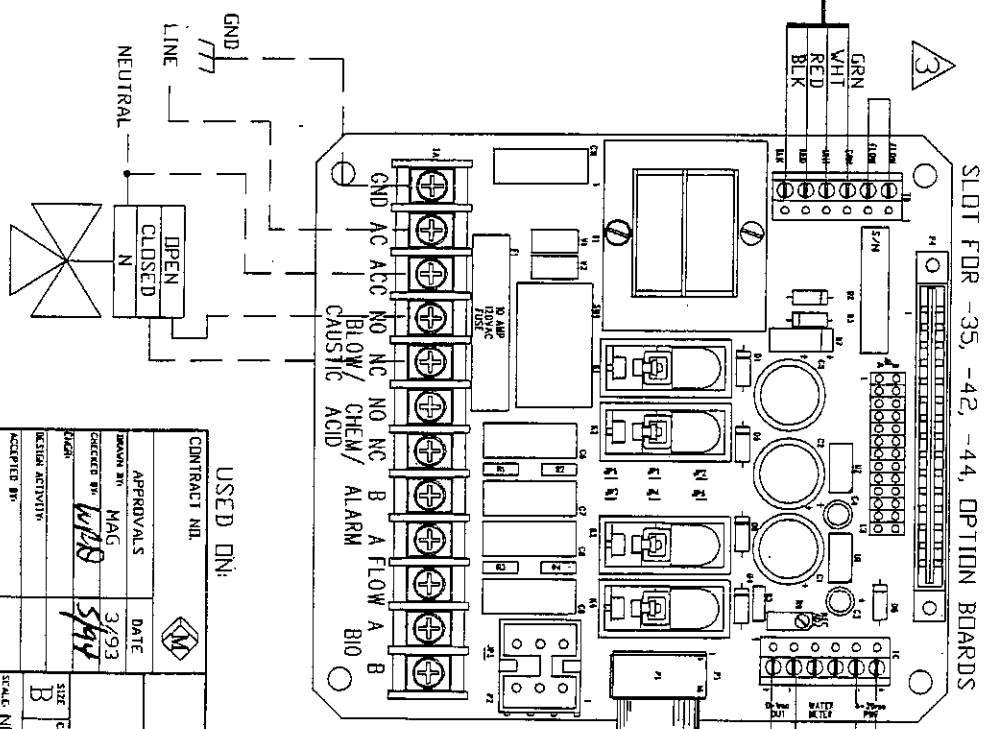
PREAMP

NOTE: CONSULT USERS MANUAL FOR CORRECT SWITCH AND JUMPER SETTINGS



CONTROLER

REMOTE



REVISIONS			
ZONE REV	DESCRIPTION	DATE	APPROVALS
NEW	W/D 0318	MAG 3/93	
A	SEE ECN 0404	MAG 9/93	
A1	W/D 0557	MAG 5/94	

USED ON:

CONTRACT NO.		DATE	
APPROVALS		DATE	
DRAWN BY: MAG		3/93	
CHECKED BY: WDB		SPY	
ACTION ACTIVITY:		SIZE: 1/2" x 1/2"	
ACCEPTED BY:		TYPE: CIRC	
SYMBOL NUMBER		REV.:	
5103659		A1	

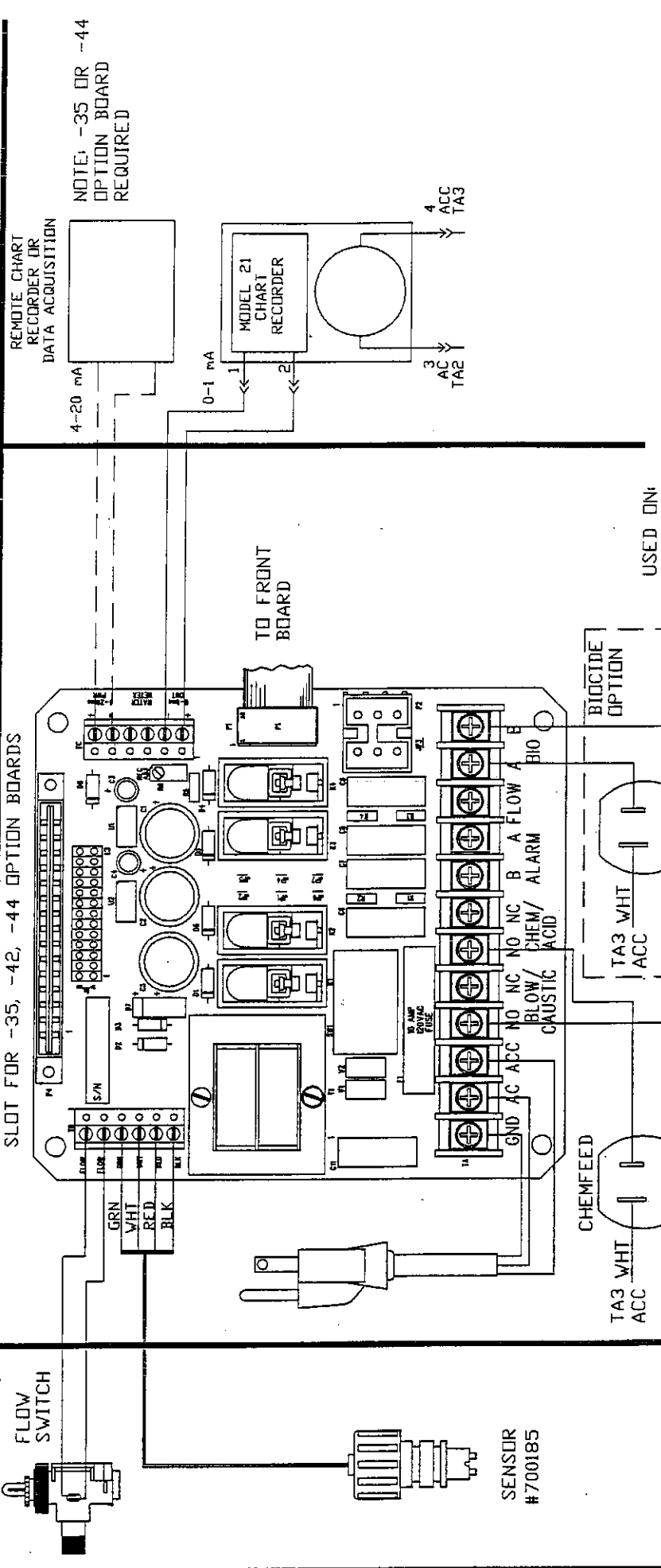


DIAGRAM - WIRING
BACKBOARD WIRING
MODEL 222-RP

REVISIONS		DATE	APPROVALS
ZONE	REV	DESCRIPTION	
	NEW	W/D 0318	MAG 3/93
	A1	W/D 0557	MAG 5/94

NOTES: UNLESS OTHERWISE SPECIFIED;
 1. WIRING BY LAKEWOOD
 2. WIRING BY OTHERS

CONTROLLER



Lakewood INSTRUMENTS INC.

DIAGRAM - WIRING
BACKBOARD WIRING

DRAWING NUMBER: 5103659

REV: A1

SCALE: NONE

SHEET: 4 OF 5

CONTRACT NO. _____

APPROVALS: _____ DATE: 3/93

DRAWN BY: MAG

CHECKED BY: MDS

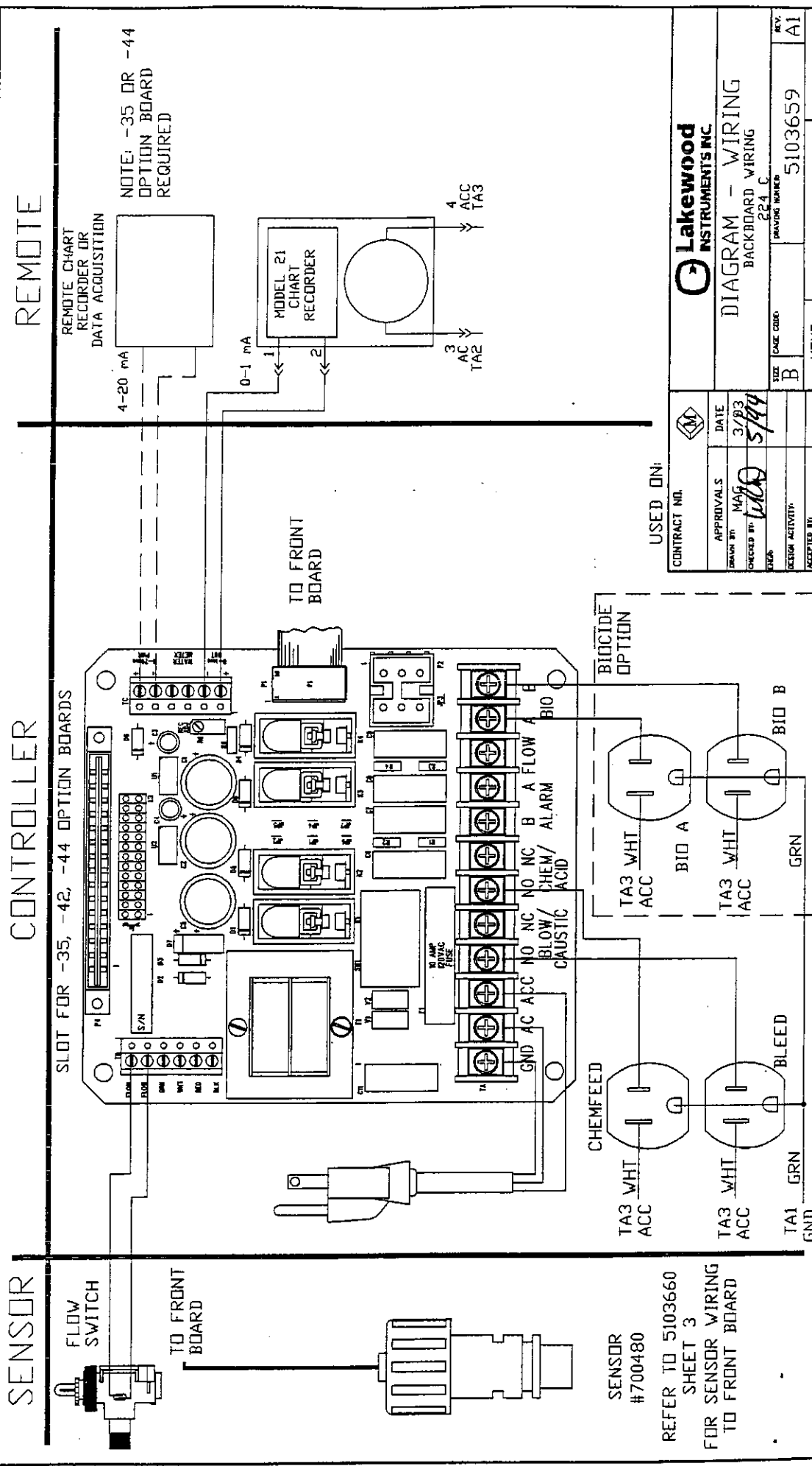
DATE: 5/94

DESIGN ACTIVITY: _____

ACCEPTED BY: _____

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVALS
	NEW	W/D 0318	MAG 3/93	
	A1	W/D 0557	MAG 5/94	

NOTES: UNLESS OTHERWISE SPECIFIED:
 1. WIRING BY LAKEWOOD
 2. WIRING BY OTHERS



		CONTRACT NO. _____ USED ON: _____
APPROVALS DRAWN BY: MAG CHECKED BY: <i>[Signature]</i> DATE: 3/93	DATE: 3/93 DRAWING NUMBER: 5103659	MODEL NUMBER: 5103659 SHEET 5 OF 5

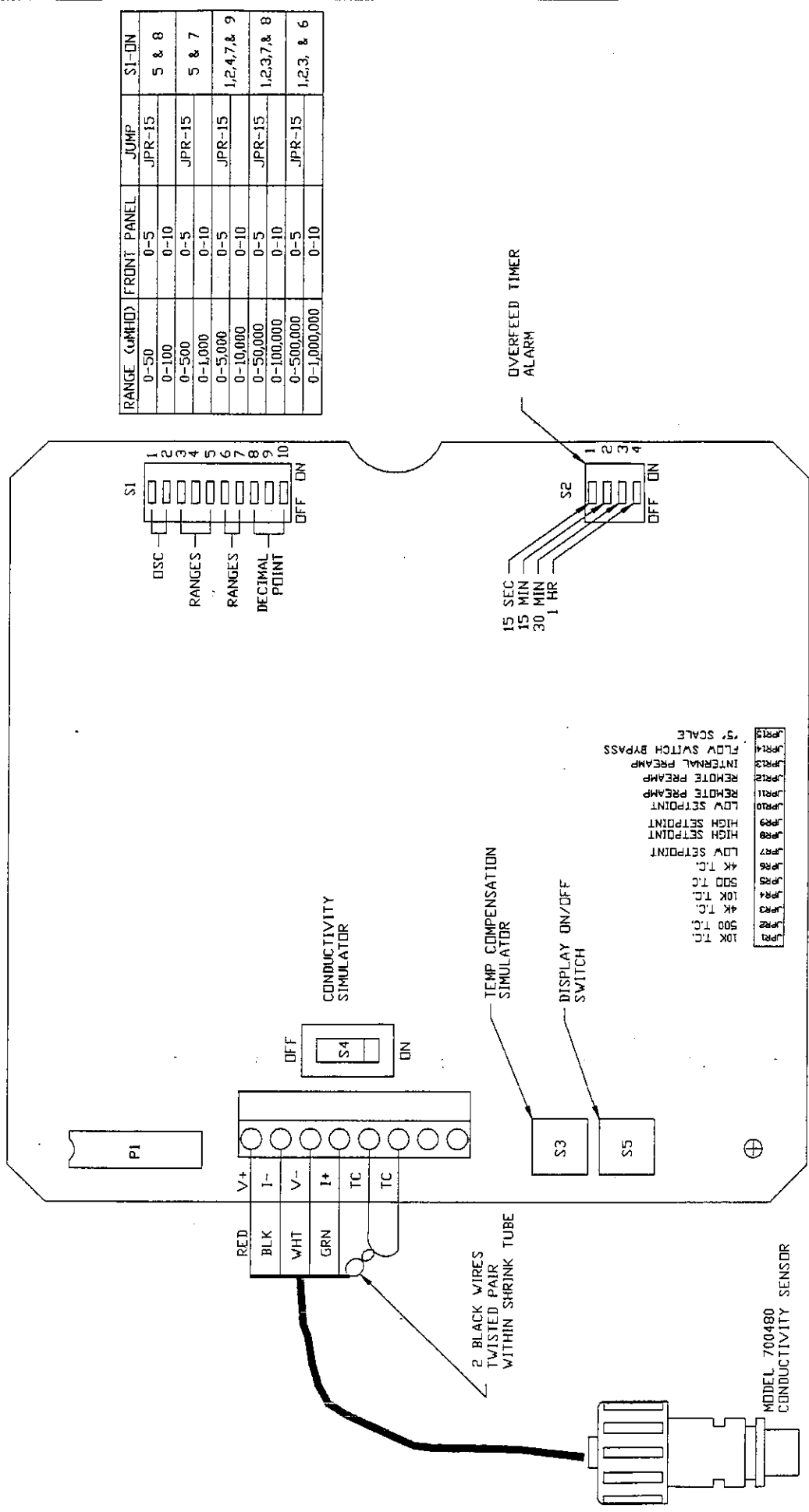
DIAGRAM - WIRING
 BACKBOARD WIRING
 224 C

SENSOR #700480
 REFER TO 5103660
 SHEET 3
 FOR SENSOR WIRING
 TO FRONT BOARD

NOTES: UNLESS OTHERWISE SPECIFIED
 1. REFER TO DRAWING 5103659 SHEET 5 FOR FURTHER DETAIL.

REVISIONS

ZONE	LTR	DESCRIPTION	DATE	APPROVED
	NEW	W/D 0318	MAG 4/93	
	A	SEE ECN 0330	MAG 4/93	
	B	SEE ECN 0404	MAG 8/83	
	B1	W/D 0541	MAG 5/94	



RANGE (uMHO)	FRONT PANEL	JUMP	SI-ON
0-50	0-5	JPR-15	5 & 8
0-100	0-10	JPR-15	5 & 7
0-500	0-5	JPR-15	5 & 7
0-1,000	0-10	JPR-15	1,2,4,7,& 9
0-5,000	0-5	JPR-15	1,2,3,7,& 8
0-10,000	0-10	JPR-15	1,2,3, & 6
0-50,000	0-5	JPR-15	
0-100,000	0-10	JPR-15	
0-500,000	0-5	JPR-15	
0-1,000,000	0-10	JPR-15	

SOLDER SIDE OF P.C.B.
 VIEWED WITH PANEL OPEN



THIRD ANGLE PROJECTION DRAWING MADE 4/93 CHECKED 10/5/94 APPROVED DESIGN ACTIVITY APPROVAL	DRAWING -- ASSEMBLY SWITCH AND JUMPER LOCATIONS MODEL 224 C	SIZE CODE IDENT NO. DWG. NO. C 5103660
USED ON NEXT ASSY APPLICATION	FINISH	SCALE NONE 1/1 SHEET 3 OF 3